

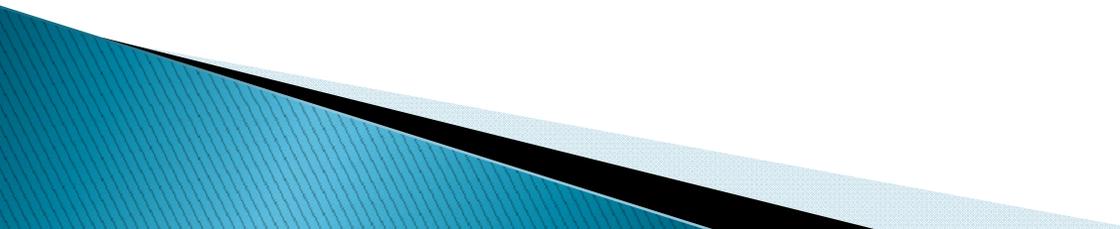
# **Integrated Ecological Research-- TVA Kingston Ash Recovery Project**

**Kingston Fly Ash Release  
Environmental Symposium  
August 2, 2011**

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Tennessee Valley Authority**



# Overview of Kingston Ecological Research

- Questions We're Trying to Answer
  - Approaches We're Using
  - Who is Involved
  - Schedules
- 

## Questions To Address:

- ▶ **What Were Initial Ecological Damages?**
- ▶ **How Is the Ecosystem Responding?**
- ▶ **Are There Likely To Be Any Long-Term Effects?**
- ▶ **Are There Likely To Be Any Latent Effects?**
- ▶ **How Long Will Ecosystem Recovery Take?**

# First, A Brief Review

- **Spill Volume: ~5.4 Million cubic yards (12/22/08)**
- **Emergency Response/Pilot Dredging Phase**
- **CERCLA Phase 1 -- Time-Critical Action Removal**
  - 3.5 million cu yd removed from Emory River
  - May 29, 2010 Emory River reopened
- **CERCLA Phase 2—Non Time-Critical Action Removal**
  - 2.8 million cu yd being removed from embayment
  - Consolidating in on-site disposal area
  - Robust subsurface perimeter containment system  
(withstand 6.0 magnitude earthquake)
- **CERCLA Phase 3--Residual Ash Study**
  - River ecosystem and human health risk assessments
  - Supplemental investigations and research

# Initial Damages? Ecosystem Response?

- ▶ **Ideally...**
  - Lots of pre-spill data for comparison...
  - Simple task to collect more, compare before/after

# Initial Damages? Ecosystem Response?

## ▶ Reality...

- A little pre-spill data available, lots of data gaps
  - Intensive sampling immediately post-spill
    - Fish and invertebrate community surveys
    - Fish “baseline” bioaccumulation surveys
- Lots of post-spill, periodic surveys over time
  - Fish, mayflies, birds, reptiles, amphibians, mammals, water, sediments, ash...
  - Bioaccumulation, ecological health, population surveys
  - Water, ash, sediment analyses
    - Chemical, physical, toxicological characteristics
    - Modeling ash transport, mixing w/ native sediments
    - Dissolution & redox kinetics

# Long-Term or Latent Effects?

- ▶ Residual Ash Investigations (River EE/CA)
  - Human Health & Ecological Risk Assessments
  - Necessary investigations described in Sampling & Analysis Plan (SAP)
- ▶ Supplemental Investigations
  - Information for operations decisions
  - Additional information relevant to risk assessments, NRDA

# Approaches

- ▶ **Multiple Lines-of-Evidence**
  - Multiple Disciplines
  - Multiple Organisms  
(cellular/organ/individual/population/community)
  - Different Trophic levels
- ▶ **Multiple Participating Institutions**
  - TVA
  - ORNL
  - USACE-ERDC
  - Nine Different Universities
    - Directly funded by TVA
    - ORAU-Administered grants
  - Multiple Environmental Consulting Firms & Laboratories  
(Environmental Standards, Arcadis, RSI, Jacobs, TestAmerica, Pace, GLEC, EEUSA, Hydrosphere, Frontier Geosciences, GEL, RJLee Group, ALS, IML, and several others)

# Engineering Evaluation/Cost Analysis (EE/CA) for the River System

- Sampling and Analysis Plan (SAP) supporting Baseline Ecological Risk Assessment
- Approved by EPA; sampling initiated in May 2010
- Focus on potential sub-lethal, cumulative, long-term effects
  - Ash deposits
  - Submerged sediments
  - Seasonally-exposed sediments
  - Sediment pore waters
  - Sediment bioassays
  - Surface water
  - Ground water
  - Ash pore water
  - Benthic invertebrates
  - Fish
  - Wildlife
  - Aquatic vegetation



