USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on the Proposed Plan for the Ocoee River (OU-5 of the Copper Basin site) is important to EPA. Comments provided by the public are valuable in helping EPA select a final cleanup remedy for the site.

You may use the space below to write your comments, then fold and mail. Comments must be postmarked for receipt by EPA no later than July 18, 2011. If you have questions about the comment period, please contact Mr. Craig Zeller, 404-562-8827. Those with electronic communications may submit their comments to EPA at the following email address: Zeller.Craig@epa.gov on or before July 18, 2011.

Name ______________________________

Address ______________________________

City ______________________________

State ______________ **Zip** __________

INSIDE: EPA Proposes Action on Ocoee River

Mr. Craig Zeller
Superfund Remedial Branch
U.S. Environmental Protection Agency
61 Forsyth Street, SW
Atlanta, Georgia 30303

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Appendix C

Comments on the Proposed Plan

TVA

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

Brenda Brickhouse
Vice President
Environmental Permits & Compliance

August 4, 2011

Mr. Craig Zeller, P.E.
Remedial Project Manager
Superfund Remedial Branch
U.S. Environmental Protection Agency
61 Forsyth Street
Atlanta, Georgia 30303

Dear Mr. Zeller:

TENNESSEE VALLEY AUTHORITY (TVA) – OCOEE HYDRO DAM(S) OPERATIONS-- COMMENTS ON DRAFT U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) PROPOSED PLAN FOR THE OCOEE RIVER- COPPER BASIN SITE, CERCLIS ID: TN0001890839

TVA has reviewed the subject draft proposed plan for the Ocoee River as outlined in the "Draft Feasibility Study Amendment for the Ocoee River" (December 17, 2010), the "U.S. Environmental Protection Agency proposed Plan Fact Sheet, Ocoee River" (June 2011), and comments from Black and Veatch (B&V) on behalf of EPA (April 29, 2011) and Barge Waggoner Sumner and Cannon, Inc. (BWSC) on behalf of Glenn Springs Holdings Incorporated (May 27, 2011). We offer the following comments in regards to TVA's proposed involvement in the remedial activities in the Ocoee River.

While TVA appreciates the work that has gone into determining the Preferred Alternatives for the remediation of the Ocoee River in the Copper Basin, we respectfully disagree that these are the best options. TVA believes that the most appropriate option for remediation is the removal of the contaminated sediments from the Parksville Reservoir for disposal. We understand that this is a costly alternative, but think it would most directly address the existing contamination and mitigate future migration of pollutants by either sediment transport or release of metals into the water column through oxidation. Neither of the selected Preferred Alternatives affecting TVA are as effective as this option. However, TVA will abide by and support the Alternative finally selected by EPA, subject to certain reservations.

The two Preferred Alternatives directly affecting TVA's operation of our dams on the Ocoee River are Alternative O3R-2: Monitored Natural Recovery (MNR) with Hydraulic Controls in the Ocoee No. 3 Reservoir and Alternative PR-5: MNR with Permanent Inundation using Flashboards and Superboards in the Parksville Reservoir.

Comments on Preferred Alternative 0R3-2: MNR with Hydraulic Controls

TVA developed a Best Management Practices (BMP) Plan for Ocoee 3 Dam in 2009, to control sediment release in response to the Tennessee Department of Environment and Conservation (TDEC) Director's Order WPC09-0008. The plan has been reviewed and approved by the TDEC and implemented by TVA. TVA proposes that this plan is acceptable to meet the requirement under this alternative that TVA develop a BMP to guide dam operations at Ocoee No. 3 to minimize the release of sediments which can occur from the lower sluice gates. TVA has provided copies of this internal process for your approval.

As part of the Director's Order, TVA has been required to collect and analyze annual fish and macroinvertebrate community samples in the summer quarter from 2009 through 2011. TVA will share any current or past monitoring results from this area with Glenn Springs Holdings. The future Ocoee No. 3 Reservoir monitoring program similar to that described in Alternative CBR-1 should be the sole responsibility of Glenn Springs Holdings Incorporated.

TVA would like language placed in the final Record of Decision (ROD) that would allow TVA the flexibility to repair, upgrade, or remove any of the dams in the Ocoee River system if it becomes necessary. Under those conditions, TVA may not be able to hydraulically control sediment mobilization. Any of the aforementioned activities will be outlined in a notification document to EPA prior to commencement of the activity.

Comments on Preferred Alternative PR-5: MNR with Permanent Inundation using Flashboards and Superboards

While TVA can support permanent inundation using flashboards, we wish to reiterate that this option is not better than the removal of contaminated sediments from the Parksville Reservoir. TVA can maintain a pool elevation to establish a consistent water cover over the sediments; however, we would like to emphasize our need to preserve operational requirements such as normal fluctuation associated with power generation and unplanned fluctuations due to maintenance or emergency activities.

As stated in the Fact Sheet, TVA would maintain a reservoir pool elevation of 834 feet (NAVD 88) to inundate the average elevation of the sediment delta. TVA agrees to maintain this elevation as is practical and safe. It is our understanding that additional sediment deposition is expected and designed to support natural recovery and will not require this inundation elevation to be changed. Also, EPA should consider contouring the contaminated sediments to further mitigate and enhance recovery.

In order to maintain a higher reservoir pool elevation, TVA will experience routine power generation losses that should be compensated by Glenn Springs Holdings. The exact cost of these generation losses has not been determined, and will be dependent on multiple conditions at the time of the permanent pool elevation establishment. TVA will provide details of this cost at that time. Costs will be incurred because of the missed generation that would normally have been realized by lowering elevation from summer to winter pool.

The EPA comments document (B&V April 29, 2011) indicates that TVA would be required "to conduct an annual inspection of the flashboards and superboards, replace any questionable boards, and completely replace the entire system every 3 to 5 years." These requirements are beyond TVA's normal maintenance program which is in accordance with recommendations in the Federal Guidelines for Dam Safety. Any inspections and repairs that exceed TVA's normal maintenance program must be agreed to by TVA and funded by Glenn Springs Holdings.

While there is an expectation in the Feasibility Study that board system replacement may be accomplished in 3 weeks (Page 26), TVA wishes to point out that this is an optimum case of the time requirement. To replace either the entire system or any damaged boards, TVA must lower the reservoir pool to an appropriate level for worker safety and access. This operation is wholly dependent on weather and flow conditions. For example, had TVA been required to replace the board system during the recent rainy spring of 2011, we would not have been able to begin the 3 week replacement process for several months. TVA will perform this work only under conditions we consider safe and effective.

TVA is still concerned with the possible liability associated with potential upstream and downstream nuisance flooding on non-TVA owned lands during operation of the Ocoee River system in this manner. We are ready to implement the revised operating policy, contingent upon successful resolution of our concerns about responsibilities and liabilities associated with increased flooding. We would like a clear statement from EPA about its views on the risk of increased flooding and who will assume responsibility for this.

General Comments

TVA appreciates the opportunity afforded to us to be involved in the Feasibility Study and Preferred Alternative selection process. We continue to fulfill our long term stewardship role over the aquatic resources in the Ocoee River. The operation of our dams and reservoirs is the critical factor to accomplishing the remedial actions necessary for the restoration of the Ocoee River within the Copper Basin. While TVA is not the cause or source of the pollutants found in the Ocoee River system, we are being asked to assume much of the risks for the success of this plan, especially in the area of possible liability for increased flooding risk. Therefore, we request that we continue to be involved as an EPA partner in the development of the final ROD. In addition, TVA would like a separate Memorandum of Understanding with Glenn Springs Holdings and EPA that specifies timing of inspections, board replacements, generation compensation, liability for increased flood risk, dispute resolution, timeframe for re-evaluation of project effectiveness, and payment arrangements outside of the ROD.

We look forward to discussing these comments with you at your convenience.

Sincerely,

Brenda E. Brickhouse

Glenn Springs Holdings, Inc.
A Subsidiary of Occidental Petroleum
970 New Highway 7, Columbia, Tennessee 38401-6660
(931) 388-6752

July 14, 2011

Craig Zeller, P.E.
Remedial Project Manager
Superfund Remedial Branch
U.S. Environmental Protection Agency
61 Forsyth Street
Atlanta, GA 30303

Re: COMMENTS REGARDING PROPOSED PLAN FOR THE OCOEE RIVER

Dear Craig:

Glenn Springs Holdings, Inc. (GSH) has reviewed the Proposed Plan Fact Sheet for the Ocoee River (June 2011) provided by USEPA. GSH generally concurs with the overall approach and the preferred alternatives outlined for each reach. We do, however, have comments regarding applying lime to the delta, which is proposed as part of the recommended remedy for the Parksville Reservoir. We formally request that the lime application be removed from the preferred alternatives for the reasons explained below.

The preferred alternative, PR-5, and alternative PR-2 propose raising the water level to cover the delta throughout the year. Prior to establishing the new permanent high pool condition, each alternative would require application of lime as a surface amendment to treat the upper 'oxidized' zone of the delta. Presumably, lime applications would be made under low pool conditions when the delta is maximally exposed. The intent of the lime application, as described in the Feasibility Study, would be to reduce acidity in shallow sediments, and, in turn, reduce the concentrations of metals in the pore water that could potentially be transferred to the surface water.

GSH has concerns about the implementability, efficacy and necessity of the lime application.

Implementability Issues

- The delta is comprised of soft, saturated materials that would not support heavy equipment that traditionally would be used for bulk lime applications. As a result, specialized low bearing pressure equipment would be required. It is possible that even low bearing pressure equipment would be unable to traverse the delta as the physical disturbance/vibration in concert with saturated conditions could lead to liquefaction of the delta materials. An additional implementability concern is that the secondary channel that crosses the delta near the Greasy Creek confluence would have to be bridged to allow access by heavy equipment to the main delta. Both space restraints and material bearing capacities could potentially be construction obstacles that could not be reasonably overcome.

- It has been suggested that a pilot study be performed to gauge the benefits of lime application under constant high pool conditions as well as the best means of applying the alkalinity source (surface broadcast vs. shallow incorporation). To do this, it would be necessary to apply/incorporate materials on a limited field trial basis, install requisite field monitoring equipment during low pool conditions, and then raise the water level above the delta to represent current summer pool. Then, it would be necessary to conduct an extensive surface water/pore water monitoring program for a reasonable time period, perhaps a year or more, in order to gauge whether the applications provided any tangible benefit under actual reservoir conditions. Upon termination of the pilot study, it would be necessary, if the pilot study proved that lime application met the objective of the study, to drawdown the reservoir for an extended period in order to 'treat' the entire delta. The latter step runs counter to EPA's suggested course of action, which is to avoid prolonged low pool conditions. Furthermore, given the RI's failure to corroborate a connection between impacted pore water and discernible surface water impacts, it is possible that the pilot study would fail to show the need for or any appreciable surface water benefits from lime application.

Efficacy Issues

- The static and dynamic treatability tests performed during the RI, and which were the basis for the recommendation for liming of the delta failed to establish conditions that were consistent with those that would be expected in the reservoir, and neither test addressed issues related to scalability. The impacts of these issues on the anticipated efficacy of the technology are discussed below.

- Static and dynamic test results for calcium and magnesium in the overlying water showed that the lime amendments were readily solubilized. During the treatability study, these constituents remained within a fixed volume of sediment/water for an extended period providing an opportunity to affect both aqueous and solid phase chemistry as the amendment-influenced waters remained in contact with, and were drawn into, the solid media during simulated high pool and drawdown conditions. The effect was an extended effective alkalinity residence time that would not be afforded by actual reservoir conditions. In Parksville, the overlying water column would be deeper on a scaled average basis than in the test cells, which would enable the amendment constituents to be dispersed into a larger relative volume. Furthermore, unlike the test cells, the delta would be subject to a constant flushing flow from both the Ocoee River and Greasy Creek.

- From the static lab tests, EPA concluded that "Although subtle, amendments do appear to have a small positive effect on pore water quality." Surface water pH decreased by 1 s.u. in the second dynamic flush and, from that, it was concluded that the findings 'may indicate that the positive effects of the amendment may decrease as continued flushing occurs during repeated reservoir drawdown cycles' (B-12). Raising the water level of the reservoir after placing lime on the surface of the delta would result in the lime being dissolved into the surface water (even if it is incorporated to depths of 4-6 inches), thus significantly reducing, or perhaps eliminating, the intended effect of the lime on the delta materials. It is not clear if the same small positive results would occur or be sustained for any appreciable period of time in the delta area if the applied lime were quickly solubilized and dispersed throughout the reservoir. It could easily be hypothesized that the continuous replacement of water at the sediment/surface water interface *in situ* would cause quicker dissipation of the potential liming effects than was observed in the treatability study. The Summary and Conclusions of the Shallow Ground Water Investigation (conducted in situ) stated that "Surface water samples did not show that delta sediment had a clear influence on surface water quality." (Page B-13.) However, the Soil Amendment Investigation (conducted during the treatability study in the laboratory) concluded that, "Results from the dynamic test cells suggest that lime amendments have a significant effect on the concentrations of metals and pH in the surface water pool overlying the sediment." The discrepancy between the treatability study results and the measured field results raises uncertainties regarding how well the simulated studies represented actual conditions.

Necessity Issues

- EPA's primary concern for the Parksville Reservoir is the draining of pore water from the delta during drawdown as discussed in Section 4.1.6.2 of the RI. Few, if any, trends were observed in metals during the study, and interpretations of continuous pH/conductivity results may not have adequately considered the influence of recent, preceding storm events and the increased surface water flow from Davis Mill Creek and North Potato Creek watersheds that resulted from the storm events. During the time of the investigation, the flow from the Copper Basin tributaries was not yet being fully treated.
- Without recognizable trends in metals concentrations, and with questionable field parameter trends to support the hypothesis that pore water to surface water transport was perceptibly influencing surface water quality, the primary line of evidence relied upon in the RI became a rise in acidity during the November 2005 sampling event. Upon further review, it would appear that the acidity results,, which constituted the only data suggesting a manifested pore water/surface water connection may have been incorrect. Aluminum, copper, iron, manganese and zinc concentrations, the primary contributors to acidity given the near neutral pH, did not vary appreciably between sampling events thus raising the question of what chemical process remained that could support the reported increased acidity. As a result, it may be concluded that, although the pathway is plausible, no evidence of significant pore water to surface water transport was observed. Thus, the need for active remediation was not supported by the water quality results reported.
- If the Proposed Plan were to be implemented, liming would not be necessary because raising the permanent pool level of the reservoir would preclude annual pool level fluctuations, which the RI concluded was the cause of the delta's adverse impacts on the surface water quality. Ending the annual pool level fluctuations would effectively:
    - Increase the reduced zone ;
    - Decrease oxidation reactions in the near surface; and
    - Eliminate the primary driving force behind the 'worst case' delta pore water drainage to surface water transport pathway.
- Surface water (surface and near sediment/surface water interface) currently meets TN Water Quality Standards in the delta toe area. From third quarter 2009 to first quarter 2011 (4 events), water quality standards were met along the delta toe for cadmium, copper, manganese, zinc and total iron. Dissolved aluminum and iron also met the standards. The only 'exceedance'

reported was for total aluminum, which could simply be a function of the varying quantity of suspended sediments. As a result, surface water quality improvements are not necessary.

