L98 160212 006

Biological Monitoring to Characterize the Aquatic Community near the Site of the Proposed Clinch River Small Modular Reactor

2011

Tennessee Valley Authority

Biological and Water Resources

Chattanooga, Tennessee

January 2013

Table of Contents

List of Tables

List of Figures

Abbreviations

BIP	Balanced Indigenous Population
CCW	Condenser Cooling Water
cm	Centimeter
CRM	Clinch River Mile
CWA	Clean Water Act
DO	Dissolved Oxygen
EF	Electrofishing
EPA	Environmental Protection Agency
ft	Foot
GN	Gill Netting
LDB	Left Descending Bank
m	Meter
µ	Micron (micrometer)
µS/cm	Microsiemens per centimeter
mm	Millimeter
ppm	Parts Per Million
RBI	Reservoir Benthic Index
RDB	Right Descending Bank
RFAI	Reservoir Fish Assemblage Index
SAHI	Shoreline Aquatic Health Index
SMR	Small Modular Reactor
TRM	Tennessee River Mile
TVA	Tennessee Valley Authority

Introduction

To assess the potential for direct, indirect, and cumulative effects of cooling water discharge required for operation of a Small Modular Reactor (SMR), the Tennessee Valley Authority (TVA) initiated studies to characterize the aquatic communities occurring in the Clinch River upstream and downstream of the proposed site. These studies were designed to evaluate the diversity, abundance, and condition of resident fish, benthic macroinvertebrate, and plankton communities in the vicinity of the SMR site to establish baseline conditions prior to construction and operation.

Section 316(a) of the Clean Water Act (CWA) regulates point source thermal effluents to assure the protection of Balanced Indigenous Populations (BIP) of aquatic life. The term "balanced indigenous population," as defined by the Environmental Protection Agency (EPA), describes a biotic community that is typically characterized by:

(1) diversity appropriate to ecoregion;
(2) the capacity to sustain itself through cyclic seasonal changes;
(3) the presence of necessary food chain species; and
(4) lack of domination by pollution-tolerant species.

TVA uses multi-metric evaluation techniques to assess maintenance of BIP. The Reservoir Fish Assemblage Index (RFAI) incorporates fish species richness and composition, trophic composition, and fish abundance and health. The RFAI has been thoroughly tested on TVA and other reservoirs and published in peer-reviewed literature (Jennings et al., 1995; Hickman and McDonough, 1996; McDonough and Hickman, 1999). Fish communities are used to evaluate ecological conditions because of their importance in the aquatic food web and because fish life cycles are long enough to integrate conditions over time. Benthic macroinvertebrate populations are assessed using the Reservoir Benthic Index (RBI) methodology. Because benthic macroinvertebrates are relatively immobile, negative impacts to aquatic ecosystems can be detected earlier in benthic macroinvertebrate communities than in fish communities. These data are used to supplement RFAI results, providing a more thorough examination of aquatic communities. In addition to fish, benthic, and plankton community sampling, shoreline and river bottom habitat, visual wildlife observations, and water quality were assessed within the sample area.

This report presents results of seasonal fish, benthic macroinvertebrate, plankton, water quality, and visual wildlife observation sampling conducted at areas upstream and downstream of the Clinch River SMR site during 2011. Also included are shoreline and benthic habitat characterizations and historical RFAI and RBI scores from data collected at other nearby sites on the Clinch River periodically from 1993 through 2010.

Site Description

The site for the proposed SMR is located on the right descending bank of the Clinch River between Clinch River Mile (CRM) 16 and 18. This location is approximately seven river miles below TVA's Melton Hill Dam and 16 river miles from the confluence with the Tennessee River near Kingston, TN at Tennessee River Mile (TRM) 567.8 (Figure 1). The proposed condenser

cooling water (CCW) intake structure will be located at approximately CRM 17.6 and the CCW discharge at CRM 16 (Figure 2).

Methods

Fish Community

Fish sampling stations were selected in the Clinch River, one upstream and one downstream of the proposed plant site. The downstream sampling station extended from CRM 14 to 16 and the upstream sampling station from CRM 18 to 19.8 (Figures 2 and 3). In this report, the downstream station will be referenced as CRM 15.0 and the upstream station as CRM 18.5. Sampling was conducted during February, May, July, and October 2011 to examine seasonal differences in fish community composition.

These sites are located in an inflow zone downstream of Melton Hill Dam. Gill nets are not typically used in inflow areas of reservoirs due to problems associated with debris clogging nets. This allows fish to see and avoid the net, and in some cases, can dislodge the anchored net due to increased resistance. Because SMR pre-operational data were being obtained, every effort was made to adequately characterize the fish community in the area. Therefore, fish sampling was conducted by both boat electrofishing and gill netting. Gill net crews worked around dam releases and were able to fish nets during periods of low discharge. RFAI scoring criteria for inflow areas were not designed to use gill net data; therefore, criteria for transition (mid reservoir) zones were used to incorporate gill net data into the analysis. Furthermore, RFAI metrics and scoring criteria were developed from datasets collected during autumn and application of the RFAI metrics to data collected during other seasons may not be fully appropriate. Explanation is provided in the results for particular metrics during other seasons where results may be misleading (e.g. dominance by sauger and white bass during February related to spawning runs).

Electrofishing methodology consisted of fifteen 300-meter (m) shoreline boat electrofishing runs. The total near-shore area sampled was approximately 4,500 m [15,000 feet (ft)]. Experimental gill nets were used as an additional gear type to collect fish from deeper habitats not effectively sampled by electrofishing. Each experimental gill net consisted of five 6.1-m panels which made up a total of 30.5 m (100.1 ft). Each panel had a different mesh size: 2.5, 5.1, 7.6, 10.2, and 12.7 centimeters (cm). Gill nets were set perpendicular to river flow extending from near-shore to the mid-channel of the river. Ten overnight experimental gill net sets were used at each area (Figures 2 and 3).

Fish collected were identified by species, counted, and examined for anomalies (such as disease, deformations, parasites, or hybridization). The resulting data were analyzed using RFAI methodology.

The RFAI uses 12 fish community metrics from four general categories: Species Richness and Composition; Trophic Composition; Abundance; and Fish Health. Individual species can be utilized for more than one metric. Together, these 12 metrics provide a balanced evaluation of fish community integrity. The individual metrics are shown below, grouped by category:

Species Richness and Composition

(1) **Total number of indigenous species** -- Greater numbers of indigenous species are considered representative of a healthier aquatic ecosystem. As conditions degrade, numbers of species at an area decline.

(2) **Number of centrarchid species** -- Sunfish species (excluding black basses) are invertivores, and a high diversity of this group is indicative of reduced siltation and suitable sediment quality in littoral areas.

(3) **Number of benthic invertivore species** -- Due to the special dietary requirements of this species group and the limitations of their food source in degraded environments, numbers of benthic invertivore species increase with better environmental quality.

(4) **Number of intolerant species** -- A group comprised of species that are particularly intolerant of physical, chemical, and thermal habitat degradation. Higher numbers of intolerant species suggest the presence of fewer environmental stressors.

(5) **Percentage of tolerant individuals** – A metric that signifies poorer water quality with increasing proportions of individuals tolerant of degraded conditions.

(6) **Percent dominance by one species** -- Ecological quality is considered reduced if one species inordinately dominates the resident fish community.

(7) **Percentage of non-indigenous species** -- Based on the assumption that non-indigenous species reduce the quality of resident fish communities.

(8) **Number of top carnivore species** -- Higher diversity of piscivores is indicative of the availability of forage species and the presence of suitable habitat.

Trophic Composition

(9) **Percentage of individuals as top carnivores** -- A measure of the functional aspect of top carnivores which feed on lower trophic levels.

(10) **Percentage of individuals as omnivores** -- Omnivores are less sensitive to environmental stresses due to their ability to vary their diets. As trophic links are disrupted due to degraded conditions, specialist species such as insectivores decline while opportunistic, omnivorous species increase in relative abundance.

Abundance

(11) **Average number per run** -- (number of individuals) -- A metric based on the assumption that high quality fish assemblages support large numbers of individuals.

Fish Health

(12) **Percentage of individuals with anomalies** -- Occurrence of diseases, lesions, tumors, external parasites, deformities, blindness, and natural hybridization is noted. A higher proportion of individuals exhibiting such conditions can indicate poor environmental conditions.

RFAI methodology addresses all four attributes or characteristics of a "balanced indigenous population" defined by the CWA, as described below:

(1) **A biotic community characterized by diversity appropriate to the ecoregion**: Diversity is addressed by the metrics in the Species Richness and Composition category, especially metric 1 – "total number of indigenous species." Determination of reference conditions based on the transition zones of upper mainstem Tennessee River reservoirs (as described below) ensures appropriate species expectations for the ecoregion.

(2) **The capacity for the community to sustain itself through cyclic seasonal change**: TVA uses an autumn data collection period for biological indicators to document community condition or health after being subjected to the wide variety of stressors throughout the year. One of the main benefits of using biological indicators is their ability to integrate stressors through time. Examining the condition or health of a community at the end of the "biological year" (i.e., autumn) provides insights into how well the community has dealt with the stresses through an annual seasonal cycle. Likewise, evaluation of the condition of individuals in the community (in this case, individual fish as reflected in Metric 12) provides insights into how well the community can be expected to withstand stressors through winter. Further, multiple sampling years during the permit renewal cycle adds to the evidence of whether or not the autumn monitoring approach has correctly demonstrated the ability of the community to sustain itself through repeated seasonal changes.

(3) **The presence of necessary food chain species**: Integrity of the food chain is measured by the Trophic Composition metrics, with support from the Abundance metric and Species Richness and Composition metrics. Existence of a healthy fish community indicates presence of necessary food chain species because the fish community is comprised of species that utilize multiple feeding mechanisms that transcend various levels in the aquatic food web. Basing evaluations on a sound multi-metric system such as the RFAI enhances the ability to discern alterations in the aquatic food chain. Three dominant fish trophic levels exist within Tennessee River reservoirs: insectivores, omnivores, and top carnivores. To determine the presence of necessary food chain species, these three groups should be well represented within the overall fish community. Other fish trophic levels include benthic invertivores, planktivores, herbivores, and parasitic species. Insectivores include most sunfish, minnows, and silversides. Omnivores include gizzard shad, common carp, carpsuckers, buffalo, and channel and blue catfish. Top carnivores include bass, gar, skipjack herring, crappie, flathead catfish, sauger, and walleye. Benthic invertivores include drum, suckers, and darters. Planktivores include alewife, threadfin shad, and paddlefish. Herbivores include

largescale stonerollers. Lampreys in the genus *Ichthyomyzon* are currently the only parasitic species known to occur in Tennessee River reservoirs.

(4) **A lack of domination by pollution-tolerant species**: Domination by pollution-tolerant species is evaluated by metrics 3 ("Number of benthic invertivore species"), 4 ("Number of intolerant species"), 5 ("Percentage of tolerant individuals"), 6 ("Percent dominance by one species"), and 10 ("Percentage of individuals as omnivores").

Scoring categories are based on "expected" fish community characteristics in the absence of human-induced impacts other than impoundment of the reservoir. These categories were developed from historical fish assemblage data representative of upper mainstem Tennessee River reservoirs (Hickman and McDonough, 1996). Attained values for each of the 12 metrics were compared to the scoring criteria and assigned scores to represent relative degrees of degradation: least degraded (5); intermediate degraded (3); and most degraded (1). Scoring criteria for upper mainstem Tennessee River reservoirs are shown in Table 1.

TVA uses RFAI results to determine maintenance of BIP using two approaches. One is "absolute" in that it compares the RFAI scores and individual metrics to predetermined values. The other is "relative" in that it compares RFAI scores attained downstream to the upstream control site. The "relative" approach is not applicable for this study since the proposed SMR plant is not yet in operation and the data collected are used to establish a baseline for future monitoring. The "absolute" approach is based on Jennings et al. (1995) who suggested that favorable comparisons of the attained RFAI score from the potential impact zone to a predetermined criterion can be used to identify the presence of normal community structure and function and hence existence of BIP. For multi-metric indices, TVA uses two criteria to ensure a conservative screening of BIP. First, if an RFAI score reaches 70% of the highest attainable score of 60 (adjusted upward to include sample variability as described below), and second, if fewer than half of RFAI metrics receive a low (1) or moderate (3) score, then normal community structure and function would be present indicating that BIP had been maintained, thus no further evaluation would be needed.

RFAI scores range from 12 to 60. Ecological health ratings (12-21 "Very Poor", 22-31 "Poor", 32-40 "Fair", 41-50 "Good", or 51-60 "Excellent") are then applied to scores. As discussed in detail below, the average variation for RFAI scores in TVA reservoirs is 6 (± 3). Therefore, any location that attains an RFAI score of 45 (42 plus the upward sample variation of 3) or higher would be considered to have BIP. It must be stressed that scores below this threshold do not necessarily reflect an adversely impacted fish community. The threshold is used to serve as a conservative screening level; i.e., any fish community that meets these criteria is obviously not adversely impacted. RFAI scores below this level require a more in-depth look to determine if a BIP exists. An inspection of individual RFAI metric results and fish species used in each metric is an initial step to help characterize the aquatic community and determine if BIP exists prior to construction and operation of the SMR.

River Channel Benthic Macroinvertebrate Community

For the benthic macroinvertebrate community, one transect was established across the full width of the reservoir downstream of the proposed plant site at CRM 15.0 (Figure 2) and another full-width transect was established upstream of the proposed site at CRM 18.8 (Figure 3).

Benthic grab samples were collected at ten points, equally-spaced from the left descending bank to the right descending bank, along the two established transects. A Ponar sampler (area per sample 0.06 m^2) or Peterson sampler (area per sample 0.11 m^2) was used depending on substrate hardness. Each sample was washed on a 533-micron (µ) screen, and organisms were picked from the screen and from any remaining substrate. For each sample, organisms and substrate were placed in a sample jar and fixed in formalin. Samples were sent to an independent consultant who identified each organism collected to the lowest possible taxonomic level.

Benthic community results were evaluated using seven community characteristics. Results for each metric were assigned a rating of 1, 3, or 5 depending upon how they scored based on reference conditions developed for Tennessee River reservoir inflow sample sites. Scoring criteria for lab processed samples are shown in Table 2. The ratings for the seven metrics were summed to produce a benthic score for each sample site. Potential scores ranged from 7 to 35. Ecological health ratings (7-12 "Very Poor", 13-18 "Poor", 19-23 "Fair", 24-29 "Good", or 30-35 "Excellent") are then applied to scores. The individual metrics are shown below:

(1) **Average number of taxa**—calculated by averaging the total number of taxa present in each sample at a site. Greater taxa richness usually indicates better conditions than lower taxa richness.

(2) **Proportion of samples with long-lived organisms**—a presence/absence metric that is evaluated based on the proportion of samples with at least one long-lived organism (*Corbicula* > 10 mm, *Hexagenia* > 10 millimeters (mm), mussels, and snails) present. The presence of long-lived taxa is indicative of conditions which allow long-term survival.

(3) **Average number of EPT taxa**—calculated by averaging the number of *Ephemeroptera*, *Plecoptera*, and *Trichoptera* taxa present in each sample at a site. Higher diversity of these taxa indicates good water quality and better habitat conditions.

(4) **Percentage as oligochaetes**—calculated by averaging the percentage of oligochaetes in each sample at a site. Oligochaetes are considered tolerant organisms so a higher proportion indicates poor water quality.

(5) **Percentage as dominant taxa**—calculated by selecting the two most abundant taxa in a sample, summing the number of individuals in those two taxa, dividing that sum by the total number of animals in the sample, and converting to a percentage for that sample. The percentage is then averaged for the 10 samples at each site. Often, the most abundant taxa differ among the 10 samples at a site. This allows more

discretion to identify imbalances at a site than developing an average for a single dominant taxon for all samples at a site. This metric is used as an evenness indicator. Dominance of one or two taxa indicates poor conditions.

(6) **Average density excluding Chironomids and Oligochaetes**—calculated by first summing the number of organisms, excluding chironomids and oligochaetes, present in each sample and then averaging these densities for the 10 samples at a site. This metric examines the community, excluding taxa which often dominate under adverse conditions. A higher abundance of non-chironomids and non-oligochaetes indicates good water quality conditions.

(7) **Zero-samples: Proportion of samples containing no organisms**—the proportion of samples at a site which have no organisms present. "Zero-samples" indicate living conditions unsuitable to support aquatic life (i.e. toxicity, unsuitable substrate, etc.). Any site having one empty sample was assigned a score of three, and any site with two or more empty samples received a score of one. Sites with no empty samples were assigned the highest metric score of five.

As a basis to determine the impact of a thermal discharge on the benthic macroinvertebrate community, the benthic index score at the downstream site was compared to that at the upstream site. A similar or higher benthic index score at the downstream site compared to the upstream site is an indication of the absence of impact. A comparison of benthic index scores from 49 paired sample sets collected over seven years ranged from 0 to 14 points, the 75th percentile was 4, the 90th percentile was 6. The mean difference between these 49 paired scores was 3.1 points with 95 % confidence limits of 2.2 and 4.1. Based on these results, a difference of 4 points or less is the value selected for defining "similar" scores between upstream and downstream benthic communities. That is, if the downstream benthic score was within 4 points of the upstream score, the communities were considered similar and the conclusion was that the thermal discharge has had no effect. It is important to consider that differences greater than 4 points can be expected simply due to method variation (25% of the QA paired sample sets exceeded that value). When such a difference occurred, a metric-by-metric examination was conducted to determine what caused the difference in scores and the potential for the difference to be thermally related. As stated previously, because the SMR is not yet in operation, benthic index scores from upstream and downstream should ideally be similar, or any difference between the scores can be attributed to factors other than thermal effluent and will be treated as baseline information for subsequent monitoring.

Shoreline Benthic Macroinvertebrate Community

In addition to dredge samples, TVA investigated diversity and abundance of benthic macroinvertebrates occurring along the shorelines during autumn. At both stations, samples were collected on the right and left descending banks in the vicinity of the endpoints of the dredge sample transects.

At the upstream site, 15 submerged rocks were collected, visible benthic organisms were picked from the rocks, and then rocks were washed over a 250-µm screen to capture any remaining

organisms. Length, width, and height measurements were taken from each rock to determine surface area sampled. Organisms were preserved in formalin and sent to an independent laboratory for identification to the lowest practicable taxonomic level.

At the downstream site, no rock habitat was available along shoreline areas. Submerged root wads were present and were sampled with a rectangular kick-net. Six kicks were collected along each bank. The contents of the net were washed into a 250-µm sieve screen, preserved in formalin, and also sent to the laboratory for identification.

Aquatic Habitat in the Vicinity of CRSMR

Shoreline Aquatic Habitat Assessment

The Shoreline Aquatic Habitat Index (SAHI), which incorporates several habitat parameters important to resident fish species, was used to evaluate the quality of fish habitat along shoreline areas in the vicinity of the proposed SMR site. Using the general format developed by Plafkin et al. (1989), seven metrics were established to characterize selected physical habitat attributes important to reservoir resident fish populations which rely heavily on the littoral (shoreline) zone for reproduction, recruitment, and prey availability (Table 3). Habitat Suitability Indices (U.S. Fish and Wildlife Service), along with other sources of information on biology and habitat requirements (e.g. Etnier and Starnes, 1993), were consulted to develop "reference" criteria or "expected" conditions from a high quality environment for each parameter. Some generalizations were necessary in setting up scoring criteria to incorporate the various requirements of all species within a single index.

Individual metrics were scored through comparison of observed conditions with these "reference" conditions and assigned a corresponding value: "Good" 5; "Fair" 3; or "Poor" 1 (Table 3). The scores for each metric were summed to obtain the SAHI value. The range of potential SAHI values (7-35) was trisected to provide some descriptor of habitat quality ("Poor" 7-16, "Fair" 17-26, and "Good" 27-35).

The quality of aquatic shoreline habitat was assessed while traveling parallel to the shoreline in a boat. Eight line-of-sight transects were established across the width of the Clinch River within each of the two fish community sampling areas centered at CRM 15.0 (downstream) and CRM 18.5 (upstream) (Figure 4). At each sampling area, near-shore aquatic habitat was assessed along sections of shoreline corresponding to the left descending (LDB) and right descending (RDB) bank locations for each of the eight line-of-sight transects. These individual sections (8 on the LDB and 8 on the RDB for a total of 16 shoreline assessments) were then scored using SAHI criteria. Percentages of aquatic macrophytes in the littoral areas of the 8 LDB and 8 RDB shoreline sections were also estimated.

River Bottom Habitat Assessment

Along each of the 8 line-of-sight transects described above, 10 benthic grab samples were collected with a Ponar sampler at equally spaced points from the left descending bank to the right descending bank. Substrate material collected with the Ponar was emptied into a screen and substrate percentages were estimated to evaluate existing benthic habitat across the width of the river. Water depths (ft) at each sample location were recorded. If no substrate was collected

after multiple Ponar drops, it was assumed that the substrate was bedrock. For example, when the Ponar sampler was pulled shut, collectors could feel substrate consistency. If it shut easily and was not embedded in the substrate after numerous drops, collectors recorded the substrate as bedrock.

Wildlife Observation Survey

Wildlife observation surveys were conducted at the RFAI sampling stations upstream and downstream of the proposed SMR site to provide a preliminary set of observations to help establish existing trophic levels of wildlife that could be affected by thermal effluent from the power plant.

Centered at each sampling station, 2,100-m transects, parallel to the shoreline, were established along each bank. For each observation period, an area along each transect of approximately 60 m in width (30 m inshore to 30 m offshore) was surveyed. Numbers observed were estimated, and wildlife species were identified to general categories and by common name when possible, providing a basic inventory against which future observations can be compared.

Reservoir Flow at CRSMR Site

The amount of water flowing past the SMR site was determined from average total daily discharge from Melton Hill Dam (approximately 7 river miles upstream), obtained from TVA's River Operations database.

Water Quality Parameters at Fish Sampling Stations during RFAI Samples

During each seasonal RFAI sample, water quality conditions (water temperature, conductivity, dissolved oxygen, and pH) were measured using a Hydrolab®. During February and May, readings were taken in the mid-channel at the downstream and upstream boundaries of each sample station. During July and October, readings were taken in the mid-channel and near the left and right banks at the upper, midpoint, and lower bounds of each sample reach. For each sample, readings were recorded at 1- to 2-m intervals along a vertical gradient from just above the river bottom to approximately 0.3 m from the surface.

Surface Water Quality Monitoring

Physical and chemical measurements of water were made once monthly from March through December 2011 at four mid-channel locations – three upstream of the of the proposed plant site at Clinch River Miles (CRM) 18.5, 19.7 and 22.0 and one downstream at CRM 15.5 (Table 29, Figures 2 and 3).

At each sample location, a low volume peristaltic pump and tubing apparatus was used to collect an integrated water sample along a vertical gradient from the bottom to the top of the photic zone – defined as the zone from the reservoir surface to twice the Secchi depth reading, or from the surface to four meters, whichever is greater. If the depth of the water at a station was less than the defined photic zone, the integrated sample was collected from one meter above the reservoir bottom to the surface. These photic zone composite water samples were collected monthly and

analyzed for nutrients (Kjeldahl nitrogen, nitrate plus nitrite-nitrogen, ammonia-nitrogen, total phosphorus, and orthophosphate), total organic carbon, alkalinity, hardness, water clarity (turbidity and suspended solids), and dissolved solids (Table 30). Every other month (April through December), the composite water samples were also analyzed for selected metals (Table 31). Concurrent with collection of each photic zone composite sample, a Hydrolab® was used to measure temperature, dissolved oxygen, pH, and conductivity along a water column profile at depths of 0.3m, 1.5m, 3.0m, and continuing at 1-meter intervals to the bottom of the reservoir.

Basic summary statistics were used to provide a synoptic view of water quality conditions in the area of the proposed CRSMR. Where applicable, results were compared to state(s) criteria for protection of aquatic life. Hardness-dependent metals criteria were adjusted based on the lowest hardness value (130 mg/L) measured during the 10 month period.

Sediment Quality Monitoring

In June, an Ekman dredge was used to collect composite sediment samples at each of three stations – CRM 15.5, 18.5, and 22.0. The composite samples were analyzed for concentrations of metals, pesticides, and PCBs (Table 32). Due to riverine conditions in the sample area, samples were collected near shore where deposition was occurring, rather than in mid-channel. Each sediment sample was a composite of at least three subsamples, each collected independently and at least 50 feet apart from any of the other subsamples. Only the top three to four centimeters of sediment from each subsample were composited for laboratory analysis.

The analytical results for sediments were compared to USEPA Region 4 ecological screening values for sediments (EPA 2011) as well as constituent concentrations in sediments samples collected in 2010 and 2011 at far-field sites upstream (CRM 24.5) and downstream (TRM 532.5 and TRM 560.8) of the proposed plant site. EPA's ecological screening values are provided as a reference point only. Results exceeding these screening values do not necessarily indicate that constituent concentrations were elevated above background for a given area/region.

Plankton Community Sampling

Samples for analysis of the phytoplankton and zooplankton communities were collected monthly and concurrently with physical/chemical samples at three locations: CRM's 15.5, 18.5, and 22.0.

Phytoplankton

From each of the photic zone composite water samples collected for chemical analysis, a subsample was removed and preserved in glutaraldehyde for taxonomic identification and enumeration of the phytoplankton community. A second subsample was removed from each composite water sample for analysis of phytopigment (chlorophyll) concentrations.

Chlorophyll a concentrations were determined using standard methods (ASTM D3731). Each chlorophyll sample (500 ml) was filtered through a 1.2 µm glass-fiber filter. Each filter was maintained in a light-excluding test tube with 5.0 ml of 90 percent buffered acetone. Samples were analyzed spectrophotometrically.

For phytoplankton enumeration and identification, at least 400 natural units (colonies, filaments, and unicells) were enumerated to genus or the lowest practical taxonomic level for each sample.

HPMA (2-hydroxypropyl methacrylate) resin was used to produce three algal slides per sample. The number of fields counted was spread evenly over the three slides. Slides were examined under multiple magnifications in order to correctly enumerate and identify taxa of different sizes. Units were counted until the standard error of the mean of the total number of natural units per field was less than 10%. This tiered counting method typically yields a minimum of 400 natural units per sample and well over 400 cells per sample. Biovolume estimates were based on measuring the greatest axial linear dimension (GALD), determined from the length, width and depth of different aspects of the colony or cell. Up to a total of 30 natural units (sometimes higher on exceptionally variable taxa) were measured for each taxon per sample depending on variability and number encountered. Cell and colony shapes were approximated to a geometric figure(s), and the appropriate calculations made to estimate biovolume. Cell densities and biovolumes were quantified on a per milliliter basis.

Basic summary statistics were used to examine spatial and temporal variability within the phytoplankton communities. Additionally, principle component analysis (PCA) was used to analyze interrelationships among the large number of phytoplankton taxa. Prior to analysis, mean taxa abundances were computed for samples collected in triplicate. For the PCA, taxa abundances were log transformed ($\log_{10}$+1).

Zooplankton

Samples for taxonomic identification and enumeration of the zooplankton community were collected using a 300 mm conical net with 153 µm mesh, towed vertically through the water column from two meters off the bottom to the surface of the reservoir. Samples were preserved in 70% ethyl alcohol (EtOH).

Zooplankton were identified and enumerated to the lowest practical taxon (typically species or genus), with the target being 200 animals per sample. One HPMA (2-hydroxypropyl methacrylate) resin slide was prepared per sample. Zooplankton were enumerated at magnifications of 100x to 200x, depending on the average size of animal present. Measurements for biomass included length, width and depth. Biomass estimates for crustaceans were based on established length/width regressions. Biomass estimates for rotifers were based on biovolume formulae, where biovolume is converted to biomass. Animal densities and biomass were quantified on a per cubic meter basis.

Basic summary statistics were used to examine spatial and temporal variability within the zooplankton communities. Prior to analysis, mean taxa abundances were computed for samples collected in triplicate. Abundance data was summed at the level of order for calanoid and cyclopoid copepods because the majority could only be identified to order. The few taxa identified to a lower taxonomic level did not necessarily represent different taxa from those only identified to order.

Results and Discussion

Fish Community

For each season, fish species collected upstream and downstream of the proposed SMR site and corresponding catch rates are shown in Tables 4–11. A comparison of each RFAI metric score between sites is shown in Tables 12-15, by season. Table 16 provides a comparison among season and station of fish species collected. RFAI scores for each season, with comparison to other RFAI scores from other sites on the Clinch River downstream of Melton Hill Dam, are shown in Table 17.

Results for each metric as they apply to the characteristics of BIP are discussed below.

(1) A biotic community characterized by diversity appropriate to the ecoregion
Scores for the five metrics discussed in this section are compared by sampling station and by season in Figure 5.

Total number of indigenous species (> 29 required for highest score)
In February, 26 indigenous species and five non-indigenous species were collected at the downstream site, while 27 indigenous and six non-indigenous species were collected at the upstream site. Dusky darter, rock bass, saugeye, skipjack herring and white sucker were collected downstream but not upstream, while brook silverside, fathead minnow, golden shiner, logperch, northern hogsucker, and quillback were collected upstream but not downstream. Fathead minnow was the only species collected in February that was not encountered during other seasons. This is a minnow frequently sold as bait, and its occurrence was most likely the result of bait-bucket release.

In May, 25 indigenous species and five non-indigenous species were collected at the downstream site, while 33 indigenous and four non-indigenous species were collected at the upstream site. Mississippi silverside (non-indigenous), muskellunge (stocked species), and smallmouth buffalo were collected downstream but not upstream, while black crappie, bullhead minnow, flathead catfish, logperch, longnose gar, redbreast sunfish, silver redhorse, spotted bass, spotted gar, threadfin shad, and walleye were collected upstream but not downstream. Bullhead minnow, spotted gar, and muskellunge were not encountered during any other seasonal sample.

In July, 32 indigenous species were collected at each site. Four non-indigenous species were collected at the downstream site, while five non-indigenous species were collected at the upstream site. Rock bass, warmouth, and white sucker were collected downstream but not upstream, while brook silverside, largescale stoneroller, Mississippi silverside and smallmouth redhorse were collected upstream but not downstream. Largescale stoneroller and smallmouth redhorse were not encountered during any other seasonal sample.

In October, 29 indigenous species and four non-indigenous species were collected at the downstream site, while 32 indigenous and five non-indigenous species were collected at the upstream site. Dusky darter, longnose gar, quillback, skipjack herring, and spotted bass were collected downstream but not upstream, while black crappie, golden shiner, greenside darter, river carpsucker, sauger, walleye, western mosquitofish, and white bass were collected upstream

but not downstream. River carpsucker and western mosquitofish were not encountered during any other seasonal sample.

Dusky darter (February and October), muskellunge (May), and white sucker (February and July) were only encountered in the downstream sample reach. Brook silverside (February and July), bullhead minnow (May), fathead minnow (February), golden shiner (February and October), greenside darter (October), largescale stoneroller (July), river carpsucker (October), smallmouth redhorse (July), spotted gar (May), and western mosquitofish (October) were only encountered in the upstream sample reach.

Total number of centrarchid species (> 4 required for highest score)
At the downstream station, seven, four, five, and five centrarchid species were observed during February, May, July, and October, respectively. Black and white crappie were only encountered during February and redbreast sunfish were not collected during May.

At the upstream station, seven, six, four, and six centrarchid species were observed during February, May, July, and October, respectively. Black crappie and warmouth were not collected during July, and a white crappie was only collected during February.

Total number of benthic invertivore species (> 7 required for highest score)
At the downstream station, four, five, seven, and six benthic invertivore species were observed during February, May, July, and October, respectively. Northern hogsuckers were absent from the February sample, logperch were only encountered during July and October, and a silver redhorse was collected only during July.

At the upstream station, six, seven, eight, and six benthic invertivore species were observed during February, May, July, and October, respectively. Silver redhorse were only encountered during May and July, and smallmouth redhorse were only collected in July.

Total number of intolerant species (> 4 required for highest score)
Each season, the number of intolerant species was similar at each site. Four intolerant species were collected at each site during February, six in May and July, and six downstream and five upstream during October. Brook silverside was the only species that was collected upstream but not downstream. All other intolerant species were encountered at both sites.

Total number of top carnivore species (> 7 required for highest score)
In February, nine top carnivore species were collected at the downstream site and seven at the upstream site. Rock bass and skipjack herring were collected downstream but not upstream.

In May, seven top carnivore species were collected downstream and 12 upstream. Black crappie, flathead catfish, longnose gar, spotted gar, and walleye were collected upstream but not downstream.

In July, ten top carnivore species were collected downstream and nine upstream. Rock bass was collected downstream but not upstream.

In October, seven top carnivore species were collected downstream and eight upstream. Longnose gar, spotted bass, and skipjack herring were collected downstream but not upstream. Black crappie, sauger, walleye, and white bass were collected upstream but not downstream.

(2) The capacity for the community to sustain itself through cyclic seasonal change

Percentage of anomalies (< 2% in gill net and electrofishing samples required for highest score)
Trends in the percentage of anomalies (i.e. visible lesions, bacterial and fungal infections, parasites, muscular and skeletal deformities, and hybridization) revealed in seasonal samples over the course of the year should be indicative of the ability of the fish community to withstand the stressors of an annual seasonal cycle.

Percentages for the downstream station varied widely over the course of the year, from a moderate occurrence of anomalies during winter (6.3% electrofishing [EF], 3.9% gill netting [GN]) and spring (2.8% EF, 4.6% GN), to a high occurrence during summer (1.5% EF, 18.7% GN), and a low occurrence during autumn (2.5% EF, 0% GN).

Percentages of anomalies for the upstream station were low during winter (1.7% EF, 0.7% GN) and autumn (0.9% EF, 0% GN), but high during spring (9.8% EF, 3.1% GN) and summer (1.1% EF, 12.7% GN).

Total number of indigenous species (> 29 required for highest score)
Numbers of indigenous species ranged from 25 to 32 in quarterly samples collected at the downstream site and from 27 to 33 at the upstream site. Numbers of indigenous species at the upstream site ranged from 32 to 33 during spring, summer, and autumn, demonstrating very little variation in the fish community among seasons. During winter and spring, indigenous species diversity was lower at the downstream site when compared to summer and autumn. Results of sampling from both sites indicated the ability of the fish community to sustain itself throughout the year.

(3) The presence of necessary food chain species

Insectivores were most the most abundant trophic level downstream during all seasons except July when omnivores were most abundant (Figure 6). Highest trophic level abundance in upstream samples was insectivores during February and October, top carnivores during May, and omnivores during July (Figure 6). Herbivores were represented by largescale stoneroller only during July at the upstream site and no parasitic species were encountered at either site.

(4) A lack of domination by pollution-tolerant species

Scores for the three metrics discussed in this section and for the metric “Total number of intolerant species”, which was previously discussed, are compared by sampling station and by season in Figure 7.

Percentage of tolerant individuals (< 31 % of EF sample and < 16% of GN sample required for highest score)
All samples from both sites contained a high percentage of tolerant species in the electrofishing portion of the sample. Most seasons, bluegill and gizzard shad accounted for the majority of tolerant individuals. The upstream station contained a higher percentage of tolerant individuals

in gill net samples each season, most notably during May, July, and October. Gizzard shad and common carp were the dominant tolerant species collected.

Percentage of omnivores (< 22 % of EF sample and < 23 % of GN sample required for highest score)
At the downstream sample site, the percentage of omnivores was high in May, July and October gill net samples and in the July electrofishing sample. Channel catfish, blue catfish, and gizzard shad were the dominant omnivorous species.

At the upstream site, gill net samples contained a large proportion of omnivores and were highest during July and October. Almost half of the July electrofishing sample consisted of omnivores. Compared with the downstream samples, greater proportions of omnivores were collected each season at the upstream site. Blue catfish, channel catfish, common carp, and gizzard shad were the dominant omnivorous species.

Percent dominance by one species (< 20 % of EF sample and <14 % of GN sample required for highest score)
The concept of this metric is that dominance by a certain species, especially one that is tolerant, may indicate impairment. RFAI scoring criteria and metrics were designed to evaluate fish communities at the end of the biological year (i.e. autumn), and metrics such as this are not necessarily indicative of impairment during other seasons.

In February, bluegill was dominant in electrofishing samples at both sites. In gill net samples, sauger was dominant at the downstream site and white bass at the upstream site. Dominance by sauger and white bass was most likely correlated to spawning migrations during this time of year; therefore, large numbers of these species don't indicate impairment, but represent spawning aggregations.

Similarly, during May, yellow bass were dominant in gill net samples. Yellow bass spawn during April and May and their presence in large numbers reflect this aspect of their life history. Bluegill was once again the dominant species in electrofishing samples.

During July, gizzard shad were dominant in electrofishing samples at both sites. Blue catfish were dominant in gill net samples at the downstream site and gizzard shad at the upstream site. During October, blue catfish were dominant in gill net samples at both sites, while spotted suckers and gizzard shad were dominant in electrofishing samples at the downstream and upstream sites, respectively. Blue catfish and gizzard shad are omnivores and made up ~ 20 % of both the electrofishing and gill net sample upstream, which could indicate lack of balanced trophic levels. Downstream, spotted suckers, a benthic invertivore, were dominant and might be an indicator of better conditions downstream than upstream during autumn.

Overall RFAI Scores

RFAI scores for the downstream station resulted in an ecological health rating of "Fair" for each season (38 for winter and spring, 39 for summer, and 37 for autumn). The upstream station received "Fair" ecological ratings for winter, summer, and autumn samples (36, 37, and 40, respectively) and a "Good" rating (42) during spring (Table 17). Scores for all seasons averaged 39 at the upstream site and 38 at the downstream site.

These scores were similar to the range of average scores (39 to 42) at other monitoring sites on the Clinch River downstream of Melton Hill Dam (Table 17).

Fish Community Summary

Overall RFAI ratings for each season were similar between the downstream and upstream sampling stations. RFAI scores during all seasons differed ≤ four points between the two sampling sites. As previously discussed, RFAI scores have an intrinsic variability of ± 3 points. This variability comes from various sources, including annual variations in air temperature and stream flow; variations in pollutant loadings from nonpoint sources; changes in habitat, such as extent and density of aquatic vegetation; natural population cycles and movements of the species being measured (TWRC, 2006). Another source of variability arises from the fact that nearly any practical measurement, lethal or non-lethal, of a biological community is a sample rather than a measurement of the entire population. This variability due to methods must be considered when comparing scores between sampling stations.

Both sites received low scores for the metric "Average number per run" for both electrofishing and gill net samples each season (Tables 12-15). Cool water temperatures from Norris Dam releases upstream may limit overall productivity, thus reducing abundance of some species in this portion of the Clinch River. Although catch rates were low, species diversity was relatively high at both stations. Averages of 33 (28 indigenous) and 36 species (31 indigenous) were collected at the downstream and upstream stations, respectively (Tables 4-11). Distinct differences in trophic guild composition were evident among stations each season (Figure 6). Each season, the upstream station contained higher proportions of omnivores and fewer proportions of insectivores than the downstream station. During spring, higher proportions of top carnivores were present upstream but were similar among sites other seasons. The downstream station had a much higher proportion of benthic invertivores during autumn.

An average of two thermally sensitive species was present all seasons at both sampling stations (Tables 4-11). Thermally sensitive species were defined as those having an upper lethal limit of water temperatures ≥ 90° F. These designations were determined by Yoder et al. (2006).
An average of 14 commercially valuable and 22 recreationally valuable fish species were collected at the downstream station during 2011 (Tables 4, 6, 8, and 10) and an average of 15 commercially valuable and 24 recreationally valuable species were collected at the upstream station (Tables 5, 7, 9, and 11). Commercially valuable species are defined as those that can be legally harvested by commercial fishing methods for sale as meat, roe, or bait (TWRA, 2012). Recreationally valuable species are those species that are commonly sought by anglers, bowfishers, or used for bait. All fish species collected were considered Representative Important Species because all were used to obtain an overall RFAI score. Representative important species are defined in EPA guidance as those species which are representative, in terms of their biological requirements, of a balanced, indigenous community of fish, shellfish, and wildlife in the body of water into which a discharge is released (EPA and NRC 1977).

Benthic Macroinvertebrate Community

Benthic macroinvertebrate communities were sampled along a transect with a Peterson or Ponar dredge downstream (CRM 15.0) and upstream (CRM 18.8) of the SMR site during spring, summer, and autumn of 2011. RBI metrics were scored using evaluation criteria for lab processed samples collected in the "inflow" reservoir zone (Table 2). In addition to dredge sampling, shoreline benthic samples were collected during autumn with a kick-net and from rocks along the shoreline at both sites to obtain additional species richness and density data.

Ponar / Peterson Dredge Sampling Results

RBI scoring resulted in an ecological health rating for the downstream station of "Good" for both spring and autumn (RBI scores of 27 and 25, respectively) and a rating of "Excellent" (RBI score of 31) for summer of 2011. RBI scoring resulted in an ecological health rating for the upstream station of "Good" for spring (RBI score of 27) and ratings of "Excellent" for both summer and autumn (RBI scores of 31 and 33, respectively) (Table 18).

Refer to Table 18 for observed values and individual metric scores. Table 19 provides mean densities of individual taxa per square meter. RBI metric results for each season are discussed below for both the downstream and upstream sample stations:

<u>Average number of taxa</u> (> 8.3 required for highest score)
Greater than 10 taxa per sample were observed during each season at the downstream station, and greater than 14 taxa per sample were observed during each season at the upstream station. Both stations received the highest score for this metric. At each site, average taxa richness per sample increased each season from spring to autumn.

<u>Proportion of samples with long-lived organisms</u> (> 0.8 required for highest score)
The downstream station received the highest rating (5) for spring, with 90% of samples collected containing at least one long-lived organism (*Corbicula* > 10 mm, *Hexagenia* >10mm, or snails). During summer, 100% of samples collected contained at least one long-lived organism, resulting in the highest score (5). During autumn, 80% of samples contained at least one long-lived organism and the station received a mid-range rating (3).

The upstream station received a mid-range score (3) for spring (80% of samples with one or more long-lived organism), and the highest score (5) for both summer and autumn (long-lived organisms in 100% of samples for each season).

Hexagenia mayflies were not present in samples from either site. *Corbicula* > 10 mm were not as common as smaller *Corbicula* at both sites. Scores for this metric were primarily driven by high densities of the snail, *Amnicola limosa*.

<u>Average number of EPT taxa</u> (> 1.9 required for highest score)
For the downstream station, an average of 0.1 Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa was present per sample during spring, resulting in the lowest score (1) for this metric for this season. Averages of 1.0 EPT taxa for both summer and autumn resulted in mid-range scores (3) for both seasons.

For the upstream station, an average of 0.8 EPT taxa in spring resulted in the lowest score. An average of 1.4 EPT taxa per sample was recorded for summer, with a mid-range score (3), and an average of 2 EPT taxa per sample in autumn resulted in the highest score (5) for this metric. No Ephemeroptera (mayflies) were collected at the downstream station during any season and very few individuals, belonging to three families, were collected upstream. Plecoptera (stoneflies) were represented by five individuals in one family during October in downstream samples. No Plecoptera were present in upstream samples. Trichoptera (caddisflies) were well represented in downstream and upstream samples during summer and autumn, with species in the family Leptoceridae being most common.

Average proportion of oligochaetes (< 12.0 required for highest score)
At the downstream station, the average proportion of oligochaete individuals in each sample was 12.8 in spring (mid-range score of 3), 10.4 in summer (highest score of 5), and 30.2 in autumn (lowest score of 1). At the upstream station, the average proportion of oligochaetes per sample was 8.7 in spring (highest score of 5), 12.1 in summer (mid-range score of 3), and 9.0 in autumn (highest score of 5).

Percentage of abundance as dominant taxa (< 73.1 required for highest score)
At the downstream station, the two most abundant taxa collected in spring were a snail, *Amnicola limosa* and Chironomidae, which together were 79.1 % of the total collected and resulted in a mid-range score (3). The same two taxa were 80.4 % of the total collected in summer, resulting in a mid-range score (3). The score for autumn was also mid-range (3). The most abundant taxon in autumn samples was *Dreissena polymorpha* (zebra mussel), followed by Chironomidae, together making up 84.6 %.

At the upstream station, the two most abundant taxa collected in spring were again *Amnicola limosa* and Chironomidae, which together made up 79 % of the total abundance, producing a mid-range score (3). The same two taxa were 70.2 % of the total collected in summer, resulting in the highest score (5). In autumn, the most abundant taxon collected was *Dreissena polymorpha*, followed by Chironomidae. Together, these two taxa were 74.3 % of the total collected, resulting in a mid-range score (3) for autumn.

Average density excluding chironomids and oligochaetes
Average densities (excluding chironomids and oligochaetes) were high at both stations during all seasons of 2011. Both stations received the highest score (5) for each season.

Proportion of samples containing no organisms
At both stations, all samples collected during all seasons of 2011 contained at least one organism (no "zero" samples were collected). Both stations received the highest score (5) for each season.

Autumn Shoreline Benthic Sampling Results

Locations and other conditions where shoreline samples were collected are described in Table 20. At the downstream station, no sufficient rock habitat was found, and samples were collected using a kick-net placed around rootwads along the shoreline. At the upstream station, samples were collected from submerged rocks.

Because of differences in sampling techniques and habitat sampled, no direct comparisons can be made from the downstream site to the upstream site, but these data do provide additional information on abundance and diversity of aquatic macroinvertebrates occurring in the vicinity of the SMR site in addition to dredge samples.

Mean density of organisms per m^2, taxa richness, and the number of non-chironomid or oligochaete taxa were similar in kick net samples from the left and right descending banks at CRM 15.0 (Table 21). Chironomids and oligochaetes were the dominant taxa.

Shoreline rock samples collected at the upstream site (CRM 18.8) contained much higher densities but had similar taxa richness and number of non-chironomid or oligochaete taxa when compared to CRM 15 (Table 21). Zebra mussels, dipterans, Hydrobiid snails, and oligochaetes were dominant.

Although Ephemeroptera (mayfly) density and diversity were low, two taxa from two families were collected at the downstream site and three taxa from three families were collected upstream (Table 21). Trichoptera (caddisflies) were represented at both sites by the same two taxa, although densities were higher upstream. No Plecoptera (stoneflies) were collected in shoreline samples.

Benthic Macroinvertebrate Summary

Both sites received high overall Reservoir Benthic Index scores for all seasons. The downstream station earned scores of mid-range (3) or higher for all three sampling periods of 2011 in five of the seven RBI metrics. The station earned the lowest score (1) only during spring for metric 3 (Average number of EPT taxa) and during autumn for metric 4 (Average proportion of oligochaetes). The upstream station earned mid-range (3) scores or higher for all three sampling periods of 2011 in six of the seven RBI metrics. The station earned the lowest score (1) only during spring for metric 3 (Average number of EPT taxa).

Taxa richness was higher in upstream dredge samples each season, but non-chironomid and oligochaete taxa richness was similar (Table 19). Mean density per square meter was much higher during autumn than any other season, due to high densities of zebra mussels. *Amnicola limnosa* was the most abundant taxon collected at either station during spring and summer. Chironomidae, with more than 55 distinct species, was particularly diverse and was the second most abundant taxon collected at either station during all seasons.

Taxa richness was similar upstream and downstream in shoreline samples. Very few taxa were present in shoreline samples that were not encountered in dredge samples.

Overall, these data depict an ecologically healthy reservoir benthic macroinvertebrate community upstream and downstream of the SMR site. One concern is the presence of high densities of zebra mussels. It is currently unknown how this may affect the native benthic fauna in the Clinch River. Horvath et al. (2002) demonstrated that rocky substrates with higher zebra mussel densities contained higher abundance and family richness of many native macroinvertebrates, potentially due to enhanced microhabitat complexity. This could be one

factor contributing to the high Chironomidae diversity and abundance. Regardless, if the SMR becomes operational, constant maintenance will be required to prevent bio-fouling issues.

Aquatic Habitat in the Vicinity of the SMR Site

Shoreline Aquatic Habitat Assessment (SAHI)

Refer to Tables 22 and 23 for the discussion below:

Of the sixteen shoreline sections sampled downstream of the SMR site, 44% (7 sections) rated "Good", 50% (8 sections) "Fair", and 6% (1 section) "Poor". The average score for shoreline sections on the left descending bank was 21 ("Fair"), while the average score for sections on the right descending bank was 27 ("Fair").

Of the sixteen shoreline sections sampled upstream of the SMR site, 12% rated "Good" (2 sections), 44% rated "Fair" (7 sections), and 44% rated "Poor" (7 sections). The average score for shoreline sections on the left descending bank was 18 ("Fair"), while the average score for sections on the right descending bank was 19 ("Fair").

No aquatic macrophytes were observed at either site.

River Bottom Habitat

Substrate percentages were estimated at 10 equally spaced drops along each transect.

Figures 8-11 display substrate proportions and water depth at each sample point along each of the 8 transects downstream of the SMR site. Substrate proportions and water depth for points along each upstream transect are shown in Figures 12-15.

Downstream, sand was the dominant substrate (36.3%) followed by cobble (26.6%) and silt (20.7%), (Table 24). Upstream of the SMR site, clay was the dominant substrate (40.7%) followed by gravel (20.5%), cobble (10.9%), and bedrock (9.8 %), (Table 24). Overall average water depth was similar upstream and downstream of the SMR site.

Wildlife Observation Survey numbers and categories of wildlife observed during all four seasons of 2011 are presented in Table 25. Observed wildlife were primarily waterfowl and of other birds commonly associated with riparian habitat (belted kingfishers, swallows, osprey, hawks, turkey vultures, etc.). Some additional bird groups were identified during autumn (wrens, crows, songbirds, pileated woodpecker). The only reptiles recorded were turtles, observed during summer and autumn. No amphibians or mammals were observed during the Visual Encounter Survey.

The diversity of bird groups provides a present or absent determination into the wildlife community around the proposed SMR site. However, limited observations of reptiles, amphibians and mammals in this survey are due primarily to the methodology utilized. Most wildlife species do not display themselves readily for passing visual observation, being cryptically patterned and secretive in behavior. As a particular example, amphibians, because their skin must remain moist, usually remain hidden under litter or rocky cover and are especially

difficult to observe using these methods. The Visual Encounter Survey provides a preliminary near shore wildlife assessment to determine if the thermally affected area downstream of a power plant has adversely affected the bird, reptile, amphibian and mammal communities. If such adverse environmental impact is suspected, more semi-quantitative sampling strategies, such as trapping or netting, active search, investigation of mammal tracks along shoreline areas, long-term observation from blinds, or the use of cameras will be proposed to accurately estimate the presence and diversity of these groups.

Reservoir Flow by the SMR Site

Total daily mean flow from Melton Hill Dam from October 2010 to October 2011 and total daily mean flow averaged from 1976 to 2010 are shown in Figure 16. Daily mean flows were similar to historical average daily mean flows (mean monthly flow for 2011 was greater than the mean monthly historical flow by an average of 2,038 cubic feet per second [cfs]).

Water Quality Parameters at Fish Sampling Stations during RFAI Samples

Observed values for water quality parameters (water temperature, dissolved oxygen, conductivity, and pH) for samples collected at each sampling station during February and May are shown in Table 26, during July in Table 27, and during October in Table 28. During winter and spring, samples were collected only in the mid-channel (no samples were collected from either the left or right descending sides of the river) and only at the upstream and downstream boundaries of the RFAI sample reach (no midpoint samples were collected). For this reason, only the mid-channel values are compared over seasons in this discussion.

Water Temperature

Water temperatures recorded in February ranged from 44.8° to 45.7° Fahrenheit (F). Temperatures recorded in July ranged from approximately 68° to 72° F. Most depth profiles showed a decrease in temperature as depth increased, indicating the expected thermal stratification of the reservoir during the summer season. However, the three profiles collected at the upstream station showed relatively little change in temperature over depth, indicating little to no stratification. This lack of stratification can be attributed to the mixing of water caused by high flow conditions present in the inflow reservoir zone.

The four profiles collected in May and the six profiles collected in October all ranged from approximately 62° to 65° F, indicating similar conditions in spring and autumn.

Dissolved Oxygen

Dissolved oxygen (DO) profiles collected during all seasons showed values generally within an acceptable range from 5-13 parts per million (ppm).

DO concentrations recorded in February showed the highest levels, generally ranging between 12 and 13 ppm and corresponding with lowest water temperatures. Two of these profiles indicated increasing DO concentrations with increasing depth.

DO concentrations recorded in July showed the lowest levels, which ranged from 4.8 to 6.3 ppm and corresponded with highest water temperatures. Most profiles showed no relationship of DO concentration to depth. However, the profile for the downstream boundary of the downstream station indicated a noticeable decrease in DO as depth increased.

The four profiles collected in May and the six profiles collected in October all ranged from 7 to 9 ppm and showed no noticeable relationship between concentration and depth.

Conductivity

The different profiles varied widely, and there was no discernible relationship between conductivity and depth. Seven profiles had surface values in the range of 275-276 microsiemens/centimeter (µS/cm), but successive values at greater depths varied widely, and there was no relationship of this group to season. All values collected for the year fell within an acceptable range of five units, 273 to 281 µS/cm, and indicated stable ion concentrations in this area of the reservoir.

pH

Depth profiles for all seasons were within an acceptable range, from approximately pH 7.30 to pH 8.20, and were slightly alkaline. The profiles collected in February ranged from 7.93 to 8.13 and were more alkaline than those collected during any other season. Profiles collected in October ranged from pH 7.00 to pH 7.48 and were the least alkaline. The profiles collected in May and July ranged from pH 7.45 to pH 7.73, indicating similar conditions for these two seasons.

Summary

Seasonal mean values for each water quality parameter collected during RFAI sampling, averaged over depth and over all sampling points, are presented for each sampling station in Figures 17-20.

Average water temperatures during 2011 were similar at both RFAI stations during all seasons, and ranged from ~ 44°F during winter to ~ 70°F during summer (Figure 17). Due to cold water releases from Norris Dam upstream, water temperatures are cooler than natural pre-impoundment temperatures in the Clinch River. These cooler temperatures limit fish species diversity and abundance. Thermal discharge from the proposed SMR may create more favorable conditions for some species.

Average dissolved oxygen concentrations during 2011 were similar at both RFAI stations during all seasons. The average concentrations cycled through the year from the lowest value of about 5.7 ppm during summer to the highest value of about 12.7 ppm during winter (Figure 18). Average conductivity values during 2011 ranged from 275 to 279 µS/cm and followed a trend similar to that for water temperature, generally cycling from lowest values in winter to the highest values in summer. Average conductivity values were similar at both RFAI stations during all seasons except summer, when the upstream value was about 3 units lower than the downstream station (Figure 19).

Average pH levels during 2011 were similar at both RFAI stations during all seasons. The average values were lowest during autumn (7.4) and highest during winter (8.0) (Figure 20).

Surface Water Quality

Field Measurement

Results of field measurements are detailed in Table 33 and summarized in Tables 34 through 35 and in Figure 21.

Water temperature measurements ranged from approximately 50 to 72° F over the 10-month sampling period and therefore did not exceed the State of Tennessee criterion of a maximum temperature of 86.9° F (30.5° C). Temperatures were coolest in March (49.7–50.3° F) and warmest in June (69.2–71.6° F) and July (68.4–71.8° F) (Table 34, Figure 21). Temperatures were nearly uniform throughout the water column at each location during each month (Table 35). Surface-to-bottom temperature differences were less than 0.5° F for each month except May (1.3° F) and July (2.1° F). In May, the greater thermal gradients occurred at CRM 15.5 and CRM 18.5. In July, water column temperatures differed by less than 1° F at each of the three most upstream locations and by approximately 2.1° F at CRM 15.5, due largely to warmer water at the surface (0.3 meter depth).

The thermal component of the Tennessee water quality standards consists of a maximum water temperature change (ΔT) of 5.4° F (3° C) relative to an upstream control point. Typically, from the most upstream to the most downstream station around the proposed CRSMR site, water temperatures at respective depths differed spatially by $\leq$1° F (Table 35). Exceptions were in June (ΔT 2.3° F) and July (ΔT 1.4° F). However, because sampling during each of these months was conducted over a two-day period, spatial differences in water temperatures were likely related to day-to-day variations in air temperatures and to releases from Melton Hill Dam.

Dissolved oxygen concentrations ranged from 2.5 to 11.8 mg/L over the 10-month period and exhibited a pattern typical of the change in seasons: concentrations became lower during the summer, as warmer water temperatures reduced the solubility of oxygen and increased the rate of decomposition (Figure 21). Concentrations varied little (typically less than 0.2 mg/L) throughout the water column at each location, except in July when moderate to appreciable vertical gradients existed at the three most upstream sampling locations (CRM 18.5: 5.3 to 6.0 mg/L, CRM 19.7: 4.2 to 6.3 mg/L, and CRM 22.0: 2.5 to 5.8 mg/L) (Table 35). Spatial differences in DO were also evident in July, with average DO concentrations increasing approximately 1.5 mg/L from the most upstream station to the most downstream station. As previously mentioned, sampling in July was conducted over a two-day period, which may account for these differences. However, similar spatial patterns were observed in the results from one-day sampling efforts on September 19 and October 11, when average DO concentrations increased approximately 1.4 (range: 5.5–6.9 mg/L) to 1.8 (range: 6.3–8.1 mg/L) mg/L from upstream (CRM 22.0) to downstream (CRM 15.5). In June, sampling was conducted over a two-day period, and the opposite spatial pattern was observed; that is, DO concentration decreased from upstream to downstream by approximately 1.5 mg/L (range: 4.8–6.6 mg/L).