# EE/CA SAP Status—August, 2011

## Field Work Completed:

- Surface water
- Ground water
- Ash pore water
- Seasonally-exposed sediment
- Wildlife
- Fish
- Benthic invertebrates
- Ash deposits
- Submerged sediment
- Sediment pore water
- Aquatic vegetation

## ▶ Underway:

- Sediment bioassay

## Weekly status updates

- ▶ Field work
- ▶ Data verification and validation
- ▶ Technical memoranda



# Weekly EE/CA Update

Status Date 3/30/2011

SAP TASK (Appendix D Reference)	FIELDWORK STATUS	DATA STATUS	TECH MEMO STATUS	DATA VERIFICATION/ VALIDATION PERCENTAGE
<b>1. Ash Deposits - (SAP D-1)</b>	Tennessee River Reaches A/B complete; Clinch River Reaches A, B, and Reference complete. Emory River Reach A and B complete; KIF Intake Channel complete; Emory River Reach C: 17/35 locations sampled for field PLM; 2 location sampled for lab PLM.	Sampling and analysis continues. 18/20 lab COCs final-verified.	Draft for TVA review 5/27/11; interim review of TN River A/B submitted to TVA; Clinch River A/B/Reference in draft.	PLM – 100% verification of lab data
<b>2. Seasonally - Exposed Sediments (SAP D-2)</b>	All sampling completed.	PLM - 4/4 final-verified; GEL Rad - 5/7 validated, 2/7 verified; Frontier - PDF received, no EDDs received; TA Burlington - 3/7 validated, 4/7 verified, Nash - 8/11 verified	Draft for TVA review 5/16/11.	PLM – 100% verification; Metals/Hg – 20% validation, 80% verification; Radionuclides – 100% validation; PAH, PCBs, Pest – 100% validation; Cr(VI) – 100% validation; Metals Speciation – 100% validation
<b>3a. Submerged sediment (SAP D-3/D-4)</b>	Tennessee River Reaches A/B completed. Clinch River Reaches A, B, and Reference completed. Emory River Reach A complete; Emory River Reach B complete; KIF Intake Channel complete; Emory River Reach C: 4/10 locations sampled for metals/mercury; 2/4 locations sampled for AVS/SEM; 1 location no recovery.	Frontier - 2/13 verified; GEL - 8/13 validated, 2/13 verified; Burlington - 2/13 validated, 9/13 verified; TAN - 4/39 validated, 13/39 final-verified, 12/39 verified; TAPitt - 5/15 verified	Draft for TVA review 6/13/11	Metals/Hg – 20% validation, 80% verification; Radionuclides – 100% validation; PAH, PCBs, Pest – 100% validation; AVS/SEM – 100% validation; Cr(VI) – 100% validation; Metals Speciation – 100% validation; TOC – 20% validation, 80% verification; Grain Size – 100% verification
<b>3b. Submerged sediment bioassay (SAP D-3/D-4)</b>	8 Clinch River site locations and 2 Clinch River reference locations have been completed; replenishment water sampling ongoing.	RSISED0211Y11 COCs - RJ Lee - final-verified; TAB, GEL, and TAN - verified	Draft for TVA review 8/22/11	100% verification PLM; 100% validation all other data.
<b>4. Sediment/Porewater (SAP D-4)</b>	8 Clinch River site locations completed, including re-attempt at CRM 4.5; 2 Clinch River reference locations completed.	Porewater - TAN - 1/4 verified, deliverables being received. Residual Sediment - TAN - 4/4 final-verified, Frontier and RJ Lee - deliverables being received	Draft for TVA review 7/5/11	Metals/Hg/DOC/Hardness/Anions/Alkalinity – 100% verification; Do, pH, ORP, SC – 100% verification
<b>5. Surface water (SAP D-5)</b>	Eight weeks of sampling completed week of November 1.	all data final	Draft submitted to TVA for review 3/7/11.	Metals/Hg/TSS/TDS/DOC/Hardness - 100% verification; Radionuclides – 100% validation; Metals Speciation – 100% validation
<b>6. Groundwater/Aquifer Testing (SAP D-6/D-7)</b>	Sampling of newly-installed wells completed 10/15; aquifer test results have been received.	all data final	Draft for TVA review 4/8/11.	Metals/Hg/TSS/TDS/Anions/Ammonia GW 100% validation; TAN Geoprobe 100% verification; Radionuclides – 100% validation
<b>7. Benthic Invertebrates (SAP D - 8)</b>	Fall collection was completed.	Mayflies and snails at lab for analysis. Data to be reported over next couple of weeks.	Draft for TVA review 8/24/11	Metals – 100% validation
<b>8. Fish (SAP D-9)</b>	Fall collection completed 10/22/2010. Additional fish collection completed.	85% validated 10% verified of metals data. Speciation, rad, pesticide/PCB analysis ongoing for Spring and Fall 2010 fish.	Draft for TVA review 5/13/11	Metals – 100% validation; PCB/Pes – 100% validation; Radionuclides – 100% validation
<b>9. Wildlife (SAP D-10)</b>	Raccoon trapping suspended at reference locations. Locations being re-evaluated.	Birds - 2009/2010 data final; 2011 collection ongoing; amphibians - 2009/2010 data final; 2011 collection ongoing turtles - 99% validated 1% verified; raccoons - 2009 raccoons verified and in process of being validated, 2010 raccoons to ship to lab week of 4/4	Amphibians-3/22/11; Heron, Osprey, Geese- 3/15/11; Tree Swallows-4/15/11; Turtles 5/1/11; Raccoons-TBD;	Metals – 100% validation
<b>10. Aquatic Vegetation (SAP D-10)</b>	Sampling initiated 5/6/2011	aquatic vegetation - not yet sampled; periphyton - not yet sampled	Draft for TVA review 9/1/11	Metals – 100% validation