- If delta sediments have no influence on surface water quality and amendments (liming) can only be expected to have a small positive effect on pore water quality at best, there does not appear to be a justifiable basis for including that technology as part of the selected alternative; particularly given the estimated costs and the uncertainties associated with implementation.

In summary, GSH believes that applying lime to the delta is neither supported by the facts of the Remedial Investigation nor necessary to meet the remedial objectives of the Feasibility Study, and that the Feasibility Study and Proposed Plan have failed to adequately consider the difficulties of the proposed lime addition and incorporation.

If you have any questions, please feel free to contact me.

Sincerely,

Ken Price
Senior Vice President, Operations
Glenn Springs Holdings, Inc.

USE THIS SPACE TO WRITE YOUR COMMENTS

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I agree with your recommendations.

Best solution / Best economic

Copper Basin Reach: CBR-1

Ocoee No. 3 Reservoir: O3R-2

Parksville Reservoir: PR-5

Name Leonard Murray
Address 3088 Foths Circle
City Chattanooga
State TN Zip 37415

INSIDE: EPA Proposes Action on Ocoee River

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Appendix D

Transcript of June 23, 2011 Public Meeting

OCOEE RIVER

PROPOSED PLAN PUBLIC MEETING

OFFICE OF GLENN SPRINGS HOLDINGS, INC.

DUCKTOWN, TENNESSEE

JUNE 23, 2011, 6:00 P.M.

NATIONAL COURT REPORTERS, INC.
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MR. ZELLER: It's a little after six o'clock, I guess we're going to try to get started here so we can get on with our evening.

I appreciate you all coming out. My name is Craig Zeller. I am a project manager, an environmental engineer with the Environmental Protection Agency, EPA, out of Atlanta. I welcome you all. Thanks for coming in. The restrooms are down here to the right. There's drinks and refreshments. You guys have probably all found that stuff for now.

So what I want to talk about I guess today is what we're here for is that tonight we are -- let me back up for a second. You will notice this lady right here. This is a court reporter. This job is being cleaned up under CERCLA or it's also known as the Superfund. Superfund requires the EPA to at this stage of the process when we're talking about the proposed cleanup plan at this public meeting, the public meeting is required by law, and so we are required by law to have a court reporter to take a verbatim transcript of the hearing and the comments and that kind of thing.

So we have been I guess working up here for about ten years since the initial agreement was in place. That's how I got started here with EPA and TDEC, working on the Copper Basin project. What I'm going to talk about tonight is our proposed cleanup plan for the Ocoee River. Okay. It's like three or four things we've got going on.

We released this proposed plan after we had studied the Ocoee River. We've got a series of alternatives, looked at a range of alternatives for several reaches of the river, and starting I guess Friday, June 17th, we started a 30-day public comment period on what we believed to be the preferred or the proposed cleanup plan for the river.

We will accept your comments tonight at this meeting, which again is why the court reporter is here. You can send me those comments via e-mail, or you can tear off the page, the little back sheet we mailed out the first part of the week, and mail them to me or give them to me at the end of the meeting.

At the end of that 30-day comment period, we will synthesize, kind of collect and look at all the comments we have and we will come out then later with the final plan. Sometimes the final plan is different than what was proposed based on comments received. So we encourage you if you have something to say, we would like to hear your voice.

So with that, let me get started here. I've got about 20, 20-some slides. At the end of this I will open it up for Q and A and we have other people here associated with the project. We have the folks here from the state of Tennessee and folks here as well from Glenn Springs as well as another colleague of mine from EPA, so if you have any comments or questions, we'll take them then, of course, and when we get to that part of the Q and A, I would ask you again for purposes of the record that you would please state your name and address if you're comfortable with that so we can know whose comment it was.

So what is the problem? Why are we here today? Why have we been up here I guess for a little over ten years now? This was a hard rock mine, we call it, a copper and zinc mine, also produced a lot of sulfuric acid. Because of that operation of that mine over about 150 years, we had about 10 to 12 square miles of the basin that was completely denuded. You will see the picture over there on the left that came out of National Geographic in 1973. It was called the Great

Eastern Desert, okay? We didn't have any canopy, we didn't have any vegetation, we had massive erosion problems coming off of about 10,000 acres of watershed.

Those sediments that came from the mining district then were transported down Davis Mill Creek, North Potato Creek, and into the Ocoee River and ultimately into the series of reservoirs that are now owned and operated by TVA.

We had discharges from the mineral processing, the beneficiation that actually produced the zinc and copper ores, they had some chemicals in that stuff they would use, and as a result copper and zinc and acid are not real good on aquatic life. Fish and aquatic life don't do real well in highly acidic waters and don't necessarily take a liking to zinc and copper as well.

So how have we went about cleaning up this problem that was created over about 150 years of operation? There was some initial vegetation efforts began in the 1930s. Some of those initial efforts didn't really take root, no pun intended. It wasn't largely successful.

Beginning then again in the '70s, started to get some things to kind of stand up out there and we continue that today. There are thousands of trees that Glenn Springs are planting out here every year to keep that revegetation and reestablish the natural environment up here.

But things really started I guess to take a turn for the better up here as far as, you know, the environmental protection standpoint, in 2001 after lots of discussions between EPA, TDEC, which stands for the Tennessee Department of Environmental Conservation, as well as Glenn Springs entered into this memorandum of understanding, which is a legal agreement that kind of set up a strategy of how we would systematically step by step go about cleaning up the legacy issues associated with the mine.

It was really kind of a three-step process. The framework was split into three. The first one which we'll talk about tonight is the EPA agreed to take the lead on the remedial investigation feasibility study. That's kind of a fancy government term where we're going to sample and analyze it and find out what the problem is, and then we're going to develop and figure out what the risks are to the human health as well as the environment, and then we're going to develop a series of alternatives that would provide adequate protection.

The EPA agreed to do that Ocoee River investigation. Oxy agreed to step up and then treat the base flows of North Potato Creek and Davis Mill Creek. Those two creeks which were virtually the bulk of the mining operation, which discharged to the river, we have now over the last ten years implemented a series of surface water treatment strategies that pull over about 10,000 pounds of metals a day out of the river. All right. I'll show you some slides on that.

Oxy agreed to address the North Potato Creek work under TDEC oversight. TDEC is kind of handling or taking the lead on the investigations in North Potato Creek.

And another big thing we agreed to do is while this was being addressed under Superfund, all right, we are used CERCLA authority to address this, this is not an official NPL or national priorities list Superfund site. If you go looking for this on the Superfund list, you're not going to find the Copper Basin Mining District. We kind of struck that deal that if we agree to do all these things, we won't. Oftentimes we do this, people in the community don't like the stigma that, oh, I live in a Superfund site, I'm going to be losing my hair and cancer clusters and all that stuff. So the big benefit of that is, again, while we are using Superfund authority, you won't find it listed on the NPL.

So about the river, which is what we'll talk most about tonight, is it did cost over -- started in 2002 over about the last nine years it has cost us about $2 million to get this done. It did involve 26 river miles of the Ocoee starting here about river mile 33 -- I'll show you a slide in a second -- it involves three TVA dams, Ocoee Number One, Ocoee Number Two, Ocoee Number Three, as well as the White Water Reach, the commercial White Water Reach that you all are very familiar with.

We split this, to help our assessment and to help our development of alternatives, we split this into three different areas, and we will talk about what we found in those three different areas and what we're proposing to do for those three different areas.

So the first one is the Copper Basin Reach. It is about a five-mile reach right here in and amongst the Davis Mill Creek/North Potato Creek confluences. Starts about river mile 38, just upstream of McCaysville, and goes down to the Ocoee Number Three slack water. This reach would be flee-flowing water, okay? It also has been the reach historically that has been the most impacted by the mining activity up here.

The second reach or second study area we'll talk about is Ocoee Number Three Reservoir. It's about a five-mile reach from river mile 33, 34, down to the Ocoee Number Three Dam, which sits about Ocoee River mile 29.2.

Then we skipped over the whole White Water Reach which sits through here. That's the commercial and the Olympic stretch. And why did we skip over that? Because there's literally no sediment to sample in the Ocoee White Water Reach because it's full of large boulders, fast moving water, and the impacts in that reach are considered to be negligible to the habitat.

Then the third and final reach that I'm talking about is the Parksville Reservoir and what we're proposing to do with that delta material that you see down there at low pool.

So what did we do? With the study in 2002, what are all the things that EPA and the State have been doing up here? Well, there was a massive investigation where we collect samples and then we send these samples into the lab to get analyzed. Once we get, you know, the chemical concentrations, then we look at the potential risks to the ecosystem, the fish and the bugs that live in the sediment, and we look at impacts to potential human health. Would white water rafters be potentially impacted? The answer to that is no, but I'll get more into that.

Then from what we looked at, we looked at sediment chemistry. Is the sediment toxic to critters living in the sediment? We looked at the pore water in the sediment, that water that if you picked up sediment would drain out of it. What's the quality of the pore water in the sediment?

We looked, of course, at water chemistry and toxicity, we looked at fish and aquatic life, and then we also saw and transported and conducted some modeling on how sediment moves through the system to get an idea over time where will this sediment end up.

So what did we find? Well, the major thing, you know, the big advantage of this investigation that was started in 2002 before any of these big actions that I mentioned, the water treatment alternatives, before they were done, so it got us snapshot of before any remediation work was done and it was phased so we got the chance to see it over time as these actions were taking place, how did they improve.

Well, they have significantly reduced the concentration of loads of metals to the river. I have a slide that will put that in better perspective.

For the most part, the water now coming in, the Tennessee or, excuse me, the Ocoee River for the most part meets Tennessee water quality standards. Ten years ago, folks, that wasn't true, all right? We had some sections of the river that just were not even close to meeting the water quality standards.

The only exceptions to that are very limited, the immediate right bank right down where Davis Mill and North Potato Creeks discharge, where that water comes in, there's some minor exceedances on occasion, and then in some places just a few inches above those contaminated sediments where we might have some pore water coming in and getting into the surface water.

Because of all the work that we've had and done over the last ten years, we no longer have acute toxicity. What I mean by acute toxicity is something that dies, fatality like that. Bugs don't like metal, bugs don't like acidity. Back in the day we had acute toxicity. Now all we're left with is this long-term chronic toxicity. Okay. The long-term chronic risks that we're seeing are pretty limited to the Ocoee Number One Reservoir down there in the Parksville delta and to the growth and reproduction of benthic macroinvertebrates. What is that? That is a bug. That's a bug that lives in the sediments there. So we believe that chronic toxicity is left from the residual levels of metals and acid that have been down in that part of the delta.

This picture I think really -- they say a picture is worth a thousand words. I think this picture really says everything on one slide. Before -- let me step over here. Before the MOU -- this is on here we've got pounds of metals a day that would have been loaded or been discharging to the Ocoee River. Before the MOU in January of 2001 we had approximately 11,000 pounds of metals a day that were discharged into the Ocoee River. Those would have been primarily from the two creeks, North Potato Creek and Davis Mill Creek.

Because of the agreements in 2001 the first water treatment plant went online in November of 2004. This was the water treatment plant that was installed near the Intertrade plant, what's called the Cantrell Flats Plant. That first stepdown we'll see then was a 74 percent reduction. We went from about 11,000 pounds a day down to around 3,000 pounds a day about three years after the MOU was signed.

All right. So we continued to look at other ways to reduce loadings to the river, and the next big step down here was when the next water treatment plant was built, and then the following water treatment plant -- that was the one at North Potato Creek -- when it went online in January of '05, we had another 13 percent reduction in metal loading so we had another -- we went from three thousand down to just under a thousand pounds.

Then some additional studies have been going on, we're building some more dams on Davis Mill Creek and when that comes online, you can see now over -- with time, over the last ten years we've reduced those loadings 98 percent.

Now, what has that done? Well, when we got started -- this is Barker Mill Bar. This is in the Copper Basin Reach, all right. These are my consultants, some of which are sitting in the audience there. This is what Barker Mill Bar looked like when we were just sitting started on the RI/FS for the Ocoee. Putting in some wells, starting to sample pore water, starting to sample sediments.

We pulled about 10,000 pounds of metals a day and that same area today looks like that. Okay. It's amazing. We haven't planted anything on there. We didn't plant any trees. We didn't throw any lime. Nature did all that. We did -- we got it started with the water treatment, but today that same area looks like that. It's quite amazing.

Okay. So that was the Copper Basin Reach. So now we're moving to Ocoee Number Three, the second area, okay?

So when we did our sampling in Ocoee Number Three, which is a pretty little reservoir, we found that the highest concentrations of sediment were deeper in the sediment horizon, so what that suggests is that when we were in the heyday of mining here, that the more concentrated or more elevated levels of metals were being deposited in Ocoee Number Three. Ocoee Number Three I think was built around the '40s. But as things have improved and as revegetation has improved here, as you move up, the most recent sediments that are deposited are less contaminated.

We show that sediment transport modeling shows that these toxic sediments can be exposed if you have these large scale sluicing events. TVA from time to time has to get into their turbines and conduct maintenance on their number three system, and by doing that, they have to lower the water level usually -- and I'll explain what happened here in January of '09 -- but we have seen that for the most part those massive sluice events of number three have been stopped.

The TVA does release water out of number three to feed the white water industry in Polk County, which is very important to this area. By doing those frequent recreational releases to feed the white water stream, that kind of more frequent -- I guess, in other words, we're doing more sediment flushing and less is coming out per event, so by these more frequent sediment releases down there, we're not getting that big accumulation up there.

Now, back in '09 TVA, like I mentioned, was doing some work on the number three system. There was a big slug of water that came from Blue Ridge upstream and it washed a big slug of mud from number three into the Ocoee River White Water Reach. This was in early January of '09. You all might remember it. It deposited a bunch of sediment in the Ocoee River White Water Reach. It was eventually scoured out with a serious high flow that came through there.

What we're looking to do as part of our proposed plan, we'll talk more about it, we're looking to avoid this type of situation in the future. And I'll tell you how we're going to do that in a minute.

