

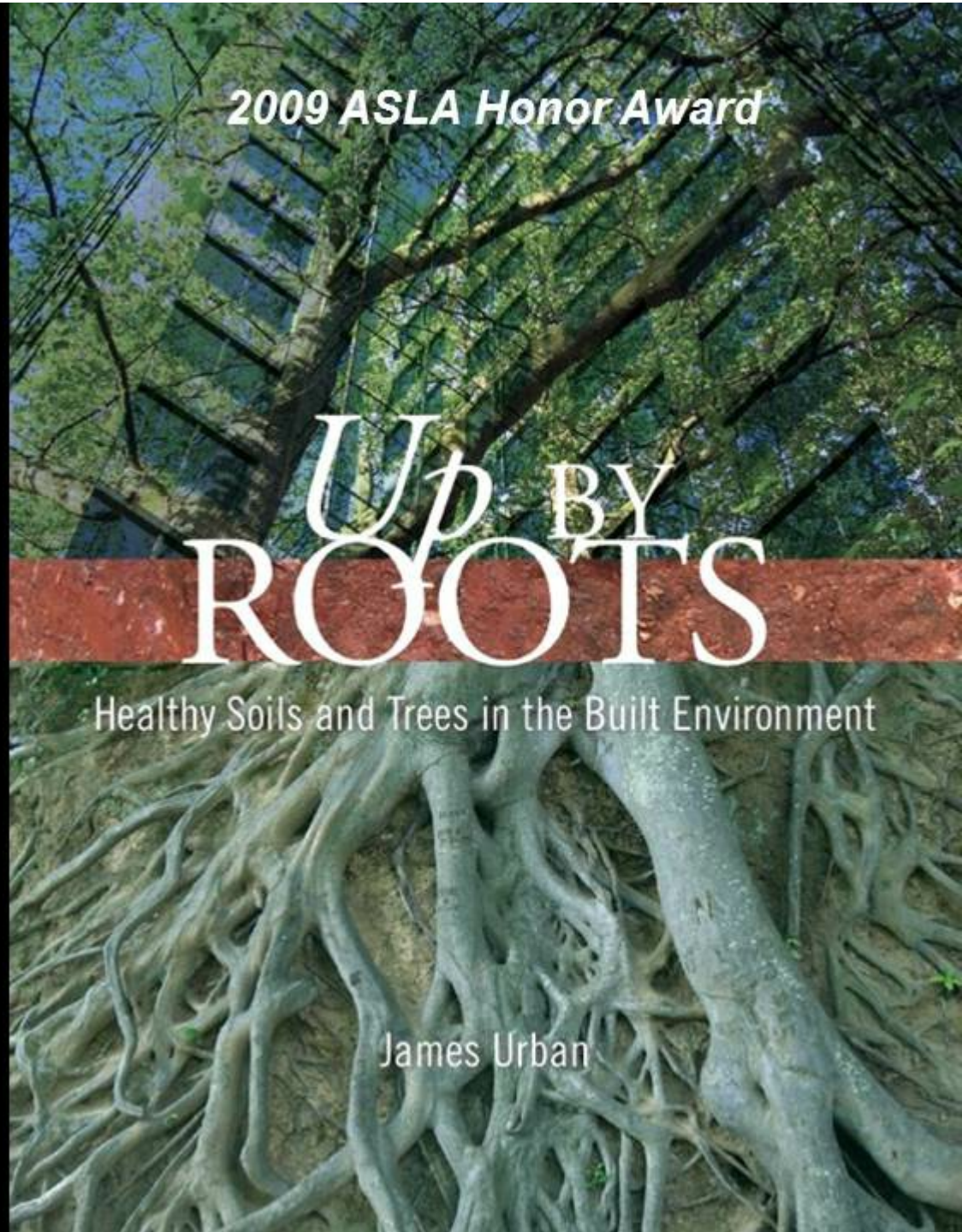
Urban Soil and
Soil Assessment

2009 ASLA Honor Award

Up BY
ROOTS

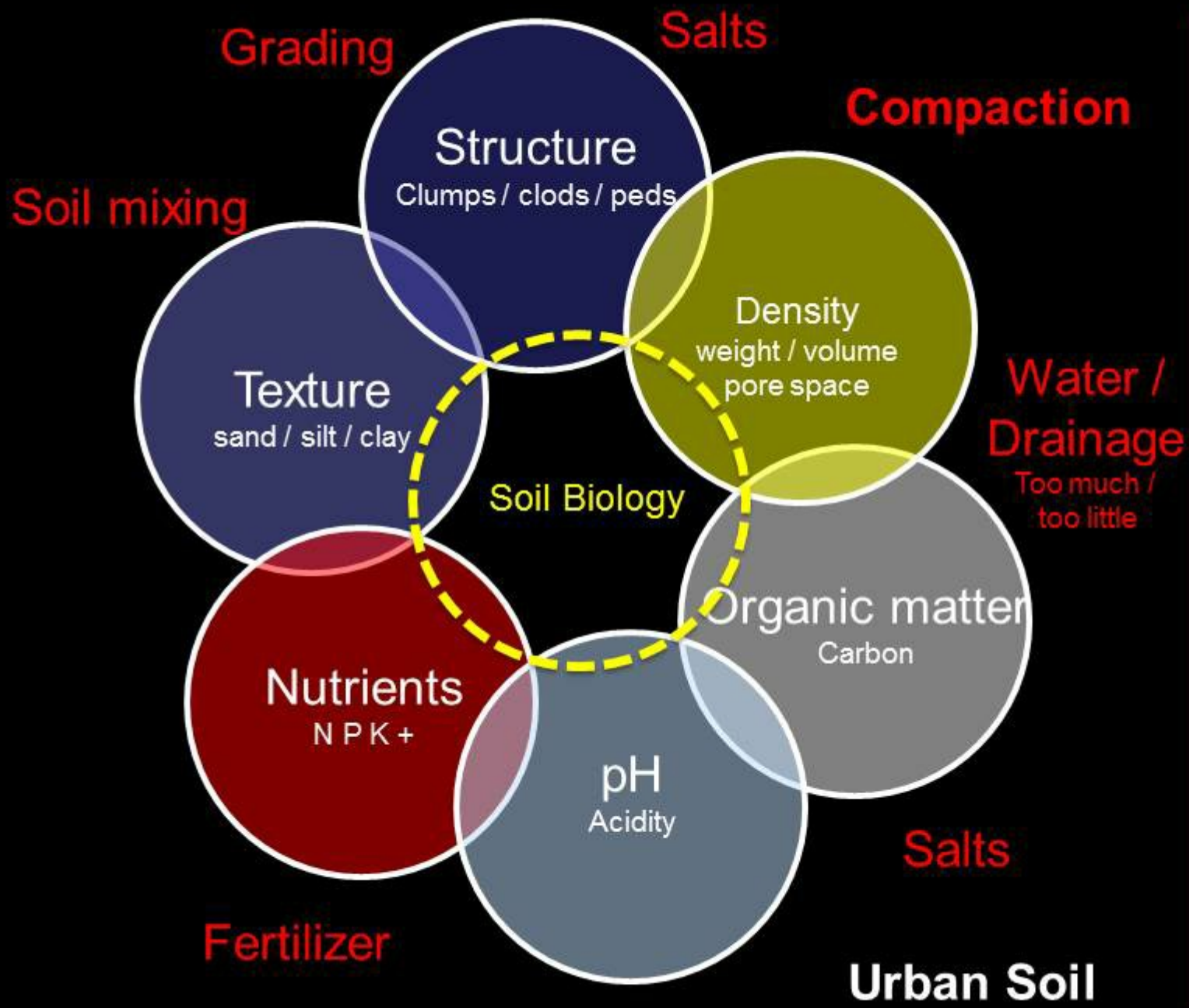
Healthy Soils and Trees in the Built Environment

