



# Assessing Environmental Health *Going Beyond the Sensor*

Arsenic is the highest priority environmental threat on the CERCLA (Superfund) list. On National Priority Sites (in the United States), arsenic is toxic, frequently encountered, and poses a high human exposure risk. Arsenic surpasses lead and mercury in its aggregate threat to superfund sites.

A close-up photograph of a person's hand holding a large mound of dark, rich soil. The soil is piled high in the palm and fingers, with some particles falling away. The background is a soft-focus outdoor setting with green grass and foliage. The overall lighting is natural and bright.

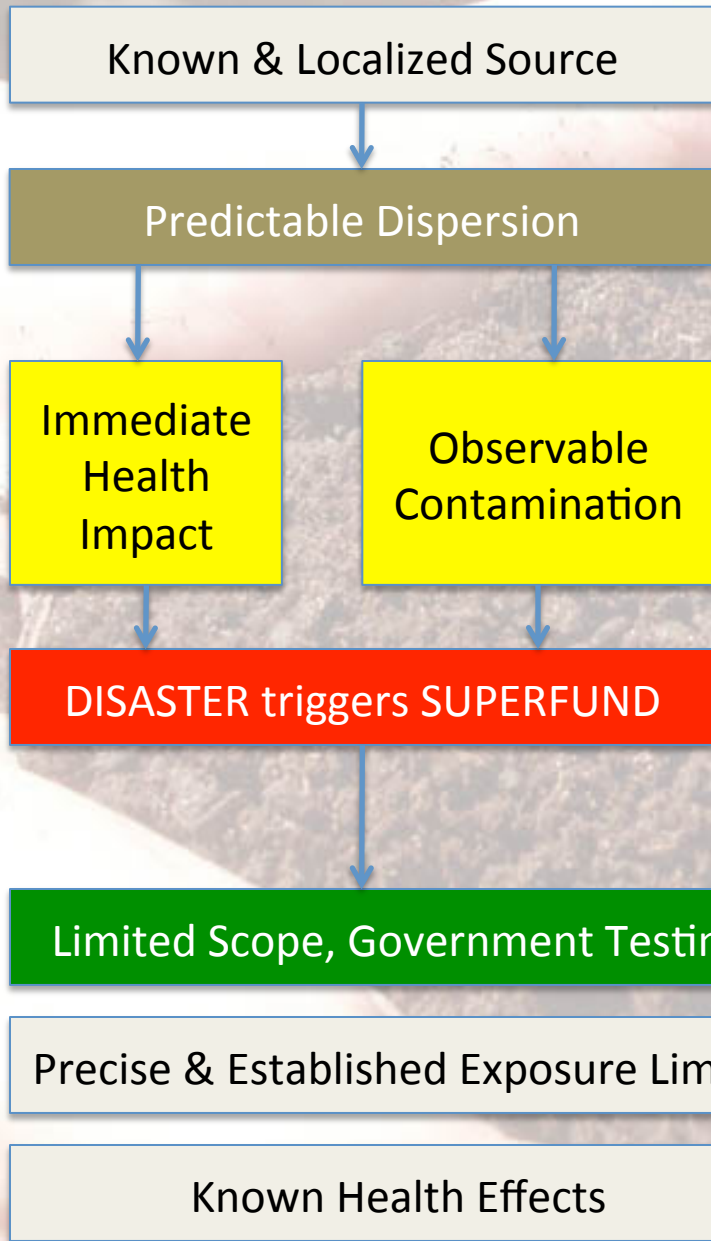
# Sensors in Environmental Health

The Mutating, Elusive, & **Ambiguous** Face of  
Arsenic In Soil

*A neurological threat to children*

*A precursor to drinking water poisoning*

# The Love Canal Framework



## The Story (The Traditional Approach)

A Chemical Company dumps toxic waste into appropriate containers in an appropriately contained landfill. Another entity purchases the adjacent land from the Chemical Company and in the process of developing it, breaches the clay landfill barrier, dispersing toxic waste into residential neighborhoods. High rates of miscarriage and birth defects trigger community action. After prolonged testing and legal action, extensive mitigation (buy-out and clean-up) is undertaken.