I'll back up to a picture. Here's a core. When we go into these lakes and sediments, we actually take vertical sediment cores down through the horizon and we can pull that core up and look at it like a little bit of history.

It didn't show up very good on this, but this is a picture from a deep interval in a core. It shows these iron calcine layers that have been washed off the base of them and have been deposited in number three.

Okay. Now, Parksville Reservoir, what did we find when we were collecting our data? Parksville Reservoir is drown down, like most lakes managed by the Corps or managed by TVA or hydroelectric entities, it's very typical for the owners of these dams to draw them down in the winter, which is storing the rains that are expected to come, and then in the summer they take it up so you can recreate, and we can drive ski boats and jet skis and all that kind of stuff.

What's this doing to Parksville Reservoir is that when they lower this elevation, what we have found is that when this stuff is lowered, in the winter it's exposed to oxygen, and people that have been up through the gorge in November, December, you see that kind of big brown spot down there,. about 300 to 400 acres in size.

Those metals and those sediments that are a result from mining upstream, they become oxidized, and as a general rule of thumb, we're not going to have a big chemistry lesson here, but as a general rule of thumb, when metals get oxidized, that's bad. When you reduce metals, they are less soluble and that's what you want to do is promote reducing conditions.

So when the sediments on that delta become oxidized, then the water level comes back up in the spring time and it has a tendency to flush or resuspend some of these oxidized salts and can cause some localized impacts of water quality and localized problems with the habitat, okay, some of that chronic toxicity that I was talking about.

You've seen that that delta cannot support a viable vegetation, no cover. There's been many attempts to get those cypress trees to grow down there. They just don't seem to be maturing very quickly, and we think that's probably a combined effect of the chemical stress as well as the reservoir level coming up.

Again, the benthic community here in these deep areas are subject to chronic adverse impacts, some of which are possibly from the mining district, some are probably from some of the seasonal cyclings that occur from the deep reservoir.

These are conditions we see in a lot of these man-made reservoirs where in the summer they will stratify and then deep water usually dissolves oxygen on the deep water and it gets rather low.

This is what the Parksville delta -- we'll talk about it -- this is what it looks like standing on the gorge road there, 64, looking out into the lake. That's what it looks like in November, December, January, February. March it comes back up, starts coming back up.

So after all that, here's some of the problems. Because of the raising and lowering, we get this sediment sloughing off; and again, it's more available for transport into the lake. You'll see some of that sloughing.

So okay. So now we've got some chronic risk that we've determined that we need to try to address here. So as we go into our engineering alternatives that we've assembled to address these risks, what are what we call our remedial action objectives? What do we want to obtain or achieve with what we're talking about tonight?

Well, the big goal here is we want to meet and achieve Tennessee water quality standards. We're almost there, and we're not done with the basin yet. I think some of the additional work that's planned ongoing for the next several years, that's certainly going to help. The plans that we have out today we hope will get us there as well.

We want to prevent and control any more

releases of sediment from number three like we talked about. We want to reduce the toxicity to the aquatic organisms we talked about. These are big long terms, called the No Observed Adverse Effect Level and the Lowest Observed Adverse Effect Level. In other words, we want to get these down into protective levels based on literature from thousands of other sites down to concentrations of surface water as well as sediments that get us into this protective range and this deals with human health.

I will say that the risk assessment, there are none. The only potential human health risk associated with this on the Ocoee River is that if you eat a lot of fish from Ocoee Number Three -- excuse me -- Ocoee Number One. We talked about that in our proposed plan fact sheet that you would have to eat upwards of 12 meals of large mouth bass a month to get to that risk. So, you know, there's really not a large human health risk with this thing.

The water quality, as I mentioned numerous times already, it's fine. As far as using that for recreation, using the Ocoee River for the continued white water impact, white water tourism industry, no problem at all.

Here's -- now, taking those RO's with the more generic, what are our specific numerical goals we hope to achieve with this action? Our surface water goals are here for copper, iron, lead, and zinc. You see we have acute numbers and chronic numbers. Again, acute is short-term exposure, chronic is long-term exposure. Then we also have sediment concentrations that we'd like to achieve that are protective to those benthic organisms that I've mentioned, the macroinvertebrates. These are concentrations that we would hope to achieve and we will monitor with time to see if we get there.

Now, once we assemble all these alternatives, CERCLA, besides saying I have to have a court reporter at this meeting, also says I need to identify or evaluate all these alternatives using these nine criteria. Okay. For alternatives, for us to select an alternative, it must be protective to human health and environment, and must comply with other federal laws, other state laws, and local laws that are applicable with environmental protection.

Then we use these middle alternatives here, long-term effectiveness, can it be done, is it implementable? Is it protective in the short-term? Does it reduce the toxicity, mobility, and volume? And the cost. These are called the balancing criteria. We use these criteria to measure the relative strengths and weaknesses of each alternative so we can kind of see which one kind of rises to the top.

The last two criteria are what we called the modifying criteria and what that involves is does the State of Tennessee concur with this remedy? Okay. And we've been working with the State of Tennessee, TDEC, in this for ten years and they have offered their concurrence with what I'm about to talk about.

And the last, the ninth and final criteria is community acceptance, and that's exactly why we're here tonight. We have opened up this public comment period, we have all our documents available in the information repository for you to review if you'd like, and the last and final criteria will be if we meet community acceptance, it will be determined by the comments I receive from you folks and we'll go from there.

So what are we talking about? All right. So now we're going to go into what the alternatives are that we've assembled for the Copper Basin Reach. Because of the water treatment, the aggressive water treatment that's been done, there's not much left to do in the Copper Basin Reach. Again, you saw the revegetation pictures before and after. There's not a lot of additional work required here.

So CERCLA requires, all these alternatives, they always require us to keep in a no action alternative. If we do nothing, what would that result in? This is required to be in there because of law.

The next alternative we evaluated was strict monitored natural recovery. What that means is just a step above no action. No action means literally we go home, we don't do anything else. Under this alternative, CB-1, we would monitor the Copper Basin Reach for a period of time to make sure we get to those numerical goals for surface water and sediment quality I just showed you.

The third alternative that we looked at was monitoring natural recovery or MNR with perhaps some enhanced sediment capping. So we're looking at some various areas where we can put some end stream structures in that could maybe promote or enhance sediment capping with cleaner sediments that are now moving down the system. That would also involve removal of the low water weir, the Intertrade weir, that they were using back in the day with water intake, sucking water out of the river, that would allow sediment to move more freely out of the system. Okay. That's for Copper Basin Reach.

This now is for our second reach. This is for number three. For number three we are again by law required to maintain and keep in the no action alternative. We also have an alternative in there called 3R-1 which is monitored natural recovery again, which is one step above doing nothing. We would continue to monitor sediment quality, water quality, and toxicity, aquatic benthics in the Ocoee Number Three Reservoir.

And the third and final one we assembled for the Ocoee river water is that of monitoring natural recovery, continue to monitor, but we're going to put in hydraulic controls that we're also calling best management processes, that TVA, almost like a procedure list, of how when TVA needs to do work on their turbines and infrastructure out there, that when you draw that water level down, these are the steps that we are going to follow so to avoid a situation like occurred in January of '09.

I will say that there has been a successful drawdown study done on that shortly after the event happened in January of '09. There was an order issued by TDEC. Dr. Urban, Dick Urban, was responsible for that. He's in the back of the room. As part of that order, that order with the State required TVA to do many things. One of the things was to do kind of a test, a drawdown study, hey, let's start looking at our procedural checklist and let's see if these things we've come up with are going to eliminate any of these widespread sluicing events. That was actually a successful study done in late '09 or early 2010.

Okay. So Parksville Reservoir, if there's anything big left to do out there, I would say for this action what are we going to do, what would we propose to do with the Parksville Reservoir, so we looked at a series of five alternatives for this one. We looked at, again, no action because we have to retain it. We looked at doing monitored natural recovery only. And then we looked at alternatives 2 and 5 were what we're calling permanent inundation. Okay.

What this would require, what this would involve, is keeping the water level up at summer pool, plus or minus several feet, all the time. Okay. It's kind of like what's called a wet closure. So we would keep this water level up, we would not create that oxidizing condition that I talked about when the sediments are exposed, and we would promote long-term reducing conditions. This stuff would be underwater, three to four feet underwater, and we would then continue to monitor that.

What that does, as I mentioned, is prevents oxidation, acid generation, all this stuff that's caused by this up and down, up and down, and this flushing. We can do that two ways. We looked at two different ways of how we could keep water level up.

The existing infrastructure out there is a system of boards called flashboards and superboards that sit on top of a concrete crest dam. Those things are designed to fail as a big storm event, okay, by design.

That's what's on there now on the top is the superboards and flashboards. That's PR-5. We also looked at maybe doing something a little fancier than wooden flashboards. We looked at putting a pneumatic gate on top of the concrete crest. What this would involve is about a $3 million piece of engineering. They're bladder pumps. If you see water coming up or coming down the gorge or coming down from Blue Ridge and you want to hold that water in number three, you actually with air compressors would fill these bladders and these things would go, shew, like this. They're a little more automated, a little fancier engineering than just boards.

And then the other ones we looked at, alternative three was a wetland development. This is kind of mid level pool. Instead of dead low pool or high summer pool, we keep the pool level right about in the middle. The water level fluctuates about six to eight feet. We keep that in the middle and just cover the top of the delta and we develop a wetland over the top of it. Very similar to permanent inundation, just a different water surface elevation.

Then the fourth alternative or actually the fifth alternative that we looked at, it's called PR-4. This is our most aggressive one, okay? This involved what if we dredged the delta and got it out of there, just scalped it. What this alternative would involve is actually putting a hydraulic cutter head dredge on the delta in high pool and this material would be dredged and slurried and disposed of in the deep portions of Parksville Reservoir. Moving it from the headquarters and slurring it for permanent disposal down deep and dark where the dissolved oxygen is deeper. Okay. They would be permanently disposed of down there where they would not oxidize or leech out.

All right. So now after all that buildup, I hope I haven't put you guys to sleep. Here's what we're proposing to do to Copper Basin Reach. Because, again, there is not a lot of work to do up there, we are proposing to go strictly with just monitored natural recovery. I will add that over the last two or three years, as we have been developing our monitoring program, Glenn Springs has voluntarily already been implementing the monitoring program that we have been proposing to do here. It would be very similar, might be some tweaks to it. Already doing it now and we would continue to do this in the future until we have shown that we have met our goals.

With regard to those stream dikes in there to promote capping or enhanced sediment capping, access in that area is very difficult, as you know. To get into the Copper Basin Reach is not easy. It didn't seem to be that effective. After we ran some models through, it didn't seem to be capturing that much sediment, and so we chose -- it really wasn't giving us much bang for the buck so we proposed to go with just the monitor only.

The net present value on that, what that means is the cost to conduct monitoring on the Copper Basin Reach forever -- that's really a 30-year cost -- is $400,000. And that's all operation and maintenance. That's really no capital cost for that, we're not buying anything except sample equipment, we're not constructing anything. It's just monitoring. So that's what we're proposing to do for the Copper Basin Reach.

For number three, Ocoee Number Three, we're proposing to go with the second alternative, which was the MNR, monitored natural recovery, with the hydraulic controls, the best management practices. The big objective of this plan, again, is to make sure that what happened in January of '09 does not happen again, and there has been what we call a BMP plan or best management practice. It's kind of a procedural checklist of things we will do to make sure this doesn't happen again. That's already been developed, already been submitted to TDEC, so what we're proposing to do is take some of that good work that's already been done as ordered by the State of Tennessee and roll this into our final cleanup decision.

The net present value for this component is $275,000, and again, that's all monitoring for a 30-year period, okay? There's not much cost. I guess the costs that have been expended to develop the BMP plan have already been expended under efforts to comply with the State of Tennessee, so there's really no cost to develop the BMP.

Okay. For the Parksville Reservoir, what we are proposing to go with is to keep the water high, plus or minus two feet, that's going to be about 834 feet above sea level. We're proposing to permanently flood that delta using existing infrastructure. Okay. So no big improvements to TVA's Ocoee Number One dam. That we would be simply maintaining the existing infrastructure and simply keeping the water level up year round. All right. Summer pool out there plus or minus a couple feet. There will be some fluctuation to get the hydropower generation and stuff, but under this alternative, permanent inundation would prevent this oxidation I talked about, the dissolution or dissolving of these metals from the sediments that occur because of these flushing events.

The net present value for this remedy was considered to be about $1.1 million. About half, about $500,000 of that, is for getting some lime on the delta before it's flooded. We have done -- of all the restoration efforts we've done here, we have found that if you put a little bit of lime in that thing, it really does promote and speed up the recovery process.

What we didn't like about the wetland number three is that the wetland water elevation is about halfway, it's between low pool and high pool. It wouldn't fill up some of the summer watering holes. The beaches wouldn't come all the way up. We thought that might be negatively received.

And then the dredging costs had a much higher cost on it, $11.3 million. We don't quite frankly believe that the risks that are out there, the chronic risks that I've talked about, we don't believe those chronic risks probably justify a

$11.3 million remedy.

So I'm about done talking here and that's a lot of information to cover in a short amount of time. So where we go from here, as I mentioned, we're kind of in the middle, we always like to have this formal public meeting in the middle with a comment period to give you guys a little primer. If you don't want to read all our stuff, we'll tell you about it, happy to do it, that's my job.

You can find all the detailed information if you people are interested in the big reports that we produce, the big remedial investigation report, the human health and ecological risk assessment report, they can be found here at our information repository locally just down the street. We have some information on the web page, which is there, and you can reach me, my e-mail address is on the fact sheet we handed out. That's how you reach me.

And comments, we would like to have comments on/or before July 18th when the comment period ends. You can e-mail them to me, you may e-mail them to Dr. Urban in the back at the State. You can mail them, you can use snail mail if you want. We do have a form here on the back of our fact sheet, if that's easy for you, you can jot your comments down on that and they'll become part of the record.

So there's my phone number, there's my e-mail address, and at this point in time we'd like to open it up for Q and A. I appreciate your attention. Hope you guys can grasp all that stuff. Like I said, it's a lot of information to cover in a short amount of time. You're a nice crowd. Shows that you guys are genuinely interested in what we try to do up here and we appreciate that, and thank you for your time and thank you for your attention and with that I'll stop talking.

If you all do have any questions, I would like to ask if you wouldn't mind to state your name, your address, if you don't mind, so we have it for the record. Again, thank you. Appreciate it. Do we have any questions? You guys are going to let me off easy. Yes, sir.