James Urban



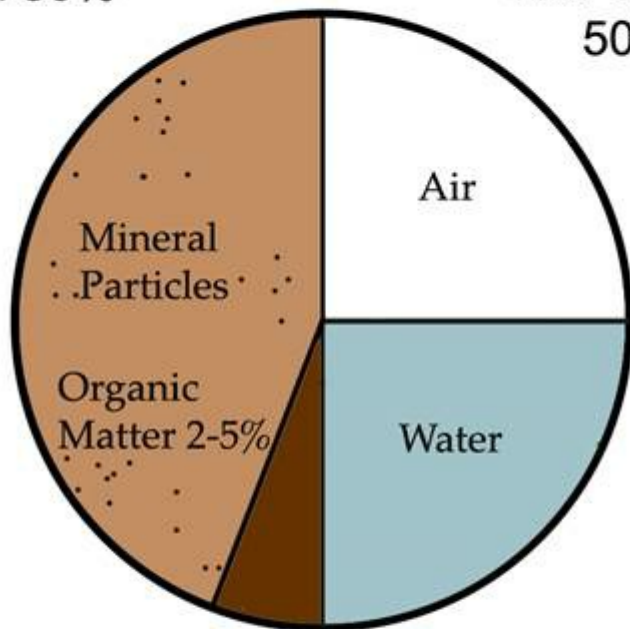


Trees in urban soils often fail, or are irregular in their growth from tree to tree.