Dissolved oxygen concentrations collected at CRM 15.5 on June 21 ranged from approximately 4.7 to 4.9 mg/L within the water column and, as measured at the depth of 1.5 m, were slightly below the State of Tennessee criterion limit of 5.0 mg/L. DO at the station immediately upstream (CRM 18.5) ranged from 5.8 to 5.9 mg/L on the same date. Notably, this sampling event was preceded by a 20-day interval with the lowest average flow (~1,700 cfs) for the 10-month sample period and a few days of rainfall that totaled over 2.0 inches. On June 20, the day

sampling was conducted at two most upstream locations (CRM 19.7 and CRM 22.0), average flow increased to approximately 4,700 cfs. When sampling was conducted at CRM 15.5 and CRM 18.5 on June 21, the average flow increased to approximately 6,700 cfs and there was an additional 0.5 inch of precipitation. The changing conditions during the time these samples were collected would have contributed to the variability observed in the field measurements as well as that of the analytical results.

In addition to monthly monitoring for water quality analysis, DO was measured during the fish community surveys in February, May, July, and October (Tables 26–28). During July, DO was measured along depth profiles in the mid-channel and near the left and right descending banks at six transects between CRM 19.8 and 14.0. At a depth of 1.5 m, DO concentrations of all 18 profiles ranged from 4.9 to 6.5 mg/L. Concentrations at two profiles (RDB at CRM 14.0 and the LDB at CRM 18.0) were slightly below the State criterion of 5 mg/L (Table 27). These two profiles were comparatively shallow, and DO concentration actually increased with depth.

An instrument malfunction in August resulted in the loss of *in situ* measurements and precludes any definitive statements about DO conditions that month. However, average daily releases from Melton Hill Dam increased in August (Figure 22), which likely improved DO conditions in the sampling reach. This is supported by DO measurements taken in the forebay (CRM 24.0) and tailwater (CRM 23.1) of Melton Hill Reservoir during 2011 as part of TVA's Valley-wide monitoring programs. These data indicated concentrations in the bottom half of the water column in the forebay averaged approximately 5.0 mg/L in mid-June and mid- to late September (Table 36). On August 1 and 15, DO concentrations in the lower water column averaged approximately 6.8 and 6.7 mg/L, respectively. Because the turbines at Melton Hill Dam withdraw water from most of the water column (the zone of water withdrawal is dependent on the volume and duration of releases), DO concentrations in the tailrace from May through September were higher than those measured in the lower column water column in the forebay. DO measurements in the tailrace ranged from 6.5–9.7 mg/L; the lowest concentration was recorded in June.

Values of pH ranged from 7.1 to 8.1 during the survey. All pH values were within the bounds of the State of Tennessee aquatic life criteria (6.5 to 9.0). The pH was essentially uniform throughout the water column at each location during each month, and values were similar among locations (Figure 21). Temporally, average pH values decreased slightly each month from March to June (7.8 to 7.3), were similar in June and July, and then increased progressively from September to December (7.5 to 8.0).

Conductivity ranged from 241 to 302 µS/cm, which is typical for the Clinch River. There were no appreciable differences in conductivity within the water column at each location, or among locations each month (Figure 21). Conductivity was lowest at each location in July (241–244 µS/cm) and highest at each location in March (294–302 µS/cm) or November (295–297 µS/cm).

Secchi-disk transparency ranged from 1.5 to 6.2 m. The average transparency was greater than 3 m (3.1 to 3.6 m) at each SMR sampling location, which is higher than typically observed in mainstream Tennessee River reservoirs. Secchi-disk readings exhibited an overall pattern that was generally the inverse of turbidity and suspended solids (Figure 23). Secchi-disk measurements trended upward from spring (1.5–3.0 m) through October (4.8–6.2 m). They then declined in November (3.5–4.8 m) and December (2.0–2.3 m) as flow increased.

Analytical Results

Analytical results are provided in Tables 37 through 40 and presented graphically in Figures 23 through 27. A brief summary of results for each parameter is provided below.

Results for alkalinity, total hardness, and dissolved solids varied little among locations each month (Figure 24). Alkalinity ranged from 95 to 130 mg/L and averaged 110 mg/L. Overall, alkalinity was highest in March and April and lowest in September, with concentrations exhibiting a general trend of decreasing during the interim. Total hardness ranged from 130 to 160 mg/L and averaged 142 mg/L. Hardness values exhibited little temporal variation, but were similar to alkalinity in that values were slightly lower in September. Dissolved solids ranged from 160 to 200 mg/L and averaged 172 mg/L. Concentrations were generally consistent across sites, with peak concentrations (190–200 mg/L) occurring in July and August.

As expected, turbidity and suspended solids exhibited similar spatial and temporal patterns, and, overall, values were relatively low. Turbidity ranged from 0.6 to 12 nephelometric turbidity units (NTU), with 68 percent of the values less than 4 NTUs (Figure 23). Suspended solids ranged from 1 to 11 mg/L, with 85 percent of the values less than 4 mg/L. Turbidity and suspended solids were generally lower in autumn than in other periods. The higher values for both parameters occurred during periods with higher flow, and except for the samples that had elevated values in March and April (CRM 15.5 and CRM 18.5), there were no appreciable differences among locations.

Total organic carbon (TOC) ranged from 1.2 to 3.6 mg/L, but concentrations were generally moderate to low, averaging 2.1 mg/L (Figure 25). TOC concentrations were low ($\leq$1.7 mg/L) most months during spring and summer and at moderate levels during autumn. A notable exception to this pattern occurred in April, when TOC concentrations were near 3.3 mg/L at all sites. There were no consistent spatial patterns, although concentrations were higher at CRM 15.5 during five of the 10 sampling events. Concentrations deviated most among sites in October (1.8–3.5 mg/L). TOC concentrations were not significantly related to phytoplankton or zooplankton standing crops or biovolume/biomass.

Orthophosphate was below the quantification limit (0.025 mg/L) in all samples (Table 37). Total phosphorus concentrations typically were moderate (0.030 mg/L) to low (<0.003 mg/L), averaging 0.014 mg/L. The highest concentration (0.048 mg/L) was measured at CRM 18.5 in July (Figure 26). There were no consistent spatial trends in total phosphorus concentrations. Though exceptions are evident, concentrations were generally lower during the spring (March–May) and higher during summer (June–September). There was a marked decrease in total phosphorus from September to October, with concentrations in the fall (October–December) only slightly higher than observed during spring.

Total nitrogen concentrations ranged from 0.57 to 1.24 mg/L, with an average concentration of 0.78 mg/L. A majority of the nitrogen typically was present as nitrate-nitrite nitrogen (0.34 to 0.70 mg/L) (Figure 27). Except for two samples in March which had the highest nitrate-nitrite nitrogen concentrations – CRM 19.7 (0.70 mg/L) and CRM 22.0 (0.66 mg/L) – the seasonal pattern was similar among sites. Concentrations were typically in the range of 0.44 to 0.60 mg/L each month except October and November (0.34 to 0.39 mg/L). The lack of lower nitrate-nitrite concentrations probably reflects the low primary productivity (i.e., chlorophyll a) in the sampling reach as the available nitrogen was not being utilized by phytoplankton.

Total Kjeldahl Nitrogen (TKN) concentrations were variable both spatially and temporally, ranging from <0.10 to 0.79 mg/L and averaging 0.28 mg/L (Figure 27). The largest spatial deviations occurred in July and November as a result of elevated concentration at CRM 18.5 (0.71 mg/L) and CRM 15.5 (0.79 mg/L), respectively. The sample collected at CRM 18.5 in July also had the highest total phosphorus concentration observed during the period. Like phosphorus, the high spatial and temporal variability in TKN concentrations precludes any definitive statements concerning overall trends, but lower concentrations were more frequent in the spring and early summer (April–June) and in the month of December.

Ammonia concentrations ranged from <0.10 to 0.19 mg/L and did not exceed State of Tennessee criteria. Ammonia concentrations were below the quantification limit (0.10 mg/L) in approximately 53 percent of the samples, while some samples had higher ammonia concentrations (0.16–0.19 mg/L) than generally expected (Figure 27). Ammonia concentrations typically are low (<0.15 mg/L) in aerated surface waters of TVA reservoirs; values greater than 0.15 mg/L are relatively infrequent.

Concentrations of selected metals in each water sample collected are provided in Table 39. The maximum concentrations of each metal at each site are shown in Table 40, along with their respective criteria for protection of aquatic life. No metal exceeded state of Tennessee water quality criteria. Additionally, the dissolved fractions of arsenic, cadmium, chromium, selenium, and zinc were below quantification limits in all samples. In a few instances, the analytical results yielded dissolved fractions that were slightly higher than the total recoverable fraction, thereby indicating possible contaminations. However, these results were considered in this assessment.

Surface Water Quality Summary

The quality of surface water in the Clinch River near the proposed SMR site is influenced largely by operations of Melton Hill and Norris Dams and inflow water quality to Melton Hill Reservoir. Consistent with the geology of the area, water in the Clinch River was slightly alkaline, moderately hard, and well buffered. The typical pH was 7.5–7.9. Nutrient concentrations typically were relatively high for nitrogen and moderate to low for phosphorus. Phosphorus concentrations were often low enough to be a limiting factor to phytoplankton, while nitrogen appeared to be underutilized. Likewise, chlorophyll a was low and water clarity moderately high relative to mainstem Tennessee River reservoirs. The maximum water temperature neared 72° F (June and July), well below the State of Tennessee criteria of a maximum temperature of 86.9° F. The water column tended to be well mixed, but appreciable vertical gradients in oxygen were observed in July. Spatially, DO concentrations often varied about 1 to 1.5 mg/L. Several water quality parameters varied seasonally in response to periodicity of rainfall and runoff as well as in-reservoir processes related to dam operations. Concentrations of metals in water were found to be below concentrations established by the state of Tennessee for protection of aquatic life.

Approximately 80 percent of the total annual inflow to Melton Hill Reservoir is discharged from Norris Dam. Because the discharge water is from deep within Norris Reservoir, water temperatures in the lower half of the water column in the forebay of Melton Hill often remain relatively cold (54–66° F) from early spring until late fall. Therefore, warming of the water can be expected with increased distance downstream from Melton Hill Dam, especially during periods of low flow. Only weak thermal stratification was documented in the CRSMR sampling reach in 2011 because the daily discharge from Melton Hill Dam resulted in sufficient flow

velocities to periodically mix the water column. As mentioned, however, appreciable vertical gradients in oxygen concentrations existed at some locations during the July survey. Likewise, the slight deviation below the State water quality criterion for dissolved oxygen at CRM 15.5 in June may have resulted from periodic increases in flow mixing oxygenated water in the upper strata with oxygen-deficient water in the lower strata.

Melton Hill Dam is operated primarily for navigation and hydroelectric purposes. Releases typically range from no discharge to the maximum turbine capacity of about 20,000 cubic feet per second (cfs). However, intervals of 12 to 22 hours with no releases are common. In 2011, daily average releases during March through December generally were above the mean daily average releases for the same months in years 2005 through 2010 (Figure 22). Also in 2011, there were no hourly releases from Melton Hill Dam for about 33 percent of the time during March through December. By comparison, the percentages of hours with no releases ranged from about 36 percent to 66 percent for 2005 through 2010. Therefore, data collected in 2011 are likely more representative of conditions that exist during above average flow conditions. During low flow years, the potential exists for greater spatial difference in temperatures and for increases in the magnitude and duration of stratification and resultant oxygen deficiencies.

Sediment Quality

Concentrations of pesticides, PCBs, and selected metals in sediment samples collected at each CRSMR sampling location (CRM 15.5, 18.5, and 22.0) in 2011 and at far-field locations (CRM 24.0, TRM 560.8, and TRM 532.5) in 2010 and 2011 are provided in Tables 41and 42.

PCBs and pesticides were not detected in the sediment samples collected near the proposed CRSMR site and metals concentrations were below EPA Region 4 ecological screening values for sediments (EPA 2001). Of the three CRSMR sampling locations, metals concentrations were lowest at the most downstream location (CRM 15.5). However, sediments at each of these locations had lower metals concentrations than typically found in more lacustrine environments within TVA reservoirs. The lack of high depositional areas near the proposed CRSMR site likely resulted in sediments having higher fractions of sands and gravels, or coarse particulates, than encountered in more lacustrine environments where velocity is not sufficient to keep fine silts and clays in suspension. Higher fractions of coarse particulates can influence (reduce) the amount of adsorbed chemicals (chlorinated pesticides, PCBs, and most metals) present. Sediments collected at the far-field locations in Melton Hill and Watts Bar Reservoirs in 2010 and 2011 were found to contain the polychlorinated biphenyl Aroclor 1242 (57–310 µg/kg d.w.). Furthermore, the Tennessee Department of Environment and Conservation's (TDEC) Division of Water Pollution Control has issued fish consumption advisories for Watts Bar Reservoir due to PCBs and for Melton Hill Reservoir due to PCBs and chlordane.

Plankton Community

Phytoplankton

The complete quantitative dataset for phytoplankton is provided in Tables 46 through 48 and summarized in Tables 43 through 45 and in Figures 28 through 33. Phytoplankton biovolumes are summarized in Tables 49 through 51.

Chlorophyll

Chlorophyll a concentrations were low (<1.0–5.0 µg/L) throughout the sampling period (Table 37). Concentrations were below detectable levels (1 µg/L) in approximately 40 percent of the samples, and only two samples had concentrations greater than 2 µg/L. These results suggest phytoplankton growth was very limited within the sample reach, which is in a riverine portion of Watts Bar Reservoir. Turbulence within the water column likely inhibited phytoplankton from remaining in the photic zone for sufficient time to sustain growth and for reproduction to occur. The occasional higher chlorophyll a concentrations at the most upstream site (CRM 22.0) may reflect influences from local inflows, but it is believed to be the result of the site's proximity to Melton Hill Dam (CRM 23.1) and the periodic entrainment of water from the photic zone of Melton Hill Reservoir in the releases. For instance, monthly (April–September) chlorophyll a samples collected from the forebay of Melton Hill Reservoir (CRM 24.0) in 2011 ranged from 6 to 19 µg/L and averaged 11.8 µg/L (data from TVA's Vital Signs Monitoring Program).

Taxa Richness

A total of 81 phytoplankton taxa were collected in samples from March through December 2011 (Table 43). Chlorophytes were the most diverse group with 32 taxa, followed by bacillariophytes (17 taxa), cyanophytes (16 taxa), and chrysophytes (8 taxa). Euglenophytes and pyrrophytes were each represented by three taxa, and cryptophytes two taxa.

Total taxa richness ranged from 22 (March) to 45 (August) during the 10-month sampling period. Spring (March–May) was characterized by greater diversity (9–11 taxa) for the group Bacillariophyta, while chlorophytes, cyanophytes, and chrysophytes each had a minimum number of taxa present in March. Summer and early autumn were characterized by a greater diversity of Chlorophyta (14–18 taxa). Taxa richness peaked for chrysophytes in May (6 taxa) followed by a secondary peak in August (5 taxa). The number of chlorophyte and cyanophyte taxa also peaked (18 and 9, respectively) in August, and then exhibited an overall trend of decreasing from September through December. Although few Pyrrophyta taxa were collected in any given month, they were more prominent in autumn with two to three taxa represented each month.

Seasonal and spatial distribution of the 81 taxa of phytoplankton collected is summarized in Table 44. Of the 81 taxa, fourteen taxa were common, occurring in 60 percent or more of the samples. Common taxa included cyanophytes within the genera *Synechococcus* and *Synechocystis* and those identifiable only to the level of family (Chroococcaceae); the bacillariophytes *Aulacoseira*, *Cyclotella*, *Nitzschia*, and *Synedra*; the chlorophytes *Chlamydomonas, Monoraphidium,* and *Scenedesmus* and those indentified only to the family level (Chlorococcaceae); the chrysophyte *Erkenia*; and cryptophytes *Cryptomonas* and *Rhodomonas*. Of the remaining 67 taxa, 36 occurred in 10 percent (3 samples) or less of the

samples. This included 21 taxa that were represented in only one sample and 9 taxa that represented in only two samples.

Composition of Major Phytoplankton Groups

Cyanophytes were numerically dominant (90–99 %t) at each site during each month (Table 45). The composition of the other algal groups typically was less than two percent with few exceptions. The composition of chlorophytes exhibited a general trend of increase from spring through early autumn, with the highest percentages (4–7 %) occurring at each location in September or October. Diatoms (bacillariophytes) were generally more abundant in the spring and autumn, but they obtain their highest composition (3–4 %) at each site in November, due primarily to decreases in the numbers of cyanophytes present. Chrysophytes and cryptophytes each typically comprised less than one percent of the population, though both groups occasionally comprised slightly higher percentages (1.5–2.4%). Euglenophytes and pyrrophytes remained below one percent.

Phytoplankton Concentrations

Phytoplankton population estimates ranged from approximately 3,600 to 52,900 cells/mL during the 10-month sampling period (Figure 28). The variability among sites and seasons was largely due to differences in abundances of cyanophytes, which comprised the bulk (90–99%) of the population in each sample. Spatially, phytoplankton populations varied by an average of approximately 30 percent, exhibiting a minimum difference of 4 percent (December) and a maximum difference of 90 percent (August). However, population estimates for triplicate samples collected at CRM 15.5 (August) and at CRM 18.5 (May) yielded estimates that varied approximately 10 to 50 percent, with an average difference of 28 percent. Therefore, some caution is warranted when evaluating both spatial and temporal trends in phytoplankton abundances due to the natural transient and patchy distribution of the populations being studied.

The highest phytoplankton densities were documented, respectively, at CRM 22.0 (52,900 cells/mL) and CRM 18.5 (47,100 cells/mL) in March. Cell densities at these sites were more than twofold higher than observed downstream (CRM 15.5; 18,500 cells/mL) and were appreciably higher than observed in other months. Population densities were lower in April than in March at all sites, but densities at the two most upstream sites (15,000–18,000 cells/mL) continued to be higher (~twofold) than at the downstream site (9,500 cells/mL). From May through July, population densities fluctuated in the range of approximately 21,000 to 24,000 cells/mL at CRM 15.5 and 20,000 to 29,000 cells/mL at CRM 22.0. Population densities were slightly more variable at CRM 18.5 during this period, ranging from 16,000 to 31,000 cells/mL.

Similar to findings in March, there was appreciable divergence (up to 90%) in population densities (3,700–38,000 cells/mL) among the sites in August due to greater abundances of several cyanophyte taxa — principally, *Cyanogranis* and Chroococcaceae — at CRM 22.0 and CRM 15.5, respectively. Though abundances of other phytoplankton groups were significantly less than cyanophytes, the spatial pattern was the same. That is, the abundance of each group was highest at CRM 22.0 followed by CRM 15.5 (Figures 29–32). Notably, the population density at CRM 22.0 in August was the second highest observed during the 10-month period and coincided with the highest chlorophyll a concentration (5 µg/L). By comparison, population densities at CRM 18.5 in August were the lowest observed among the sites. Additionally, chlorophyll a concentrations at the four water quality sampling locations (CRMs 22.0, 19.7,

18.5, and 15.5) in August exhibited a trend of decreasing from upstream to downstream (5.0, 2.0, 1.0, and <1.0 µg/L, respectively) (Table 37).

The large discrepancies in standing crops among the sites in August likely reflects, in part, the patchy nature of plankton distribution as well as the interrelated effects of the increased magnitude and duration of daily peak releases from Melton Hill Dam (Figure 22). The higher densities observed at CRM 22.0 were possibly related to increased entrainment of phytoplankton in releases from Melton Hill Dam, located approximately one mile upstream from the sample site. In contrast, the higher flow velocities likely increased mixing within the water column and reduced phytoplankton growth (i.e., light limitation), resulting in lower densities at CRM 15.5 and CRM 18.5. Similar patterns in have been observed in mainstream Tennessee River reservoirs. Though phytoplankton densities can be relatively sparse in the tailwaters immediately downstream of dams, densities often are highest close to the dam, but then continually decrease downstream until velocities are sufficiently reduced to allow phytoplankton to remain in the photic zone long enough to sustain growth and reproduction. Moreover, both total population densities and major phytoplankton group densities at CRM 22.0 tended to show the greatest deviation among the sample sites – often being markedly higher than at the other sites – each month during March through August. This pattern was not evident after August. Autumn was characterized by overall lower standing crops of phytoplankton and less spatial variation; the probable response of phytoplankton to seasonal declines in water temperatures, solar illumination, and nutrients (i.e., phosphorus), and to increased flow velocities.

<u>Phytoplankton Biovolume</u>

Phytoplankton biovolume estimates ranged from $2.3x10^4$ to $9.2x10^5$ µm³/mL (Table 49). Biovolume exhibited the expected spring maximums often associated with greater abundances of diatoms. The maximum biovolume for the 10-month period occurred at CRM 18.5 in March and coincided with the maximum population density. However, the majority of the biovolume in the sample was attributable to greater abundances of large-celled diatoms as opposed to the higher density of cyanophytes present in the sample (Table 50). The biovolume in this sample was approximately two-fold higher than the maximums observed at the other sites. This sample also had the only occurrence of the diatom *Melosira*; a genus typically more prevalent in Valley reservoirs. *Melosira* accounted for almost 60 percent of the total biovolume in the sample and contributed the highest biovolume ($5.4x10^5$ µm³/mL) of any taxa in an individual sample (Table 51). Diatoms also accounted for the maximum biovolumes observed at CRM 15.5 ($3.6x10^5$ µm³/mL) and CRM 22.0 ($5.4x10^5$ µm³/mL). These maximums occurred in May, largely in association with the diatoms *Aulacoseira* and *Fragilaria*.

Moreover, diatoms dominated phytoplankton biovolume during most months (Table 50). The relative contribution of diatoms was generally higher in the spring (up to 97%) and late autumn (up to 88%). Diatoms comprised less than 30 percent of the total biovolume in only a few (6) samples, most notably in September, when percentages ranged from 10 to 16 percent across sites. September — and early autumn in general — was characterized by lower abundances of large-celled diatoms and increased abundances of large-celled cryptophytes and pyrrophytes.

Over the 10-month period, *Aulacoseira* was the principal diatom in terms of biovolume, followed by *Cyclotella* and *Synedra*, respectively; though other diatoms — *Asterionella*,

Diatoma, *Fragilaria*, *Melosira*, and *Stephanodiscus* — also contributed appreciable biovolume in some samples, especially during the spring.

The chlorophytes and cryptophytes typically comprised a lesser but still important component of the total biovolume; more so in summer and early autumn, when together they accounted for an average of approximately 40 percent of the total biovolume. Additionally, C*ryptomonas* was one of the predominant genera in terms of biovolume, usually comprising from 10 to 30 percent of the total phytoplankton biovolume from June through November.

Chrysophyta were never a dominant contributor to biovolume. Percentages of this group were highest at CRM 15.5 in July (14%) and August (13%), but typically accounted for less than 4 to 5 percent of the total. *Erkenia* was the dominant chrysophyte numerically and generally contributed the most biovolume within the group, followed by the occasional presence of larger-celled *Mallomonas* (Table 51).

Although cyanophytes dominated phytoplankton abundance, they only comprised about 7 percent of the total biovolume on average, with percentages ranging from approximately 2 to 23 percent in individual samples. Small-celled cyanophytes in the families Chroococcaceae and Synechococcaceae were the most abundant and typically accounted for most of the group's biovolume. Larger-celled genera such as *Anabaena, Cylindrospermopsis, and Oscillatoria* were relatively uncommon and sporadic in occurrence, but they occasionally contributed appreciable biovolume and resulted in cyanophytes comprising greater than 10 percent of the total.

Pyrrophytes and euglenophytes were absent in about 53 to 77 percent of the samples, respectively. When present, euglenophytes (1–7 cells/mL) and pyrrophytes (2–27 cells/mL) were not very abundant relative to total phytoplankton populations. However, due to the fact these genera often are represented by large-celled phytoplankton, a few individuals can contribute considerable biovolume. If present, euglenophytes (*Euglena*, *Lepocinclis*, and/or *Trachelomonas*) comprised from 2 to 10 percent of the total phytoplankton biovolume. Pyrrophytes (*Glenodinium, Gymnodinium*, and *Peridinium*), when present, comprised from 1 to 65 percent of the total biovolume. Pyrrophytes contributed appreciable biovolume in several samples during the months from August through November, with the greatest biovolume and percentage contribution (26-65 %) occurring in September.

Multivariate analysis of Phytoplankton Assemblages

Principle Component Analysis (PCA) was utilized to examine spatial and temporal differences in phytoplankton community structure. Multiple runs of the PCA were performed for various subsets of the phytoplankton results to better understand which taxa were contributing most to the trends in the results. An initial run of the PCA included all taxa (81) collected. As expected, taxa occurring in only one or two samples (21 and 9 taxa, respectively) did not contribute to dominant trends in the PCA and were removed from the data set.

A subsequent PCA was performed using 51 of the original 81 taxa. For this reduced data set, the first two components of the PCA explained approximately 45 percent of the total variation in the phytoplankton abundance data. The resulting ordination diagram (Figure 34) clearly shows similar temporal patterns in the phytoplankton assemblages among sites. Sites tended to group closer together by month as well as by "season": spring (March–May), summer (June–August), and autumn (September–December).

Component one (PC-1, x-axis) of the PCA explained 33 percent of the variation and primarily represented differences between the spring phytoplankton assemblages and those in summer and autumn. The second component (PC-2, y-axis) explained an additional 12 percent of the variation in the data and, for the most part, appeared to reflected differences between summer and autumn. Because cyanophytes were highly dominant (90–99 %) throughout the sampling period, similarities or differences in the relative abundances of genera within this group accounted for the dominant trends in the PCA. Those trends were largely found in the greater composition of *Aphanocapsa* in the spring, *Cyanogranis* in the summer, and *Merismopedia* and *Synechocystis* in autumn (Figure 34).

[*A PCA also was performed using only the taxa yielding covariance coefficients greater than 0.10 on the first (Figure 36) or second component (Figure 37) in the initial PCA. The resulting ordination diagram is shown in Figure 35 and includes 18 of the original 81 taxa. This PCA explained approximately 63 percent of the variation with the first two components (PC-1, ~46%; PC-2, ~17%) and essentially yields the same ordination diagram as Figure 34*]

Although cyanophytes within the genus *Synechococcus* and those identifiable only to the family Chroococcaceae were ubiquitous throughout the 10-month period, with each group typically comprising from 20–60 percent of the total population, they did not account for the dominant trends in the PCA. The remaining cyanophyte genera occurred more sporadically. Five of the sixteen cyanophyte taxa were found in only one sample each, and none of these taxa occurred in the same month. This included the genera *Anabaena*, *Leptolyngbya*, *Lyngbya*, *Phormidium*, and *Cyanocatena*. Phytoplankton assemblages at each site did, however, exhibit similarities in the cyanophytes *Aphanothece* (collected only in April) and in *Cylindrospermopsis* (collected only in August).

In March, peak densities of the cyanophyte *Aphanocapsa* occurred at each site (14.500 – 36,437 cells/mL), making it the dominant genus (49-79%) (Figure 34; upper left quadrant). The abundance and percentage composition of *Aphanocapsa* trended downward in subsequent months. By June, *Aphanocapsa* comprise a considerable percentage (19%) of the population only at CRM 22.0 (upper left quadrate); it comprised less than 2 percent of the populations at the other sites. *Aphanocapsa* was collected infrequently after June and was no longer a major component of the phytoplankton assemblages. The greater dissimilarity among sites in June was largely due to differences in the relative abundance of *Aphanocapsa* and of another cyanophyte, *Cyanogranis.* Cyanogranis was absent from the sample collected at CRM 22.0 and comprised less than 1 percent of the population at CRM 15.5, but it accounted for almost 34 percent of the population at CRM 18.5 (upper right quadrant).

Similar to observations for several other cyanophytes, *Cyanogranis* was not present in the spring (March–May). Although extremely sporadic in occurrence and abundance, it was often a major component (up to 58%) of the phytoplankton assemblages during the summer months (June–August) and was a major component of the assemblage again in December, when it comprised about 31percent of the population at CRM 22.0. Variability in the occurrence of *Cyanogranis* also contributed to dissimilarity among sites in August. As previously discussed, substantial differences in total population densities were observed among sites in August (Figure 28). Densities were highest at CRM 22.0, followed by CRM 15.5 and CRM 18.5, respectively. Although cyanophytes dominated at each sample location (94–97%), major differences among the sites were evident in the composition of *Cyanogranis* and, to a lesser degree*, Synechocystis*.

Cyanogranis was not present in the sample collected at CRM 18.5 (Figure 34, lower left quadrant) in August, while it comprised 17 and 39 percent of the populations at CRM 15.5 and CRM 22.0, respectively (upper right quadrant). The cyanophyte *Synechocystis* also comprised a greater percentage of the population at CRM 22.0 (7%) in August than at the other sites (2–3%).

Synechocystis was one of the more common cyanophytes throughout the 10-month period. The percentage contribution of this genus to the total population was generally lower in the spring and early summer — typically less than one percent — and greatest in autumn (up to 11%). Additionally, *Merismopedia* was a common component of the autumn assemblages, but it only occurred concurrently at all sites in December, when it was found in the highest relative abundance (2.5–6.1%) at each site. These gradients are reflected in PC-1 and PC-2, with those samples having a higher composition of *Synechocystis* and *Merismopedia* trending toward the lower right quadrant (Figure 34).

Several additional taxa that were each in relatively low abundance in the flora, and which typically attained only moderate to low loadings in the PCA, were still important components in the description of trends. One temporal pattern reflected in the PCA was the more diverse diatom assemblage during the spring and, conversely, the absence of several cyanophyte taxa from the spring assemblages. These gradients are reflected in the loadings for PC-1 (Figure 36). Notable exceptions to these generalizations were found in the diatom *Cyclotella* and the cyanophyte *Aphanocapsa*. *Aphanocapsa*, as previously discussed, reached maximum densities in the spring. While *Cyclotella* was absent in March, it exhibited a sigmoidal pattern of abundance in all samples thereafter, occurring in lower abundance in April, June, August, and October. As with other non-cyanophyte genera, *Cyclotella* never comprised a large proportion of the population, but percentages were generally higher in autumn (up to 2.8%).

Aulacoseira and *Stephanodiscus* were the most prevalent and abundant diatoms in spring (Figure 34, upper left quadrate). *Aulacoseira* continued to be present each month and exhibited an autumn peak at each site in December, but *Stephanodiscus* was absent from most samples during the remainder of the year.

The pyrrophyte *Glenodinium* was absent from the assemblages until autumn. While not present in high numbers, *Glenodinium* peaked in abundance in September (lower right quadrant).

Chlorophyte abundance and composition, though variable both spatially and temporally, were generally lower in the spring, then reached an initial peak in June followed by a second peak in October. Summer and early autumn were characterized by a greater diversity of Chlorophyta (14–18 taxa), but of the 32 chlorophyte taxa collected during the 10-month period, about half (15) occurred in only one or two samples and were not included to the PCA. Peak densities of chlorophytes were largely due to greater abundances of undefined taxa in the family Chlorococcaceae. Other prevalent chlorophytes included, respectively, *Chlamydomonas, Scenedesmus*, *Monoraphidium, and Lagerheimia*.

Erkenia was the most prevalent chrysophyte, exhibiting a general pattern of higher abundance in late spring (April and May) and in July. Other chrysophyte taxa (8) were collected infrequently.

The cryptophytes *Cryptomonas* and *Rhodomonas* were present throughout the study period but did not account for the dominant trends in the PCA. Together, these genera typically comprised

less than one percent of the populations. Conversely, euglenophytes were very sporadic in occurrence and, therefore, did not contribute to trends in the PCA.

Summary of Phytoplankton

Phytoplankton populations in the area of the proposed CRSMR were characterized by low abundance and appeared to be mainly the results of phytoplankton populations generated within Melton Hill Reservoir and transported downstream. Based on chlorophyll results, phytoplankton productivity in the sampled reach was very limited and phytoplankton populations were essentially in a senescent phase. Productivity was likely light-limited due to turbulence within the water column.

Many phytoplankton taxa occurred at various times and locations, but similar temporal patterns in the structure of the communities were evident among the sites, though quantitative characteristics (total and group cell densities) often varied appreciably. Overall, cyanophytes were dominant numerically throughout the 10-month period, while bacillariophytes (diatoms) were typically dominate in terms of biovolume.

Although no definitive spatial trends were evident, there was general pattern of higher population densities at the most upstream site from March through August. These higher densities are likely related to entrainment of phytoplankton in releases from Melton Hill Dam and the proximity of most upstream station. This pattern was not evident after August as phytoplankton densities were substantially lower at all sites due to increased flow and the interrelated effects of seasonal changes.

Zooplankton

The complete quantitative dataset for zooplankton is provided in Tables 58 through 60 and summarized in Tables 52 through 57 and in Figure 41. Zooplankton biomass is summarized in Tables 61 and 62 and in Figure 42.

Taxa Richness

Only 18 zooplankton taxa were collected in samples from March through December, 2011 (Table 52). Cladocerans were the most diverse group with 8 taxa, followed by rotifers (7 taxa). Only 3 distinct copepod taxa were identified as a majority of the specimens were only identifiable to the level of order (Calanoida and Cyclopoida). *Diaptomus* sp. was the only calanoid indentified within the order. *Tropocyclops prasinus* and *Cyclops* sp. were indentified within the order Cyclopoida.

During the monthly surveys, total richness ranged from 4 to 8 taxa. Richness in individual samples ranged from 1 to 7, and averaged approximately 3 taxa per sample (Table 53). Of the 18 zooplankton taxa represented, there were 7 taxa that each had concurrently collections at the three sites in at least one sample period. An additional 7 taxa were represented in only one sample each. The cladoceran *Bosmina longirostris* was the most prevalent taxa, and it occurred in approximately 63 percent of the samples (19 of 30). Other common taxa — 30 to 33 percent occurrence rate — included *Daphnia lumholtzi* and *Asplanchna brightwellii.* Copepods in the order Cyclopoida occurred in 21 (70%) samples, but *Tropocyclops prasinus* was identified in only one sample, while *Cyclops* sp. was identified in 11 (37%) samples. Calanoid copepods occurred in 13 (43%) samples, but *Diaptomus* sp. was only indentified in three samples.

Zooplankton Abundance and Composition

Overall, the zooplankton assemblages were characterized by low abundance (Table 54, Figure 38), though population densities ranged from 34 to as high as 12,790 organisms/m^3 during the 10-month sample period. The seasonal pattern in zooplankton densities was similar among sites. Densities trended upward from March through June and then declined substantially in July, followed by a subsequent decline in August. Zooplankton densities were relatively sparse from August through December and exhibited a slight, autumn peak at CRM 15.5 and CRM 22.0 in September.

Total zooplankton abundance was moderate to low in early spring (March and April) relative to other months. Copepods were numerically dominant (40–100%) at each site during early spring (Table 55), with greater abundances of cyclopoid copepods (Table 56). In March, the zooplankton assemblages were similar at CRM 15.5 and CRM 18.5, with similar composition of Calanoid (10%) and cyclopoid (50–70%) copepods, the cladoceran *Bosmina longirostris* (10–20%), and the rotifer *Asplanchna brightwellii* (10%) (Table 57). However, only cyclopoid copepods were collected at CRM 22.0 in March, making this site more dissimilar. Likewise, in April, only Cyclopoida were common to all sites, comprising 40 to 85 percent of the populations. None of the seven additional taxa collected in April were shared by any two sites.

Rotifers were the dominant taxonomic group (59–84%) in May. Peak densities of *Asplanchna brightwellii* and *Conochilus unicornis* occurred at each site, but densities of both taxa were several fold higher at CRM 22.0. Peak density of the cladoceran *Bosmina longirostris* also occurred at CRM 22.0 in May. *B. longirostris* was present at each site, but the density was about 2 to 3 fold higher at CRM 22.0. Thus, the zooplankton population density was substantially higher at CRM 22.0 in May than at more downstream sites (Figure 38).

Maximum population densities occurred at each site in June. Similar to findings in May, the density of zooplankton was substantially higher at CRM 22.0 (12,790 organism/m^3) than at more downstream sites (approximately 5000 organism/m^3). Cladocera was the dominant taxonomic group (75–100%) at each site. *Daphnia lumholtzi*, *Daphnia pulicaria*, and *Diaphanosoma leuchtenbergianum* each had peak overall abundance in June. Copepods comprised about 20 percent of the populations at CRM 15.5 and CRM 22.0 and were absent from the sample collected at the central site. Additionally, *Bosmina longirostris* and *Chydorus sphaericus* occurred in moderate abundances at CRM 22.0 and were absent from samples collected at other sites. Notably, this was the only occurrence of *C. sphaericus* during the 10-month period.

Abundances of all major groups were substantially lower in July than in June, but Cladocera continued to be dominant (75–100%). The assemblages at sites maintained a commonality only in *Daphnia lumholtzi*. This was the only taxa collected at CRM 18.5. Six taxa were collected at CRM 15.5 and the composition of the assemblage was generally similar to that observed at the site in June. The population density was markedly lower at CRM 22.0 than at other sites and composition was equally distributed (25%) across four taxa and included the only occurrence of *Daphnia pulicaria* during the 10-month period.

From August through December, zooplankton populations were characterized by sparse abundance and greater sporadicity in the occurrence of taxa. Except for a slight, autumn peak in abundance at CRM 15.5 and CRM 22.0 in September (approximately 800–1,800 organisms/m^3, respectively), population estimates were less than 500 organisms/m^3 from August through

December. The lowest densities (34 – 70 organisms/m^3) were documented at sites in October or November. The low abundances of zooplankton in autumn often resulted in compositional measures being sensitive to what in reality were minor differences within the assemblages. However, there were some general commonalities among sites. Although dominance varied by sample, cladocerans and copepods tended to be codominant each month except in October, when samples consisted mainly of rotifers in the family Notommatidae; this was the first incidence of Notommatidae during the sampling period. *Bosmina longirostris* was common to sites in September, November, and December, and absent from assemblages in October.

Zooplankton Biomass

Zooplankton biomass estimates ranged from approximately 1 to 42,300 µg d.w./m^3 (Figure 39) Except for a few samples with moderate biomass (~33,500 to 42,300 µg d.w./m^3) in June and July, biomass could be characterized as low or sparse.

The temporal pattern in biomass was similar to that of zooplankton population density. As expected, there was some dissimilarity between the two measures as a result of differences in the sizes of the organisms collected. Generally, zooplankton within the group Cladocera contributed the most biomass per individual, followed by copepods and rotifers, respectively. Also the size structure of some taxa varied seasonally.

Zooplankton biomass was lowest in late autumn and highest mid-summer. Maximum biomass at each site was associated with greater numbers and sizes of the cladocerans within genera *Daphnia* and *Diaphanosoma* (Table 61). Peak biomass for other taxa was markedly lower. Cyclopoid copepods reached maximum biomass in samples collected at CRM 18.5 in March and April (~2400 and 3200 µg d.w./m^3). *Asplanchna brightwellii* was the only rotifer to contribute appreciable biomass, and this occurred at CRM 22.0 in May (~3400 µg d.w./m^3). The relative biomass of taxa tended to be sporadic, partly because of seasonal succession within the zooplankton assemblage, but largely due to the low overall abundance and diversity of zooplankton each month (Table 62).

Summary of Zooplankton Results

Zooplankton assemblages in the vicinity of the proposed SMR were characterized by low abundance and diversity throughout the 10-month sampling period. As with phytoplankton, high turbulence and advection within the sampled reach likely limited zooplankton populations and affected their distribution. Zooplankton assemblages often showed a notable degree of spatial heterogeneity in terms of both species composition and total abundance, but no systematic differences were apparent. On the other hand, similar temporal patterns were evident among sites owing to seasonal succession within the zooplankton communities and the proximity of the locations sampled. At each site, copepods were the dominant taxonomic group in early spring (March and April), and rotifers were dominant in May. Peak zooplankton abundance and biomass occurred during June and/or July and were dominated by Cladocera. These peaks were associated with warmer water temperatures and generally low flow. Abundance and biomass were extremely sparse throughout the remainder of the year, with no ecologically significant differences evident among sites.

Literature Cited

EPA (U.S. Environmental Protection Agency) and NRC (U.S. Nuclear Regulatory Commission). 1977 (draft). Interagency 316(a) Technical Guidance manual and Guide for Thermal Effects Sections of Nuclear Facilities Environmental Impact Statements. U.S. Environmental Protection Agency, Office of Water Enforcement, Permits Division, Industrial Permits Branch, Washington, DC.

Etnier, D.A. & Starnes, W.C. 1993. The Fishes of Tennessee. University of Tennessee Press, Knoxville, Tennessee, 681 pp.

Hickman, G. D. and T. A. McDonough. 1996. Assessing the Reservoir Fish Assemblage Index- A potential measure of reservoir quality. *In*: D. DeVries (Ed.) Reservoir symposium- Multidimensional approaches to reservoir fisheries management. Reservoir Committee, Southern Division, American Fisheries Society, Bethesda, MD. pp 85-97.

Horvath, T.G., K.M. Martin, and G.A. Lamberti. 1999. Effect of zebra mussels, *Dreissena polymorpha*, on macroinvertebrates in a lake outlet stream. American Midland Naturalist 142(2):340-347.

Jennings, M. J., L. S. Fore, and J. R. Karr. 1995. Biological monitoring of fish assemblages in the Tennessee Valley reservoirs. Regulated Rivers 11:263-274.

McDonough, T.A. and G.D. Hickman. 1999. Reservoir Fish Assemblage Index development: A tool for assessing ecological health in Tennessee Valley Authority impoundments. *In*: Assessing the sustainability and biological integrity of water resources using fish communities. Simon, T. (Ed.) CRC Press, Boca Raton, pp 523-540.

Plafkin, J.L., Barbour, M.T., Porter, K.D., Gross, S.K., and Hughes, R.M. (1989). Rapid assessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. EPA/444/4-89-001, Washington DC, USA.

Tennessee Wildlife Resources Commission (TWRC). 2006. Strategic Plan, 2006-2012. Tennessee Wildlife Resources Commission, Nashville, TN. March 2006. pp 124-125. http://tennessee.gov/twra/pdfs/StratPlan06-12.pdf

Tennessee Wildlife Resources Agency (TWRA). 2012. Tennessee Commercial Fishing Regulation Summary. http://www.tn.gov/twra/fish/Commercial/TN%20COMM%20FISH%20REG_2012.pdf

USEPA. 2001. Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published November 1995. U.S. Environmental Protection Agency. Website version last updated November 30, 2001: http://www.epa.gov/region4/superfund/programs/ riskassess/ecolbul.html.

Yoder, C.O., B.J. Armitage, and E.T. Rankin. 2006. Re-evaluation of the Technical Justification for Existing Ohio River Mainstem Temperature Criteria. Midwest Biodiversity Institute, Columbus, Ohio.

Table 1. RFAI metrics and scoring criteria for forebay, transition, and inflow sections of upper mainstream Tennessee River reservoirs. Upper mainstream reservoirs include Nickajack, Chickamauga, Watts Bar, Melton Hill, Fort Loudoun, and Tellico. Transition criteria were used for SMR sites.

		Scoring Criteria								
		Forebay			Transition			Inflow		
Metric	**Gear**	**1**	**3**	**5**	**1**	**3**	**5**	**1**	**3**	**5**
1. Total species	Combined	<14	14-27	>27	<15	15-29	>29	<14	14-27	>27
2. Total Centrarchid species	Combined	<2	2-4	>4	<2	2-4	>4	<3	3-4	>4
3. Total benthic invertivores	Combined	<4	4-7	>7	<4	4-7	>7	<3	3-6	>6
4. Total intolerant species	Combined	<2	2-4	>4	<2	2-4	>4	<2	2-4	>4
5. Percent tolerant individuals	Electrofishing	>62%	31-62%	<31%	>62%	31-62%	<31%	>58%	29-58%	<29%
	Gill netting	>28%	14-28%	<14%	>32%	16-32%	<16%			
6. Percent dominance by 1 species	Electrofishing	>50%	25-50%	<25%	>40%	20-40%	<20%	>46%	23-46%	<23%
	Gill netting	>29%	15-29%	<15%	>28%	14-28%	<14%			
7. Percent non-indigenous species	Electrofishing	>4%	2-4%	<2%	>6%	3-6%	<3%	>17%	8-17%	<8%
	Gill netting	>16%	8-16%	<8%	>9%	5-9%	<5%			
8. Total top carnivore species	Combined	<4	4-7	>7	<4	4-7	>7	<3	3-6	>6
9. Percent top carnivores	Electrofishing	<5%	5-10%	>10%	<6%	6-11%	>11%	<11%	11-22%	>22%
	Gill netting	<25%	25-50%	>50%	<26%	26-52%	>52%			
10. Percent omnivores	Electrofishing	>49%	24-49%	<24%	>44%	22-44%	<22%	>55%	27-55%	<27%
	Gill netting	>34%	17-34%	<17%	>46%	23-46%	<23%			
11. Average number per run	Electrofishing	<121	121-241	>241	<105	105-210	>210	<51	51-102	>102
	Gill netting	<12	12-24	>24	<12	12-24	>24			
12. Percent anomalies	Electrofishing	>5%	2-5%	<2%	>5%	2-5%	<2%	>5%	2-5%	<2%
	Gill netting	>5%	2-5%	<2%	>5%	2-5%	<2%			

Table 2. Metrics and scoring criteria for benthic macroinvertebrate community samples (lab-processed) for forebay, transition, and inflow zones of mainstem Tennessee River reservoirs. Inflow scoring criteria were used for sites upstream and downstream of the proposed SMR site.

	Forebay			Transition			Inflow		
Benthic Community Metrics	**1**	**3**	**5**	**1**	**3**	**5**	**1**	**3**	**5**
Average number of taxa	< 2.8	2.8-5.5	> 5.5	< 3.3	3.3-6.6	> 6.6	< 4.2	4.2-8.3	> 8.3
Proportion of samples with long-lived organisms	< 0.6	0.6-0.8	> 0.8	< 0.6	0.6-0.9	> 0.9	< 0.6	0.6-0.8	> 0.8
Average number of EPT (Ephemeroptera, Plecoptera, Trichoptera)	< 0.6	0.6-0.9	> 0.9	< 0.6	0.6-1.4	> 1.4	< 0.9	0.9-1.9	> 1.9
Average proportion of oligochaete individuals	> 41.9	41.9-21.0	< 21.0	> 21.9	21.9-11.0	< 11.0	> 23.9	23.9-12.0	< 12.0
Average proportion of total abundance comprised by the two most abundant taxa	> 90.3	90.3-81.7	< 81.7	> 87.9	87.9-77.8	< 77.8	> 86.2	86.2-73.1	< 73.1
Average density excluding chironomids and oligochaetes	< 125.0	125.0-249.9	> 249.9	< 305.0	305.0-609.9	> 609.9	< 400.0	400.0-799.9	> 799.9
Zero-samples - proportion of samples containing no organisms	> 0	---	0	> 0	---	0	> 0	---	0

Table 3. Shoreline Aquatic Habitat Index (SAHI) metrics and scoring criteria.

Metric	Scoring Criteria	Score
Cover	Stable cover (boulders, rootwads, brush, logs, aquatic vegetation, artificial structures) in 25 to 75 % of the drawdown zone	5
	Stable cover in 10 to 25 % or > 75 % of the drawdown zone	3
	Stable Cover in < 10 % of the drawdown zone	1
Substrate	Percent of drawdown zone with gravel substrate > 40	5
	Percent of drawdown zone with gravel substrate between 10 and 40	3
	Percent substrate gravel < 10	1
Erosion	Little or no evidence of erosion or bank failure. Most bank surfaces stabilized by woody vegetation.	5
	Areas of erosion small and infrequent. Potential for increased erosion due to less desirable vegetation cover (grasses) on > 25 % of bank surfaces.	3
	Areas of erosion extensive, exposed or collapsing banks occur along > 30% of shoreline.	1
Canopy Cover	Tree or shrub canopy > 60 % along adjacent bank	5
	Tree or shrub canopy 30 to 60 % along adjacent bank	3
	Tree or shrub canopy < 30 % along adjacent bank	1
Riparian Zone	Width buffered > 18 meters	5
	Width buffered between 6 and 18 meters	3
	Width buffered < 6 meters	1
Habitat	Habitat diversity optimum. All major habitats (logs, brush, native vegetation, boulders, gravel) present in proportions characteristic of high quality, sufficient to support all life history aspects of target species. Ready access to deeper sanctuary areas present.	5
	Habitat diversity less than optimum. Most major habitats present, but proportion of one is less than desirable, reducing species diversity. No ready access to deeper sanctuary areas.	3
	Habitat diversity is nearly lacking. One habitat dominates, leading to lower species diversity. No ready access to deeper sanctuary areas.	1
Gradient	Drawdown zone gradient abrupt (> 1 meter per 10 meters). Less than 10 percent of shoreline with abrupt gradient due to dredging.	5
	Drawdown zone gradient abrupt. (> 1 meter per 10 meters) in 10 to 40 % of the shoreline resulting from dredging. Rip-rap used to stabilize bank along > 10 % of the shoreline.	3
	Drawdown zone gradient abrupt in > 40 % of the shoreline resulting from dredging. Seawalls used to stabilize bank along > 10 % of the shoreline.	1

Table 4. Species collected, ecological and recreational designations, and corresponding electrofishing (EF) and gill net (GN) catch per unit effort downstream (CRM 15.0) of the proposed CRSMR discharge, February 15, 2011.

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	0.13	0.61	2	.	.	2
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	X	0.07	0.30	1	.	.	1
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	0.07	0.30	1	.	.	1
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	.	.	.	1.13	5.18	17	.	.	17
White sucker	*Catostomus commersoni*	OM	X	TOL	X	X	.	0.07	0.30	1	.	.	1
Redbreast sunfish*	*Lepomis auritus*	IN	.	TOL	.	.	X	0.13	0.61	2	.	.	2
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	0.87	3.96	13	.	.	13
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	10.9	50.00	164	.	.	164
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	0.20	0.91	3	.	.	3
White crappie	*Pomoxis annularis*	TC	X	TOL	.	.	X	0.07	0.30	1	.	.	1
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	3.53	16.2	53	.	.	53
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	.	.	0.53	2.44	8	0.30	3	11
Rock bass	*Ambloplites rupestris*	TC	X	INT	.	.	X	0.20	0.91	3	.	.	3
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	X	.	.	.	0.20	2	2
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	X	2.53	11.59	38	.	.	38
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	.	.	.	0.10	1	1
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	0.30	3	3
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	.	.	.	1.00	10	10
White bass	*Morone chrysops*	TC	X	.	.	.	X	.	.	.	4.20	42	42
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	0.07	0.30	1	0.70	7	8
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	.	.	.	1.90	19	19
Hybrid striped bass	Hybrid *Morone*	TC	.	.	.	.	X	.	.	.	0.10	1	1
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	1.00	4.57	15	.	.	15
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	1.13	5.18	17	0.10	1	18
Hybrid sunfish	Hybrid *Lepomis* sp.	IN	X	.	.	.	X	0.20	0.91	3	.	.	3
Black crappie	*Pomoxis nigromaculatus*	TC	X	.	.	.	X	0.07	0.30	1	.	.	1
Walleye	*Sander vitreus*	TC	X	.	.	.	X	.	.	.	0.60	6	6
Sauger	*Sander canadensis*	TC	X	.	.	.	X	.	.	.	5.30	53	53
Saugeye	Hybrid *Sander*	TC	X	.	.	.	X				0.20	2	2
Yellow perch*	*Perca flavescens*	IN	.	.	.	.	X	0.27	1.22	4	.	.	4

Table 4. Continued (CRM 15.0, February 2011)

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Dusky darter	*Percina sciera*	IN	X	.	.	.	.	0.07	0.30	1	.	.	1
Banded sculpin	*Cottus carolinae*	IN	X	.	.	.	.	1.67	7.62	25	.	.	25
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	X	.	.	.	0.30	3	3
Mississippi silverside*	*Menidia audens*	IN	.	.	.	X	X	3.60	16.50	54	.	.	54
Total								**28.5**	**130.5**	**428**	**15.3**	**153**	**581**
Number Samples								**15**			**10**		
Species Collected	**31**		**26**		**2**	**12**	**26**	**22**			**12**		

Trophic level: benthic invertivore (BI), insectivore (IN), omnivore (OM), planktivore (PK), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally. *Denotes aquatic nuisance species next to common name. All species are considered representative important species. No species collected have a Federal Threatened or Endangered status.

Table 5. Species collected, ecological and recreational designations, and corresponding electrofishing (EF) and gill net (GN) catch per unit effort upstream (CRM 18.5) of the proposed CRSMR discharge, February 16, 2011.

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	3.60	16.72	54	.	.	54
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	X	0.47	2.17	7	0.10	1	8
Golden shiner	*Notemigonus crysoleucas*	OM	X	TOL	.	X	X	0.13	0.62	2	.	.	2
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	1.00	4.64	15	.	.	15
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	.	.	.	2.13	9.91	32	.	.	32
Fathead minnow	*Pimephales promelas*	OM	.	TOL	.	X	X	0.07	0.31	1	.	.	1
Redbreast sunfish*	*Lepomis auritus*	IN	.	TOL	.	.	X	0.53	2.48	8	.	.	8
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	1.07	4.95	16	.	.	16
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	6.60	30.65	99	.	.	99
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	0.60	2.79	9	.	.	9
White crappie	*Pomoxis annularis*	TC	X	TOL	.	.	X	0.13	0.62	2	.	.	2
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	.	.	.	.	.	0.20	2	2
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	1.87	8.67	28	0.20	2	30
Northern hogsucker	*Hypentelium nigricans*	BI	X	INT	.	.	.	.	.	.	0.30	3	3
Brook silverside	*Labidesthes sicculus*	IN	X	INT	.	X	.	0.13	0.62	2	.	.	2
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	X	0.27	1.24	4	.	.	4
Quillback	*Carpiodes cyprinus*	OM	X	.	.	X					0.10	1	1
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	.	.	.	0.10	1	1
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	1.30	13	13
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	.	.	.	2.00	20	20
White bass	*Morone chrysops*	TC	X	.	.	.	X	0.40	1.86	6	4.40	44	50
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	0.07	0.31	1	0.60	6	7
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	.	.	.	2.30	23	23
Hybrid striped bass	Hybrid *Morone*	TC	.	.	.	.	X	.	.	.	0.40	4	4
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	0.07	0.31	1	.	.	1
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	0.33	1.55	5	.	.	5
Hybrid sunfish	Hybrid *Lepomis* sp.	IN	X	.	.	.	X	0.20	0.93	3	.	.	3
Black crappie	*Pomoxis nigromaculatus*	TC	X	.	.	.	X	0.07	0.31	1	.	.	1
Sauger	*Sander canadensis*	TC	X	.	.	.	X	.	.	.	2.30	23	23
Walleye	*Sander vitreus*	TC	X	.	.	.	X	.	.	.	0.20	2	2
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	X	.	.	.	0.10	1	1

Table 5. Continued (CRM 18.5, February 2011)

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Yellow perch*	*Perca flavescens*	IN	.	.	.	.	X	0.53	2.48	8	.	.	8
Logperch	*Percina caprodes*	BI	X	.	X	.	.	0.47	2.17	7	.	.	7
Banded sculpin	*Cottus carolinae*	IN	X	.	.	.	.	2.13	9.91	32	.	.	32
Mississippi silverside*	*Menidia audens*	IN	.	.	.	X	X	0.07	0.31	1	.	.	1
Total								**22.94**	**106.53**	**344**	**14.60**	**146**	**490**
Number Samples								**15**			**10**		
Species Collected	**33**		**27**		**2**	**14**	**25**	**24**			**15**		

Trophic level: benthic invertivore (BI), insectivore (IN), omnivore (OM), planktivore (PK), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally. *Denotes aquatic nuisance species next to common name. All species are considered representative important species. No species collected have a Federal Threatened or Endangered status.

Table 6. Species collected, ecological and recreational designations, and corresponding electrofishing (EF) and gill net (GN) catch per unit effort downstream (CRM 15.0) of the proposed CRSMR discharge, May 18, 2011.

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	1.00	4.48	15	0.30	3	18
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	X	0.27	1.19	4	0.10	1	5
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	0.27	1.19	4	.	.	4
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	.	.	.	2.27	10.15	34	.	.	34
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	2.87	12.84	43	.	.	43
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	8.47	37.91	127	.	.	127
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	1.27	5.67	19	0.60	6	25
Muskellunge	*Esox masquinongy*	TC	.	INT	.	.	X	0.07	0.30	1	.	.	1
Northern hog sucker	*Hypentelium nigricans*	BI	X	INT	.	.	.	0.07	0.30	1	.	.	1
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	X	.	.	.	1.70	17	17
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	3.33	14.93	50	1.10	11	61
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	.	.	2.33	10.45	35	0.10	1	36
Rock bass	*Ambloplites rupestris*	TC	X	INT	.	.	X	0.33	1.49	5	.	.	5
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.13	0.60	2	.	.	2
Quillback	*Carpiodes cyprinus*	OM	X	.	.	X	.	.	.	.	0.10	1	1
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	0.07	0.30	1	.	.	1
Black buffalo	*Ictiobus niger*	OM	X	.	.	X	.	0.20	0.90	3	0.10	1	4
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	0.80	3.58	12	1.00	10	22
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	1.90	19	19
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	0.20	0.90	3	1.30	13	16
White bass	*Morone chrysops*	TC	X	.	.	.	X	0.40	1.79	6	0.20	2	8
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	0.73	3.28	11	2.70	27	38
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	0.13	0.60	2	0.80	8	10
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	1.07	4.78	16	.	.	16
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	0.33	1.49	5	0.20	2	7
Yellow perch*	*Perca flavescens*	IN	.	.	.	.	X	1.67	7.46	25	.	.	25
Sauger	*Sander canadensis*	TC	X	.	.	.	X	.	.	.	0.10	1	1
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	X	0.13	0.60	2	0.80	8	10

Table 6. Continued (CRM 15.0, May 2011)

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Banded sculpin	*Cottus carolinae*	IN	X	.	.	.	.	1.33	5.97	20	.	.	20
Mississippi silverside*	*Menidia audens*	IN	.	.	.	X	X	6.53	29.25	98	.	.	98
Total								**36.27**	**162.4**	**544**	**13.1**	**131**	**675**
Number Samples								**15**			**10**		
Species Collected	**30**		**25**		**1**	**13**	**20**	**26**			**17**		

Trophic level: benthic invertivore (BI), insectivore (IN), omnivore (OM), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally. *Denotes aquatic nuisance species next to common name. All species are considered representative important species. No species collected have a Federal Threatened or Endangered status.