MR. GREEN: My name is Craig Green. I'm here from the Copper Basin, Copperhill, Tennessee. When you said there was maybe some health hazards down at Ocoee Number One, what is the manifestations?

MR. ZELLER: It's actually caused by PCBs, polychlorinated biphenyls. They were used in electrical transformers back in the day, and I've worked on a lot of PCB sites. They're pretty persistent industrial chemicals that don't rapidly break down. And it doesn't take much PCBs to cause a potential carcinogenic risk in fish. PCBs are biocumulative. Unlike copper and zinc, which are our primary contaminants here, PCBs biocumulate. They will get into the food web, they get into the little fish, the big fish eat the little fish, and then you eat the fish, and you could potentially biocumulate PCBs. Very, very low risk. You have to eat a lot of fish.

In fact, Dick would tell you there is not a fish advisory on number one for PCBs. If there was -- if the State of Tennessee thought there was an imminent, you know -- they have posted other lakes and streams in the state of Tennessee for PCBs or mercury or other contaminants. This one is not. There is not a fish consumption advisory here, which so again, it's caused by PCBs, actually rather low levels, and it doesn't take much as far as levels to cause this potential effect.

It's very low, very low. You would have to eat like 12 meals of large mouth bass a month for 30 years, and we just don't think people are eating that much bass.

The fishery has really rebounded. They caught I guess I think it was the state record for yellow perch in number one not too long ago. It was a big yellow perch, over five pounds. So that's a good question. Thank you.

AUDIENCE MEMBER: When was the last risk assessment done?

MR. ZELLER: The last risk assessment was done? The human health was done before my time. It would have been done in like, god, I don't know, I'd have to dig that up. Do you know for sure?

MR. CARR: It was around 2003, 2004.

AUDIENCE MEMBER: Is there going to be another one that's going to be done soon?

MR. ZELLER: Well, then, we did the ecological risk assessment when the R.I. was done and the remedial investigation was done in '05. The risk assessment done in '02 didn't show any -- excuse me -- '03, 2003, didn't show any adverse impacts to human health and recreation at that time. It was just going to have to be a lot better. We didn't really show any risk back before a lot of this work was done. So from a human health standpoint, because of all the good work that has been done, the risk would certainly be lower and they were acceptable back then and so lower than acceptable I don't think we need to approve, you know.

Again, we've had a lot of questions, a lot of concerns from the white water folks saying, hey, man, don't come up here and start saying Superfund and chase off all the rafters and that type of thing. But, no, we've had to from the very front of this job, we've been very focused in that industry, making sure that we were adequately protective of rafters and guides and recreators and it is certainly protective for that use.

AUDIENCE MEMBER: Is there a way to do something in between for the wetlands and the one that you're proposing to kind of help with some of the --

MR. ZELLER: That was the idea behind the wetland idea is that wetland treatment and water treatment is kind of the cool thing to do these days, and it causes a lot of other issues besides the recreation issues. After all is said and done, after we kind of looked at those criteria, I think from a management standpoint with regard to TVA and their operation, I think it's easier for us to hold it at summer pool. It gives us a better -- we like it better. Trading off all those criteria, we think this, get it under a good cap of water, is the way to go.

AUDIENCE MEMBER: How deep is Parksville Lake?

MR. ZELLER: It's deep in places, 120-some feet when you get out in the deep body. Right here at the delta it's very shallow. In fact, there's buoys put up saying watch out for your propeller. Yes, ma'am.

AUDIENCE MEMBER: Keeping the summer pool in winter, is that going to increase the risk of flooding?

MR. ZELLER: It could. It could. There is a -- we did look at the increased flood risk, and the increased flood risk, TVA maintains number one is really not designed for flood storage, okay? It's not that big as far as what it can handle.

We did look at modeling scenarios about what it would do for increased flooding and it showed a moderate increase, a moderate increase primarily at the low level storm events like the two-year event, the five-year event, and the ten-year event. Now, those flood risks were still in the channel. It was higher water surface elevation, but still showing to be in the channel.

When you got your big storms, the ones that would be expected to cause the massive flooding, the 25-year, the 50-year, and the 100-year, this high water alternative doesn't change what happens at the 25, 50, and 100 because there's so much water that this little added level doesn't do much to change it, okay, so really the change is at the nuisance level. So there is a slight increase, but I think it's rather small. Yes.

AUDIENCE MEMBER: I have been told that there's a great deal of sediment building up against some of these TVA dams and that's really stressing the dams themselves. Is that true? And will the sediment -- will that sediment that's up against those dam works, will that have to be dredged out and what comes of that downstream?

MR. ZELLER: That's a good question. I am not aware of any infrastructure issues, instability issues, with TVA's dams because of sediment buildup. Sediment buildup behind a dam is going to happen. As soon as you put a structure across the river, there's always a natural bed load and you're going to get sediment accumulation. Sediment management on any type of hydroelectric structure is an issue.

So we always have to manage sediment movement from these empilements to keep it hop scotching downstream. The way we're proposing to do this, to manage sediment moving on number three, is with this BMP plan.

But really what's working the best is the frequent releases. They release water during the summer about every day, right? And so those frequent releases, short-term, are actually kind of helping pull sediment down a little bit at a time instead of doing this big massive event that unfortunately by accident really happened in January of '09. We don't want to move sediment that way because that causes problems at the white water center where you have three foot of mud in there. What you want to do is move a little bit of sediment more frequently.

What you get is turbine water, kind of dirty, chocolatey-covered stuff like that that naturally happens during a storm. If you go down the Ocoee River and see what it looks like when it's raining, you're going to get that dirty little water. That's what we're looking to do is to pull it down in short little slugs as opposed to one big, so that's a problem.

Sediment management on these man-made

reservoir systems is a problem anywhere on God's green earth and it can be a hassle, but that's -- what we're proposing to do here is with that more frequent flushing and BMP.

AUDIENCE MEMBER: Is there a toxicity level associated with those sediments?

MR. ZELLER: Yeah. The numbers, these numbers here, these sediment quality goals, those are for copper, 680 parts per million, iron, lead, and zinc, these numbers were derived -- that's a good question, I should have mentioned that -- were derived from the tox testing that was done. So in theory, if our calculations are right -- and we believe we are -- you can subject the critters to these concentrations in the sediment and they will do just fine. They will grow, they will reproduce. They're living now, but these numbers, once we get to these numbers, we believe those would be adequately protective to eliminate that chronic toxicity.

For the most part, most of our surface quality, we're approaching these numbers. Not there at all on all aspects. For the most part, I mentioned with the surface water, we're right there, too. You'll notice those surface water numbers for copper and zinc are really low. They're in the parts per billion number. It hasn't been easy to get there, but copper and zinc are used in maritime paint quite frequently.

Copper and zinc are toxic at low levels to aquatic organisms. If you don't want barnacles growing on your Navy ships, they used to use this stuff as a maritime paint. It's very toxic at those low levels, but for the most part we've already reached those numbers with some minor exceptions. Good question.

AUDIENCE MEMBER: What about the air? Has there been any testing done on the air and the quality of it from especially around the plant? Can you see a lot of the increased levels of iron calcine?

MR. ZELLER: There's been some -- the State of Tennessee has air monitors in the area for PMT-5 and PM-10 and ozone and all that stuff. I'm not aware if there has been any -- I think probably back in the day when this place was actively manufacturing sulfuric acid, there was probably some air monitoring done, I'm sure there was, but now that that industry is pretty much shut down -- we haven't done, as part of this study -- this is all about the river -- we haven't done any air monitoring as part of this work. We wouldn't expect there to be any issue with the air on the Ocoee.

You guys got monitors in the area, don't you?

MR. CARR: Are you referring to the iron calcine levels out there.

AUDIENCE MEMBER: Yeah, yeah.

MR. CARR: They have companies that are doing that that have the air permits from TDEC, an air quality permit. They have requirements on that to keep that water -- not water -- keep that material from getting into the air. They have to keep it covered.

AUDIENCE MEMBER: Keep it covered?

MR. CARR: Keep it covered either wet or -- you can talk to TDEC about it. They have a permit and monitor so that if they do something wrong, they can see it. I'm not familiar with every requirement. It's basically dust, so if you see something, you can call EPA or call TDEC and we'll send somebody up here.

AUDIENCE MEMBER: Is that tailings? Is the iron calcine from the tailings, the tailings in the mining operation?

MR. CARR: Iron calcine is from when they used to mine, they would separate the water into the different concentrates. They would send the copper concentrate to the copper smoker and catch the acid gas out of it. The iron --

COURT REPORTER: I'm sorry. Can you speak up?

MR. CARR: They send the iron concentrate to the iron roaster and they roast the sulfur off of that to make acid and then they roast that until all sulfur they could get out of it was out of it, and then they take that material left over, which is basically iron oxide and that's iron calcine. It's called calcine because they quench it in water and then they stockpiled it. They stockpiled it for years and years on the site.

AUDIENCE MEMBER: When will that be gone from the area? I know -- I mean, they're taking it away daily, but how long --

MR. CARR: The original estimate from when they started last year, you know, this is approximate, it was about five years, it could be less and hopefully it will won't be more. It's just based on how -- I mean, they can't load when it's raining and they can't load when it's wet and that sort of thing, so that's a best guess estimate from how much is layered. There's a lot of variables in that so the estimate is five years, maybe less.

AUDIENCE MEMBER: Someone told me that that substance was going through China. Is that true?

MR. CARR: Yes, that's true.

AUDIENCE MEMBER: Because they can't process it here?

MR. CARR: That's what I've been told that steel mills in the U.S. don't use the powder material and China can process it and so -- and China right now is, quite frankly, sucking up resources from everywhere in the world, concrete, steel, everything. That's one reason the metal markets and everything like that, the number is so high because China can't get enough. So it has to do with economics with those companies and how much they can get for it I'm sure and things like that.

AUDIENCE MEMBER: In conjunction with that, I wonder if it was ever considered whether all of the objectionable substances could be removed from this whole site or whether that was just absolutely out of the question.

MR. CARR: The EPA typically doesn't take every molecule of everything and take it away.

They typically try to do the most cost effective remedy we can using those criteria Craig was talking about. We go through those criteria. Sometimes it might be more cost effective to cap something and leave it in place and make sure nobody can touch it anymore.

A lot of the materials that are recyclable are going to be recycled as best we can, the stuff on that part of the site was owned by Intertrade Holdings. It was their material to recycle and they are recycling a lot of it. They recycle as much as they can because they can make money off of it.

AUDIENCE MEMBER: So that is to keep whatever can't be recycled in place undisturbed?

MR. CARR: I'll be having a public meeting on some of that in the not too distant future, and so anyway, yeah.

AUDIENCE MEMBER: What about just the geographic instability? We felt the few tremors here lately and I know if you're capping things like that -- and I've done some studies where out West they're saying they can put a cap on some materials that they don't want to go into the habitat, but if you're looking at geologic instability, are you looking at that at all? Is that a concern of geologic instability here?

MR. CARR: I've had a bachelors and masters in geology and I don't think that's a concern. Those tremors are just general geologic occurrences in this part of the world and doesn't have anything to do with what's going on out here.

AUDIENCE MEMBER: I didn't know whether or not there had --

MR. CARR: We're in a pretty geologically stable area. Always -- the earth's crust is always shifting and depending on where you are, you're going to have tremors.

MR. ZELLER: Again, nobody is proposing now or in the future we're going to build some sort of vast repository like Yucca Mountain. That's not our strategy here. We are doing a lot of waste consolidation, taking piles and getting them covered up, you know; but as far as vast vaults that could potentially fail under some catastrophic seismic event --

MR. CARR: We're pretty safe here. Geologically unstable areas are around Charleston and around Memphis in the Southeastern area.

AUDIENCE MEMBER: New Madrid, all down through there.

MR. ZELLER: Yeah.

AUDIENCE MEMBER: As you travel from Georgia into Tennessee, at the Coppermill plant complex, on this side of the hill is very -- it looks really rust ridden and for lack of a better word kind of an eyesore.

MR. ZELLER: Pot slag.

AUDIENCE MEMBER: Are you planning to remedy that or is that a finished product or is that going to be addressed?

MR. ZELLER: I'll let him handle that one.

MR. CARR: That material is called pot slag and in the early 1900s up till, you know, probably the earliest part of the century that was molten copper slag that was poured off the top of the pots and they used it as fill material to bring the -- I guess the floor of the valley up out of the flood zone of the river. There's a lot of that material around there. There's probably -- not just that area, but there's more of it you can't see from the road that's further back. I'm trying to remember the right number.

MR. ZELLER: A lot.

MR. CARR: A lot, two or three million cubic yards of material. That material is currently being recycled by Intertrade and hopefully it will all be recycled at some point.

AUDIENCE MEMBER: So that will disappear?

MR. CARR: Yes. It will disappear.

MR. ZELLER: I probably should have mentioned this at the front. This is one component of this cleanup plan, all right, of the entire Copper Basin.

MR. CARR: Show the slide of the river.

MR. ZELLER: So you're going to see up here --

MR. CARR: I'm here to take these questions because we knew you guys had a lot more questions than just about the river.

MR. ZELLER: There are going to be subsequent actions coming for the entire, you know, the rest of this. This is really just --

MR. CARR: Okay. Whoa. Right. Craig's been talking about the river. So there's two other big parts of this cleanup going on. Craig -- what we're talking about tonight is the river, okay, the receiver of all the stuff that came out of these two watersheds. The green one is North Potato Creek Watershed. That's being cleaned up under an order that TDEC and EPA helped with the oversight of that. And then this is the Davis Mill Creek Watershed and Coppermill plant area is this green area down here. This area is also being cleaned up under EPA orders, too, okay? And then what's even more complicated, because Intertrade Holdings owns most of this property and they own all those mine waste and mine by-product materials and if they can recycle them, they will, and they're actively doing that.

The pot slag is currently being sent off and being made into rockwool, which is insulation, and there's potential for it to be sent other places, too. If there's community interest in that, we will be glad to in the future periodically update you with an availability session like this.

Yes, ma'am.

AUDIENCE MEMBER: I'd like to know if that pot slag is useful as a building material, or whether it has some toxic run-off. I've always -- I live along the river walk, whether we can use that as a material even though he says it's not attractive.

MR. CARR: Well, because this is essentially a Superfund site and that's essentially a waste material, we typically don't want to go spreading that in other places, as road base or even, you know, decorative rock or something like that, you know, so we are approving whether or not the way the material is being recycled. For instance, rockwool, the stuff is ground up, it's taken off to a giant machine, it's like a giant cotton candy machine and they heat the material up so hot and they mix it with other types of material and they spin it like cotton candy and basically make it into fiber and it's like an industrial fiber that's used for insulation and it won't burn, and that's what that's being turned into.

