

**Fish and Aquatics IAG and Water Quality IAG Joint Meeting
February 3, 2004
Alcoa Conference Center
Badin, North Carolina**

Final Meeting Summary

Meeting Agenda

Attachment 1.

Meeting Attendees

Attachment 2.

Introductions, Review Agenda

Jane Peeples, Meeting Director, opened the meeting with introductions and a review of the agenda. Jane mentioned that she had been asked about the procedure for postponing the Issue Advisory Group (IAG) meetings in the event of inclement weather. Jane explained that if Yadkin has to postpone a meeting, Yadkin would send a notice via email to the IAG. Wendy Bley, Long View Associates, said that the purpose of the meeting was to update the IAG on the ongoing fish and aquatics and water quality studies.

Update on Water Quality Studies

Wendy Bley explained that Yadkin recently completed four consecutive years of monthly reservoir water quality monitoring. She added that Yadkin also operated continuous temperature and dissolved oxygen (DO) monitors in all four tailwaters during 2003. Also, as part of the upgrade program, Yadkin operated continuous monitors in the Narrows and Falls tailwaters in 2001 and 2002 (for a total of three years of consecutive data from these areas). Wendy explained that Yadkin is required by the FERC order to continue operating the continuous monitors in the Narrows and Falls tailwaters. She said that one year of continuous temperature and DO data from below the High Rock and Tuckertown dams should be sufficient to characterize the conditions below the dams and suggested that these monitors be removed and no additional data be collected in 2004. Continuing, Wendy introduced Don Kretchmer, Normandeau Associates, who reviewed water quality data collected in 2003.

First, Don reviewed the objectives of the water quality studies: 1) characterize baseline water quality in the reservoirs and tailwaters, 2) evaluate effects of Project operations on reservoir water quality, and 3) evaluate effects of Project operations on tailwater water quality (see Attachment 3). Don also briefly reviewed the study components: continuous monitoring of temperature and DO below Narrows and Falls from 2001 through 2004; continuous monitoring of temperature and DO below High Rock and Tuckertown in 2003; and a series of lateral transects in the tailraces to confirm monitor placement. Don said that he was convinced that the monitors were located in a representative location downstream of the dams. Darlene Kucken, NC

Division of Water Quality, asked if Normandeau had also completed the longitudinal investigation of DO. Don said no, Normandeau could not complete the work during summer 2003 because of the high flows in the river.

Next, Don reviewed the continuous monitoring results. He showed river flow at the Yadkin College gage from 1999 through 2003 (the sampling period) and the daily water elevations at each of the four reservoirs (see Attachment 3). Andy Abramson, Central NC Land Trust, asked if there were any times that the High Rock Reservoir elevation was greater than 655-ft. Don said that 655-ft is full pond. Gene Ellis, Yadkin, said that APGI would spill at the dam before allowing the reservoir to top 655-ft. Continuing, Don reviewed the minimum daily DO for each of the tailwaters. He explained that 4.0 mg/l is the instantaneous standard. He noted the instances when minimum daily DO was below the 4.0 mg/l standard in the four tailwaters.

Gerrit Jobsis, SC Coastal Conservation League and American Rivers, noted that there is not a lot of difference in the number of violations in the high and low flow years in the Narrows tailwater. Larry Jones, High Rock Lake Association, said that flow, or water condition, through the turbines at Narrows is representative of the conditions of flow entering Narrows Reservoir.

Gerrit Jobsis asked Don if the DO violations at Narrows were occurring earlier than June and later than October. Don answered that the violations were occurring as early as May. Don said that the data would be presented year-by-year in the study report and would therefore be easier to interpret. Don said that he saw no clear pattern among the dry (2002), wet (2003), and average (2001) years. Gerrit said the pattern across the years was that there are water quality violations from about late spring through early fall.

Mark Oden, High Rock Lake Business Owners Group, asked what was causing the low DO concentrations. Don replied that low DO conditions are a result of several factors: river flow, temperature, and particularly, nutrients entering the system from upstream sources.

Next, Don reviewed the daily average DO data for each of the tailwaters. The daily average standard for DO is 5.0 mg/l. Don highlighted the instances when the DO in the tailwaters did not meet this standard. Larry Jones commented that 2001 should not be considered an “average year”. Don explained that while overall it was a dry year, hydrologically, 2001 was closer to an average year than 2002, since it did not have the same mid-summer issues that 2002 had. Continuing, Don discussed the relationships among turbine discharge, spill, and DO at each of the developments. He highlighted spills at the dam and the related spike in DO. He also noted spikes in DO, unrelated to spills at the dam (e.g. Tuckertown tailwater in August 2003). Mark Oden asked if the continuous temperature and DO data was collected from one location. Don replied yes – there was one continuous monitor in each tailwater collecting data every 15 minutes from May through November 2003. Larry asked if the spike with no turbine discharge at Tuckertown is reflective of what happens when the mix does not occur. Mark asked Normandeau to plot the temperature and DO data together. Gerrit Jobsis commented that it would be beneficial to understand what happened to water temperatures during spill events. Don agreed to look at the effect of spills on water temperature, but noted that water temperatures in 2003 were generally lower because of the higher river flows and reduced reservoir stratification. Jim Mead, NC Division of Water Resources, asked about the location of the continuous monitors and

questioned if they were placed far enough downstream to pick up water spilling over the dam. Don said that the monitors were located in the tailwaters based on consultation with the resource agencies and then the location of the monitors was confirmed with lateral transects.

In conclusion, Don said that the monthly reservoir monitoring was completed in 2004; the longitudinal DO survey will be completed in summer 2004; and the continuous temperature and DO monitoring will continue at Narrows and Falls. Ben West, US Environmental Protection Agency, questioned the purpose of the lateral transects in the reservoir. Don explained that the IAG asked Normandeau to study the effects of changes in operation at the dam on DO profiles up and downstream of the dam (e.g. DO profiles above and below before and after generation). Gerrit Jobsis asked if Normandeau was collecting any DO data on inflows to High Rock. Don answered that Normandeau collected grab samples from the monthly monitoring station above the reservoir.

Chris Goudreau, NC Wildlife Resources Commission, asked about the status of the turbine upgrades at Narrows. Gene Ellis explained that Yadkin had successfully completed one of the unit upgrades (unit four) at Narrows but Yadkin notified FERC in early 2003 when it filed its Notice of Intent that the original upgrade program would be modified and some of the upgrades would not be completed under the present license. Gene said that the economics of the planned upgrades were stalled when capital dried up but that APGI is continuing to evaluate the issue. Wendy Bley added that the one upgrade completed at Narrows also added air injection capabilities at the unit. The air injection at unit four is currently operated continually May through November, whenever unit four is operating. Having seen the continuous DO data at Narrows, Gerrit asked when the air injection was operational. Wendy replied that the air injection was operational in 2002 and 2003 and possibly part of 2001. Wendy said that Yadkin had measured the contribution of unit four during its operation and had found a substantial improvement in DO (about a 1.0-2.0 mg/l enhancement). A report including this information was filed with FERC.

Darlene Kucken observed that even with the air injection in place at Narrows, there are still violations of the DO standard. Wendy explained that the current license amendment approves upgrades at High Rock and Narrows. As these units are upgraded, APGI can consider the design and installation of aeration technology. Wendy said that an outstanding question is whether aeration technology is needed at all or a portion of the units at the dams.

Mark Oden asked if air injection is required by FERC or is it done voluntarily by the licensee. Darlene explained that to get a new license from FERC, APGI must first be issued a Clean Water Act Section 401 Water Quality Certificate from North Carolina. In order to receive a 401 Certificate, APGI must meet water quality standards at the Project. Larry Jones asked about the consequences of not meeting the standards. Darlene explained that the state would either 1) require APGI to conduct further studies and implement measures to achieve the standards, or 2) not issue a 401 Certificate.