Table 7. Species collected, ecological and recreational designations, and corresponding electrofishing (EF) and gill net (GN) catch per unit effort upstream (CRM 18.5) of the proposed CRSMR discharge, May 18, 2011.

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Longnose gar	*Lepisosteus osseus*	TC	X	TOL	.	X	.	.	.	.	1.0	10	10
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	1.40	6.10	21	0.50	5	26
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	X	0.07	0.29	1	1.50	15	16
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	0.13	0.58	2	.	.	2
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	.	.	.	0.27	1.16	4	.	.	4
Redbreast sunfish*	*Lepomis auritus*	IN	.	TOL	.	.	X	0.27	1.16	4	.	.	4
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	0.73	3.20	11	.	.	11
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	3.00	13.08	45	.	.	45
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	1.13	4.94	17	.	.	17
Northern hog sucker	*Hypentelium nigricans*	BI	X	INT	.	.	.	0.07	0.29	1	0.10	1	2
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	X	.	.	.	0.50	5	5
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	1.07	4.65	16	0.70	7	23
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	.	.	1.13	4.94	17	0.20	2	19
Rock bass	*Ambloplites rupestris*	TC	X	INT	.	.	X	0.80	3.49	12	.	.	12
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.07	0.29	1	.	.	1
Spotted gar	*Lepisosteus oculatus*	TC	X	.	.	X	.	0.40	1.74	6	.	.	6
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	X	0.47	2.03	7	.	.	7
Bullhead minnow	*Pimephales vigilax*	IN	X	.	.	.	.	0.20	0.87	3	.	.	3
Quillback	*Carpiodes cyprinus*	OM	X	.	.	X	.	.	.	.	0.80	8	8
Silver redhorse	*Moxostoma anisurum*	BI	X	.	.	X	.	.	.	.	0.70	7	7
Black buffalo	*Ictiobus niger*	OM	X	.	.	X	.	0.20	0.87	3	0.10	1	4
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	0.20	0.87	3	0.70	7	10
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	2.10	21	21
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	.	.	.	1.00	10	10
Flathead catfish	*Pylodictis olivaris*	TC	X	.	.	X	X	.	.	.	0.30	3	3
White bass	*Morone chrysops*	TC	X	.	.	.	X	0.13	0.58	2	0.50	5	7
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	0.27	1.16	4	2.80	28	32
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	.	.	.	1.20	12	12
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	0.13	0.58	2	.	.	2
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	0.07	0.29	1	0.20	2	3

Table 7. Continued (CRM 18.5, May 2011)

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Hybrid sunfish	Hybrid *Lepomis* sp.	IN	X	.	.	.	X	0.13	0.58	2	.	.	2
Black crappie	*Pomoxis nigromaculatus*	TC	X	.	.	.	X	0.07	0.29	1	.	.	1
Yellow perch*	*Perca flavescens*	IN	.	.	.	.	X	1.67	7.27	25	0.10	1	26
Logperch	*Percina caprodes*	BI	X	.	X	.	.	0.13	0.58	2	.	.	2
Sauger	*Sander canadensis*	TC	X		.	.	X	.	.	.	0.30	3	3
Walleye	*Sander vitreus*	TC	X	.	.	.	X	.	.	.	0.30	3	3
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	X	0.20	0.87	3	0.60	6	9
Banded sculpin	*Cottus carolinae*	IN	X	.	.	.	.	0.53	2.33	8	.	.	8
Total								**14.94**	**65.08**	**224**	**16.2**	**162**	**386**
Number Samples								**15**			**10**		
Species Collected	**37**		**33**		**2**	**16**	**24**	**27**			**22**		

Trophic level: benthic invertivore (BI), insectivore (IN), omnivore (OM), planktivore (PK), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally. *Denotes aquatic nuisance species next to common name. All species are considered representative important species. No species collected have a Federal Threatened or Endangered status.

Table 8. Species collected, ecological and recreational designations, and corresponding electrofishing (EF) and gill net (GN) catch per unit effort downstream (CRM 15.0) of the proposed CRSMR discharge, July 14, 2011.

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Longnose gar	*Lepisosteus osseus*	TC	X	TOL	.	X	.	0.07	0.25	1	.	.	1
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	11.00	41.67	165	2.00	20	185
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	X	0.93	3.54	14	0.20	2	16
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	0.40	1.52	6	.	.	6
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	.	.	.	0.80	3.03	12	.	.	12
White sucker	*Catostomus commersoni*	OM	X	TOL	X	X	.	0.07	0.25	1	.	.	1
Redbreast sunfish*	*Lepomis auritus*	IN	.	TOL	.	.	X	0.33	1.26	5	.	.	5
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	0.93	3.54	14	.	.	14
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	8.67	32.83	130	.	.	130
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	1.07	4.04	16	.	.	16
Nothern Hog sucker	*Hypentelium nigricans*	BI	X	INT	.	.	.	.	.	.	0.10	1	1
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	X	.	.	.	0.50	5	5
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	4.13	15.66	62	.	.	62
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	.	.	2.40	9.09	36	0.40	4	40
Rock bass	*Ambloplites rupestris*	TC	X	INT	.	.	X	0.47	1.77	7	.	.	7
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.13	0.51	2	.	.	2
Hybrid shad	Hybrid *Dorosoma*	OM	X	.	.	.	X	.	.	.	0.80	8	8
Quillback	*Carpiodes cyprinus*	OM	X	.	.	X	.	.	.	.	0.50	5	5
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	0.47	1.77	7	0.10	1	8
Silver redhorse	*Moxostoma anisurum*	BI	X	.	.	X	.	.	.	.	0.10	1	1
Black buffalo	*Ictiobus niger*	OM	X	.	.	X	.	0.40	1.52	6	.	.	6
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	0.87	3.28	13	0.50	5	18
Blue Catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	3.10	31	31
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	0.20	0.76	3	0.60	6	9
Flathead catfish	*Pylodictis olivaris*	TC	X	.	.	X	X	.	.	.	0.20	2	2
White bass	*Morone chrysops*	TC	X	.	.	.	X	.	.	.	0.10	1	1
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	0.13	0.51	2	0.10	1	3
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	.	.	.	2.30	23	23
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	0.47	1.77	7	.	.	7
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	1.00	3.79	15	.	.	15

Table 8. Continued (CRM 15.0, July 2011)

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Snubnose darter	*Etheostoma simoterum*	SP	X	.	.	.	.	0.07	0.25	1	.	.	1
Yellow perch*	*Perca flavescens*	IN	.	.	.	.	X	3.80	14.39	57	0.10	1	58
Logperch	*Percina caprodes*	BI	X	.	X	.	.	1.20	4.55	18	.	.	18
Sauger	*Sander canadensis*	TC	X	.	.	.	X	.	.	.	0.30	3	3
Walleye	*Sander vitreus*	TC	X	.	.	.	X	.	.	.	0.10	1	1
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	X	.	.	.	1.30	13	13
Banded sculpin	*Cottus carolinae*	IN	X	.	.	.	.	0.47	1.77	7	.	.	7
Total								**40.48**	**153.32**	**607**	**13.40**	**134**	**741**
Number Samples								**15**			**10**		
Species Collected	**36**		**32**		**3**	**16**	**22**	**25**			**20**		

Trophic level: benthic invertivore (BI), insectivore (IN), omnivore (OM), specialized insectivore (SP), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally. *Denotes aquatic nuisance species next to common name. All species are considered representative important species. No species collected have a Federal Threatened or Endangered status.

Table 9. Species collected, ecological and recreational designations, and corresponding electrofishing (EF) and gill net (GN) catch per unit effort upstream (CRM 18.5) of the proposed CRSMR discharge, July 13, 2011.

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Longnose gar	*Lepisosteus osseus*	TC	X	TOL	.	X	.	0.07	0.24	1	.	.	1
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	17.13	61.19	257	5.10	51	308
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	X	1.07	3.81	16	1.40	14	30
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	3.40	12.14	51	.	.	51
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	.	.	.	1.27	4.52	19	.	.	19
Redbreast sunfish*	*Lepomis auritus*	IN	.	TOL	.	.	X	0.13	0.48	2	.	.	2
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	0.60	2.14	9	.	.	9
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	2.93	10.48	44	.	.	44
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	0.93	3.33	14	.	.	14
Northern hog sucker	*Hypentelium nigricans*	BI	X	INT	.	.	.	0.20	0.71	3	.	.	3
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	X	.	.	.	1.00	10	10
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	1.20	4.29	18	0.20	2	20
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	.	.	3.13	11.19	47	0.50	5	52
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.13	0.48	2	.	.	2
Brook silverside	*Labidesthes sicculus*	IN	X	INT	.	X	X	0.07	0.24	1	.	.	1
Largescale stoneroller	*Campostoma oligolepis*	HB	X	.	.	.	X	0.13	0.48	2	.	.	2
Silver redhorse	*Moxostoma anisurum*	BI	X	.	.	X	.	.	.	.	0.30	3	3
Smallmouth redhorse	*Moxostoma breviceps*	BI	X	.	.	.	.	.	.	.	0.20	2	2
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	0.40	1.43	6	0.10	1	7
Black buffalo	*Ictiobus niger*	OM	X	.	.	X	.	0.27	0.95	4	0.60	6	10
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	1.07	3.81	16	0.90	9	25
Hybrid shad	Hybrid *Dorosoma*	OM	X	.	.	.	X	.	.	.	1.50	15	15
Quillback	*Carpiodes cyprinus*	OM	X	.	.	X	.	.	.	.	0.60	6	6
Blue Catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	3.10	31	31
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	0.20	0.71	3	0.50	5	8
Flathead catfish	*Pylodictis olivaris*	TC	X	.	.	X	X	.	.	.	0.40	4	4
White bass	*Morone chrysops*	TC	X	.	.	.	X	0.07	0.24	1	0.20	2	3
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	3.33	11.90	50	0.60	6	56
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	0.20	0.71	3	1.10	11	14
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	0.13	0.48	2	.	.	2

Table 9. Continued (CRM 18.5, July 2011)

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Hybrid sunfish	Hybrid *Lepomis* sp.	IN	X	.	.	.	X	0.07	0.24	1	.	.	1
Snubnose darter	*Etheostoma simoterum*	SP	X	.	.	.	.	0.07	0.24	1	.	.	1
Yellow perch*	*Perca flavescens*	IN	.	.	.	.	X	3.40	12.14	51	.	.	51
Logperch	*Percina caprodes*	BI	X	.	X	.	.	0.20	0.71	3	.	.	3
Sauger	*Sander canadensis*	TC	X	.	.	.	X	.	.	.	0.20	2	2
Walleye	*Sander vitreus*	TC	X	.	.	.	X	.	.	.	0.40	4	4
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	X	0.20	0.71	3	1.60	16	19
Banded sculpin	*Cottus carolinae*	IN	X	.	.	.	.	0.47	1.67	7	.	.	7
Mississippi silverside*	*Menidia audens*	IN	.	.	.	X	X	0.13	0.48	2	.	.	2
Total								**42.60**	**152.14**	**639**	**20.50**	**205**	**844**
Number Samples								**15**			**10**		
Species Collected	**37**		**32**		**2**	**17**	**24**	**30**			**21**		

Trophic level: benthic invertivore (BI), herbivore (HB), insectivore (IN), omnivore (OM), specialized insectivore (SP), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally. *Denotes aquatic nuisance species next to common name. All species are considered representative important species. No species collected have a Federal Threatened or Endangered status.

Table 10. Species collected, ecological and recreational designations, and corresponding electrofishing (EF) and gill net (GN) catch per unit effort downstream (CRM 15.0) of the proposed CRSMR discharge, October 12, 2011.

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Longnose gar	*Lepisosteus osseus*	TC	X	TOL	.	X	.	0.07	0.27	1	.	.	1
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	0.80	3.30	12	0.20	2	14
Common carp*	*Cyprinus carpio*	OM	.	TOL	.	X	X	0.73	3.02	11	.	.	11
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	0.07	0.27	1	.	.	1
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	.	.	.	0.13	0.55	2	.	.	2
Redbreast sunfish*	*Lepomis auritus*	IN	.	TOL	.	.	X	0.27	1.10	4	.	.	4
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	1.20	4.95	18	.	.	18
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	8.13	33.52	122	.	.	122
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	0.73	3.02	11	.	.	11
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	X	.	.	.	0.20	2	2
Northern hog sucker	*Hypentelium nigricans*	BI	X	INT	.	.	.	0.40	1.65	6	.	.	6
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	9.87	40.66	148	0.10	1	149
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	.	.	1.20	4.95	18	0.30	3	21
Rock bass	*Ambloplites rupestris*	TC	X	INT	.	.	X	0.47	1.92	7	.	.	7
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.07	0.27	1	.	.	1
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	X	0.13	0.55	2	.	.	2
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	0.07	0.27	1	0.10	1	2
Black buffalo	*Ictiobus niger*	OM	X	.	.	X	.	0.13	0.55	2	.	.	2
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	0.80	8	8
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	.	.	.	0.10	1	1
Quillback	*Carpiodes cyprinus*	OM	X	.	.	X	.	.	.	.	0.20	2	2
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	0.67	2.75	10	0.20	2	12
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	.	.	.	0.10	1	1
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	0.20	0.82	3	.	.	3
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	0.47	1.92	7	.	.	7
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	2.00	8.24	30	.	.	30
Spotted bass	*Micropterus punctulatus*	TC	X	.	.	.	X	0.07	0.27	1	.	.	1
Snubnose darter	*Etheostoma simoterum*	SP	X	.	.	.	.	0.07	0.27	1	.	.	1
Yellow perch*	*Perca flavescens*	IN	.	.	.	.	X	3.67	15.11	55	.	.	55

Table 10. Continued (CRM 15.0, October 2011)

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Logperch	*Percina caprodes*	BI	X	.	X	.	.	0.27	1.10	4	.	.	4
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	X	.	.	.	0.10	1	1
Dusky darter	*Percina sciera*	IN	X	.	.	.	.	0.07	0.27	1	.	.	1
Banded sculpin	*Cottus carolinae*	IN	X	.	.	.	.	0.13	0.55	2	.	.	2
Total								**32.09**	**132.12**	**481**	**2.4**	**24**	**505**
Number Samples								**15**			**10**		
Species Collected	**33**		**29**		**2**	**14**	**19**	**27**			**11**		

Trophic level: benthic invertivore (BI), insectivore (IN), omnivore (OM), planktivore (PK), specialized insectivore (SP), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally. *Denotes aquatic nuisance species next to common name. All species are considered representative important species. No species collected have a Federal Threatened or Endangered status.

Table 11. Species collected, ecological and recreational designations, and corresponding electrofishing (EF) and gill net (GN) catch per unit effort upstream (CRM 18.5) of the proposed CRSMR discharge, October 11, 2011.

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	X	5.80	24.90	87	0.70	7	94
Common carp*	*Cyprinus carpio**	OM	.	TOL	.	X	X	0.40	1.71	6	0.20	2	8
Golden shiner	*Notemigonus crysoleucas*	OM	X	TOL	.	X	X	0.50	2.00	7	.	.	7
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	0.10	0.57	2	.	.	2
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	.	.	.	0.40	1.71	6	.	.	6
River carpsucker	*Carpiodes carpio*	OM	X	TOL	.	X	.	.	.	.	0.10	1	1
Western mosquitofish	*Gambusia affinis*	IN	X	TOL	.	.	.	0.10	0.29	1	.	.	1
Redbreast sunfish*	*Lepomis auritus*	IN	.	TOL	.	.	X	0.70	2.86	10	.	.	10
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	2.00	8.57	30	.	.	30
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	4.60	19.70	69	.	.	69
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	1.20	5.14	18	.	.	18
Northern hog sucker	*Hypentelium nigricans*	BI	X	INT	.	.	.	0.10	0.29	1	.	.	1
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	2.50	10.90	38	.	.	38
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	.	.	1.00	4.29	15	0.30	3	18
Rock bass	*Ambloplites rupestris*	TC	X	INT	.	.	X	0.20	0.86	3	.	.	3
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.10	0.29	1	.	.	1
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	X	0.10	0.57	2	.	.	2
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	0.10	0.29	1	.	.	1
Black buffalo	*Ictiobus niger*	OM	X	.	.	X	.	0.50	2.00	7	0.10	1	8
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	0.10	0.57	2	0.10	1	3
White bass	*Morone chrysops*	TC	X	.	.	.	X	0.10	0.29	1	0.20	2	3
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	0.90	9	9
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	.	.	.	0.10	1	1
Yellow bass	*Morone mississippiensis*	TC	X	.	.	X	X	0.10	0.29	1	.	.	1
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	0.10	0.29	1	0.50	5	6
Warmouth	*Lepomis gulosus*	IN	X	.	.	.	X	0.30	1.14	4	.	.	4
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	0.70	2.86	10	.	.	10
Black crappie	*Pomoxis nigromaculatus*	TC	X	.	.	.	X	0.10	0.29	1	.	.	1
Greenside darter	*Etheostoma blennioides*	SP	X	.	X	.	.	0.10	0.29	1	.	.	1

Table 11. Continued (CRM 18.5, October 2011)

Common Name	Scientific name	Trophic level	Indigenous species	Tolerance	Thermally Sensitive Species	Comm. Valuable Species	Rec. Valuable Species	EF Catch Per Run	EF Catch Per Hour	Total Fish EF	GN Catch Per Net	Total Fish GN	Total Fish Combined
Snubnose darter	*Etheostoma simoterum*	SP	X	.	.	.	.	0.50	2.29	8	.	.	8
Yellow perch*	*Perca flavescens*	IN	.	.	.	.	X	3.60	15.40	54	.	.	54
Logperch	*Percina caprodes*	BI	X	.	X	.	.	2.00	8.57	30	.	.	30
Sauger	*Sander canadensis*	TC	X	.	.	.	X	.	.	.	0.20	2	2
Walleye	*Sander vitreus*	TC	X	.	.	.	X	.	.	.	0.10	1	1
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	X	.	.	.	0.50	5	5
Banded sculpin	*Cottus carolinae*	IN	X	.	.	.	.	0.70	2.86	10	.	.	10
Mississippi silverside*	*Menidia audens*	IN	.	.	.	X	X	0.10	0.29	1	.	.	1
Total								**28.90**	**122.37**	**428**	**4.00**	**40**	**468**
Number Samples								**15**			**10**		
Species Collected	**37**		**32**		**3**	**14**	**23**	**31**			**13**		

Trophic level: benthic invertivore (BI), insectivore (IN), omnivore (OM), planktivore (PK), specialized insectivore (SP), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally. *Denotes aquatic nuisance species next to common name. All species are considered representative important species. No species collected have a Federal Threatened or Endangered status.

Table 12. Individual metric scores and the overall RFAI scores downstream (CRM 15.0) and upstream (CRM 18.5) of the proposed CRSMR - February, 2011.

February 2011 Metric		CRM 15.0 Obs	Score	CRM 18.5 Obs	Score
Species richness and composition					
1. Number of indigenous species		**26**	**3**	**27**	**3**
2. Number of centrarchid species (less *Micropterus*)		**7** Black crappie Bluegill Green sunfish Redbreast sunfish Redear sunfish Warmouth White crappie	**5**	**7** Black crappie Bluegill Green sunfish Redbreast sunfish Redear sunfish Warmouth White crappie	**5**
3. Number of benthic invertivore species		**4** Black redhorse Golden redhorse Spotted sucker Freshwater drum	**3**	**6** Black redhorse Golden redhorse Spotted sucker Northern hogsucker Logperch Freshwater drum	**3**
4. Number of intolerant species		**4** Black redhorse Rock bass Spotted sucker Skipjack herring	**3**	**4** Black redhorse Northern hogsucker Brook silverside Spotted sucker	**3**
5. Percent tolerant individuals	EF	**47.9%** Bluegill 38.3 % Bluntnose minnow 4.0 % Green sunfish 3.0 % Largemouth bass 0.7 % Redbreast sunfish 0.5 % Gizzard shad 0.5 % Common carp 0.2 % Spotfin shiner 0.2 % White crappie 0.2 % White sucker 0.2 %	**1.5**	**71.2%** Bluegill 28.8 % Gizzard shad 15.7 % Bluntnose minnow 9.3 % Green sunfish 4.7 % Spotfin shiner 4.4 % Largemouth bass 2.6 % Redbreast sunfish 2.3 % Common carp 2.0 % White crappie 0.6 % Golden shiner 0.6 % Fathead minnow 0.3 %	**0.5**
	GN	**0%**	**2.5**	**0.7%** Common carp	**2.5**

Table 12. February 2011 (Continued, February, 2011)

February 2011 Metric		CRM 15.0 Obs	Score	CRM 18.5 Obs	Score
6. Percent dominance by one species	EF	**38.3%** Bluegill	**1.5**	**28.8%** Bluegill	**1.5**
	GN	**34.6%** Sauger	**0.5**	**30.1%** White bass	**0.5**
7. Percent non-indigenous species	EF	**14.3%** Mississippi silverside 12.6 % Common carp 2.0 % Yellow perch 0.9 % Redbreast sunfish 0.5 %	**0.5**	**7.3%** Redbreast sunfish 2.4 % Yellow perch 2.3 % Common carp 2.0 % Fathead minnow 0.3 % Mississippi silverside 0.3 %	**0.5**
	GN	**14.4 %** Striped bass 12.4 % Redbreast sunfish 1.3 % Hybrid Striped bass 0.7 %	**0.5**	**19.2 %** Striped bass 15.8 % Hybrid Striped bass 2.7 % Common carp 0.7 %	**0.5**
8. Number of top carnivore species		**9** Black crappie White crappie Largemouth bass Rock bass Sauger Walleye Skipjack herring White bass Yellow bass	**5**	**7** Black crappie White crappie Largemouth bass Sauger Walleye White bass Yellow bass	**3**
Trophic composition					
9. Percent top carnivores	EF	**2.1%** Largemouth bass 0.7 % Rock bass 0.7 % White crappie 0.2 % Yellow bass 0.2 % Black crappie 0.2 %	**0.5**	**5.5%** Largemouth bass 2.6 % White bass 1.7 % White crappie 0.6 % Yellow bass 0.3 % Black crappie 0.3 %	**0.5**
	GN	**86.3%** Sauger 34.6 % White bass 27.5 % Striped bass 12.4 % Yellow bass 4.6 % Walleye 3.9 % Saugeye 1.3 % Skipjack herring 1.3 % Hybrid Striped bass 0.7 %	**2.5**	**69.9%** White bass 30.1 % Sauger 15.8 % Striped bass 15.8 % Yellow bass 4.1 % Hybrid striped bass 2.7 % Walleye 1.4 %	**2.5**

Table 12. February 2011 (Continued, February, 2011)

February 2011 Metric		CRM 15.0 Obs	Score	CRM 18.5 Obs	Score
10. Percent omnivores	EF	**4.9%** Bluntnose minnow 4.0 % Common carp 0.2 % White sucker 0.2 % Gizzard shad 0.5 %	**2.5**	**27.9%** Gizzard shad 15.7% Bluntnose minnow 9.3 % Common carp 2.0 % Golden shiner 0.6 % Fathead minnow 0.3 %	**1.5**
	GN	**8.5%** Channel catfish 6.5 % Blue catfish 2.0 %	**2.5**	**24.0%** Channel catfish 13.7 % Blue catfish 8.9 % Common carp 0.7 % Quillback 0.7 %	**1.5**
Fish abundance and health					
11. Average number per run	EF	**28.5**	**0.5**	**22.9**	**0.5**
	GN	**15.3**	**1.5**	**14.6**	**1.5**
12. Percent anomalies	EF	**6.3%**	**0.5**	**1.7%**	**2.5**
	GN	**3.9%**	**1.5**	**0.7%**	**2.5**
Overall RFAI Score			**38** **Fair**		**36** **Fair**

Table 13. Individual metric scores and the overall RFAI scores downstream (CRM 15.0) and upstream (CRM 18.5) of the proposed CRSMR - May, 2011.

May 2011 Metric		CRM 15.0 Obs		Score	CRM 18.5 Obs		Score
Species richness and composition							
1. Number of indigenous species		**25**		**3**	**33**		**5**
2. Number of centrarchid species (less *Micropterus*)		**4** Bluegill Green sunfish Redear sunfish Warmouth		**3**	**6** Black crappie Bluegill Green sunfish Redbreast sunfish Redear sunfish Warmouth		**5**
3. Number of benthic invertivore species		**5** Black redhorse Golden redhorse Spotted sucker Northern hogsucker Freshwater drum		**3**	**7** Black redhorse Golden redhorse Silver redhorse Spotted sucker Northern hogsucker Logperch Freshwater drum		**3**
4. Number of intolerant species		**6** Black redhorse Northern hogsucker Spotted sucker Rock bass Smallmouth bass Skipjack herring		**5**	**6** Black redhorse Northern hogsucker Spotted sucker Brook silverside Rock bass Smallmouth bass Skipjack herring		**5**
5. Percent tolerant individuals	EF	**45.2%** Bluegill Green sunfish Bluntnose minnow Largemouth bass Gizzard shad Common carp Spotfin shiner	 23.3 % 7.9 % 6.3 % 3.5 % 2.8 % 0.7 % 0.7 %	**1.5**	**46.9%** Bluegill Gizzard shad Largemouth bass Green sunfish Bluntnose minnow Redbreast sunfish Spotfin shiner Common carp	 20.1 % 9.4 % 7.6 % 4.9 % 1.8 % 1.8 % 0.9 % 0.4 %	**1.5**
	GN	**7.6%** Largemouth bass Gizzard shad Common carp	 4.6 % 2.3 % 0.8 %	**2.5**	**18.4%** Common carp Longnose gar Gizzard shad	 9.2 % 6.1 % 3.1 %	**1.5**

Table 13. May 2011 (Continued, May, 2011)

May 2011 Metric		CRM 15.0 Obs	Score	CRM 18.5 Obs	Score
6. Percent dominance by one species	EF	**23.3%** Bluegill	**1.5**	**20.1%** Bluegill	**1.5**
	GN	**20.6%** Yellow bass	**1.5**	**17.2%** Yellow bass	**1.5**
7. Percent non-indigenous species	EF	**23.9%** MS silverside 18.0 % Yellow perch 4.6 % Common carp 0.7 % Striped bass 0.4 % Muskellunge 0.2 %	**0.5**	**13.4%** Yellow perch 11.2 % Redbreast sunfish 1.8 % Common carp 0.4 %	**0.5**
	GN	**6.9%** Striped bass 6.1 % Common carp 0.8 %	**1.5**	**17.2%** Common carp 9.2 % Striped bass 7.4 % Yellow perch 0.6 %	**0.5**
8. Number of top carnivore species		**7** Largemouth bass Sauger Rock bass Smallmouth bass Skipjack herring White bass Yellow bass	**3**	**12** Black crappie Largemouth bass Flathead catfish Longnose gar Spotted gar Rock bass Smallmouth bass Skipjack herring Sauger Walleye White bass Yellow bass	**5**
Trophic composition					
9. Percent top carnivores	EF	**8.5%** Largemouth bass 3.5 % White bass 1.1% Yellow bass 2.0 % Rock bass 0.9 % Smallmouth bass 0.4 % Striped bass 0.4 % Muskellunge 0.2 %	**1.5**	**19.2%** Largemouth bass 7.6 % Rock bass 5.4 % Spotted gar 2.7 % Yellow bass 1.8 % White bass 0.9 % Black crappie 0.4 % Smallmouth bass 0.4 %	**2.5**
	GN	**46.6%** Yellow bass 20.6 % Skipjack herring 13.0 % Striped bass 6.1 % Largemouth bass 4.6 % White bass 1.5 % Sauger 0.8 %	**1.5**	**42.9%** Yellow bass 17.2 % Striped bass 7.4 % Longnose gar 6.1 % Skipjack herring 3.1 % White bass 3.1 % Sauger 1.8 % Flathead catfish 1.8 % Walleye 1.8 % Smallmouth bass 0.6 %	**1.5**

Table 13. May 2011 (Continued, May, 2011)

May 2011 Metric		CRM 15.0 Obs	Score	CRM 18.5 Obs	Score
10. Percent omnivores	EF	**11.0%** Bluntnose minnow 6.3 % Gizzard shad 2.8 % Common carp 0.7 % Black buffalo 0.6 % Channel catfish 0.6 % Smallmouth buffalo 0.2 %	**2.5**	**12.9%** Gizzard shad 9.4 % Bluntnose minnow 1.8 % Black buffalo 1.3 % Common carp 0.4 %	**2.5**
	GN	**29.0%** Blue catfish 14.5 % Channel catfish 9.9 % Gizzard shad 2.3 % Common carp 0.8 % Black buffalo 0.8 % Quillback 0.8 %	**1.5**	**36.8%** Blue catfish 12.9 % Common carp 9.2 % Channel catfish 6.1 % Quillback 4.9 % Gizzard shad 3.1 % Black buffalo 0.6 %	**1.5**
Fish abundance and health					
11. Average number per run	EF	**36.3**	**0.5**	**14.9**	**0.5**
	GN	**13.1**	**1.5**	**16.3**	**1.5**
12. Percent anomalies	EF	**2.8%**	**1.5**	**9.8%**	**0.5**
	GN	**4.6%**	**1.5**	**3.1%**	**1.5**
Overall RFAI Score			**38** **Fair**		**42** **Good**

Table 14. Individual metric scores and the overall RFAI scores downstream (CRM 15.0) and upstream (CRM 18.5) of the proposed CRSMR - July, 2011.

July 2011		CRM 15.0		CRM 18.5	
Metric		**Obs**	**Score**	**Obs**	**Score**
Species richness and composition					
1. Number of indigenous species		**32**	**5**	**32**	**5**
2. Number of centrarchid species (less *Micropterus*)		**5** Bluegill Green sunfish Redear sunfish Redbreast sunfish Warmouth	**5**	**4** Bluegill Green sunfish Redbreast sunfish Redear sunfish	**3**
3. Number of benthic invertivore species		**7** Black redhorse Golden redhorse Silver redhorse Spotted sucker Northern hogsucker Freshwater drum Logperch	**3**	**8** Black redhorse Golden redhorse Silver redhorse Smallmouth redhorse Spotted sucker Northern hogsucker Logperch Freshwater drum	**5**
4. Number of intolerant species		**6** Black redhorse Northern hogsucker Spotted sucker Rock bass Smallmouth bass Skipjack herring	**5**	**6** Black redhorse Northern hogsucker Spotted sucker Brook silverside Smallmouth bass Skipjack herring	**5**
5. Percent tolerant individuals	EF	**60.0%** Gizzard shad 27.2 % Bluegill 21.4 % Largemouth bass 2.6 % Common carp 2.3 % Green sunfish 2.3 % Bluntnose minnow 2.0 % Spotfin shiner 1.0 % Redbreast sunfish 0.8 % Longnose gar 0.2 % White sucker 0.2 %	**1.5**	**64.6%** Gizzard shad 40.2 % Spotfin shiner 8.0 % Bluegill 6.9 % Bluntnose minnow 3.0 % Common carp 2.5 % Largemouth bass 2.2 % Green sunfish 1.4 % Redbreast sunfish 0.3 % Longnose gar 0.2 %	**0.5**
	GN	**16.4%** Gizzard shad 14.9 % Common carp 1.5 %	**1.5**	**31.7%** Gizzard shad 24.9 % Common carp 6.8 %	**1.5**

Table 14. July 2011 (Continued, July, 2011)

July 2011 Metric		CRM 15.0 Obs	Score	CRM 18.5 Obs	Score
6. Percent dominance by one species	EF	**27.2%** Gizzard shad	**1.5**	**40.2%** Gizzard shad	**0.5**
	GN	**23.1%** Blue catfish	**1.5**	**24.9%** Gizzard shad	**1.5**
7. Percent non-indigenous species	EF	**12.5%** Yellow perch 9.4 % Common carp 2.3 % Redbreast sunfish 0.8 %	**0.5**	**11.6%** Yellow perch 8.0 % Common carp 2.5 % Striped bass 0.5 % Redbreast sunfish 0.3 % MS silverside 0.3 %	**0.5**
	GN	**19.4%** Striped bass 17.2 % Common carp 1.5 % Yellow perch 0.7 %	**0.5**	**12.2%** Common carp 6.8 % Striped bass 5.4 %	**0.5**
8. Number of top carnivore species		**10** Largemouth bass Flathead catfish Longnose gar Rock bass Smallmouth bass Skipjack herring Sauger Walleye White bass Yellow bass	**5**	**9** Largemouth bass Flathead catfish Longnose gar Smallmouth bass Skipjack herring Sauger Walleye White bass Yellow bass	**5**
Trophic composition					
9. Percent top carnivores	EF	**4.6%** Largemouth bass 2.6 % Smallmouth bass 1.2 % Rock bass 0.3 % Yellow bass 0.3 % Longnose gar 0.2 %	**0.5**	**11.1%** Yellow bass 7.8 % Largemouth bass 2.2 % Striped bass 0.5 % Smallmouth bass 0.3 % Longnose gar 0.2 % White bass 0.2 %	**2.5**
	GN	**26.9%** Striped bass 17.2 % Skipjack herring 3.7 % Sauger 2.2 % Flathead catfish 1.5 % Yellow bass 0.7 % Walleye 0.7 % White bass 0.7 %	**1.5**	**19.0%** Striped bass 5.4 % Skipjack herring 4.9 % Yellow bass 2.9 % Flathead catfish 2.0 % Walleye 2.0 % White bass 1.0 % Sauger 1.0 %	**0.5**

Table 14. July 2011 (Continued, July, 2011)

July 2011 **Metric**		**CRM 15.0** **Obs**	**Score**	**CRM 18.5** **Obs**	**Score**
10. Percent omnivores	EF	**34.3%** Gizzard shad 27.2 % Common carp 2.3 % Bluntnose minnow 2.0 % Smallmouth buffalo 1.2 % Black buffalo 1.0 % Channel catfish 0.5 % White sucker 0.2 %	**1.5**	**47.7%** Gizzard shad 40.2 % Bluntnose minnow 3.0 % Common carp 2.5 % Smallmouth buffalo 0.9 % Black buffalo 0.6 % Channel catfish 0.5 %	**0.5**
	GN	**54.5%** Blue catfish 23.1 % Gizzard shad 14.9 % Hybrid shad 6.0 % Channel catfish 4.5 % Quillback 3.7 % Common carp 1.5 % Smallmouth buffalo 0.7 %	**0.5**	**62.9%** Gizzard shad 24.9 % Blue catfish 15.1 % Hybrid shad 7.3 % Common carp 6.8 % Black buffalo 2.9 % Quillback 2.9 % Channel catfish 2.4 % Smallmouth buffalo 0.5 %	**0.5**
Fish abundance and health					
11. Average number per run	EF	**40.5**	**0.5**	**42.6**	**0.5**
	GN	**13.4**	**1.5**	**20.5**	**1.5**
12. Percent anomalies	EF	**1.5%**	**2.5**	**1.1%**	**2.5**
	GN	**18.7%**	**0.5**	**12.7%**	**0.5**
Overall RFAI Score			**39** **Fair**		**37** **Fair**

Table 15. Individual metric scores and the overall RFAI scores downstream (CRM 15.0) and upstream (CRM 18.5) of the proposed CRSMR - October, 2011.

October 2011 **Metric**		**CRM 15.0** **Obs**	**Score**	**CRM 18.5** **Obs**	**Score**
Species richness and composition					
1. Number of indigenous species		**29**	**3**	**32**	**5**
2. Number of centrarchid species (less *Micropterus*)		**5** Bluegill Green sunfish Redear sunfish Redbreast sunfish Warmouth	**5**	**6** Bluegill Green sunfish Redbreast sunfish Redear sunfish Warmouth Black crappie	**5**
3. Number of benthic invertivore species		**6** Black redhorse Golden redhorse Spotted sucker Northern hogsucker Freshwater drum Logperch	**3**	**6** Black redhorse Golden redhorse Spotted sucker Northern hogsucker Freshwater drum Logperch	**3**
4. Number of intolerant species		**6** Black redhorse Northern hogsucker Spotted sucker Rock bass Smallmouth bass Skipjack herring	**5**	**5** Black redhorse Northern hogsucker Spotted sucker Rock bass Smallmouth bass	**5**
5. Percent tolerant individuals	EF	**37.8%** Bluegill 25.4 % Green sunfish 3.7 % Gizzard shad 2.5 % Largemouth bass 2.3 % Common carp 2.3 % Redbreast sunfish 0.8 % Bluntnose minnow 0.4 % Spotfin shiner 0.2 % Longnose gar 0.2 %	**1.5**	**55.1%** Gizzard shad 20.3 % Bluegill 16.1 % Green sunfish 7.0 % Largemouth bass 4.2 % Redbreast sunfish 2.3 % Golden shiner 1.6 % Bluntnose minnow 1.4 % Common carp 1.4 % Spotfin shiner 0.5 % W. mosquitofish 0.2 %	**1.5**
	GN	**8.3%** Gizzard shad 8.3 %	**2.5**	**25.0%** Gizzard shad 17.5 % Common carp 5.0 % River carpsucker 2.5 %	**1.5**

Table 15. October 2011 (Continued, October, 2011)

October 2011 Metric		CRM 15.0 Obs	Score	CRM 18.5 Obs	Score
6. Percent dominance by one species	EF	**30.8%** Spotted sucker	**1.5**	**20.3%** Gizzard shad	**1.5**
	GN	**33.3%** Blue catfish	**0.5**	**22.5%** Blue catfish	**1.5**
7. Percent non-indigenous species	EF	**15.2%** Yellow perch 11.4 % Common carp 2.3 % Redbreast sunfish 0.9 % Striped bass 0.6 %	**0.5**	**16.8%** Yellow perch 12.6 % Redbreast sunfish 2.3 % Common carp 1.4 % Striped bass 0.2 % MS silverside 0.2 %	**0.5**
	GN	**0%**	**2.5**	**17.5%** Striped bass 12.5 % Common carp 5.0 %	**0.5**
8. Number of top carnivore species		**7** Largemouth bass Longnose gar Rock bass Smallmouth bass Spotted bass Skipjack herring Yellow bass	**3**	**8** Largemouth bass Black crappie Smallmouth bass Rock bass Sauger Walleye White bass Yellow bass	**5**
Trophic composition					
9. Percent top carnivores	EF	**5.0%** Largemouth bass 2.3 % Rock bass 1.5 % Striped bass 0.6 % Longnose gar 0.2 % Smallmouth bass 0.2 % Spotted bass 0.2 %	**0.5**	**6.1%** Largemouth bass 4.2 % Rock bass 0.7 % Black crappie 0.2 % Smallmouth bass 0.2 % Striped bass 0.2 % White bass 0.2 % Yellow bass 0.2 %	**1.5**
	GN	**12.5%** Skipjack herring 8.3 % Yellow bass 4.2 %	**0.5**	**25.0%** Striped bass 12.5 % White bass 5.0 % Sauger 5.0 % Walleye 2.5 %	**0.5**

Table 15. October 2011 (Continued, October, 2011)

October 2011 Metric		CRM 15.0 Obs	Score	CRM 18.5 Obs	Score
10. Percent omnivores	EF	**5.8%** Gizzard shad 2.5 % Common carp 2.3 % Black buffalo 0.4 % Bluntnose minnow 0.4 % Smallmouth buffalo 0.2 %	**2.5**	**26.6%** Gizzard shad 20.3 % Black buffalo 1.6 % Golden shiner 1.6 % Bluntnose minnow 1.4 % Common carp 1.4 % Smallmouth buffalo 0.2 %	**1.5**
	GN	**58.3%** Blue catfish 33.3 % Gizzard shad 8.3 % Quillback 8.3 % Channel catfish 4.2 % Smallmouth buffalo 4.2 %	**0.5**	**52.5%** Blue catfish 22.5 % Gizzard shad 17.5 % Common carp 5.0 % Black buffalo 2.5 % Channel catfish 2.5 % River carpsucker 2.5 %	**0.5**
Fish abundance and health					
11. Average number per run	EF	**32.1**	**0.5**	**28.5**	**0.5**
	GN	**2.4**	**0.5**	**4.0**	**0.5**
12. Percent anomalies	EF	**2.5%**	**1.5**	**0.9%**	**2.5**
	GN	**0%**	**2.5**	**0%**	**2.5**
Overall RFAI Score			**37** **Fair**		**40** **Fair**

Table 16. Fish species collected, by season, upstream and downstream of the proposed CRSMR (listed alphabetically by common name).

	February		May		July		October	
	Clinch River Mile		Clinch River Mile		Clinch River Mile		Clinch River Mile	
Species	15.0	18.5	15.0	18.5	15.0	18.5	15.0	18.5
Banded sculpin	X	X	X	X	X	X	X	X
Black buffalo	---	---	X	X	X	X	X	X
Black crappie	X	X	---	X	---	---	---	X
Black redhorse	X	X	X	X	X	X	X	X
Blue catfish	---	---	X	X	X	X	X	X
Bluegill	X	X	X	X	X	X	X	X
Bluntnose minnow	X	X	X	X	X	X	X	X
Brook silverside	---	X	---	---	---	X	---	---
Bullhead minnow	---	---	---	X	---	---	---	---
Channel catfish	X	X	X	X	X	X	X	X
Common carp	X	X	X	X	X	X	X	X
Dusky darter	X	---	---	---	---	---	X	---
Fathead minnow	---	X	---	---	---	---	---	---
Flathead catfish	---	---	---	X	X	X	---	---
Freshwater drum	X	X	X	X	X	X	X	X
Gizzard shad	X	X	X	X	X	X	X	X
Golden redhorse	X	X	X	X	X	X	X	X
Golden shiner	---	X	---	---	---	---	---	X
Green sunfish	X	X	X	X	X	X	X	X
Greenside darter	---	---	---	---	---	---	---	X
Hybrid shad	---	---	---	---	X	X	---	---
Hybrid Striped bass	X	X	---	---	---	---	---	---
Hybrid sunfish	X	X	---	X	---	X	---	---
Largemouth bass	X	X	X	X	X	X	X	X
Largescale stoneroller	---	---	---	---	---	X	---	---
Logperch	---	X	---	X	X	X	X	X
Longnose gar	---	---	---	X	X	X	X	---
Mississippi silverside	X	X	X	---	---	X	---	X
Muskellunge	---	---	X	---	---	---	---	---
Northern hogsucker	---	X	X	X	X	X	X	X
Quillback	---	X	X	X	X	X	X	---
Redbreast sunfish	X	X	X	X	X	X	X	X
Redear sunfish	X	X	---	X	X	X	X	X
River carpsucker	---	---	---	---	---	---	---	X
Rock bass	X	---	X	X	X	---	X	X
Sauger	X	X	X	X	X	X	---	X
Saugeye	X	---	---	---	---	---	---	---
Silver redhorse	---	---	---	X	X	X	---	---
Skipjack herring	X	---	X	X	X	X	X	---
Smallmouth bass	---	---	X	X	X	X	X	X
Smallmouth buffalo	---	---	X	---	X	X	X	X
Smallmouth redhorse	---	---	---	---	---	X	---	---
Snubnose darter	---	---	---	---	X	X	X	X
Spotfin shiner	X	X	X	X	X	X	X	X
Spotted bass	---	---	---	X	---	---	X	---
Spotted gar	---	---	---	X	---	---	---	---
Spotted sucker	X	X	X	X	X	X	X	X
Striped bass	X	X	X	X	X	X	X	X
Threadfin shad	X	X	---	X	---	---	X	X
Walleye	X	X	---	X	X	X	---	X
Warmouth	X	X	X	X	X	---	X	X
Western mosquitofish	---	---	---	---	---	---	---	X
White bass	X	X	X	X	X	X	---	X
White crappie	X	X	---	---	---	---	---	---
White sucker	X	---	---	---	X	---	---	---
Yellow bass	X	X	X	X	X	X	X	X
Yellow perch	X	X	X	X	X	X	X	X

Table 17. Summary of RFAI scores from sites located upstream and downstream of proposed SMR and scores from sampling conducted during 1993-2011 at other locations in the Clinch River downstream of Melton Hill Dam.

Station	Location	1993	1994	1996	1998	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Avg.
Inflow	CRM 22.0	38	46	48	36	44	---	42	---	38	---	40	---	44	44	44	**---**	**42**
Transition	CRM 4.4	---	---	---	---	---	45	---	42	---	44	---	36	---	38	42	44	**42**
Transition	CRM 1.5	---	---	---	---	---	42	---	44	---	41	---	34	---	36	42	36	**39**

Station	Location	February 2011	May 2011	July 2011	October 2011	Avg.
Transition- SMR Upstream	CRM 18.5	36	42	37	40	**39**
Transition- SMR Downstream	CRM 15.0	38	38	39	37	**38**

RFAI Scores: 12-21 ("Very Poor"), 22-31 ("Poor"), 32-40 ("Fair"), 41-50 ("Good"), or 51-60 ("Excellent")

Table 18. Individual metric ratings and overall RBI scores for lab processed reservoir benthic dredge samples collected upstream and downstream of the proposed SMR, 2011.

	CRM 15.0						CRM 18.8					
	May 2011		July 2011		October 2011		May 2011		July 2011		October 2011	
Metric	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**
1. Average number of taxa	10.6	5	12	5	14.5	5	14.8	5	16.8	5	24	5
2. Proportion of samples with long-lived organisms	0.9	5	1	5	0.8	3	0.8	3	1	5	1	5
3. Average number of EPT taxa	0.1	1	1	3	1	3	0.8	1	1.4	3	2	5
4. Average proportion of oligochaete individuals	12.8	3	10.4	5	30.2	1	8.7	5	12.1	3	9	5
5. Average proportion of total abundance comprised by the two most abundant taxa	79.1	3	80.4	3	84.6	3	79	3	70.2	5	74.3	3
6. Average density excluding chironomids and oligochaetes	2112.7	5	1868.3	5	3791.7	5	1784.5	5	2356.4	5	8650	5
7. Zero-samples – proportion of samples containing no organisms	0	5	0	5	0	5	0	5	0	5	0	5
Benthic Index Score		**27**		**31**		**25**		**27**		**31**		**33**
Ecological Health Rating		**Good**		**Excellent**		**Good**		**Good**		**Excellent**		**Excellent**

Reservoir Benthic Index Scores: 7-12 (“Very Poor”), 13-18 (“Poor”), 19-23 (“Fair”), 24-29 (“Good”), 30-35 (“Excellent”)

Table 19. Mean densities (organisms/m^2) of benthic taxa collected by dredge samples, upstream and downstream of the proposed SMR, 2011.

Taxon	Downstream CRM 15 May 2011	Downstream CRM 15 July 2011	Downstream CRM 15 October 2011	Upstream CRM 18.8 May 2011	Upstream CRM 18.8 July 2011	Upstream CRM 18.8 October 2011
Cnidaria						
Hydra sp.	---	---	52	15	3	88
Nematoda	---	---	7	2	1	3
Nemertea						
Prostoma sp.	---	---	2	---	---	5
Platyhelminthes				1		
Dugesia tigrina	9	---	8	1	1	67
Annelida						
Oligochaeta						
Haplotaxida						
Lumbricidae	---	5	---	3	---	---
Naididae			60		1	18
Dero sp.	---	---	17	---	---	---
Nais bretscheri	---	---	---	2	---	18
Nais communis	---	---	---	---	---	2
Nais pardalis	---	---	---	---	---	38
Nais sp.	2	---	---	---	---	2
Ophidonais serpentina	22	23	---	---	5	13
Pristina aequiseta	---	2	---	---	---	---
Pristina leidyi	---	---	---	---	---	2
Pristina sp.	---	---	60	---	---	8
Slavina appendiculata	---	---	7	---	---	155
Stylaria lacustris	---	23	70	---	5	10
Tubificidae	176	88	455	186	272	598
Aulodrilus piqueti	---	2	33	---	---	---
Branchiura sowerbyi	---	7	52	1	4	67
Ilyodrilus templetoni	---	5	---	---	---	---
Isochaetides freyi	---	---	---	---	15	---
Limnodrilus cf. cervix	2	---	---	---	---	---
Limnodrilus claparedianus		---	---	3	---	---
Limnodrilus hoffmeisteri	5	3	2	3	8	---
Spirosperma ferox	---	---	---	---	3	---
Spirosperma sp.	---	---	---	1	---	---
Varichaetadrilus angustipenis	4	---	---	---	1	---
Lumbriculidae		2		4	6	17

Table 19. (Continued)

Taxon	Downstream CRM 15 May 2011	July 2011	October 2011	Upstream CRM 18.8 May 2011	July 2011	October 2011
Hirudinea						7
Rhynchobdellida						
Glossiphoniidae			2			
Batracobdella phalera	---	---	---	---	5	---
Helobdella tricerialis	---	---	---	---	---	7
Arachnoidea						
Lebertiidae						
Lebertia sp.	---	---	---	---	---	30
Unionicolidae						
Unionicola sp.	---	---	2	---	---	---
Neumania sp.	---	3	---	---	---	---
Crustacea						
Brachiopoda						
Cladocera						
Daphnidae						
Daphnia lumholtzi	---	---	5	---	---	17
Sididae						
Sida crystallina	---	---	18	---	---	27
Malacostraca						
Amphipoda						
Crangonyctidae						
Crangonyx sp.	---	---	---	---	---	2
Isopoda						
Asellidae						
Lirceus sp.	---	---	---	1	1	---
Gammaridae						
Gammarus sp.	29	22	95	30	84	73
Talitridae						
Hyalella azteca	41	25	135	7	209	32
Maxillopoda						
Cyclopoida	5	5	18	---	---	2
Harpacticoida	---	---	3	---	---	---
Ostracoda	1	7	8	---	---	22
Candoniidae						
Candona sp.	19	---	22	---	---	5

Table 19. (Continued)

Taxon	Downstream CRM 15 May 2011	July 2011	October 2011	Upstream CRM 18.8 May 2011	July 2011	October 2011
Insecta						
Collembola	4	---	---	---	---	---
Odonata						
Zygoptera						
Corduliidae						
Neurocordulia obsoleta	---	---	---	---	---	5
Diptera						
Athericidae						
Atherix lantha	---	---	2	---	---	---
Ceratopogonidae	5	2	7	---	---	2
Chaoboridae						
Chaoborus punctipennis	---	15	13	---	41	3
Chaoborus sp.	---	2	---	---	---	---
Chironomidae	3					
Ablabesmyia annulata	---	2	---	---	---	---
Ablabesmyia mallochi	---	---	73	1	12	17
Ablabesmyia rhamphe gp.	---	2	---	2	1	---
Brillia flavifrons	---	---	2	---	---	---
Chaetocladius sp.	---	---	---	2	---	---
Chironomus sp.	52	10	---	57	2	5
Cladotanytarsus sp.	34	40	7	28	27	118
Conchapelopia sp.	---	---	8	---	---	---
Corynoneura sp.	---	---	---	---	---	5
Cricotopus bicinctus	---	---	---	---	---	28
Cricotopus (isocladius) intersectus	---	---	---	5	---	---
Cricotopus reversus gp.	---	---	17	---	---	2
Cricotopus sp.	1	---	---	---	---	7
Cricotopus sylvestris gp.	---	---	---	---	5	---
Cryptochironomus sp.	7	10	55	8	9	47
Cryptotendipus sp.	---	---	---	3	---	---
Dicrotendipes modestus	24	3	---	27	1	---
Dicrotendipes neomodestus	35	2	8	89	23	187
Dicrotendipes simpsoni	---	---	---	---	---	13
Dicrotendipes sp.	---	---	---	2	---	---
Eukiefferiella claripennis gp.	---	---	---	1	---	---
Glyptotendipes amplus	---	2	---	---	---	---
Harnischia sp.	---	3	---	---	5	---

Table 19. (Continued)

Taxon	Downstream CRM 15 May 2011	July 2011	October 2011	Upstream CRM 18.8 May 2011	July 2011	October 2011
Chironomidae (Cont.)						
Hydrobaenus sp.	---	2	---	---	---	---
Microtendipes pedellus gp.	7	27	782	64	205	1420
Nanocladius alternantherae	---	---	---	3	---	---
Nanocladius distinctus	---	---	10	14	---	20
Natarsia sp.	---	---	---	2	---	---
Omisus sp.	---	---	---	---	5	---
Parachaetocladius abnobaeus	---	---	2	---	---	---
Paracladopelma undine	3	---	---	---	---	---
Paracladopelma sp.	---	---	2	---	---	---
Parakiefferiella sp.	---	---	183	---	---	---
Paralauterborniella nigrohalteralis	13	8	50	---	1	---
Parametriocnemus sp.	---	---	5	---	---	---
Paratanytarsus sp.	6	2	195	15	16	225
Paratendipes albimanus	---	3	---	---	14	---
Phaenopsectra obediens gp.	---	2	---	5	15	---
Phaenopsectra punctipes gp.	---	2	---	---	---	---
Polypedilum flavum	---	---	17	---	---	---
Polypedilum halterale gp.	12	22	363	26	28	33
Polypedilum illinoense gp.	3	3	52	1	1	---
Polypedilum scalaenum gp.	5	10	---	4	10	---
Polypedilum sp.	1	---	---	---	---	---
Procladius sp.	52	23	50	24	22	2
Psectrocladius sp.	---	---	---	---	---	2
Pseudochironomus sp.	---	2	---	---	---	8
Rheotanytarsus exiguus gp.	---	---	35	59	1	285
Stenochironomus sp.	---	2	---	---	---	---
Stictochironomus devinctus	---	---	---	1	---	---
Synorthocladius semivirens	---	---	---	14	---	48
Tanypodinae	---	2	---	---	---	---
Tanytarsus sp.	16	23	193	14	8	80
Thienemanniella lobapodema	---	---	2	---	---	60
Tribelos fuscicorne	25	---	---	---	---	---
Tribelos jucundus	15	18	140	7	22	17
Tribelos sp.	2	---	---	---	---	---
Tvetenia paucunca	---	---	---	---	4	---
Xenochironomus xenolabis	---	---	---	1	---	---

Table 19. (Continued)

Taxon	Downstream CRM 15 May 2011	July 2011	October 2011	Upstream CRM 18.8 May 2011	July 2011	October 2011
Empididae						
Hemerodromia sp.	---	---	---	---	1	2
Tipulidae						
Hexatoma sp.	---	---	2	---	---	---
Pseudolimnophila sp.	---	---	28	---	---	---
Ephemeroptera						
Baetidae						
Baetis sp.	---	---	---	---	4	---
Caenidae						
Caenis sp.	---	---	---	---	---	2
Heptageniidae						
Stenacron interpunctatum	---	---	---	---	---	3
Plecoptera						
Leuctridae						
Leuctra sp.	---	---	5	---	---	---
Trichoptera						
Hydroptilidae						
Hydroptila sp.	1	12	37	2	25	10
Oxyethira sp.	---	2	---	---	---	---
Hydropsychidae						
Diplectrona modesta	---	---	---	---	---	2
Philopotamidae	---	---	2	---	---	---
Polycentropodidae						
Cyrnellus fraternus	---	---	---	---	---	2
Polycentropus sp.	---	---	---	1	48	42
Leptoceridae					1	12
Ceraclea sp.	---	---	---	5	---	---
Mystacides sepulchralis	---	12	---	---	3	2
Oecetis sp.	---	5	52	1	5	32
Triaenodes ignitus	---	---	5	---	---	2
Triaenodes injustus	---	2	2	---	---	---
Triaenodes sp.	---	2	20	---	---	---
Megaloptera						
Sialidae						
Sialis sp.	18	10	---	4	8	5
Curculionidae	---	---	---	---	4	---

Table 19. (Continued)

Taxon	Downstream CRM 15 May 2011	July 2011	October 2011	Upstream CRM 18.8 May 2011	July 2011	October 2011
Coleoptera						
Elmidae						
Dubiraphia sp.	9	3	5	---	6	7
Stenelmis sp.	---	2	---	---	1	---
Mollusca						
Gastropoda						
Basommatophora						
Ferrissia rivularis	---	---	117	5	49	218
Mesogastropoda						
Hydrobiidae						
Amnicola limosa	1670	1488	122	1160	1262	1250
Amnicola sp.	---	---	---	---	16	---
Somatogyrus sp.	1	2	15	9	12	482
Physidae						
Physella sp.	---	---	8	---	9	27
Planorbidae						
Menetus dilatatus	14	5	60	---	38	5
Pleuroceridae		2				
Pleurocera caniculata	5	5	---	---	---	---
Pleurocera unciala	---	---	---	---	1	3
Pleurocera sp.	---	---	---	---	1	15
Bivalvia						
Veneroida						
Corbiculidae						
Corbicula fluminea <10mm	20	50	342	8	27	370
Corbicula fluminea >10mm	4	10	10	11	43	92
Dreissenidae						
Dreissena polymorpha	73	123	2702	396	272	5850
Sphaeriidae						
Pisidium sp.	215	80	---	141	225	17
Number of samples	**10**	**10**	**10**	**10**	**10**	**10**
Mean Density per meter^2	**2,670**	**2,281**	**6,940**	**2,482**	**3,163**	**12,426**
Taxa Richness	**41**	**56**	**59**	**53**	**62**	**67**
Non-Chironomid /Oligochaete taxa	**17**	**24**	**32**	**17**	**26**	**37**
Sum of area sampled (meters^2)	**1.1**	**0.6**	**0.6**	**1.1**	**1.1**	**0.6**

Table 20. Descriptions, GPS locations and supporting information for shoreline benthic sampling sites, 10/10/2011.