# Arsenic in Post-Katrina New Orleans

*Arsenic is the top environmental contaminant in the United States (ATSDR)*

**The Story (A New Approach)**

Multiple Shipping & Petrochemical Sources

Dispersion by Flooding

Chronic Long Term Impact

Plants & Soil show no indication

Non-profits Trigger Alarm

Hurricanes Katrina & Rita caused extensive flooding in New Orleans; waters from the Industrial Canal, heavily used by commercial shipping, flooded the poorest neighborhoods, leaving behind an “immediate” toxic gumbo in the soil that has distilled into a long term chronic health risk. Ambiguous exposure limits in soil prevent mitigation of arsenic contamination, even when such mitigation is inexpensive and accessible to residents.

Arsenic Sediment Testing

Vague, Variable Exposure Limits

Known Health Effects

Arguable Risk

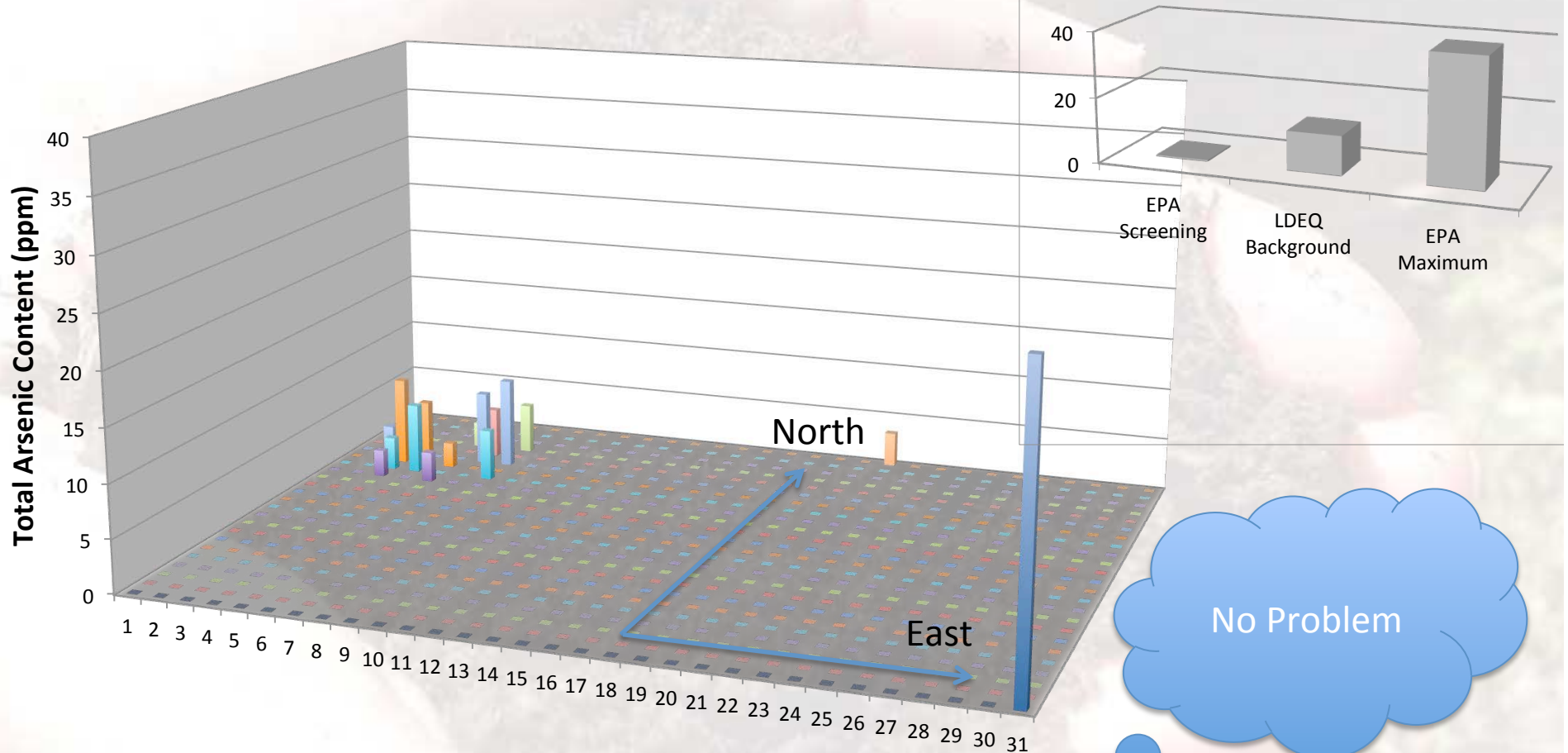
No Litigation Possible

No Mitigation Action Taken



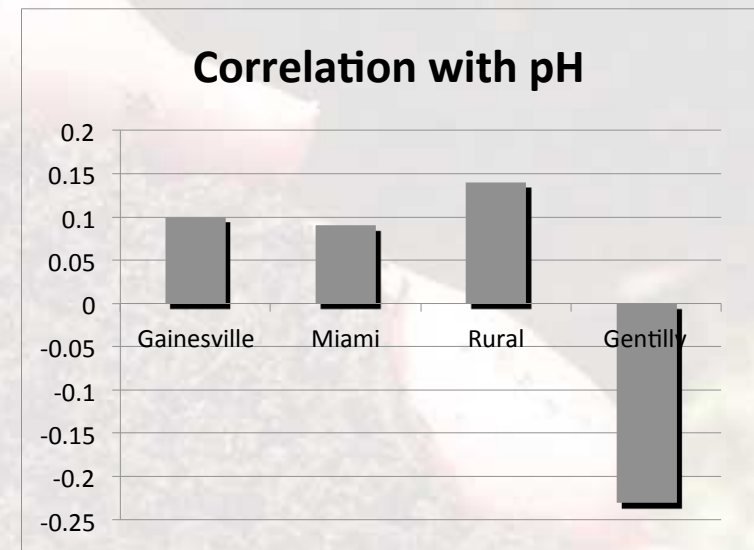
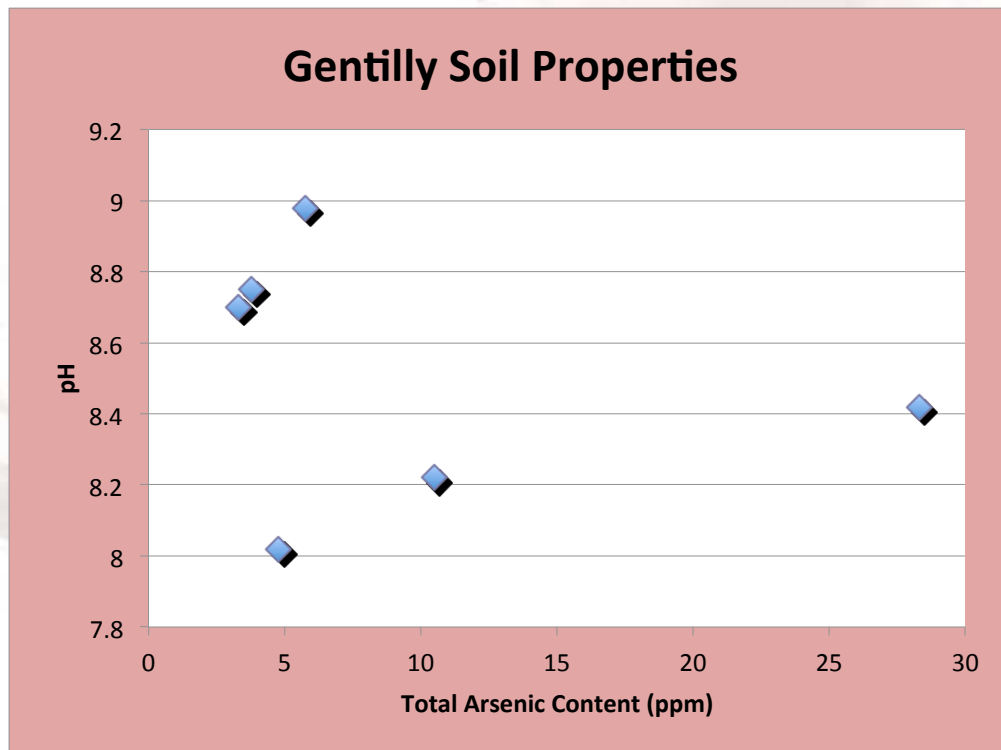
# Health Risk Assessment: Based on the Traditional Approach