Based on the data, Gerrit Jobsis commented that even a 1.0-2.0 mg/l enhancement might not help Yadkin meet the standard. He asked if APGI had considered oxygen injection. Wendy Bley said that the aeration technology used would be specific to each unit and site. She said that APGI had

considered oxygen injection and for a variety of reasons (cost, safety etc.), APGI would prefer not to do oxygen injection.

Jim Melton, SaveHighRockLake.org, asked if the benefit of the air injection is system-wide or more localized. Wendy answered system-wide. Wendy said if the water quality is improved at High Rock Dam, some improvement in DO might be evident all of the way downstream. Larry commented that if the water quality is improved in High Rock Reservoir, water quality would be improved system-wide.

Gerrit Jobsis asked whether air injection is different than venting. Wendy said that like venting, air injection is forcing air into the water, as opposed to pure oxygen. Gerrit said that several hydro projects were considering how different gate openings at the dam could help improve DO levels (e.g. set the wicket gates a certain way to create more turbulence in the water). Wendy explained that when Voith designed the air injection valve at Narrows unit four, changes in operation at the dam were also considered. Gerrit added that other projects have been able to run more efficiently with changes in operations without extensive and costly upgrades. He said that baffles to increase turbulence in the water only result in a 1-2 percent loss in efficiency. He said that APGI was at the end of the line and asked what it planned to do.

Gene Ellis stated that APGI does want a 401 Certificate and that it will continue working to correct the DO violations, but that it might take a while. John Ellis, US Fish and Wildlife Service, asked if APGI contemplated correcting the violations before submitting its application for a new license to FERC. Gene said that actions to correct the DO violations would be staged during the new license term. Gene said that APGI still desires to complete the unit upgrades because the upgrades can increase generating efficiency and address the DO problem, but currently there is no capital to complete the upgrades. Gene said that APGI had notified FERC of the change in schedule.

Mark Oden asked about preventative measures to reduce pollutants in the river basin (e.g. the “Don’t Mess with Texas” campaign). John Ellis said that the USFWS works with landowners and farms to implement water quality improvement strategies, with the focus of restoring fish and wildlife habitat. Mark Cantrell, USFWS, said that his agency also provides comments to the NC Division of Water Quality on NPDES (National Pollutant Discharge Elimination System) permits. Andy Abramson added that the NCDWQ also has developed basinwide water quality plans for each of the state’s river basins. He said that the agencies have many “carrots” to encourage the landowners to do the right thing, but no “sticks”.

Larry Jones commented that there is still time before APGI submits its license application to explore operating High Rock differently to demonstrate that dam operation does or does not have an effect on downstream water quality problems. He suggested that if the Project was operated as run-of-river and High Rock was kept full year round, water quality might improve.

Darlene Kucken said that improving water quality in High Rock Reservoir will first require improving water quality flowing into the reservoir. She said that the watershed is disproportionately big when compared to the much smaller reservoir. She encouraged the locals to work with their local governments to encourage responsible land use and management. She

said that the NCDWQ developed a TMDL (Total Maximum Daily Load) for the South Yadkin River, but there are no regulations to allow implementation of the TMDL. Mark Oden observed that there were no local government officials present at the meeting. Mark asked if it was typical in a hydropower relicensing to see no involvement from local leaders. Gene Ellis noted that APCI had in December 2003, reached out again with letters and phone calls to local government officials, inviting them to participate in the relicensing process. Andy Abramson said that the Land Trust invited all the riparian landowners to a public meeting and only 30 showed up. He said the interest in these types of issues is not there.

Wendy Bley commented that though the root cause of the DO problem is upstream sources of nutrients and BOD (biological oxygen demand), Yadkin recognizes that the reservoirs may also be contributing to the problem. She said that for APCI to get a 401 Certificate it expects to take care of its share of the responsibility. She concluded that the IAG would have to come up with some concepts to address the DO problem.

John Ellis asked if APCI envisioned everything happening after the issuance of a new license, or if would try to do something in the interim to show a good faith effort. Gene Ellis said that he would be willing to consider looking into possible modifications in operations at the dams to improve tailwater DO. John Ellis suggested that changes in operation at the dam could be a "band-aid" until the capital becomes available to complete the unit upgrades. Jim Mead asked if the lack of capital was local problem. Gene said no, the lack of capital is a company-wide problem due to the general downturn in the economy. Wendy suggested that Normandeau complete their data analysis to determine if there are any operational changes that could be tested in lieu of more permanent measures to improve DO at the Project.

For clarification, Darlene Kucken said that while she is representing the NCDWQ, she does not work for the 401 water quality certification division. She said that she could not say if the certification division would provide a water quality certificate based on a promise to meet the standards in the future. Darlene thought it worthwhile to meet with John Dorney. John Ellis suggested that John Dorney be invited to come and speak to the IAG. Darlene agreed to invite John Dorney to a future IAG meeting.

Mark Cantrell asked that Normandeau show percent saturation on the graphs included in the study report. Don Kretchmer agreed.

Before moving to the next topic on the agenda, Wendy asked that the IAG resolve the outstanding question about monitoring in 2004. She said that Normandeau plans to do the longitudinal transects and continuous monitoring below Narrows and Falls. Ben West asked if Wendy was recommending no further continuous monitoring below High Rock and Tuckertown. Wendy said that originally, she was concerned about having only one year of continuous data below High Rock and Tuckertown because of the abnormally high flows. However, the 2003 data did document a problem in those tailwaters as well. Wendy recommended no further continuous monitoring below High Rock and Tuckertown. Ben agreed that it makes sense to focus on evaluating potential ways to mitigate the problem rather than just continuing to document it.

Darlene Kucken thought it worthwhile to continue monitoring temperature and DO below High Rock on a continuous basis because of the high flows, reduced reservoir stratification, and other unknowns. Chris Goudreau suggested that APGI ask FERC permission to remove the continuous monitors from below Narrows and Falls and instead operate one of the monitors below High Rock. Jim Mead agreed that the monitor below Falls is probably no longer necessary. Gerrit suggested that APGI start looking at changes in operations at Narrows (rather than continue to monitor) to address the DO problem.

Wendy Bley thought the only issue about asking FERC about revising the monitoring plan would be that FERC would have questions about the upgrades and associated schedule that APGI might not be able to answer. Wendy suggested the following actions: complete data analysis; review analysis of the operation of unit four at Narrows with air injection; consider asking FERC permission to revise the monitoring plan (specifically, to remove the monitor from below Falls and monitor at High Rock and Narrows); and start investigating gate settings at Narrows. Gene Ellis indicated that he wanted the opportunity to discuss these actions with his internal team first before making a commitment to go to FERC. Jim Mead said that APGI would only need FERC's approval to remove the Falls monitor.

Jim Mead commented that the longitudinal monitoring might suggest some other options for improving water quality. For clarification, Wendy explained that the lateral surveys would not extend all the way up into the headwaters; rather, the monitoring would be conducted immediately above and below the four dams.

Gerrit Jobsis asked what Normandeau would be looking at specifically during its analysis of the data. Don said that he would look at, among other things, water quality coming in and going out of the reservoirs; generation and no generation; unit four at Narrows operating and not operating etc. Gerrit said the focus should be the effect of the Project on water quality (i.e. how temperature is being altered; seasonal loading of nutrients etc.).

Mark Cantrell asked if there were operational scenarios being developed that may influence water quality. Wendy Bley explained that the Operations Model IAG is not that far along yet, that the OASIS model is still being developed, and that it would be some time before specific operational scenarios were being discussed. She acknowledged, however, that there will be alternative operating scenarios to be considered in the future.

Ben asked when the study report would be available. Don said the report should be available sometime during the third quarter of 2004.

