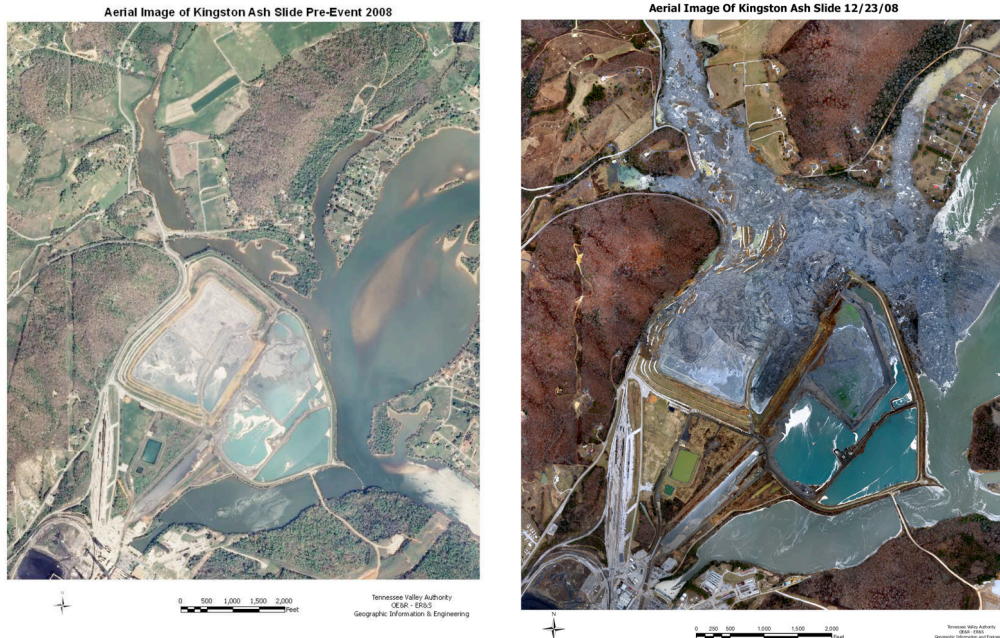


A CALL FOR HELP
TO EVALUATE THE RISKS OF THE TVA ASH DREDGE PLAN AND
TO PREVENT LOSS OF THE WATTS BAR RESERVOIR FISHERY

By
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At 1 AM on December 22nd, 2008 the sixty-foot ash and earthen dike securing a retention pond at the Tennessee Valley Authority's (TVA) Kingston Fossil Plant holding five decades of coal fly ash gave way causing a catastrophic wave of ash slurry to cover 300 acres of nearby land and water. Fortunately there were no serious injuries or loss of life among workers or local residents, but the impacts on the land and water were severe. TVA estimated that a total of 5.4 million cubic yards of ash escaped the pond (See Figure 1). Subsequently the Tennessee Department of Environment and Conservation (TDEC) reported that 5 million cubic yards of the spilled ash ended up in the Emory River, an arm of Watts Bar Reservoir. The adverse acute and chronic effects of the coal ash slurry on aquatic benthic invertebrates (including 4 freshwater mussels species of special concern), the newly reintroduced lake sturgeon, and other sensitive populations of fish, such as the spotfin chub and the ashy darter, is unknown at this time.

Figure 1. Aerial views of the TVA Kingston plant area before and after the ash spill of 22 December 2008.



TVA undertook spill response efforts immediately and quickly focused on removing the ash from buried roads and railways, and the river channel, presumably to prevent upstream flooding impacts and movement of the spilled ash further downstream. From late December 2008 until March 2009 TVA

worked with its consultants on a dredge plan, including obtaining comments from TDEC, the U.S. Army Corps of Engineers (ACE), the U.S. Environmental Protection Agency (EPA), the Tennessee Wildlife Resource Agency, and the US Department of Fish and Wildlife (FWS). The resulting plan for a maximum effort hydraulic (suction) dredging of ash from the Emory River channel was approved and pilot dredging began on 20 March 2009.

Dr. Bryce Payne* began attempting to contact TVA and TDEC regarding spill response approaches and the dangers inherent in using conventional dredging to clean up the spill in early January 2009. During that effort Dr. Payne formed alliances with other scientists living in the area of or working on the spill. When it became apparent that TVA and TDEC would not pay heed, Dr. Payne and allied scientists approached the Tennessee Clean Water Network (TCWN), which became convinced that Dr. Payne's concerns were serious and had a solid scientific basis. With the encouragement and support of TCWN and other organizations new efforts to communicate with TVA and TDEC were undertaken. Two lengthy conference calls occurred. Federal scientists with expertise in selenium ecotoxicology participated in those calls, and confirmed the scientific legitimacy of the selenium concerns. Those communications led to minor intensifications of the water quality monitoring efforts for the dredge plan, but not to serious efforts to verify or quantify the potential selenium problem prior, to or even in conjunction with, the beginning of dredging operations.