Solid 50%

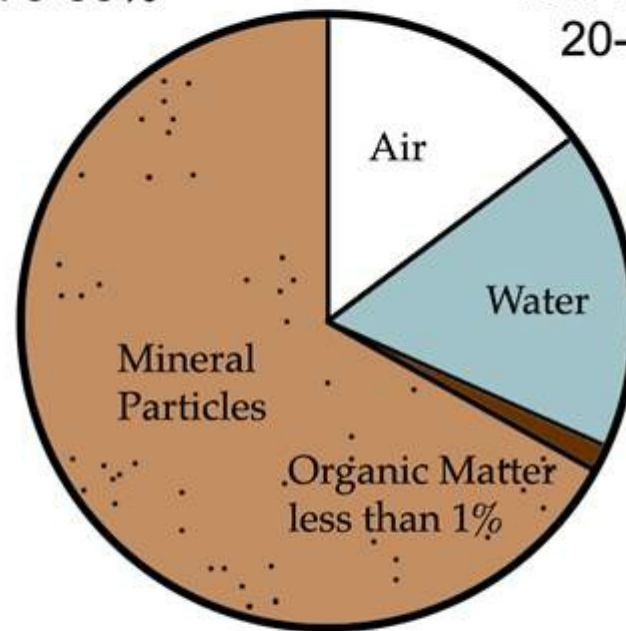
Void Space
50%



IDEAL FOREST
SOILS

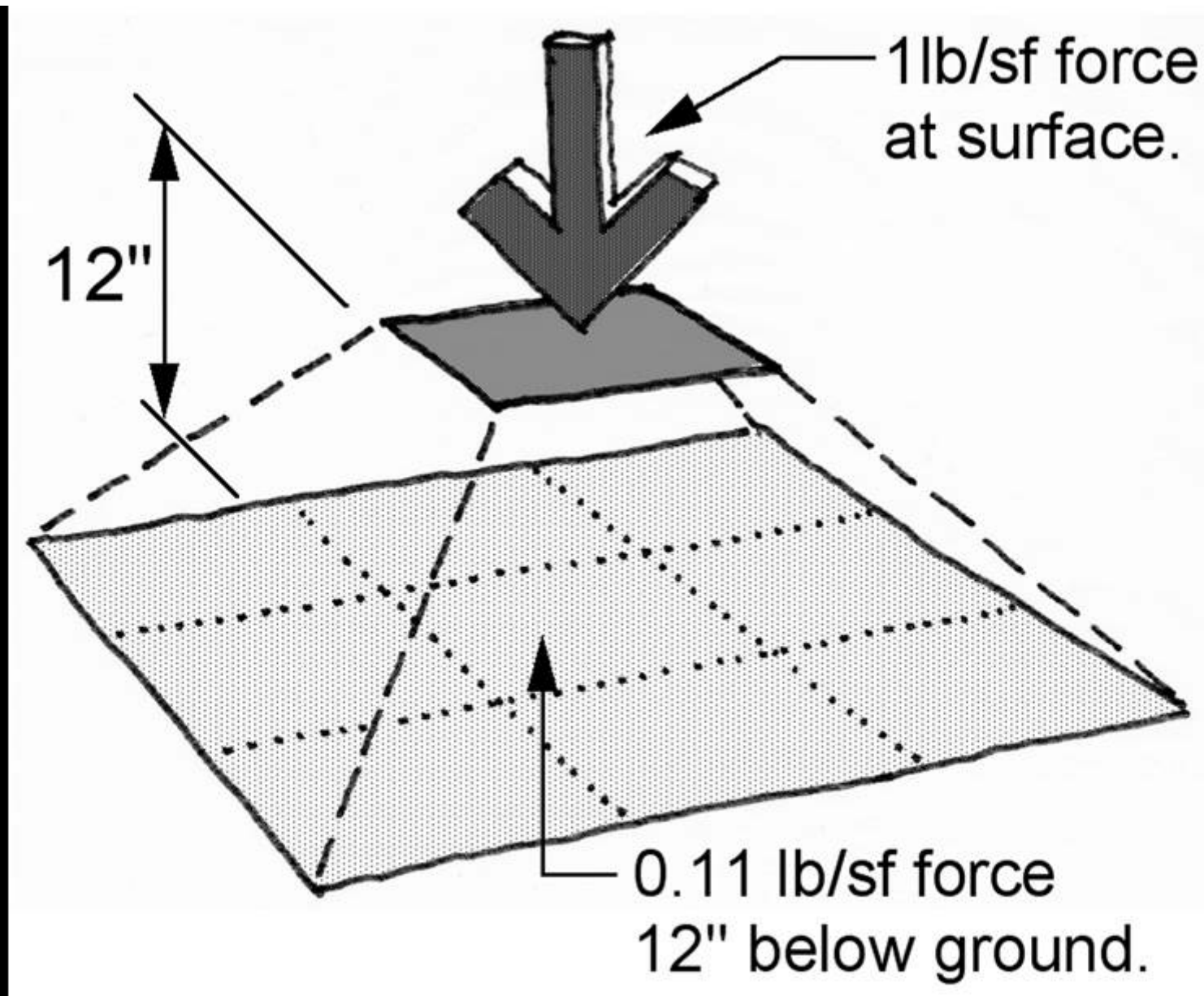
Solid 70-80%

Void Space
20-30%



URBAN SOILS

As compaction increases, pore space for
water and air decreases



There is a decrease in compaction with depth as the compaction force spread out into the soil in a cone shaped wave.

Compaction results in massive structure and horizontal peds





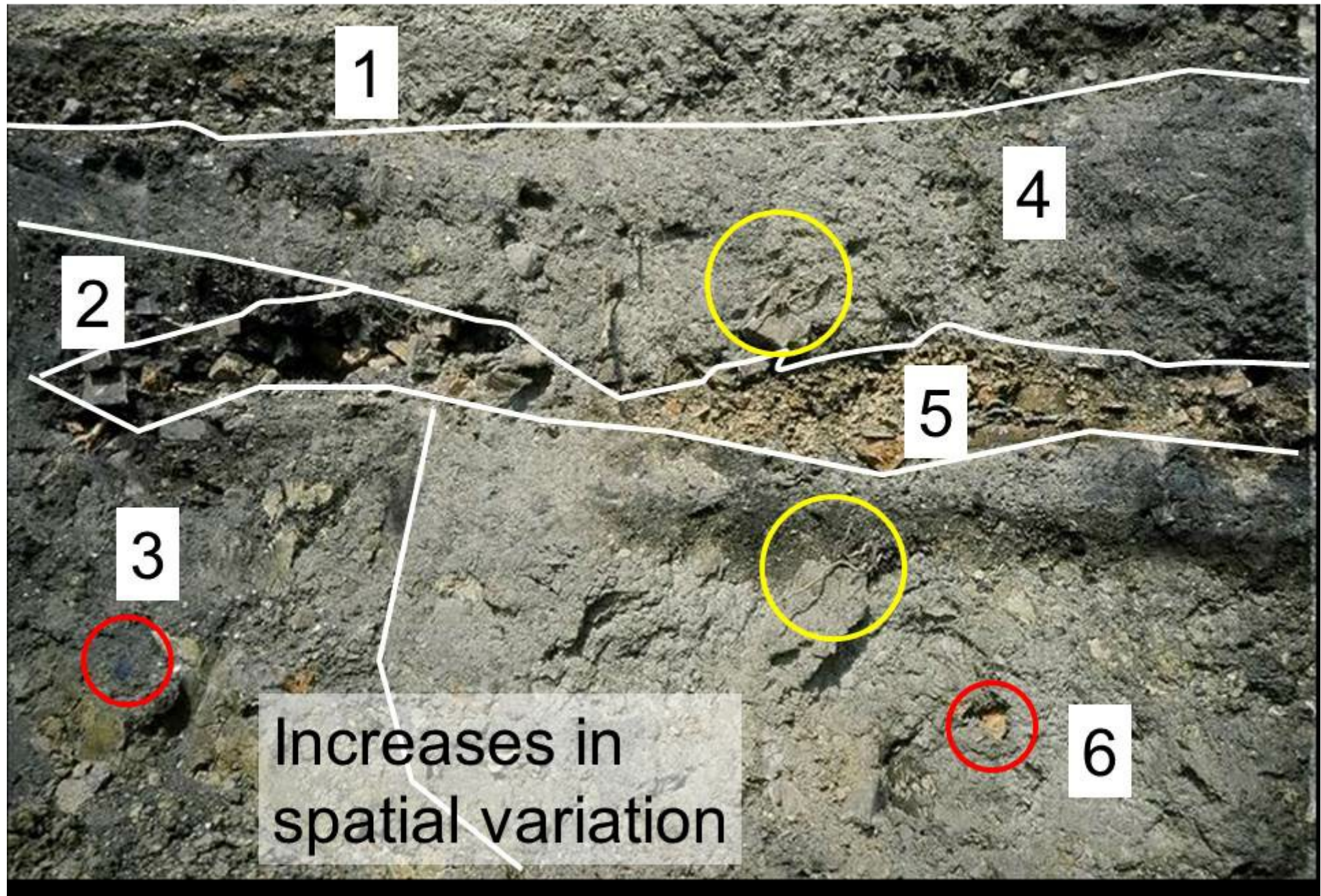
Perched water table



Seeps

Depending on your climate and soil a perched water table or a seep might be a good or bad thing.

Urban soil profiles - many different soil conditions in small areas.



Dramatic changes over small distances, Do not make assumptions!





Utilities - Part of the urban soil profile that severely limit options to improve the soil.