After some discussion, it was agreed that the Water Quality IAG would meet independent of the Fish and Aquatics IAG on March 31 and May 4. Wendy said that Normandeau would try to complete its data analysis prior to the March meeting. She said that the IAG could possibly hear from APGI sooner than March 31 if APGI decides to seek FERC permission to revise the current DO monitoring plan and remove the Falls continuous monitor. Darlene Kucken committed to asking John Dorney to participate in the May meeting. Agenda topics for the March 31 meeting include a review of the data analysis (focus on parameters that directly impact DO such as chlorophyll a) and recommendations for investigations of gate settings and/or additional data

analysis. Larry Jones suggested that APCI give its operational staff a “heads up” about potential investigations of gate settings and other operational changes for summer 2004. Donley Hill, US Forest Service, suggested that APCI also consider long sustained periods of one unit generation (i.e. pick out instances when there was generation with one turbine and look at the effect on DO in the tailwater).

Update on Tailwater Fish and Aquatic Studies

Wendy Bley introduced Rick Simmons, Normandeau, who provided an update on the status of the fish and aquatic studies. Rick mentioned that the Fish Entrainment Evaluation was nearly complete and that a draft study report would be available soon for review by the IAG. Specific to the Tailwater Fish and Aquatic Study, Rick said that Normandeau had completed both summer (August/September 2003) and fall (November 2003) fish and mussel sampling (see Attachment 4). Rick shared fish species lists for each of the Project tailwaters. The Falls tailwater was sampled August 26-28 and November 4-6 and bluegill, redbreast sunfish, and white perch were the top three species captured (by percent composition). The Narrows tailwater was sampled August 28-September 1 and November 6-8 and white perch, largemouth bass, and gizzard shad were the top three species captured. The Tuckertown tailwater was sampled September 1-4 and November 9-11 and bluegill, gizzard shad, and white perch were the top three species captured. The High Rock tailwater was sampled September 15-18 and November 11-13 and bluegill, white perch, and channel catfish were the top three species captured.

Mark Oden asked if Rick considered the reservoirs to have a healthy fish population. Rick said that based on the number of species present in the reservoirs, he considers the reservoir fish populations to be healthy. He said that if conditions were poor, he would expect to find less species. He said that some species captured are very sensitive to water quality. He said that how the reservoirs are operated impact species assemblages (e.g. largemouth bass, adults and juveniles, benefit from a drawdown). In response to a question from Mark Cantrell, Rick said that he would be providing the age and lengths of the captured fishes.

Continuing, Rick explained that Wendell Pennington, Pennington and Associates, surveyed the tailwaters in September and November 2003 for macroinvertebrates and mussels. Rick commented that the Falls tailwater provides the best habitat for mussels. The USFWS and NCWRC noted that the *Lampsilis radiata* and *Villosa delumbis* are both rare species. Mark Cantrell noted that additional mussel species that were not found in September were found in November. Rick said that visibility may have been a factor in September. Mark also asked if Pennington had looked at the fish in the tailwaters for glochidia (larvae). Rick said he would ask his crew to look for this. Rick showed species lists for the other three tailwaters (see Attachment 4).

Larry Jones asked about the relationship between the mussel populations in the reservoir and the tailwater. Specifically, he said, that High Rock Reservoir used to have a large number of mussels present. He wondered if the decline of mussels in the reservoir had affected the tailwater mussel population.

Mark Oden asked how long it would take macroinvertebrates and mussels to recolonize after a drought. Ryan Heise, NCWRC, said that most freshwater mussel species typically live in flowing water environments (rivers and streams) and that while some mussel species may persist in reservoirs, they may never be able to reproduce. However, mussel species that prefer a still water environment and many macroinvertebrate species can recover within one year. Rick said it would take about 45 days for the macroinvertebrates to recolonize.

Update on Reservoir Aquatic Habitat Assessments

Rick said that Normandeau completed the Narrows Reservoir Aquatic Habitat Assessment in December 2003. He discussed the habitat composition of the drawdown area (see Attachment 4) – cobble and boulder are the dominant habitat types. Rick noted that boat docks and the default substrate had not been included in this calculation of habitat composition. Rick commented that Narrows had more gravel habitat than expected. Chris Goudreau asked if Sarah Allen's (Normandeau) aquatic vegetation work would be included in the habitat assessment. Rick replied yes. Rick explained that Normandeau filmed the entire Narrows shoreline and had collected gps data for eroding areas (with a minimum 30-ft linear extent).

Rick explained that Normandeau is currently working on the High Rock Reservoir Aquatic Habitat Assessment. At the time of the meeting, Normandeau had surveyed 160 shoreline miles. Rick showed a graphic, which depicted the areas surveyed to date. Larry Jones said that he knew that some areas shown as having been surveyed were not in fact surveyed. Rick said that his crew had filmed all of the areas surveyed. When asked, Rick said that he expected the assessment to be completed within about a week and a half (by February 13, 2004).

Habitat Fragmentation Study Request

Rick distributed several Yadkin River RTE species maps and asked that the IAG not distribute this sensitive information. Wendy Bley felt that the mussel species maps are a good starting point to determine what, if any, additional data collection and analysis should be done to complete the Habitat Fragmentation Study. Wendy commented that Progress Energy was asked to collect mussel data, but not to conduct a habitat fragmentation study, as Yadkin had been. Chris Goudreau said that he had asked Progress to do such a study, but that they are more focused on looking for opportunities for mitigation.

Mark Cantrell suggested that Normandeau also look at the fish hosts for the mussels and overlay the dams, land use, and NPDES discharges to the maps.

Wendy asked that the agencies look at the maps and then get back to Normandeau with ideas to build the database and refine the study. The agencies agreed that they would review the mussel data and get together to discuss possible next steps.

Progress Energy Instream Flow Study

Wendy Bley said that she had attended a December meeting of the Progress Energy Instream Flow Study subcommittee to discuss the details of an instream flow study plan. She said that

Progress recently distributed a draft study plan, which she had not had the opportunity to review. She added that the subcommittee would be meeting on February 12 to discuss the draft study plan. Field work is planned for summer 2004. Chris Goudreau said that he had reviewed the study plan and that it was well put together.

Jim Mead acknowledged that both Wendy and Paul Leonard, Entrix, were participating on the subcommittee on behalf of Yadkin. He asked that Yadkin formally bless the study plan for the record to avoid any disagreements later on about methodology etc.

Schedule and Agenda for Next Meeting

Chris Goudreau suggested that an hour be set aside on March 31 for a discussion of the Habitat Fragmentation Study.

Gene Ellis acknowledged that Yadkin had received numerous emails and phone calls about the High Rock drawdown and that Yadkin had surprised many with how deep the draw was. He acknowledged that Yadkin could have communicated better. Gene explained that one of Alcoa's communications representatives is contacting several key stakeholders to solicit ideas about how to improve communications in the future. Larry Jones commented that Yadkin had done a great job communicating with shoreline residents on Narrows during the planned drawdown, but not with those living on High Rock. Mark Oden asked if the newspapers respond to Yadkin when it distributes a press release. Gene said that both drawdowns were well covered by the press. Max Walser, Davidson County Commissioner, reiterated Gene's commitment to improve communications to the county and shoreline residents.

The Water Quality IAG will meet on March 31, 2004 and May 4, 2004. A discussion of the Habitat Fragmentation Study will be included on the March 31 agenda.

