Utilization of CCRs on Coal Mining Sites; Where are We?

W. Lee Daniels -- Virginia Tech

A Short History of Fly Ash

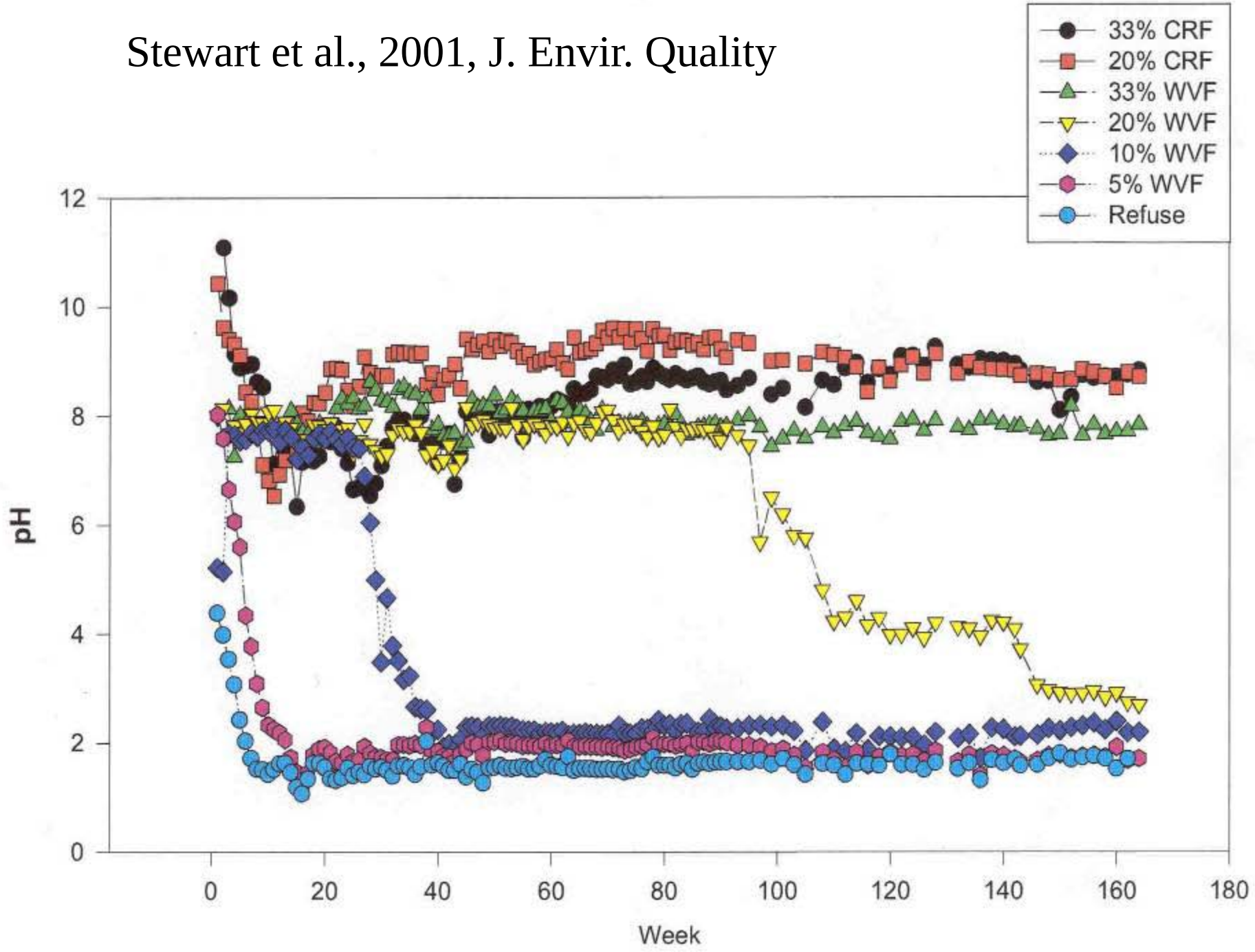
- **USEPA "delisted" fly ash and related coal combustion residuals (CCR's) in the early 1990's from RCRA-C designation. This assumes ash passes a TCLP (Toxicity Characteristic Leaching Procedure) test and other tests which vary by state/application.**

- **Many states developed CCR utilization guidelines for beneficial use by 1993 for both mine and non-mine applications.**