AUDIENCE MEMBER: I understand it's being used as an aggregate in concrete.

MR. CARR: It has in the past. You'll see it in concrete around here in the past, but we don't want to promote doing that anymore.

AUDIENCE MEMBER: You feel that may not be -- it may be dangerous?

MR. CARR: Yeah. We don't want to spread -- we don't want to spread the contamination from the Copper Basin site other places.

AUDIENCE MEMBER: Isn't there run-off from the river just right there? I mean, how could it not?

MR. CARR: I'll get you. There's a guy in the back raising his hand. Go ahead. What was your question one more time?

MR. HENSLEY: Owen Hensley from this area here. I'm 72 years old, grow'd up in this area all my life, and I've worked in the mines to every department that they've got over here at the Copperhill for 36 years, and I know just about everything that's going on and went on over here all my life from my father working in the mines that grow'd up right across the hill here. And we know all these contaminants that went down the stream, but like he said, down here at Ocoee Number Three branch, he said these metals was down near the bottom, correct? Wasn't that what you said?

MR. ZELLER: Correct, the highest levels, yes.

MR. HENSLEY: Okay. This flood, when they come, this metal does not want to move. This topsoil is what's going to be a'moving. It's right down here in Ocoee Number One. All of those metals is down here, and I don't think it would be no time -- I'm using my opinion -- I don't think it will be no time to disturb no such contaminants that's already down here, iron, zinc, copper, that's what they manufactured, why don't we leave this be?

MR. ZELLER: We are. That's the plan. That's the plan. That's the plan, leave it there.

MR. HENSLEY: As far as TVA, I don't see why you people couldn't work with them and keep a minimum elevation of the water --

MR. ZELLER: That's it.

MR. HENSLEY: -- where it will keep that covered if that's so to be.

MR. ZELLER: That's exactly the plan. We have been working with TVA as well as TDEC because of that event that happened in '09. In fact, this list of procedures does just that, it talks about where the water level should be, it talks about what's going on at Blue Ridge. It's really what the combination you're looking for is the one, two punch. What you don't want to happen, what happened in January of '09 is the water level went down pretty quick and then a big slug of water came from Blue Ridge and so all that exposed sediment, you know, some of it is deeper stuff that we don't want to move. We are on the same page. I want that stuff -- our plan proposes to keep that stuff that's at the bottom of number three there, and so the stuff that we want to keep moving through is the stuff that's on top. We're moving that stuff through these more frequent white water releases.

In other words, there's a nice little hole that stays in place in front of those sluice gates, so we're removing the new stuff and not the deep stuff.

MR. HENSLEY: That would be in Rock Creek. That's the upper, upper rafting water.

MR. ZELLER: Yes.

MR. HENSLEY: I caught trout in there 18 inches long --

MR. ZELLER: Yeah. The perch --

MR. HENSLEY: -- back in the '50s.

MR. ZELLER: I seen in the number three reservoir, I've seen fishermen up there with strings of perch of 20 fish.

MR. HENSLEY: This is down on below Ocoee Number Three down there where the white water rafting is.

Well, I've been fishing Greasy Creek down there ever since I was just 10 or 12 years old, hitchhiked down, and as far as Ocoee, you didn't see no fish in it, in the Parksville Lake. There wasn't nothing there. But now everything is a'booming and, hey, they're coming on and they're doing good. I fish it quite a bit.

MR. ZELLER: Oh, yeah. It's all coming along. I see a gentleman from the forest service here.

They do annual snorkel surveys where they actually put a snorkel on and stick their face in the water down in that white water reaches you're talking about. When we first got started up here, their snorkel surveys were very simple. I don't see anything, you know. There wasn't anything to count. And now the most recent one, I think there was upwards of -- there were double digits numbers of species. Not just pollution-tolerant fish, but the ones that are a little more sensitive. It was like 10 or 12 different fish, different types of fish. People are seeing trout.

MR. HENSLEY: I seen right in this water up here, in the Copperhill area there, in and around where the plants was at, I feel like if that's treated, we'll be in pretty good shape on down the river. I really do.

MR. ZELLER: Well, you know, we are, and that's -- I mean, I will tell you that this alternative, what we're proposing today, really isn't much. I'm telling you, a big chunk of this is monitored natural recovery. A big chunk of this says we're going to monitor. That's what it is. For the Copper Basin Reach immediately downstream from here is monitored. We've been doing that for two years. For number three, it's monitored, and make sure we don't release mud like we did in '09. That's essentially it. And then for Parksville Reservoir, the delta, let's keep that water level, keep the top of that thing covered.

MR. HENSLEY: Did anyone have any idea what happened about three or four or five weeks ago when mud was all over the white water rafting down through there? I mean, it was covered up. You can see it on the rocks. It was mud all the way down through there, even where the Olympics was at there. It just -- you know, I was wondering about that. What happened there? Did they open the gates and just let all the sludge out? I'm still wondering, I mean, which that's all right, you know, I've seen it for years so it really ain't that alarming, but I was just a'wondering since we're here a'talking tonight what's happened that all this suddenly happened. It's one big --

MR. ZELLER: Did it look like that?

MR. HENSLEY: Do what?

MR. ZELLER: Did it look like that?

MR. HENSLEY: Yeah. Where they put the rafting in there, what we call the stickdown down there, the swinging bridge.

MR. ZELLER: Do you know something about that, Dick?

DR. URBAN: When we had the big rock slide that closed the Highway 64, then a little bit after that slide we had a rock slide on the other side of the river that took out the flume that goes from dam two down to powerhouse two, they took out the flume. About around the first of April, TVA finished -- completed the reconstruction of the flume and started water flowing through the flume, and since the boards in the flume had been dried out, there was a lot of water being released from the flume and it resulted in several land slides underneath the flume that went down into the Ocoee River, and in some cases it put some trees down as well, and so that was the genesis of what happened a few weeks ago. It was right when we were in the process of starting a lot of the rafting.

There was a discussion with the rafting entities, they felt that that was not going to preclude their being able to navigate around through the Ocoee.

So there was a lot of sediment that went into the river through that, and there's still some evidence of that presently because it's difficult to get to.

MR. HENSLEY: I think you're talking about a leak. I've seen that, a lot of leaks, the flume a'swelling back up, you know. But this was like something that's been turned loose, I mean.

DR. URBAN: Well, the land slides are just like that. It happened in about five different locations.

MR. HENSLEY: I would say four or five weeks ago was when I noticed it. It was alarming to me, where did this come from, you know.

Anyway, I just want to see everything cleaned up. Everything appears to be good down here a'fishing. I just hate to see any kind of money spent today knowing the shape that the United States is in financially.

MR. ZELLER: Yeah.

MR. HENSLEY: I hate to see any money spent that maybe we can get by without spending for anybody.

MR. ZELLER: The bulk of the money we're proposing to spend here is through the monitoring piece only. There's very little infrastructure improvements, no capital cost. This is pretty much the cost that you saw up there were 30 years of monitoring costs. That's about it.

MR. HENSLEY: That's what we got to do is to keep monitoring and see if anything, you know --

MR. ZELLER: Once a year. It's basically once a year at the right location.

MR. HENSLEY: And that Ocoee Number Three, I believe just leave it like it is, like it's been for years, which, you know, what's going over the top, it's not got any chemicals in it much, I don't think, since we've cleaned up Copperhill.

MR. ZELLER: Yeah.

MR. HENSLEY: That's my opinion and I thank you very much.

MR. ZELLER: Well, thank you.

MR. CARR: There was another question from the gentleman with the black hat on right in front of him. I didn't hear your question before.

AUDIENCE MEMBER: I was talking about the run-off from the plant just during --

MR. CARR: Well, okay. Without trying to -- I don't want to -- basically, this will be the subject of the next public meeting, but some of the actions we've done, some of the actions we've done at Copperhill, here's the road coming by the plant, okay, there's Davis Mill Creek, all the water that falls on this entire plant area is collected in these different ponds and treated at Cantrell Flats.

We have just completed dam five and dam four. There is no discharge from the creek to the river whatsoever. All this water is collected and treated at the Cantrell Flats. So any run-off from this area is collected and treated by this water treatment plant and clean water discharged over here.

AUDIENCE MEMBER: So it's been contained, is what you're telling me?

MR. CARR: It's been contained.

AUDIENCE MEMBER: Even the rain water?

MR. CARR: Yes, ma'am.

MR. ZELLER: Great questions.

Do we have any other lingering concerns or questions? We do appreciate again you all coming out, taking your time to learn about what's been going on up here in the basin, and we're always available whether we're formally here in front of you, you know how to reach us if you have any questions. Of course, Glenn Springs' door is always open. They do their mining tours. They sell out every year. You had over 200 or something last year, right?

AUDIENCE MEMBER: Yes, and we had 80 people held over to this year.

MR. ZELLER: Okay. That's a great way to learn about it instead of looking at fancy posters and stuff. Great way to learn about all the good stuff that's been done.

We do again want to thank you all for coming out and have a good evening.

(PROCEEDINGS REPORTED WERE CONCLUDED.)

CERTIFICATE OF COURT REPORTER

I hereby certify that the foregoing proceedings was reported as stated in the caption, by the method of Machine Shorthand, and the proceedings, questions, and answers thereto were reduced to typewriting by me; that the foregoing pages represent a true, correct, and complete transcript of the proceedings on June 23, 2011.

This the 27th day of June, 2011.

Carol Glazier, RDR

Appendix E

Ocoee River Monitoring Results, 2009 to 2011

Ocoee River Long-Term Monitoring
2009 and 2010 Report

Copper Basin Site, Operable Unit 5
Polk County, Tennessee
CERCLIS ID TN0001890839

Prepared for:

Glenn Springs Holdings, Inc.
A subsidiary of Occidental Petroleum

September 2011

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ENGINEERS ARCHITECTS PLANNERS LANDSCAPE ARCHITECTS SURVEYORS

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1.0 Introduction

In May 2008, the U.S. Environmental Protection Agency (EPA) completed a remedial investigation (RI) of the Ocoee River that evaluated the river from Blue Ridge Dam to Ocoee No. 1 Dam (Black & Veatch, 2008). One principle recommendation of the RI was to establish a multi-media and biological monitoring program in the Ocoee River; more specifically the Copper Basin reach, and the Ocoee #3 and Parksville (Ocoee #1) reservoirs. The intent of the program is to provide data to assist in the evaluation of long-term effectiveness in achieving remedial action objectives and reducing environmental risks.

Barge Waggoner Sumner and Cannon, Inc. (BWSC) was retained by Glenn Springs Holdings, Inc. (GSHI) to develop and implement a monitoring plan. Ocoee River Long-Term Monitoring Plan, Copper Basin Site, Operable Unit 5, Polk County, Tennessee (CERCLIS ID TN0001890839) (the work plan) was issued in March 2009 and approved by USEPA. The purpose of this plan was to create a long-term monitoring program for the Ocoee River that will document changes in water quality, sediment toxicity, aquatic organism communities, and human exposure to contaminants that result from remedial actions implemented in the river and Copper Basin tributaries as well as natural recovery processes.

Consistent with the RI summary of findings and the identified risks, the following Remedial Action Objectives (RAOs) were used as the basis for the monitoring program:

- Meet and sustain the applicable Tennessee Water Quality Standards (WQS) for aquatic life and human recreation, and the narrative standards for biological integrity, in the Ocoee River.
- Prevent or control releases of hazardous substances from contaminated soils, sediments and associated pore water, wastes, and in-stream sources into the Ocoee River.
- Reduce the toxicity to aquatic organisms within the river to acceptable levels, defined as being between the No Observed Adverse Effect Level (NOAEL) and the Lowest Observed Adverse Effect Level (LOAEL).
- Reduce human exposure to contaminants through the ingestion of fish at rates that could result in a cumulative hazard index greater than or equal to 1, or exceed the acceptable range for cancer risk, defined by EPA as being an added health risk between 1 in 10,000 (1×10^{-4}) and 1 in 1,000,000 (1×10^{-6}). TDEC identifies an acceptable risk range as being less than 1 in 100,000 (1×10^{-5}).

Long-term monitoring was initiated in April 2009 and this report summarizes all activities and results for the 2009 and 2010 calendar years. During this period, interim actions were being implemented in Davis Mill Creek (DMC). The Belltown diversion extension and Dam #5 projects were initiated in November 2008 with construction activities overlapping some or all of the 2009 sampling events. In August 2009, the flow from upper Belltown Creek was diverted around the area extending from DMC Dam #3 to the Ocoee River confluence. The Dam #5 structure was completed in December 2009 with one operational pump in place on December 21, 2009; augmented by the existing pumping system at

Dam #3. At that time, base flow discharge from DMC was effectively eliminated. The Dam #5 installation was finished in early 2010 and includes a total of three pumps capable of capturing residual base flow in the DMC watershed and conveying it for treatment. DMC Dam #4 was completed in 2011 and allows the system to capture and treat storm flow (up to a 10 year/24 hour storm).

2.0 2009 and 2010 Monitoring Summary

2.1 Planned Activities

The long-term monitoring activities originally scheduled for 2009 and 2010 are presented in Table 1.

Table 1
Planned Monitoring Activities

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2009												
Surface Water				X a			X b			X d		
Macroinvertebrates				X a					X c			
Habitat				X a					X c			
Sediment Chemistry/Toxicity							X					
Fish Tissue										X e		
Fish Community										X f		
Sediment Revegetation				X a			X b					
2010												
Surface Water	X b			X a			X b			X d		
Macroinvertebrates				X a					X c			
Habitat				X a					X c			
Sediment Chemistry/Toxicity												
Fish Tissue												
Fish Community												
Sediment Revegetation				X a			X b					

a – Copper Basin reaches only (OM3670, OM3510)
b – Parksville only; for surface water – summer high pool and winter low pool
c – Parksville only; initial and every other year thereafter
d – Copper Basin reach and Ocoee #3; for surface water – low flow period September or October
e – Coincides with Parksville fish community monitoring during first year only, USEPA/TDEC may conduct
f – Set for Parksville in fall, Copper Basin/Ocoee #3 may be monitored during early fall

2.2 Completed Activities

Not all activities originally proposed for 2009 and 2010 were completed during the specific year or at the time originally scheduled. Table 2 shows the long-term monitoring work accomplished during 2009 and 2010; the first two years of the program.