Attachment 1 – Meeting Agenda

**Yadkin Project
(FERC No. 2197)**

Communications Enhanced Three-Stage Relicensing Process

**Water Quality and Fish and Aquatics Issue Advisory Groups
Joint Meeting**

**Tuesday, February 3, 2004
Alcoa Conference Center
Badin, North Carolina**

9:00 AM – Noon

Preliminary Agenda

1. Introductions, Review Agenda
2. Update on Water Quality Studies
 - i. Review of Continuous DO/Temperature Tailwater Data from 2003
 - ii. Discuss DO Monitoring Requirements for 2004
3. Update on Tailwater Fish and Aquatic Studies (November Sampling)
4. Update on Reservoir Aquatic Habitat Assessments
 - i. Narrows Drawdown Initial Observations
 - ii. Update on High Rock Field Work
5. Review and Discuss Habitat Fragmentation Study Request
6. Update on Progress Energy's Instream Flow Studies in Lower Yadkin/Pee Dee River
7. Schedule and Agenda for Next Meeting

Attachment 2 – Meeting Attendees

Name	Organization
Andy Abramson	Land Trust
Best West*	Environmental Protection Agency
Chris Goudreau	NC Wildlife Resources Commission
Darlene Kucken	NC Division of Water Quality
Don Kretchmer	Normandeau Associates
Donley Hill	US Forest Service
Gene Ellis	APGI, Yadkin Division
Gerrit Jobsis	SC Coastal Conservation League & American Rivers
Jim Mead	NC Division of Water Resources
Jim Melton	SaveHighRockLake.org
Jody Cason	Long View Associates
John Ellis	US Fish and Wildlife Service
Larry Jones	High Rock Lake Association
Mark Cantrell	US Fish and Wildlife Service
Mark Oden	High Rock Business Owners Group
Max Walser	Davidson County
Pat Masters	Concerned Property Owners of High Rock Lake
Rick Simmons	Normandeau Associates
Roy Rowe	Piedmont Boat Club
Ryan Heise	NC Wildlife Resources Commission
Sarah Allen	Normandeau Associates
Steve Reed	NC Division of Water Resources
Todd Ewing	NC Wildlife Resources Commission
Wendy Bley	Long View Associates

*participated by phone

Attachment 3 – Water Quality Monitoring Studies Presentation



**Yadkin Project
Continuous Dissolved Oxygen
Monitoring
June 2001 - November 2003**

Feb 03, 2004


Normandeau Associates




Study Objectives

- Characterize baseline water quality in reservoirs and tailwaters
 - Evaluate effects of project operations on reservoir water quality
 - Evaluate effects of project operations on tailwater water quality
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Continuous Monitoring Study Components

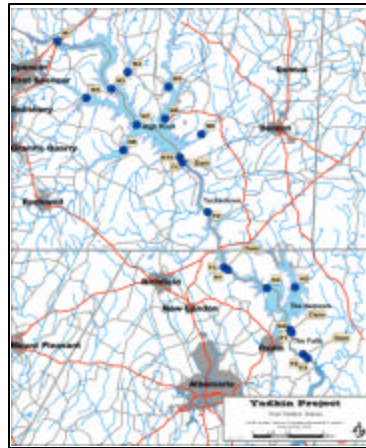
- Continuous monitoring of dissolved oxygen and temperature below Falls and Narrows from 2001 through 2004
 - Continuous monitoring of dissolved oxygen and temperature below High Rock and Tuckertown in 2003.
 - Series of lateral transects in tailraces to confirm monitor placement
- 

Continuous Monitoring Results

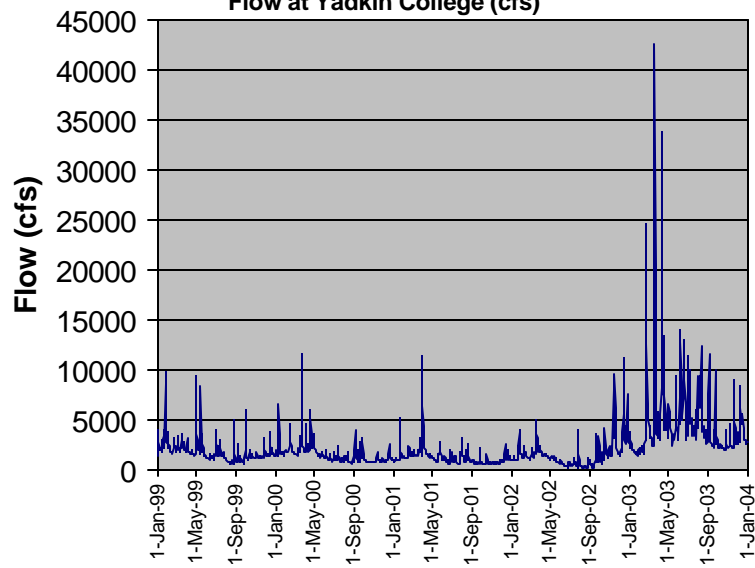
- Results for Falls and Narrows are from June 2001 through Nov of 2003
 - Span a wide range of hydrometeorologic conditions
 - High Rock and Tuckertown results from 2003 only
- 



SAMPLING LOCATION MAP

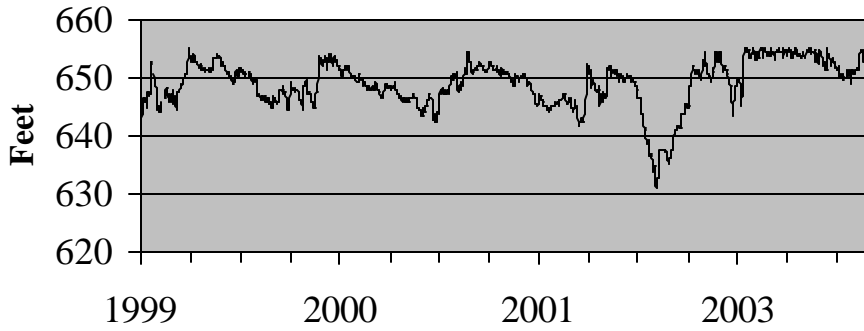


Flow at Yadkin College (cfs)