There are other risks presented by the TVA ash spill dredging plans, but the selenium risk is near term and potentially far-reaching and assessable. Fish tissue samples taken and analyzed so far (data from Appalachian State University and TDEC) show the fish in the Emory and Clinch Rivers already contain toxic levels of selenium. Indirect inferences by Dr. Payne from very limited data suggest the local sediments in the river might have contained substantial selenium before the ash spill. Both these selenium contaminations are presumably due to 50 years of discharging ash settling pond water from the TVA Kingston plant into the river. Recently a sample of the spilled ash collected by the U.S. Fish and Wildlife Service was subjected to test using the modified toxic contaminant leaching procedure (TCLP). The resulting leachate contained 78 ppb selenium. This TCLP result suggests the potential for release of substantially greater amounts of selenium when the expected effects of dredging occur. The fish and similarly vulnerable biota in the Emory-Clinch river system simply will not be able to tolerate additional selenium.

The planned TVA conventional dredging operation will optimize conditions for selenium release (see "Note on Selenium in Coal Fly Ash" that follows this text). There will be intense mechanical disturbance of the ash deposits in the river by

* Independent consulting soil/environmental scientist with more than 10 years experience working with fly ash, and who investigated and explained the selenium ground water impacts of a 2005 coal fly ash spill in Pennsylvania.

the dredge machinery. During that disturbance secondary mineral particles will be dislodged and the ash will be intimately mixed with well-oxygenated river water, raising the oxygen exposure of selenite adsorbed on the secondary minerals. Transformation from selenite to selenate will begin shortly thereafter and continue as long as the oxygen levels remain elevated. There is nothing in the TVA dredge plan to indicate that the ash processing or temporary storage measures will do anything but further the increased ash exposure to more oxygenated conditions and sustain the selenite-to-selenate conversion and consequent release of dissolved selenium. The plan even suggests that dissolved metals might be removed during processing of dredged ash through the ash settling pond. At least in the case of selenium, dissolved levels should be expected to increase if processed through the ash settling pond.

To complicate the situation further, there is often a delay between the initial change to more oxygenated conditions and the actual appearance of increases in dissolved selenium. Experience suggests the delay under field conditions will be in the range of 1 to 2 months. The important point is that if there is such a delay before unacceptable increases in dissolved selenium levels are recognized, and even if dredging were halted entirely in response, nothing could be done to prevent the release of most of the selenium in the ash already dredged to that point. That is, as far as selenium goes, if there are toxic impacts, there is no backing up or undoing those impacts of a conventional dredging operation once it has moved any substantial amount of ash. In fact, because the selenium release rate will lag behind and be slow relative to the rate at which dredged ash will accumulate, it can be reasonably expected that once selenium levels start to rise, the rise will continue to get faster each day that dredging continues and for some time after dredging stops.

Still another complication is the dislodging of the very fine secondary mineral particles from the original ash particles. Field experience suggests that these particles are so fine that presence of substantial amounts may not be apparent to visual observation. They will likely either readily pass through or clog up silt curtains. They are too small to settle out of suspension and may drift downstream unobserved for unpredictable, and potentially long distances. They can be expected to be substantially enriched with selenium and arsenic compared to the original ash particles. It is reasonable to expect that one or the other or both these toxic elements will become dissolved at some point along the released particles journey. At present we do not know how much of these very small secondary mineral particles are associated with the spilled ash, their toxic element contents, or probable toxic release rates if they escaped the dredge and ash processing confinement efforts. In fact, these particles may be small enough to enter the food chain through direct ingestion by a range of organisms.

The aquatic ecosystem of the Emory and Clinch Rivers clearly cannot tolerate further selenium loading. There is a serious likelihood that the already selenium impacted zone reaches into Watts Bar Reservoir. There is no data that would

allow confident assessment of the risks posed by the spilled ash or the selenium stress that pre-dates the ash spill. There is, therefore, no means by which to evaluate the risk to the entire Watts Bar Reservoir system fishery and aquatic ecosystem. The National Pollutant Discharge Elimination System (NPDES) permit of the TVA Kingston plant expired in 2008 and none of its permits ever regulated selenium or arsenic, as is typical for coal fired plants throughout the U.S. There is urgent need to collect data to establish the chronic risk posed by the NPDES discharges and ash spilled from the TVA Kingston plant to the fisheries of the impacted rivers and reservoir, to enable a reasonable effort to prevent further injury or destruction of the fisheries of those waters and enable an environmentally and economically sound clean up of the spilled ash.

