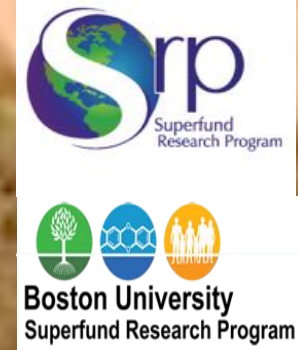


Seeds of Health: Safer Soils for Growing Food

W. Heiger-Bernays, PhD – Boston University
P. Drohan, PhD – Penn State
V. Tikku - Trustees



CHE- Boston University Superfund Research Program Partnership

March 30, 2021

Growing and Eating Food: Benefits and Risks

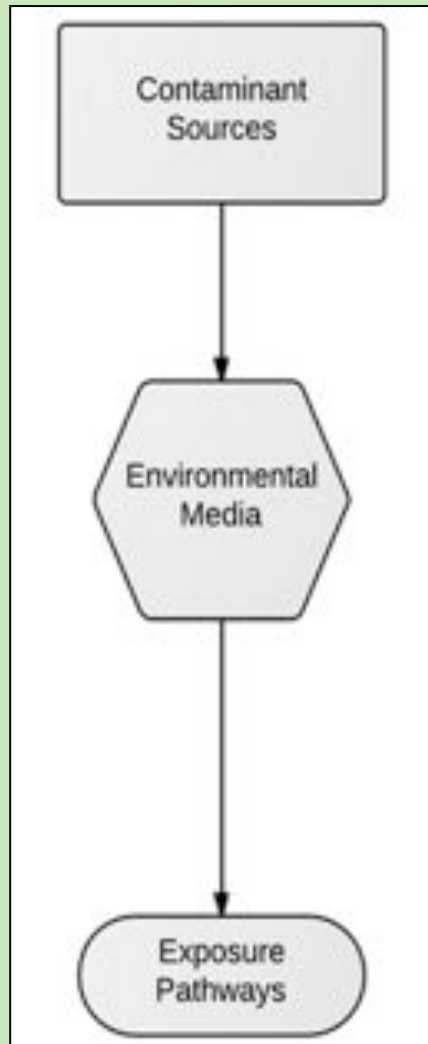
Historical
Contamination

New
Contamination



Human Soil Exposures

Direct and Indirect



Ingestion of Soil While Gardening

Inhalation of Dust While Gardening

Ingestion of Soil on Plants

Uptake into Plants



What's New is Old.....Growing Food

Community Gardens



“Backyard” Gardens



Urban Environmental Transition

- **Stage 1:** “brown” environmental issues – clean water supply and waste management.
 - Wealth builds...
- **Stage 2:** “grey” issues of air and water pollution become increasingly important.
- **Stage 3:** “green” environmental agenda of sustainable ecosystems and life-support.
 - Sorensen and Okata (2010)

What soils can I find in urban areas?