	CRM 15.0		CRM 18.8	
	LDB	**RDB**	**LDB**	**RDB**
	N 35.90051 W -84.38865	N 35.89725 W -84.38675	N 35.89872 W -84.36314	N 35.89984 W -84.36321
Description and Notes:	No rock habitat found within 1/4 mile either direction from the center of this transect. Root wads were sampled by kicknet.	No rock habitat found within 1/4 mile either direction from the center of this transect. Root wads were sampled by kicknet.	Wooded area at gas pipeline crossing; eroded banks; a lot of fine sediment	Wooded area/grassy field at gas pipeline crossing; eroded banks; a lot of fine sediment
Total area sampled (m^2): Rock Samples	---	---	0.95	0.98
Total area sampled (m^2): Kicknet Samples	3	3	---	---
Water Temp. (°C):	---	---	18	18

Table 21. Mean Density (organisms/m^2) of benthic taxa collected along each shoreline (left descending and right descending), upstream and downstream of the SMR site, October 2011.

	CRM 15.0 Kick-Net Samples		CRM 18.8 Rock Samples	
Taxon	**LDB**	**RDB**	**LDB**	**RDB**
Oligochaeta				
Haplotaxida				
Enchytraeidae	2	6	26	---
Naididae	1	---	26	147
Nais bretscheri	---	---	886	98
Nais communis	---	1	---	---
Nais pardalis	38	---	300	295
Nais sp.	1	22	788	295
Pristinella sp.	---	---	---	48
Slavina appendiculata	---	22	---	48
Stylaria lacustris	71	57	---	48
Tubificidae				
Branchiura sowerbyi	1	---	---	---
Arthropoda				
Arachnomorpha				
Arachnoidea				
Acariformes	---	1	---	---
Lebertiidae				
Lebertia sp.	---	1	---	---
Crustacea				
Brachiopoda				
Cladocera				
Chydoridae	---	---	---	48
Sididae				
Sida crystallina	35	32	41	---
Malacostraca				
Amphipoda	---	---	---	177
Gammaridae				
Gammarus sp.	2	3	---	18
Talitridae				
Hyalella azteca	1	6	---	37
Maxillopoda				
Cyclopoida	1	2	112	145
Ostracoda	---	---	90	81

Table 21. (Continued)

Taxon	CRM 15.0 Kick-Net Samples		CRM 18.8 Rock Samples	
	LDB	RDB	LDB	RDB
Insecta				
Odonata				
Zygoptera				
Coenagrionidae	1	1	---	---
Diptera				
Ceratopogonidae	---	---	25	---
Atrichopogon sp.	1	---	---	---
Dasyhelea sp.	---	---	514	113
Chironomidae				
Ablabesmyia mallochi	---	2	37	2
Chironomus sp.	---	1		48
Cladotanytarsus sp.	---	---	16	164
Cricotopus bicinctus	6	23	286	535
Cricotopus (l.) "ozarks"	---	---	147	48
Cricotopus reversus gp.	---	---	920	371
Cricotopus sp.	2	2	41	109
Cricotopus trifascia	---	2	---	---
Dicrotendipes neomodestus	15	30	540	2469
Dicrotendipes simpsoni	---	2	---	---
Glyptotendipes sp.	1	2	---	---
Microtendipes pedellus gp.	4	1	16	111
Paratanytarsus sp.	44	80	758	3395
Polypedilum illinoense gp.	3	19	585	2
Pseudochironomus sp.	---	---	16	48
Rheotanytarsus exiguus gp.	---	11	---	161
Rheotanytarsus sp.	2	2	---	---
Stenochironomus sp.	2	---	---	---
Synorthocladius semivirens	1	2	---	---
Tanypodinae				
Tanytarsus sp.	44	27	95	903
Thienemanniella lobapodema	6	3	74	323
Tribelos jucundus	5	1	---	50
Empididae				
Hemerodromia sp.	---	2	8	---
Tipulidae				
Ormosia sp.	---	---	---	2

Table 21. (Continued)

Taxon	CRM 15.0 Kick-Net Samples LDB	CRM 15.0 Kick-Net Samples RDB	CRM 18.8 Rock Samples LDB	CRM 18.8 Rock Samples RDB
Ephemeroptera				
Baetidae			8	16
Callibaetis sp.	5	2	---	---
Caenidae				
Caenis sp.	1	---	---	16
Heptageniidae				
Stenacron interpunctatum	---	---	---	3
Trichoptera				
Hydroptilidae				
Hydroptila sp.	1	3	8	28
Polycentropodidae				
Polycentropus sp.	25	20	8	104
Coleoptera				
Elmidae				
Dubiraphia sp.	4	---	---	60
Mollusca				
Gastropoda				
Mesogastropoda				
Hydrobiidae				
Amnicola limosa	5	1	---	476
Physidae				
Physella sp.	---	---	84	---
Planorbidae				
Menetus dilatatus	---	1	---	---
Pleuroceridae				
Pleurocera caniculata	---	---	2	---
Bivalvia				
Veneroida				
Corbiculidae				
Corbicula fluminea	---	---	28	---
Dreissenidae				
Dreissena polymorpha	9	23	203	1053
Total Area Sampled (meter^2)	**3**	**3**	**0.95**	**0.98**
Taxa Richness	**28**	**32**	**27**	**35**
Non-Chironomid or Oligochaete taxa	**13**	**13**	**11**	**14**
Mean Density per meter^2	**340**	**416**	**6,688**	**12,095**

Table 22. SAHI scores assessed for 16 sections of shoreline within the RFAI fish community sample area downstream (CRM 15.0) of the proposed Clinch River SMR, May 2011.

Left Descending Bank	1	2	3	4	5	6	7	8	Avg.
Latitude	35.90969	35.90750	35.90558	35.90180	35.89933	35.89650	35.89402	35.89175	
Longitude	-84.397722	-84.394306	-84.392222	-84.289500	-84.388111	-84.388389	-84.390028	-84.391056	
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	3	3	3	3	5	5	5	3	4
Substrate	3	1	1	1	1	1	1	1	1
Erosion	5	3	1	1	3	5	1	3	3
Canopy Cover	3	3	3	5	5	5	5	5	4
Riparian Zone	1	1	3	1	5	5	5	5	3
Habitat	3	3	3	3	5	3	3	3	3
Slope	1	5	5	3	3	1	1	3	3
Total	**19**	**19**	**19**	**17**	**27**	**25**	**21**	**23**	**21**
Rating	**FAIR**	**FAIR**	**FAIR**	**FAIR**	**GOOD**	**FAIR**	**FAIR**	**FAIR**	**FAIR**

Right Descending Bank	1	2	3	4	5	6	7	8	Avg.
Latitude	35.911139	35.909056	35.907000	35.902472	35.899556	35.896167	35.893556	35.891500	
Longitude	-84.398111	-84.393028	-84.390333	-84.387917	-84.386694	-84.387167	-84.388889	-84.389417	
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	5	3	3	5	5	5	5	5	5
Substrate	3	1	1	1	1	1	1	1	1
Erosion	3	3	3	3	3	5	3	5	4
Canopy Cover	3	5	1	5	5	5	5	5	4
Riparian Zone	3	3	1	5	5	3	5	5	4
Habitat	5	3	3	5	5	3	3	3	4
Slope	5	5	3	5	5	5	5	5	5
Total	**27**	**23**	**15**	**31**	**29**	**27**	**27**	**29**	**27**
Rating	**GOOD**	**FAIR**	**POOR**	**GOOD**	**GOOD**	**GOOD**	**GOOD**	**GOOD**	**GOOD**

Scoring criteria: “Poor” (7-16); “Fair” (17-26); and “Good” (27-35)

Table 23. SAHI scores assessed for 16 sections of shoreline within the RFAI fish community sample area upstream (CRM 18.5) of the proposed Clinch River SMR, May 2011.

Left Descending Bank	1	2	3	4	5	6	7	8	Avg.
Latitude	35.89734	35.89895	35.89895	35.89874	35.89865	35.89867	35.89954	35.89959	
Longitude	-84.37358	-84.36810	-84.36443	-84.36285	-84.35797	-84.35648	-84.35287	-84.35081	
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	1	1	1	5	1	1	3	5	2
Substrate	1	1	1	3	1	1	1	3	2
Erosion	1	1	1	3	3	3	3	5	3
Canopy Cover	5	3	1	1	1	3	3	5	3
Riparian Zone	1	3	1	1	1	3	3	3	2
Habitat	1	3	1	3	1	1	1	5	2
Slope	3	5	5	1	5	5	5	5	4
Total	**13**	**17**	**11**	**17**	**13**	**17**	**19**	**31**	**18**
Rating	**Poor**	**Fair**	**Poor**	**Fair**	**Poor**	**Fair**	**Fair**	**Good**	**Fair**

Right Descending Bank	1	2	3	4	5	6	7	8	Avg.
Latitude	35.89793	35.90041	35.89995	35.89936	35.89948	35.89958	35.90023	35.90065	
Longitude	-84.37440	-84.36772	-84.36420	-84.36166	-84.35815	-84.35661	-84.35274	-84.35067	
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	5	1	1	1	3	1	3	5	3
Substrate	5	1	1	1	1	3	1	3	2
Erosion	3	1	3	3	3	3	3	5	3
Canopy Cover	3	3	3	3	1	1	3	5	3
Riparian Zone	3	3	3	3	5	3	3	5	4
Habitat	5	1	1	1	1	1	3	3	2
Slope	1	1	3	3	3	1	3	3	2
Total	**25**	**11**	**15**	**15**	**17**	**13**	**19**	**29**	**19**
Rating	**Fair**	**Poor**	**Poor**	**Poor**	**Fair**	**Poor**	**Fair**	**Good**	**Fair**

Scoring criteria: “Poor” (7-16); “Fair” (17-26); and “Good” (27-35)

Table 24. Substrate percentages and average water depth (ft) per transect downstream (8 transects) and upstream (8 transects) of the Clinch River SMR.

	% Substrate per transect - Downstream								
	Transect								
	1	2	3	4	5	6	7	8	AVG
Sand	56.7	11.6	42.5	48.3	36.5	34.7	27.5	32.3	36.3
Cobble	28.9	27.9	18	3.3	28.3	39.4	37.5	29.6	26.6
Silt	0	54.1	33	24.9	23.5	9.9	9.3	11.7	20.7
Gravel	11.1	0.1	3.8	10.1	5	15.8	24.9	15.5	10.8
Clay	0	5	0	0	0	0	0	9.5	1.8
Detritus	0.4	1	2.2	1.7	6.5	0.2	0.3	0.3	1.6
Bedrock	0	0	0	11	0	0	0	0	1.4
Mollusk shell	2.9	0.3	0.5	0.7	0.2	0	0.5	1.1	0.8
Avg. depth (ft)	21.6	14.4	20.1	18.1	21.2	21.9	21.1	17.8	19.5
Actual depth range: 4.4 to 28.8ft									

	% Substrate per transect - Upstream								
	Transect								
	1	2	3	4	5	6	7	8	AVG
Detritus	0	10	.5	0.5	0	0	8	0	2.4
Clay	10.3	20	51	51	50.5	42.5	32.5	67.5	40.7
Gravel	36.8	56.5	4	7	14	13	13.5	19	20.5
Cobble	7	1	38	40.5	0	0	0	1	10.9
Bedrock	27	0	0	0	17	16	18	0	9.8
Sand	12.5	8.5	0.5	0	6	12	11	5	6.9
Mollusk shell	1.4	0	2	0	8	11	6.5	4	4.1
Plant	0	13	4	0	0	0	0	3.5	2.6
Silt	0	0	0	0	4.5	5.5	8	0	2.3
Boulder	5	0	0	0	0	0	0	0	0.6
Avg. depth (ft)	17.7	11.1	13.3	18.5	16.8	16.5	18.9	12.5	13.6
Actual depth range: 2.7 to 22.5ft									

Table 25. Wildlife observed along 2100 m transects parallel to the Clinch River shoreline, downstream and upstream of the proposed SMR site, 2011.

Season	Transect		Birds	Obs.	Reptiles	Obs.
March 2011	Upstream	RDB	Swallow sp.	79		
			Belted Kingfisher	13		
			Unidentified Raptor	1		
			Wood Duck	13		
			American Coot	1		
			Double-crested Cormorant	10		
		LDB	Great Blue Heron	1		
			Black-crowned Night Heron	1		
	Downstream	RDB	Swallow sp.	30		
			Bald Eagle	1		
			Wood Duck	4		
			Osprey	1		
		LDB	Belted Kingfisher	1		
			Double-crested Cormorant	1		
			Great Blue Heron	1		
			Osprey	1		
June 2011	Upstream	RDB	Wood Duck	2		
			Double-crested Cormorant	4		
			Osprey	1		
			Canada Goose	9		
		LDB	Swallow sp.	7		
			Songbird sp.	2		
			Great Blue Heron	5		
			Double-crested Cormorant	15		
			Black-crowned Night Heron	2		
	Downstream	RDB	Osprey	1		
			Double-crested Cormorant	4		
		LDB	Swallow sp.	2		
August 2011	Upstream	RDB	Osprey	1		
		LDB	Hawk sp.	1	Turtle	2
			Bald Eagle	1		
	Downstream	RDB	Bald Eagle	2	Turtle	1
			Hawk sp.	1		
			Osprey	1		
		LDB	Belted Kingfisher	2		
			Double-crested Cormorant	1		
October 2011	Upstream	RDB	Wren sp.	1	Turtle	2
			American Crow	4		
			Songbird sp.	2		
			Turkey Vulture	1		
		LDB	American Crow	1		
			Great Blue Heron	1		
	Downstream	RDB	Songbird sp.	5	Turtle	1
			American Crow	1		
			Great Blue Heron	1		
		LDB	Pileated Woodpecker	1		
			Turkey Vulture	4		
			Pied-billed Grebe	1		
			Great Blue Heron	1		

RDB= Right descending bank, LDB= Left descending bank

Table 26. Mid-channel water quality parameters collected along vertical depth profiles at the downstream and upstream ends of the RFAI sample reach downstream (CRM 15.0) and upstream (CRM 18.5) of the proposed SMR site, February and May 2011.

2/15/2011	CRM 15.0						CRM 18.5					
	Depth	°C	°F	Cond	DO	pH	Depth	°C	°F	Cond	DO	pH
Downstream Boundary	0.3	7.48	45.46	275.7	12.54	8.04	0.3	7.33	45.19	274.9	12.10	7.97
	1.5	7.26	45.07	275.0	12.60	8.04	1.5	7.29	45.12	274.8	12.04	7.93
	3	2.20	45.96	274.6	12.67	8.05	3	7.26	45.07	275.5	12.00	7.96
	4	7.20	44.96	274.5	12.70	8.06	4	7.23	45.01	274.9	12.02	8.03
	5	7.21	44.98	274.0	12.68	8.05	5	7.37	45.27	273.6	11.93	7.93
Upstream Boundary	0.3	7.59	45.66	275.6	12.80	8.10	0.3	7.39	45.30	275.0	12.36	8.08
	1.5	7.48	45.46	275.4	12.82	8.09	1.5	7.29	45.12	275.6	12.47	8.08
	3	7.22	45.00	274.4	12.83	8.08	3	7.12	44.82	274.5	12.58	8.12
	4	7.15	44.87	275.9	12.88	8.08	4	7.11	44.80	274.9	12.60	8.13
	6	7.17	44.91	275.9	12.86	8.10						

5/18/2011	CRM 15.0						CRM 18.5					
	Depth	°C	°F	Cond	DO	pH	Depth	°C	°F	Cond	DO	pH
Downstream Boundary	0.3	17.68	63.82	277.30	8.35	7.62	0.3	17.93	64.27	278.20	8.31	7.56
	1.5	17.22	63.00	277.20	8.32	7.62	1.5	17.21	62.98	277.50	8.35	7.55
	3	17.14	62.85	277.40	8.29	7.61	3	17.15	62.87	277.00	8.32	7.55
	4	17.11	62.80	277.60	8.28	7.61	4	17.15	62.87	277.00	8.31	7.55
	6	17.09	62.76	277.50	8.28	7.64	6	17.11	62.80	277.10	8.27	7.56
Upstream Boundary	0.3	18.00	64.40	278.30	8.32	7.60	0.3	17.60	63.68	277.90	8.37	7.53
	1.5	17.26	63.07	277.70	8.40	7.60	1.5	17.24	63.03	277.40	8.35	7.52
	3	17.19	62.94	278.10	8.36	7.60	3	17.12	62.82	277.20	8.35	7.52
	4	17.13	62.83	277.90	8.32	7.60	4	17.09	62.76	277.10	8.37	7.51
	5	17.11	62.80	277.20	8.33	7.63	5	17.10	62.78	277.10	8.41	7.52

Abbreviations: °C –Temperature (degrees Celsius), °F – Temperature (degrees Fahrenheit), Cond – Conductivity (µS/cm), DO – Dissolved Oxygen (ppm)

Table 27. Water quality parameters collected along vertical depth profiles at the downstream, midpoint, and upstream end of the RFAI sample reach downstream (CRM 15.0) and upstream (CRM 18.5) of the proposed SMR site, July 2011.

7/14/2011	LDB						Mid-channel						RDB					
CRM 15.0	**Depth**	**°C**	**°F**	**Cond**	**DO**	**pH**	**Depth**	**°C**	**°F**	**Cond**	**DO**	**pH**	**Depth**	**°C**	**°F**	**Cond**	**DO**	**pH**
Downstream Boundary	0.3	22.24	72.03	277.9	6.2	7.54	0.3	22.19	71.94	280.8	5.9	7.73	0.3	22.94	73.29	279.4	4.8	7.75
	1.5	21.37	70.47	279.3	5.6	7.60	1.5	21.40	70.52	278.1	5.6	7.68	1.5	21.41	70.54	278.5	4.9	7.69
	3	21.26	70.27	279.1	5.4	7.54	3	21.20	70.16	278.8	5.2	7.64	2.5	21.19	70.14	278.7	5.5	7.63
	4	21.33	70.39	277.9	5.4	7.54	4	21.18	70.12	280.8	5.2	7.62	3.5	21.19	70.14	279.9	6.0	7.62
							5	21.13	70.03	279.2	5.0	7.61						
							6.5	21.12	70.02	279.2	4.8	7.62						
Midpoint	0.3	22.26	72.07	279.5	5.4	7.43	0.3	22.05	71.69	279.9	5.7	7.64	0.3	22.08	71.74	280.6	5.8	7.64
	1.5	21.06	69.91	278.6	5.4	7.48	1.5	20.99	69.78	280.5	5.7	7.63	1.5	21.04	69.87	279.1	5.5	7.64
	3	20.97	69.75	278.7	5.5	7.52	3	20.88	69.58	279.7	5.7	7.62	2.5	20.88	69.58	279.4	5.6	7.68
	4.5	20.95	69.71	278.7	5.7	7.55	4	20.84	69.51	280.1	5.7	7.61						
	5.5	20.88	69.58	278.9	5.7	7.58	5	20.82	69.48	279.5	5.7	7.60						
	6.5	20.88	69.58	279.1	5.9	7.61	6	20.81	69.46	279.7	5.7	7.60						
Upstream Boundary	0.3	21.00	69.80	283.2	6.8	7.60	0.3	21.90	71.42	278.4	6.3	7.55	0.3	21.91	71.44	279.6	5.8	7.61
	1	20.90	69.62	278.5	6.5	7.57	1	21.20	70.16	278.2	6.2	7.53	1.5	20.86	69.55	279.1	5.8	7.55
	1.5	21.02	69.84	277.1	6.2	7.45	1.5	21.90	71.42	278.2	6.1	7.55	2.5	20.86	69.55	280.2	5.9	7.54
	2.5	21.12	70.02	277.0	5.9	7.38							3	20.82	69.48	280.3	6.4	7.56
CRM 18.5 Downstream Boundary	0.3	21.02	69.84	275.5	4.9	7.40	0.3	21.00	69.80	275.8	5.1	7.52	0.3	20.85	69.53	275.7	5.1	7.51
	1.5	20.86	69.55	275.1	4.9	7.43	1.5	20.75	69.35	276.0	5.1	7.49	1.5	20.79	69.42	276.2	5.0	7.50
	3.0	21.00	69.80	275.8	4.9	7.48	3	20.73	69.31	276.2	5.2	7.48	3	20.79	69.42	276.2	4.0	7.47
							4	20.75	69.35	276.0	5.2	7.47	4	20.80	69.44	276.3	5.0	7.45
							5	20.73	69.31	276.0	5.2	7.46	5	20.81	69.46	276.0	5.0	7.45
							6	20.77	69.39	276.4	5.2	7.45						

Table 27. (Continued)

7/14/2011	LDB						Mid-channel						RDB					
CRM 18.5	**Depth**	**°C**	**°F**	**Cond**	**DO**	**pH**	**Depth**	**°C**	**°F**	**Cond**	**DO**	**pH**	**Depth**	**°C**	**°F**	**Cond**	**DO**	**pH**
Midpoint	0.3	20.69	69.24	275.7	5.7	7.58	0.3	20.54	68.97	276.0	5.9	7.62	0.3	20.55	68.99	275.6	5.9	7.64
	1.5	20.66	69.19	275.5	5.7	7.55	1.5	20.55	68.99	275.0	6.0	7.62	1.5	20.54	68.97	275.7	5.9	7.61
	2.5	20.71	69.28	275.8	5.7	7.51	3	20.53	68.95	275.3	5.9	7.60	3	20.55	68.99	275.4	5.9	7.61
							4	20.52	68.94	276.6	6.0	7.59	4	20.54	68.97	276.0	5.9	7.60
							5	20.51	68.92	276.1	6.0	7.59	5	20.53	68.95	275.5	5.9	7.59
													6	20.55	68.99	276.3	5.9	7.58
Upstream Boundary	0.3	20.37	68.67	275.5	6.1	7.66	0.3	20.40	68.72	275.2	6.0	7.68	0.3	20.46	68.83	275.0	6.0	7.66
	1.5	20.37	68.67	274.8	6.1	7.66	1.5	20.35	68.63	275.7	6.0	7.66	1.5	20.44	68.79	275.3	6.0	7.64
	3	20.36	68.65	275.7	6.1	7.65	3	20.34	68.61	274.0	6.0	7.65	3	20.42	68.76	275.8	6.0	7.62
	4	20.36	68.65	275.3	6.3	7.65	4	20.37	68.67	275.2	6.0	7.64	4	20.42	68.76	275.5	6.0	7.61
							5	20.33	68.59	275.1	6.0	7.64	5	20.44	68.79	275.6	6.0	7.62

Abbreviations: °C –Temperature (degrees Celsius), °F – Temperature (degrees Fahrenheit), Cond – Conductivity (µS/cm), DO – Dissolved Oxygen (ppm)

Table 28. Water quality parameters collected along vertical depth profiles at the downstream, midpoint, and upstream end of the RFAI sample reach downstream (CRM 15.0) and upstream (CRM 18.5) of the proposed SMR site, October 2011

10-12-2011			LDB						Mid-channel						RDB			
CRM 15.5	Depth	°C	°F	Cond	DO	pH	Depth	°C	°F	Cond	DO	pH	Depth	°C	°F	Cond	DO	pH
Downstream Boundary	0.3	18.12	64.62	278.2	7.3	7.39	0.3	18.08	64.54	279.1	7.2	7.41	0.3	18.09	64.6	278.1	7.3	7.42
	1.5	17.87	64.17	278.3	7.3	7.36	1.5	17.76	63.97	278.6	7.2	7.36	1.5	17.75	64.0	278.2	7.2	7.37
	3	17.79	64.02	278.0	7.3	7.34	3	17.74	63.93	278.8	7.2	7.34	3	17.74	63.9	278.7	7.2	7.36
	5	17.75	63.95	278.0	7.5	7.35	4	17.73	63.91	278.3	7.2	7.32	4	17.72	63.9	278.7	7.2	7.35
							6	17.72	63.9	279.2	7.4	7.33	6	17.72	63.9	279.0	7.3	7.34
Midpoint	0.3	18.15	64.67	278.9	7.9	7.44	0.3	18.13	64.63	277.8	8.0	7.46	0.3	18.39	65.1	278.0	8.0	7.49
	1.5	17.92	64.26	278.9	7.9	7.41	1.5	18.12	64.62	279.1	7.9	7.44	1.5	17.87	64.2	278.0	7.8	7.44
	3	17.88	64.18	278.1	7.8	7.38	3	17.84	64.11	278.1	7.8	7.4	3	17.86	64.2	278.0	7.8	7.41
	4	17.84	64.11	277.8	7.7	7.36	4	17.83	64.09	278.4	7.8	7.39	4	17.85	64.1	278.0	7.8	7.41
	6	17.83	64.09	277.5	7.8	7.34	6	17.83	64.09	278.7	7.9	7.38	6	17.83	64.1	278.0	7.8	7.39
Upstream Boundary	0.3	18.26	64.87	278.5	8.2	7.49	0.3	18.25	64.85	277.9	8.2	7.48	0.3	18.10	64.6	278.0	8.2	7.49
	1.5	18.09	64.56	276.9	8.2	7.45	1.5	18.17	64.71	277.5	8.2	7.45	1.5	18.01	64.4	277.5	8.2	7.47
	3	18.04	64.47	277.7	8.2	7.42	3	17.99	64.38	277.7	8.3	7.44	3	18.00	64.4	277.7	8.2	7.45
	5	18.02	64.44	277.7	8.1	7.41	5	17.99	64.38	277.5	8.2	7.43	4	17.99	64.4	277.8	8.2	7.44
													6	17.99	64.36	277.7	8.2	7.43
10/11/2011																		
CRM 18.5 Downstream Boundary	0.3	18.26	64.87	277.7	8.5	7.36	0.3	18.27	64.89	277.4	8.5	7.39	0.3	18.30	64.9	277.4	8.5	7.42
	1	18.2	64.76	276.0	8.5	7.33	1.5	18.18	64.72	277.5	8.5	7.38	1.5	18.20	64.8	277.4	8.4	7.38
	3	18.16	64.69	277.2	8.4	7.29	3	18.15	64.67	277.6	8.4	7.34	3	18.13	64.6	277.5	8.4	7.35
	5	18.14	64.65	277.0	8.4	7.28	5	18.12	64.62	277.4	8.4	7.31	4	18.12	64.6	277.2	8.3	7.34
	7	18.14	64.65	277.6	8.4	7.25	7	18.12	64.62	277.4	8.4	7.3	6	18.12	64.6	278.0	8.4	7.32
Midpoint	0.3	18.14	64.65	277.4	8.2	7.41	0.3	18.18	64.72	278.0	8.3	7.44	0.3	18.21	64.8	277.9	8.3	7.45
	1.5	18.13	64.63	277.8	8.2	7.37	1.5	18.14	64.65	277.8	8.3	7.41	1.5	18.15	64.7	278.0	8.3	7.43
	3	18.10	64.58	277.4	8.2	7.35	3	18.07	64.53	277.8	8.2	7.37	3	18.12	64.6	277.9	8.3	7.41
	5	18.10	64.58	277.4	8.2	7.34	5	18.07	64.53	277.3	8.3	7.35	5	18.11	64.6	277.4	8.3	7.39
Upstream Boundary	0.3	18.10	64.58	277.7	8.1	7.44	0.3	18.07	64.53	277.9	8.0	7.43	0.3	17.99	64.4	278.1	7.8	7.38
	1.5	18.10	64.58	277.3	8.1	7.43	1.5	18.08	64.54	277.8	8.0	7.41	1.5	17.99	64.4	278.2	7.8	7.36
	3	18.10	64.58	277.9	8.1	7.41	3	18.06	64.51	277.6	8.0	7.37	3	17.99	64.4	279.0	7.8	7.34
	5	18.10	64.58	277.9	8.1	7.4	4	18.06	64.51	277.9	8.0	7.38	4	17.96	64.3	278.2	7.8	7.33
							6	18.00	64.4	277.8	8.0	7.32	6	17.95	64.3	277.9	7.8	7.32

Abbreviations: °C –Temperature (degrees Celsius), °F – Temperature (degrees Fahrenheit), Cond – Conductivity (µS/cm), DO – Dissolved Oxygen (ppm)

Table 29. Summary of surface water (SW), phytoplankton, zooplankton, and sediment sampling.

Location	Description	Sampling Frequency				
		Monthly (March – December)			Bi-Monthly (April – December)	Annually (June)
CRM 15.5	Downstream, main channel	SW Physical/Chemical Measurements	Phyto-plankton	Zoo-plankton	SW Total and Dissolved Metals	Sediment Quality
CRM 18.5	Upstream, main channel	SW Physical/Chemical Measurements	Phyto-plankton	Zoo-plankton	SW Total and Dissolved Metals	Sediment Quality
CRM 19.7	Upstream, main channel	SW Physical/Chemical Measurements	---	---	SW Total and Dissolved Metals	---
CRM 22.0	Upstream, main channel	SW Physical/Chemical Measurements	Phyto-plankton	Zoo-plankton	SW Total and Dissolved Metals	Sediment Quality

Table 30. Standard water quality parameters, reporting limits, and methods of analysis.

Parameter	Reporting Limit	Units	Method of Analysis
Alkalinity	20	mg/L	2320B
Ammonia Nitrogen	0.1	mg/L	350.1
Chlorophyll-a	1	µg/l	ASTM D3731
Dissolved Solids	10	mg/L	2540C
Hardness, Total (mg/L as CaCO3)	30	mg/L	130.1
Kjeldahl Nitrogen, TKN	0.1	mg/L	351.2
Nitrate-Nitrite	0.1	mg/L	353.2
Phosphate,Ortho	0.025	mg/L	4500P-E
Phosphorus,Total	0.003	mg/L	365.1
Suspended Solids	1	mg/L	2540D
Total Organic Carbon (TOC)	1	mg/L	9060A
Turbidity	0.1	NTU	SM2130B
Temperature	0.1	C	Hydrolab®
pH	0.1	Stand. Units	Hydrolab®
Conductivity	0.1	µS/cm	Hydrolab®
Dissolved Oxygen	0.1	mg/L	Hydrolab®

Table 31. Total and dissolved metals analyses in water, reporting limits, and methods.

Metals, Total and Dissolved	Reporting Limit	Units	Method of Analysis
Aluminum	100	µg/l	200.7
Arsenic	1	µg/l	200.8
Cadmium	0.5	µg/l	200.8
Calcium	500	µg/l	200.7
Chromium	1	µg/l	200.8
Copper	1	µg/l	200.8
Iron	100	µg/l	200.7
Lead	1	µg/l	200.8
Magnesium	100	µg/l	200.7
Manganese	10	µg/l	200.7
Nickel	1	µg/l	200.8
Selenium	1	µg/l	200.8
Zinc	10	µg/l	200.8

Table 32. Chemical measurements in sediments, detection limits, and methods.

Analysis	Method Detection Limit	Units	Method of Analysis
	Metals		
Aluminum, Total	5	mg/kg	EPA 6010B
Arsenic, Total	0.5	mg/kg	EPA 7060A
Cadmium, Total	0.5	mg/kg	EPA 6010B
Calcium, Total	10	mg/kg	EPA 6010B
Chromium, Total	5	mg/kg	EPA 6010B
Copper, Total	1	mg/kg	EPA 6010B
Iron, Total	1	mg/kg	EPA 6010B
Lead, Total	5	mg/kg	EPA 6010B
Magnesium, Total	1	mg/kg	EPA 6010B
Manganese, Total	0.5	mg/kg	EPA 6010B
Mercury, Total	0.1	mg/kg	EPA 7471A
Nickel, Total	5	mg/kg	EPA 6010B
Zinc, Total	1	mg/kg	EPA 6010B
	Organochlorine Pesticides and PCB's		
Aldrin	10	µg/kg	EPA 8081A
alpha-BHC	10	µg/kg	EPA 8081A
beta-BHC	10	µg/kg	EPA 8081A
gamma-BHC (Lindane)	10	µg/kg	EPA 8081A
delta-BHC	10	µg/kg	EPA 8081A
Chlordane	10	µg/kg	EPA 8081A
Dieldrin	10	µg/kg	EPA 8081A
4,4'-DDD	10	µg/kg	EPA 8081A
4,4'-DDE	10	µg/kg	EPA 8081A
4,4'-DDT	10	µg/kg	EPA 8081A
Endosulfan alpha	10	µg/kg	EPA 8081A
Endosulfan beta	10	µg/kg	EPA 8081A
Endosulfan sulfate	10	µg/kg	EPA 8081A
Endrin	10	µg/kg	EPA 8081A
Endrin aldehyde	10	µg/kg	EPA 8081A
Heptachlor	10	µg/kg	EPA 8081A
Heptachlor epoxide	10	µg/kg	EPA 8081A
Methoxychlor	10	µg/kg	EPA 8081A
Aroclor 1016	25	µg/kg	EPA 8082
Aroclor 1221	25	µg/kg	EPA 8082
Aroclor 1232	25	µg/kg	EPA 8082
Aroclor 1242	25	µg/kg	EPA 8082
Aroclor 1248	25	µg/kg	EPA 8082
Aroclor 1254	25	µg/kg	EPA 8082
Aroclor 1260	25	µg/kg	EPA 8082
Toxaphene	500	µg/kg	EPA 8081A

Table 33. Dataset of water column profiles – water temperature, pH, conductivity, and dissolved oxygen (DO) – and Secchi-disk transparency measured monthly, March through December 2011, at CRMs 15.5, 18.5, 19.7, and 22.0.

River Mile	Date	Time (Central)	Secchi (meters)	Depth (meters)	Temp (C)	Temp (F)	pH (SU)	Conductivity (µs/cm)	% DO Saturation	Dissolved Oxygen (mg/L)
CRM 15.5	03/24/2011	11:35:32	2.75	0.3	10.14	50.25	7.71	294.2	105.7	11.55
CRM 15.5	03/24/2011	11:35:01		1.5	10.14	50.25	7.71	294.2	105.5	11.53
CRM 15.5	03/24/2011	11:33:27		3	10.13	50.23	7.70	294.2	105.2	11.50
CRM 15.5	03/24/2011	11:32:23		4	10.14	50.25	7.70	294.5	105.1	11.48
CRM 15.5	03/24/2011	11:31:35		5	10.13	50.23	7.70	294.6	105.0	11.47
CRM 15.5	03/24/2011	11:30:05		5.9	10.13	50.23	7.69	294.1	105.0	11.48
CRM 18.5	03/24/2011	12:56:52	1.5	0.3	10.19	50.34	7.74	294.5	108.5	11.84
CRM 18.5	03/24/2011	12:55:22		1.5	10.17	50.31	7.74	294.3	108.0	11.79
CRM 18.5	03/24/2011	12:54:32		3	10.16	50.29	7.75	294.5	107.8	11.77
CRM 18.5	03/24/2011	12:53:47		4	10.16	50.29	7.74	294.7	107.7	11.76
CRM 18.5	03/24/2011	12:52:34		4.6	10.16	50.29	7.76	294.0	107.3	11.72
CRM 19.7	03/25/2011	10:54:05	3	0.3	9.99	49.98	7.75	301.2	103.1	11.36
CRM 19.7	03/25/2011	10:53:14		1.5	9.97	49.95	7.73	301.7	102.9	11.33
CRM 19.7	03/25/2011	10:52:08		3	9.96	49.93	7.72	301.2	102.4	11.28
CRM 19.7	03/25/2011	10:51:12		3.9	9.97	49.95	7.70	301.4	102.3	11.27
CRM 22.0	03/25/2011	9:47:48	2.35	0.3	9.85	49.73	7.84	300.3	102.8	11.35
CRM 22.0	03/25/2011	9:46:35		1.5	9.84	49.71	7.84	300.5	102.8	11.35
CRM 22.0	03/25/2011	9:45:16		3	9.82	49.68	7.83	300.0	102.3	11.31
CRM 22.0	03/25/2011	9:44:37		4	9.82	49.68	7.83	300.0	102.0	11.28
CRM 22.0	03/25/2011	9:43:28		4.9	9.82	49.68	7.82	300.5	101.8	11.25
CRM 15.5	04/26/2011	9:22:19	2.3	0.3	14.77	58.59	7.50	274.1	97.4	9.55
CRM 15.5	04/26/2011	9:21:52		1.5	14.75	58.55	7.49	274.1	97.3	9.54
CRM 15.5	04/26/2011	9:21:17		3	14.75	58.55	7.50	274.1	97.0	9.51
CRM 15.5	04/26/2011	9:20:33		4	14.75	58.55	7.49	273.7	96.8	9.49
CRM 15.5	04/26/2011	9:20:09		5	14.75	58.55	7.49	273.7	96.6	9.47
CRM 15.5	04/26/2011	9:19:25		6.09	14.75	58.55	7.52	273.7	96.5	9.46
CRM 18.5	04/26/2011	10:37:06	1.5	0.3	14.67	58.41	7.51	275.1	97.8	9.61
CRM 18.5	04/26/2011	10:36:14		1.5	14.59	58.26	7.51	274.9	97.8	9.63
CRM 18.5	04/26/2011	10:35:38		3	14.59	58.26	7.50	275.1	97.6	9.60
CRM 18.5	04/26/2011	10:34:53		4	14.59	58.26	7.49	275.3	97.4	9.58
CRM 18.5	04/26/2011	10:33:54		5	14.61	58.30	7.49	274.9	97.1	9.55
CRM 18.5	04/26/2011	10:33:03		5.17	14.63	58.33	7.50	275.1	97.0	9.54
CRM 19.7	04/26/2011	13:01:35	2.6	0.3	14.85	58.73	7.55	274.9	100.2	9.81
CRM 19.7	04/26/2011	13:01:18		1.5	14.84	58.71	7.55	274.9	100.2	9.80
CRM 19.7	04/26/2011	13:00:56		2	14.85	58.73	7.55	274.5	100.0	9.78
CRM 19.7	04/26/2011	13:00:27		3	14.84	58.71	7.55	274.9	99.8	9.77
CRM 19.7	04/26/2011	13:00:01		4	14.84	58.71	7.56	274.7	99.5	9.74
CRM 19.7	04/26/2011	12:59:39		5.04	14.85	58.73	7.58	274.6	99.2	9.71
CRM 22.0	04/26/2011	13:39:27	1.85	0.3	14.79	58.62	7.60	274.9	101.2	9.91
CRM 22.0	04/26/2011	13:39:07		1.5	14.78	58.60	7.59	275.1	101.1	9.90
CRM 22.0	04/26/2011	13:38:42		2	14.78	58.60	7.60	274.9	100.7	9.87
CRM 22.0	04/26/2011	13:38:19		3	14.79	58.62	7.59	275.2	100.7	9.87
CRM 22.0	04/26/2011	13:37:50		4	14.79	58.62	7.60	274.9	100.5	9.84
CRM 22.0	04/26/2011	13:37:16		5	14.82	58.68	7.62	274.7	100.2	9.81
CRM 15.5	05/24/2011	12:12:53	2.65	0.3	16.40	61.52	7.62	285.6	97.0	9.22
CRM 15.5	05/24/2011	12:11:49		1.5	16.20	61.16	7.60	285.6	96.4	9.20
CRM 15.5	05/24/2011	12:11:26		3	16.22	61.20	7.60	285.6	96.1	9.16
CRM 15.5	05/24/2011	12:10:34		4	15.91	60.64	7.58	285.3	94.8	9.11
CRM 15.5	05/24/2011	12:10:03		5	15.78	60.40	7.57	285.3	94.3	9.08
CRM 15.5	05/24/2011	12:09:43		6	15.73	60.31	7.57	285.6	94.0	9.06

Table 33. (Continued)

River Mile	Date	Time (Central)	Secchi (meters)	Depth (meters)	Temp (C)	Temp (F)	pH (SU)	Conductivity (µs/cm)	% DO Saturation	Dissolved Oxygen (mg/L)
CRM 15.5	05/24/2011	12:09:13		6.9	15.68	60.22	7.58	285.4	93.6	9.03
CRM 18.5	05/24/2011	9:41:26	3.75	0.3	16.03	60.85	7.45	285.3	95.9	9.19
CRM 18.5	05/24/2011	9:40:32		1.5	15.60	60.08	7.43	285.2	94.8	9.17
CRM 18.5	05/24/2011	9:39:55		3	15.46	59.83	7.42	285.1	94.4	9.15
CRM 18.5	05/24/2011	9:39:30		4	15.43	59.77	7.41	285.2	94.0	9.12
CRM 18.5	05/24/2011	9:38:59		5	15.39	59.70	7.40	285.0	93.7	9.09
CRM 18.5	05/24/2011	9:38:46		5.4	15.39	59.70	7.40	284.9	93.7	9.10
CRM 19.7	05/23/2011	11:38:37	2.6	0.3	15.75	60.35	7.58	279.5	94.0	9.08
CRM 19.7	05/23/2011	11:38:13		1.5	15.72	60.30	7.58	279.2	93.9	9.08
CRM 19.7	05/23/2011	11:36:37		3	15.71	60.28	7.58	279.4	93.5	9.05
CRM 19.7	05/23/2011	11:37:41		3	15.71	60.28	7.57	279.6	93.7	9.06
CRM 19.7	05/23/2011	11:36:08		4	15.77	60.39	7.59	279.2	93.3	9.02
CRM 19.7	05/23/2011	11:35:42		5	15.74	60.33	7.60	279.5	93.3	9.02
CRM 19.7	05/23/2011	11:35:07		5.2	15.74	60.33	7.63	279.2	93.3	9.02
CRM 22.0	05/23/2011	10:05:03	2.25	0.3	15.65	60.17	7.66	279.5	94.7	9.17
CRM 22.0	05/23/2011	10:04:43		1.5	15.68	60.22	7.61	279.5	94.6	9.16
CRM 22.0	05/23/2011	10:04:13		3	15.62	60.12	7.66	279.6	94.2	9.13
CRM 22.0	05/23/2011	10:03:49		4	15.63	60.13	7.66	279.2	94.0	9.10
CRM 22.0	05/23/2011	10:03:25		5	15.62	60.12	7.66	279.3	93.6	9.07
CRM 22.0	05/23/2011	10:03:01		6	15.60	60.08	7.66	279.3	93.4	9.05
CRM 15.5	06/21/2011	12:35:39	2.85	0.3	22.00	71.60	7.32	262.0	57.3	4.87
CRM 15.5	06/21/2011	12:35:22		1.5	21.97	71.55	7.29	261.4	57.1	4.86
CRM 15.5	06/21/2011	12:35:00		3	21.93	71.47	7.26	261.5	57.0	4.85
CRM 15.5	06/21/2011	12:34:40		4	21.94	71.49	7.24	261.5	56.5	4.81
CRM 15.5	06/21/2011	12:34:16		5	21.89	71.40	7.21	261.4	56.2	4.78
CRM 15.5	06/21/2011	12:33:42		6	21.91	71.44	7.19	261.2	55.6	4.73
CRM 15.5	06/21/2011	12:33:22		6.87	21.88	71.38	7.15	261.3	55.9	4.76
CRM 18.5	06/21/2011	10:52:18	3.15	0.3	22.04	71.67	7.52	260.6	69.3	5.89
CRM 18.5	06/21/2011	10:51:50		1.5	21.99	71.58	7.50	261.2	69.0	5.87
CRM 18.5	06/21/2011	10:51:27		3	21.98	71.56	7.47	260.5	68.7	5.84
CRM 18.5	06/21/2011	10:50:47		4	21.98	71.56	7.46	260.5	68.6	5.84
CRM 18.5	06/21/2011	10:50:26		5.1	21.97	71.55	7.44	261.1	68.4	5.82
CRM 19.7	06/20/2011	12:03:06	3.45	0.3	20.63	69.13	7.23	279.4	68.2	5.95
CRM 19.7	06/20/2011	12:02:48		1.5	20.60	69.08	7.22	279.4	68.1	5.94
CRM 19.7	06/20/2011	12:02:19		3	20.63	69.13	7.22	279.1	67.8	5.91
CRM 19.7	06/20/2011	12:01:54		4	20.63	69.13	7.23	279.8	67.8	5.91
CRM 19.7	06/20/2011	12:01:22		5.07	20.62	69.12	7.23	279.6	67.5	5.88
CRM 22.0	06/20/2011	10:13:24	3.2	0.3	20.70	69.26	7.34	278.3	72.2	6.28
CRM 22.0	06/20/2011	10:12:28		1.5	20.66	69.19	7.33	278.3	72.0	6.27
CRM 22.0	06/20/2011	10:11:36		3	20.66	69.19	7.32	278.3	71.8	6.25
CRM 22.0	06/20/2011	10:10:14		4	20.67	69.21	7.29	278.3	71.3	6.21
CRM 22.0	06/20/2011	10:08:05		5	20.69	69.24	7.26	278.0	71.2	6.20
CRM 15.5	07/18/2011	10:58:39	2.9	0.3	22.10	71.78	7.43	265.0	75.2	6.42
CRM 15.5	07/18/2011	10:58:19		1.5	21.22	70.20	7.42	264.6	74.2	6.44
CRM 15.5	07/18/2011	10:57:56		3	21.06	69.91	7.41	264.3	73.6	6.41
CRM 15.5	07/18/2011	10:57:27		4	20.97	69.75	7.37	264.2	71.4	6.23
CRM 15.5	07/18/2011	10:57:00		5	20.96	69.73	7.36	264.4	71.0	6.19
CRM 15.5	07/18/2011	10:56:29		6	21.01	69.82	7.34	264.1	70.8	6.17
CRM 15.5	07/18/2011	10:55:53		6.9	20.93	69.67	7.33	264.2	70.5	6.15
CRM 18.5	07/18/2011	9:21:51	2.6	0.3	21.28	70.30	7.36	264.2	69.1	5.99
CRM 18.5	07/18/2011	9:21:20		1.5	20.99	69.78	7.33	264.0	68.8	6.00
CRM 18.5	07/18/2011	9:20:43		3	20.96	69.73	7.30	263.7	69.7	6.08

Table 33. (Continued)

River Mile	Date	Time (Central)	Secchi (meters)	Depth (meters)	Temp (C)	Temp (F)	pH (SU)	Conductivity (µs/cm)	% DO Saturation	Dissolved Oxygen (mg/L)
CRM 18.5	07/18/2011	9:19:55		4	20.95	69.71	7.26	264.0	68.7	5.99
CRM 18.5	07/18/2011	9:19:22		5	20.91	69.64	7.18	264.0	65.1	5.68
CRM 18.5	07/18/2011	9:18:47		5.3	20.96	69.73	7.07	263.9	60.6	5.29
CRM 19.7	07/19/2011	10:00:04	4.1	0.3	21.15	70.07	7.41	272.0	72.4	6.27
CRM 19.7	07/19/2011	9:59:22		1.5	20.89	69.60	7.38	271.7	71.9	6.25
CRM 19.7	07/19/2011	9:58:28		3	20.82	69.48	7.34	272.4	71.1	6.19
CRM 19.7	07/19/2011	9:57:44		4	20.90	69.62	7.27	272.3	65.7	5.71
CRM 19.7	07/19/2011	9:56:35		4.8	20.89	69.60	7.12	273.2	47.7	4.15
CRM 22.0	07/19/2011	9:01:29	3.65	0.3	20.50	68.90	7.39	274.5	66.5	5.83
CRM 22.0	07/19/2011	9:00:19		1.5	20.31	68.56	7.36	274.2	65.9	5.80
CRM 22.0	07/19/2011	8:59:28		3	20.31	68.56	7.30	274.2	62.3	5.48
CRM 22.0	07/19/2011	8:58:32		4	20.21	68.38	7.20	275.0	50.3	4.43
CRM 22.0	07/19/2011	8:57:44		5	20.22	68.40	7.08	276.2	28.7	2.53
CRM 15.5	09/19/2011	10:52:44	3.5	0.3	20.95	69.71	7.57	243.3	80.2	7.00
CRM 15.5	09/19/2011	10:52:29		1.5	20.75	69.35	7.55	242.8	79.7	6.98
CRM 15.5	09/19/2011	10:52:05		3	20.71	69.28	7.54	243.0	79.1	6.93
CRM 15.5	09/19/2011	10:51:42		4	20.69	69.24	7.52	243.3	78.2	6.86
CRM 15.5	09/19/2011	10:51:24		5	20.67	69.21	7.50	243.5	77.9	6.83
CRM 15.5	09/19/2011	10:51:04		6	20.68	69.22	7.48	242.9	77.9	6.83
CRM 15.5	09/19/2011	10:50:32		6.23	20.69	69.24	7.41	242.9	78.1	6.85
CRM 18.5	09/19/2011	10:16:47	4	0.3	20.39	68.70	7.42	243.1	69.7	6.15
CRM 18.5	09/19/2011	10:16:28		1.5	20.31	68.56	7.42	242.9	69.1	6.11
CRM 18.5	09/19/2011	10:16:08		3	20.29	68.52	7.41	243.0	69.1	6.11
CRM 18.5	09/19/2011	10:15:50		4	20.25	68.45	7.39	243.1	68.7	6.07
CRM 18.5	09/19/2011	10:15:35		4.8	20.25	68.45	7.37	243.1	68.7	6.07
CRM 19.7	09/19/2011	9:38:46	3.9	0.3	20.39	68.70	7.57	242.0	74.4	6.56
CRM 19.7	09/19/2011	9:38:29		1.5	20.35	68.63	7.57	242.1	74.4	6.57
CRM 19.7	09/19/2011	9:38:02		3	20.26	68.47	7.57	241.7	73.5	6.51
CRM 19.7	09/19/2011	9:37:41		4	20.25	68.45	7.56	242.0	73.3	6.48
CRM 19.7	09/19/2011	9:36:53		4.71	20.25	68.45	7.56	241.8	72.7	6.43
CRM 22.0	09/19/2011	8:50:39	4.7	0.3	20.27	68.49	7.45	240.6	62.9	5.56
CRM 22.0	09/19/2011	8:50:16		1.5	20.25	68.45	7.44	240.5	62.9	5.56
CRM 22.0	09/19/2011	8:49:33		3	20.21	68.38	7.46	240.6	63.8	5.64
CRM 22.0	09/19/2011	8:49:04		4	20.21	68.38	7.43	240.6	62.2	5.50
CRM 22.0	09/19/2011	8:48:17		5.03	20.20	68.36	7.37	241.1	59.1	5.24
CRM 15.5	10/11/2011	11:02:38	4.75	0.3	18.18	64.72	7.60	282.2	88.5	8.13
CRM 15.5	10/11/2011	11:02:24		1.5	18.16	64.69	7.60	282.2	88.4	8.12
CRM 15.5	10/11/2011	11:01:58		3	18.08	64.54	7.58	282.0	87.9	8.09
CRM 15.5	10/11/2011	11:01:41		4	18.07	64.53	7.57	282.0	87.8	8.08
CRM 15.5	10/11/2011	11:01:14		5	18.07	64.53	7.54	281.9	87.7	8.07
CRM 15.5	10/11/2011	11:00:55		6	18.07	64.53	7.50	282.1	87.6	8.06
CRM 15.5	10/11/2011	11:00:38		6.72	18.07	64.53	7.44	282.8	87.8	8.08
CRM 18.5	10/11/2011	10:24:34	5.2	0.3	18.17	64.71	7.64	281.6	91.1	8.37
CRM 18.5	10/11/2011	10:24:19		1.5	18.13	64.63	7.63	281.6	90.8	8.35
CRM 18.5	10/11/2011	10:23:58		3	18.11	64.60	7.62	281.6	90.5	8.33
CRM 18.5	10/11/2011	10:23:28		4	18.09	64.56	7.59	281.5	90.1	8.29
CRM 18.5	10/11/2011	10:23:05		5	18.08	64.54	7.56	281.5	90.0	8.28
CRM 18.5	10/11/2011	10:22:45		5.5	18.08	64.54	7.52	281.5	90.2	8.30
CRM 19.7	10/11/2011	9:54:27	5.5	0.3	17.96	64.33	7.54	282.4	83.7	7.73
CRM 19.7	10/11/2011	9:54:15		1.5	17.90	64.22	7.51	282.4	83.5	7.71
CRM 19.7	10/11/2011	9:53:38		3	17.89	64.20	7.48	282.5	82.4	7.61
CRM 19.7	10/11/2011	9:53:23		4	17.88	64.18	7.45	282.4	81.9	7.57

Table 33. (Continued)

River Mile	Date	Time (Central)	Secchi (meters)	Depth (meters)	Temp (C)	Temp (F)	pH (SU)	Conductivity (µs/cm)	% DO Saturation	Dissolved Oxygen (mg/L)
CRM 19.7	10/11/2011	9:53:04		4.97	17.87	64.17	7.41	282.2	81.8	7.56
CRM 22.0	10/11/2011	9:02:31	6.15	0.3	17.63	63.73	7.46	282.7	69.7	6.48
CRM 22.0	10/11/2011	9:02:05		1.5	17.60	63.68	7.46	283.8	69.6	6.47
CRM 22.0	10/11/2011	9:01:33		3	17.59	63.66	7.44	282.7	68.5	6.37
CRM 22.0	10/11/2011	9:01:13		4	17.59	63.66	7.45	282.8	66.7	6.20
CRM 22.0	10/11/2011	9:00:41		5.03	17.59	63.66	7.44	283.2	66.5	6.18
CRM 15.5	11/10/2011	13:19:36	4	0.3	14.40	57.92	7.85	296.6	80.2	8.00
CRM 15.5	11/10/2011	13:19:14		1.5	14.40	57.92	7.84	295.9	80.1	7.99
CRM 15.5	11/10/2011	13:18:43		3	14.39	57.90	7.82	296.1	80.3	8.02
CRM 15.5	11/10/2011	13:18:22		4	14.39	57.90	7.76	295.8	80.2	8.01
CRM 15.5	11/10/2011	13:17:56		5	14.39	57.90	7.71	295.7	80.4	8.03
CRM 15.5	11/10/2011	13:17:41		5.75	14.38	57.88	7.61	295.9	80.5	8.04
CRM 18.5	11/10/2011	12:37:22	4.5	0.3	14.47	58.05	7.83	295.8	80.8	8.06
CRM 18.5	11/10/2011	12:36:58		1.5	14.46	58.03	7.81	295.6	80.9	8.07
CRM 18.5	11/10/2011	12:36:38		3	14.45	58.01	7.80	295.4	81.0	8.08
CRM 18.5	11/10/2011	12:36:22		4	14.45	58.01	7.78	295.8	80.9	8.07
CRM 18.5	11/10/2011	12:35:58		4.67	14.45	58.01	7.76	295.5	81.1	8.09
CRM 19.7	11/10/2011	11:30:49	4.75	0.3	14.43	57.97	7.84	295.9	79.6	7.94
CRM 19.7	11/10/2011	11:30:30		1.5	14.41	57.94	7.82	295.8	79.5	7.94
CRM 19.7	11/10/2011	11:29:46		3	14.41	57.94	7.79	295.4	79.7	7.95
CRM 19.7	11/10/2011	11:29:30		4	14.41	57.94	7.78	295.8	79.8	7.96
CRM 19.7	11/10/2011	11:29:10		4.12	14.41	57.94	7.65	295.4	80.0	7.99
CRM 22.0	11/10/2011	10:42:12	3.5	0.3	14.40	57.92	7.82	295.4	79.0	7.88
CRM 22.0	11/10/2011	10:41:46		1.5	14.40	57.92	7.81	295.4	78.9	7.87
CRM 22.0	11/10/2011	10:40:58		3	14.38	57.88	7.76	295.4	79.0	7.89
CRM 22.0	11/10/2011	10:40:30		4	14.37	57.87	7.73	295.3	79.1	7.90
CRM 22.0	11/10/2011	10:40:08		4.5	14.37	57.87	7.67	296.2	78.9	7.88
CRM 15.5	12/13/2011	11:38:47	2.25	0.3	11.69	53.04	8.10	272.6	88.5	9.51
CRM 15.5	12/13/2011	11:38:33		1.5	11.69	53.04	8.09	267.7	88.5	9.51
CRM 15.5	12/13/2011	11:38:07		3	11.69	53.04	8.04	268.0	88.5	9.51
CRM 15.5	12/13/2011	11:37:47		4	11.69	53.04	8.08	267.3	88.5	9.50
CRM 15.5	12/13/2011	11:37:35		5	11.69	53.04	7.96	267.8	88.3	9.48
CRM 15.5	12/13/2011	11:36:40		7.27	11.69	53.04	7.92	267.7	88.0	9.46
CRM 18.5	12/13/2011	12:29:23	2.25	0.3	11.74	53.13	8.04	267.9	88.5	9.50
CRM 18.5	12/13/2011	12:28:53		1.5	11.73	53.11	8.06	268.1	88.8	9.53
CRM 18.5	12/13/2011	12:28:16		3	11.74	53.13	7.96	267.2	88.8	9.53
CRM 18.5	12/13/2011	12:27:54		4	11.73	53.11	7.88	267.7	88.5	9.50
CRM 18.5	12/13/2011	12:27:32		4.98	11.73	53.11	7.70	267.4	88.9	9.54
CRM 19.7	12/13/2011	10:37:22	2.25	0.3	11.69	53.04	8.06	267.4	88.4	9.50
CRM 19.7	12/13/2011	10:37:06		1.5	11.69	53.04	8.06	268.2	88.1	9.47
CRM 19.7	12/13/2011	10:36:41		3	11.69	53.04	8.03	268.0	88.1	9.47
CRM 19.7	12/13/2011	10:36:17		4	11.69	53.04	7.96	267.9	88.4	9.50
CRM 19.7	12/13/2011	10:35:48		5	11.69	53.04	7.92	268.0	88.3	9.48
CRM 19.7	12/13/2011	10:35:17		5.48	11.69	53.04	7.90	267.9	88.1	9.47
CRM 22.0	12/13/2011	9:45:11	1.95	0.3	11.69	53.04	8.05	267.9	88.7	9.53
CRM 22.0	12/13/2011	9:44:46		1.5	11.69	53.04	8.05	268.5	88.9	9.55
CRM 22.0	12/13/2011	9:44:23		3	11.69	53.04	8.04	267.4	88.9	9.55
CRM 22.0	12/13/2011	9:44:04		4	11.69	53.04	8.01	267.7	88.7	9.53
CRM 22.0	12/13/2011	9:43:40		5	11.69	53.04	7.99	267.5	88.6	9.52
CRM 22.0	12/13/2011	9:43:10		5.89	11.69	53.04	8.01	267.5	88.2	9.48

Table 34. Range in measurements of water temperature, dissolved oxygen, pH, and conductivity across all monitoring locations (CRMs 15.5, 18.5, 19.8, and 22.0) each month during March through December 2011.