Reduction in organic content



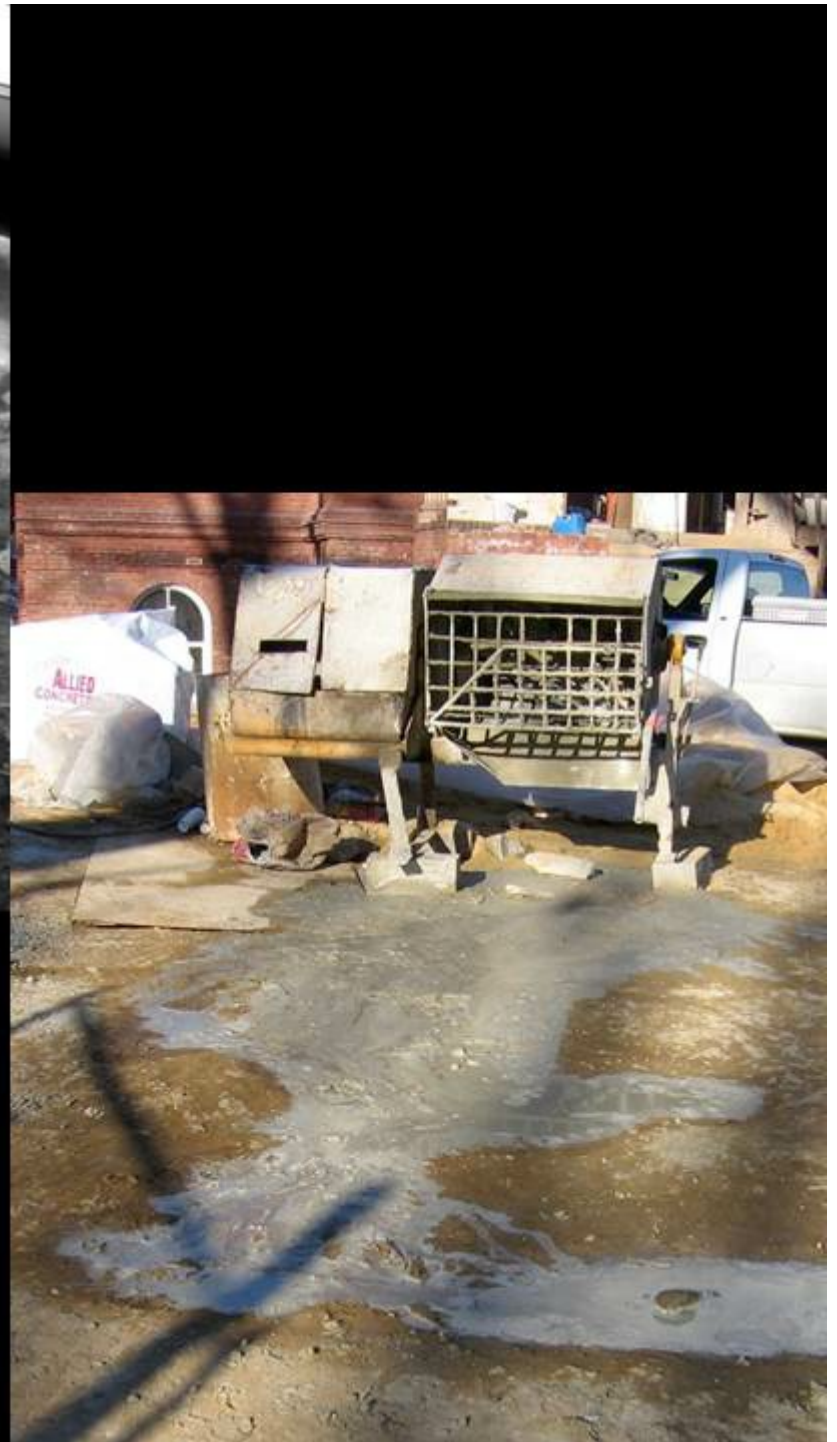


Human induced chemical changes

pH rise

Over fertilization

Salt



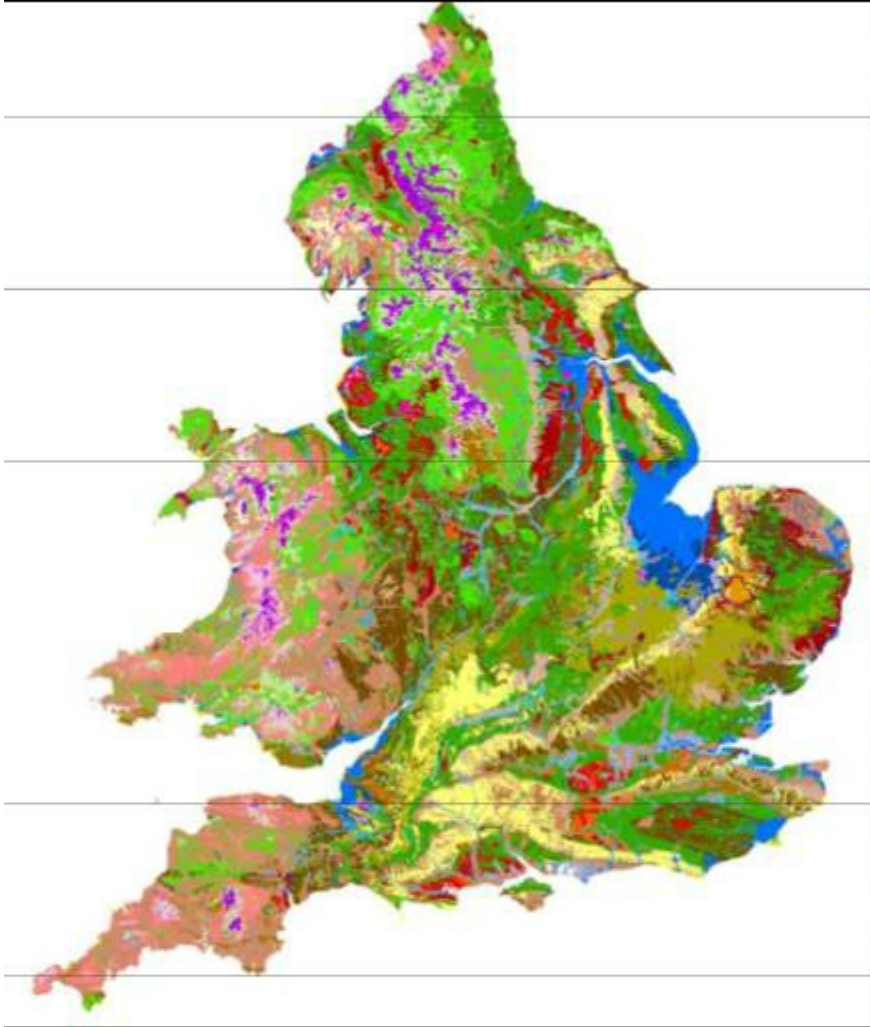


Air born salt



Soil water born salt

Salt damage



Natural soil



© Paolo Nespoli / ESA

Urban soil

Urban's *Real* Soil Classifications

Conclusions

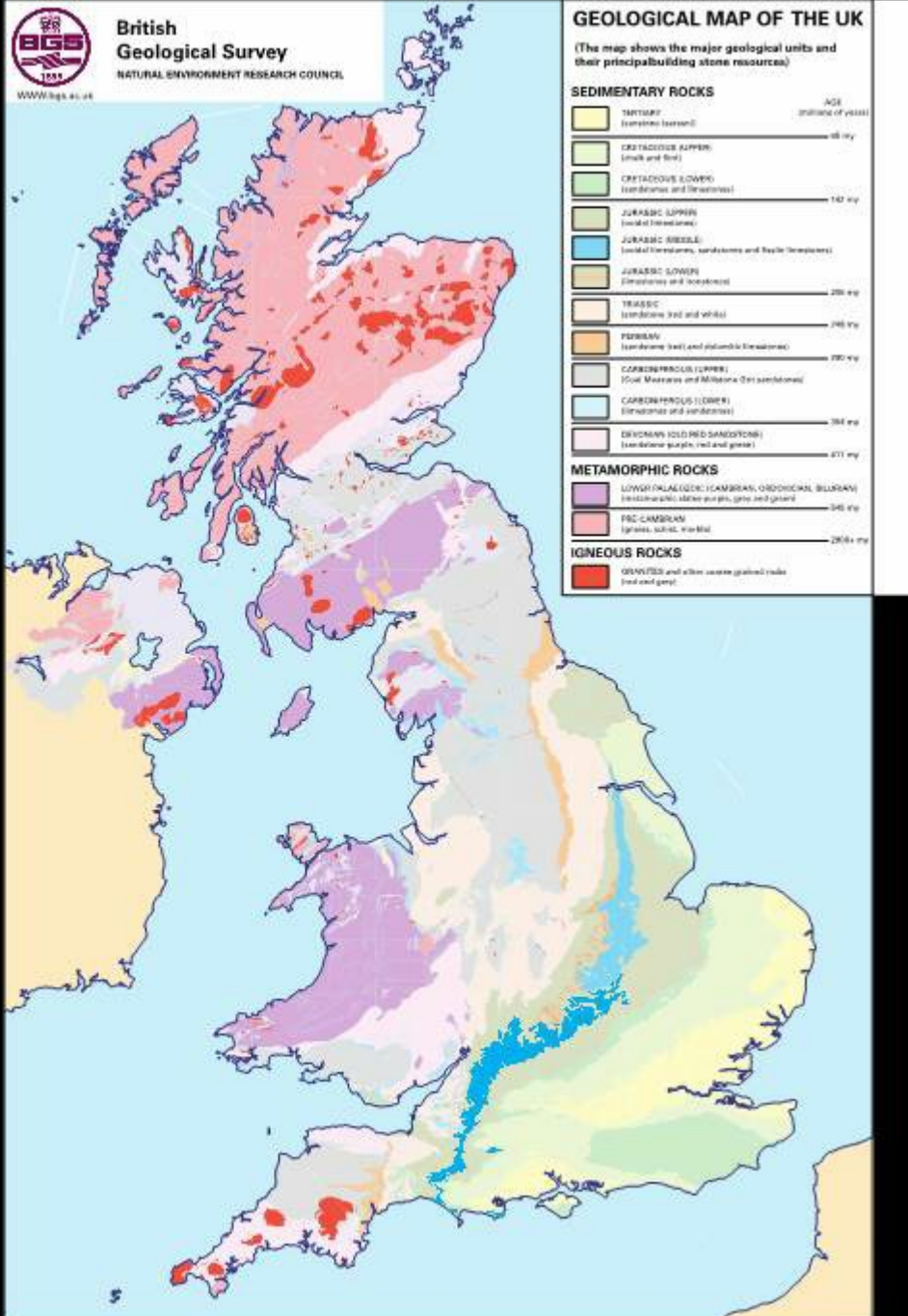
	<u>Sort of Bad</u>	<u>Good</u>	<u>Real bad</u>
Drainage	Excessive Dry	Moist but well drained	Excessively Wet
Compaction	Very Loose	Consolidated or Aggregated	Very Compacted
Organic Content	Greater than 10%	2-3%	0.5 - 0%
Texture	High sand	Loam	High Clay or Silt
Fertility Indicators	high or Low	Just Right	Very high or low
pH	Below 5.5	6.0 to 7.5	Above 8.5 or Below 5

Non traditional ways to survey urban soil



Boring No. B-15		Total Depth 25.0'	Surface Elev. 673 (approx.)	
Type of Boring HSA	Equipment:	Started 2/23/06	Completed 2/23/06	