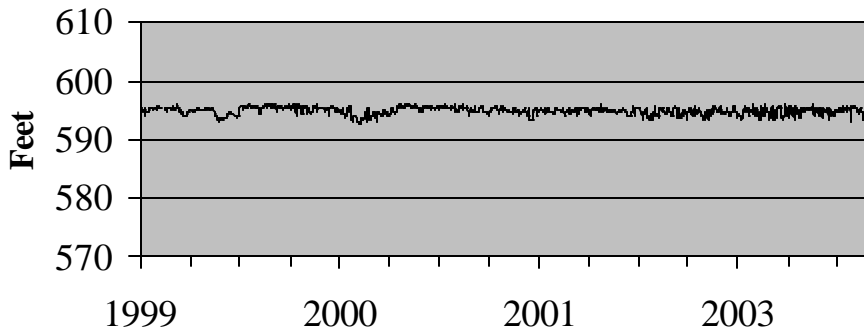




High Rock Reservoir Daily Water Elevations

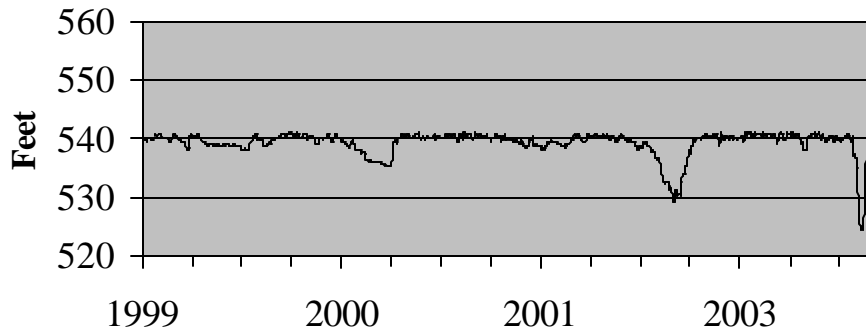


Tuckertown Reservoir Daily Water Elevations

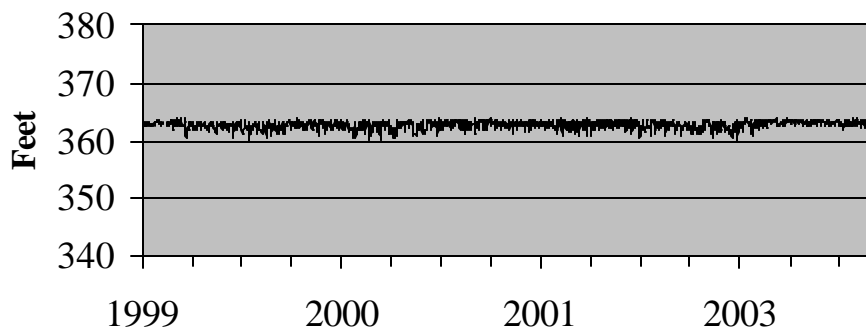




Narrows Reservoir Daily Water Elevations

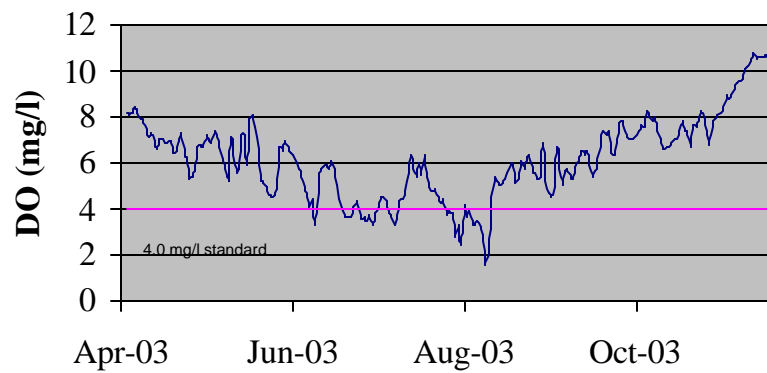


Falls Reservoir Daily Water Elevations

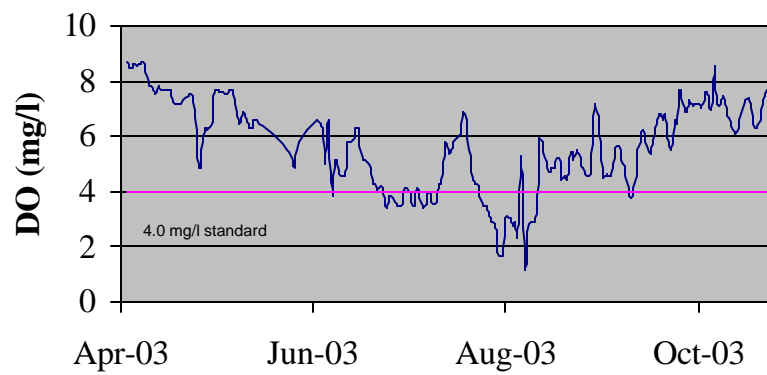




High Rock Tailwater Minimum Daily DO

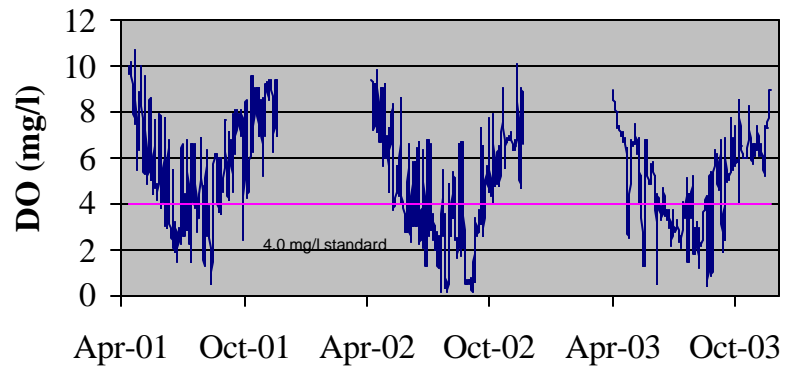


Tuckertown Tailwater Minimum Daily DO

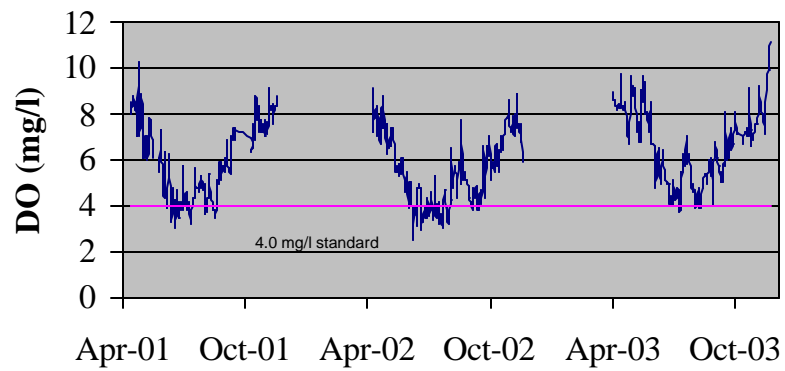




Narrows Tailwater Minimum Daily DO

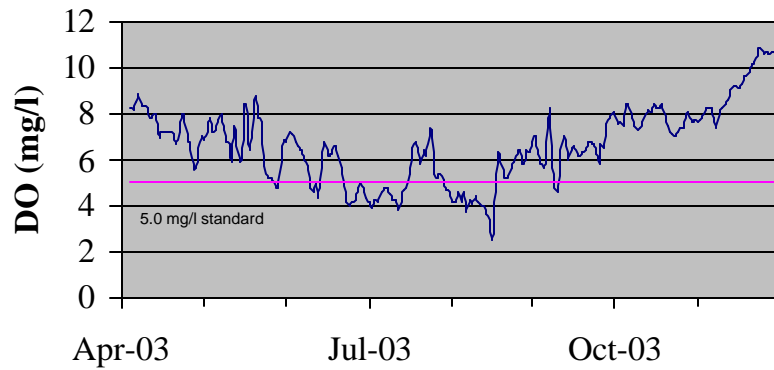


Falls Tailwater Minimum Daily DO

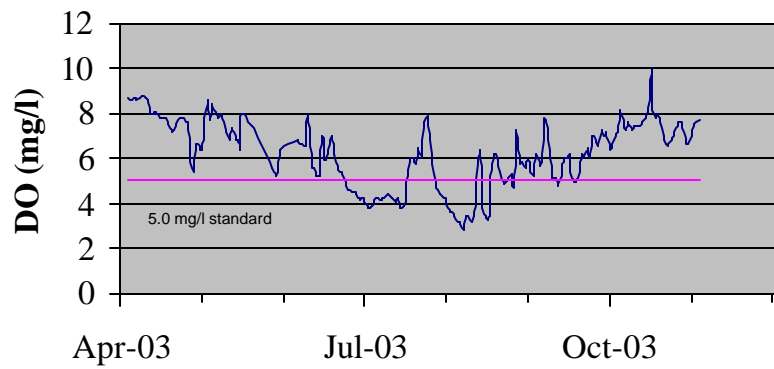




High Rock Tailwater Daily Average DO

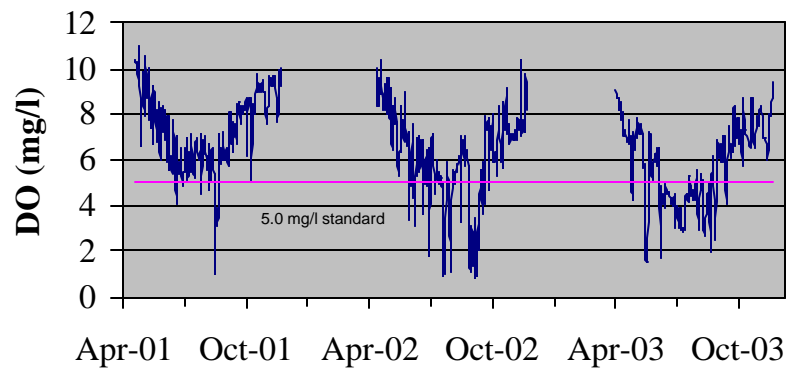


Tuckertown Tailwater Daily Average DO

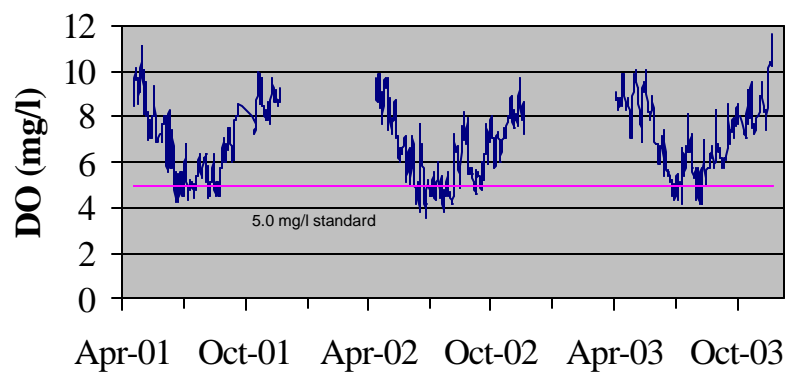




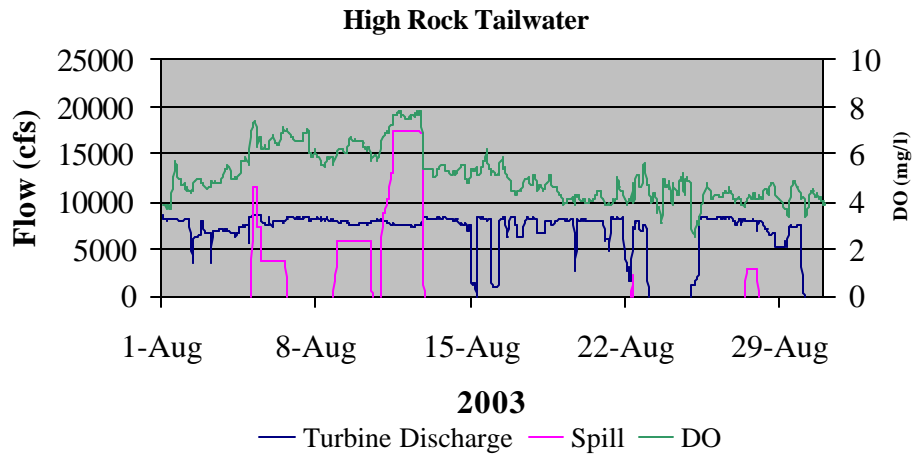
Narrows Tailwater Daily Average DO




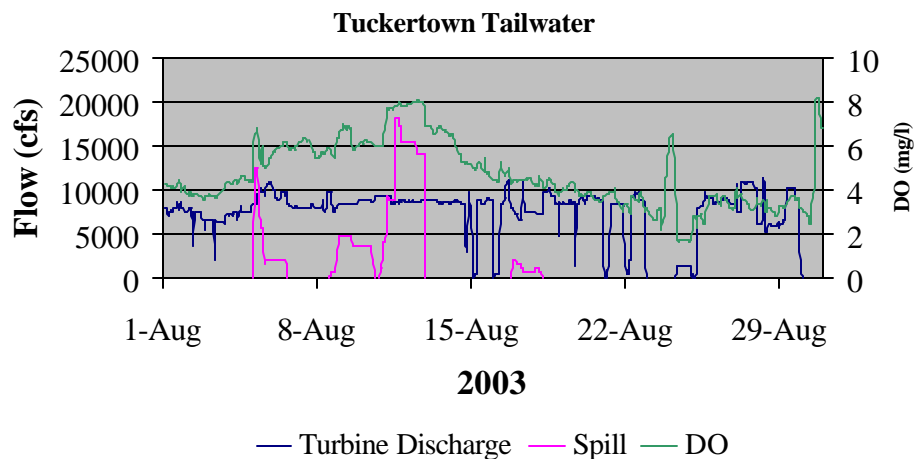
Falls Tailwater Daily Average DO



 **High Rock Tailwater August 2003
Turbine Discharge, Spill and DO**

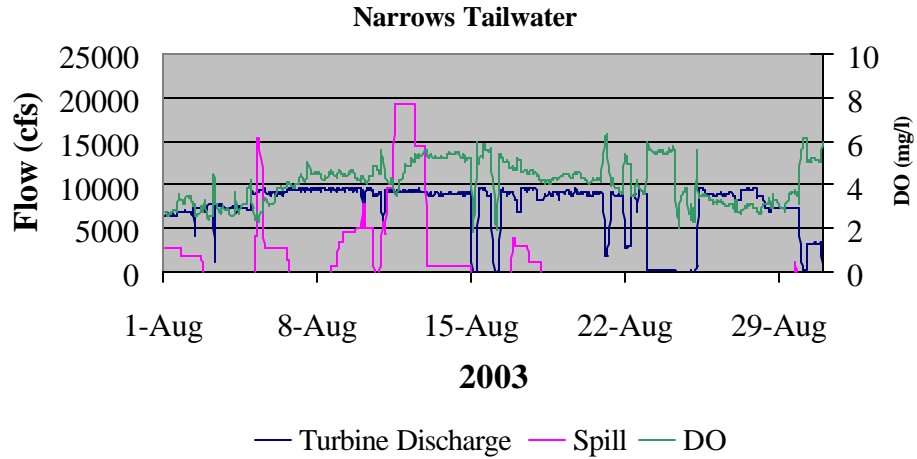


 **Tuckertown Tailwater August 2003
Turbine Discharge, Spill and DO**

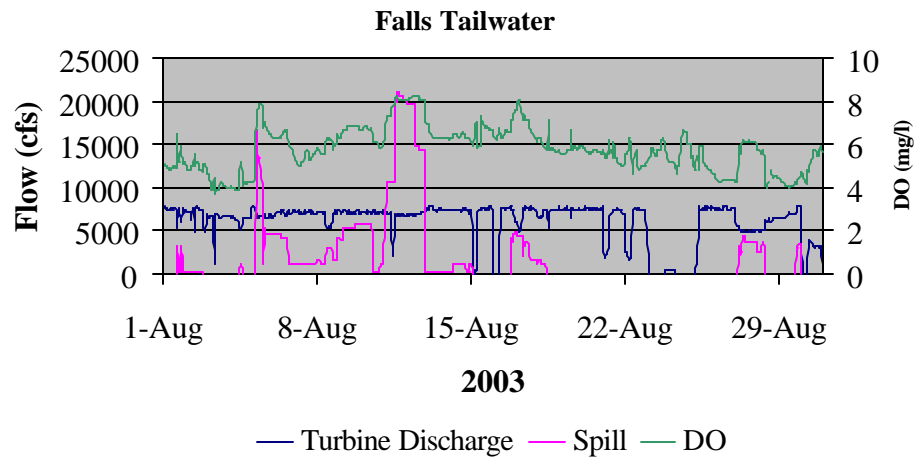




Narrows Tailwater August 2003 Turbine Discharge, Spill and DO



Falls Tailwater August 2003 Turbine Discharge, Spill and DO



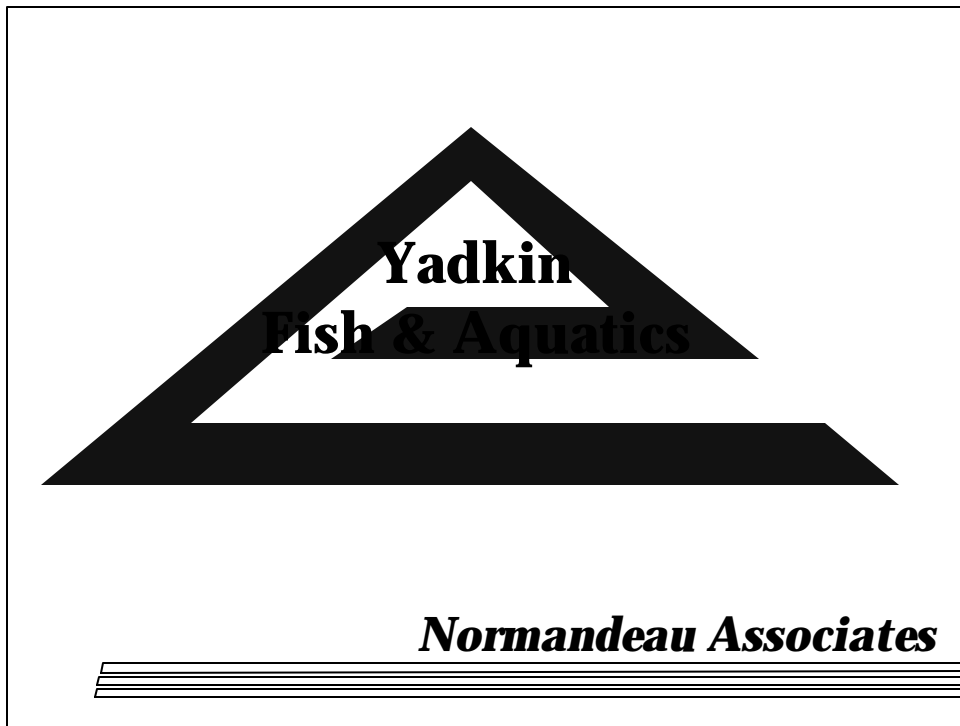


Ongoing Studies