Month	Temperature (F)			Dissolved Oxygen (mg/L)			pH (stand. units)			Conductivity (µS/cm)		
	Min	Max	Diff	Min	Max	Diff	Min	Max	Diff	Min	Max	Diff
March	49.7	50.3	0.7	11.3	11.8	0.6	7.7	7.8	0.1	294	302	7.7
April	58.3	58.7	0.5	9.5	9.9	0.4	7.5	7.6	0.1	274	275	1.6
May	59.7	61.5	1.8	9.0	9.2	0.2	7.4	7.7	0.3	279	286	6.4
June	69.1	71.7	2.6	4.7	6.3	1.6	7.2	7.5	0.4	261	280	19.3
July	68.4	71.8	3.4	2.5	6.4	3.9	7.1	7.4	0.4	264	276	12.5
August*	---	---	---	---	---	---	---	---	---	---	---	---
September	68.4	69.7	1.4	5.2	7.0	1.8	7.4	7.6	0.2	241	244	3.0
October	63.7	64.7	1.1	6.2	8.4	2.2	7.4	7.6	0.2	282	284	2.3
November	57.9	58.0	0.2	7.9	8.1	0.2	7.6	7.9	0.2	295	297	1.3
December	53.0	53.1	0.1	9.5	9.6	0.1	7.7	8.1	0.4	267	273	5.4
10-Month Period	49.7	71.8	22.1	2.5	11.8	9.3	7.1	8.1	1	241	302	61

**An instrument malfunction in August resulted in the loss of in situ measurements.*

Table 35. Summary of water column profiles of temperature, DO, pH, and conductivity measured monthly, March through December 2011, at CRM 15.5, 18.5, 19.7, and 22.0.

Month Day	Temperature (F)				DO (mg/L)				pH (stand. units)				Conductivity (µS/cm)			
	Clinch River Mile				Clinch River Mile				Clinch River Mile				Clinch River Mile			
Depth (m)	15.5	18.5	19.7	22.0	15.5	18.5	19.7	22.0	15.5	18.5	19.7	22.0	15.5	18.5	19.7	22.0
March 24-25																
0.3	50.3	50.3	50.0	49.7	11.6	11.8	11.4	11.4	7.7	7.7	7.8	7.8	294	295	301	300
1.5	50.3	50.3	49.9	49.7	11.5	11.8	11.3	11.4	7.7	7.7	7.7	7.8	294	294	302	301
3	50.2	50.3	49.9	49.7	11.5	11.8	11.3	11.3	7.7	7.8	7.7	7.8	294	295	301	300
4	50.3	50.3	49.9	49.7	11.5	11.8	11.3	11.3	7.7	7.7	7.7	7.8	295	295	301	300
4.5		50.3				11.7				7.8				294		
5	50.2			49.7	11.5			11.3	7.7			7.8	295			301
6	50.2				11.5				7.7				294			
Difference*	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	1	1	1	1
Average	50.2	50.3	50.0	49.7	11.5	11.8	11.3	11.3	7.7	7.7	7.7	7.8	294	294	301	300
April 26																
0.3	58.6	58.4	58.7	58.6	9.6	9.6	9.8	9.9	7.5	7.5	7.6	7.6	274	275	275	275
1.5	58.6	58.3	58.7	58.6	9.5	9.6	9.8	9.9	7.5	7.5	7.6	7.6	274	275	275	275
2			58.7	58.6			9.8	9.9			7.6	7.6			275	275
3	58.6	58.3	58.7	58.6	9.5	9.6	9.8	9.9	7.5	7.5	7.6	7.6	274	275	275	275
4	58.6	58.3	58.7	58.6	9.5	9.6	9.7	9.8	7.5	7.5	7.6	7.6	274	275	275	275
5	58.6	58.3	58.7	58.7	9.5	9.6	9.7	9.8	7.5	7.5	7.6	7.6	274	275	275	275
6	58.6				9.5				7.5				274			
Difference*	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0	0	0	1
Average	58.6	58.3	58.7	58.6	9.5	9.6	9.8	9.9	7.5	7.5	7.6	7.6	274	275	275	275
May 23-24																
0.3	61.5	60.9	60.4	60.2	9.2	9.2	9.1	9.2	7.6	7.5	7.6	7.7	286	285	280	280
1.5	61.2	60.1	60.3	60.2	9.2	9.2	9.1	9.2	7.6	7.4	7.6	7.6	286	285	279	280
3	61.2	59.8	60.3	60.1	9.2	9.2	9.1	9.1	7.6	7.4	7.6	7.7	286	285	280	280
4	60.6	59.8	60.4	60.1	9.1	9.1	9.0	9.1	7.6	7.4	7.6	7.7	285	285	279	279
5	60.4	59.7	60.3	60.1	9.1	9.1	9.0	9.1	7.6	7.4	7.6	7.7	285	285	280	279
5.5		59.7				9.1				7.4				285		
6	60.3			60.1	9.1			9.1	7.6			7.7	286			279
7	60.2				9.0				7.6				285			
Difference*	1.3	1.2	0.1	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0	0	0	0
Average	60.8	60.0	60.3	60.1	9.1	9.1	9.1	9.1	7.6	7.4	7.6	7.7	285	285	279	279
June 20-21																
0.3	71.6	71.7	69.1	69.3	4.9	5.9	6.0	6.3	7.3	7.5	7.2	7.3	262	261	279	278
1.5	71.5	71.6	69.1	69.2	4.9	5.9	5.9	6.3	7.3	7.5	7.2	7.3	261	261	279	278
3	71.5	71.6	69.1	69.2	4.9	5.8	5.9	6.3	7.3	7.5	7.2	7.3	262	261	279	278
4	71.5	71.6	69.1	69.2	4.8	5.8	5.9	6.2	7.2	7.5	7.2	7.3	262	261	280	278
5	71.4	71.5	69.1	69.2	4.8	5.8	5.9	6.2	7.2	7.4	7.2	7.3	261	261	280	278
6	71.4				4.7				7.2				261			
7	71.4				4.8				7.2				261			
Difference*	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.0	0.1	1	1	1	0
Average	71.5	71.6	69.1	69.2	4.8	5.9	5.9	6.2	7.2	7.5	7.2	7.3	261	261	279	278

Table 35. (continued)

	Temperature (F)				DO (mg/L)				pH (stand. units)				Conductivity (µS/cm)			
Month Day	**Clinch River Mile**				**Clinch River Mile**				**Clinch River Mile**				**Clinch River Mile**			
Depth (m)	**15.5**	**18.5**	**19.7**	**22.0**	**15.5**	**18.5**	**19.7**	**22.0**	**15.5**	**18.5**	**19.7**	**22.0**	**15.5**	**18.5**	**19.7**	**22.0**
July 18-19																
0.3	71.8	70.3	70.1	68.9	6.4	6.0	6.3	5.8	7.4	7.4	7.4	7.4	265	264	272	275
1.5	70.2	69.8	69.6	68.6	6.4	6.0	6.3	5.8	7.4	7.3	7.4	7.4	265	264	272	274
3	69.9	69.7	69.5	68.6	6.4	6.1	6.2	5.5	7.4	7.3	7.3	7.3	264	264	272	274
4	69.7	69.7	69.6	68.4	6.2	6.0	5.7	4.4	7.4	7.3	7.3	7.2	264	264	272	275
5	69.7	69.6	69.6	68.4	6.2	5.7	4.2	2.5	7.4	7.2	7.1	7.1	264	264	273	276
5.5		69.7				5.3				7.1				264		
6	69.8				6.2				7.3				264			
7	69.7				6.2				7.3				264			
Difference*	2.1	0.7	0.6	0.5	0.3	0.8	2.1	3.3	0.1	0.3	0.3	0.3	1	1	2	2
Average	70.1	69.8	69.7	68.6	6.3	5.8	5.7	4.8	7.4	7.3	7.3	7.3	264	264	272	275
September 19																
0.3	69.7	68.7	68.7	68.5	7.0	6.2	6.6	5.6	7.6	7.4	7.6	7.5	243	243	242	241
1.5	69.4	68.6	68.6	68.5	7.0	6.1	6.6	5.6	7.6	7.4	7.6	7.4	243	243	242	241
3	69.3	68.5	68.5	68.4	6.9	6.1	6.5	5.6	7.5	7.4	7.6	7.5	243	243	242	241
4	69.2	68.5	68.5	68.4	6.9	6.1	6.5	5.5	7.5	7.4	7.6	7.4	243	243	242	241
4.5			68.5				6.4				7.6				242	
5	69.2	68.5		68.4	6.8	6.1		5.2	7.5	7.4		7.4	244	243		241
6	69.2				6.9				7.5				243			
Difference*	0.5	0.3	0.3	0.1	0.2	0.1	0.1	0.4	0.1	0.0	0.0	0.1	1	0	0	1
Average	69.3	68.5	68.5	68.4	6.9	6.1	6.5	5.5	7.5	7.4	7.6	7.4	243	243	242	241
October 11																
0.3	64.7	64.7	64.3	63.7	8.1	8.4	7.7	6.5	7.6	7.6	7.5	7.5	282	282	282	283
1.5	64.7	64.6	64.2	63.7	8.1	8.4	7.7	6.5	7.6	7.6	7.5	7.5	282	282	282	284
3	64.5	64.6	64.2	63.7	8.1	8.3	7.6	6.4	7.6	7.6	7.5	7.4	282	282	283	283
4	64.5	64.6	64.2	63.7	8.1	8.3	7.6	6.2	7.6	7.6	7.5	7.5	282	282	282	283
5	64.5	64.5	64.2	63.7	8.1	8.3	7.6	6.2	7.5	7.6	7.4	7.4	282	282	282	283
5.5		64.5				8.3				7.5				282		
6	64.5				8.1				7.5				282			
6.5	64.5				8.1				7.4				283			
Difference*	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.3	0.2	0.1	0.1	0.0	1	0	0	1
Average	64.6	64.6	64.2	63.7	8.1	8.3	7.6	6.3	7.5	7.6	7.5	7.5	282	282	282	283
November 10																
0.3	57.9	58.0	58.0	57.9	8.0	8.1	7.9	7.9	7.9	7.8	7.8	7.8	297	296	296	295
1.5	57.9	58.0	57.9	57.9	8.0	8.1	7.9	7.9	7.8	7.8	7.8	7.8	296	296	296	295
3	57.9	58.0	57.9	57.9	8.0	8.1	8.0	7.9	7.8	7.8	7.8	7.8	296	295	295	295
4	57.9	58.0	57.9	57.9	8.0	8.1	8.0	7.9	7.8	7.8	7.8	7.7	296	296	296	295
4.5		58.0		57.9		8.1		7.9		7.8		7.7		296		296
5	57.9				8.0				7.7				296			
6	57.9				8.0				7.6				296			
Difference*	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.2	1	0	1	1
Average	57.91	58.02	57.95	57.89	8.02	8.07	7.96	7.88	7.77	7.80	7.81	7.76	296	296	296	296

Table 35. (continued)

Month Day Depth (m)	Temperature (F) Clinch River Mile 15.5	18.5	19.7	22.0	DO (mg/L) Clinch River Mile 15.5	18.5	19.7	22.0	pH (stand. units) Clinch River Mile 15.5	18.5	19.7	22.0	Conductivity (µS/cm) Clinch River Mile 15.5	18.5	19.7	22.0
December 13																
0.3	53.0	53.1	53.0	53.0	9.5	9.5	9.5	9.5	8.1	8.0	8.1	8.1	273	268	267	268
1.5	53.0	53.1	53.0	53.0	9.5	9.5	9.5	9.6	8.1	8.1	8.1	8.1	268	268	268	269
3	53.0	53.1	53.0	53.0	9.5	9.5	9.5	9.6	8.0	8.0	8.0	8.0	268	267	268	267
4	53.0	53.1	53.0	53.0	9.5	9.5	9.5	9.5	8.1	7.9	8.0	8.0	267	268	268	268
5	53.0	53.1	53.0	53.0	9.5	9.5	9.5	9.5	8.0	7.7	7.9	8.0	268	267	268	268
5.5			53.0				9.5				7.9				268	
6				53.0				9.5				8.0				268
7	53.0				9.5				7.9				268			
Difference*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4	0.2	0.1	5	1	1	1
Average	53.04	53.12	53.04	53.04	9.50	9.52	9.48	9.53	8.03	7.93	7.99	8.03	269	268	268	268

**Difference is the extent between the maximum and minimum values for a parameter as measured throughout the water column at a given location.*
Temperature, DO, pH, and Depth were rounded to the nearest 10th.
Conductivity was rounded to nearest whole number.
Primary data are provided in Table35.

Table 36. Dissolved oxygen concentrations (mg/L) in the forebay (CRM 24.0) and tailrace (CRM 23.1) of Melton Hill Reservoir, March through September 2011.

Melton Hill Forebay	March			April		May		June		July		August		September		
Depth (m)	3	16	31	14	25	11	23	8	20	5	20	1	15	1	13	26
0.3	9.9	11.3	10.6	12.4	12.2	12.1	10.8	9.4	10.2	13.6	12.3	11.7	10.8	10.1	12.7	14.4
1.5	9.8	11.3	10.6	11.9	11.5	11.8	9.9	9.7	10.4	13.5	13.5	12.3	11.1	10.3	12.4	14.2
4	9.8	11.3	10.5	10.9	9.8	10.0	9.6	13.8	9.2	5.0	6.1	7.0	7.8	9.3	7.6	5.9
5		11.3	10.5			9.6	9.3	12.6	7.4	5.0	5.1			8.8	6.1	5.6
6	9.8			10.1	9.7		9.3	10.6	6.3		5.3	6.8	7.3	8.4	5.9	
7		11.2	10.5			9.4		9.0	5.7	6.0		6.8		7.6		5.4
8	9.8			9.6	9.7		9.1	8.2	5.1		5.6		7.1	7.3	5.6	
9		11.2	10.5			9.1		7.3	5.1	6.5		6.8				5.3
10	9.7			9.4	9.7		9.1				5.7		7.0	6.7	5.4	
11		11.1	10.4			8.9		7.2	5.1	6.6		6.8				5.3
12	9.7			9.2	9.6		9.0				6.0		6.9	6.5	5.2	
13		11.1	10.4			8.8		7.3	5.1	6.6		6.9				5.3
14	9.7			9.2	9.7		9.0				6.0		6.9	6.0	4.9	
15		11.1	10.4			8.7		7.2	5.5	6.6		6.8				5.2
16	9.6			9.1	9.7		8.9		5.4		6.0		6.7	5.8	4.7	
17		11.0	10.3			8.5		6.7	4.5	6.5		6.8				5.1
18	9.6	11.0		9.0	9.6		8.9				5.7		6.4	5.6	4.1	
18.5							8.8				5.7		6.5			
19				8.9	9.5	8.0	8.8	6.2	4.0	6.4		6.7			3.7	5.0
19.5									4.0			6.7		4.8		
Average Water Column DO Concentration	9.7	11.2	10.5	10.0	10.1	9.4	9.3	8.7	6.2	7.4	6.9	7.7	7.7	7.5	6.5	7.0
Melton Hill Tailrace DO Concentration						9.7	9.3	8.5	6.5	7.1		8.1	7.8		7.1	

Table 37. Analytical results for standard water quality parameters and chlorophyll a in samples collected monthly, March through December 2011, at Clinch River Miles (CRM) 15.5, 18.5, 19.7 and 22.0.

		Parameter	Alkalinity	Ammonia Nitrogen	Dissolved Solids	Hardness, Total (as CaCO3)	Kjeldahl Nitrogen, TKN	Nitrate-Nitrite	Phosphate,Ortho	Phosphorus,Total	Suspended Solids	Total Organic Carbon	Turbidity	Apparent Chlorophyll a	Corrected Chlorophyll a	Corrected Phaeo a
		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	µg/L	µg/L	µg/L
		Reporting Limit	20	0.1	10	30	0.1	0.1	0.025	0.003	1.0	1.0	0.1	1.0	1.0	1.0
Location	QC	Date														
CRM 15.5		03/24/2011	120	<0.10	170	*NM*	<0.10	0.48	<0.025	0.005	2.8	1.4	4.9	1.0	<1.0	<1.0
		04/26/2011	120	<0.10	170	140	0.14	0.52	<0.025	0.010	6.5	3.6	7.5	2.0	1.0	1.4
		05/24/2011	110	---	170	140	0.41	0.6	<0.025	0.006	2.9	1.4	2.7	2.0	1.0	<1.0
		06/21/2011	110	0.17	160	140	0.33	0.47	<0.025	0.029	3.0	2.6	4.9	<1.0	<1.0	2.0
		07/18/2011	100	0.13	200	140	0.44	0.51	<0.025	0.015	3.4	1.3	4.0	2.0	1.0	<1.0
	T1	08/22/2011	100	0.11	200	140	0.49	0.58	<0.025	0.018	1.9	1.2	1.8	1.0	<1.0	<1.0
	T2	08/22/2011	110	<0.10	190	140	0.36	0.58	<0.025	0.016	2.0	1.2	1.9	2.0	<1.0	1.3
	T3	08/22/2011	110	<0.10	190	140	0.36	0.59	<0.025	0.016	2.4	1.2	2.1	2.0	1.0	1.2
		09/19/2011	95	0.11	160	140	0.37	0.49	<0.025	0.022	2.0	2.5	0.7	2.0	1.0	<1.0
		10/11/2011	110	0.16	160	150	0.38	0.35	<0.025	0.005	1.5	3.5	1.5	1.0	<1.0	<1.0
		11/10/2011	110	---	160	160	0.79	0.36	<0.025	0.010	2.2	3.2	3.5	1.0	1.0	<1.0
		12/13/2011	110	0.11	170	150	<0.10	0.56	<0.025	0.010	4.0	2.8	6.4	1.0	<1.0	<1.0
CRM 18.5		03/24/2011	130	0.15	170	*NM*	0.18	0.48	<0.025	0.012	8.4	1.5	12.0	2.0	1.0	1.4
		04/26/2011	120	<0.10	170	140	0.14	0.53	<0.025	0.006	11.0	3.3	8.0	2.0	2.0	<1.0
	T1	05/24/2011	110	<0.10	170	140	0.13	0.61	<0.025	0.005	1.8	1.4	1.6	1.0	1.0	<1.0
	T2	05/24/2011	110	0.11	150	140	0.13	0.61	<0.025	0.005	1.5	1.3	1.3	1.0	<1.0	<1.0
	T3	05/24/2011	110	<0.10	160	140	0.20	0.61	<0.025	<0.003	1.6	1.4	1.6	1.0	<1.0	<1.0
		06/21/2011	110	0.11	170	140	0.31	0.44	<0.025	0.018	2.5	1.4	3.4	1.0	<1.0	<1.0
		07/18/2011	100	---	200	140	0.71	0.53	<0.025	0.048	2.5	1.6	2.1	2.0	1.0	<1.0
		08/22/2011	110	0.14	190	140	0.42	0.61	<0.025	0.020	2.8	1.2	2.2	2.0	1.0	1.2
		09/19/2011	97	<0.10	160	130	0.34	0.54	<0.025	0.027	1.5	2.6	0.6	1.0	<1.0	<1.0
		10/11/2011	110	<0.10	160	150	0.31	0.34	<0.025	0.005	1.5	1.8	1.6	2.0	1.0	<1.0
		11/10/2011	120	0.12	160	150	0.25	0.35	<0.025	0.008	1.1	3.1	2.6	1.0	<1.0	<1.0
		12/13/2011	110	<0.10	180	140	<0.10	0.54	<0.025	0.010	3.5	2.2	9.8	<1.0	<1.0	<1.0

Table 37. (Continued)

Parameter			Alkalinity	Ammonia Nitrogen	Dissolved Solids	Hardness, Total (as CaCO3)	Kjeldahl Nitrogen, TKN	Nitrate-Nitrite	Phosphate,Ortho	Phosphorus,Total	Suspended Solids	Total Organic Carbon	Turbidity	Apparent Chlorophyll a	Corrected Chlorophyll a	Corrected Phaeo a
Units			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	µg/L	µg/L	µg/L
Reporting Limit			20	0.1	10	30	0.1	0.1	0.025	0.003	1.0	1.0	0.1	1.0	1.0	1.0
Location	**QC**	**Date**														
CRM 19.7		03/25/2011	130	<0.10	170	*NM*	<0.10	0.7	<0.025	<0.003	2.5	1.3	2.9	<1.0	<1.0	<1.0
		04/26/2011	120	<0.10	180	140	0.31	0.52	<0.025	<0.003	2.8	3.1	2.9	2.0	2.0	<1.0
		05/23/2011	110	---	170	140	0.12	0.5	<0.025	0.006	3.0	1.4	3.3	3.0	<1.0	6.5
		06/20/2011	100	0.17	160	140	<0.10	0.5	<0.025	0.010	3.4	1.8	2.9	2.0	2.0	<1.0
		07/19/2011	100	0.14	180	140	0.27	0.54	<0.025	0.021	1.2	1.4	1.7	1.0	1.0	<1.0
		08/22/2011	110	0.19	200	140	0.38	0.6	<0.025	0.030	4.5	1.2	5.6	3.0	2.0	2.3
		09/19/2011	97	<0.10	160	130	0.37	0.51	<0.025	0.024	1.7	2.7	0.7	2.0	1.0	<1.0
		10/11/2011	110	<0.10	170	150	0.35	0.36	<0.025	0.007	1.1	1.8	1.1	1.0	2.0	<1.0
		11/10/2011	110	0.11	160	150	0.28	0.34	<0.025	0.012	1.1	3.0	3.6	<1.0	<1.0	<1.0
		12/13/2011	110	<0.10	160	140	0.11	0.53	<0.025	0.011	3.1	2.0	7.5	1.0	<1.0	1.2
CRM 22.0		03/25/2011	130	<0.10	170	*NM*	0.11	0.66	<0.025	0.004	3.1	1.4	3.8	1.0	<1.0	<1.0
		04/26/2011	120	<0.10	170	140	0.38	0.53	<0.025	<0.003	2.2	2.9	2.8	2.0	2.0	<1.0
		05/23/2011	110	<0.10	170	130	0.15	0.49	<0.025	0.010	3.2	1.4	5.0	4.0	3.0	1.3
		06/20/2011	100	0.12	170	140	0.19	0.49	<0.025	0.010	2.0	2.1	2.1	2.0	2.0	<1.0
		07/19/2011	110	0.12	190	140	0.25	0.58	<0.025	0.015	1.9	1.3	2.1	2.0	1.0	<1.0
		08/22/2011	110	<0.10	200	150	0.34	0.57	<0.025	0.027	4.3	1.2	4.9	5.0	5.0	1.3
		09/19/2011	96	0.11	160	130	0.41	0.52	<0.025	0.032	1.8	2.8	2.1	<1.0	<1.0	<1.0
		10/11/2011	110	<0.10	170	150	0.40	0.39	<0.025	0.014	1.2	2.4	1.1	1.0	1.0	<1.0
		11/10/2011	110	0.11	160	150	0.22	0.35	<0.025	0.018	1.2	2.6	1.9	1.0	1.0	<1.0
		12/13/2011	110	<0.10	170	150	0.14	0.52	<0.025	0.008	3.6	2.8	7.8	1.0	1.0	<1.0
Container Blank		05/25/2011	<20	<0.10	<10	<30	<0.10	<0.10	<0.025	<0.003	<1.0	<1.0	<0.1	*NM*	*NM*	*NM*
Container Blank		08/23/2011	<20	<0.10	<10	<30	<0.10	<0.10	<0.025	<0.003	<1.0	<1.0	0.2	*NM*	*NM*	*NM*

T1, T2, and T3 are Triplicate Samples that are three distinct samples, each collected separately and in the same manner.

Container Blanks are sample containers filled with deionized (DI) water directly from the DI system.

NM = Not Measured. Symbol (---) = Non-reportable results.

Table 38. Summary of analytical results.

Summary	Alkalinity	Ammonia Nitrogen	Dissolved Solids	Hardness, Total (CaCO3)	Kjeldahl Nitrogen, TKN	Nitrate-Nitrite	Phosphate,Ortho	Phosphorus,Total	Suspended Solids	Total Organic Carbon	Turbidity	Apparent Chlorophyll A	Corrected Chlorophyll A	Corrected Phaeo A
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	µg/L	µg/L	µg/L
Reporting Limit	20	0.1	10	30	0.1	0.1	0.025	0.003	1.0	1.0	0.1	1.0	1.0	1.0
Number of Results	40	36	40	36	40	40	40	40	40	40	40	40	40	40
Minimum Value	95	<0.10	160	130	<0.10	0.34	<0.025	<0.003	1.1	1.2	0.6	<1	<1	<1
Maximum Value	130	0.19	200	160	0.79	0.7	<0.025	0.048	11.0	3.6	12.0	5.0	5.0	6.5
Average	110.4	0.12	172	142.2	0.28	0.50	<0.025	0.014	2.89	2.11	3.69	1.68	1.33	1.25
Standard Error	± 1.4	± 0.00	± 2.0	± 1.1	± 0.03	± 0.01	NA	± 0.002	± 0.3	± 0.1	± 0.4	± 0.1	± 0.1	

Table 39. Concentrations of total and dissolved metals in water samples collected bi-monthly, April through December 2011, at Clinch River Miles (CRM) 15.5, 18.5, 19.7 and 22.0.

			Metals, Total and Dissolved (µg/L)																								
			Aluminum	Aluminum, Dissolved	Arsenic	Arsenic, Dissolved	Cadmium	Cadmium, Dissolved	Calcium	Chromium	Chromium, Dissolved	Copper	Copper, Dissolved	Iron	Iron, Dissolved	Lead	Lead, Dissolved	Magnesium	Magnesium, Dissolved	Manganese	Manganese, Dissolved	Nickel	Nickel, Dissolved	Selenium	Selenium, Dissolved	Zinc	Zinc, Dissolved
			Method Reporting Limit																										
Location	**QC**	**Date**	**100**	**100**	**1.0**	**1.0**	**0.5**	**0.5**	**500**	**2.0**	**2.0**	**2.0**	**1.0/2.0**	**100**	**100**	**1.0**	**1.0**	**100**	**100**	**10**	**10**	**1.0**	**1.0**	**1.0**	**1.0**	**10**	**10**
CRM 15.5		04/26/2011	800	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	<1.0	610	<100	<1.0	<1.0	11000	9900	58	<10	1.3	2.5 *DT*	<1.0	<1.0	<10	<10
		06/21/2011	290	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	2.2 *DT*	170	<100	8.6	<1.0	10000	11000	29	10	1.0	<1.0	<1.0	<1.0	<10	<10
	T1	08/22/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	<100	<100	<1.0	<1.0	10000	10000	33	<10	3.1	<1.0	<1.0	<1.0	<10	<10
	T2	08/22/2011	<100	<100	1.1	<1.0	<0.5	<0.5	37000	<2.0	<2.0	<2.0	<2.0	<100	<100	<1.0	<1.0	11000	11000	20	<10	1.1	<1.0	<1.0	<1.0	<10	<10
	T3	08/22/2011	<100	<100	1.0	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	<100	<100	<1.0	<1.0	11000	11000	21	<10	1.4	1.0	<1.0	<1.0	<10	<10
		10/11/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	38000	<2.0	<2.0	<2.0	---	<100	<100	<1.0	<1.0	10000	11000	15	42 *DT*	<1.0	<1.0	<1.0	<1.0	<10	<10
		12/13/2011	170	<100	<1.0	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	230	<100	<1.0	<1.0	11000	11000	48	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
CRM 18.5		04/26/2011	680	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	<1.0	480	<100	<1.0	<1.0	10000	10000	42	<10	1.1	1.9 *DT*	<1.0	<1.0	<10	<10
		06/21/2011	170	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	<2.0	<100	<100	1.4	<1.0	10000	11000	20	<10	1.1	1.1	<1.0	<1.0	<10	<10
		08/22/2011	<100	<100	1.1	<1.0	<0.5	<0.5	35000	<2.0	<2.0	<2.0	<2.0	<100	<100	<1.0	<1.0	10000	10000	31	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		10/11/2011	<100	150 *DT*	<1.0	<1.0	<0.5	<0.5	37000	<2.0	<2.0	<2.0	---	<100	<100	<1.0	<1.0	10000	12000	14	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		12/13/2011	180	<100	<1.0	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	200	<100	<1.0	<1.0	11000	11000	47	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
CRM 19.7		04/26/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	<1.0	120	<100	<1.0	<1.0	10000	10000	12	<10	<1.0	1.8 *DT*	<1.0	<1.0	<10	<10
		06/20/2011	120	<100	<1.0	<1.0	<0.5	<0.5	34000	<2.0	<2.0	<2.0	<2.0	110	<100	<1.0	<1.0	11000	11000	29	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		08/22/2011	150	<100	1.1	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	150	<100	<1.0	1.3 *DT*	11000	11000	52	<10	1.3	<1.0	<1.0	<1.0	<10	<10
		10/11/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	37000	<2.0	<2.0	<2.0	---	<100	<100	<1.0	<1.0	10000	11000	12	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		12/13/2011	170	<100	<1.0	<1.0	<0.5	<0.5	35000	<2.0	<2.0	<2.0	<2.0	130	<100	<1.0	<1.0	11000	11000	40	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
CRM 22.0		04/26/2011	140	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	<1.0	130	<100	<1.0	<1.0	10000	10000	14	<10	1.3	1.9 *DT*	<1.0	<1.0	<10	<10
		06/20/2011	110	<100	<1.0	<1.0	<0.5	<0.5	34000	<2.0	<2.0	<2.0	<2.0	<100	<100	<1.0	<1.0	11000	11000	24	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		08/22/2011	110	<100	<1.0	<1.0	<0.5	<0.5	37000	<2.0	<2.0	<2.0	<2.0	100	<100	<1.0	1.5 *DT*	10000	11000	46	<10	2.3	<1.0	<1.0	<1.0	<10	<10
		10/11/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	37000	<2.0	<2.0	<2.0	---	<100	<100	<1.0	<1.0	11000	12000	17	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		12/13/2011	180	<100	<1.0	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	140	<100	<1.0	<1.0	11000	11000	47	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
Container Blank		08/23/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	<500	<2.0	<2.0	<2.0	<2.0	<100	<100	<1.0	1.3 *DT*	<100	<100	0	<10	<1.0	<1.0	<1.0	<1.0	<10	<10

DT= Dissolved fraction exceeded the total recoverable metal concentration. Symbol (---) = Non-reportable results

Table 40. Maximum concentrations of selected metals in water samples collected at Clinch River Miles (CRMs) 15.5, 18.5, 19.7, and 22.0 and respective water quality criteria for the protection of fish and aquatic life.

State Criteria [1]	Metal	Water Quality Criteria		Maximum Concentration (µg/l)			
		Acute [2] (µg/l)	Chronic [3] (µg/l)	CRM 15.5	CRM 18.5	CRM 19.7	CRM 22.0
West Virginia	Aluminum *	750	750	<100	150 [DT]	<100	<100
Tennessee	Arsenic (III)*	340	150	<1.0	<1.0	<1.0	<1.0
	Cadmium**	2.60	0.30	<0.5	<0.5	<0.5	<0.5
	Chromium (III)**	706	92	<2.0	<2.0	<2.0	<2.0
	Copper**	17	11.2	2.2 [DT]	<2.0	<2.0	<2.0
	Lead**	86	3.3	<1.0	<1.0	1.3 [DT]	1.5 [DT]
	Nickel**	585	65	2.5 [DT]	1.9 [DT]	1.8 [DT]	1.9 [DT]
	Selenium***	20	5	<1.0	<1.0	<1.0	<1.0
	Zinc**	146	140	<10	<10	<10	<10

1. *The state of West Virginia's criteria for aluminum was used for comparison. The state of Tennessee has not promulgated criteria for aluminum.*
2. *The acute exposure limit is a one hour average concentration which is not to be exceeded more than once every three years on the average.*
3. *The chronic exposure limit is a four day average concentration which is not to be exceeded more than once every three years on the average.*

* *Criteria for these metals are expressed as dissolved.*

** *Criteria for these metals are expressed as dissolved and are a function of total hardness (130 mg/L; Table 37).*

*** *Criteria are expressed in terms of total recoverable metal.*

DT = Dissolved fraction exceeded the total recoverable metal concentration in the sample (Table 39).

Table 41. Pesticide and PCB concentrations in sediments collected at CRM’s 15.5, 18.5, and 22.0 in 2011 and at far-field locations (CRM 24.5, TRM 560.8, and TRM 532.5) in 2010 and 2011.

					Organochlorine Pesticides and PCB's (ug/kg dry weight)												
					(EPA 8081A)				(EPA Method 8082)								(EPA 8081A)
									Polychlorinated Biphenyls (PCB's)								
	Reservoir	Mile	Replicate No.	Collection Date	ENDRIN ALDEHYDE	HEPTACHLOR	HEPTACHLOR EPOXIDE	METHOXYCHLOR	1016	1221	1232	1242	1248	1254	1260	TOTAL	TOXAPHENE
Clinch SMR	Watts Bar	CRM 15.5	1	06/21/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 500
	Watts Bar	CRM 15.5	2	06/21/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 500
	Watts Bar	CRM 18.5	1	06/21/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 500
	Watts Bar	CRM 22.0	1	06/21/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 500
Far-field	Melton Hill	CRM 24.0	1	06/21/2010	< 10	< 10	< 10	< 10	< 25	< 25	< 25	310	< 25	< 25	< 25	310	< 500
	Melton Hill	CRM 24.0	1	06/08/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	72	< 25	< 25	< 25	72	< 500
	Watts Bar	TRM 532.5	1	06/15/2010	< 10	< 10	< 10	< 10	< 25	< 25	< 25	160	< 25	< 25	< 25	160	< 500
	Watts Bar	TRM 532.5	2	06/15/2010	< 10	< 10	< 10	< 10	< 25	< 25	< 25	150	< 25	< 25	< 25	150	< 500
	Watts Bar	TRM 532.5	1	06/16/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	77	< 25	< 25	< 25	77	< 500
	Watts Bar	TRM 560.8	1	06/15/2010	< 10	< 10	< 10	< 10	< 25	< 25	< 25	110	< 25	< 25	< 25	110	< 500
	Watts Bar	TRM 560.8	2	06/15/2010	< 10	< 10	< 10	< 10	< 25	< 25	< 25	140	< 25	< 25	< 25	140	< 500
	Watts Bar	TRM 560.8	1	06/16/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	57	< 25	< 25	< 25	57	< 500
U.S. Environmental Protection Agency Region 4 Ecological Screening Value (ESV) for Sediment (2001).												>MDL					

Table 41. (continued)

Organochlorine Pesticides and PCBs (ug/kg, dry weight)

(EPA Method 8081A)

	Reservoir	River Mile	Replicate No.	Collection Date	ALDRIN	Benzene Hexachloride (BHC)				CHLORDANE	DIELDRIN	DDT's			Endosulfan			ENDRIN
						ALPHA	BETA	DELTA	GAMMA			p,p DDD	p,p DDE	p,p DDT	ALPHA	BETA	SULFATE	
Clinch SMR	**Watts Bar**	**CRM 15.5**	1	06/21/2011	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	**CRM 15.5**	2	06/21/2011	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	**CRM 18.5**	1	06/21/2011	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	**CRM 22.0**	1	06/21/2011	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Far-field	**Melton Hill**	**CRM 24.0**	1	06/21/2010	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Melton Hill	**CRM 24.0**	1	06/08/2011	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	**TRM 532.5**	1	06/15/2010	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	**TRM 532.5**	2	06/15/2010	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	**TRM 532.5**	1	06/16/2011	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	**TRM 560.8**	1	06/15/2010	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	**TRM 560.8**	2	06/15/2010	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	**TRM 560.8**	1	06/16/2011	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
U.S. Environmental Protection Agency Region 4 Ecological Screening Value (ESV) for Sediment (2001).					>MDL													

Table 42. Metals concentrations in sediments collected at CRM's 15.5, 18.5, and 22.0 in 2011 and at far-field locations (CRM 24.5, TRM 560.8, and TRM 532.5) in 2010 and 2011.

					Metals (mg/kg, dry weight)												
					(EPA 6010)	(EPA 7060)	(EPA 6010)								(EPA 7471)	(EPA 7060)	
	Reservoir	River Mile	Replicate No.	Collection Date	ALUMINUM	ARSENIC	CADMIUM	CALCIUM	CHROMIUM	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	ZINC
Clinch SMR	**Watts Bar**	**CRM 15.5**	1	06/21/2011	4300	1.5	< 0.50	810	7.6	3.1	6500	5.9	650	430	< 0.10	5.7	22
	Watts Bar	**CRM 15.5**	2	06/21/2011	4800	1.6	< 0.50	1100	12	3.8	7400	6.2	720	480	< 0.10	7.8	24
	Watts Bar	**CRM 18.5**	1	06/21/2011	10000	6.2	< 0.50	2900	18	8.7	14000	16	1400	1500	< 0.10	14	51
	Watts Bar	**CRM 22.0**	1	06/21/2011	11000	4.7	< 0.50	2200	14	8.1	15000	16	1400	1100	< 0.10	12	50
Far-field	**Melton Hill**	**CRM 24.0**	1	06/21/2010	31000	15	< 0.50	24000	32	41	35000	29	4500	3742	0.1	31	110
	Melton Hill	**CRM 24.0**	1	06/08/2011	35000	20	< 0.50	20000	31	38	39000	27	3100	3600	0.11	29	120
	Watts Bar	**TRM 532.5**	1	06/15/2010	43000	18	< 0.50	3500	41	41	45000	28	4100	3100	0.43	33	160
	Watts Bar	**TRM 532.5**	2	06/15/2010	44000	18	< 0.50	3600	41	41	46000	28	4100	3100	0.42	32	160
	Watts Bar	**TRM 532.5**	1	06/16/2011	43000	20	0.58	3500	49	51	46000	35	3600	2900	0.31	42	160
	Watts Bar	**TRM 560.8**	1	06/15/2010	37000	23	< 0.50	4200	38	46	37000	28	3800	2600	0.47	34	150
	Watts Bar	**TRM 560.8**	2	06/15/2010	38000	24	< 0.50	4000	38	47	37000	28	3700	2700	0.49	34	150
	Watts Bar	**TRM 560.8**	1	06/16/2011	37000	22	0.71	3800	39	56	41000	34	3500	2900	0.42	39	160
U.S. Environmental Protection Agency Region 4 Ecological Screening Values (ESV) for Sediment (2001)*.					NA	7.24	1.0	NA	52.3	18.7	NA	30.2	NA	NA	0.13	15.9	124

**USEPA ecological screening values for metals in sediments are provided as a reference only. Since these numbers are based on conservative endpoints and sensitive ecological effects data, they represent a preliminary screening of site contaminant levels. Concentrations that exceed these values are not necessarily above expected background levels for a given region or area.*

Table 43. Number of taxa represented in the major phytoplankton groups, March through December 2011.

	Number of Taxa										
Group	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Combined**
Bacillariophyta	9	11	11	7	7	9	8	7	9	7	17
Chlorophyta	5	10	12	14	14	18	16	12	12	9	32
Chrysophyta	1	3	6	2	2	5	2	3	2	3	8
Cryptophyta	2	2	2	2	2	2	2	2	2	2	2
Cyanophyta	4	7	6	7	8	9	6	8	5	6	16
Euglenophyta	0	1	1	0	1	0	0	0	1	1	3
Pyrrophyta	1	1	0	0	1	2	3	2	3	1	3
Total Taxa Richness	22	35	38	32	35	45	37	34	34	29	81

Table 44. Phytoplankton taxa collected monthly, March through December 2011, at Clinch River Miles (CRMs) 15.5, 18.5, and 22.0.

Division	Taxa	March			April			May					June			July			August					September			October			November			December			Total Occurrence	% Occurrence
		15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5		
									T1	T2	T3								T1	T2	T3																
Bacillariophyta	*Achnanthes*																			X														X		2	6
	Amphora														X										X		X									3	9
	Anomoeneis							X																												1	3
	Asterionella						X	X	X	X		X																								5	15
	Aulacoseira	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X		X			X			X	X	X	X	X	27	79
	Cocconeis	X			X	X						X	X																			X				6	18
	Cyclotella				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	31	91
	Diatoma	X	X				X																													3	9
	Fragilaria		X			X	X	X	X		X	X						X	X	X		X		X				X	X	X			X	X	X	18	53
	Gomphonema				X																									X						2	6
	Melosira		X																																	1	3
	Navicula	X	X		X						X		X		X				X			X			X	X	X	X		X			X			14	41
	Nitzschia		X		X	X	X	X	X	X		X						X	X	X	X			X	X	X	X		X	X	X	X		X		21	62
	Rhoicosphenia															X																				1	3
	Skeletonema						X			X	X	X				X				X						X				X	X	X				10	29
	Stephanodiscus	X	X	X	X	X	X	X	X	X	X	X			X					X																13	38
	Synedra	X		X				X			X	X	X		X			X	X	X	X		X			X	X	X	X	X	X	X	X	X	X	22	65
	Total	6	7	3	7	6	8	8	6	6	7	9	4	2	6	4	2	4	6	8	4	4	3	3	5	5	5	5	4	7	5	6	5	6	4	34	100
Chlorophyta	*Ankistrodesmus*				X					X	X	X				X			X	X	X	X	X		X	X	X	X	X			X				16	47
	Carteria						X	X									X	X		X																5	15
	Characium																					X														1	3
	Chlamydomonas			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	32	94
	Chlorococcaceae	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	33	97
	Coelastrum														X			X	X						X									X		5	15
	Cosmarium														X			X																		2	6
	Crucigenia																X	X	X										X							4	12
	Dictyosphaerium									X			X						X							X			X	X						6	18
	Golenkinia																		X							X										2	6
	Gonium																											X								1	3
	Kirchneriella																									X										1	3
	Lagerheimia									X		X	X	X	X					X	X	X	X	X	X	X	X	X	X			X	X	X		18	53
	Lobomonas								X									X																		2	6

Table 44. (Continued)

Division	Taxa	March			April			May					June			July			August					September			October			November			December			Total Occurrence	% Occurrence
		15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5		
									T1	T2	T3								T1	T2	T3																
Chlorophyta (continued)	*Micractinium*					X			X	X	X				X				X	X	X	X		X	X						X	X				13	38
	Monomastix																											X								1	3
	Monoraphidium						X	X	X	X	X	X			X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X			23	68
	Oocystis	X			X								X	X	X		X	X					X		X	X								X		11	32
	Pandorina				X	X												X																		3	9
	Pediastrum												X					X																		2	6
	Planctonema			X																																1	3
	Pyramichlamys				X	X	X	X		X		X								X			X	X		X					X	X				12	35
	Quadrigula																								X										X	2	6
	Scenedesmus		X		X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	29	85
	Schroederia										X													X		X										3	9
	Selenastrum																															X				1	3
	Sphaerellopsis																			X																1	3
	Staurastrum														X																					1	3
	Stichococcus																										X									1	3
	Tetraedron												X	X	X			X					X					X	X	X		X	X		X	11	32
	Tetrastrum														X				X																	2	6
	Treubaria																							X	X							X				3	9
	Total	2	2	3	7	5	5	5	6	9	7	7	8	6	12	5	5	13	11	10	7	8	9	9	11	12	7	9	9	5	6	11	6	6	5	34	100
Chrysophyta	*Chromulina*																								X											1	3
	Chrysocapsaceae							X				X																						X		3	9
	Chrysococcus							X	X	X	X								X	X	X	X										X			X	10	29
	Dinobryon								X	X	X	X			X				X	X	X	X	X				X									11	32
	Erkenia	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	33	97
	Kephyrion							X	X	X									X		X															5	15
	Mallomonas					X	X				X					X			X		X		X				X									8	24
	Synura				X																															1	3
	Total	1	1	1	2	2	2	4	4	4	4	3	1	1	1	2	1	1	5	3	5	3	3	1	2	1	3	1	1	1	1	2	1	2	2	34	100
Cryptophyta	*Cryptomonas*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		32	94
	Rhodomonas	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	34	100
	Total	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	34	100

Table 44. (Continued)

Division	Taxa	March			April			May					June			July			August					September			October			November			December			Total Occurrence	% Occurrence
		15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5		
									T1	T2	T3								T1	T2	T3																
Cyanophyta	*Anabaena*														X																					1	3
	Aphanocapsa	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						X		X	X											18	53
	Aphanothece				X	X	X																													3	9
	Chroococcaceae	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	34	100
	Chroococcus					X						X															X			X						4	12
	Cyanocatena																											X								1	3
	Cyanogranis												X	X		X	X	X	X	X	X		X			X	X						X	X	X	14	41
	Cylindrospermopsis																		X	X	X	X	X													5	15
	Leptolyngbya				X																															1	3
	Lyngbya																				X															1	3
	Merismopedia															X								X		X		X	X	X	X		X	X	X	10	29
	Myxobaktron											X				X	X			X	X		X													6	18
	Oscillatoria													X	X					X			X				X	X	X					X	X	9	26
	Phormidium															X																				1	3
	Synechococcus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	34	100
	Synechocystis		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	32	94
	Total	3	4	3	6	6	5	4	4	4	4	6	5	6	6	8	5	4	5	7	7	5	7	5	4	5	6	6	5	5	4	3	5	6	6	34	100
Euglenophyta	*Euglena*							X				X				X															X	X				5	15
	Lepocinclis					X																														1	3
	Trachelomonas																																	X		1	3
	Total					1		1				1				1															1	1		1		7	21
Pyrrophyta	*Glenodinium*																							X	X	X	X	X			X					6	18
	Gymnodinium	X			X	X															X					X	X	X				X		X		9	26
	Peridinium																	X	X	X	X		X		X	X						X				8	24
	Total	1			1	1												1	1	1	2		1	1	2	3	2	2			1	2		1		16	47
	Grand Total	16	17	12	25	23	23	28	24	27	26	31	21	17	29	24	15	27	32	34	29	23	27	26	30	32	29	28	25	24	22	32	20	26	21	34	100

Table 45. Percentage composition of major phytoplankton groups in samples collected monthly, March through December 2011, at Clinch River Miles (CRM) 15.5, 18.5, and 22.0.

	CRM 15.5												CRM 18.5												CRM 22.0									
	Mar	Apr	May	Jun	Jul	Aug			Sep	Oct	Nov	Dec	Mar	Apr	May			Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Group						T1	T2	T3							T1	T2	T3																	
Bacillariophyta	0	2	1	0	1	1	0	0	2	0	4	1	1	1	1	2	1	0	1	1	1	0	4	2	0	2	2	0	1	0	1	0	3	2
Chlorophyta	0	1	0	1	1	2	1	1	6	7	2	0	0	1	1	0	1	4	1	2	2	6	2	1	0	1	1	3	3	1	4	3	1	1
Chrysophyta	0	1	0	0	1	2	0	0	0	0	1	0	0	1	0	1	2	0	0	0	0	0	0	0	0	2	2	0	1	0	0	0	0	1
Cryptophyta	0	0	0	0	0	2	1	0	1	1	1	0	0	1	0	1	0	0	0	2	0	1	1	0	0	2	1	0	0	1	1	0	1	0
Cyanophyta	99	96	97	98	96	94	97	98	90	91	93	98	99	96	98	97	95	95	98	94	96	92	93	96	99	94	94	96	94	97	94	96	94	97
Euglenophyta	---	---	0	---	0	---	---	---	---	---	---	---	---	0	---	---	---	---	---	---	---	---	0	0	---	---	0	---	---	---	---	---	0	---
Pyrrophyta	0	0	---	---	---	0	0	0	0	0	---	---	---	0	---	---	---	---	---	---	0	0	0	0	---	---	---	---	0	0	0	---	0	---

To enhance pattern recognition, percentages are rounded to whole numbers, and values may not add to 100.

"0" values indicate percentages less than 0.5%. Blank values (---) indicate no individuals within the division were collected.

Table 46. Phytoplankton taxa and density (cells/mL) estimates for samples collected monthly at Clinch River Mile 15.5 near the proposed Small Modular Reactor site on the Clinch River – March through December, 2011

Taxon	CRM 15.5											
	Mar	Apr	May	Jun	Jul	Aug			Sep	Oct	Nov	Dec
						T1	T2	T3				
Bacillariophyta												
Achnanthaceae												
Achnanthes							2					
Aulacoseriaceae												
Aulacoseira	45	24	143		68	5	9	27				69
Bacillariaceae												
Nitzschia		3	20			7	7	11	3	2	5	
Catenulaceae												
Amphora										1		
Cocconiedaceae												
Cocconeis	4	3		7								
Fragilariaceae												
Asterionella			7									
Diatoma	4											
Fragilaria			51			2	13		10		2	3
Synedra	4		3	14		20	2	8		5	73	1
Gomphonemataceae												
Gomphonema		3									2	
Melosiraceae												
Melosira												
Naviculaceae												
Anomoeneis			7									
Navicula	4	5		7		2				5	2	1
Rhoicospheniaceae												
Rhoicosphenia					4							
Skeletonemaceae												
Skeletonema					30		5				5	
Stephanodiscaceae												
Cyclotella		25	37	35	136	50	23	19	115	23	136	103
Stephanodiscus	27	87	25				2					
Bacillariophyta Total	90	150	294	63	238	86	63	65	128	35	225	178
Chlorophyta												
Characiaceae												
Characium												
Chlamydomonadaceae												
Carteria			7				2					
Chlamydomonas		5	27	14	45	14	23	11	176	16	23	3
Lobomonas												
Pyramichlamys		14	3				5		9			
Sphaerellopsis							5					
Chlorococcaceae												
Chlorococcaceae	9	3	58	126	76	68	75	55	21	545	23	33
Schroederia									3			
Tetraedron				7							2	1
Coelastraceae												
Coelastrum						36						

Table 46. (CRM 15.5, continued)

Taxon	CRM 15.5											
	Mar	Apr	May	Jun	Jul	Aug T1	Aug T2	Aug T3	Sep	Oct	Nov	Dec
Chlorophyta (continued)												
Desmidiaceae												
Cosmarium												
Staurastrum												
Dictyosphaeriaceae												
Dictyosphaerium				42		36					4	
Hydrodictyaceae												
Pediastrum				35								
Micractinaceae												
Golenkinia						2						
Micractinium						18	18	33	5			
Oocystaceae												
Ankistrodesmus		3			15	5	9	3		7		
Kirchneriella												
Monoraphidium			7		30	5	16	14	30	32		3
Oocystis	9	3		7								
Quadrigula												
Treubaria									6			
Pedinomonadaceae												
Monomastix												
Scenedesmaceae												
Crucigenia						9						
Lagerheimia				7			14	19	18	16		6
Scenedesmus		14		56	61	39	14	33	24	23	37	6
Selenastrum												
Tetrastrum						9						
Ulotrichaceae												
Planctonema												
Stichococcus										2		
Volvocaceae												
Gonium												
Pandorina		44										
Chlorophyta Total	18	85	102	294	227	241	179	166	293	641	89	53
Chrysophyta												
Chromulinaceae												
Chromulina												
Chrysocapsaceae												
Chrysocapsaceae			3									
Chrysococcaceae												
Chrysococcus			3			11	5	5				
Kephyrion			17			5		3				
Dinobryaceae												
Dinobryon						11	11	14		2		
Ochromonadaceae												
Erkenia	9	87	77	49	348	164	11	27	21	27	30	51
Synuraceae												
Mallomonas					4	5		5		1		
Synura		3										
Chrysophyta Total	9	90	101	49	352	195	27	55	21	30	30	51

Table 46. (CRM 15.5, continued)

Division Taxon	CRM 15.5 Mar	Apr	May	Jun	Jul	Aug T1	T2	T3	Sep	Oct	Nov	Dec
Cryptophyta												
Cryptomonadaceae												
Cryptomonas	9	8	10	21	45	27	14	22	33	16	9	
Rhodomonas	73	38	75	35	15	179	82	27	33	32	23	18
Cryptophyta Total	82	46	85	56	61	207	95	49	67	48	32	18
Cyanophyta												
Chroococcaceae												
Aphanocapsa	14531	1147	1802	28	909				85			
Aphanothece		16										
Chroococcaceae	3762	5256	4620	5749	5817	2300	4106	3696	2920	3080	2875	8760
Chroococcus										18	9	
Merismopedia					182				24		55	466
Synechocystis		34	128	21	909	259	327	341	582	177	314	963
Nostocaceae												
Anabaena												
Cylindrospermopsis						13	35	33				
Oscillatoriaceae												
Leptolyngbya		27										
Lyngbya								22				
Oscillatoria							307			148		
Phormidium					45							
Synechococcaceae												
Cyanocatena												
Cyanogranis				168	1696	2792	493	3696		516		73
Myxobaktron					30		2	3				
Synechococcus	9	2628	15916	14373	13704	5420	7227	8281	1104	4170	1820	3996
Cyanophyta Total	18303	9109	22465	20338	23293	10784	12498	16071	4715	8109	5071	14259
Euglenophyta												
Euglenaceae												
Euglena			7		4							
Lepocinclis												
Trachelomonas												
Euglenophyta Total			7		4							
Pyrrophyta												
Glenodiniaceae												
Glenodinium									9	2		
Gymnodiniaceae												
Gymnodinium	9	5						3		2		
Peridinaceae												
Peridinium						2	2	3				
Pyrrophyta Total	9	5				2	2	5	9	5		
Miscellaneous			10							2		
Total Cell Count	**18511**	**9485**	**23064**	**20800**	**24174**	**11516**	**12865**	**16412**	**5233**	**8869**	**5446**	**14559**

Counts are rounded to whole numbers.
"0" values indicate counts less than 0.5 cells per ml.
Abbreviations "T1", T2 and "T3" designate replicate samples.

Table 47. Phytoplankton taxa and density (cells/mL) estimates for samples collected monthly at Clinch River Mile 18.5 near the proposed Small Modular Reactor site on the Clinch River – March through December, 2011.

	CRM 18.5											
Division	**Mar**	**Apr**	**May**			**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Taxon			**T1**	**T2**	**T3**							
Bacillariophyta												
Achnanthaceae												
Achnanthes												2
Aulacoseiraceae												
Aulacoseira	173	9	65	81	54	15	11	22	2	18	4	74
Bacillariaceae												
Nitzschia	11	9	5	3					2		11	4
Catenulaceae												
Amphora									2			
Cocconiedaceae												
Cocconeis		9										
Fragilariaceae												
Asterionella			27	27								
Diatoma	23											
Fragilaria	23	5	33		20			4		7		7
Synedra					3					9	3	2
Gomphonemataceae												
Gomphonema												
Melosiraceae												
Melosira	191											
Naviculaceae												
Anomoeneis												
Navicula	11				3			2	2	1		
Rhoicospheniaceae												
Rhoicosphenia												
Skeletonemaceae												
Skeletonema				5	3						20	
Stephanodiscaceae												
Cyclotella		59	46	123	57	30	170	23	59	23	139	126
Stephanodiscus	45	109	19	8	3							
Bacillariophyta Total	477	200	196	247	142	45	181	51	67	58	178	215
Chlorophyta												
Characiaceae												
Characium								2				
Chlamydomonadaceae												
Carteria							5					
Chlamydomonas		23	30	14	8	30	57	16	20	23	25	10
Lobomonas			3									
Pyramichlamys		27		3							7	
Sphaerellopsis												
Chlorococcaceae												
Chlorococcaceae	11	32	44	19	49	636		35	22	500	25	67
Schroederia					3							
Tetraedron						15				9		
Coelastraceae												
Coelastrum									32			16

Table 47. (CRM 18.5, continued).

Division Taxon	CRM 18.5 Mar	Apr	May T1	T2	T3	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chlorophyta (continued)												
Desmidiaceae												
Cosmarium												
Staurastrum												
Dictyosphaeriaceae												
Dictyosphaerium				11								
Hydrodictyaceae												
Pediastrum												
Micractinaceae												
Golenkinia												
Micractinium		9	33	5	87			4	6		27	
Oocystaceae												
Ankistrodesmus				3	3			4	4	5		
Kirchneriella												
Monoraphidium			11	3	5			2	22	77	2	
Oocystis						30	57		2			2
Quadrigula									4			
Treubaria									4			
Pedinomonadaceae												
Monomastix										5		
Scenedesmaceae												
Crucigenia							102					
Lagerheimia				3		15		2	6	9		4
Scenedesmus	23		16	5	11	91	22	8	14	132	5	2
Selenastrum												
Tetrastrum												
Ulotrichaceae												
Planctonema												
Stichococcus												
Volvocaceae												
Gonium										36		
Pandorina		73										
Chlorophyta Total	34	164	136	65	166	818	243	72	137	796	91	101
Chrysophyta												
Chromulinaceae												
Chromulina									2			
Chrysocapsaceae												
Chrysocapsaceae												2
Chrysococcaceae												
Chrysococcus			5	5	3			2				
Kephyrion			8	5								
Dinobryaceae												
Dinobryon			5	22	41			2				
Ochromonadaceae												
Erkenia	11	142	89	68	150	61	114	8	10	18	18	55
Synuraceae												
Mallomonas		9			3							
Synura												
Chrysophyta Total	11	151	108	101	196	61	114	12	12	18	18	57

Table 47. (CRM 18.5, continued).