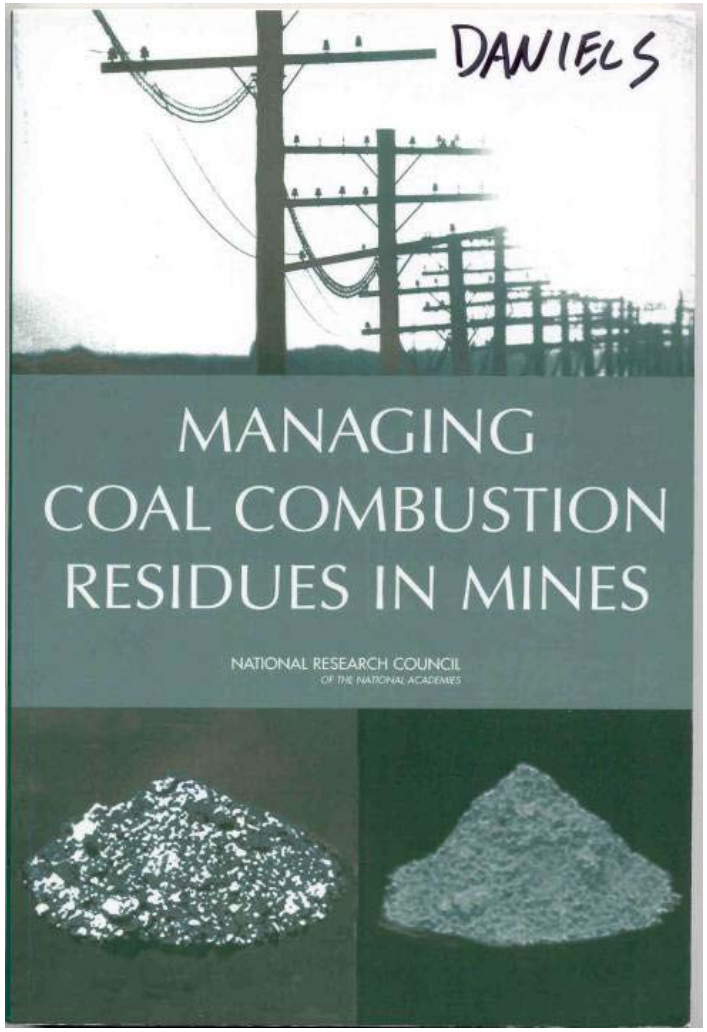
- **EPA re-evaluated regulatory stance in the early 2000's via a new round of public hearings and strawman regulatory proposals.**

Since the mid-1990s, the use of CCR's to offset AMD from coal refuse disposal fills was a major rationale for the backhaul of ash from power plants to refuse piles in WV and KY. Other presumed beneficial uses included highwall elimination and other AOC or bulk mine fill applications to benefit final landform reconstruction.

Stewart et al., 2001, J. Envir. Quality



NRC, 2006 Study & Report



While the report did offer overall support for the beneficial utilization of CCP's in mining environments, it specifically recommended permittees to:

(1) Carefully characterize the geochemical properties of both the CCR to be utilized and the mine site;

(2) understand and predict long-term reactions and contaminant release patterns;

(3) fully characterize potential site hydrologic impacts;

(4) minimize contact with groundwater

Coal Combustion Products (CCP's)

- **EPA did set aside mining applications for further review, however, due to problems reported with certain applications in the Midwest (e.g. disposal of ash and other residuals into unlined mining pits below the water table).**
- **OSM decided in 2007 to promulgate comprehensive new regulations for use of CCP's on SMCRA permitted sites.**

Hiccups in the past decade (*not associated with mine placement*)

- **Kingston TN impoundment failure**
- **Battlefield golf course in Chesapeake VA**
- **Dan River stormwater drain collapse**

In all of these, the major public reaction and concern has been over As, Hg and other "unknown contaminants".