## Gentilly Neighborhood (New Orleans)



All samples test below the maximum allowable (EPA)  
All but one sample test below the Louisiana Background Level  
All samples test above the EPA screen level

# Health Risk Assessment: Based on our Approach

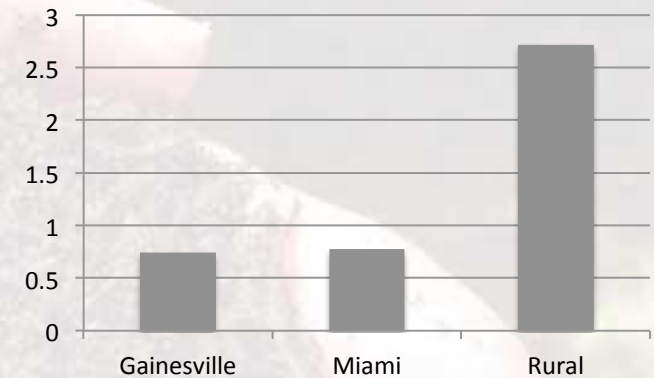
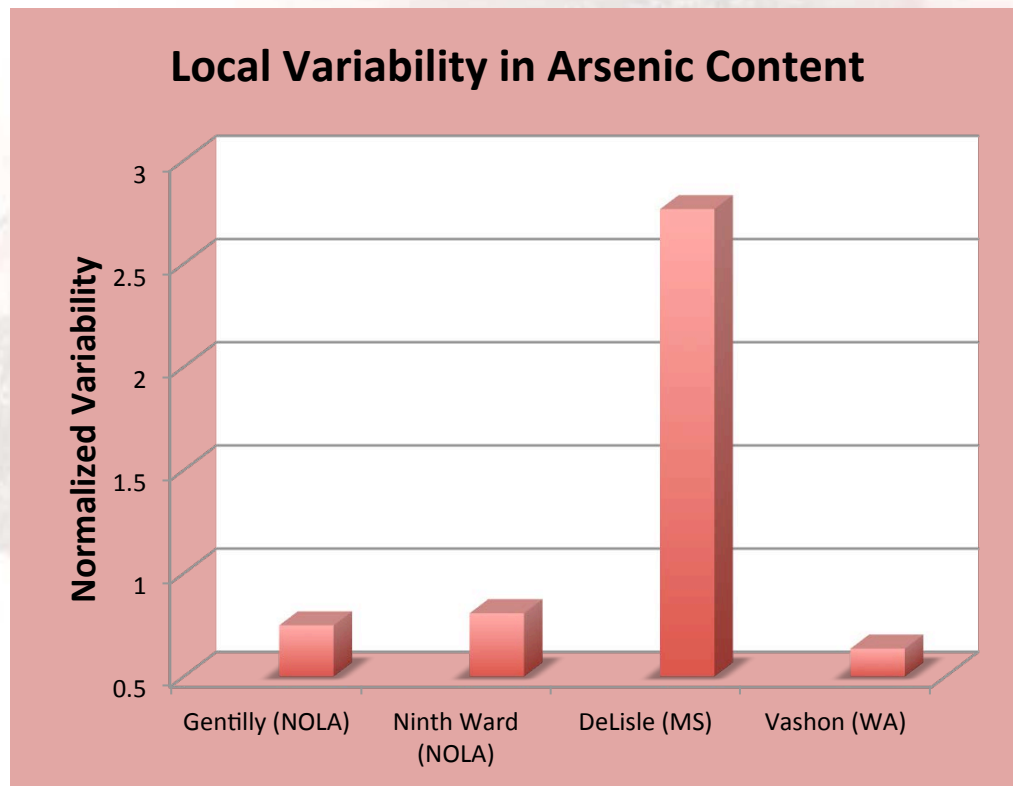


Florida Data: Chirenje et al, 2003

Potential  
Problem

Arsenic content correlates poorly with pH  
Poor Correlation indicates the soil has been disturbed (flooding) ...  
and that the source of the disturbance is likely inorganic (man-made) arsenic