Table 2 Completed Monitoring Activities												
2009												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Surface Water				X a				X b			X c	
Macroinvertebrates				X a								
Habitat				X a								
Sediment Chemistry/Toxicity								X b			X d	
Fish Tissue												
Fish Community												
Sediment Revegetation				X a				X b				
2010												
Surface Water		X b		X a				X b			X d	
Macroinvertebrates				X a					X c			
Habitat				X a					X c			
Sediment Chemistry/Toxicity						X a						
Fish Tissue										X c		
Fish Community						X a				X c		
Sediment Revegetation				X a				X b				

a – Copper Basin reaches only (OM3670, OM3510)
b – Parksville only; for surface water – summer high pool and winter low pool
c – Parksville only; initial and every other year thereafter
d – Copper Basin reach and Ocoee #3; for surface water – low flow period September or October
e – Coincides with Parksville fish community monitoring during first year only, USEPA/TDEC may conduct
f – Set for Parksville in fall, Copper Basin/Ocoee #3 may be monitored during early fall

2.3 Reasons for Deviations from Planned Activities

The initial macroinvertebrate, fish tissue and fish community sampling and habitat assessment activities in Parksville reservoir were postponed until 2010 with USEPA's approval. Surface water, sediment chemistry/toxicity and sediment revegetation work in Parksville Reservoir was moved from July to August 2009. Fish community sampling in the Copper Basin and Ocoee #3 reaches was to have been performed in early fall 2009. Due to numerous storm events and sustained releases from Blue Ridge dam between September and December 2009, the fish sampling could not be performed. In December, USEPA approved postponement of these tasks until 2010. The same storm events and releases necessitated a delay in 2009 Copper Basin and Ocoee #3 low flow surface-water and sediment chemistry/toxicity sampling until early November. At that time, sediment samples were collected from Copper Basin and Ocoee #3 reaches. However, issues related to toxicity testing protocols (identified during earlier Parksville sediment testing) had not been resolved. As a result, the samples that had been collected were discarded, and the sampling was rescheduled for 2010. Chemical analyses were completed for the 2009 Ocoee #3 sediments and the results are included in this report. Sediment chemistry/toxicity and fish community work in the Copper Basin and Ocoee #3 reaches for 2010 was performed in June. Although originally planned for later in the year, the schedule was modified to avoid irregular flow conditions due to planned maintenance activities on the Blue Ridge Dam which began in July 2010.

3.0 Monitoring Details

The following sections detail the 2009 and 2010 monitoring efforts in all Ocoee River reaches covered by the long-term monitoring program. Figures 1 through 3 show the Copper Basin, Ocoee #3 and Parksville Reservoir monitoring locations, respectively.

3.1 Surface Water

All surface samples were collected using direct fill or transfer bottle techniques while the deep samples were obtained using a peristaltic pump. Field parameters including pH, conductivity, dissolved oxygen, oxidation-reduction potential (ORP), turbidity, temperature and flow were measured at each sampling location or transect, and depth (where applicable). The analytical suite included an abridged list of TAL metals (total and dissolved), acidity, alkalinity, hardness, chloride, sulfate, TDS and TSS as outlined in Table 4-2 of the work plan.

3.1.1 Copper Basin Reach

2009 and 2010 Monitoring

In 2009 and 2010, multiple surface-water sampling events were conducted in the Copper Basin reach. April 2009 and 2010 events were limited in scope and included only those transects associated with macroinvertebrate sampling (OM3670 and OM3510). During the November events each year, thalweg samples were collected at location OM3760 and tributary locations NPC0000 and DMC0000 (initially designated DDM-05 in error) while five-point transects were sampled at locations OM3680 (or OM3670), OM3570 and OM3510. Locations are shown in Figure 1. November 2009 and 2010 sampling was conducted during a period when Blue Ridge Dam, which controls flow in the Ocoee River, was releasing minimum base-flow, and flow conditions were monitored before and after the sampling event to confirm that sampling was conducted under consistent low-flow conditions. Flow was monitored prior to sampling during April events.

Historical Monitoring

From 2006 through 2008, GSHI conducted annual surface-water sampling events in the Copper Basin reach. Each event was timed to correspond with low flow conditions in the river. Collection methods and field measurements were generally consistent with those for the 2009 and 2010 events. The analytical suite varied year-to-year, but included the standard long-term monitoring analytical parameters in each case. Details regarding historical surface-water monitoring were provided in previously submitted reports.

Reconciliation of Historical and Long-term Monitoring Locations

The work plan for long-term monitoring proposed a standardized location naming scheme that will be retained for the duration of the program. Table 3 shows 2009 and 2010 long-term monitoring locations (or transects) and matches those used during earlier sampling events to represent the same or similar locations.

Table 3
Copper Basin Reach Long-Term Monitoring and Historical Surface Water Location Designations

Long-Term Monitoring Location Names	Description	Historical (or Alternate) Location Names
OM3760 (a)	River mile 37.6 (background), upstream of DMC in Copperhill	OM-01, OM-376
OM3670	River mile 36.7, just downstream of DMC	OM-365, OM3680 (b)
OM3570	River mile 35.7, just upstream of NPC and Grassy Creek bridge	OM-03, OM-356
OM3510	River mile 35.10, downstream of NPC	OM-04, OM-352
DMC0000 (a)	Davis Mill Creek at Ocoee confluence	OM-DM (a), D1106 (a)
NPC0000 (a)	North Potato Creek at Ocoee confluence	OM-NP (a), NPC11-03 (a)

Notes:

(a) – thalweg sample, other Ocoee River locations sampled on 5 point transect

(b) – slightly upstream from OM3670 November 2009

The long-term monitoring location designations were used in subsequent analyses and discussions. GSHI monitoring events and locations from 2006 to 2010 are summarized in Table 4.

Table 4
Copper Basin Reach Surface-water Sampling Events 2006-2010

Location Name	August 2006	October 2007	October 2008	April 2009	November 2009	April 2010	November 2010
OM3760	X	X	X		X		X
OM3670			X	X	X	X	X
OM3570	X	X	X		X		X
OM3510	X	X	X	X	X	X	X
DMC0000	X		X		X		X
NPC0000	X		X		X		X

Notes:

- X indicates location was sampled during the associated event

3.1.2 Ocoee #3 Reservoir

Two surface-water sampling events were conducted in the Ocoee #3 reservoir in November 2009 and 2010; timed to coincide with low flow (relative) conditions in the river. During the events, samples were collected from the center of the reservoir at locations OM3280, OM3000 and OM2920. Locations are shown in Figure 2. At each location, two water samples were collected; one from the surface and one from approximately one meter above the sediment. In November 2010, the water level was extremely low at OM3280 and only a surface sample was collected.

3.1.3 Parksville Reservoir

Three surface-water sampling events were conducted in the Parksville reservoir; summer high pool in August 2009 and 2010 and winter low pool in February 2010. During the events, samples were collected from the center of the main reservoir and inlets at locations OM1560, SI0040 (Sylco Inlet) and BI0160 (Baker Inlet). Locations are shown in Figure 3. At each location, two water samples were collected; one from the surface and one from approximately one meter above the sediment.

3.2 Sediment

Sediment samples were collected using a mini Ponar dredge or hand trowel. At each reservoir location, 2 to 5 aliquots were collected to create each composite sample. In flowing reaches, 10 or more aliquots were required to provide sufficient volume of fine material due to the predominantly coarse (e.g., large gravel, cobble) substrate. Aliquots were placed in a stainless steel bowl and homogenized before being placed in containers. The analytical suite included an abridged list of TAL metals and total organic carbon (TOC) as outlined in Table 4-2 of the work plan. The physical characteristics (e.g., color, texture, %mine waste/sulfide minerals/organic detritus, etc.) of each sample were also recorded. Toxicity testing was performed using USEPA Method 100.4 - 28 day chronic test for Hyalella azteca with survival and growth endpoints measured. Influent water was modified to simulate that in the Ocoee River (nominal hardness 20 mg/L, circumneutral pH). Toxicity testing was also conducted using a laboratory control (glass beads) and control sediment (Ogeechee River from SESD or Bearskin Lake (MN) from Limnologic). A toxicity test optimization study was performed in early 2010 in response to poor control performance during 2009 tests for Parksville Reservoir samples. The optimization study report is provided in Appendix D. Based on optimization study findings, the water exchange rate was increased from the standard two volumes/day to eight volumes/day; the latter was used for all 2010 tests.

3.2.1 Copper Basin Reach

A sediment sampling event was conducted in the Copper Basin reach in June 2010. During the event, samples were collected at locations OM3650A (three samples along right bank downstream of DMC), OM3680C, D and E (three locations from left half of river downstream of DMC) and OM3510A, C and E (three locations spanning river downstream of NPC). Locations are shown in Figure 1. Chemistry and toxicity testing was performed for each sample

3.2.2 Ocoee #3 Reservoir

A sediment sampling event was conducted in the Ocoee #3 reservoir in November 2009. During the event, samples were collected at three points along a transect at location OM3000. The location is shown in Figure 2. Toxicity testing was not performed, as previously described above. Ocoee #3 reservoir sediment sampling was repeated in June 2010, and chemistry and toxicity testing was performed for each sample.

3.2.3 Parksville Reservoir

A sediment sampling event was conducted in the Parksville reservoir in August 2009; timed to coincide with summer high pool conditions. During the event, samples were collected at three points along transects at locations OM1560 (toe of Parksville delta), SI0040 (Sylco Inlet) and BI0160 (Baker Inlet). Locations are shown in Figure 3. Chemistry and toxicity testing was performed for each sample.

3.3 Macroinvertebrates

3.3.1 Copper Basin Reach

The macroinvertebrate community in the Copper Basin reach was sampled in April 2009 and 2010. Three locations were sampled during each event; OM3670D (left bank-reference area downstream of DMC), OM3670A (right bank downstream of DMC) and OM3510 (downstream of NPC). Locations are shown in Figure 1. Six samples were collected in the reference area and three were collected in each of the other areas. All samples were collected using TDEC's semi-quantitative kick sampling protocol (TDEC 2006) employing a standard 'D' net and focusing on riffle (or fast/shallow) habitat. Level of effort was maintained constant and no attempt was made to extend the sampling period or area to ensure collection of 200± 20% organisms. Organisms were enumerated and identified in accordance with TDEC's standard operating procedure (SOP)(TDEC 2006) although species level identification was performed where possible. All macroinvertebrate metrics were, however, calculated based on genus level per SOP.

3.3.2 Parksville Reservoir

Parksville Reservoir benthic macroinvertebrates were sampled in September 2010 following the TVA "Vital Signs" sampling protocol. Transects were established at locations OM1560, SI0040 (Sylco Inlet) and BI0160 (Baker Inlet), and ten (10) evenly spaced samples were collected along the length of the transect, excluding a 50-foot zone out from each bank. Replicate sample sets were collected at BI0160 from two closely spaced transects (within 25 to 50 feet). Locations are shown in Figure 3. Samples were collected using a petite Ponar dredge with two aliquots (0.5 ft^2 by 2 inch depth (est.))

making up the full sample for each point. Reservoir water was used to wash the full dredge sample onto a 500 µm mesh sorting screen, and large substrate materials were hand-scrubbed and visually inspected for invertebrates before being discarded. Additional water was used to concentrate the remaining material to the edge of the screen before transfer to a container jar for later sorting and identification of organisms. Each sample was processed and analyzed separately. Organisms were enumerated and identified in accordance with TDEC's SOP (TDEC 2006) although species level identification was performed where possible. All macroinvertebrate metrics were, however, calculated based on genus level.

3.4 Habitat

3.4.1 Copper Basin Reach

Habitat assessment and physical characterization were performed in April 2009 and 2010 in each macroinvertebrate sampling reach by a consensus of field team members using USEPA visual-based methods (USEPA, 1999). The methods address habitat quality, based on the ten habitat-quality parameters as described in the project work plan. A scoring method was also developed for iron armoring and precipitate to further characterize the habitat conditions of this site. Appendix A provides site-specific interpretive guidance for applying the USEPA visual-based method and the supplemental 'iron effects' scoring criteria. The parameters were scored and placed in four habitat-quality categories corresponding to the following habitat-quality conditions (numerical scores given in parentheses):

- Optimal (16-20)
- Suboptimal (11-15)
- Marginal (6-10)
- Poor (0-5)

Bank and riparian habitat parameters for left and right bank were assessed separately at RM36.7 (locations OM3670A and OM3670D, see Figure 1). Total scores at these locations were modified to reflect single bank scoring so they would be comparable to other reaches.

Photographs were taken at the upstream and downstream ends of each sampling reach.

3.4.2 Parksville Reservoir

Physical habitat characterization was performed in September 2010 at each macroinvertebrate sampling transect using USEPA Environmental Monitoring and Assessment Program (EMAP) methods for lakes (EMAP 1997). Riparian and littoral zones were evaluated documenting vegetative conditions, substrate type, bank features and human influences in proximity to each transect. Multiple photographs were taken of each bank.

3.5 Sediment Revegetation

3.5.1 Copper Basin Reach

In April and June 2009 and April 2010, selected features were evaluated in the Copper Basin reach; Davis Mill delta, North Potato Creek island and Barker Mill bar. For each feature, four permanent photo points were established in 2009 near the upstream and downstream ends of each feature, as well as near-shore and inland points near the longitudinal midpoint of the feature. A steel post with flagging tape was installed at each point. A minimum of two photographs were taken at each point each year, oriented approximately 180 degrees from one another. Additional photographs were taken of features shown in historical photographs, which are also presented in this report.

Dominant plant species observed on each feature were documented, and total vegetative cover and the percentage of native and exotic species were estimated. At least one tree was selected on each feature for which the species, height, circumference (at breast height), physical condition and location were recorded each year.

3.5.2 Parksville Reservoir

In August 2009 and 2010, photographs were taken from locations upstream, downstream and along the left (south) bank of the Parksville delta area to document emergent vegetation and the extent of materials exposed during summer high pool. Due to high water levels and boating safety concerns, permanent photographic point markers were not installed.

3.6 Fish Community

3.6.1 Copper Basin Reach

In June 2010, a fish community survey was performed. Activities focused on an area around location OM3530 (just downstream of the NPC confluence and NPC island). The location is shown in Figure 1. Fish were collected using a boat-mounted electroshocking unit with dip nets for retrieval.

Shocking was performed for a total of 1052 seconds over a 150 meter stream length including both banks and in-channel habitats. Each specimen was identified, length and weight were recorded and any abnormalities were documented.

3.6.2 Ocoee #3 Reservoir

In June 2010, a fish community survey was performed. Activities focused on an area around location OM3040 (just downstream of the Tumbling Creek confluence). The location is shown in Figure 2. Fish were collected using a boat-mounted electroshocking unit with dip nets for retrieval. Shocking was performed for a total of 1839 seconds over a 150 meter stream length focusing on right and left bank littoral zones. The shocking time was evenly divided between banks. Each specimen was identified, length and weight were recorded and any abnormalities were documented.