Approx. Elevation**	Depth**	DESCRIPTION OF MATERIALS (Classification)	Sample Slows*	Sample Depth (Feet)
672.2	0.8	TOPSOIL		1.0
670.0	3.0	RESIDUAL (Possible Alluvial) - Soft, Brown, Sandy Elastic SILT (MH) - moist to wet.	2-2-2	2.5
		Very Stiff, Brown and Tan, Clayey Sandy SILT (ML) - moist to wet.	5-7-9	3.5
667.0	6.0			5.0
665.0	8.0	Loose, Tan and Gray, Clayey Silty Fine SAND (SM) - moist to wet.	3-4-6	6.0
		Stiff, Gray and Tan, Sandy Lean CLAY (CL) with trace rootlets - moist to wet.	4-4-5	7.5
661.0	12.0			8.5
		Dense, Tan, Silty Fine SAND (SM) - moist to wet.	12-17-15	10.0
656.0	17.0			13.5
		Very Stiff, Tan and Gray, Sandy SILT (ML) - moist.	7-9-12	15.0
651.0	22.0			18.5
		Dense, Brown, Silty SAND (SM) - moist to wet.	11-19-22	20.0
648.0	25.0			23.5
		Boring Terminated at 25 feet		25.0
		Groundwater:		
		0 Hour - 14.5 feet		
		1 Hour - 4.5 feet		
		Stabilized - 2 feet		