Former natural soil

- Disturbed by people

New soil

- Manufactured



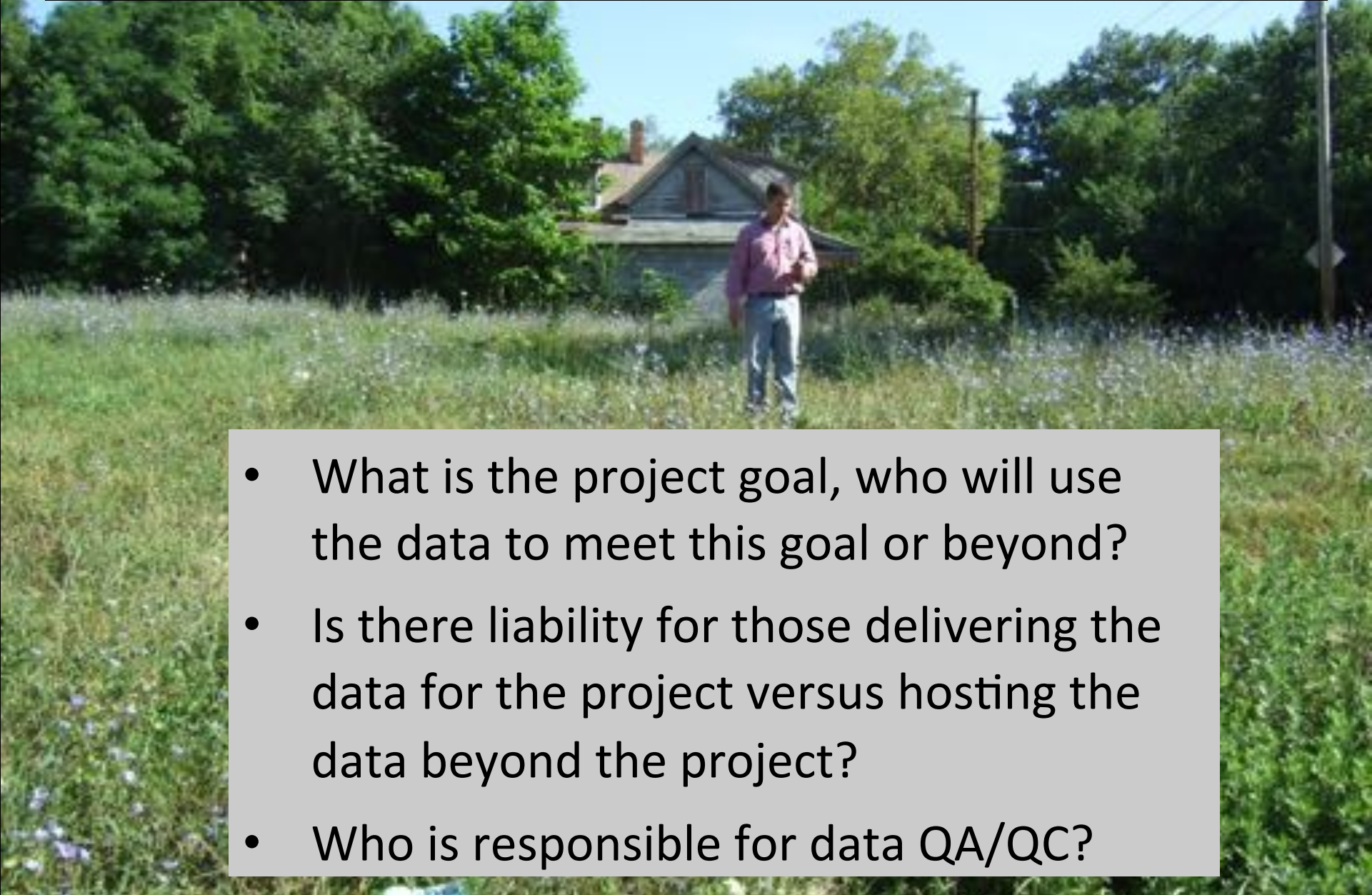
USDA-Soil Survey (2008)

Bottom

Top



Site Assessment Process: Project Evaluation

- 
- What is the project goal, who will use the data to meet this goal or beyond?
 - Is there liability for those delivering the data for the project versus hosting the data beyond the project?
 - Who is responsible for data QA/QC?







Site Assessment Process: Develop Base Data

- a) The big 3: topography (DEM, old USGS surveys), parent material and lithology type
- b) Map the evolution of the city with time
- c) Identify cultural community development with time
- d) Identify hot spots through time (tanneries, railroad facilities, factories, warehouses, hospitals, slaughterhouses, shipping areas and loading docks, utility development, etc.)
- e) Historic soil distribution and parameters (depth, particle size, pH minimum)
- f) Historic drainage and its conveyance over time
- g) Historic wind patterns (remember wind patterns change as the city and its surroundings are built up)



Sample Sanborn Fire Insurance Map

Site Assessment Process: Develop Base Data



1. Who acquires permissions for site access, utility calls, risk/liability insurance?
2. Are police services needed for protection/security?
3. Target testing to the question
4. How should soils be examined versus how they will be

Site Assessment Process: Develop Base Data

A photograph of a wooded area with a utility pole and a fallen log in the foreground. The scene is outdoors with green trees and a clear sky. The utility pole is in the center, with several power lines extending from it. A large log lies horizontally across the lower left portion of the image. The ground is covered with grass and some bare patches.

