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# *The Hydrologic Implications Of Unique Urban Soil Horizon Sequencing On The Functions Of Passive Green Infrastructure*

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## Available land for water management

- Vacant-lots are well-integrated into the urban fabric
- Serve as passive green infrastructure to absorb rainfall, prevent runoff formation, and regulate, diminish runoff flow into sewer collection system, avoid sewer malfunctions

Subject: Urban core areas with a long, unique history

Native>Development> Demolition>Pastoral

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# Urban Soils as a basis for GI

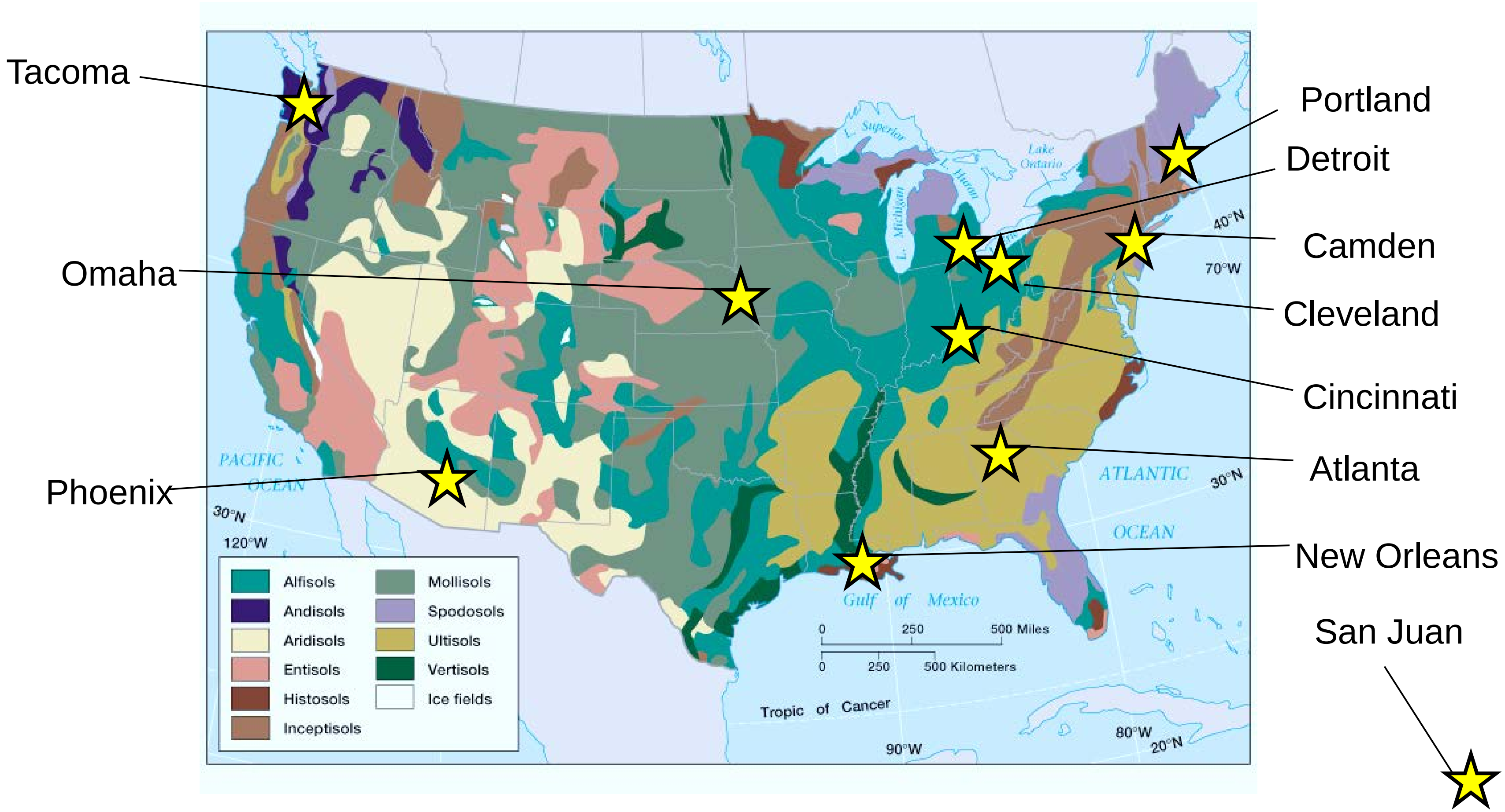
- Disturbance history has affected the way urban soils are layered
- Changes in structure predict changes in function(s)
- Use actual field measurements to understand these changes under urbanization