Regional geology mapping
can give clues to parent
material

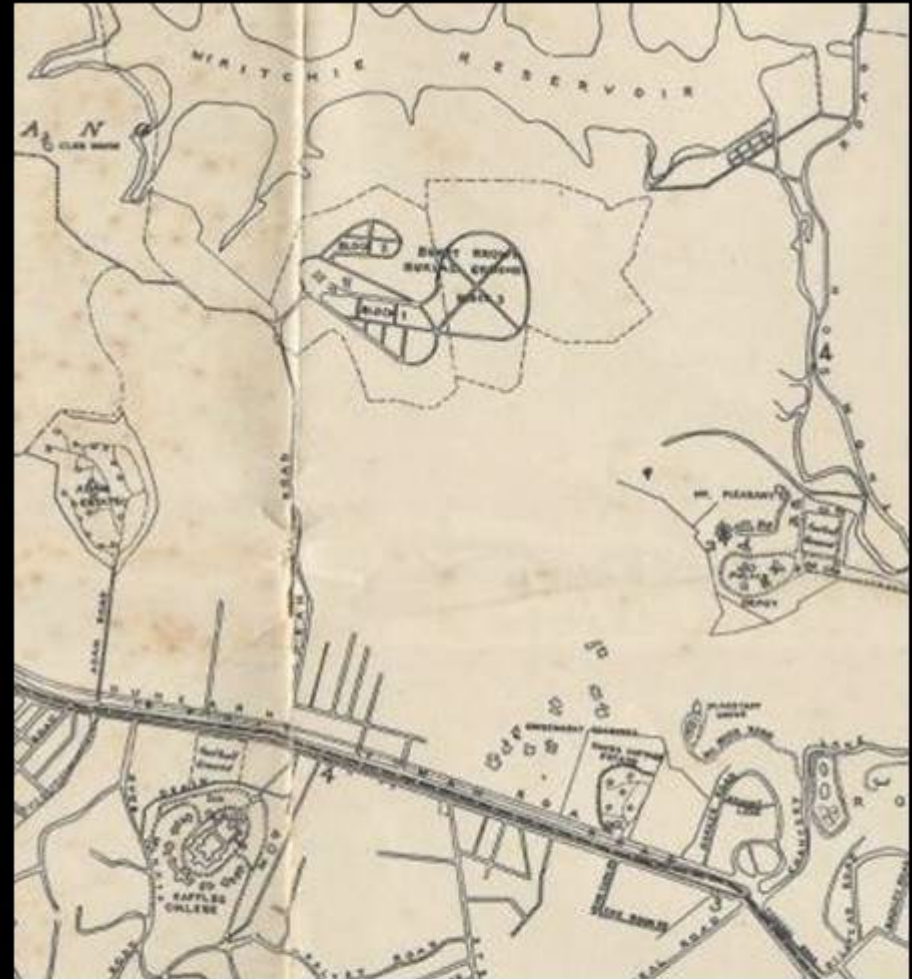
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Groundwater:
 0 Hour - 14.5 feet
 1 Hour - 4.5 feet
 Stabilized - 2 feet

Geotechnical Test Borings
 Good information on deep soil texture, color, and drainage



Recent and older
aerial
photographs

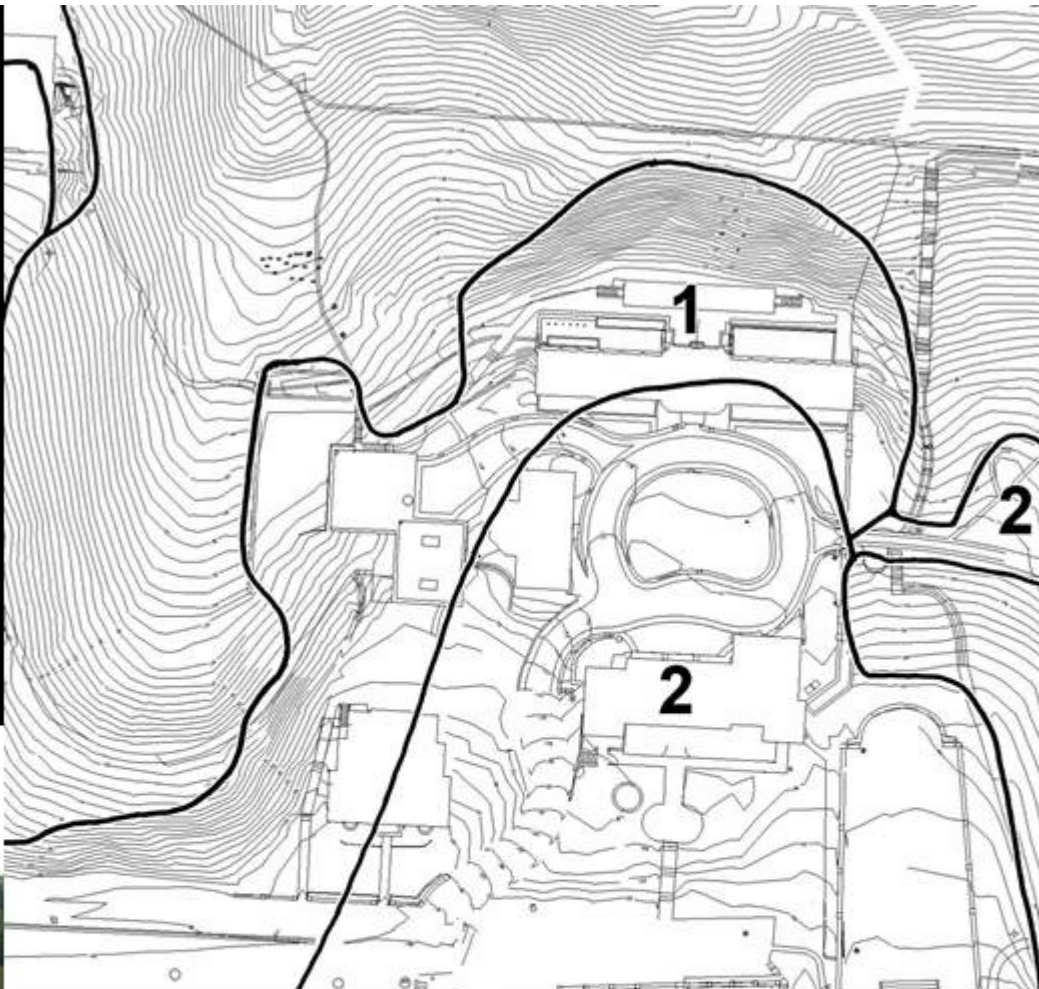
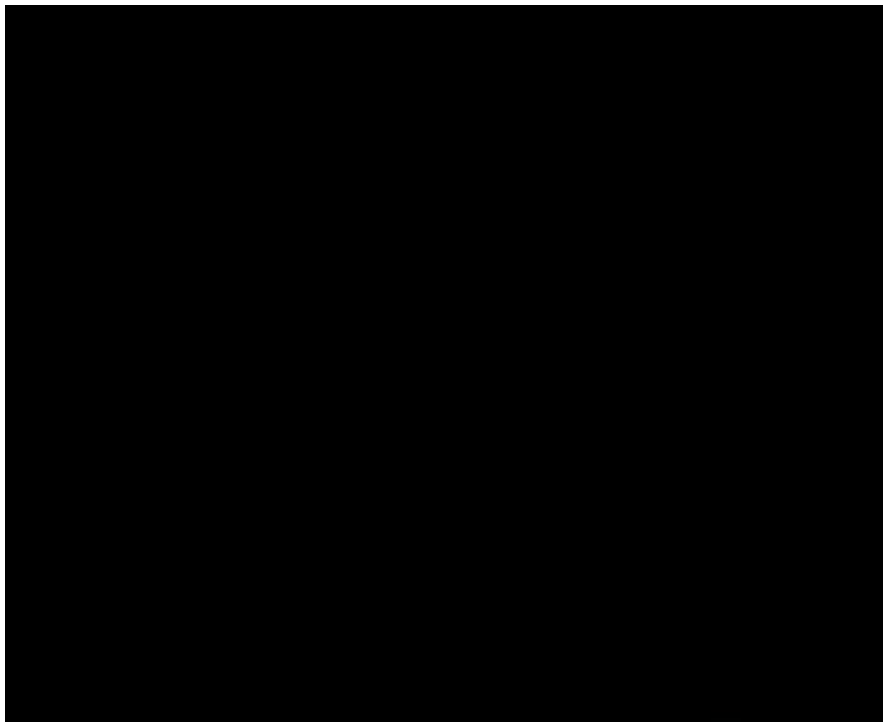