Division Total	CRM 18.5 Mar	Apr	May T1	T2	T3	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cryptophyta												
Cryptomonadaceae												
Cryptomonas	11	27	3	16	5	30	5	16	14	5	14	4
Rhodomonas	34	91	65	106	38	15	57	56	18	59	25	30
Cryptophyta Total	45	118	68	123	44	45	62	72	32	64	39	34
Cyanophyta												
Chroococcaceae												
Aphanocapsa	23044	3782	1022	2127	1645	318		37	103			
Aphanothece		36										
Chroococcaceae	18479	8870	2464	7392	4599	3614	9445	1408	2738	6570	1848	6205
Chroococcus		55										
Merismopedia										64	109	291
Synechocystis	34	11	95	136	191	136	227	117	424	863	182	364
Nostocaceae												
Anabaena												
Cylindrospermopsis								18				
Oscillatoriaceae												
Leptolyngbya												
Lyngbya												
Oscillatoria						227				183		94
Phormidium												
Synechococcaceae												
Cyanocatena										548		
Cyanogranis						6570	14629					202
Myxobaktron							114					
Synechococcus	4928	4599	18068	5338	4271	7556	6160	1877	3830	3397	2555	4014
Cyanophyta Total	46485	17353	21650	14993	10706	18421	30574	3457	7095	11625	4693	11170
Euglenophyta												
Euglenaceae												
Euglena											2	
Lepocinclis		5										
Trachelomonas												2
Euglenophyta Total		5									2	2
Pyrrophyta												
Glenodiniaceae												
Glenodinium									14	5	2	
Gymnodiniaceae												
Gymnodinium		5								5		2
Peridinaceae												
Peridinium									2			
Pyrrophyta Total		5							16	9	2	2
Miscellaneous	23											
Total Cell Count	**47075**	**17994**	**22158**	**15529**	**11254**	**19391**	**31175**	**3664**	**7360**	**12569**	**5024**	**11581**

Table 48. Phytoplankton taxa and density (cells/mL) estimates for samples collected monthly at Clinch River Mile 22.0 near the proposed Small Modular Reactor site on the Clinch River – March through December, 2011

	CRM 22.0									
Division **Taxon**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Bacillariophyta										
Achnanthaceae										
Achnanthes										
Aulacoseriaceae										
Aulacoseira	86	72	145	16		26			3	69
Bacillariaceae										
Nitzschia		5	41		5		5	2	3	
Catenulaceae										
Amphora				5						
Cocconiedaceae										
Cocconeis			6						2	
Fragilariaceae										
Asterionella		55	51							
Diatoma		5								
Fragilaria		14	127		18			5		21
Synedra	11		26	5	32	91	1	2	3	9
Gomphonemataceae										
Gomphonema										
Melosiraceae										
Melosira										
Naviculaceae										
Anomoeneis										
Navicula				5			2			
Rhoicospheniaceae										
Rhoicosphenia										
Skeletonemaceae										
Skeletonema		9	6				9		24	
Stephanodiscaceae										
Cyclotella		36	119	33	95	73	48	7	183	142
Stephanodiscus	34	100	119	5						
Bacillariophyta Total	132	295	640	71	150	190	65	16	218	241
Chlorophyta										
Characiaceae										
Characium										
Chlamydomonadaceae										
Carteria		5			9					
Chlamydomonas	11	36	40	16	14	18	20	20	36	18
Lobomonas					5					
Pyramichlamys		18	17			9	2		6	
Sphaerellopsis										
Chlorococcaceae										
Chlorococcaceae	23	18	23	551	136	245	15	161	12	42
Schroederia							2			
Tetraedron				11	5	18		5	2	3
Coelastraceae										
Coelastrum				174	18					

Table 48. (CRM 22.0, continued)

Division Taxon	CRM 22.0 Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chlorophyta (continued)										
Desmidiaceae										
Cosmarium				4	5					
Staurastrum				4						
Dictyosphaeriaceae										
Dictyosphaerium							9	9		
Hydrodictyaceae										
Pediastrum					18					
Micractinaceae										
Golenkinia							2			
Micractinium				87					6	
Oocystaceae										
Ankistrodesmus			11			82	2	7	2	
Kirchneriella							109			
Monoraphidium		5	11	16	36	45	36	16	8	
Oocystis				16	5	9	2			
Quadrigula										6
Treubaria									2	
Pedinomonadaceae										
Monomastix										
Scenedesmaceae										
Crucigenia					64			9		
Lagerheimia			17	11		9	9	7	2	
Scenedesmus			34	65	91	109	21	45	13	23
Selenastrum									2	
Tetrastrum				44						
Ulotrichaceae										
Planctonema	170									
Stichococcus										
Volvocaceae										
Gonium										
Pandorina					242					
Chlorophyta Total	204	82	153	1001	646	545	231	279	89	92
Chrysophyta										
Chromulinaceae										
Chromulina										
Chrysocapsaceae										
Chrysocapsaceae			11							
Chrysococcaceae										
Chrysococcus									3	3
Kephyrion										
Dinobryaceae										
Dinobryon			153	27		27				
Ochromonadaceae										
Erkenia	34	354	528		286	109	23	11	24	97
Synuraceae										
Mallomonas		9				9				
Synura										
Chrysophyta Total	34	364	693	27	286	145	23	11	27	100

Table 48. (CRM 22.0, continued)

Division Taxon	CRM 22.0									
	Mar	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Cryptophyta										
Cryptomonadaceae										
Cryptomonas	11	86	23	22	64	118	39	14	15	
Rhodomonas	34	164	273	49	32	173	18	11	23	45
Cryptophyta Total	45	250	295	71	95	291	57	25	38	45
Cyanophyta										
Chroococcaceae										
Aphanocapsa	36437	5075	3834	5608						
Aphanothece		45								
Chroococcaceae	13141	7227	16426	9855	2053	9034	2669	5133	3696	6023
Chroococcus			45							
Merismopedia							82	36		850
Synechocystis		55	34	164	727	2726	627	454	115	1136
Nostocaceae										
Anabaena				436						
Cylindrospermopsis						1486				
Oscillatoriaceae										
Leptolyngbya										
Lyngbya										
Oscillatoria				142		209		15		97
Phormidium										
Synechococcaceae										
Cyanocatena										
Cyanogranis					11703	14783	114			4380
Myxobaktron			6			18				
Synechococcus	2875	1971	6981	11909	4584	8624	2436	2395	2327	1049
Cyanophyta Total	52452	14373	27326	28114	19068	36881	5927	8033	6138	13534
Euglenophyta										
Euglenaceae										
Euglena			6						1	
Lepocinclis										
Trachelomonas										
Euglenophyta Total			6						1	
Pyrrophyta										
Glenodiniaceae										
Glenodinium							11			
Gymnodiniaceae										
Gymnodinium							2		2	
Peridinaceae										
Peridinium					2	27	5		2	
Pyrrophyta Total					2	27	18		3	
Miscellaneous	23								6	
Total Cell Count	**52891**	**15364**	**29113**	**29284**	**20247**	**38079**	**6321**	**8365**	**6520**	**14013**

Counts are rounded to whole numbers.
"0" values indicate counts less than 0.5 cells per ml.
Abbreviations "T1", T2 and "T3" designate replicate samples.

Table 49. Biovolume estimates for major phytoplankton divisions in samples collected monthly at locations near the proposed Small Modular Reactor site on the Clinch River – March through December, 2011. Biovolume expressed as ([total biovolume µm³/ml]/100). Blank values indicate taxa not present in sample.

Site	Month	QC	Bacillariophyta	Chlorophyta	Chrysophyta	Cryptophyta	Cyanophyta	Euglenophyta	Pyrrophyta	Miscellaneous	Total
CRM 15.5	Mar		2594	20	3	79	96		7		2799
	Apr		505	115	50	83	32		13		797
	May		2908	94	31	60	88	358		16	3557
	Jun		828	143	15	237	75				1298
	Jul		671	246	223	278	118	115			1650
	Aug	T1	233	162	81	178	45		7		707
		T2	217	122	17	106	93		7		563
		T3	248	60	105	178	72		71		734
	Sep		146	215	6	307	23		241		939
	Oct		261	91	13	209	41		124	14	753
	Nov		448	112	9	100	22				691
	Dec		245	20	16	6	58				345
CRM 18.5	Mar		8794	7	3	47	191			15	9058
	Apr		422	254	75	247	102	18	24		1143
	May	T1	1379	106	39	102	86				1712
		T2	999	33	44	138	55				1269
		T3	1102	84	122	73	41				1423
	Jun		249	505	18	731	87				1589
	Jul		445	170	34	107	104				861
	Aug		234	72	5	126	18				456
	Sep		112	53	3	46	36		463		713
	Oct		193	115	5	53	65		142		573
	Nov		270	106	5	106	19	67	214		788
	Dec		677	29	16	25	48	18	2		815
CRM 22.0	Mar		587	138	10	52	238			12	1038
	Apr		1240	363	141	700	69				2513
	May		4299	166	396	273	119	168			5421
	Jun		337	518	21	128	284				1288
	Jul		950	681	87	252	78		23		2070
	Aug		939	230	196	506	468		425		2764
	Sep		101	92	7	315	30		498		1042
	Oct		49	78	3	62	33				226
	Nov		327	100	8	92	23	29	10	31	620
	Dec		1022	30	30	15	61				1158

Table 50. Percentage biovolume of major phytoplankton groups in samples collected monthly, March through December 2011, at Clinch River Miles (CRMs) 15.5, 18.5, and 22.0.

Group	CRM 15.5											
	Mar	Apr	May	Jun	Jul	Aug T1	Aug T2	Aug T3	Sep	Oct	Nov	Dec
Bacillariophyta	93	63	82	64	41	33	39	34	16	35	65	71
Chlorophyta	1	14	3	11	15	23	22	8	23	12	16	6
Chrysophyta	0	6	1	1	14	12	3	14	1	2	1	5
Cryptophyta	3	10	2	18	17	25	19	24	33	28	14	2
Cyanophyta	3	4	2	6	7	6	17	10	2	5	3	17
Euglenophyta	---	---	10	---	7	---	---	---	---	---	---	---
Pyrrophyta	0	2	---	---	---	1	1	10	26	16	---	---

Group	CRM 18.5											
	Mar	Apr	May T1	May T2	May T3	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bacillariophyta	97	37	81	79	77	16	52	51	16	34	34	83
Chlorophyta	0	22	6	3	6	32	20	16	7	20	13	4
Chrysophyta	0	7	2	3	9	1	4	1	0	1	1	2
Cryptophyta	1	22	6	11	5	46	12	28	7	9	13	3
Cyanophyta	2	9	5	4	3	5	12	4	5	11	2	6
Euglenophyta	---	2	---	---	---	---	---	---	---	---	9	2
Pyrrophyta	---	2	---	---	---	---	---	---	65	25	27	0

Group	CRM 22.0									
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bacillariophyta	57	49	79	26	46	34	10	22	53	88
Chlorophyta	13	14	3	40	33	8	9	35	16	3
Chrysophyta	1	6	7	2	4	7	1	2	1	3
Cryptophyta	5	28	5	10	12	18	30	27	15	1
Cyanophyta	23	3	2	22	4	17	3	15	4	5
Euglenophyta	---	---	3	---	---	---	---	---	5	---
Pyrrophyta	---	---	---	---	1	15	48	---	2	---

To enhance pattern recognition, percentages are rounded to whole numbers, and values may not add to 100.

"0" values indicate percentages less than 0.5%. Blank values (---) indicate no individuals within the division were collected.

Table 51. Percentage biovolume of each phytoplankton taxa in samples collected upstream and downstream of the proposed CRSMR, March through December, 2011. "T1", "T2", and "T3" denote samples collected in triplicate.

Division	Taxa	March			April			May					June			July			August					September			October			November			December		
		15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5 T1	22.0 T2	15.5 T3	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0 T1	15.5 T2	18.5 T3	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5
Bacillariophyta	*Achnanthes*																			1														0	
	Amphora														8										1		23								
	Anomoeneis							1																											
	Asterionella						6	1	8	8		4																							
	Aulacoseira	13	20	49	38	5	33	49	35	49	47	27		14	12	24	18		10	7	27	27	11		0			25			5	2	56	63	37
	Cocconeis	1			2	6						1	5																			2			
	Cyclotella				1	2	1	1	4	20	7	3	9	1	4	14	34	5	8	11	2	12	4	13	15	8	8	5	14	27	21	35	8	18	22
	Diatoma	13	11				3																												
	Fragilaria		0			1	0	23	32		22	37						2	1	3		7		2				2	3	1			1	1	24
	Gomphonema				2																									0					
	Melosira		60																																
	Navicula	3	2		7						0		2		0				0			6			0	0	1	0		2			2		
	Nitzschia		0		0	11	0	1	1	1		1						1	1	3	2			1	0	0	1		1	0	2	0		0	
	Rhoicosphenia															1																			
	Skeletonema						0			1	0	0				1				1						0				0	2	3			
	Stephanodiscus	61	4	4	13	13	6	5	2	1	0	4			0					13															
	Synedra	2		4				2			2	2	48		2			38	13	1	3		19			1	1	2	5	34	5	11	4	1	5
	Total	93	97	57	63	37	49	82	81	79	77	79	64	16	26	41	52	46	33	39	34	51	34	16	16	10	35	34	22	65	34	53	71	83	88
Chlorophyta	*Ankistrodesmus*				0					0	0	0				1			0	1	0	0	1		0	0	0	0	1			0			
	Carteria						2	1									5	3		2															
	Characium																					0													
	Chlamydomonas			1	1	3	9	1	3	1	1	1	1	3	2	12	3	2	2	6	1	10	1	16	3	2	6	3	10	10	7	7	1	1	2
	Chlorococcaceae	0	0	1	0	2	1	1	1	0	2	0	6	24	18	2		9	9	5	3	5	3	0	0	2	5	4	12	0	0	4	3	2	1
	Coelastrum														5			1	8						1									1	
	Cosmarium														0			0																	
	Crucigenia																2	1	0										0						
	Dictyosphaerium									0			0						1							0			0	5					
	Golenkinia																		1							0									
	Gonium																											7							
	Kirchneriella																									1									
	Lagerheimia									0		0	0	0	0					1	1	0	0	0	0	0	0	0	0			0	0	0	

Table 51. (Continued)

Division	Taxa	March			April			May					June			July			August					September			October			November			December		
		15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5
									T1	**T2**	**T3**								**T1**	**T2**	**T3**														
Chlorophyta (continued)	*Lobomonas*								1									0																	
	Micractinium					1			1	0	2				1				1	1	2	0		0	0						2	0			
	Monomastix																											0							
	Monoraphidium						0	0	0	0	0	0			0	0		0	0	1	1	0	0	1	1	1	1	2	2		0	0	0		
	Oocystis	0			0								0	2	0		9	0					0		0	0								0	
	Pandorina				6	7												13																	
	Pediastrum												2					1																	
	Planctonema			11																															
	Pyramichlamys				7	10	3	0		1		1								3			1	4		1					4	4			
	Quadrigula																								0										0
	Scenedesmus		0		0				0	0	0	0	1	1	1	0	1	1	1	0	1	0	1	0	0	0	0	2	7	0	0	0	0	0	0
	Schroederia										0													0		0									
	Selenastrum																															0			
	Sphaerellopsis																			2															
	Staurastrum														10																				
	Stichococcus																										0								
	Tetraedron												1	1	1			1					0					1	2	0		0	1		0
	Tetrastrum														1				0																
	Treubaria																							1	1							0			
	Total	1	0	13	14	22	14	3	6	3	6	3	11	32	40	15	20	33	23	22	8	16	8	23	7	9	12	20	35	16	13	16	6	4	3
Chrysophyta	*Chromulina*																								0										
	Chrysocapsaceae							0				0																						1	
	Chrysococcus							0	0	0	0								0	0	0	0										0			0
	Dinobryon								1	2	2	4			2				1	2	2	0	1				0								
	Erkenia	0	0	1	3	4	4	1	2	2	3	3	1	1		6	4	4	7	1	1	1	1	1	0	1	1	1	2	1	1	1	5	2	3
	Kephyrion							0	0	0									0		0														
	Mallomonas					3	1				3					7			3		11		5				0								
	Synura				3																														
	Total	0	0	1	6	7	6	1	2	3	9	7	1	1	2	14	4	4	12	3	14	1	7	1	0	1	2	1	2	1	1	1	5	3	3

Table 51. (Continued)

Division	Taxa	March			April			May					June			July			August					September			October			November			December		
		15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5
									T1	T2	T3								T1	T2	T3														
Cryptophyta	*Cryptomonas*	2	0	4	9	19	25	1	5	8	4	3	17	46	9	16	10	12	17	14	23	23	16	31	5	30	26	5	26	13	12	14		2	
	Rhodomonas	1	0	1	2	3	2	1	1	3	1	2	1	0	1	1	2	1	9	5	1	4	2	2	1	1	2	4	2	1	1	1	2	1	1
	Total	3	1	5	10	22	28	2	6	11	5	5	18	46	10	17	12	12	25	19	24	28	18	33	7	30	28	9	27	14	13	15	2	3	1
Cyanophyta	*Anabaena*														12																				
	Aphanocapsa	3	1	18	1	2	1	0	0	1	1	0	0	0	3	0						0		0	0										
	Aphanothece				0	3	0																												
	Chroococcaceae	1	1	3	2	2	1	0	0	2	1	1	1	1	2	1	3	0	1	2	1	1	1	1	1	1	1	3	6	1	1	2	7	2	1
	Chroococcus					1						0															0			0					
	Cyanocatena																											0							
	Cyanogranis												0	2		0	6	2	1	0	2		2			0	0						0	0	1
	Cylindrospermopsis																		0	1	1	1	10												
	Leptolyngbya				0																														
	Lyngbya																				0														
	Merismopedia															0								0		0		0	0	0	0		0	0	0
	Myxobaktron											0				0	0			0	0		0												
	Oscillatoria													1	1					7			1				1	2	0					1	1
	Phormidium															0																			
	Synechococcus	0	0	1	1	2	0	2	4	2	1	1	4	2	4	5	3	1	3	5	5	2	1	0	3	1	2	3	5	1	1	2	5	2	0
	Synechocystis		0		0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	2	1	1	1	0	3	4	1	0	0	5	1	2
	Total	3	2	23	4	9	3	2	5	4	3	2	6	5	22	7	12	4	6	17	10	4	17	2	5	3	5	11	15	3	2	4	17	6	5
Euglenophyta	*Euglena*							10				3				7															9	5			
	Lepocinclis					2																													
	Trachelomonas																																	2	
	Total	0	0	0	0	2	0	10	0	0	0	3	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	5	0	2	0
Pyrrophyta	*Glenodinium*																							26	61	38	9	20			27				
	Gymnodinium	0			2	2															0					1	8	5				0		0	
	Peridinium																	1	1	1	9		15		4	8						1			
	Total	0	0	0	1.6	2.1	0	0	0	0	0	0	0	0	0	0	0	1.1	1	1.3	9.6	0	15	26	65	48	16	25	0	0	27	1.7	0	0.2	0
	Miscellaneous		0	1				0																			2					5			

Table 52. Number of taxa represented in the major zooplankton taxonomic groups each month, March through December 2011.

	Number of Taxa										
Group	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Cladocera	2	4	2	5	5	4	3	1	1	1	8
Copepoda	3	2	2	2	2	2	2	1	2	1	3
Rotifera	1	2	3	1	1	2	3	4	1	2	7
Total Taxa Richness	6	8	7	8	8	8	8	6	4	4	18

Table 53. Zooplankton taxa collected each month, upstream and downstream of the proposed CRSMR.

Group	Taxa	March			April			May					June			July			August					September			October			November			December			Total Occurrence	% Occurrence
		15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5 T1	18.5 T2	18.5 T3	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5 T1	15.5 T2	15.5 T3	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0	15.5	18.5	22.0		
Cladocera	Cladocera																				X															1	3
	Bosmina longirostris	X	X			X		X			X	X			X	X		X		X				X	X	X				X	X	X	X	X	X	19	63
	Chydorus sphaericus														X																					1	3
	Daphnia ambigua						X																													1	3
	Daphnia galeata	X					X				X																									3	10
	Daphnia lumholtzi												X	X	X	X	X	X	X		X			X			X	X								10	33
	Daphnia pulicaria																	X																		1	3
	Daphnia retrocurva				X								X	X	X	X			X	X		X														7	23
	Diaphanosoma leuchtenbergianum												X	X	X	X				X				X												6	20
	Total	2	1		1	1	2	1			2	1	3	3	5	4	1	3	2	3	2	1		3	1	1	1	1		1	1	1	1	1	1	27	90
Copepoda	Calanoida	X	X		X							X	X		X	X						X		X	X		X				X	X				13	43
	Cyclopoida	X	X	X	X	X	X	X		X	X	X	X		X	X			X	X		X	X	X	X	X				X			X		X	21	70
	Total	2	2	1	2	1	1	1		1	1	2	2		2	2			1	1		2	1	2	2	1	1			1	1	1	1		1	24	80
Rotifera	Conochilus unicornis						X	X	X	X	X	X								X						X	X									7	23
	Filinia longiseta					X																														1	3
	Asplanchna brightwellii	X	X					X	X	X	X	X								X				X		X		X								9	30
	Kellicottia longispina																																		X	1	3
	Lecane												X																							1	3
	Notommatidae																										X	X	X		X			X		5	17
	Polyarthra vulgaris							X										X								X			X							4	13
	Total	1	1			1	1	3	2	2	2	2	1					1		2				1		3	2	2	2		1			1	1	18	60
Grand Total		5	4	1	3	3	4	5	2	3	5	5	6	3	7	6	1	4	3	6	2	3	1	6	3	5	4	3	2	2	3	2	2	2	3	30	100

Table 54. Density estimates for major zooplankton taxonomic groups (organisms/m^3).

Group	CRM 15.5											
	Mar	Apr	May	Jun	Jul	Aug T1	Aug T2	Aug T3	Sep	Oct	Nov	Dec
Cladocera	154	231	152	3681	1482	380	122	55	363	27	56	107
Copepoda	309	1156	381	1052	312	380	41		282	27	19	107
Rotifera	51		762	175			41		121	379		
Total	514	1388	1296	4908	1794	759	203	55	766	433	74	215

Group	CRM 18.5											
	Mar	Apr	May T1	May T2	May T3	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cladocera	179	127			325	4959	1871	121	225	12	22	80
Copepoda	1433	1401		417	54			364	150		22	
Rotifera	179	127	1800	2922	704					58	22	80
Total	1792	1656	1800	3339	1084	4959	1871	485	376	70	65	160

Group	CRM 22.0									
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cladocera		340	1161	10995	174		215		83	108
Copepoda	760	453	774	1795		108	43		28	36
Rotifera		340	7352		58		1508	34		36
Total	760	1132	9287	12790	232	108	1766	34	111	180

Table 55. Percentage composition of major zooplankton taxonomic groups.

Group	CRM 15.5											
	Mar	Apr	May	Jun	Jul	Aug T1	Aug T2	Aug T3	Sep	Oct	Nov	Dec
Cladocera	30	17	12	75	83	50	60	100	47	6	75	50
Copepoda	60	83	29	21	17	50	20	---	37	6	25	50
Rotifera	10	---	59	4	---	---	20	---	16	88	---	---

Group	CRM 18.5											
	Mar	Apr	May T1	May T2	May T3	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cladocera	10	8	---	---	30	100	100	25	60	17	33	50
Copepoda	80	85	---	13	5	---	---	75	40	---	33	---
Rotifera	10	8	100	87	65	---	---	---	---	83	33	50

Group	CRM 22.---									
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cladocera	---	30	12	86	75	---	12	---	75	60
Copepoda	100	40	8	14	---	100	2	---	25	20
Rotifera	---	30	79	---	25	---	85	100	---	20

Table 56. Densities estimates (organisms/m^3) for each zooplankton taxa.

Group		Cladocera									Copepoda		Rotifera						
Taxa		**Bosmina longirostris**	**Chydorus sphaericus**	**Cladocera**	**Daphnia ambigua**	**Daphnia galeata**	**Daphnia lumholtzi**	**Daphnia pulicaria**	**Daphnia retrocurva**	**Diaphanosoma leuchtenbergianum**	**Calanoida**	**Cyclopoida**	**Asplanchna brightwellii**	**Conochilus unicornis**	**Filinia longiseta**	**Kellicottia longispina**	**Lecane**	**Notommatidae**	**Polyarthra vulgaris**
Month	**Site**																		
March	15.5	103				51					51	257	51						
	18.5	179									179	1254	179						
	22.0											760							
April	15.5								231		463	694							
	18.5	127										1401			127				
	22.0				113	226						453		340					
May	15.5	152										381	381	305					76
	18.5	90				18						157	1079	730					
	22.0	1161									387	387	3869	3483					
June	15.5						877		877	1928	175	877					175		
	18.5						1550		930	2480									
	22.0	449	673				224		1122	8526	449	1346							
July	15.5	78					780		390	234	78	234							
	18.5						1871												
	22.0	58					58	58											58
August	15.5	7		12			69		84	14		140	7	7					
	18.5								121		121	243							
	22.0											108							
September	15.5	225										150							
	18.5	161					121			81	81	202	121						
	22.0	215										43	991	431					86
October	15.5						27				27			27				352	
	18.5						12						12					46	
	22.0																	17	17
November	15.5	56										19							
	18.5	22									22							22	
	22.0	83									28								
December	15.5	107										107							
	18.5	80																80	
	22.0	108										36				36			
Total Occurrences		19	1	1	1	3	10	1	7	6	12	21	9	7	1	1	1	5	4

Highlighted values indicate a taxon that was concurrent at all sites in a given month.
Blank values indicate no individuals of the taxon were collected.

Table 57. Percentage composition of total abundance for each zooplankton taxa.

Group		Cladocera									Copepoda		Rotifera						
Taxa — Month	Site	Bosmina longirostris	Chydorus sphaericus	Cladocera	Daphnia ambigua	Daphnia galeata	Daphnia lumholtzi	Daphnia pulicaria	Daphnia retrocurva	Diaphanosoma leuchtenbergianum	Calanoida	Cyclopoida	Asplanchna brightwellii	Conochilus unicornis	Filinia longiseta	Kellicottia longispina	Lecane	Notommatidae	Polyarthra vulgaris
March	15.5	20				10					10	50	10						
	18.5	10									10	70	10						
	22.0											100							
April	15.5								17		33	50							
	18.5	8										85			8				
	22.0				10	20						40		30					
May	15.5	12										29	29	24					6
	18.5	4				1						8	52	35					
	22.0	13									4	4	42	38					
June	15.5						18		18	39	4	18					4		
	18.5						31		19	50									
	22.0	4	5				2		9	67	4	11							
July	15.5	4					43		22	13	4	13							
	18.5						100												
	22.0	25					25	25											25
August	15.5	2		4			20		25	4		41	2	2					
	18.5								25		25	50							
	22.0											100							
September	15.5	60										40							
	18.5	21					16			11	11	26	16						
	22.0	12										2	56	24					5
October	15.5						6				6			6				81	
	18.5						17						17					66	
	22.0																	50	50
November	15.5	75										25							
	18.5	33									33							33	
	22.0	75									25								
December	15.5	50										50							
	18.5	50																50	
	22.0	60										20				20			
Total Occurrences		19	1	1	1	3	10	1	7	6	12	21	9	7	1	1	1	5	4

Highlighted values indicate a taxon that was concurrent at all sites in a given month.
Percentages are rounded to whole numbers, and values may not add to 100. Blank values indicate no individuals of the taxon were collected.

Table 58. Zooplankton taxa and density (organisms/m^3) estimates for samples collected monthly at Clinch River Mile 15.5 near the proposed Small Modular Reactor site on the Clinch River – March through December 2011.

	CRM 15.5											
	Mar	Apr	May	Jun	Jul	Aug			Sep	Oct	Nov	Dec
Group / Taxon						T1	T2	T3				
Cladocera												
Cladocera								37				
Diplostraca												
Bosminidae												
Bosmina longirostris	103		152		78	20			161		56	107
Daphniidae												
Daphnia galeata	51											
Daphnia lumholtzi				877	780		190	18	121	27		
Daphnia retrocurva		231		877	390	61	190					
Sididae												
Diaphanosoma leuchtenbergianum				1928	234	41			81			
Cladocera Total	154	231	152	3681	1482	122	380	55	363	27	56	107
Copepoda												
Calanoida												
Calanoida	51	463		175	78				81	27		
Diaptomidae												
Diaptomus sp.				175								
Cyclopoida												
Cyclopoida	206	694	381	701	234	20	190		202		19	
Cyclops sp.	51					20	190					107
Copepoda Total	309	1156	381	1052	312	41	380		282	27	19	107
Rotifera												
Flosculariaceae												
Conochilidae												
Conochilus unicornis			305			20				27		
Ploima												
Lecanidae												
Lecane sp.				175								
Synchaetidae												
Polyarthra vulgaris			76									
Asplanchnidae												
Asplanchna rightwellii	51		381			20			121			
Notommatidae										352		
Rotifera Total	51		762	175		41			121	379		
Total Count – CRM 15.5	**514**	**1388**	**1296**	**4908**	**1794**	**203**	**759**	**55**	**766**	**433**	**74**	**215**

Counts are rounded to whole numbers.

Abbreviations "T1", T2 and "T3" designate replicate plankton net tows

Table 59. Zooplankton taxa and density (organisms/m^3) estimates for samples collected monthly at Clinch River Mile 18.5 near the proposed Small Modular Reactor site on the Clinch River – March through December 2011.

		CRM 15.5											
		Mar	Apr	May	Jun	Jul	Aug			Sep	Oct	Nov	Dec
Group	Taxon						T1	T2	T3				
Cladocera													
	Cladocera								37				
	Diplostraca												
	Bosminidae												
	Bosmina longirostris	103		152		78	20			161		56	107
	Daphniidae												
	Daphnia galeata	51											
	Daphnia lumholtzi				877	780		190	18	121	27		
	Daphnia retrocurva		231		877	390	61	190					
	Sididae												
	Diaphanosoma leuchtenbergianum				1928	234	41			81			
	Cladocera Total	154	231	152	3681	1482	122	380	55	363	27	56	107
Copepoda													
	Calanoida												
	Calanoida	51	463		175	78				81	27		
	Diaptomidae												
	Diaptomus sp.				175								
	Cyclopoida												
	Cyclopoida	206	694	381	701	234	20	190		202		19	
	Cyclops sp.	51					20	190					107
	Copepoda Total	309	1156	381	1052	312	41	380		282	27	19	107
Rotifera													
	Flosculariaceae												
	Conochilidae												
	Conochilus unicornis			305			20				27		
	Ploima												
	Lecanidae												
	Lecane sp.				175								
	Synchaetidae												
	Polyarthra vulgaris			76									
	Asplanchnidae												
	Asplanchna rightwellii	51		381			20			121			
	Notommatidae										352		
	Rotifera Total	51		762	175		41			121	379		
Total Count – CRM 18.5		**514**	**1388**	**1296**	**4908**	**1794**	**203**	**759**	**55**	**766**	**433**	**74**	**215**

Counts are rounded to whole numbers.

Abbreviations “T1”, T2 and “T3” designate replicate plankton net tows

Table 60. Zooplankton taxa and density (organisms/m^3) estimates for samples collected monthly at Clinch River Mile 22.0 near the proposed Small Modular Reactor site on the Clinch River – March through December 2011.

		CRM 22.0									
Group	**Taxon**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Cladocera											
	Diplostraca										
	Bosminidae										
	Bosmina longirostris			1161	449	58		215		83	108
	Chydoridae										
	Chydorus sphaericus				673						
	Daphiniidae										
	Daphnia ambigua		113								
	Daphnia galeata		226								
	Daphnia lumholtzi				224	58					
	Daphnia retrocurva				1122						
	Daphnia pulicaria					58					
	Sididae										
	Diaphanosoma leuchtenbergianum				8526						
	Cladocera Total		340	1161	10995	174		215		83	108
Copepoda											
	Calanoida										
	Calanoida			387	449					28	
	Diaptomidae										
	Diaptomus sp.				224						
	Cyclopoida										
	Cyclopoida	380	453	387	1122		108	43			
	Cyclopidae										
	Cyclops sp.	190									36
	Tropocyclops prasinus	190									
	Copepoda Total	760	453	774	1795		108	43		28	36
Rotifera											
	Flosculariaceae										
	Conochilidae										
	Conochilus unicornis		340	3483				431			
	Ploima										
	Brachionidae										
	Kellicottia longispina										36
	Synchaetidae										
	Polyarthra vulgaris					58		86	17		
	Asplanchnidae										
	Asplanchna brightwellii			3869				991			
	Notommatidae								17		
	Rotifera Total		340	7352		58		1508	34		36
Total Count – CRM 22.0		**760**	**1132**	**9287**	**12790**	**232**	**108**	**1766**	**34**	**111**	**180**

Counts are rounded to whole numbers.

Table 61. Biomass estimates (µg/m^3) for each zooplankton taxa.

Group		Cladocera									Copepoda		Rotifera						
Taxa																			
Month	**Site**	**Bosmina longirostris**	**Chydorus sphaericus**	**Cladocera**	**Daphnia ambigua**	**Daphnia galeata**	**Daphnia lumholtzi**	**Daphnia pulicaria**	**Daphnia retrocurva**	**Diaphanosoma leuchtenbergianum**	**Calanoida**	**Cyclopoida**	**Asplanchna brightwellii**	**Conochilus unicornis**	**Filinia longiseta**	**Kellicottia longispina**	**Lecane**	**Notommatidae**	**Polyarthra vulgaris**
March	15.5	141				445					12	450	46						
	18.5	334									32	3563	160						
	22.0											1184							
April	15.5								640		48	736							
	18.5	237										3597			2				
	22.0				332	2434						241		2					
May	15.5	107										273	339	1					3
	18.5	84				234						431	960	4					
	22.0	951									70	272	3444	30					
June	15.5						5140		2996	4690	920	376					1		
	18.5						26215		1367	5853									
	22.0	802	268				4798		5953	20935	1599	471							
July	15.5	82					34329		2051	474	219	276							
	18.5						42255												
	22.0	108					3140	234											1
August	15.5	7		6			763		246	33		398	6	0					
	18.5								191		12	831							
	22.0											37							
September	15.5	170					4296			187	16	189	40						
	18.5	217									322	334							
	22.0	184										24	532	6					7
October	15.5						1361				7			1				5	
	18.5						673						3					2	
	22.0																	1	0
November	15.5	44										19							
	18.5	30									2							0	
	22.0	58									53								
December	15.5	46										535							
	18.5	34																1	
	22.0	83										160				0			

Highlighted values indicate a taxon that was concurrent at all sites in a given month.
To enhance pattern recognition, densities are rounded to whole numbers. "0" values indicate densities less than 0.5 organisms/m^3.
Blank values indicate no individuals of the taxon were collected.

Table 62. Percentage composition of total biomass for each zooplankton taxa.

Group		Cladocera									Copepoda		Rotifera						
Taxa		Bosmina longirostris	Chydorus sphaericus	Cladocera	Daphnia ambigua	Daphnia galeata	Daphnia lumholtzi	Daphnia pulicaria	Daphnia retrocurva	Diaphanosoma leuchtenbergianum	Calanoida	Cyclopoida	Asplanchna brightwellii	Conochilus unicornis	Filinia longiseta	Kellicottia longispina	Lecane	Notommatidae	Polyarthra vulgaris
Month	**Site**																		
March	15.5	13				41					1	41	4						
	18.5	8									1	87	4						
	22.0											100							
April	15.5								45		3	52							
	18.5	6										94			0				
	22.0				11	81						8		0					
May	15.5	15										38	47	0					0
	18.5	5				14						25	56	0					
	22.0	20									1	6	72	1					
June	15.5						36		21	33	7	3					0		
	18.5						78		4	18									
	22.0	2	1				14		17	60	5	1							
July	15.5	0					92		5	1	1	1							
	18.5						100												
	22.0	3					90	7											0
August	15.5	0		0			52		17	2		27	0	0					
	18.5								18		1	80							
	22.0											100							
September	15.5	3					88			4	0	4	1						
	18.5	25									37	38							
	22.0	24										3	71	1					1
October	15.5						99				1			0				0	
	18.5						99						1					0	
	22.0																	60	40
November	15.5	70										30							
	18.5	94									5							1	
	22.0	52									48								
December	15.5	8										92							
	18.5	97																3	
	22.0	34										66				0			

Highlighted values indicate a taxon that was concurrent at all sites in a given month.
Percentages are rounded to whole numbers, and values may not add to 100. "0" values indicate percentages less than 0.5%.
Blank values indicate no individuals of a taxon were collected.

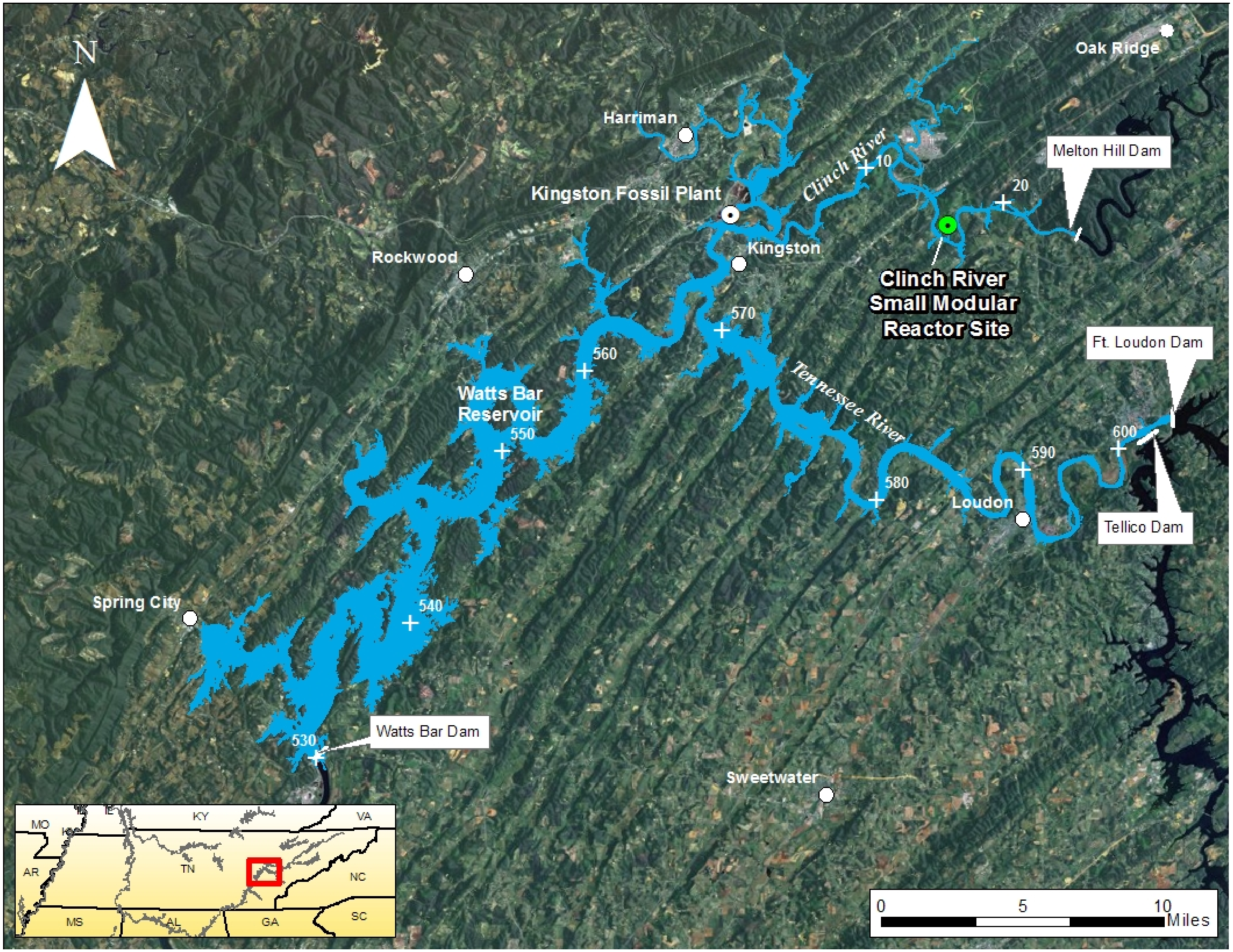

Figure 1. Location of the Clinch River SMR site, Roane County, Tennessee.

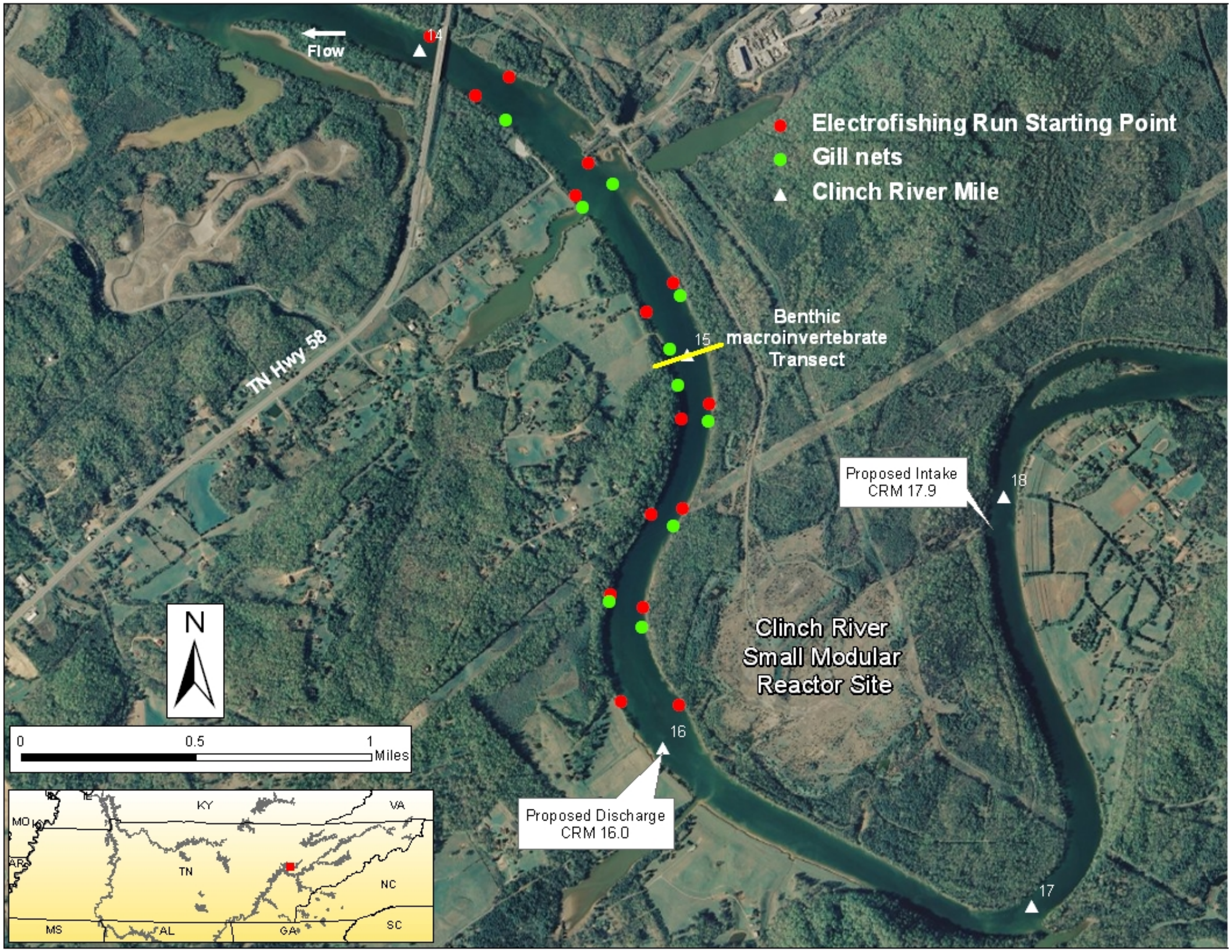

Figure 2. Electrofishing, gill net, benthic macroinvertebrate and plankton community sampling locations downstream of the proposed Clinch River SMR site.

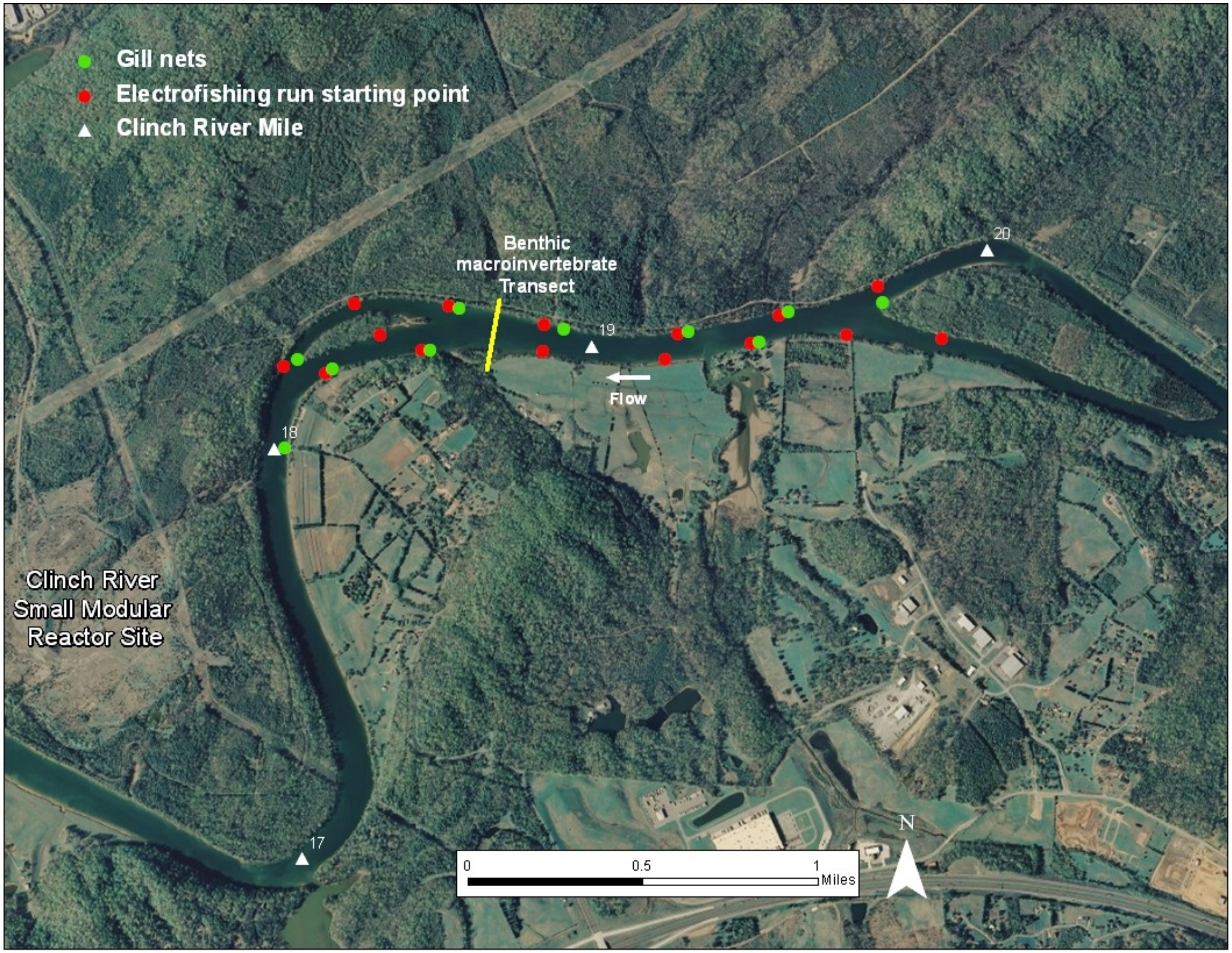

Figure 3. Electrofishing, gill net, benthic macroinvertebrate, and plankton community sampling locations upstream of the proposed Clinch River SMR site.

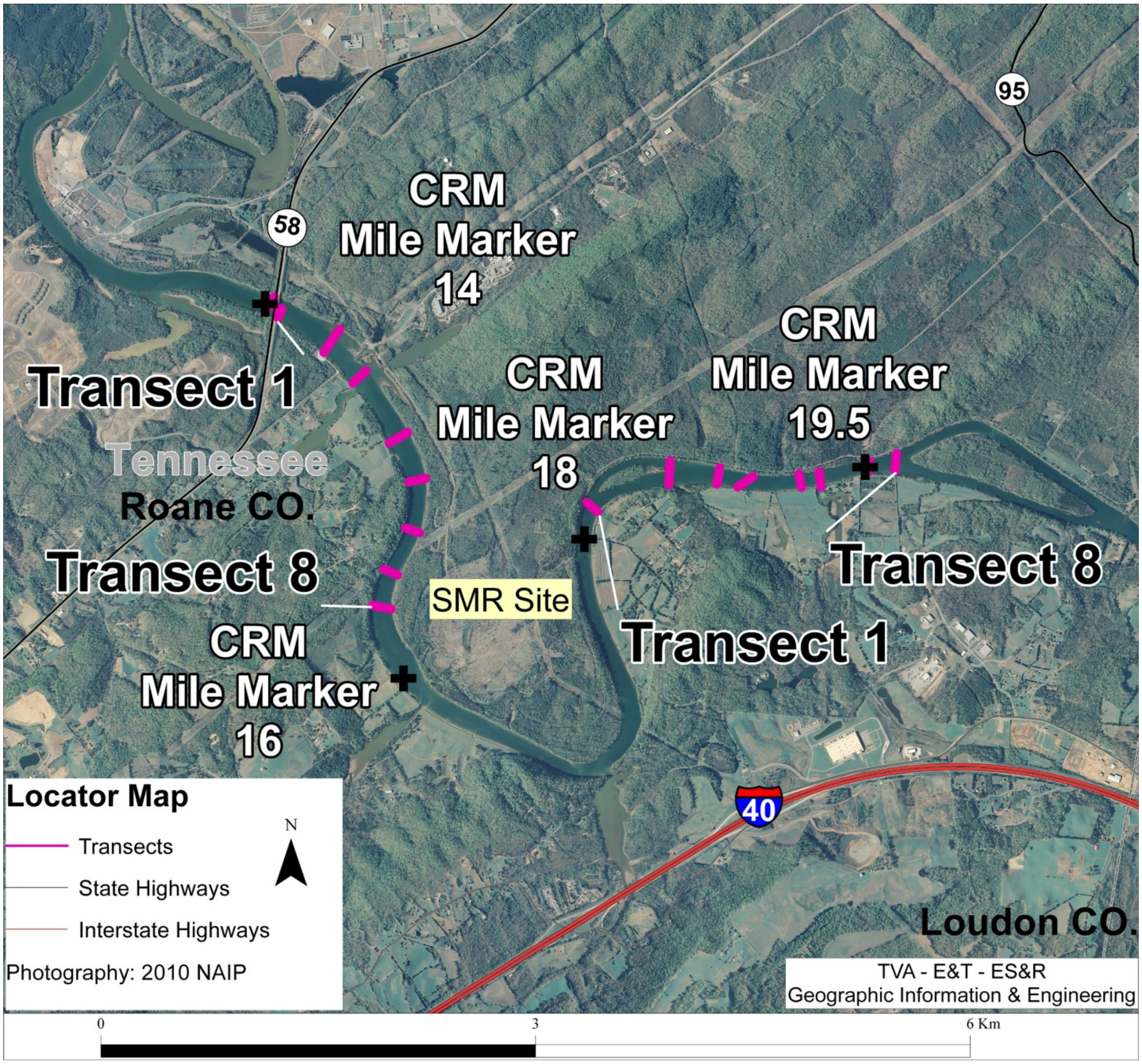

Figure 4. Locations of benthic habitat transects evaluated downstream and upstream of the SMR site. Shoreline habitat was evaluated at the endpoints of each transect.

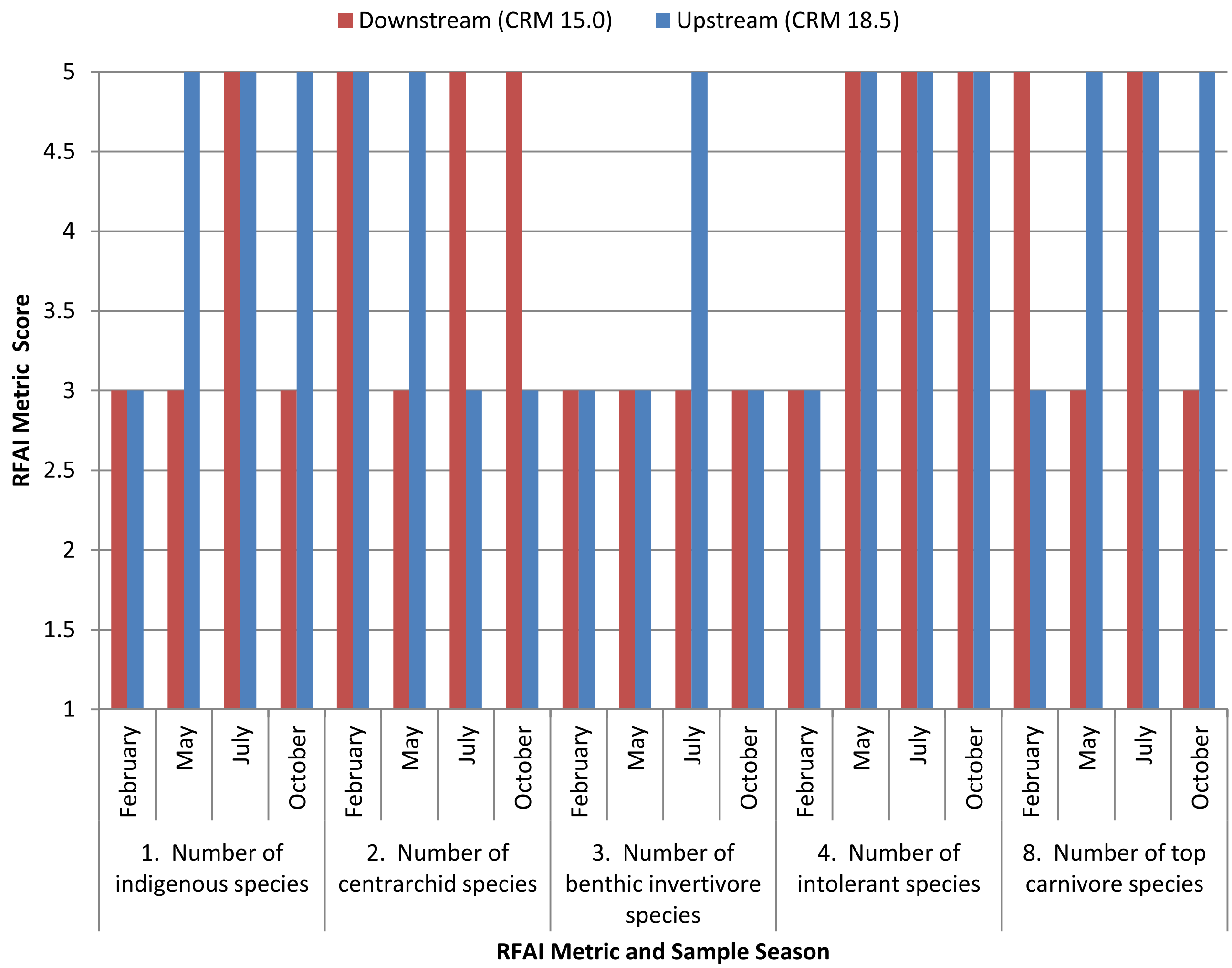

Figure 5. Selected RFAI metrics compared by sample station and by season for discussion of BIP characteristic 1: "A biotic community characterized by diversity appropriate to the ecoregion", in assessment of the fish community at the proposed SMR site.

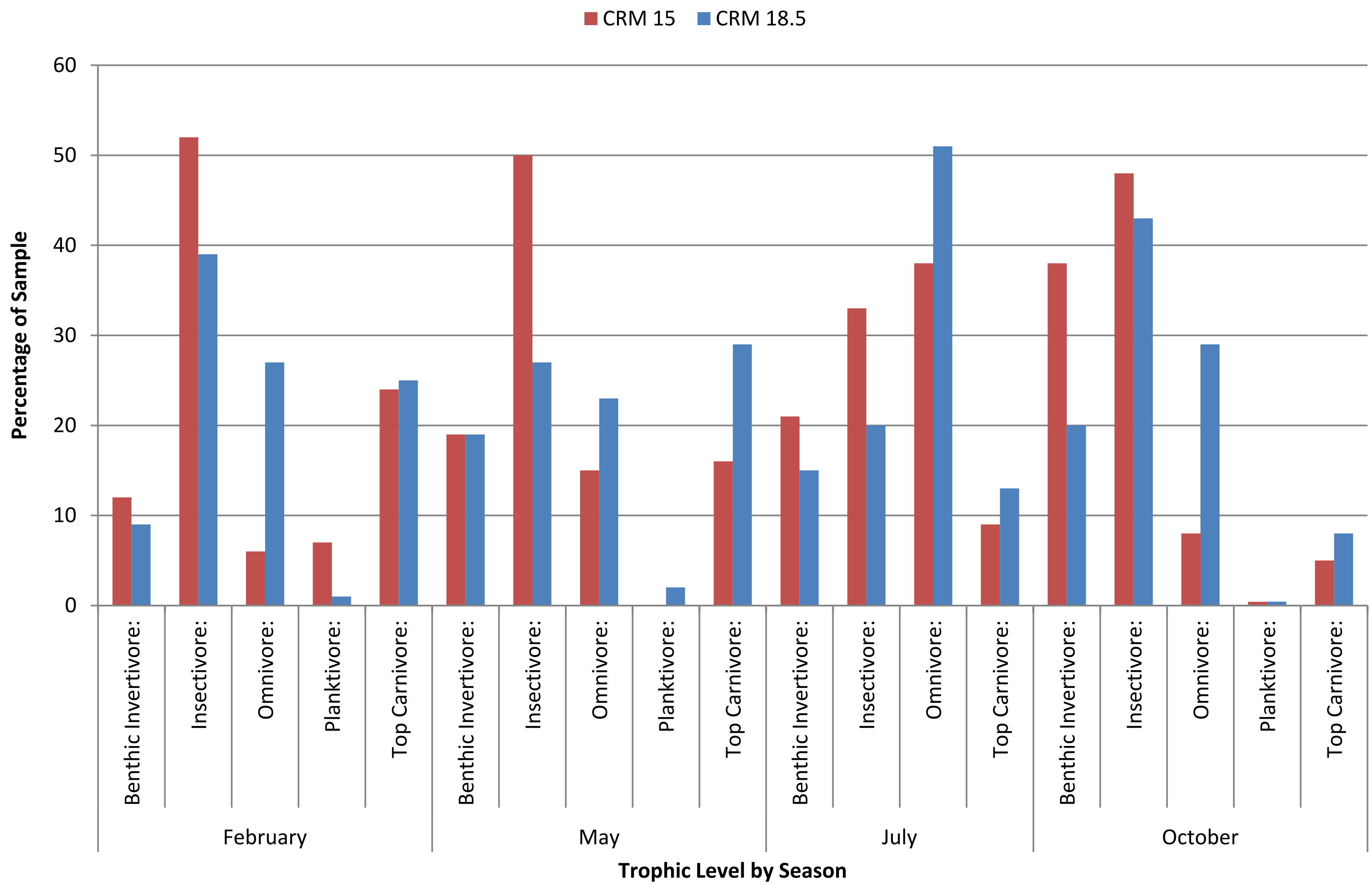

Figure 6. Percent composition each season, by trophic level, of the fish community sampled in 2011 upstream (CRM 18.5) and downstream (CRM 15) of the SMR site. Herbivores (Central stoneroller) were only collected during July at CRM 18.5 and only constituted 0.2 % of the sample, and therefore, were not included in chart.