Current OSM and EPA Positions

- **After Kingston, most new permit applications were "held in limbo" waiting on a final regulatory determination by EPA. This was issued in April, 2015.**

- **In 2007, OSM reviewed all water quality data from all active SMCRA permitted areas receiving CCP's and saw no evidence of CCP related degradation. Related presentations by active & former OSM personnel have reiterated this position over the past several years.**

EPA Final CCR Rule – April, 2015

- **Regulates CCR's under Subtitle D rather than as a "special waste". Recognizes potential risks for groundwater contamination etc. and need for specific locational restrictions etc.**

- **Requires closure of unlined landfills where water quality criteria have been exceeded or that do not meet location/structural criteria. Mandates new design criteria for new disposal facilities.**

- ***Specifically excludes CCR placement on coal mines*. Refers to NRC 2006 report recommendations for guidance on new coal mine permit standards.**

EPA Final CCR Rule – April, 2015

- **Recognizes OSM for joint new regulations; expected early 2016**
- **EPA will review proposed OSM rules this fall before publication**
- **Revises and narrows down "beneficial use" criteria for future permits.**

2015 EPA CCR Beneficial Use Definition

The final beneficial use criteria are as follows:

(1) The CCR must provide a functional benefit;

(2) The CR must substitute for the use of a virgin material, conserving natural resources that would otherwise need to be obtained through practices such as extraction;

(3) the use of CCR must meet relevant product specifications, regulatory standards, or design standards when available, and when such standards are not available, CCR are not used in excess quantities;

2015 Beneficial Use Definition

and (4) when unencapsulated use of CCR involves placement on the land of 12,400 tons or more in non-roadway applications, the user must demonstrate and keep records, and provide such documentation upon request, that environmental releases to groundwater, surface water, soil and air are comparable to or lower than those from analogous products made without CCR, *or* that environmental releases to groundwater, surface water, soil and air will be at or below relevant regulatory and health-based benchmarks for human and ecological receptors during use.

Any use that fails to comply with all of the relevant criteria will be considered to be disposal of CCR, subject to all of the requirements in the disposal regulations, and the user will be considered to be the owner or operator of a CCR disposal unit.

What will be in the new CCR reg?

- **The OSM rule will follow recommendations from the NRC report for probable hydrologic consequences (PHC), predicting long term geochemical changes in placement environment, etc.**

- **Will not allow "disposal". Mine placement for cost minimization etc. will not be acceptable.**

- **Thus, "acceptable use" will need to be *clearly demonstrated/presumed*. OSM will use "acceptable use" vs. "beneficial use".**

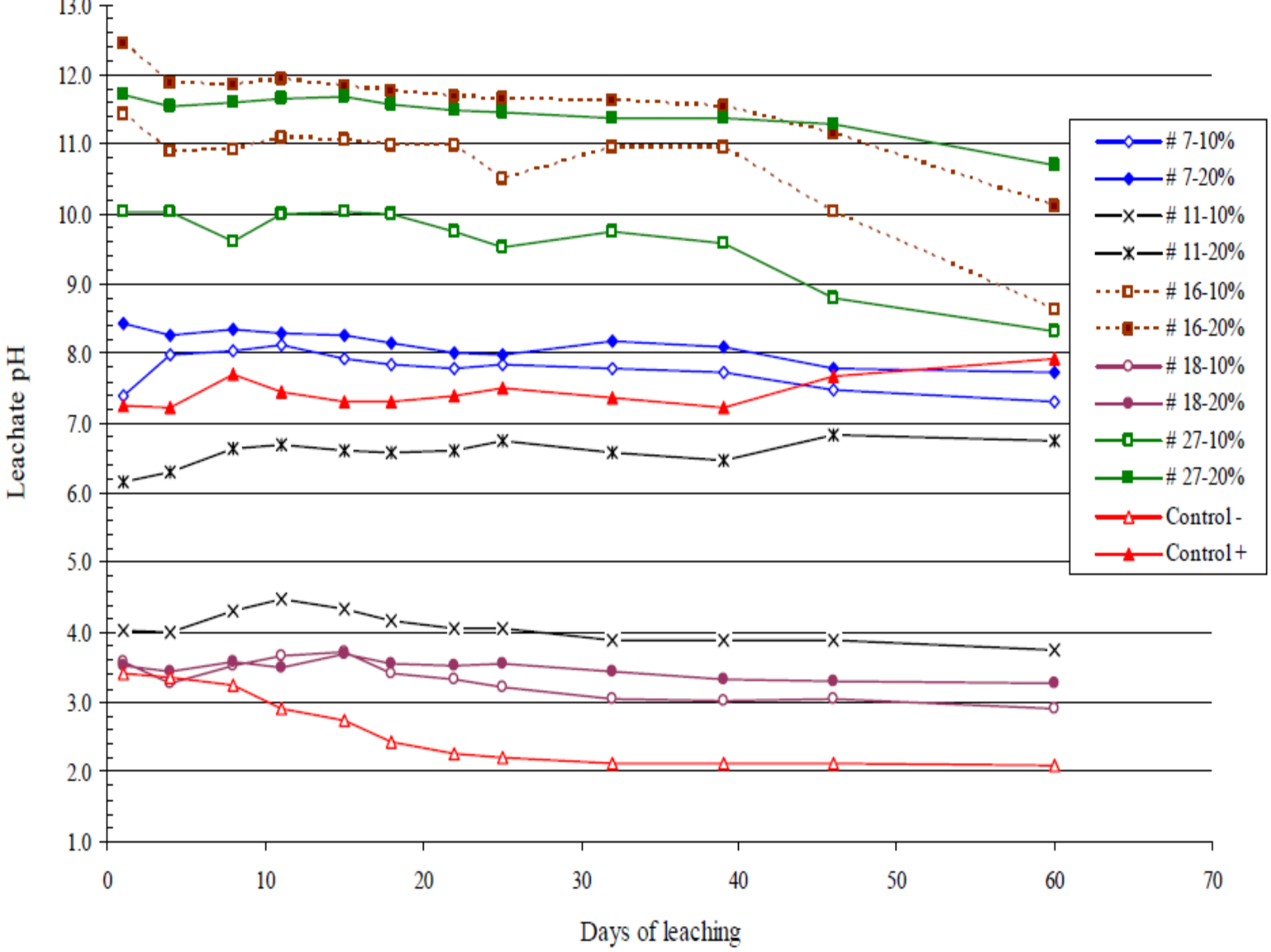
What's an Acceptable Use on Coal Mines?