# EE/CA Schedule

- Sample Collection
  - May 2010 --June 2011
- Lab analysis, data validation
  - July 2010 --July 2011
- Technical memoranda
  - March 2011 -- September 2011
- EE/CA Report Preparation
  - March 2011 -- June 2012

## Interim Reporting

- Technical memoranda
- Ground Water Model Briefing
- Interagency Data Briefing
- Interagency Baseline Ecological Risk Assessment (BERA)/Removal Alternatives Preliminary Results: December 2011
- Final BERA: May 2012

# Supplemental Investigations

- **Oak Ridge Associated Universities –Administered Grants:**
  - Old Dominion (two studies)
  - North Carolina State University
  - Duke University/University of Kentucky/  
University of Illinois
  - University of Colorado/USGS
  - Iowa State/Northwestern
- **Direct contracts with:**
  - Oak Ridge National Laboratory (ORNL)
  - USACE Engineer Research and Development Center (ERDC)
  - Virginia Tech
  - University of Tennessee
  - Appalachian State University

# Supplemental Investigations

- Results support both EE/CA and NRDA
- Quality Assurance Project Plans (QAPP) per CERCLA guidance
- Field Surveillances, lab audits



# FY 2011 Biota Sampling...

- ▶ Heron & Goose Eggs (March-April)
- ▶ Spring sport fish survey (April-May)
- ▶ Fish bioaccumulation, Spring fish reproductive survey, Larval fish (April—May)
- ▶ Tree Swallows, Turtles (April—August)
- ▶ Periphyton & aquatic vegetation (June-July)
- ▶ Emory River sediment toxicity bioassays & porewater (March-May; June--August)
- ▶ Mayfly nymphs (April—June)
- ▶ Mayfly adults, snails (June—August)
- ▶ Raccoons (August—October)
- ▶ Fish Bioaccumulation (October-November (December?))
- ▶ Fish community, Benthic Community surveys (October-November)
- ▶ Universities' research surveys (various times, as scheduled by researchers)