# Health Risk Assessment: Based on our Approach

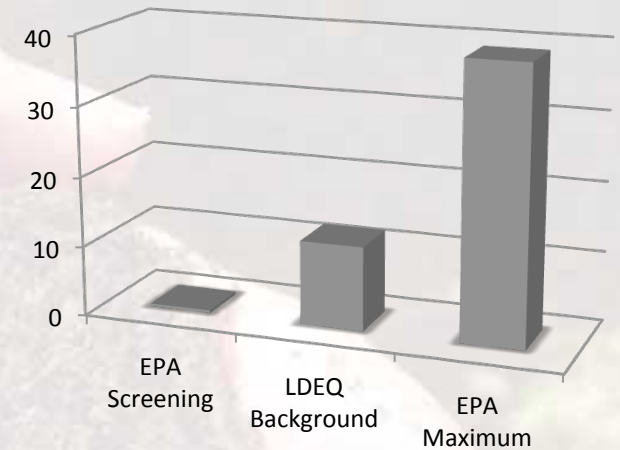
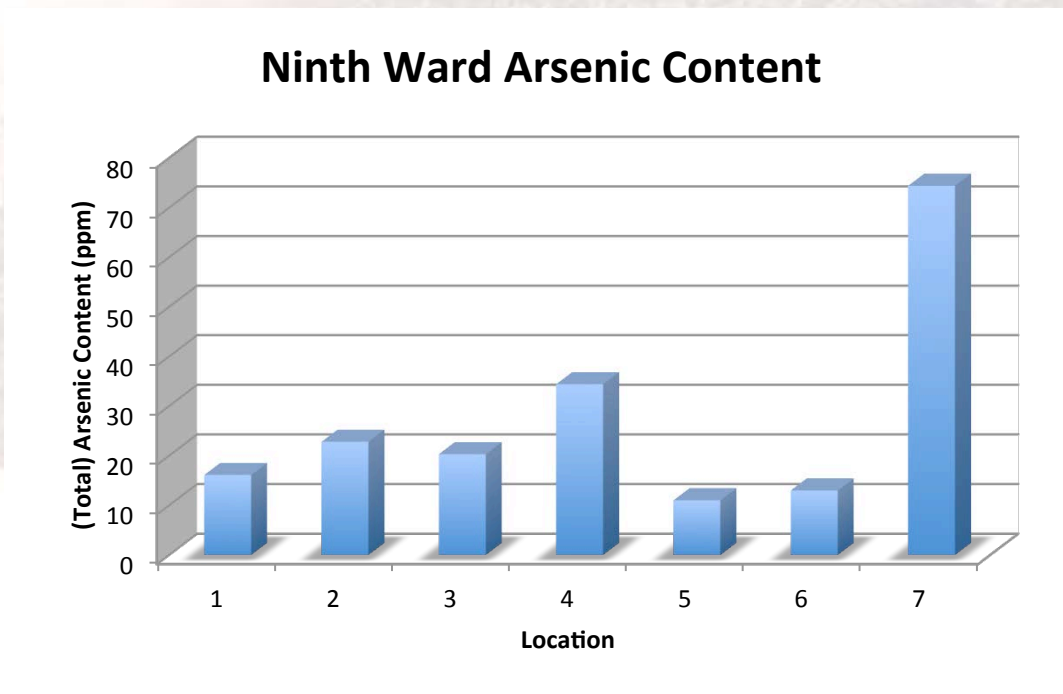


*Florida Data: Chirenje et al, 2003*

Potential  
Problem

Arsenic content has low variability in suspect areas  
Previous studies have shown low variability to be correlated to soils both disturbed and impacted by man-made arsenic