- **Use as a bulk backfill/monofill to achieve AOC**

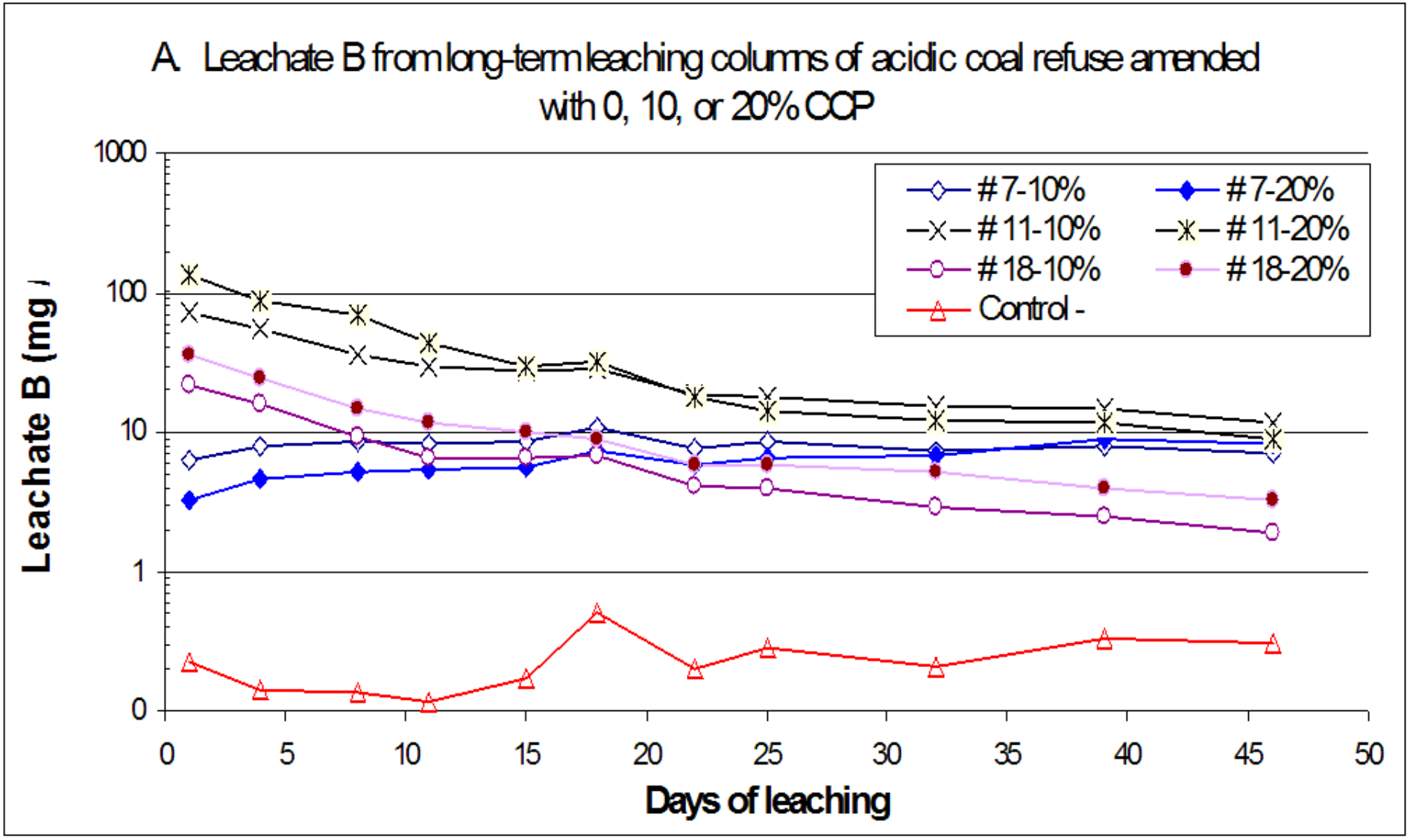
  -- ***Acceptable use criteria to be developed; use for AOC backfill on active permits likely; many other monofill applications will be restricted.***