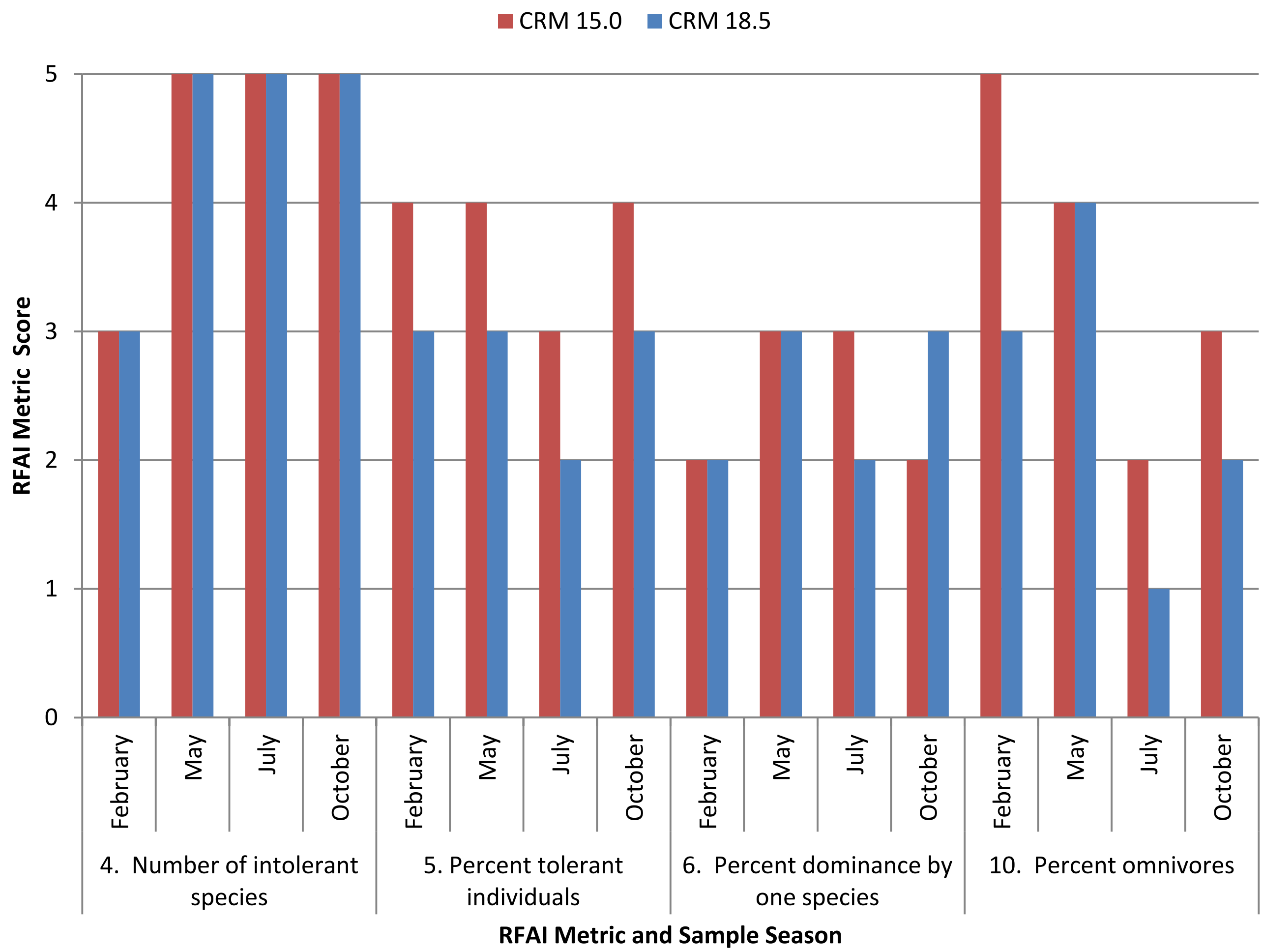

Figure 7. Selected RFAI metrics compared by sample station and by season for discussion of BIP characteristic 4: "A lack of domination by pollution tolerant species", in assessment of the fish community at the proposed SMR site on the Clinch River.

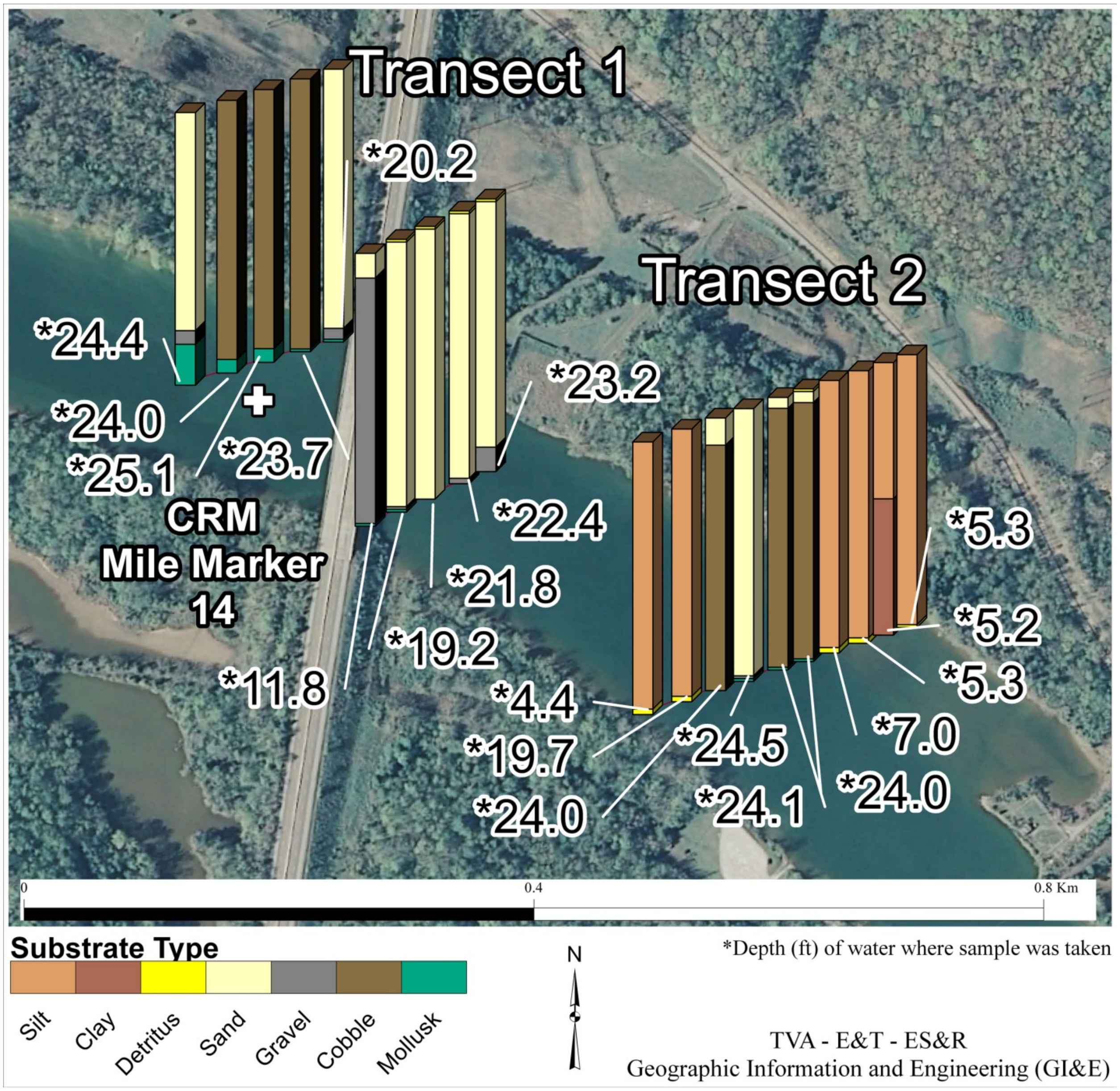

Figure 8. Substrate composition at ten equally spaced points per transect across the Clinch River downstream of the SMR site. *Water depth (ft) at each point is denoted. Transects 1 and 2 are the furthest downstream of the eight transects downstream of the SMR site.

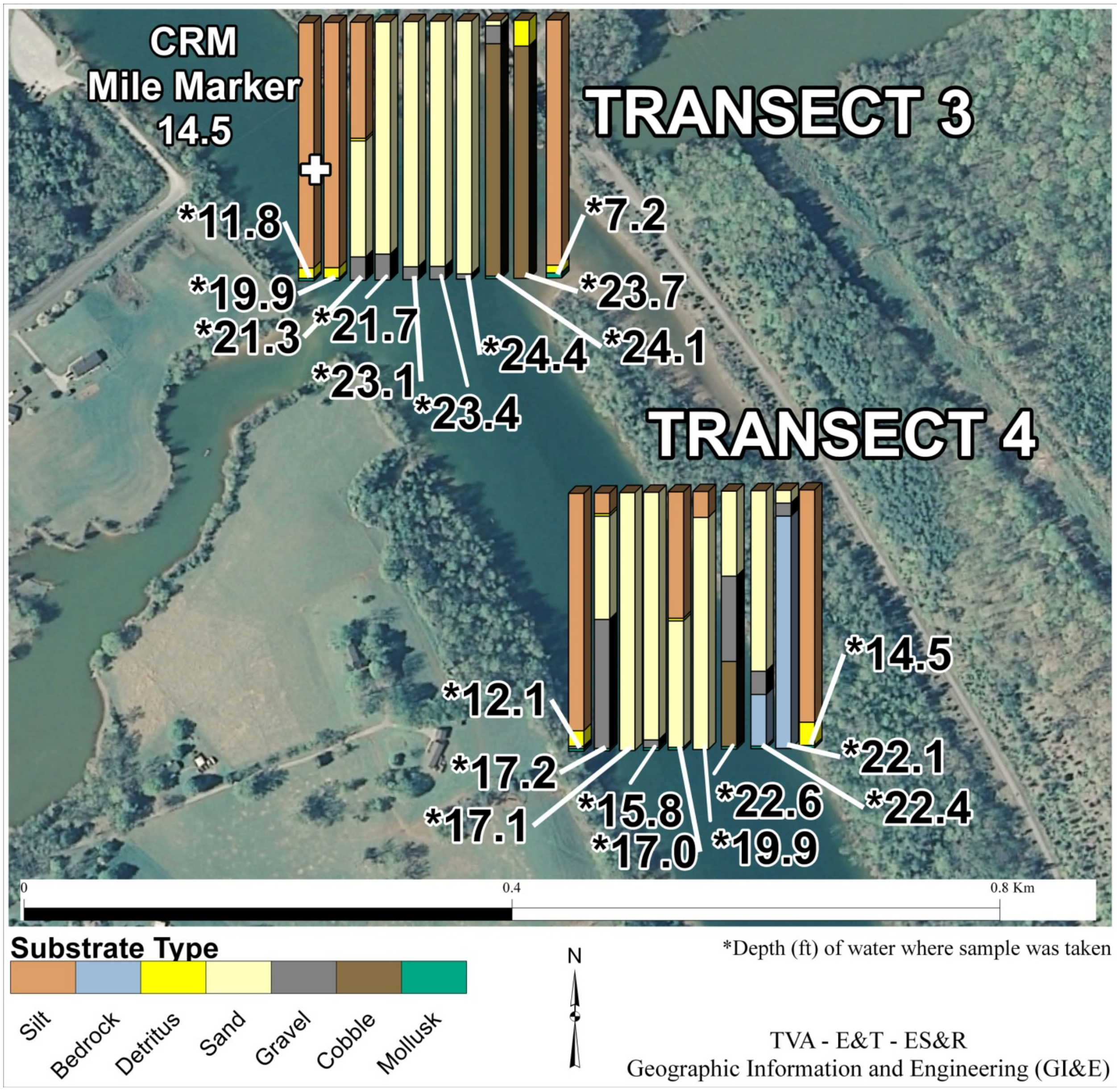

Figure 9. Substrate composition at ten equally spaced points per transect for transects 3 and 4 across the Clinch River downstream of the SMR site. *Water depth (ft) at each point is denoted.

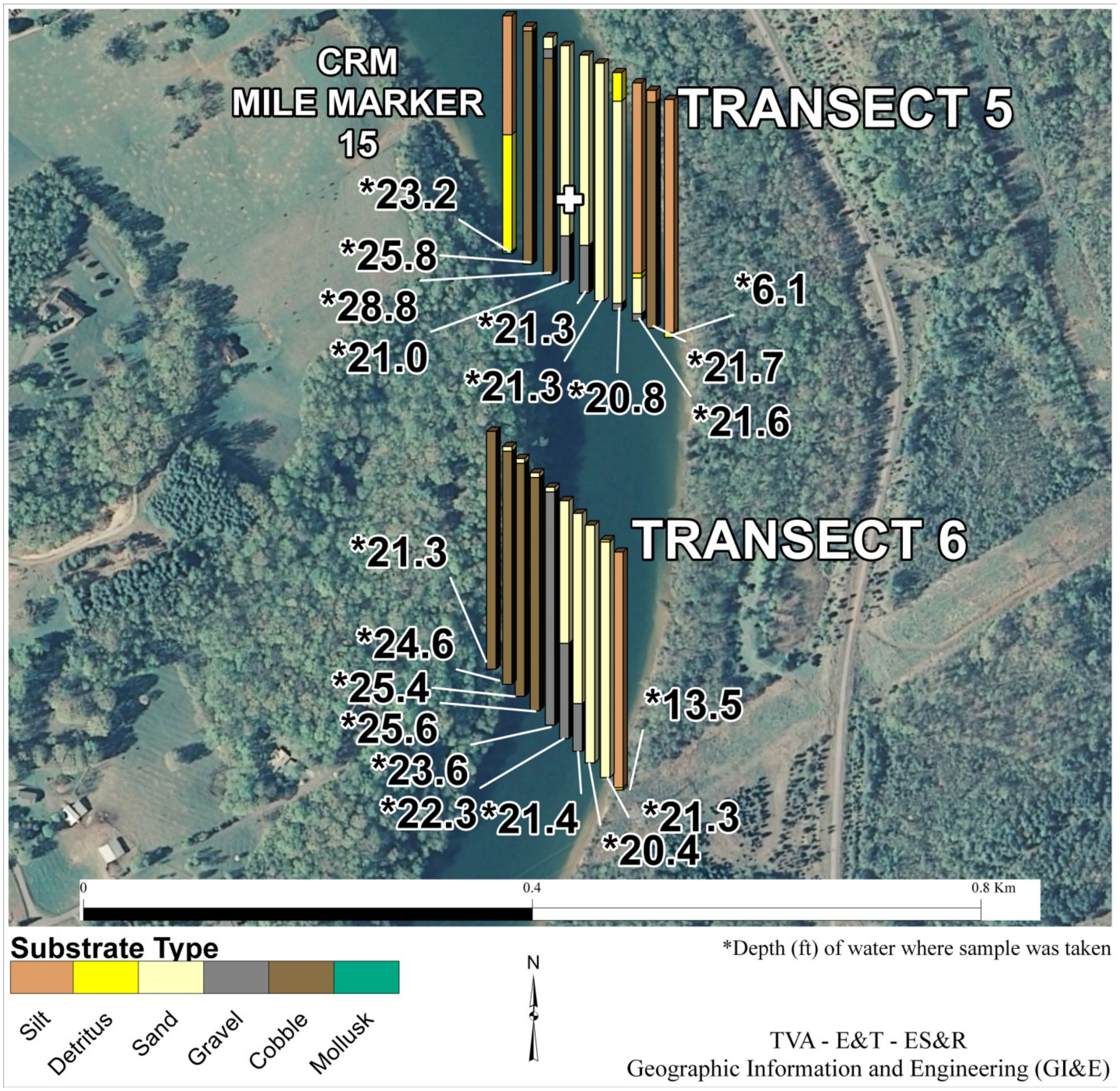

Figure 10. Substrate composition at ten equally spaced points per transect for transects 5 and 6 across the Clinch River downstream of the SMR site. *Water depth (ft) at each point is denoted.

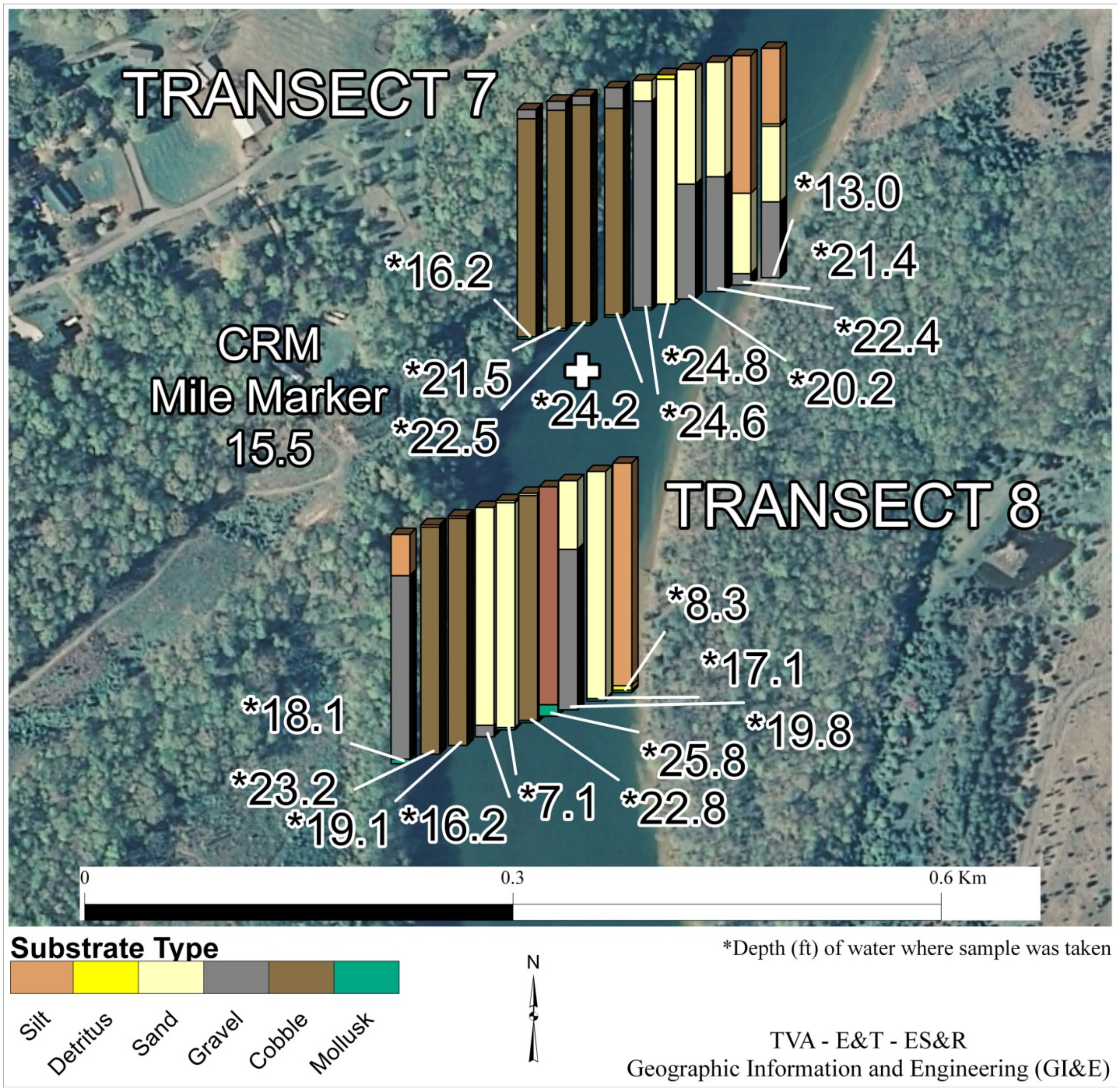

Figure 11. Substrate composition at ten equally spaced points per transect for transects 7 and 8 across the Clinch River downstream of the SMR site. *Water depth (ft) at each point is denoted. Transects 7 and 8 are the most upstream of the eight transects downstream of the SMR site.

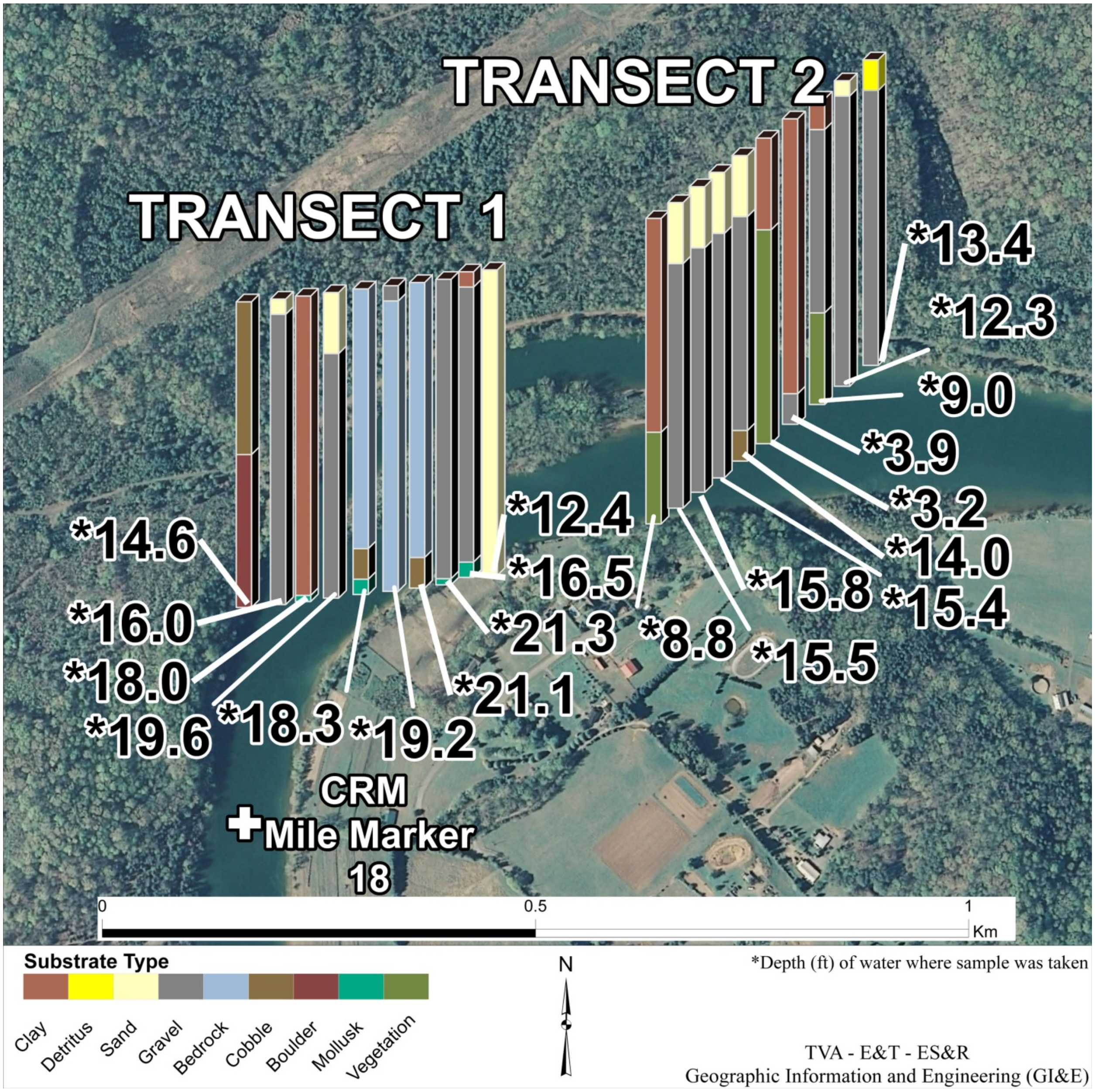

Figure 12. Substrate composition at ten equally spaced points per transect for transects 1 and 2 across the Clinch River upstream of the SMR site. *Water depth (ft) at each point is denoted. Transects 1 and 2 are the most downstream of the eight transects upstream of the SMR site.

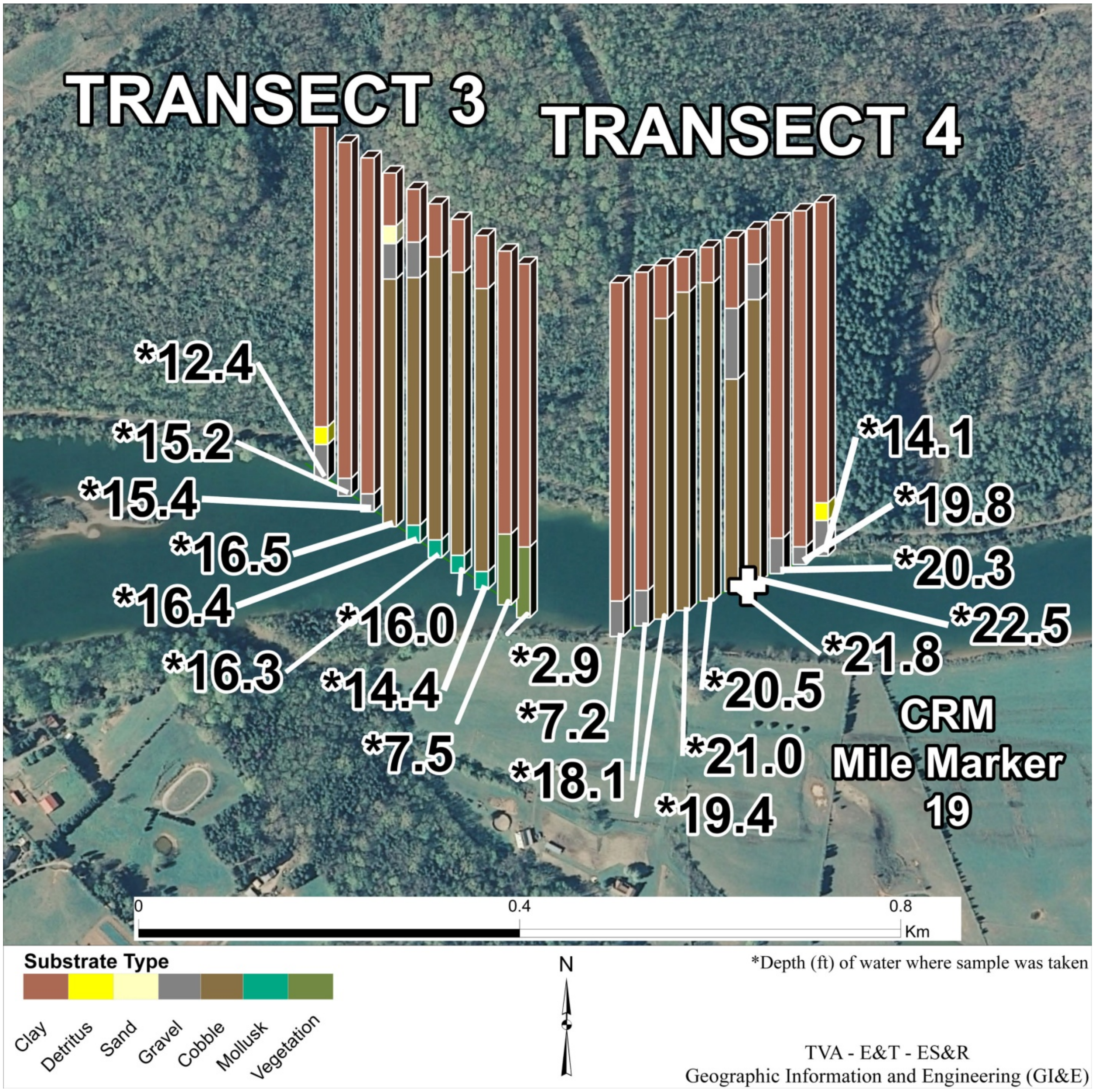

Figure 13. Substrate composition at ten equally spaced points per transect for transects 3 and 4 across the Clinch River downstream of the SMR site. *Water depth (ft) at each point is denoted.

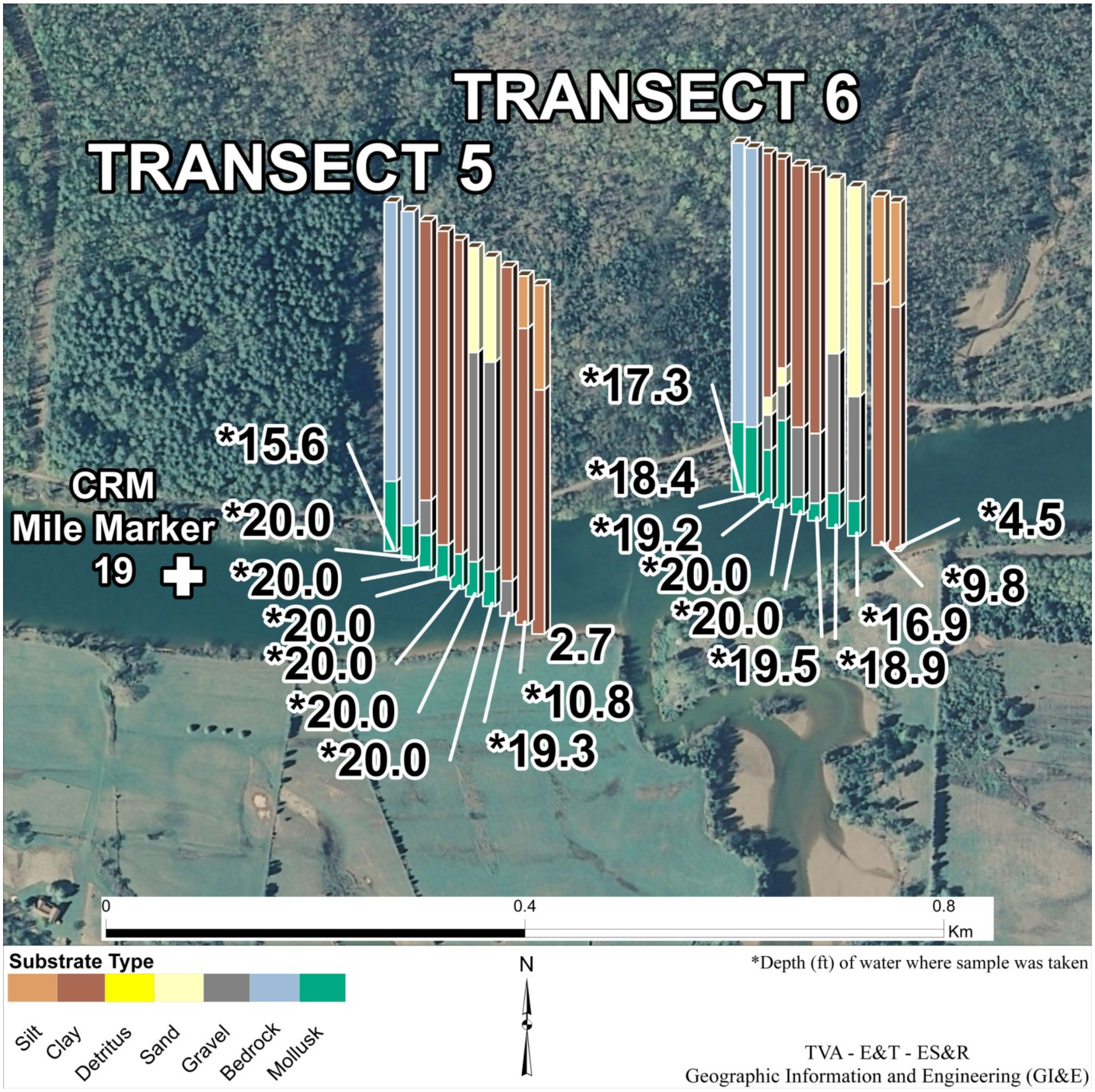

Figure 14. Substrate composition at ten equally spaced points per transect for transects 5 and 6 across the Clinch River downstream of the SMR site. *Water depth (ft) at each point is denoted.

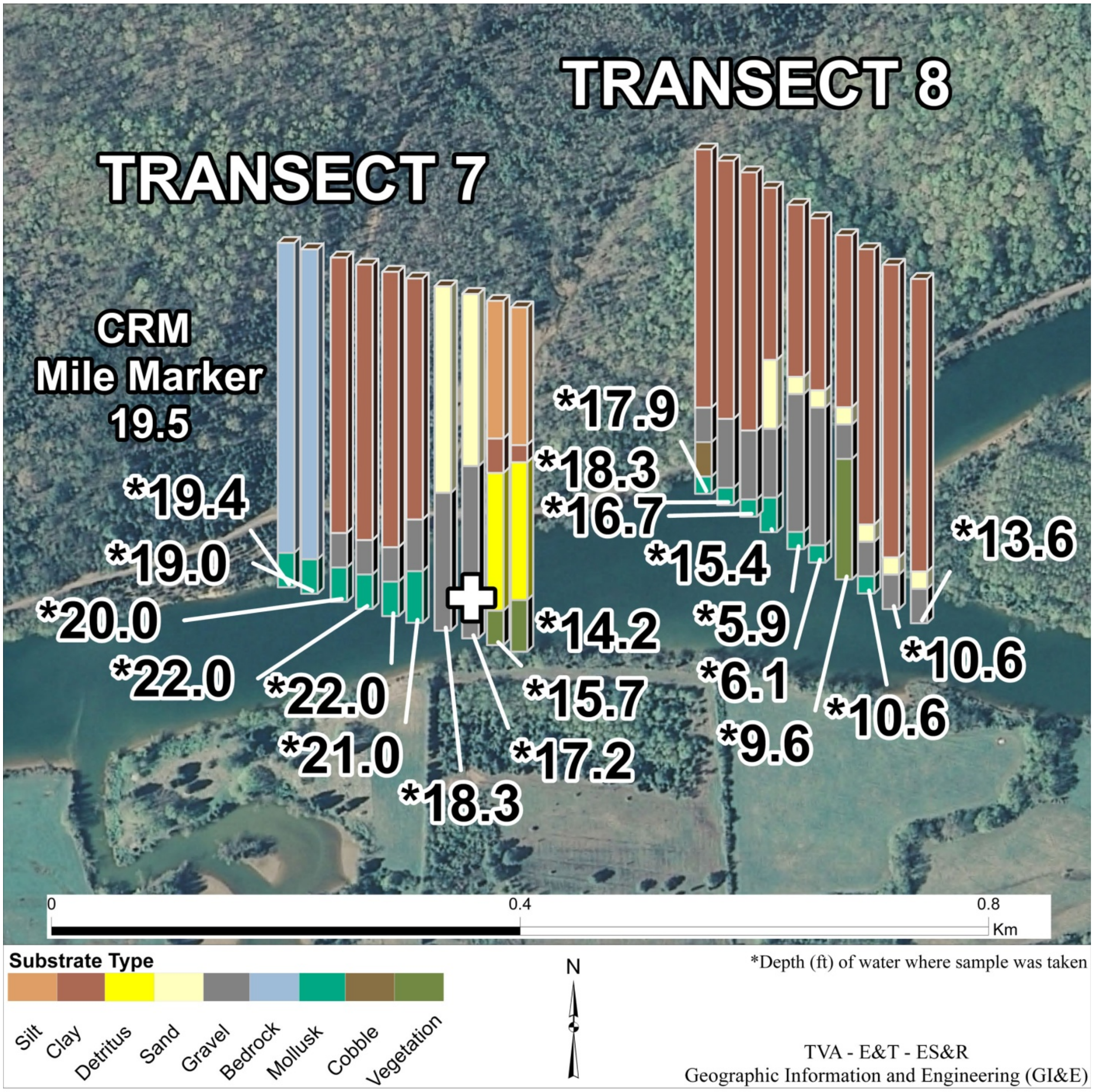

Figure 15. Substrate composition at ten equally spaced points per transect for transects 7 and 8 across the Clinch River downstream of the SMR site. *Water depth (ft) at each point is denoted. Transects 7 and 8 are the furthest upstream of the eight transects upstream of the SMR site.

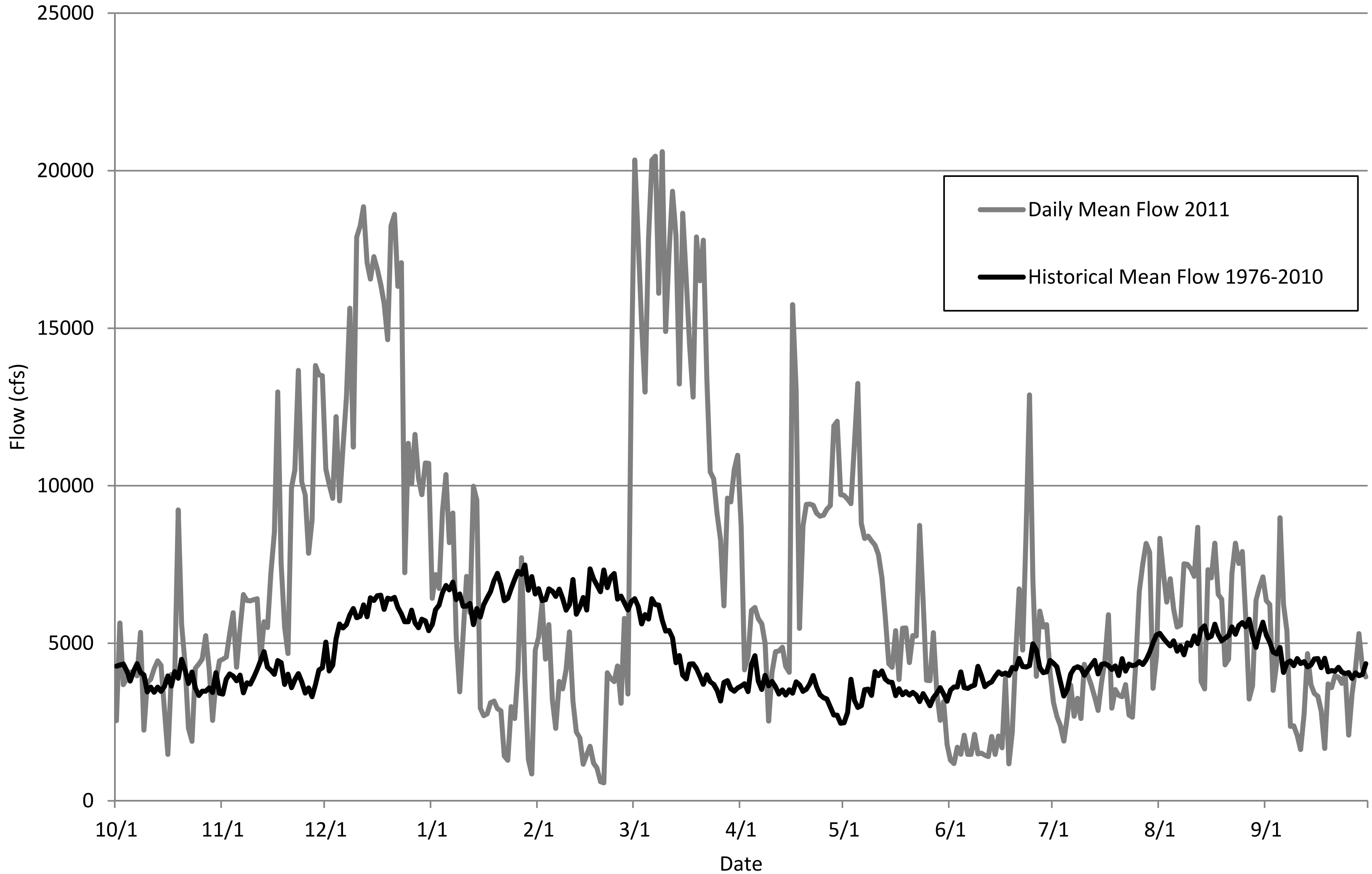

Figure 16. Daily mean flow (cubic feet per second) from Melton Hill Dam passing the SMR site on the Clinch River, October 2010 through October 2011.

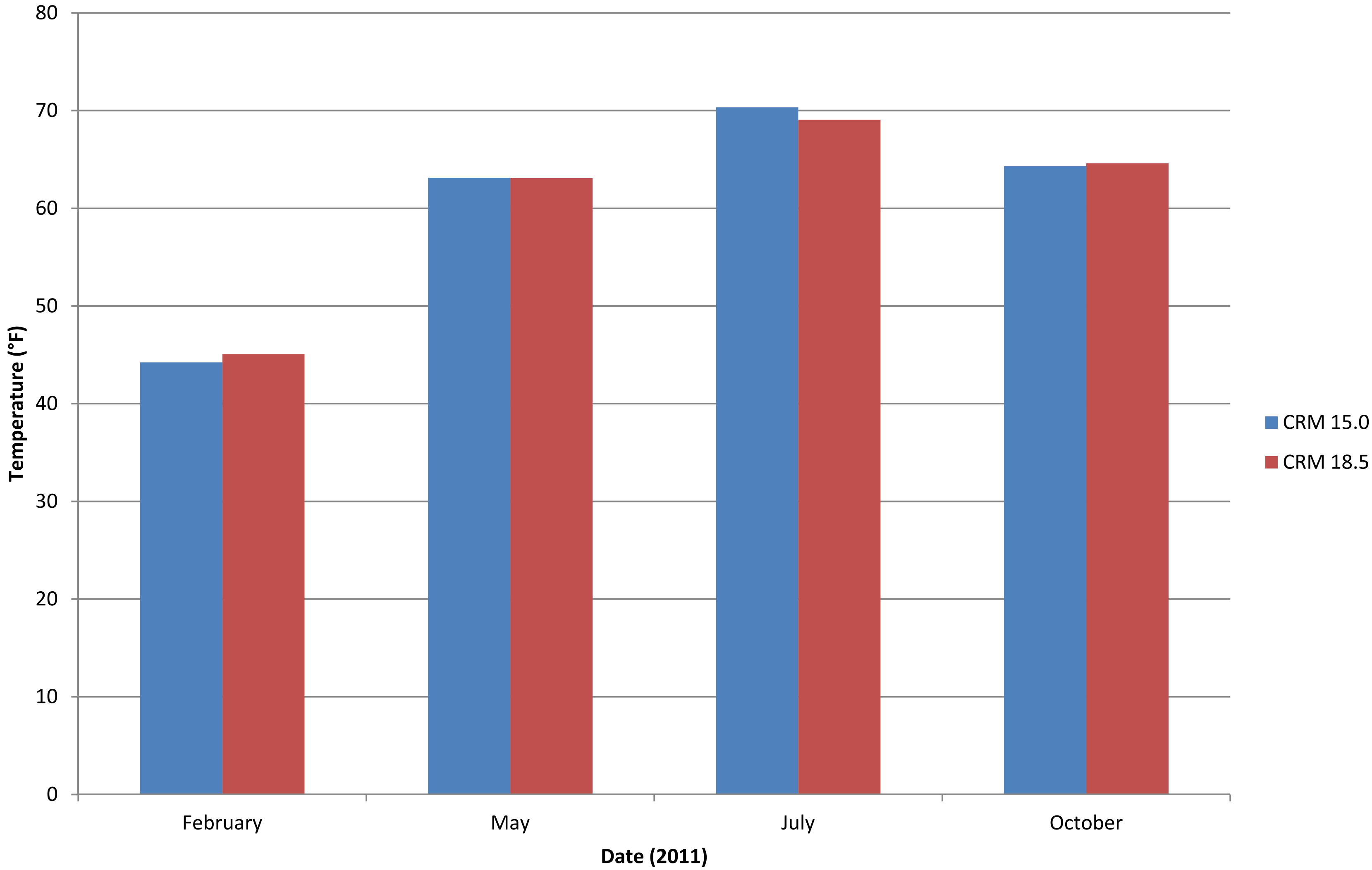

Figure 17. Seasonal average water temperatures at RFAI sample stations upstream (CRM 18.5) and downstream (CRM 15) of the SMR site. Mean values were calculated over all data points collected at a station (from US to DS boundary, from RDB to LDB, and over depth).

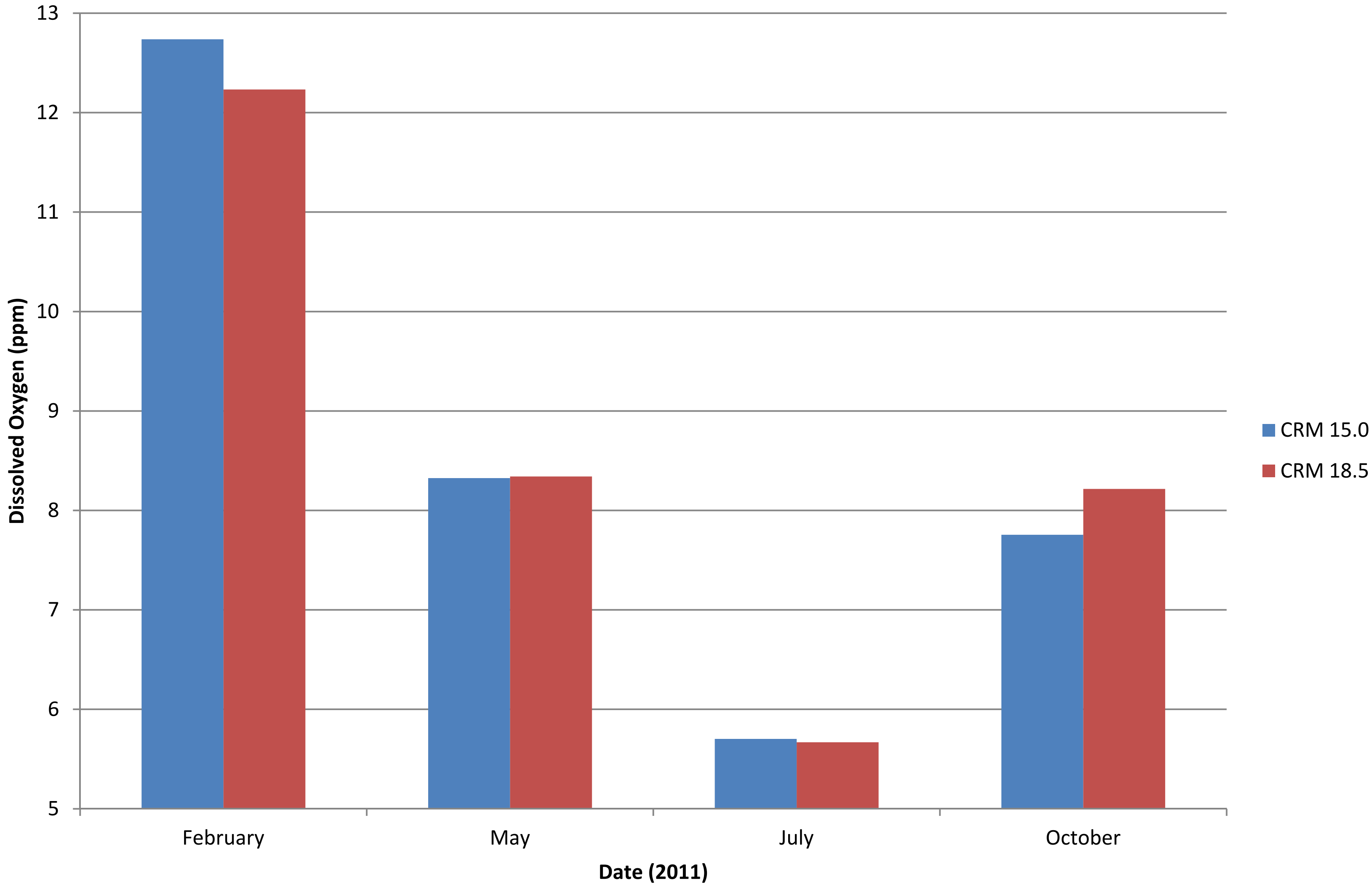

Figure 18. Seasonal average dissolved oxygen concentrations at RFAI sample stations upstream (CRM 18.5) and downstream (CRM 15) of the SMR site. Mean values were calculated over all data points collected at a station (from US to DS boundary, from RDB to LDB, and over depth).

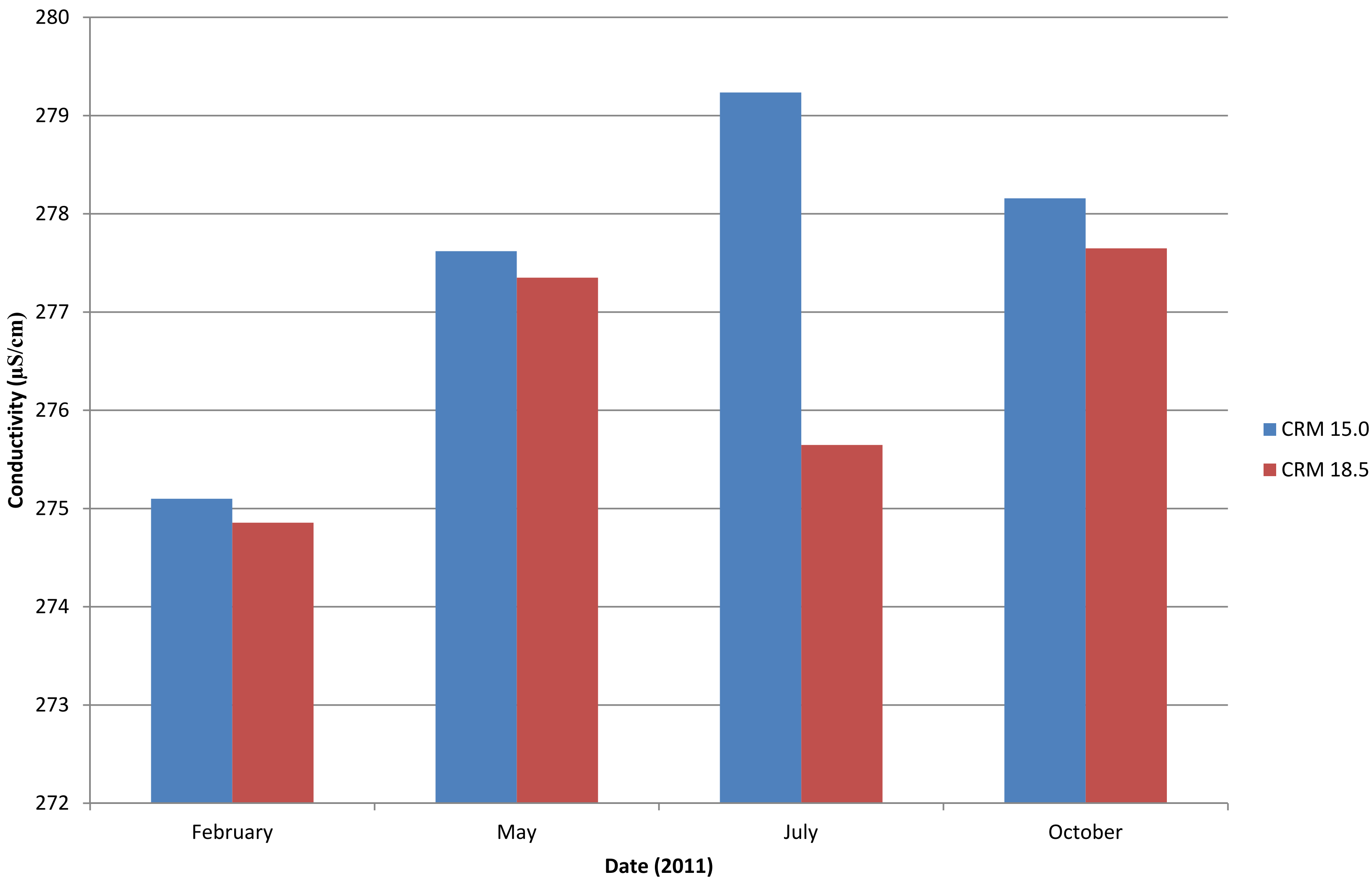

Figure 19. Seasonal average conductivity values at RFAI sample stations upstream (CRM 18.5) and downstream (CRM 15) of the SMR site. Mean values were calculated over all data points collected at a station (from US to DS boundary, from RDB to LDB, and over depth).

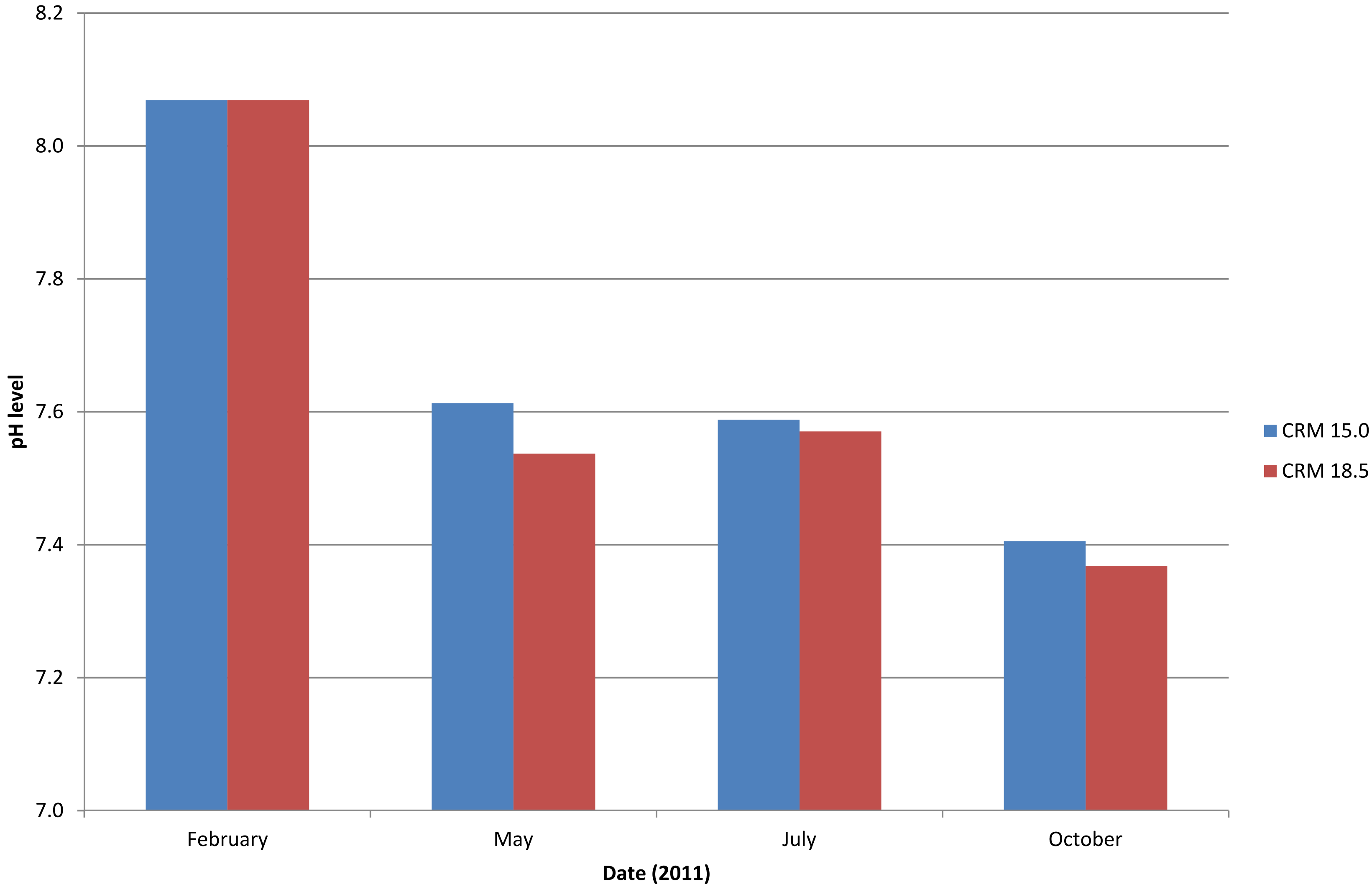

Figure 20. Seasonal average pH values at RFAI sample stations upstream (CRM 18.5) and downstream (CRM 15) of the SMR site. Mean values were calculated over all data points collected at a station (from US to DS boundary, from RDB to LDB, and over depth).