# Health Risk Assessment: Based on the Traditional Approach

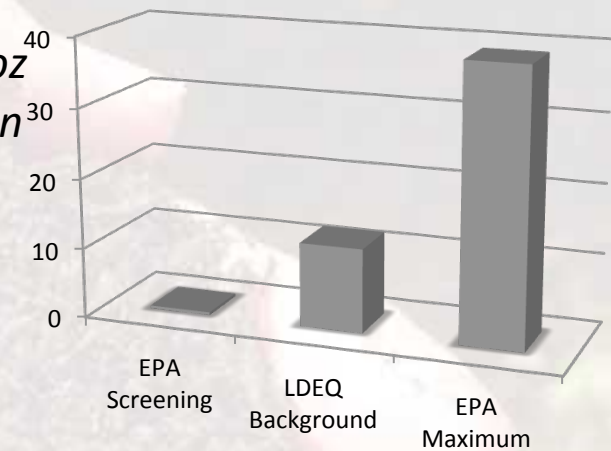
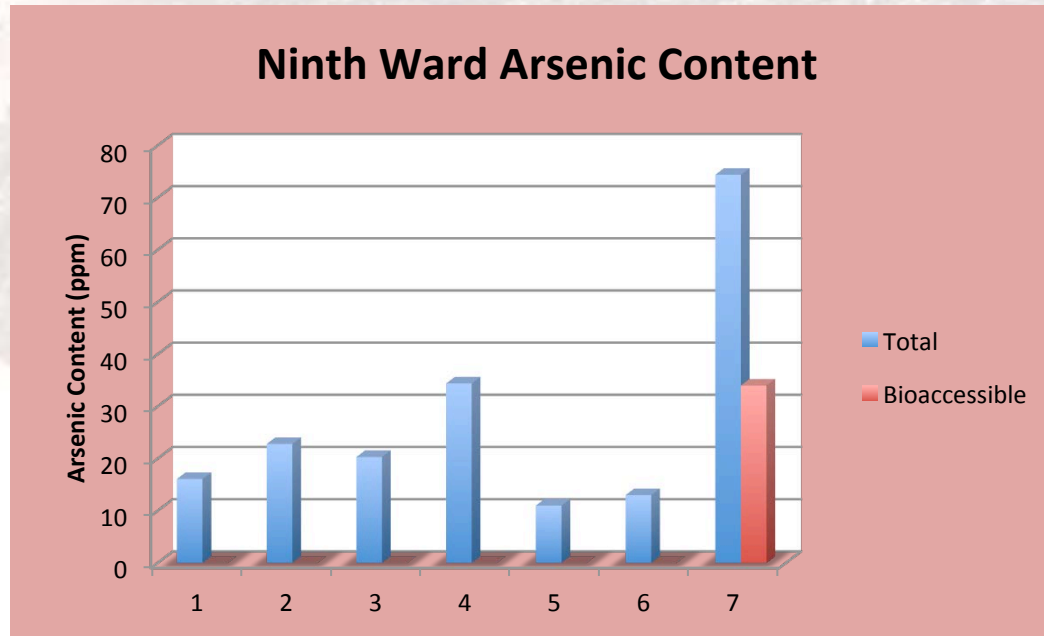


Only one sample tests above the maximum allowable (EPA)  
All but one sample test above the Louisiana Background Level  
All samples test above the EPA screening level



# Health Risk Assessment: Based on our Approach

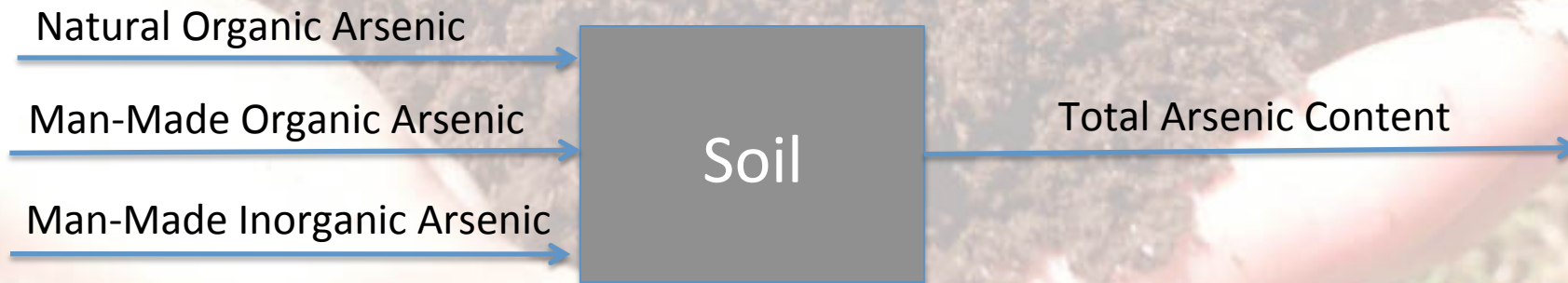
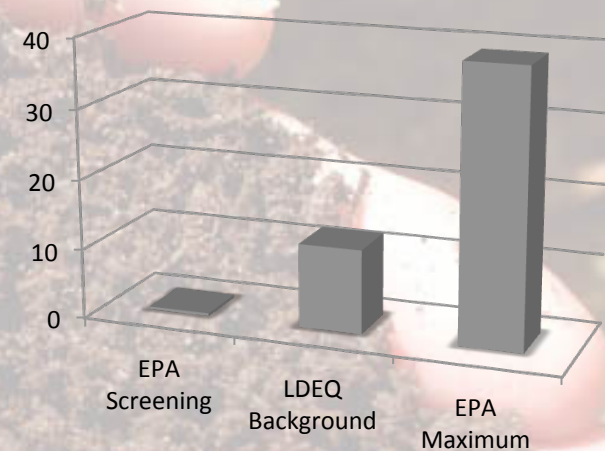
*If we translate the (well defined) exposure limit for arsenic exposure in drinking water to soil (for children based on 32 oz of water consumed per day and 200 mg of soil), the ingestion limit for safe exposure is about **45 ppm in soil**.*