# Data Quality

## Thousands of samples, multiple matrices...

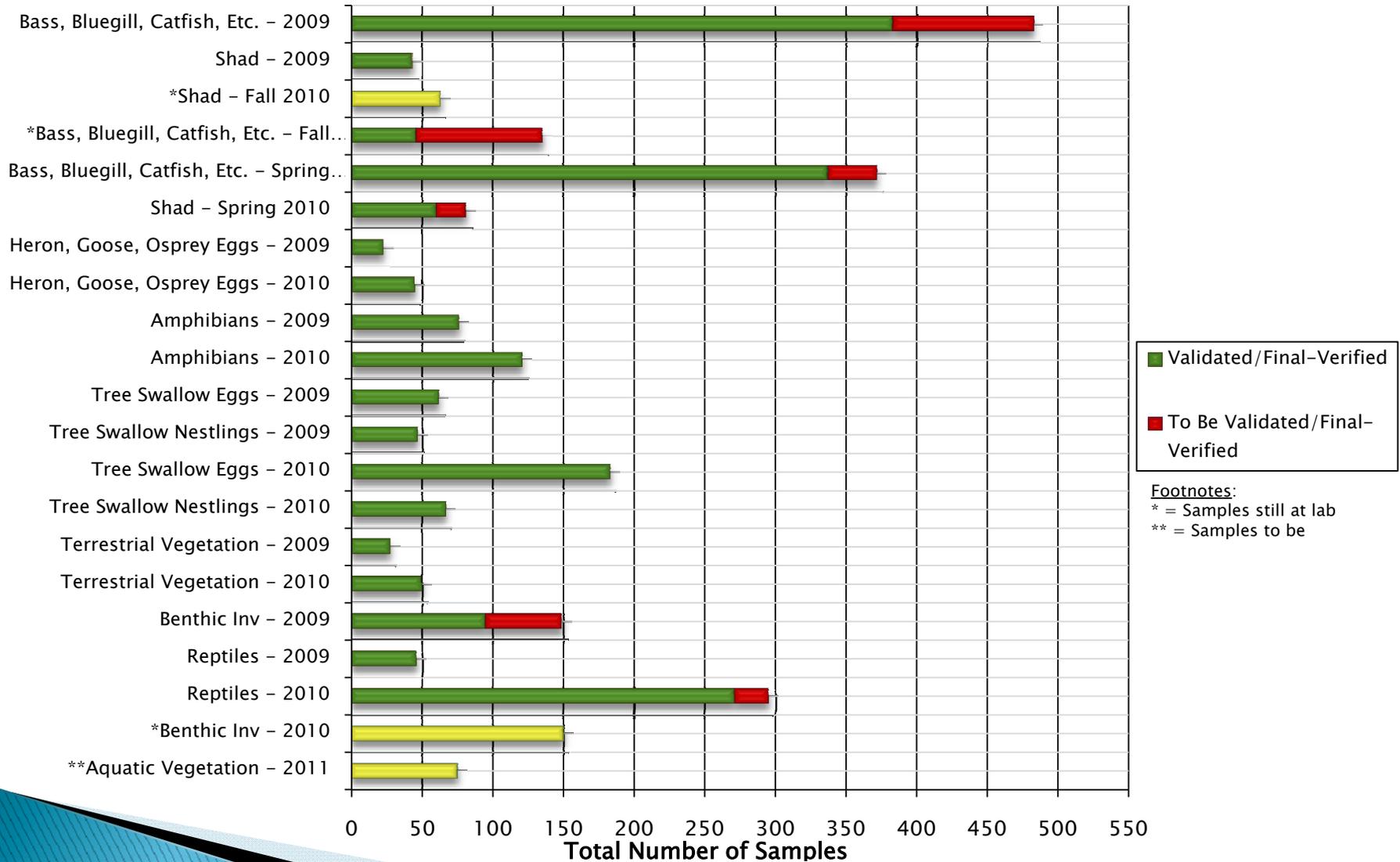
- Using EQUIS software for tracking
  - Chains of custody—automated lab data verification—data storage & management
- Laboratory specifications
  - Full electronic data deliverables
    - Raw data, as well as lab QA/QC results, field/method blank results, instrument calibrations, spike recoveries, etc.
- Electronic verification of lab data
  - Completeness? Right analyses? QA results within specifications?
- Data validation
  - Manual checks of calculations
  - Review instrument blanks
  - Check for reasonableness of results

# Data Quality

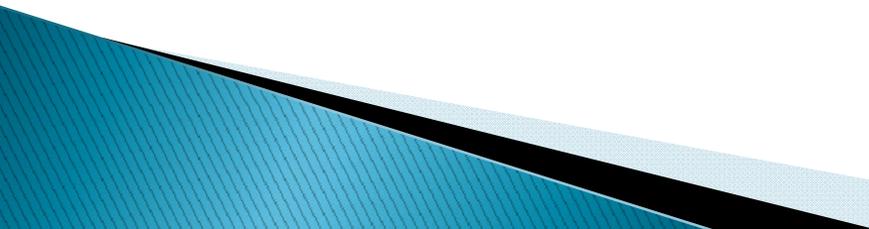
## “Hands-on” sample management

- Weekly on-site status/prioritization meetings
  - Priorities for sampling, shipping, chemical analysis, data verification/validation
  - Status updates
- Weekly laboratory teleconferences
  - Sample analysis sequence priorities
  - Resolution of analytical issues

# Data Verification/Validation Status—Weekly Update



# Summary

- **Broad Range of Ecological Investigations**
  - **Robust, Comprehensive: Multiple Lines of Evidence, Multiple Institutions, Multiple Trophic Levels,**
  - **Assessing Cellular Level Through Population & Community-Level Responses**
  - **Results Applicable to NRDA & Ecological Risk Assessment**
  - **Rigorous Data Quality Requirements: QAPP, SOPs, data verification/validation, internal and external audits = fully defensible data**
  - **“Hands-on” Sample Management: from planning through data validation**
- 

## To Date...

- **>8,300 samples** (not counting air or Hydrolab data)
- **99.8% data acceptance**
- **Nine Universities**
- **Oak Ridge National Laboratory**
- **Corps of Engineers Engineer Research & Development Center**
- **Site-wide Quality Assurance Project Plan**
- **60+ Standard Operating Procedures**
- **Laboratory and field audits**
- **Multiple Environmental Consulting Firms**
- **Multiple Environmental Laboratories**