Basic - Urban soils are not mapped for many urban centers, GI target areas

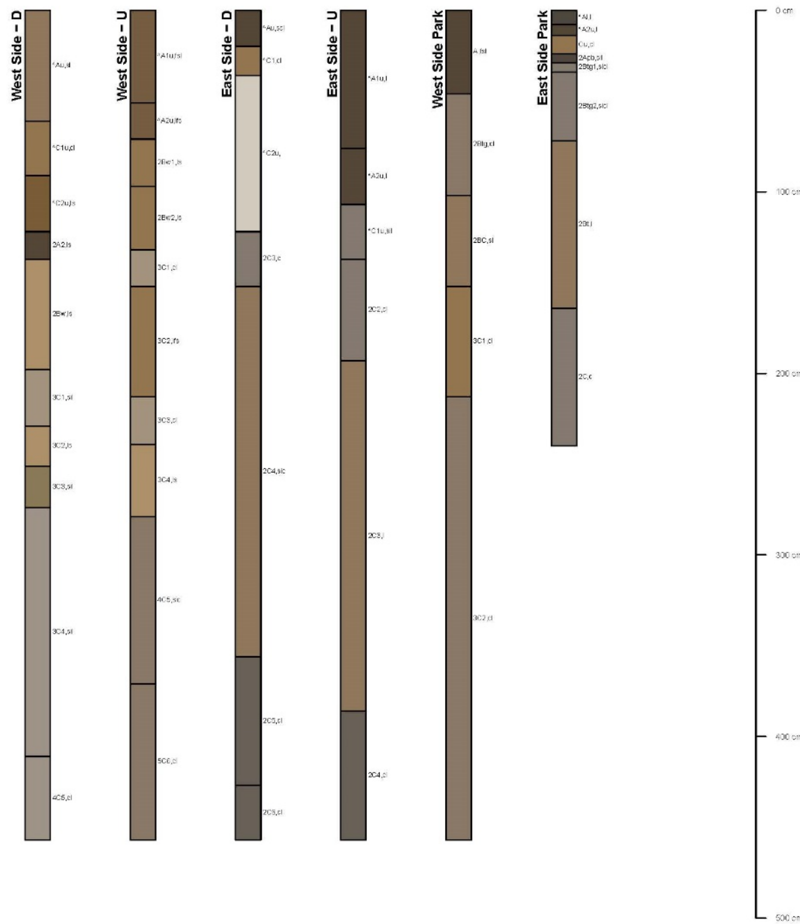
Practical - Hydrologic suitability of urban park, vacant land soils

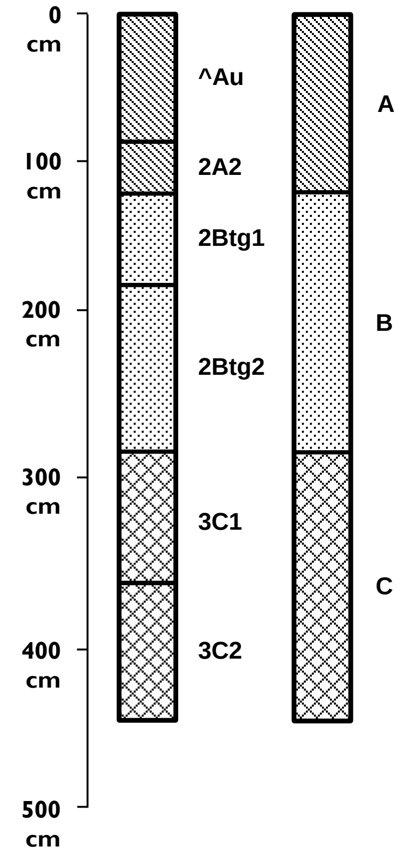
May minimize risks of unintended consequences (e.g., return flow), maximize ecosystem services

# Cover 10/12 major soil orders



# Urban Soil Assessments




We know that soil characteristics and layering has an impact on how water moves through the soil

# Hydrology

Above – tension infiltrometer, double-ring unit

Left – "Amoozemeter" measures sub-surface hydraulic conductivity (proxy for drainage)

# Urban and reference pedons

Compared to reference pedons (A-B-C), we found that urban soil profiles were missing B horizons, with deeper A, shallower C horizons

*A-C Predominant*

| City | Urban pedons | Soil series | Reference pedons |
|---|---|---|---|
| Atlanta | 14 | 7 | 12 |
| Camden | 23 | 4 | 7 |
| Cincinnati | 43 | 5 | 22 |
| Cleveland | 72 | 9 | 28 |
| Detroit | 57 | 13 | 28 |
| New Orleans | 20 | 6 | 11 |
| Omaha | 36 | 6 | 24 |
| Phoenix | 11 | 4 | 9 |
| Portland, Maine | 20 | 9 | 20 |
| San Juan | 21 | 8 | 12 |
| Tacoma | 15 | 4 | 8 |
| Total | 332 | 75 | 181 |