Bioaccessible content near a school tests near EPA maximum allowable level for soil AND at exposure limit for drinking water.

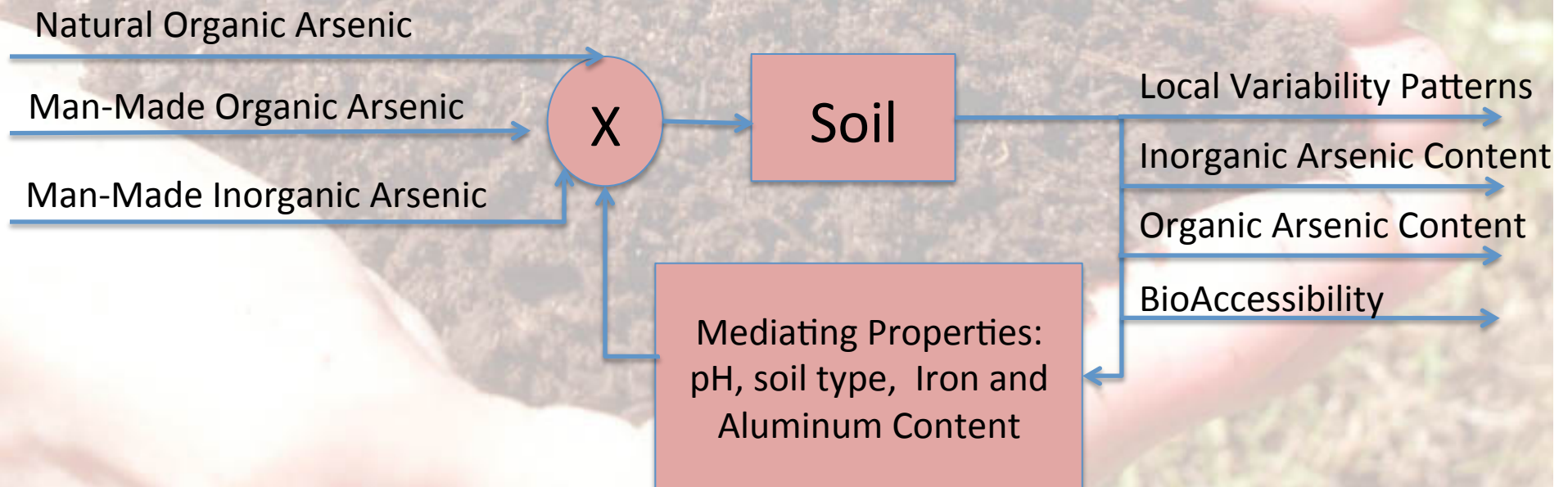
# *Sensing Arsenic in Soil: Based on the Traditional Approach*

Traditional Methods use sophisticated, EPA-approved laboratory analysis techniques to extract total arsenic content from soil. Research has attempted to translate these laboratory sensing methods to the field with no commercial success. The meaning of total arsenic content is heavily confounded by (natural) background levels in a geographical region and soil properties which influence the type (inorganic vs. organic) and accessibility to the human digestive system.