3.6.3 Parksville Reservoir

In October 2010, a fish community survey was performed. Activities focused on areas around locations OM1560 (Parksville delta toe), SI0040 (Sylco Inlet) and BI0160 (Baker Inlet). The locations are shown in Figure 3. Fish were collected using a boat-mounted electroshocking unit with dip nets for retrieval. At each location, shocking was performed for approximately 6000 seconds over a 150 meter stream length focusing on right and left bank littoral zones. The shocking time was evenly divided between banks. In addition to electroshocking, experimental gill nets were also used. At each location, ten 125 foot by 6 foot nets with five 25 foot panels (1, 1.5, 2, 2.5 and 3 inch bar mesh) (five per bank) were deployed for one overnight period. The nets were spaced along each bank at 75 to 100 foot intervals with the bar mesh size alternated. Each specimen was identified, length and weight of sport fish (white, largemouth and spotted bass, channel catfish, trout, crappie) were recorded and any abnormalities were documented.

3.7 Fish Tissue

Parksville Reservoir

In conjunction with the October 2010 fish community survey work, fish tissue sampling was also performed. Three tissue samples were collected from specimens collected around location OM1560, delta toe area. One grab sample (largest largemouth bass) and two composite samples (one largemouth/spotted bass and one channel catfish) were submitted for PCB and lipids analysis.

4.0 Monitoring Results

The following sections discuss the results of the 2009 and 2010 Ocoee River long-term monitoring efforts. Historical (2006 to 2008) surface-water results for the Copper Basin reach are also presented. Field notes, chain of custody forms and QC documentation for all 2009 and 2010 environmental media samples are provided in Appendix A. Macroinvertebrate laboratory benchsheets, habitat assessment and physical characterization forms and sediment formation revegetation evaluation forms are also provided. Photographs and photograph logs are provided in Appendix B. Laboratory analytical results for all media (including historical surface water) are presented in Appendix C. Toxicity testing and related reports are provided in Appendices D and E.

4.1 Copper Basin Reach

4.1.1 Surface Water

2009 and 2010 Results

Copper Basin reach surface-water results for 2009 and 2010 are summarized in Table 5. Data for the primary tributaries in the reach are also summarized in Table 5 although they were not sampled during each event. Surface-water sampling locations are shown in Figure 1. Flow-weighted average concentrations of copper, lead, zinc and pH for a specific transect were the primary basis for evaluation. Calculated cross-channel flow distributions for each transect are provided in Table 6. Cross-channel flow distributions measured during November 2009 were used to estimate flow-weighted averages for the April 2009 event because cross-channel flow measurements were not taken during the April 2009 sampling event. Computed flow-weighted average (FWA) concentrations are summarized in Table 7. One-half the detection limit was substituted for non-detects when computing the flow-weighted average. Where applicable, water quality criteria were computed using 17 mg/L hardness.

At transect OM3670, the dissolved copper flow-weighted average concentration was approximately equal to the water quality criterion (2 ug/L) in April 2009. No transect produced results that exceeded the criterion during any event, based on flow-weighted average. The right bank (OM3670A) grab sample had the highest concentration of dissolved copper during each 2009 and 2010 event.

Dissolved zinc flow-weighted average concentration at transect OM3670 exceeded the water quality criterion (26 ug/L) in November 2009. No other transect produced results that exceeded the criterion during any event based on flow-weighted average. The right bank (OM3670A) grab sample had the highest concentration of dissolved zinc during both 2009 events and the April 2010 event. The dissolved zinc concentrations in the two samples closest to the right bank at transect OM3570 also exceeded the criterion in November 2009.

Dissolved lead levels were generally non-detect in all transects during 2009 and 2010 events, and the flow-weighted average did not exceed its criterion at any transect. No transect had a flow-weighted average pH of less than 6 s.u. in 2009. In April 2009, both the far left and right bank sampling points at transect OM3670 had pH slightly below 6 s.u. In November 2009, only the far left bank sampling point had a pH below 6 s.u. Transect OM3510 had a flow-weighted average pH of 5.81 s.u. during the April 2010 event with the lowest readings at locations closest to the left bank.

As shown in Table 5, DMC, just upstream of OM3670, represented a potential copper and zinc source prior to 2010. With the completion of Dam #5 and Belltown Diversion extension in December 2009, significant reductions in copper and zinc concentrations in the tributary water were observed. From upstream to downstream, flow-weighted average copper and zinc concentrations were observed to increase above background downstream of DMC; particularly along the far right bank prior to 2010. Below DMC, concentrations appeared to equilibrate suggesting no additional discernible inputs. Downstream of DMC, the pH dropped slightly, but then rose downstream of North Potato Creek during most events.

Additional parameters that were detected above applicable water quality criteria or other ecological benchmarks in Ocoee River samples are discussed below.

Aluminum (total) was detected above its water quality criterion (87 ug/L) at multiple locations during each 2009 and 2010 event. In 2009, the flow-weighted averages at all transects were above the criterion although background (OM3760) concentrations were compliant. All locations (including OM3760) exceeded the criterion during 2010 events. During the April 2009 and each 2010 sampling event, concentrations were fairly consistent across and between transects. In November 2009, transect OM3670 showed variability with the far right bank grab sample having a substantially higher concentration. Dissolved aluminum concentrations were below the criterion in all samples.

Iron (total and dissolved) flow-weighted average concentrations at each transect met the criterion during all events. Total iron concentrations exceeded the water quality criterion (1000 ug/L) in the grab sample collected along the far right bank at transect OM3670 in April and November 2009. Dissolved iron concentrations were well below the criterion during each event.

As shown in Table 5, DMC represented a potential aluminum and iron source in 2009; just upstream of OM3670. Aluminum patterns upstream to downstream were comparable to those observed for copper and zinc in 2009. Iron concentrations rose downstream of DMC and also slightly increased downstream of North Potato Creek prior to 2010. Completion of Dam #5 and the Belltown Diversion extension December 2009 substantially decreased aluminum and iron loading to the Ocoee River from DMC.

Historical Trends and Remedial Actions 2006-2010

Data collected by GSHI between 2006 and 2008, prior to initiation of the long-term monitoring program, were evaluated to identify spatial and temporal patterns potentially associated with actions taken in Copper Basin tributaries over that period. Historical data are summarized, along with 2009 and 2010 results, in Table 8. Data for the primary tributaries in the reach are also summarized in Table 8, although they were not sampled during every event.

Since flow-weighted average concentrations of copper, lead, zinc and pH will determine whether associated remedial goals have been met, focus was placed on those parameters. Total and dissolved aluminum and iron are also discussed. Computed flow-weighted average concentrations for each event are summarized in Table 7. One-half the detection limit was substituted for non-detects when computing flow-weighted average. Where applicable, water quality criteria were computed using 17 mg/L hardness. When evaluating the significance of temporal trends, it should be noted that flow during 2009 and 2010 sampling events was at least two times higher than observed during events in 2006 through 2008. Dilution of tributary loading and cross transect variability would be expected to differ based on river flow stage.

Dissolved copper flow-weighted average concentrations at transects OM3510 and OM3570 exceeded the water quality criterion (2 ug/L) in 2006 and 2007; in 2008, only the OM3510 concentration was above the criterion. In each case, the criterion was exceeded at grab sample points across the respective transects. In 2008, grab sample results from the right bank at transects OM3570 and OM3670 exceeded the criterion, although the flow-weighted average did not. From 2006 to 2010, dissolved copper flow-weighted average concentrations showed a general decline at each transect. The far right bank grab sample at transect OM3670 (OM3670A) consistently produced the highest result although concentrations in this area were considerably lower in 2010.

Dissolved zinc flow-weighted average concentrations at transects OM3510 and OM3570 exceeded the water quality criterion (26 ug/L) in 2006 and 2007. In each case, the criterion was exceeded at grab sample points across the respective transects. No flow-weighted average exceeded the remedial goal in 2008, although grab sample OM3760A results did exceed the limit. From 2006 to 2010, dissolved zinc flow-weighted average concentrations showed a general decline at each transect. OM3670 was an exception in November 2009 when the far right bank grab sample (OM3670A) produced the highest Ocoee in-stream zinc concentration reported in GSHI monitoring events (253 ug/L). When sampled, OM3670A consistently produced the highest result although concentrations in this area were considerably lower in 2010.

Dissolved lead was generally non-detect and the flow-weighted average did not exceed its criterion at any transect during any sampling event. Transect OM3570 had a flow-weighted average pH of less than 6 s.u. in 2006 as did the upstream reference transect (OM3760). During sampling events in 2007 through 2010, only transect OM3510 in April 2010 had a flow-weighted average pH less than 6 s.u.. As mentioned earlier, a few locations at transect OM3670 did have pH readings below 6 s.u. during 2009 sampling events.

As shown in Table 8, DMC represented a potential copper and zinc source; just upstream of OM3670 prior to 2010. From upstream to downstream, copper and zinc concentrations increased downstream of DMC during each event. In 2007 and 2008, the flow-weighted average concentrations of each also rose slightly immediately downstream of North Potato Creek. Notable declines in flow-weighted average copper and zinc were observed at transect OM3670 between November 2009 and April 2010; coinciding with the completion of Dam #5 on DMC. Downstream of DMC, pH dropped slightly, then rose or stayed consistent downstream of North Potato Creek during most events. An exception was noted in April 2010 at transect OM3510. In that case, the flow-weighted average pH dropped from 6.42 s.u. at transect OM3670 (just downstream of DMC) to 5.81 s.u. at transect OM3510 (downstream of NPC). At transect OM3510, the lowest pH readings were recorded for locations in the left half of the channel suggesting the pattern was not related to NPC-related effects.

Total aluminum was detected above its water quality criterion (87 ug/L) at multiple transects during all but the 2007 event (Table 8). During most events, concentrations were fairly consistent across and between transects. In most cases, background concentrations (from location OM3760) were comparable to or higher than those reported downstream. Dissolved aluminum concentrations in these samples were below the criterion.

Iron (total and dissolved) flow-weighted average concentrations in all transects met the criterion during each event. Total iron concentrations exceeded the water quality criterion (1000 ug/L) in grab samples from the far right bank at transect OM3670 during 2008 and 2009 sampling events. Although the maximum total iron concentrations were also reported in this area during 2010 events, the criterion was met in each case. Dissolved iron concentrations were well below the criterion in all samples collected between 2006 and 2010. As shown in Table 8, DMC historically represented a potential aluminum and iron source; just upstream of OM3670 but the source was largely abated in 2010 with completion of Dam #5 in DMC.

4.1.2 Sediment

Copper Basin reach sediment chemistry results are summarized in Table 9. Toxicity test results are presented in Table 10 and summarized in Table 11. Sediment sampling locations are shown in Figure 1. As shown in Table 9, the lotic remedial goals for copper, iron, lead and zinc (based on bulk concentrations) were exceeded in each sample collected from location OM3650A (right bank, downstream of DMC) and transect OM3510 (downstream of NPC). Despite the bulk chemistry results, toxicity testing did not indicate any survival effects in 28-day chronic tests. Mean organism growth in samples from OM3650A and OM3510 was lower than that reported for reference area (OM3680C,D&E, left bank downstream of DMC) samples but greater than that for laboratory control and study control material (Bearskin Lake (MN) sediment) samples. It was speculated that organic and nutrient inputs from a WWTP outfall just upstream of OM3680C, D and E sampling locations may have contributed to the exceptional growth results for those samples. Results suggest that factors beyond bulk chemistry (as discussed at length in the RI report) have a substantial effect on sediment metal bioavailability and toxicity.

4.1.3 Macroinvertebrates

The April 2009 macroinvertebrate survey was intended to establish baseline conditions in the Copper Basin reach with the 2010 survey providing the first opportunity to evaluate trends. Macroinvertebrate sampling reaches are shown in Figure 1.

Three metrics were selected for macroinvertebrate data analysis – total abundance, taxa richness, and EPT richness. Each metric is briefly described in the following paragraphs.

Macroinvertebrate total abundance (the numbers of organisms present) typically decreases with increasing chemical or physical stress. However, macroinvertebrate total abundance can increase with increasing chemical stress in circumstances where tolerant taxa proliferate. Therefore, community composition is an important consideration when interpreting total abundance. Total abundance was evaluated because it provides a means of documenting responses to initial reclamation efforts in severely impacted areas. In those sampling reaches with low taxa richness and EPT richness, increases in total abundance would indicate increased productivity (and possibly recovery) where improvements in diversity have not yet occurred.

Two metrics, taxa richness and EPT richness, typically used by TDEC to analyze macroinvertebrate data, were also selected for initial data analysis.

Taxa richness is an important component of community diversity, and values typically decrease with increasing chemical or physical stress. EPT richness is a measure of the number of pollution- and degraded habitat-intolerant benthic organisms. EPT richness derives its acronym from the orders

Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), which are typically found in well oxygenated, uncontaminated, and physically diverse environments. A poor EPT community is usually an indication of physical disruption and/or chemical stress in a stream system. Therefore, sampling reaches with higher EPT richness values represent higher water or habitat quality, or both.

TDEC multi-metric index (MMI) scores were also computed for each sample in accordance with TDEC's 2003 and 2006 SOPs and project SOPs. MMI scores may range from 0 to 42, with 42 being optimal (non-impaired; fully supporting a healthy macroinvertebrate community). The target score for the bioregion is 32. Although MMI scores were computed using both 2003 and 2006 TDEC SOPs, 2003 SOP scores were used as the primary basis for evaluating trends.

Year-to-year reach-specific comparisons of metrics and MMI scores were used as the basis for trend analysis. Average MMI scores in comparison to those in the reference area (OM3670D) will determine whether remedial goals have been met and were the primary basis for evaluation. Tables 12 and 13 provide project-specific species lists along with computed metrics and MMI scores for 2009 and 2010 macroinvertebrate samples, respectively. Tables 14 and 15 present sample- and area-specific statistics, respectively for the computed metrics and MMI scores.

Figure 4 shows that the reference area (OM3670D) was highly productive each year with an average of 1600 to 1650 organisms/sample. The average total abundance in samples from the OM3670A (downstream of DMC) and OM3510 (downstream of NPC) reaches was significantly lower. Abundance results for 2009 indicated heterogeneous distribution in the OM3670A reach with two of three samples having fewer than 100 organisms. In 2010, however, average total abundance in the OM3670A reach was over six times higher than in 2009; an indication of increased productivity. The number of organisms was consistent between 2009 samples from the OM3510 reach with each having 200±20%. Average total abundance in the OM3510 reach was lower in 2010 with no sample containing more than 130 organisms.