How should soils be examined versus how they will be

- i. Auger, hand dug, piston corer, backhoe
- ii. Horizon/layer description per what protocol
- iii. Site recovery and seeding, follow-up

Site Assessment Process: Develop Base Data

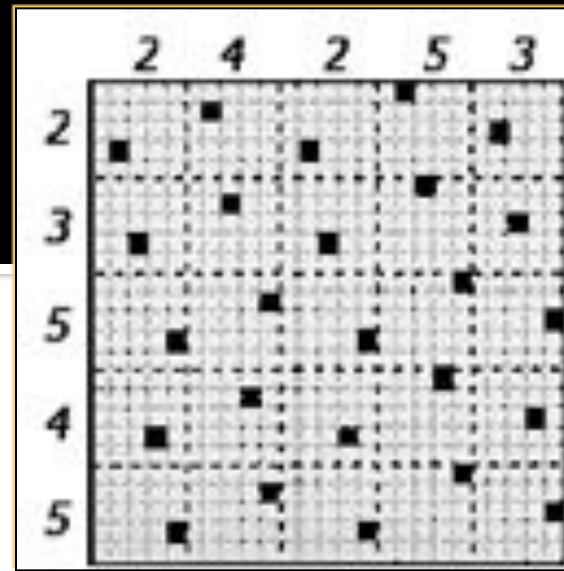
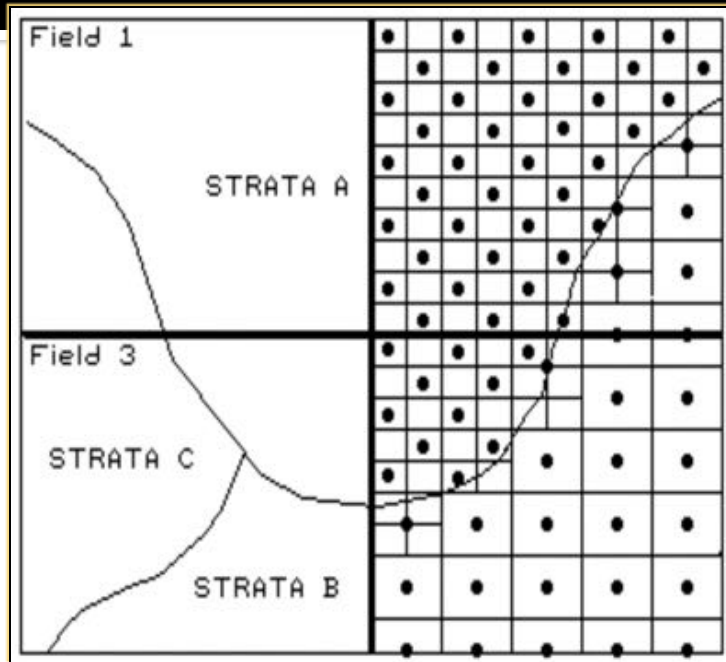
Physical data

- Hydrological (surface infiltration (saturated) and subsurface most restrictive horizon)
- Particle size (USDA textural class and Unified classification)