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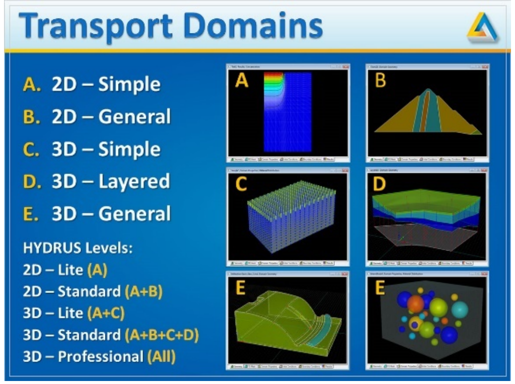
# Concept and approach

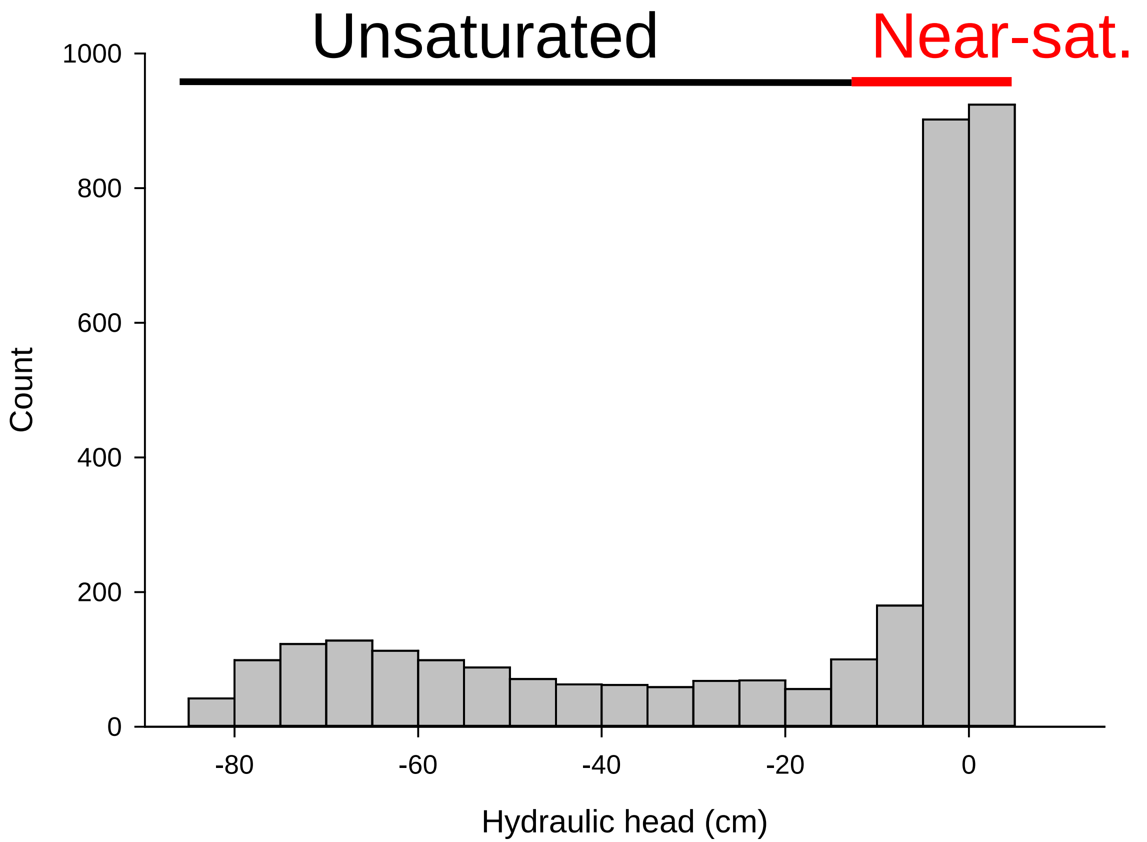
- Target ecosystem services:
  - ➢Supporting: *Plant Growth* (how often does rooting zone water content approach wilting point?);
  - ➢Regulating: *Runoff Formation* (how often does hydraulic head at soil surface approach zero?)
- Use HYDRUS model with a combination of ROSETTA predictions for van Genucten parameters, and actual field data for horizon texture, thickness, and surface, subsurface K