- Monthly monitoring completed December 2004
- Lateral dissolved oxygen survey next summer
- Continuous dissolved oxygen monitoring continues at Falls and Narrows



Attachment 4 – Fish and Aquatics Studies Presentation

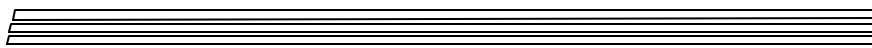


△ *Status of Fish and Aquatics Studies*

- Entrainment study draft report being reviewed
- Tailwater fish & mussel sampling began in Aug/Sept; Fall sampling completed in Nov 2003
- Habitat survey on Narrows completed in Dec 2003 - High Rock survey began end of January

 *Yadkin tailwater fish collections*

- Falls tailwater fish sampling - 8/26 thru 8/28; 11/4 – 11/6; fished gill nets, boat electrofishing (day & night), backpackshocking & seining
- Habitat mostly boulder/cobble with submerged trees around islands – most fish captured around the islands



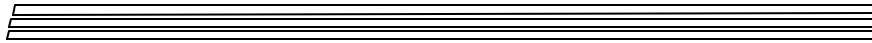
 *Falls Tailwater Species List*

29 Species

Black Crappie**	Longnose Gar	Striped Bass
Blueback Herring	Pumpkinseed	Tessellated Darter
Bluegill	Redbreast Sunfish	Threadfin Shad
Blue Catfish	Redear Sunfish	Warmouth
Channel Catfish	Satinfin Shiner*	White Catfish
Creek Chubsucker	Shorthead Redhorse	White Crappie**
Flathead Catfish**	Silver Redhorse	White Perch
Gizzard Shad	Smallmouth Bass	Yellow Bullhead*
Largemouth Bass	Snail Bullhead	White sucker
	Spotted Sucker*	Yellow Perch

* Not collected by Progressive Energy in 2000 Study

** Not collected by Progressive Energy in tailwater, however, collected in reservoir



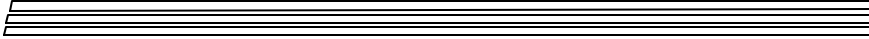