Our efforts in this regard over the last three months have fallen upon deaf ears at TVA, TDEC, ACE, and EPA. Some members of Congress, including a major Senate committee are aware of and concerned about the situation, but without clear indications of public concern and support Congressional intervention will come too late if at all. We are urgently seeking assistance from all concerned citizens, scientists and organizations to obtain the support needed to gather essential data. At the very least we need data to evaluate the imminent risk of total loss of the local fisheries, to enable development of appropriate clean up plans, and to initiate a long-needed review of the NPDES permitting system and its practical disregard for pollutants that are the most injurious to aquatic ecosystems. Precious time has been lost pursuing a clean up plan that presents unnecessary environmental and economic risks. There are other clean up approaches that TVA has confirmed were never seriously considered. Other approaches should be identified, examined, and the best among them applied as soon as possible. The bigger picture impacts of the situation should not be forgotten. We need coal energy, but we need to find out how to use it wisely. The investigative, monitoring, and planning work so urgently needed in the Watts Bar Reservoir-TVA Kingston ash spill case could provide a critically needed first step in cleaning up our coal energy production system and laying the ground work for a brighter environmental and economic future.

If you share our concerns and can assist us or provide support in any way, please contact Dr. Payne by email at payneb@nni.com or call 215 272-0124.

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Note on Selenium in Coal Fly Ash

The environmental chemistry of selenium is complex, but constraining the subject to selenium associated with coal fly ash (CFA) simplifies the discussion. There are only two forms of selenium typically associated with CFA, selenite and selenate.

In the coal furnace the selenium in coal is burned to selenium oxides, either selenite or selenate, and incorporated into and on the spherical glass particles that make up >95% or so of coal fly ash. The selenium fused into the CFA glass is not water soluble, while that

on the glass surface is. The soluble portion may account for <1% to 70% of the total selenium, and is dissolved by the slurry water used to carry the ash from the power plant to the ash settling pond. When the ash settles in the pond, the slurry water carries that dissolved selenium into the water body receiving the effluent from the pond. This can be, and in the TVA Kingston case does appear to be, a substantial amount of selenium.

Once the ash has settled into the pond, the natural and unavoidable process of mineral weathering of the CFA glass begins. During weathering the major elements, aluminum, iron, oxygen, and silicon, dissolve and re-crystallize to form stable, crystalline compounds called secondary minerals. These secondary minerals form as extremely small particles, often apparent as accumulating deposits on the CFA glass particles. Because they are young minerals and the particles are so small, they may be relatively easily dislodged from the CFA particles surfaces if physical disturbance of the ash occurs.

Minor and trace elements, like selenium and arsenic, are also dissolved during the weathering process. These trace elements do not fit into the crystalline structure of the forming secondary minerals. So, they tend to remain in solution. Since there is limited or no movement of water in the ponded ash, these minor elements undergo their own changes in response to their new chemical environment. In the case of selenium, and mostly because of restricted oxygen supplies, the dominant form is selenite.

As it turns out, the surfaces of the forming secondary minerals have a strong adsorptive affinity for selenite (and related forms of arsenic). Once present, the secondary minerals begin to adsorb all or nearly all the dissolved selenium in the ash pond. Shea Tuberty and Sarah Carmichael at Appalachian State University recently examined samples of the spilled TVA ash using scanning electron microscopy. That work clearly showed the secondary minerals coated on the ash particles and confirmed that those secondary minerals are heavily enriched with arsenic relative to the original ash particles. At this time we do not have such direct measurements for selenium due to its relatively lower concentrations and limited detection capabilities of the scanning electron microscope for surface metal concentrations.

As long as aged ash in a storage pond is not disturbed the selenium (and arsenic) remains fairly tightly bound to the secondary minerals attached to the ash particle surfaces. If, however, the aged, ponded ash is disturbed so that either oxygen levels increase, or the small secondary mineral particles are dislodged and moved to areas with higher oxygen levels, the selenium stabilizing process is undone. Selenite converts naturally to selenate. The adsorptive affinity of the secondary minerals for selenate is about 10 times less than for selenite. So, the selenium is no longer adsorbed by the secondary minerals, and dissolved selenium levels rise. How high and how fast depend on a number of factors, but the amount released can be considerable.
