

Kingston Ash Release - Initial Water, Air, and Sediment Monitoring Response and Subsequent Refinements

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ABSTRACT

The Tennessee Valley Authority's (TVA) response to the December 22, 2008 release of ash from a holding cell into the Emory River included an immediate assessment of the surface water quality effects and the extent of ash deposits that entered the river system. The surface water quality monitoring response initially necessitated a coordinated and multi-disciplined effort for sample collection, analytical support, and data management, with on-site input from regulatory agencies. Although this early and immediate effort was a significant challenge, the water quality monitoring program implemented during the first week has continued with relatively few changes. Since that time, other sampling and analytical programs have been implemented for a variety of purposes (e.g., human health and ecological risk assessment and disposal purposes).

Briefly, the collective programs include air monitoring, ash and sediments, waste disposal monitoring, and an array of aquatic and terrestrial biota monitoring. Each of these programs required objective formulation, documented rationale and planning, and execution by TVA and consulting environmental experts, analytical service providers, and data management professionals.

Of particular challenge was the ash and sediment monitoring, since it required a more dynamic approach to evaluate redistribution by high flow events and mixing of ash with native sediments. Further complicating the ash and sediment program was the objective to separate the effects of the recent spill from effects of legacy pollutants in the system. While the collective monitoring programs since the spill have been substantial, sampling locations maps that are presented are limited to ash/sediment and surface water.

Summaries of surface water, ash, and sediment analytical results generated for samples collected during the first 10 months following the release are presented. In addition, summaries of ambient air monitoring efforts at the site are presented.



INITIAL MONITORING PROGRAMS RATIONALE

The initial water monitoring was designed to immediately assess: 1) downstream extent of ash deposition, and 2) potential impacts to downstream municipal water supplies. Acoustic depth soundings on December 22 & 23, followed within a week by surveys with specialized bathymetric survey equipment determined that the initial ash flow extended to Emory River Mile 1.5. River water sampling at approximately one-mile intervals on the Emory, Clinch, and Tennessee Rivers and at the Kingston and Rockwood municipal water treatment plants determined that there was no impact to those water supplies.

The initial air monitoring program consisted of establishing a network of fixed monitoring stations encircling the plant so there would always be upwind/downwind data, supplemented by mobile, roving monitoring conducted from vehicles. Those results indicated dust suppression efforts at the site were effective.

Initial ash monitoring included surface samples from the ash flow, a Geoprobe sample through the full depth of the part of the cell that didn't fail, and grab samples from the ash in the river. The objective was to obtain information on the chemical and physical characteristics of the ash.

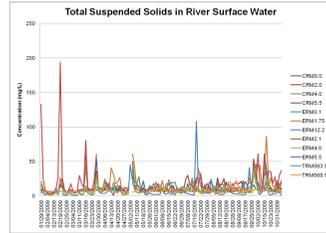


SURFACE WATER

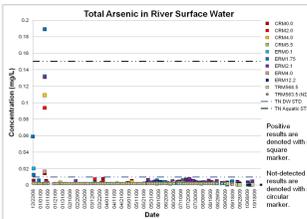
Routine fixed-station surface water monitoring includes:

- five sampling locations on the Emory River
- four sampling locations on the Clinch River
- two sampling locations on the Tennessee River

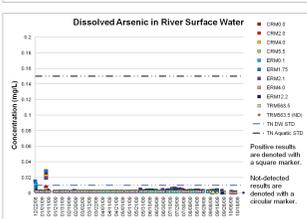
The locations were established to assess the impacts of the fly ash release on the local river system and to detect any changes to surface water quality associated with the continued presence of a large volume of ash in the Emory River.



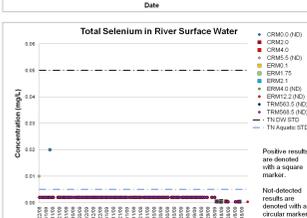
	Average of Detected Results (mg/L)	Maximum of Detected Results (mg/L)	Total Number of Samples	Number of "Not-Detected" Results	% Non-Detects
Clinch River	9.4	80.6	484	9	2%
Emory River	9.7	108	578	15	3%
Tennessee River	7.0	14.9	126	2	2%
All River Locations	9.3	108	1188	26	2%



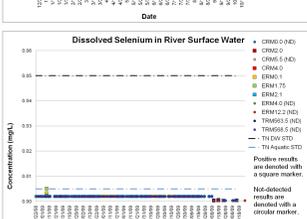
	Average of Detected Results (mg/L)	Maximum of Detected Results (mg/L)	Total Number of Samples	Number of "Not-Detected" Results	% Non-Detects
Clinch River	0.00501	0.109	485	392	84%
Emory River	0.00706	0.189	546	425	78%
Tennessee River	0.000684	0.00165	125	118	94%
All River Locations	0.00605	0.189	1134	933	82%



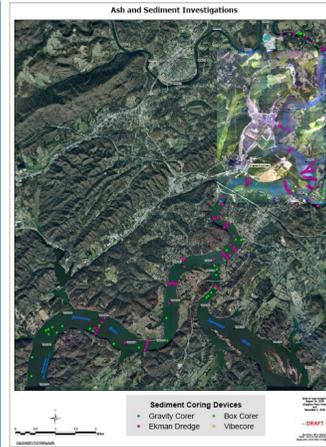
	Average of Detected Results (mg/L)	Maximum of Detected Results (mg/L)	Total Number of Samples	Number of "Not-Detected" Results	% Non-Detects
Clinch River	0.00275	0.0242	465	416	89%
Emory River	0.00339	0.0281	546	462	85%
Tennessee River	0.00047	0.000770	125	119	94%
All River Locations	0.00302	0.0281	1134	994	88%