Narrows Tailwater Species List

27 Species

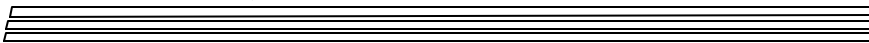
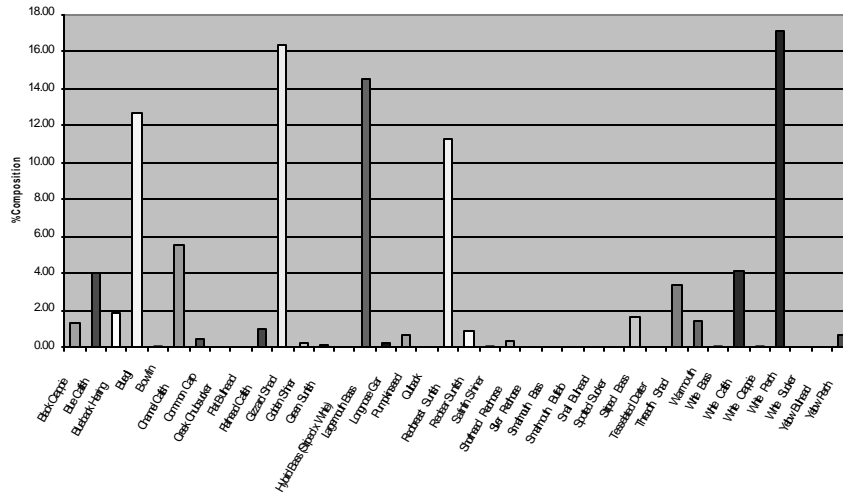
Bowfin	Gizzard Shad	Shorthead Redhorse
Black Crappie	Golden Shiner	Striped Bass
Blueback Herring	Green Sunfish	Threadfin Shad
Bluegill	Largemouth Bass	Warmouth
Blue Catfish	Longnose Gar	White Bass
Carp	Pumpkinseed	White Catfish
Channel Catfish	Redbreast Sunfish	White Crappie
Flat Bullhead*	Redear Sunfish	White Perch
Flathead Catfish	Satinfin Shiner*	Yellow Perch

* Not collected by Progressive Energy in 2000 Study



Narrows Species Composition

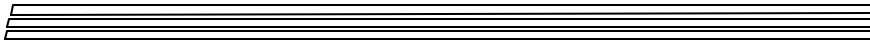
Narrows Tailwater



Tuckertown tailwater fish sampling

- Gill nets, boat electrofishing, backpack shocking & seining; 9/1 - 9/4 & 11/9-11/11

Cobble/boulder substrate in upper tailwater, overhanging trees & submerged trees/limbs dominant habitat downstream

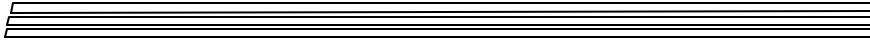


Tucker Town Tailwater Species List

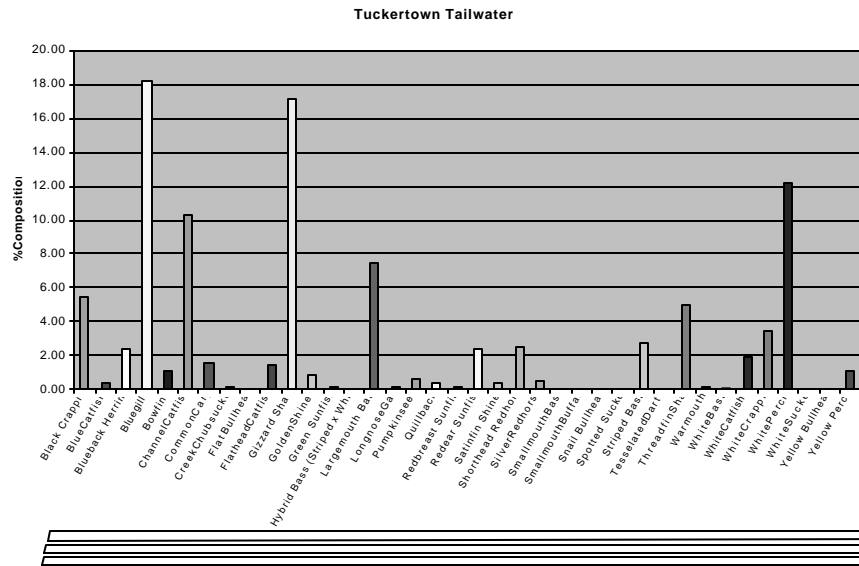
28 Species

Black Crappie	Green Sunfish	Shorthead Redhorse
Blueback Herring	Hybrid Bass	Silver Redhorse*
Bluegill	(Striped X White)	Striped Bass
Blue Catfish	Largemouth Bass	Threadfin Shad
Carp	Longnose Gar	Warmouth
Channel Catfish	Pumpkinseed	White Catfish
Creek Chubsucker	Quillback*	White Crappie
Flathead Catfish	Redbreast Sunfish	White Perch
Gizzard Shad	Redear Sunfish	Yellow Perch
Golden Shiner	Satinfin Shiner	

