Problem Statement – Risk Assessment of Arsenic-Bearing Solid Residuals of Water Treatment Processes

In Ela's 2004 *Environmental Science & Technology* paper, he cites EPA data that estimates the revised arsenic MCL standard will ultimately impact about 4000 drinking water utilities. The data further show that over 95 % of those affected will be small utilities (*serving less than 3301 people*). It is expected that these utilities will primarily implement arsenic removal using iron- or alumina- based sorbents. These processes result in the generation of ABSRs. Most ABSRs tested to date pass the toxicity characteristic leaching procedure (TCLP) and, consequently, are expected to be disposed in non-hazardous municipal solid waste (MSW) landfills. Ela estimates that nationally approximately 6 million pounds of solid residuals containing approximately 30 thousand pounds of arsenic will be generated every year, and presumably disposed in MSW landfills. Ela's investigation indicates that the TCLP is likely to underestimate leaching of arsenic from these residuals if disposed in a mature MSW landfill. Some portion of the arsenic contained in these residuals is likely to leach out and ultimately end up in the landfill leachate or the groundwater beneath the landfill.

Modeling Questions to consider: G. Helms Note: The questions as initially drafted include policy judgments and regulatory interpretations as well as environmental risk assessment modeling (e.g., calling a material a hazardous waste, or potential creation of Superfund sites). I suggest the following reformulation to separate the policy/regulatory judgments from the technical analysis:

> What is the range of risks to human health from arsenic attributable to the disposal of ABSRs in MSW landfills and by other legal waste management methods:
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>> In lined landfills and unlined landfills?
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>> As a national assessment and for individual landfills (and what landfill conditions represent the highest risks)?
>>
>> By direct ingestion of ABSR contaminated groundwater, and other exposure routes?

Some key areas of uncertainty:

1. leaching characteristics of the ABSRs – many different types of adsorbents are likely to be employed by small utilities (many Fe or Al-based), each possessing unique characteristics, and each demonstrating unique leaching behavior. The TCLP may underestimate the leaching of As from some of these types of wastes. What are the distributions of: ABSR types being disposed; ABSR total As loadings at removal from service; ABSR As leaching rates.

2. volume of ABSRs – current national estimate is 6M lb (3000 tons) ABSR, containing 30,000 lbs (15 Tons) As annually. Volume could also vary significantly based on the actual technologies employed; some technologies produce only liquid residual streams. [Note: liquid residuals would not be managed by disposal in an MSW landfill.] Does this volume estimate need updating?

3. distribution of ABSR disposal: We anticipate that ABSRS may be disposed in landfills in one or two patterns: 1) disposal of ABSR material by the water supplier at the nearest local MSW landfill; or 2) disposal of ABSRs by treatment media vendors, who, under a service contract with the water supplier, replace spent media, and transport the spent ABSRs to the vendor's business "hub" city, for disposal. Some combination of these two approaches to ABSR disposal may also occur. What As risk levels would result from ABSR disposal practices more resembling pattern 1, pattern 2, and also ABSR disposal distributed equally between the two patterns?

4. characteristics of landfills (or other WMUs) used for disposal – there is variability in construction standards for MSW landfills (liner types, leachate collection systems, etc., as defined by regulations at 40 CFR part 258). Other disposal options may be allowed by some states.

5. regional characteristics affecting risks attributable to ABSR disposal: Can a national risk assessment be weighted to reflect the geographic distribution of ABSR generation, and the climatological, hydrogeological, and other relevant factors prevalent in the region of ABSR generation?

6. particular management practices may be employed such as stabilization/solidification methods for the ABSRs aimed at reducing the leaching potential. At least one vendor exchanges the sorbent and regenerates it. Some research indicates that natural aging of the Fe-based residues results in mineralization, which may reduce leaching.

7. F/T of the arsenic once released from the ABSRs – how quick is the movement into and down the contaminant plume

8. exposure potential – residents near the landfill might be exposed to ABSR contaminated ground water. Note: pathways other than GW exposure MAY also be significant, although for this exercise we have so far limited our investigation to the GW pathway.