- **Use a bulk-blended alkaline amendment to offset AMD?**

  -- ***Maybe; but will need to address secondary effects on TDS, B etc. Will also need to assure acid-base balances and the fact that "layered" approaches are ineffective.***



Leachate pH from various blends (10 and 20%) of alkaline fly ash with acid-forming coal refuse. Lime control (solid red triangles) received lime to potential acidity level (- 30 T/1000 T. Unlimed control (open red triangles) was not limed.



Leachate B from various blends (10 and 20%) of alkaline fly ash with acid-forming coal refuse. Unlimed control in open red triangles.

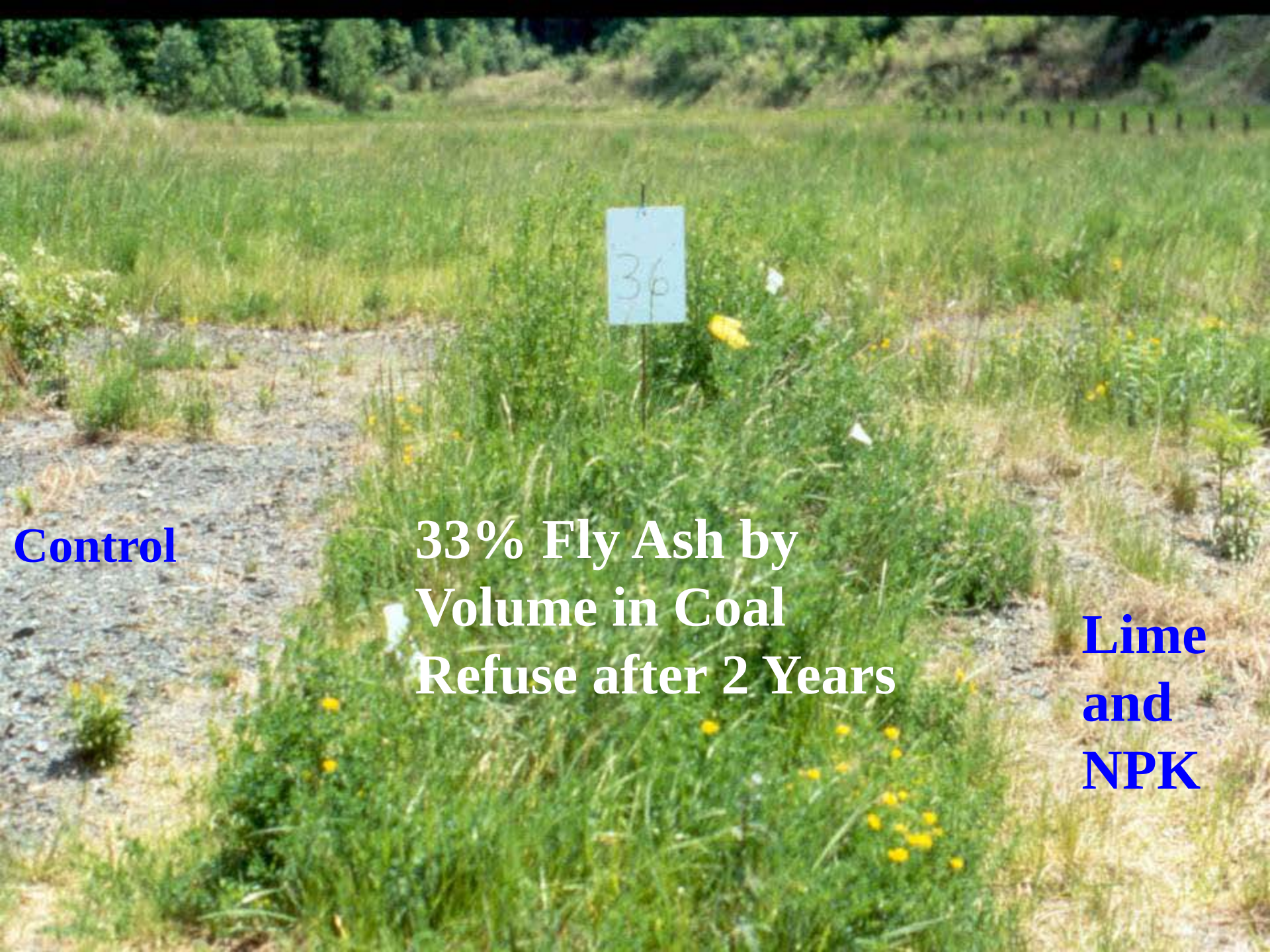
What's an Acceptable Use on Coal Mines?