* Not collected by Progressive Energy in 2000 Study



Tuckertown Species Composition



High Rock tailwater fish sampling

- Gill nets set 9/4 but had to retrieve on 9/5 due to spill (12 spp captured then)
- Returned 9/15 – gill nets & boat e-fish done 9/15 - 9/18, backpack shocking & seining done 9/16
- Nov sampling 11/11-11/13
- Boulder/cobble in tailrace with overhanging vegetation – rip-rap at boat ramp held numerous sunfish & lgm. bass

High Rock Tailwater Species List

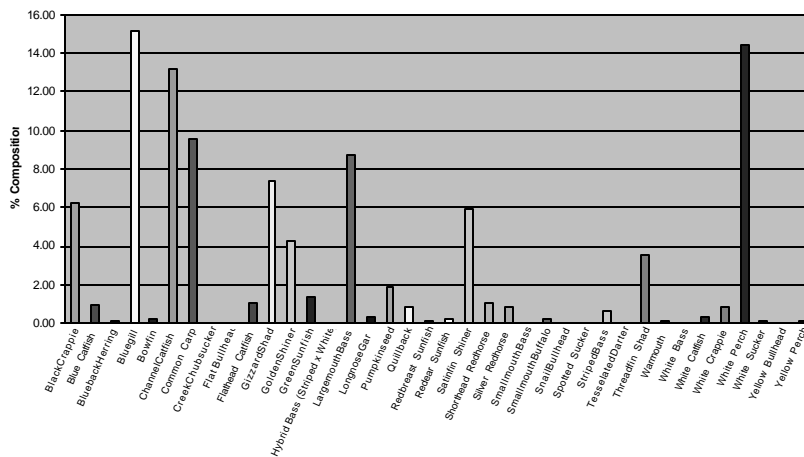
29 Species

Black Crappie	Hybrid Bass	Shorthead Redhorse
Blueback Herring	(Striped X White)	Silver Redhorse
Bluegill	Largemouth Bass	Smallmouth Buffalo*
Blue Catfish	Longnose Gar	Striped Bass
Carp	Pumpkinseed	Threadfin Shad
Channel Catfish	Quillback	Warmouth
Flathead Catfish	Redbreast Sunfish	White Catfish
Gizzard Shad	Redear Sunfish	White Crappie
Golden Shiner	River Carpsucker	White Perch
Green Sunfish	Satinfin Shiner	Yellow Perch

* Not collected by Progressive Energy in 2000 Study

High Rock Species Composition

High Rock Tailwater

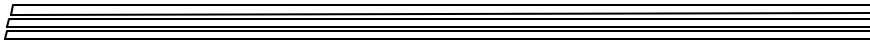




Falls Tailwater Mollusca Survey, Sep-Nov 2003

Species	September '03								November '03			
	T1		East bank Is.		T2		Rapids West Bank Is.		T1		T2	
	L	R	L	R	L	R	L	R	L	R	L	R
<i>Elliptio complanata</i>	21	9	34	29	23	15	26	9	20	34	4	11
<i>Elliptio cf. lanceolata</i>	6	4	7	5	7	1	7	1	11	11		15
<i>Lampsilis radiata</i>	11	2	15	11	13	7		1	22	13	7	5
<i>Utterbackia imbecillis</i>			1						2			
<i>Villosa delumbis</i>				3						1		2
<i>Corbicula fluminea</i>	A	A	A	A	A	A	A	A	A	A	A	A
<i>Pyganodon cataracta</i>				3					1			2
<i>Anodonta implicata</i>		5										

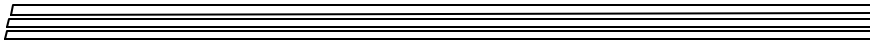
L= Live specimen; R=Relic specimen; A= Abundant



Narrows Tailwater Mollusca Survey, Sep-Nov 2003

Species	September '03						November '03				
	T1		East Bank Is.		T2		T1		T2		
	L	R	L	R	L	R	L	R	L	R	
<i>Anodonta implicata</i>	1	4									
<i>Elliptio complanata</i>	1						1	6			
<i>Elliptio cf. lanceolata</i>							1	4			
<i>Lampsilis radiata</i>								1			
<i>Pyganodon cataracta</i>								1			
<i>Utterbackia imbecillis</i>	1							2			
<i>Corbicula fluminea</i>	A	A	A	A	A	A	A	A	A	A	A

L= Live specimen; R=Relic specimen; A= Abundant

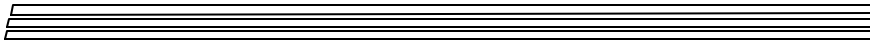




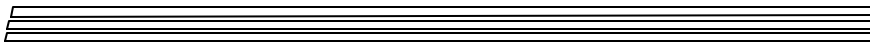
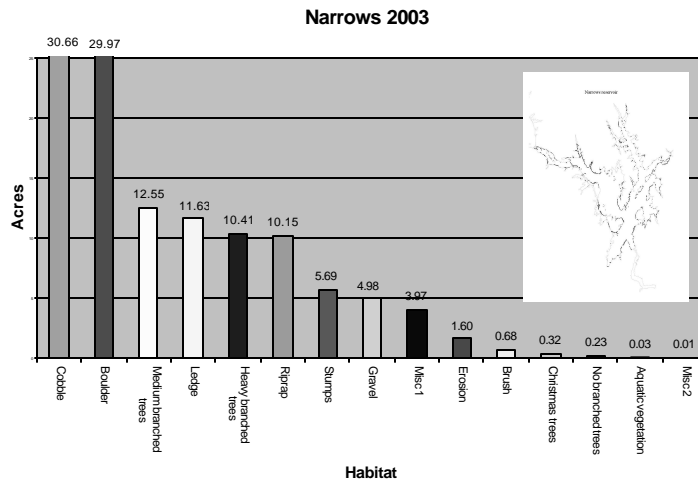
Tucker Town and High Rock Tailwaters Mollusca Surveys, Sep-Nov 2003

	September '03						November '03			
Tucker Town Tailwater										
Species	T1		T2				T1		T2	
	L	R	L	R			L	R	L	R
<i>Corbicula fluminea</i>	A	A	A	A			A	A	A	A
High Rock Tailwater										
Species	T1		T2		Shallows		T1		T2	
	L	R	L	R	L	R	L	R	L	R
<i>Corbicula fluminea</i>	A	A	A	A	A	A	A	A	A	A
<i>Campeloma decisum</i>			9	1	16					
<i>Cipangopaludina chinensis</i>							7			

L= Live specimen; R=Relic specimen; A= Abundant



Narrows Habitat Composition



△ *Progress as of January 31, 2004*

