Addressing Uranium Contamination on the Wind River Reservation: Environmental Justice, Phytoremediation and Risk Analysis

Honors Thesis/EPSCoR
Kyle Bochanski
Environmental Justice
• Site Background
• Injustice

Phytoextraction Project
• Process
• Outcomes
• XPS Data

@Risk Analysis
• Results
• Recommendations
The Fact of the Case

- 1958, Susquehanna-Western dumped 1.8 million cubic yards of the radioactive material
Tribal Sovereignty: Asserting Responsibility Against Structurally Produced Injustice

DOE mission: “to ensure America’s security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions” (Mission-DOE)

“All those who contribute by their actions to structural processes with some unjust outcomes share responsibility for the injustice” (Young).
Figure 2. Institutional Control Boundary and 2012 Monitoring Locations at the Riverton Site

Site Dynamics
EPA MCL

2010 Flood!!

Figure 11. Uranium Concentrations in Surficial Aquifer Wells within the Contaminant Plume.
Bioremediation?

Plants up-concentrate uranium differently depending on uranium species which are site specific.
Project

Table 1. Latin names and common names of plants used in experiment.

<table>
<thead>
<tr>
<th>Plant Species</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Helianthus annuus</em></td>
<td>Sunflower</td>
</tr>
<tr>
<td><em>Phaseolus vulgaris</em></td>
<td>Bean</td>
</tr>
<tr>
<td><em>Brassica juncea</em></td>
<td>Mustard</td>
</tr>
<tr>
<td><em>Spirodela Polyrhiza</em></td>
<td>Duckweed (aquatic)</td>
</tr>
</tbody>
</table>

Figure 1. Taking samples from the UMTRCA with members of the Wind River Environmental Quality commission May 29, 2014

Figure 1. Seed Planting and Duckweed Aquarium Schematic
Results

Sunflower up-concentrated uranium 15.8 times the soil concentration

UMTRA Control

Dirt [Uranium]

Plant [Uranium]
Implications

- Planting many sunflowers could possibly lower uranium levels in soil

- **New risk analysis** w/updated plant values

Needs characterization
X-Ray Photoelectron Spectroscopy (XPS)
Crystal Precipitate
U 4f<sub>7/2</sub> (expected)
Risk Analysis

Conceptual Model

- Vegetation
- Animals/Livestock
- Surficial Aquifer Groundwater
- Uranium Contamination in Dirt

Receptors → Assessment Endpoint

Direction of Bioaccumulation
From Study!!
Results

- **100% chance** of uranium exposure exceeding EPA maximum concentration limit (MCL) of 0.003 mg/kg/day of uranium

  
  Hazard Quotient \((\frac{0.05734}{0.003})=19.11\)

- **97.8% chance** of cancer risk exceeding National Contingency Plan lifetime cancer risk limit of 1/10,000 (based on 30 year exposure according to 1995 Risk Analysis)
What if water is removed from model?
Recommendations

- **Further studies** to see how uranium levels in dirt may bio-accumulate through plants/animals/etc and **disperse beyond the site**

- **Continue to promote communication** between site managers and community

- **Connections**: Bowman Labs & Lawrence Livermore National Laboratory?
Thank You!

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- Bill Dam, DOE
- Rick Trosper & Steve Babits
- Erwin Sabio, XPS Analysis
Sources