# Concept and approach

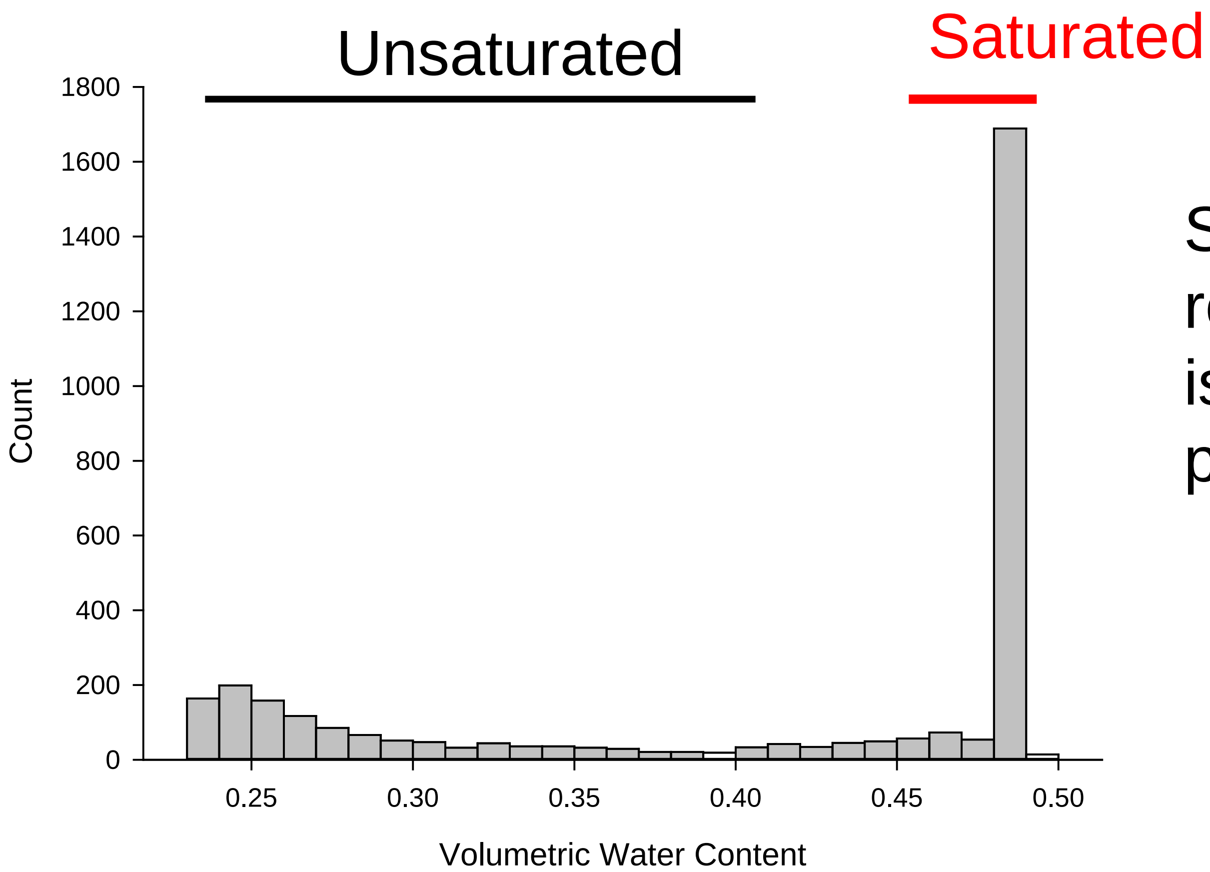
- Compare histograms-freq. distributions of HYDRUS hydraulic head, water content outputs among reference and urbanized pedons
- Portland ME soil pedon sample set employed for this conceptual approach
- Forced HYDRUS model with different, representative hourly-resolution rainfall records from long-term NCDC records for Portland ME airport

# Example output: urbanized Portland ME A-C sequence




Frequent runoff production

# Example output: urbanized Portland ME A-C sequence




Saturated rooting zone is predominant

# Conclusions and ongoing work

- We determined how urbanization processes altered the sequence of soil horizons
- An unsaturated zone hydrologic model was used to simulate hydraulic head and water content at different soil depths
- Case study: urbanized soil profiles show low capacity for rendering supporting (plant-available soil water), and regulating (runoff mitigation) ecosystem services
- Model stability issues for reference profiles

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# Thanks, and any questions?

<u>Thanks to</u>: our consulting USDA-NRCS Soil Scientists: Carl Fuller, Eric Gano, Jeff Glanville, Manuel Matos, Maxine Levin, Rich Shaw Stephon Thomas, Steve Baker; Ryan Stuart, Virginia Tech, and to all of the citizens and agencies in the cities that we worked in.

*<u>Disclaimer</u>: The views in this presentation are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.*

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