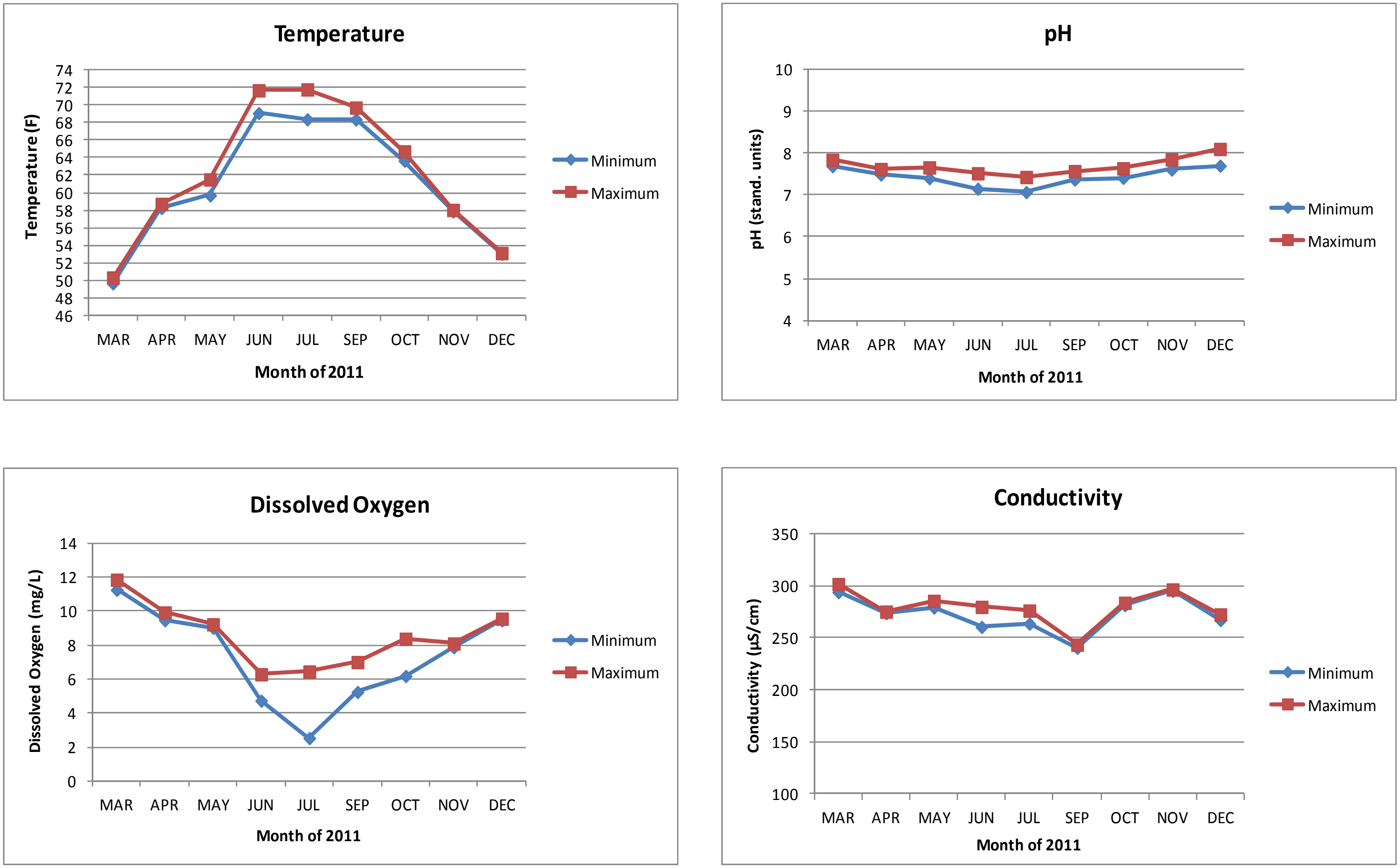

Figure 21. The maximum and minimum values observed for water temperature, dissolved oxygen, pH, and conductivity across all monitoring locations (CRMs 15.5, 18.5, 19.8, and 22.0) each month during March through December 2011. Figures show the maximum variation in these parameters each month.

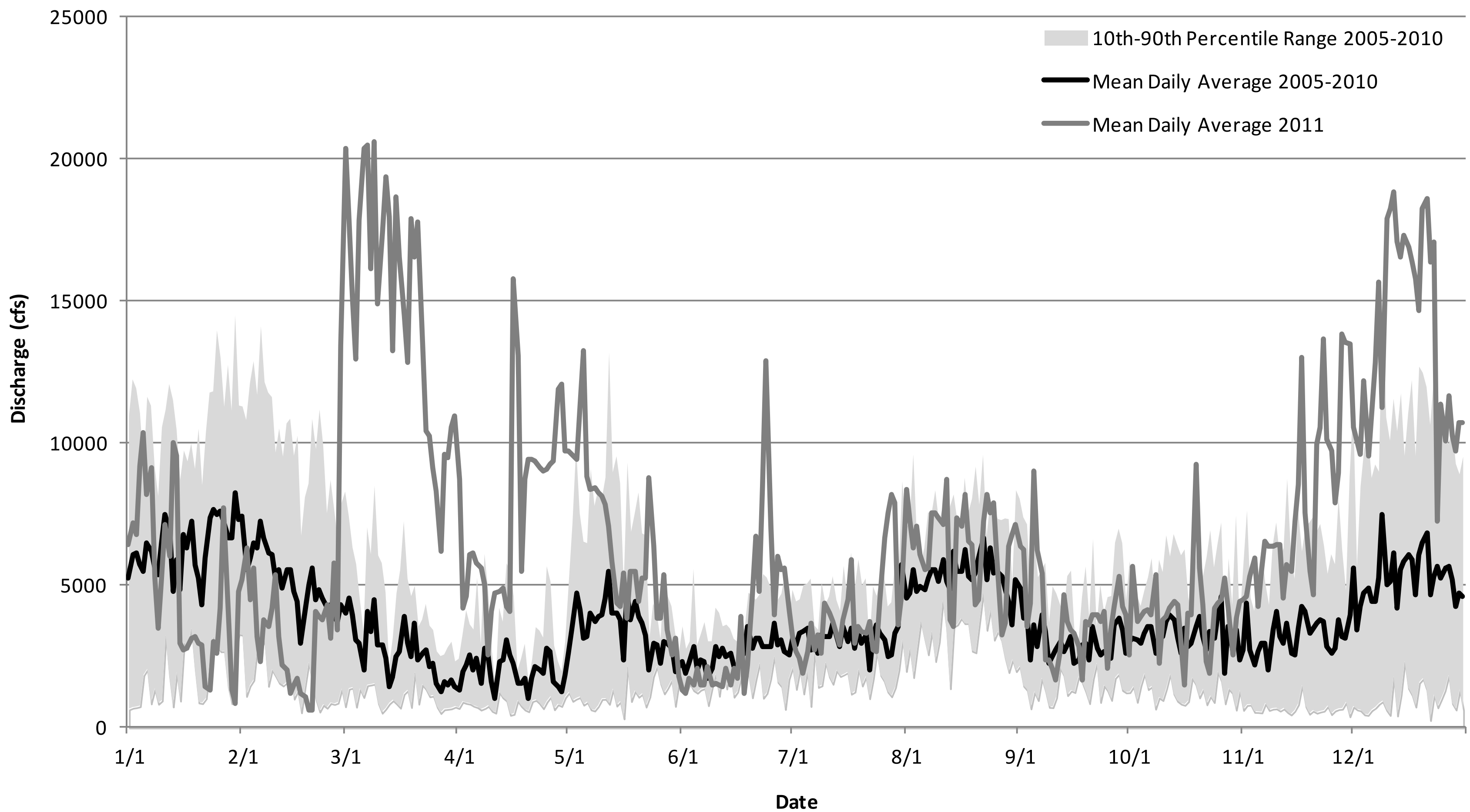

Figure 22. Daily average releases (cfs) from Melton Hill Dam January through December 2011. Daily average releases for the period 2005 to 2010 bound by the 10th to 90th percentile range are shown for comparison.

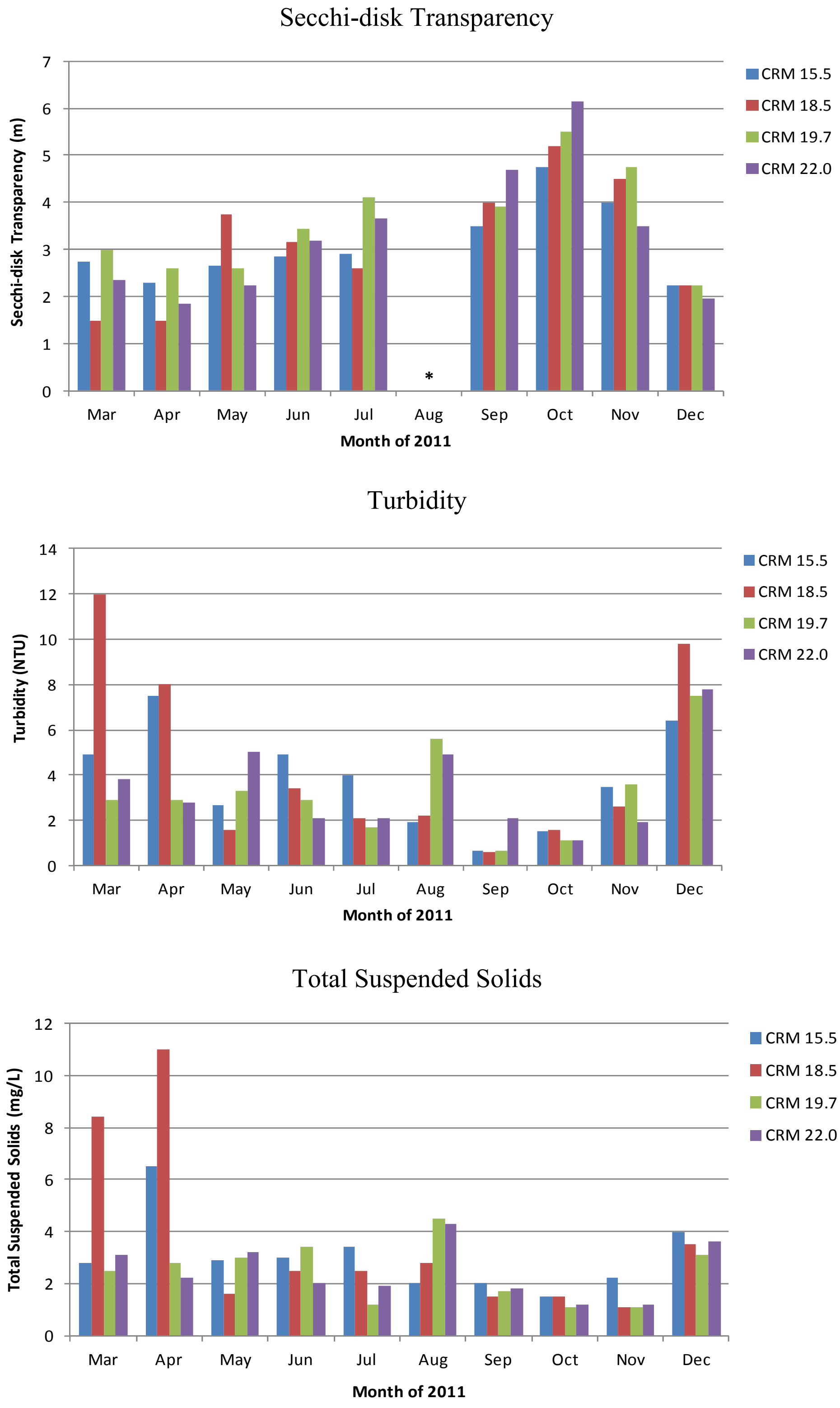

Figure 23. Secchi-disk transparency, turbidity, and total suspended solids results for samples collected monthly, March through December 2011. ***Data not available due to equipment malfunction.***

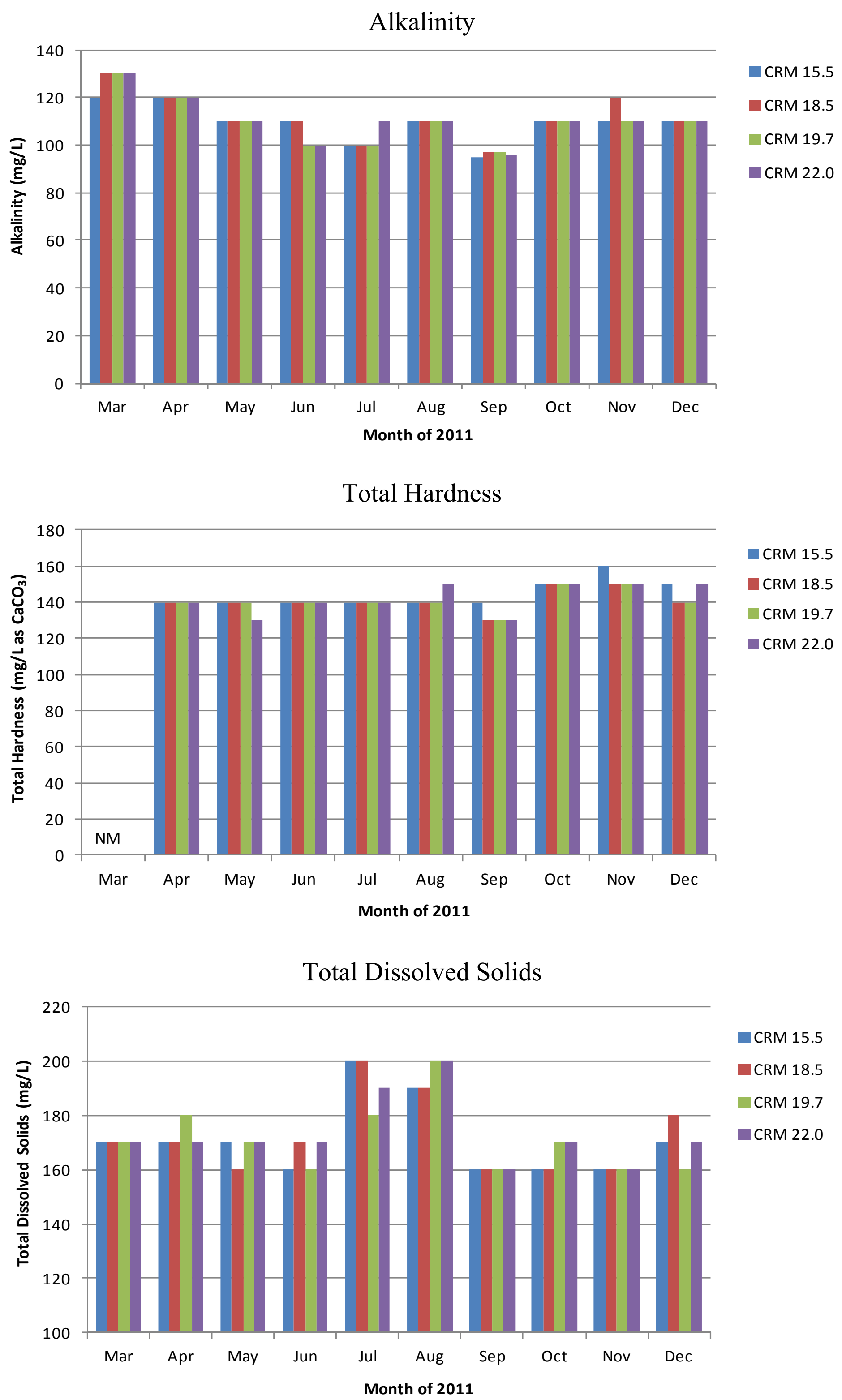

Figure 24. Alkalinity, total hardness, and total dissolved solids concentrations in samples collected monthly, March through December 2011. ***NM=not measured.***

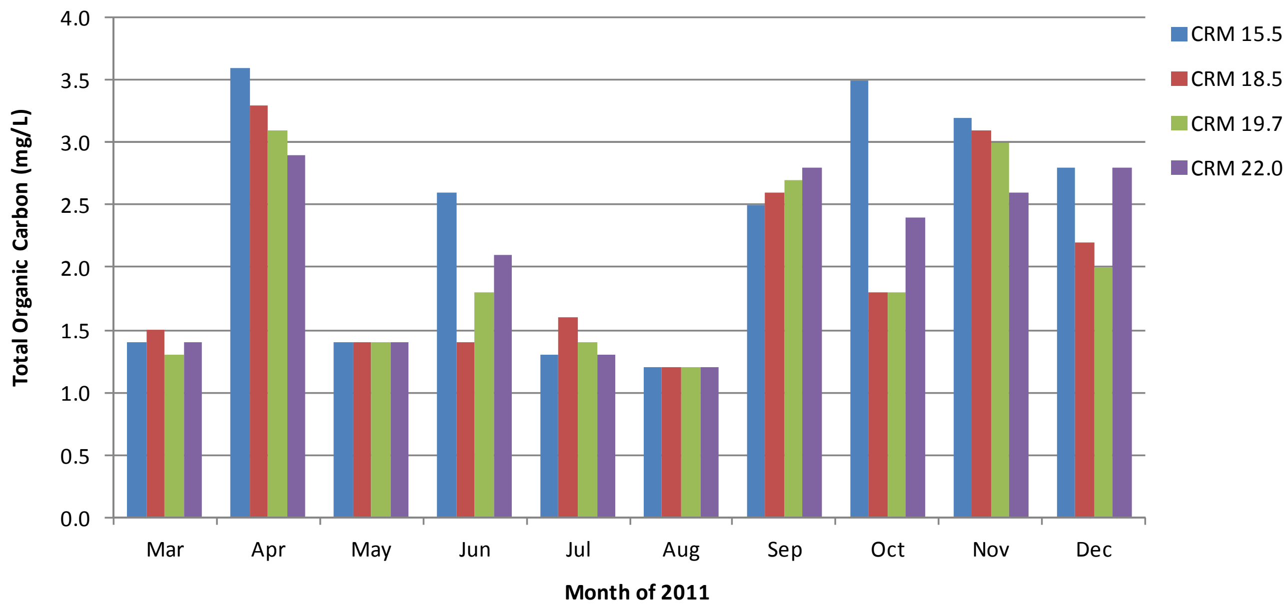

Figure 25. Total organic carbon concentrations in samples collected monthly, March through December 2011.

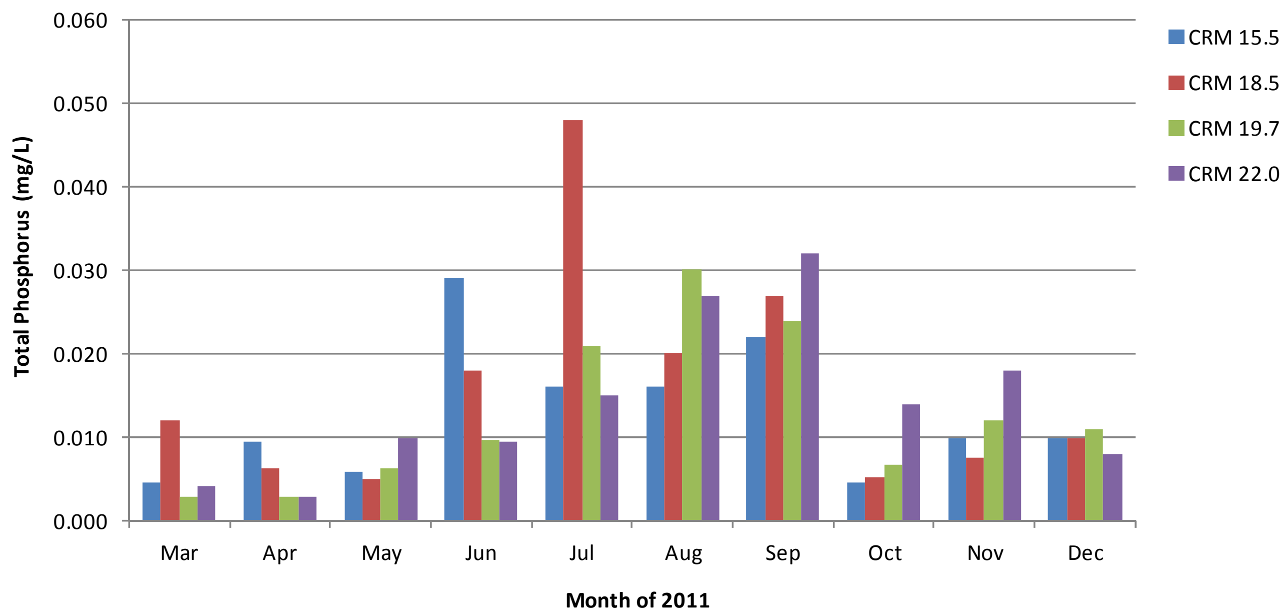

Figure 26. Total phosphorus concentrations in samples collected monthly, March through December 2011.

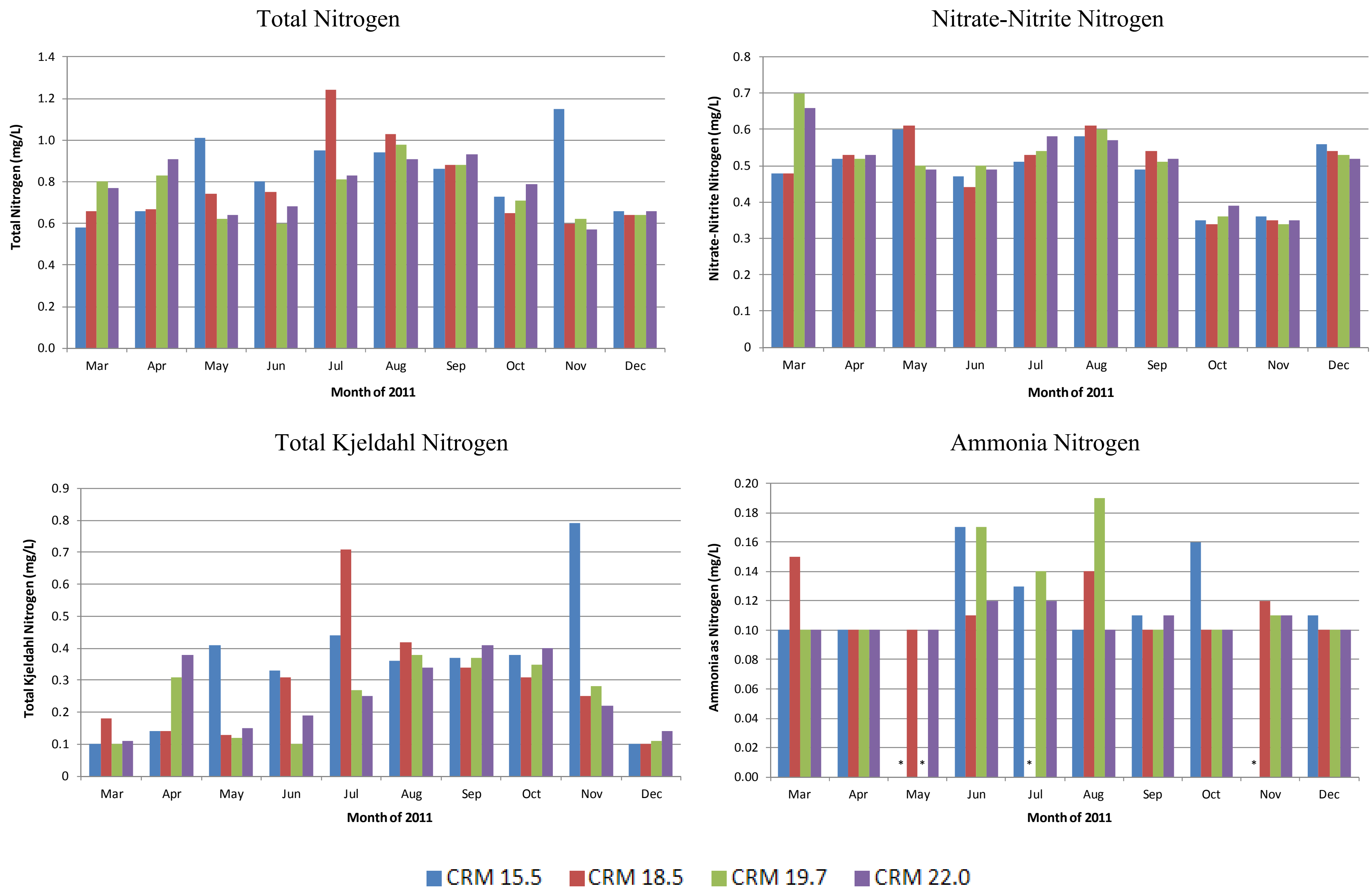

Figure 27. Concentrations of nitrogen parameters collected monthly, March through December 2011. ****=non-reportable results.***

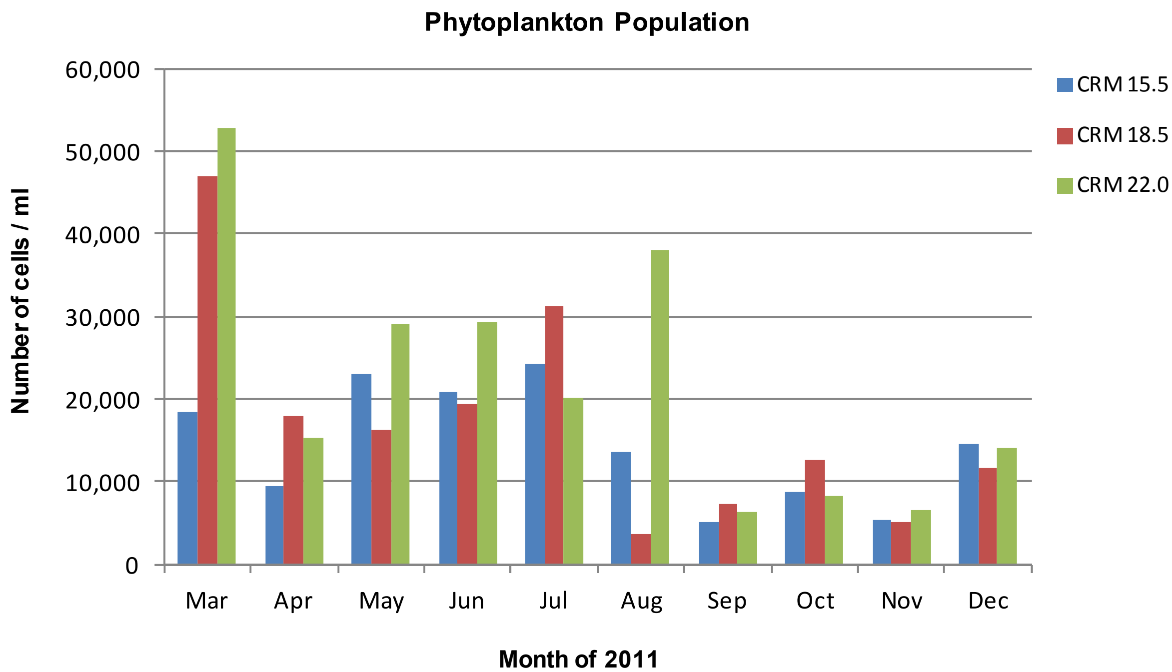

Figure 28. Monthly phytoplankton population densities, March through December 2011

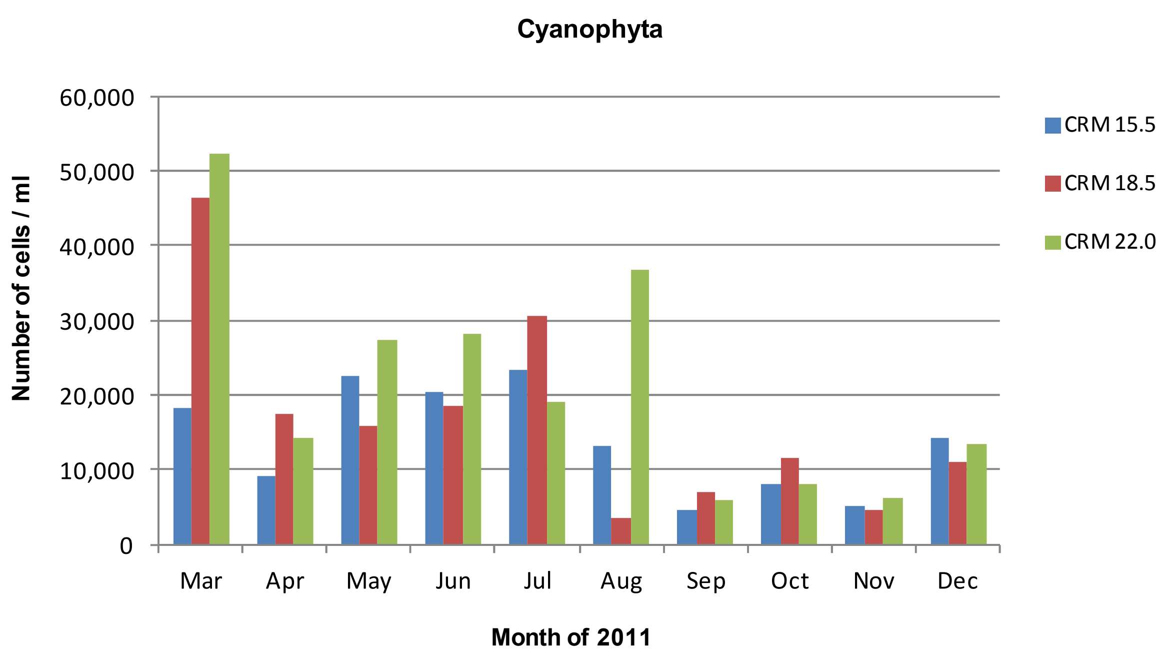

Figure 29. Monthly Cyanophyta densities, March through December 2011.

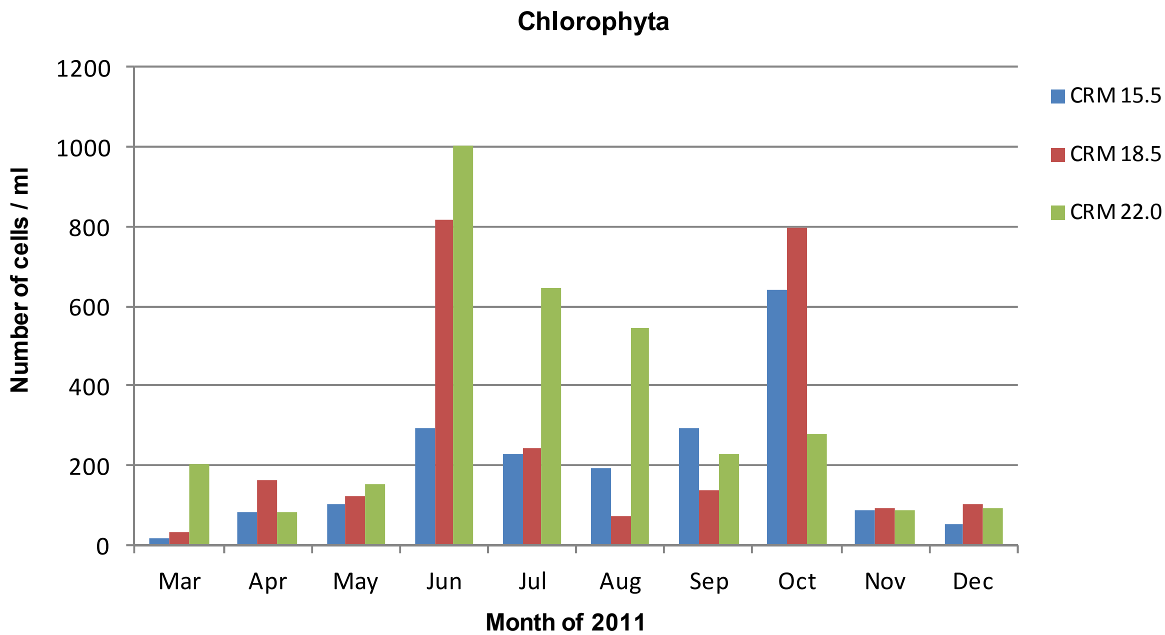

Figure 30. Monthly Chlorophyta densities, March through December 2011.

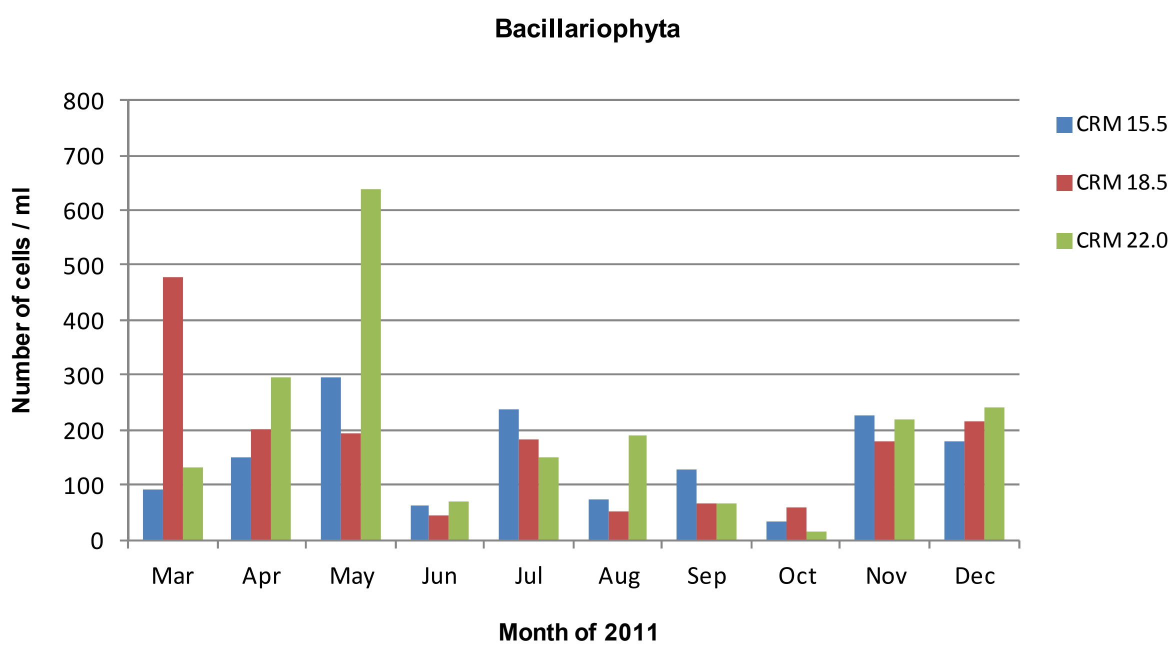

Figure 31. Monthly Bacillariophyta densities, March through December 2011.

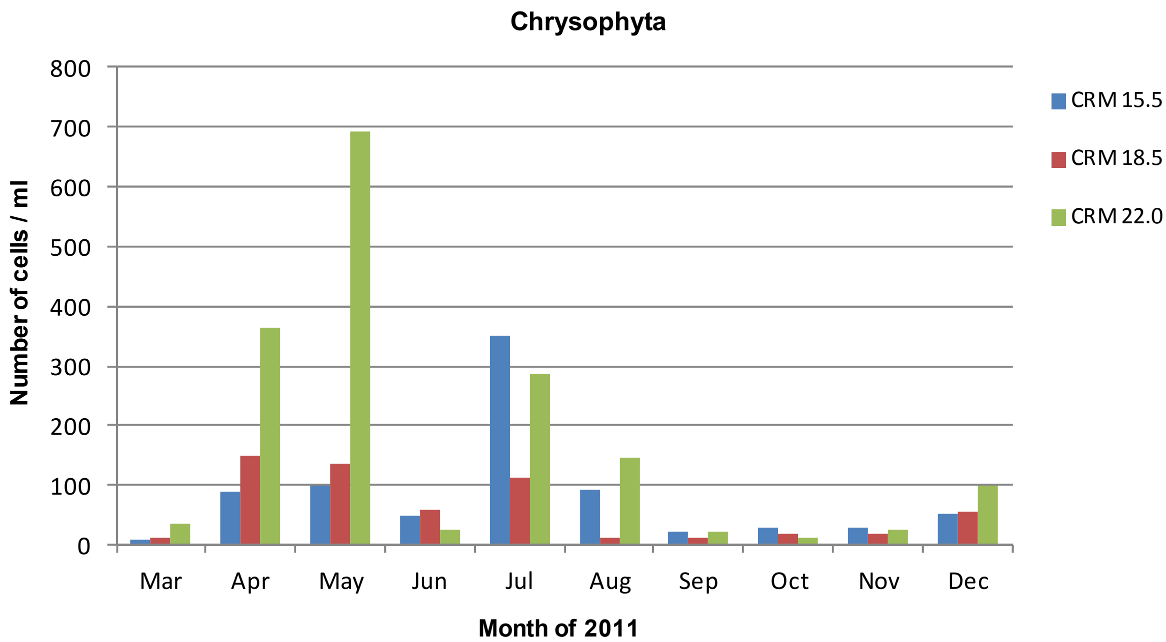

Figure 32. Monthly Chrysophyta densities, March through December 2011.

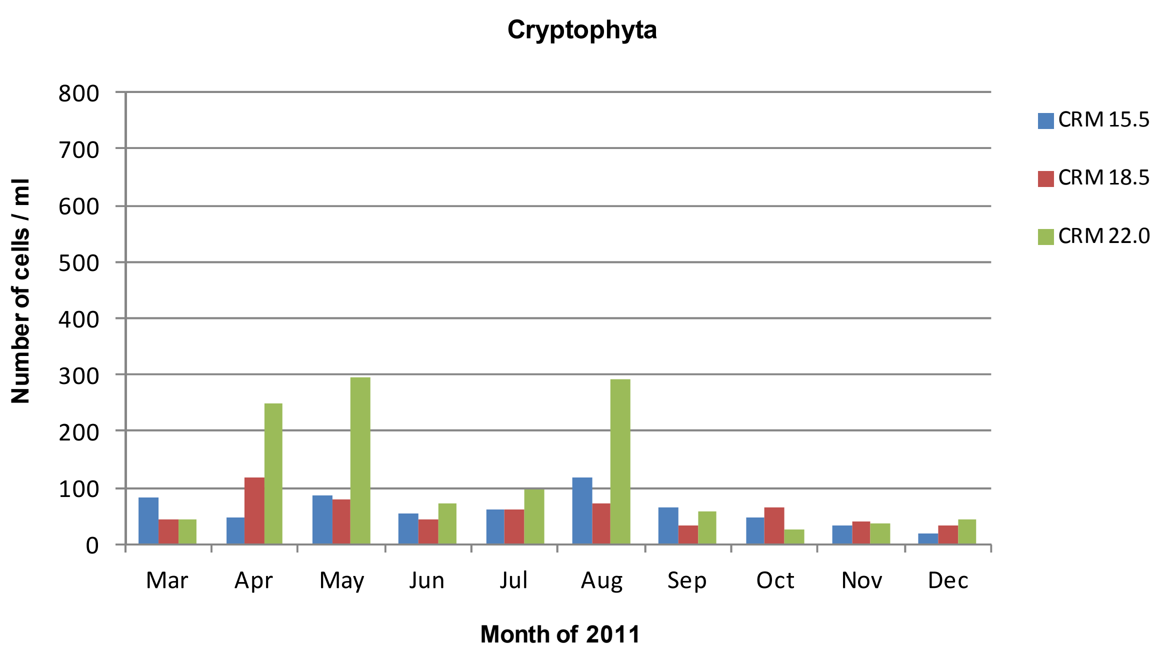

Figure 33. Monthly Cryptophyta densities, March through December 2011.

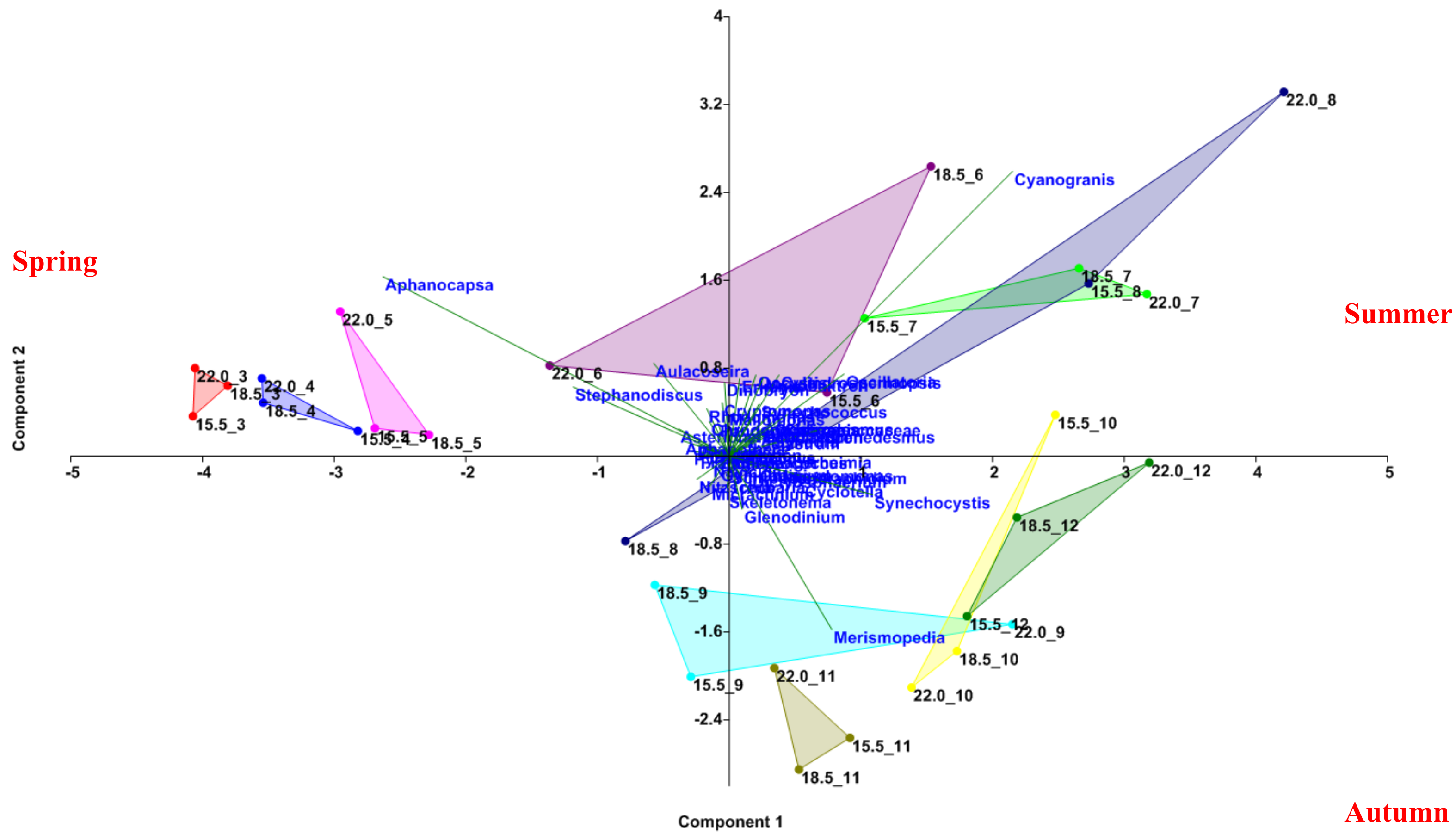

Figure 34. Principle Component Analysis (PCA) plots for phytoplankton results (51 taxa) in 2011.

Monthly densities (log10+1) for each taxon occurring in more than two samples during the 10-month period were used in the analysis. Samples for each location are coded by river mile and month. For example, code "15.5_3", denotes the sample collected at CRM 15.5 in March. In addition, samples collected in the same month are represented by the same color. Samples (i.e., coordinates) closest to one another on the diagram are the most similar based on the integrated response of all genera.

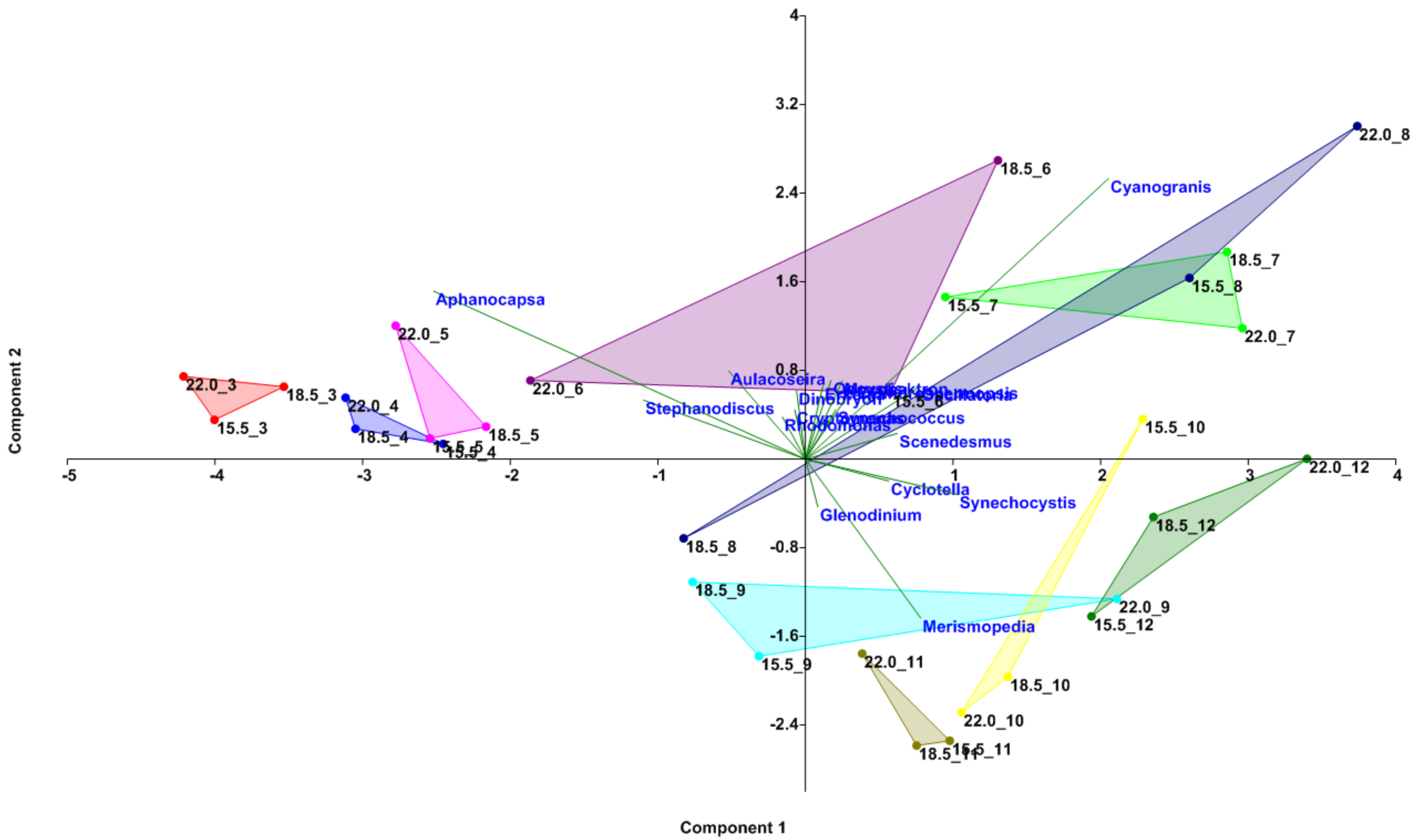

Figure 35. Principle Component Analysis (PCA) plots for phytoplankton results (18 taxa) in 2011.

Monthly densities (log10+1) for each taxa yielding covariance coefficients greater than 0.10 in the PCA of all 81 taxa collected during the 10-month period were used in the analysis. Samples for each location are coded by river mile and month. For example, code "15.5_3", denotes the sample collected at CRM 15.5 in March. In addition, samples collected in the same month are represented by the same color. Samples (i.e., coordinates) closest to one another on the diagram are the most similar based on the integrated response of all genera.

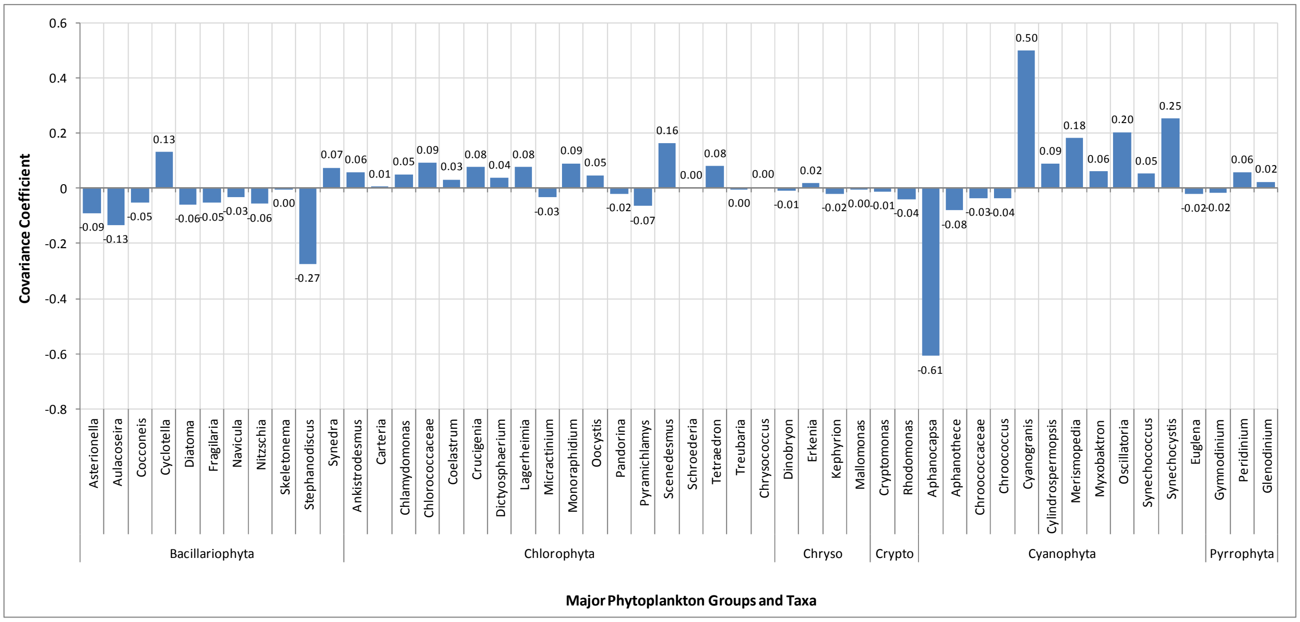

Figure 36. Principle component-1 covariance coefficients for phytoplankton taxa.

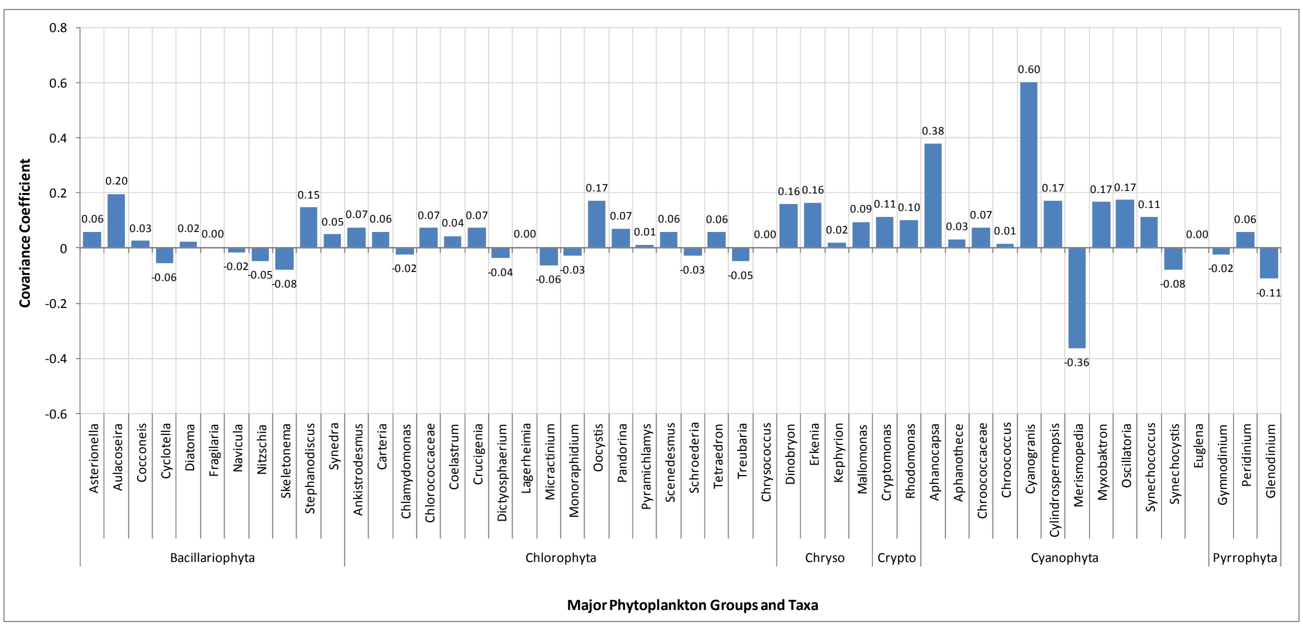

Figure 37. Principle component-2 covariance coefficients for phytoplankton taxa.

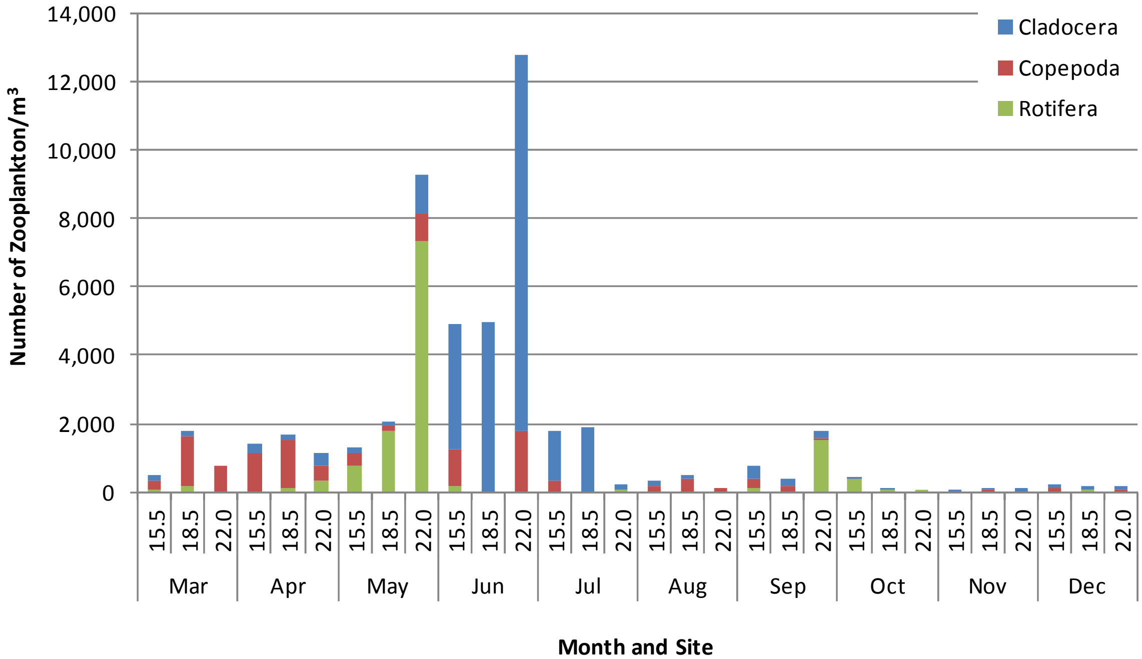

Figure 38. Density of major zooplankton groups each month, March through December 2011, at CRSMR sampling sites (CRM 15.5, 18.5, and 22.0).

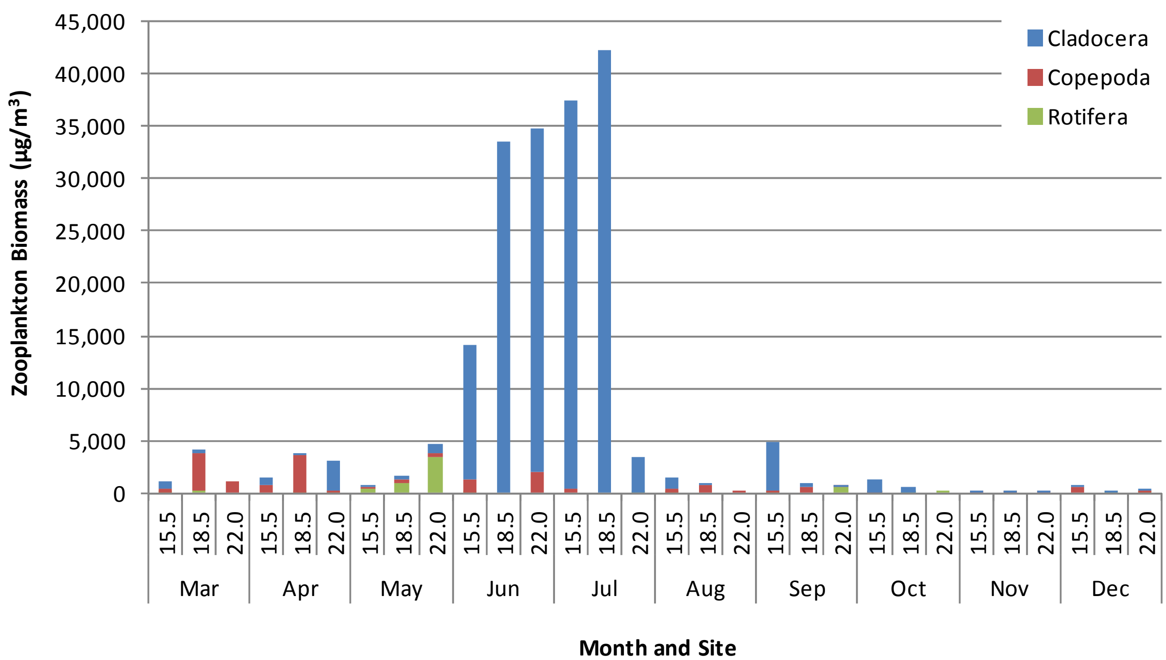

Figure 39. Biomass of major zooplankton groups each month, March through December 2011, at CRSMR sampling sites (CRMs 15.5, 18.5, and 22.0).