	Average of Detected Results (mg/L)	Maximum of Detected Results (mg/L)	Total Number of Samples	Number of "Not-Detected" Results	% Non-Detects
Clinch River	0.000520	0.000640	465	452	99%
Emory River	0.000428	0.000570	546	537	98%
Tennessee River	ND	ND	125	125	100%
All River Locations	0.000481	0.000640	1134	1122	99%



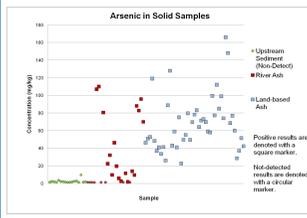
	Average of Detected Results (mg/L)	Maximum of Detected Results (mg/L)	Total Number of Samples	Number of "Not-Detected" Results	% Non-Detects
Clinch River	0.00113	0.00302	465	461	99%
Emory River	0.00128	0.00512	546	535	98%
Tennessee River	ND	ND	125	125	100%
All River Locations	0.00122	0.00512	1134	1119	99%



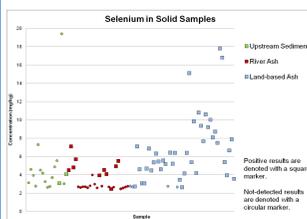
SEDIMENT AND ASH SAMPLING

The objectives of the sediment and ash sampling are to characterize the chemical nature of the ash, determine if the released ash resulted in residual impacts to native soil, and evaluate the potential threat of the released ash to human health and the environment. Ash sampling has focused on determining the long-term and short-term potential toxicological ecological impacts from the released ash.

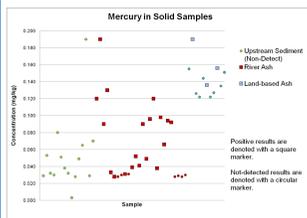
Since the ash release, TVA has collected samples of river sediments upstream of the impacted area, of land-based ash, and of sub-aqueous ash from the Emory River. Sediment and ash samples have been analyzed for metals; in addition, ash samples are used for toxicological evaluations.



	Average of Detected Results (mg/kg)	Maximum Detected Results (mg/kg)	Total Number of Samples	Number of "Not-Detected" Results	% Non-Detects
River Ash	45	110	26	8	31%
Upstream Sediment	ND	ND	17	17	100%
Land-based Ash	68	166	45	0	0%



	Average of Detected Results (mg/kg)	Maximum Detected Results (mg/kg)	Total Number of Samples	Number of "Not-Detected" Results	% Non-Detects
River Ash	4.8	7	26	16	62%
Upstream Sediment	3.6	4.06	17	15	88%
Land-based Ash	6.9	18	45	4	9%



	Average of Detected Results (mg/kg)	Maximum Detected Results (mg/kg)	Total Number of Samples	Number of "Not-Detected" Results	% Non-Detects
River Ash	0.0788	0.190	26	7	27%
Upstream Sediment	ND	ND	15	15	100%
Land-based Ash	0.161	0.190	11	8	73%



AMBIENT AIR MONITORING

The ambient air monitoring program includes mobile and stationary monitoring for airborne particulate matter. The primary objective of the ambient air monitoring program is to monitor air quality in the vicinity of fly ash release remediation in real time. The primary analytes of concern are particulate matter (≤ 2.5 microns and ≤ 10 microns), silica, and metals.

Fixed locations were selected to represent areas closely associated with and proximal to the released fly ash. These areas were selected to characterize ambient concentrations of particles and target compounds potentially associated with fly ash in community-based locations near the fly ash. Prevailing wind direction near the plant is strongly influenced by ridge and valley topography oriented along the southwest to northeast axis of the Tennessee River Valley. The stationary monitoring locations include:

- One background sampling location upwind, but not impacted by the ash release
- Two monitoring locations to the northeast of the plant and one to the southwest representing upwind and downwind conditions for most days
- A pair of monitoring locations on a line roughly northwest-southeast, perpendicular to the upwind and downwind locations

Summary Statistics for Fixed-Base Air Monitoring (through 10/31/2009)

	Maximum (ug/m ³)	Total Number of Samples	Number of "Not-Detected" Results	% Non-Detects
Arsenic	0.0053	969	847	88.3%
Selenium	62	667	643	96.4%
PM _{2.5}	25	413	9	2.2%
PM ₁₀	72.7	389	12	3.1%

TOTAL SAMPLE COUNT

Matrix	Number of Samples (through 2/4/2010)
Air	168,976
Surface Water	1,584
Groundwater	2,712
Sediment and Ash	68
Biota	74
	632

MONITORING PROGRAM REFINEMENTS

There have been only minor changes in the surface water quality monitoring program. Two Clinch River stations sampled initially were dropped, and upstream stations on the Emory and Clinch Rivers were added. Water supply monitoring was transferred to the Tennessee Department of Environment and Conservation.

Standard sediment samplers were unsuccessful in penetrating the river ash deeper than a few inches. A vibratory coring device eventually was found to successfully collect undisturbed core samples. That instrument has been used for all river ash sampling since October, 2009. In addition, it has been used to map ash depths throughout the system, guide dredging operations during the last phases of river dredging, and evaluate ash movement during high flows.

A mobile air monitoring laboratory activated immediately after the release was sent back to Muscle Shoals, AL, once the air fixed stations were established. Battery-powered industrial hygiene-type instruments at those stations were replaced with Federal Reference Standards instruments in March, 2009, and plans now are underway to replace or supplement those instruments with continuous PM 2.5 monitors. The mobile air monitors have continued as a primary part of the overall air monitoring program.

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