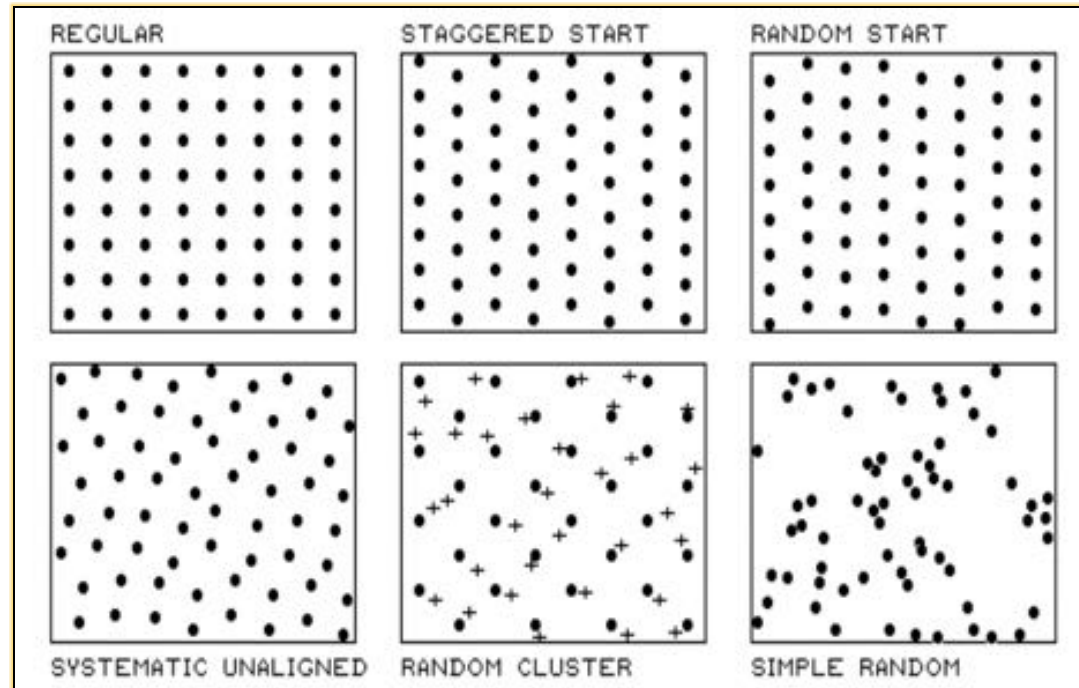
Chemical data

- Fertility versus total elemental versus human exposure risk assessment

Sampling



- Intensity = \$\$
- Random = risk?
- Stratified = natural feature tendency
- Flexibility, adjust sample size



Site Assessment Process: Develop Base Data

A vibrant mural of a peacock with a large sun in the background, set against a brick building and a garden. The mural is the central focus, featuring a peacock with blue, red, and yellow feathers, and a large sun with a face. The background is a brick building with arched windows and a garden with green plants and yellow flowers. A white van is parked in the background.

Site solar radiation (thermal profiling, ET)



Other tests to keep in mind

- i. Mineralogical and chemical (XRF versus Mehlich III, versus EPA 3050B; XRD)
- ii. Soil mechanics (Atterberg limits, Proctor values, nuclear density gauge Bd, restrictive layer presence and characterization)
- iii. Geophysics (EM, GPR, resistivity)




Boston Community Gardens



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Boston Community Gardens

-  Community Garden
-  Other Nonowner Property
-  Boston Public Market



BOSTON COMMUNITY GARDENS

- | | |
|-----------------------------|------------------------------|
| 1. Agis Hill CG | 49. Paul Davis & Seaver CG |
| 2. Bar Farms CG | 50. Salem, Johnson & Dean CG |
| 3. Berkeley CG | 51. Leffell CG |
| 4. Warren & Cleveland CG | 52. Stone & Plymouth CG |
| 5. Denmark Green | 53. Stone & Woodbury CG |
| 6. Springdale CG | 54. Westbrook CG |
| 7. Washington Common | 55. Sun Lane Park |
| 8. Washington Green | 56. Southside CG |
| 9. Worcester CG | 57. Chelsea & Everett CG |
| 10. Rutland Green | 58. Berry CG |
| 11. Rutland's Green | 59. Sunnyside CG |
| 12. Rutland & Washington CG | 60. Mission Square CG |
| 13. Harrison Urban Garden | 61. Newton & Southside CG |
| 14. West Springfield CG | 62. Elm Green |
| 15. Lewis & Furlong CG | 63. Belmont CG |
| 16. Stone Street Green | 64. Audette Junior CG |
| 17. Stone Street CG | 65. St. Joseph's CG |
| 18. Northampton CG | 66. St. Joseph's CG |
| 19. Mission Hill CG | 67. Laurel CG |
| 20. East Knowledge CG | 68. Greenwood CG |
| 21. Knowledge Green | 69. Highgate Hill |
| 22. Working CG | 70. Somers CG |
| 23. Weymouth & Forest | 71. Huxford CG |
| 24. Myrtle CG | 72. Lyden CG |
| 25. Wye CG | 73. Leonard, Spence & Lee CG |
| 26. Day & Franklin CG | 74. Winton CG |
| 27. Apple Green | 75. Whitehouse CG |
| 28. Parker CG | 76. Whitehouse CG |
| 29. Southern Common | |
| Common Farm | |



• Why Community Gardens?

- Boston's 2nd Park System, vital neighborhood open spaces
- Provide healthy, fresh local food that supplements food budgets
- Promote active living and recreational opportunities
- Build civic engagement & stronger communities
- Provides lifelong educational and learning experiences



Minton Stables CG, Before



Minton Stables CG, After





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Good Gardening Practices

- Try to wear gloves while gardening
- Remember to wash hands before eating
- Wash or peel vegetables before cooking and or eating
- Try to leave shoes outdoors or at the door so as not to track soils inside

- Only use soil or compost from known, trusted sources.

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