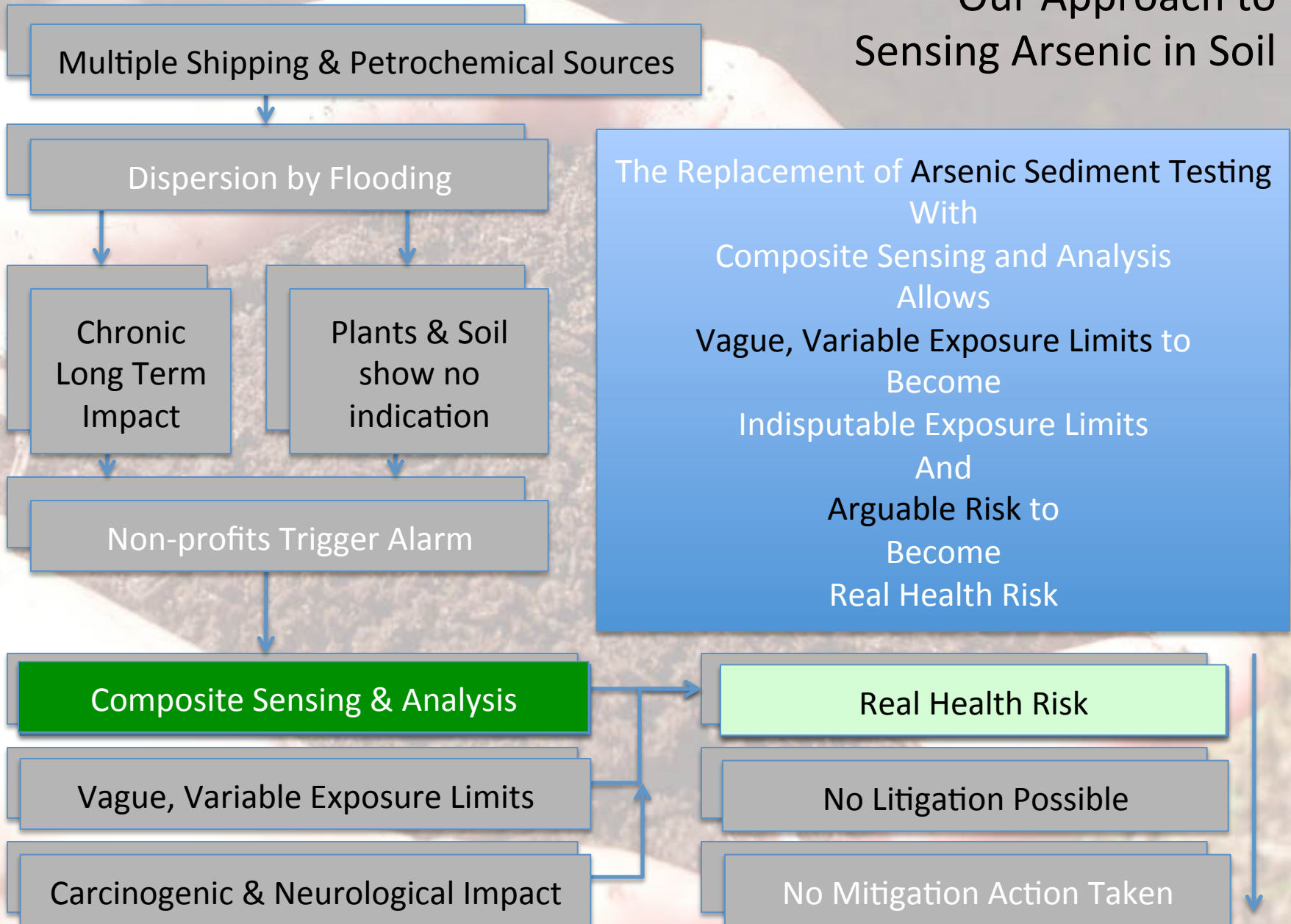
# *Sensing Arsenic in Soil: Based on our Health-Relevant Approach*

Mediating Properties in Soil can be measured using composite portable sensing instruments (designed for these soil-based problems) and used in conjunction with local arsenic patterns and food related arsenic intake (primarily seafood) to resolve ambiguity of arsenic levels in soil. Resolving ambiguity enables calculation of an actionable health risk (and subsequent mitigation)



# Arsenic in Post-Katrina New Orleans

## Our Approach to Sensing Arsenic in Soil



# Arsenic in Post-Katrina New Orleans

## Our Approach to Sensing Arsenic in Soil