Old historic mapping



Historic photographs
and town histories





Topographic
Indicators of Past
Disturbance



Interviews: a good way to get urban soil information



Adjacent constructions can reveal soil types and issues

Plants as indicators
of soil differences
and problems





C. Stress responses

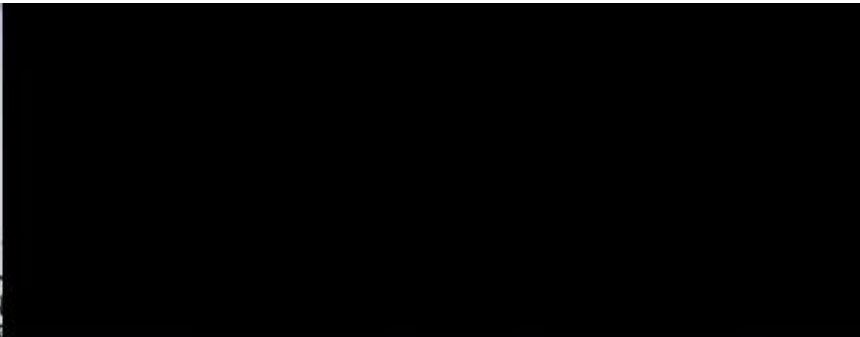
1. Leaf response
2. Node length and branch extensions
3. Decline and branch dieback
4. Wood growth reduction
5. Compartmentalization
6. Pruning response
 - Branches
 - Roots

Compare urban tree leaf growth with those from nearby native soils.