Taxa richness in the reference area averaged 37 in 2009 with a narrow range between samples, as shown in Figure 5. Fewer taxa were found in this area in 2010 (average 29). For the OM3670A reach, taxa richness was significantly lower (average 23 in 2009 and 2010) than in the reference area each year and varied between samples. Taxa richness in OM3510 was consistent between samples and statistically similar (average 36 and 26 in 2009 and 2010) to that in the reference area.

EPT richness in the OM3760D reference area averaged 17 in 2009 with a narrow range between samples (Figure 6). The number of sensitive taxa dropped to 12 at OM3760D, however, in 2010. For the OM3670A reach, EPT richness was significantly lower (average 8) in 2009 than in the reference area and varied between samples. Similar results were observed in 2010 although the disparity between reaches OM3670A and OM3670D was less. EPT richness in OM3510 was reasonably consistent between samples and statistically similar (averages of 14 and 10) to that in the reference area each year.

As shown in Figure 7, MMI scores (TDEC 2003 SOP) in the OM3760D reference area averaged 38 and 31 in 2009 and 2010, respectively with little variability between samples. For the OM3670A reach, average MMI score was lower (averages of 25 and 18) than in the reference area each year, and varied considerably between samples in 2009. As noted above, two of three 2009 samples from OM3670A had fewer than the requisite 200±20% organisms specified in the TDEC SOP. As a result, associated MMI scores are of questionable reliability. MMI scores in OM3510 were reasonably consistent each year. In 2009, the average MMI in this reach was statistically similar (average 33) to that in the reference area. All samples from the OM3670D and OM3510 reaches met the bioregion MMI target score in 2009. In 2010, only half the reference area samples met the target score and based on the paucity of organisms at OM3510, reliable MMI scores could not be computed for any sample.

With the exception of abundance, the macroinvertebrate community in the OM3510 reach was largely similar to that in the OM3760D reference area in 2009 and 2010. Changes observed year-to-year in reach OM3510 may be related to increased substrate fines and altered flow patterns. Although the benthic community in the OM3670A reach was found to be inferior to that in the reference area, the general diversity and presence of relatively intolerant genera in 2009 was encouraging given the chemical and physical stressors reported in the area (see Sections 4.1.1 and 4.1.3). Despite a lower average MMI score in 2010, the dramatic increase in total abundance at OM3670A is considered evidence of a recovering macroinvertebrate community.

4.1.4 Habitat

Habitat scores assigned to each of the macroinvertebrate sampling reaches in 2009 and 2010 are presented in Table 16. Habitat characterization is used to assess general conditions and trends, and can support diagnostic analysis should biotic measures not meet goals. Figure 8 depicts the same information. The total habitat score for the reference area (OM3670D) was 174 and 172 (optimal) in 2009 and 2010, respectively, and no iron effects were noted. The only notable changes year to year were a slight increase in embeddedness and minor deterioration in left bank conditions.

The total habitat score for the OM3670A reach was 148 and 152 (suboptimal) in 2009 and 2010, respectively. Channel alteration, vegetative protection and riparian vegetative zone width parameters each indicated habitat inferior to that observed in the reference area. In 2009, iron effects in the form of armoring were noted on 100% of stream substrate in this area. Iron armor coverage had decreased to 50% by 2010.

In the OM3510 reach, the total habitat score was 118 (low suboptimal) both years. Epifaunal substrate, sediment deposition, frequency of riffles, bank stability, vegetative protection and riparian vegetative zone width parameters each indicated habitat inferior to that observed in the reference area. Iron effects were not noted on substrate in the reach.

4.1.5 Sediment Revegetation

Davis Mill delta, North Potato Creek island and Barker Mill bar were evaluated in 2009 and 2010 to determine whether and to what extent vegetation has been reestablished. The sediment features are shown in Figure 1. These features were created by deposition (deltaic or fluvial) of sediments originating in Copper Basin tributaries and upstream areas of the Toccoa/Ocoee watershed. Each feature had sparse to no vegetation when GSHI initiated their restoration efforts in the Copper Basin.

Plant growth would be expected to stabilize the sediments, and live and senescent materials could provide nutrients further supporting vegetative cover.

The following paragraphs discuss findings for each feature with 2009 serving as the baseline year for formal assessment. Field observations and measurements for each are summarized in Table 17.

The Davis Mill delta covers approximately three acres at the mouth of Davis Mill Creek on the downstream side. Figures 9 and 10 show the delta condition in 2001-2002. In 2004, GSHI actively restored the delta adding lime and soil amendments along with various grass and tree plantings. Figures 11 through 13 show photographs taken in 2009 and 2010, and the delta had approximately 95% vegetative coverage composed of 95% native species. The majority of the delta was covered with grasses planted during reclamation with some interspersed river birch. Along the margins, more diverse grasses/weeds were present along with alder, black willow and some scrub pines. The primary exotic species was knot weed. No significant barren areas were identified.

A single river birch located in the south-central portion of the formation was selected to provide a basis for tracking long-term tree growth on the delta. It was one of three closely bunched trunks; each budding out at the time of evaluation with no signs of stress. In 2009, the tree was 15 feet high and had a breast height circumference of 0.58 feet. The tree had grown to 18 feet by 2010 and it remained vigorous.

The North Potato Creek island is located on the downstream side of the North Potato Creek mouth and is slightly greater than two acres. Figures 14 and 15 show the island in 2002 prior to initiation of Copper Basin remedial activities. No active revegetation efforts have been made on this island. Figures 16 through 18 show photographs taken in 2009 and 2010. The island had approximately 80 to 90% vegetative coverage overall composed of 80 to 90% native species each year. Lower vegetative coverage was noted in 2010 due to recent sediment deposition. Plant species were diverse with numerous tree (dominant: river birch, alder), shrub (blackberry, mulberry, honeysuckle) and grass/weed species represented. Exotic species included knot weed and royal paulownia. Trees were predominant in interior areas with shrubs, grasses and weeds generally providing cover along the river bank. A relatively small nearly barren area (Figure 18) was identified on the downstream (western) end of the island. The barren area is likely within the river flow path when the river stage is elevated. The upstream (eastern) tip of the island showed signs of slumping and appeared susceptible to erosion during high flow conditions. Between June 2009 and April 2010, a number of high flow events deposited piles of large woody debris on the river bank which extended upwards of 30 feet inshore as well as new sediment nearly a foot thick in some areas (see Figures 16 and 17).

A single river birch located in the western portion of the formation was selected to provide a basis for tracking long-term tree growth on the island. It was approximately 50 feet downstream (west) of the downstream photopoint. It was one of many in a stand and showed no signs of stress. In 2009, the tree was 20 feet high and had a breast height circumference of 0.625 feet. Its height was estimated at 25 feet in 2010 and the circumference had increased to 0.8 feet.

Barker Mill bar is a long, narrow sand bar located on the inside of a bend (right bank) starting at approximately river mile 34.9 and comprises around two acres. As shown in Figure 19, the bar was nearly devoid of vegetation in 2002 prior to initiation of Copper Basin remedial activities. No active revegetation efforts have been made on this feature. Figures 20 through 22 show photographs taken in 2009 and 2010. The bar had approximately 20 to 30% vegetative coverage; the majority composed of native species. Plant species were relatively diverse with a few tree (dominant: river birch, alder), shrub (blackberry, briers) and grass/weed species represented. Exotic species included bamboo, knot weed and royal paulownia. Most vegetation was clustered along the natural levee that has formed adjacent the Ocoee River bank and the inland margin along the bankfull demarcation. A large interior swath with generally sparse vegetation ran the length of the feature although patchy grasses, shrubs and a few trees did exist where new sediments had been deposited and retained (ex. in old tires). Based on topography and other observations, the sparsely vegetated area is suspected to be within the river flow path when the river stage is elevated.

A single river birch located in the eastern (upstream) portion of the formation was selected to provide a basis for tracking long-term tree growth on the bar. It was paired with another river birch (within five feet), was budding out and appeared healthy. In 2009, the tree was 30 feet high, had a breast height circumference of 1.58 feet. Its height was estimated at 35 feet in 2010 and the circumference had increased to 1.78 feet.

Each sediment feature in the Copper Basin reach has shown significant improvement in vegetative cover since 2000.

4.1.6 Fish Community

The 2010 fish community survey was conducted to provide an assessment of baseline conditions. The fish survey location is shown in Figure 1. Fish community survey results for the Copper Basin reach (OM3530, just downstream of NPC) are presented in Table 18. Various metrics commonly used as part of TVA's Vital Signs program were computed to assess the fish community.

During the 15 minute shocking run, specimens representing eight species were caught with a total collection of 20 fish. River chub were the most numerous (six) and a single rainbow trout was collected. Most fish were insectivores, and either intolerant or of intermediate tolerance. Diversity and abundance were comparable to that observed during an RI fish survey in 2005 in the same area.

4.1.7 Conclusions

In the Copper Basin reach, dissolved copper and zinc concentrations appeared to decline between 2006 and 2009 in most areas and flow-weighted average concentrations in 2009 and 2010 were below water quality criteria in all but one instance (OM3670 November 2009, zinc 35.8 ug/L). Total aluminum and iron levels were above their respective water quality benchmarks primarily along the right bank immediately downstream of DMC prior to 2010. Flow-weighted average total aluminum concentrations regularly exceeded the criterion at most transects (including background), although little dissolved aluminum is present. The flow-weighted total iron concentration did not exceed its criterion at any transect between August 2006 and November 2010.

Sediment remedial goals for copper, iron, lead and zinc were exceeded in each affected area sample. In spite of the bulk chemistry of the materials, toxicity testing produced no mortality in any sample. Mean organism growth in samples from OM3650A and OM3510 was lower than that in reference area (OM3680C,D&E) samples but exceeded that reported for lab control and study control materials.

The benthic macroinvertebrate community at transect OM3510 was found to be comparable to that in the reference area (OM3670D), although productivity was lower. At OM3670A, the community was inferior to the reference area by most measures each year. However, the differences between OM3670A and OM3670D were less pronounced in 2010 in terms of productivity and diversity. Habitat at OM3670A was not as good as in the reference area. The substrate at this location had 100% iron armoring in 2009 but coverage had decreased to around 50% by 2010. At transect OM3510, a number of key in-stream habitat parameters were inferior to those at OM3670D, but no iron effects were observed.

Sediment formations in this reach have shown obvious improvement since GSHI initiated remedial activities in the Copper Basin tributaries. Davis Mill delta and the North Potato Creek island supported dense vegetation with greater than 80% coverage. On Barker Mill bar, vegetative cover remained somewhat sparse. Frequent scour through secondary river flow paths may partially account for it. Eight fish species were identified in the reach below NPC; most being intolerant or intermediate tolerance insectivores.

4.2 Ocoee #3 Reservoir

4.2.1 Surface Water

Surface-water sampling was performed at three locations in the Ocoee #3 reservoir: OM2920 (RM29.2, upstream of #3 dam), OM3000 (RM30.0, mid-reservoir) and OM3280 (RM32.8, reservoir inflow) in November 2009 and 2010. Surface-water sampling locations are shown in Figure 2. Ocoee #3 Reservoir surface-water results are summarized in Table 19. One-half the detection limit was substituted for non-detects when computing the location-specific average. Where applicable, water quality criteria were computed using 17 mg/L hardness.

Average concentrations of copper, lead, zinc and pH at a specific location will determine whether associated remedial goals have been met and were the primary basis for evaluation. Other parameters are discussed to provide an account of water quality conditions.

Dissolved zinc and pH met remedial goals at all locations and depths during both sampling events. Average dissolved copper and lead levels were above goals at location OM2920 in November 2009. In both cases, the surface grab sample had the highest concentration and was the primary reason for the exceedance. The spatial patterns for these parameters are interesting as copper and lead concentrations at locations just upstream in the reservoir were compliant.

Additional parameters that do not have specific remedial goals within the long-term monitoring program were also analyzed. Aluminum (total) was detected above its water quality criterion (87 ug/L) in all shallow and deep grab samples except those from OM3000 in November 2009. Dissolved aluminum concentrations in all samples were well below the criterion. Iron (total and dissolved) concentrations in all 2009 and 2010 reservoir grab samples met the chronic criterion.

4.2.2 Sediment

Table 20 summarizes sediment chemistry data for the samples collected from the reservoir in 2009 and 2010 along with sediment remedial goals developed during the RI. Sediment sampling locations are shown in Figure 2. Average concentrations at a specific transect will assist in determining whether associated remedial goals have been met and were the primary basis for evaluation. As shown, no average result exceeded the goals for copper, iron, lead or zinc. The iron concentration in one grab sample exceeded the goal in both 2009 and 2010. In 2009, it was the sample from along the right bank (OM3000A) and in 2010, the sample along the left bank (OM3000E). The OM3000E zinc concentration was above the associated goal in 2010 only.

Despite the bulk chemistry results, toxicity testing in 2010 did not indicate any survival effects in 28-day chronic tests. Mean organism growth in samples from OM3000 was lower than that reported for the Ocoee River reference area (OM3680C, D and E, left bank, downstream of DMC) samples but greater than that for laboratory control and study control material (Bearskin Lake (MN) sediment) samples. It was speculated that organic and nutrient inputs from a WWTP outfall just upstream of OM3680C, D and E sampling locations may have contributed to the exceptional growth results for those samples. Results suggest that factors beyond bulk chemistry (as discussed at length in the RI report) have a substantial effect on sediment metal bioavailability and toxicity.

4.2.3 Fish Community

The 2010 fish community survey was conducted to provide an assessment of baseline conditions. Fish community survey results for the Ocoee #3 reservoir reach (OM3040, just downstream of Tumbling Creek confluence) are presented in Table 18. Various metrics commonly used as part of TVA's Vital Signs program were computed to assess the fish community. The fish survey location is shown in Figure 2.

During the 30 minute shocking run, specimens representing five species were caught with a total collection of 37 adult fish and 846 largemouth bass fry (young of year). Bluegill were the most numerous (21) among adult fish. Most adult fish were insectivores, and largely tolerant. A number of largemouth bass in the four to six pound range were collected suggesting conditions were conducive to growth, and the presence of fry indicates local reproduction. Diversity and abundance were comparable to that observed during an RI fish survey in 2005.

4.2.4 Conclusions

In the Ocoee #3 reservoir reach, dissolved copper and lead concentrations were above the water quality criteria at some locations in 2009. Total aluminum levels above the water quality criterion were also reported; in the lower and upper portions of the reservoir.