- **Use CCR's as a soil amendment for revegetation, topsoil substitute enhancement, etc.**

  -- May be viable for surface treatment of refuse piles, but EC/TDS and B will limit loading rates to < 50 T per acre in most scenarios.

- **Use CCR's to minimize leaching rates through coarse refuse**

  -- Albuquerque (1994) showed that bulk blends up to 33% can reduce Ksat from 10^{-3} to 10^{-5} cm/sec with no reduction in shear strength. This option has not been tested to date with regulatory community.


Control
33% Fly Ash by Volume in Coal Refuse after 2 Years
Lime and NPK

What will be in the new regs?

- **Water quality monitoring requirement will be enhanced. Existing SMCRA monitoring networks may not be sufficient to monitor ash placement or utilization zones. We should expect that at a minimum, As, B and Se will become mandatory. See recommended NRC analytes list for insight.**

- **PHC of placement will need to be predicted, particularly risk of long-term contaminant release. This will need to be modeled relative to both the environment of placement and downgradient groundwater path(s)**

- **Baseline sampling and/or verifiable up- and down-gradient monitoring locations for ground water.**

What will be in the new regs?

- **Regardless of the proposed “acceptable use”, the applicant will need to justify how the use minimizes contact and interactions with groundwater. This could greatly complicate most potential uses just discussed.**

- **OSM is still working on how and what it will define as “acceptable use”.**

What leaching/solubility test?

- Many alternatives exist including
  - -- WVU (Ziemkiewicz et al.) Mine Water Leach Procedure; 0.002 N H_2SO_4
  - -- Kosson et al. 20 step pH x L:S ratio approach
  - -- Hassett et al. (UND) Synthetic Groundwater Leaching Procedure (Long term DI)
  - -- Hesbach et al. Serial Batch Procedure (HNO_3 serial addition followed by DI)
  - -- TCLP (generally agreed not applicable)

Summary available in Hesbach et al., 2005 – Inter-Laboratory Comparison of Leaching Methods. World of Coal Ash Proceeding, Lexington

Conclusions

While CCR's have shown a range of very positive beneficial uses in coal mining environments in the past, future claims for "acceptable use" will need to be carefully developed and supported.

Future options for coal mine placement will be much more limited than available today and permitting and monitoring requirements will increase significantly.

Much more accurate predictions of PHC over more extended periods of time will be required. Technologies and field validated models for this may not exist today.

Regardless of the above, *gaining public* acceptance will be the major hurdle for new permit applications.

Applications to Non-coal Sites?

- We can only assume that once EPA and OSM adopt their joint CCR rule that similar criteria for CCR use on other mining and rehabilitation sites will be applied.

- The critical issues will more than likely be (a) meeting the overall 2015 beneficial use definitions and (b) agreeing on minimum monitoring criteria, particularly for groundwater.