RALEIGH
CIVIC CENTER



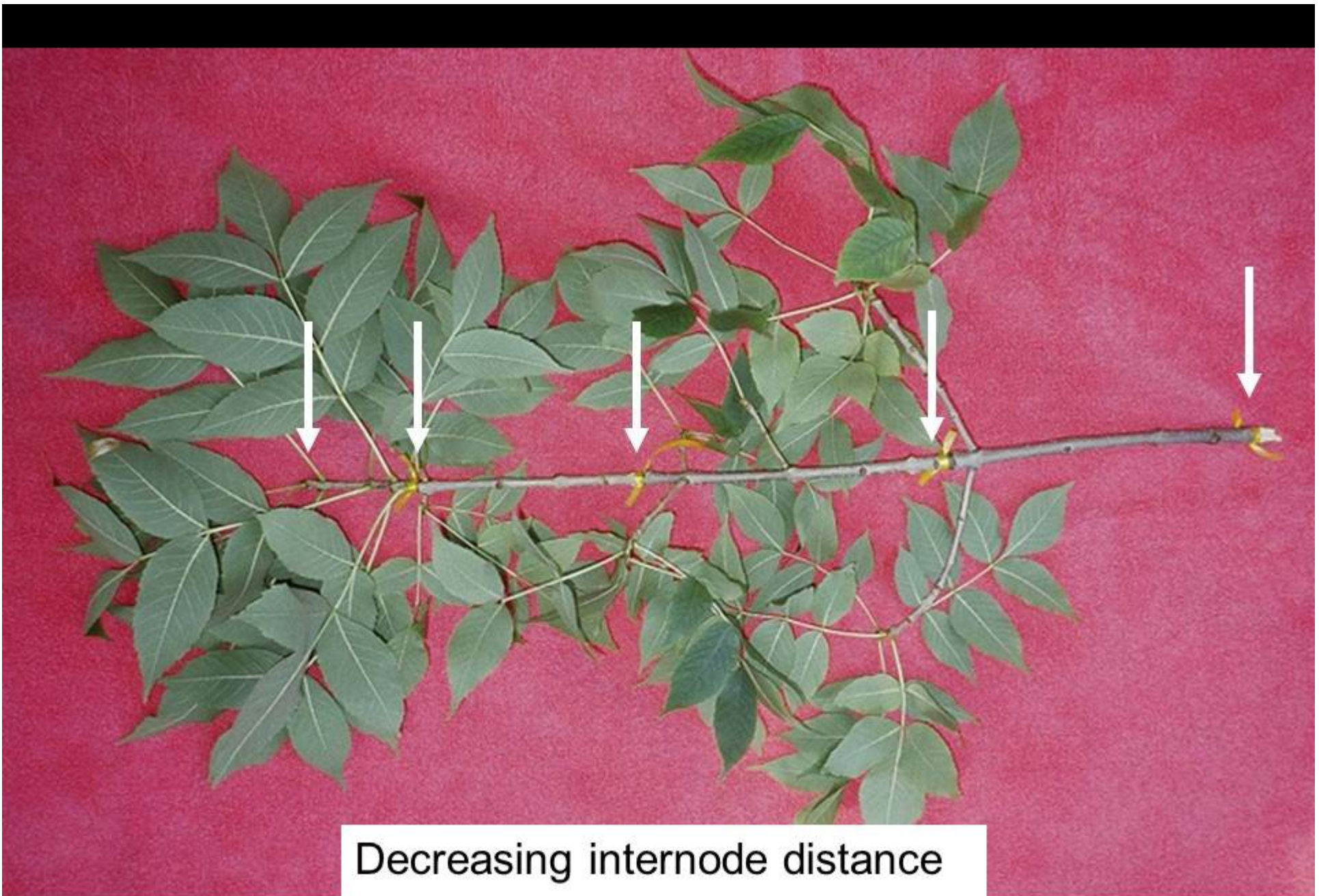
FOREST EDGE



Stressed tree
Poor soil

Healthy tree
Good soil





Decreasing internode distance

The result of tree stress

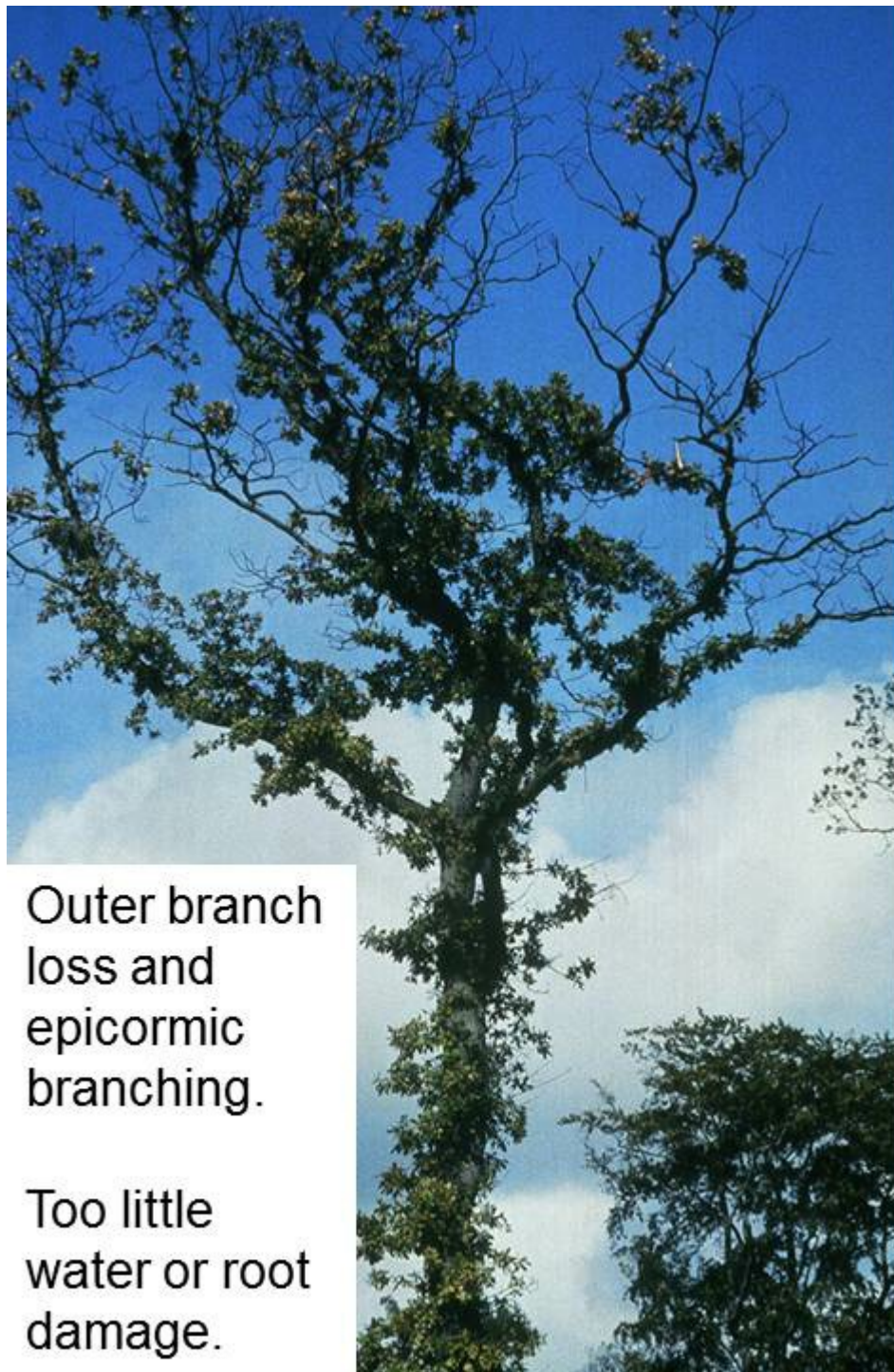


Stressed tree
Poor soil



Healthy tree
Good soil

Decreasing internode distance causes angular branch growth as stress increases.



Outer branch
loss and
epicormic
branching.

Too little
water or root
damage.




Lower or
interior leaf
loss.

Too much
water.



Early Fall Color
indicating soil stress



These trees are the same age from the same planting about 100 feet apart.

Size at year of planting

Soil stress - Lower yearly trunk diameter growth.



Soil Test will be required after the initial non traditional assessment, but the assessment limits the location for testing.

Soil probes and test pits

At some point you need to start digging, but the more research you do the less digging is required.

A Dutch auger is the best option for soil test pits.



Creating a soil profile with a Dutch auger



Remnant Soils

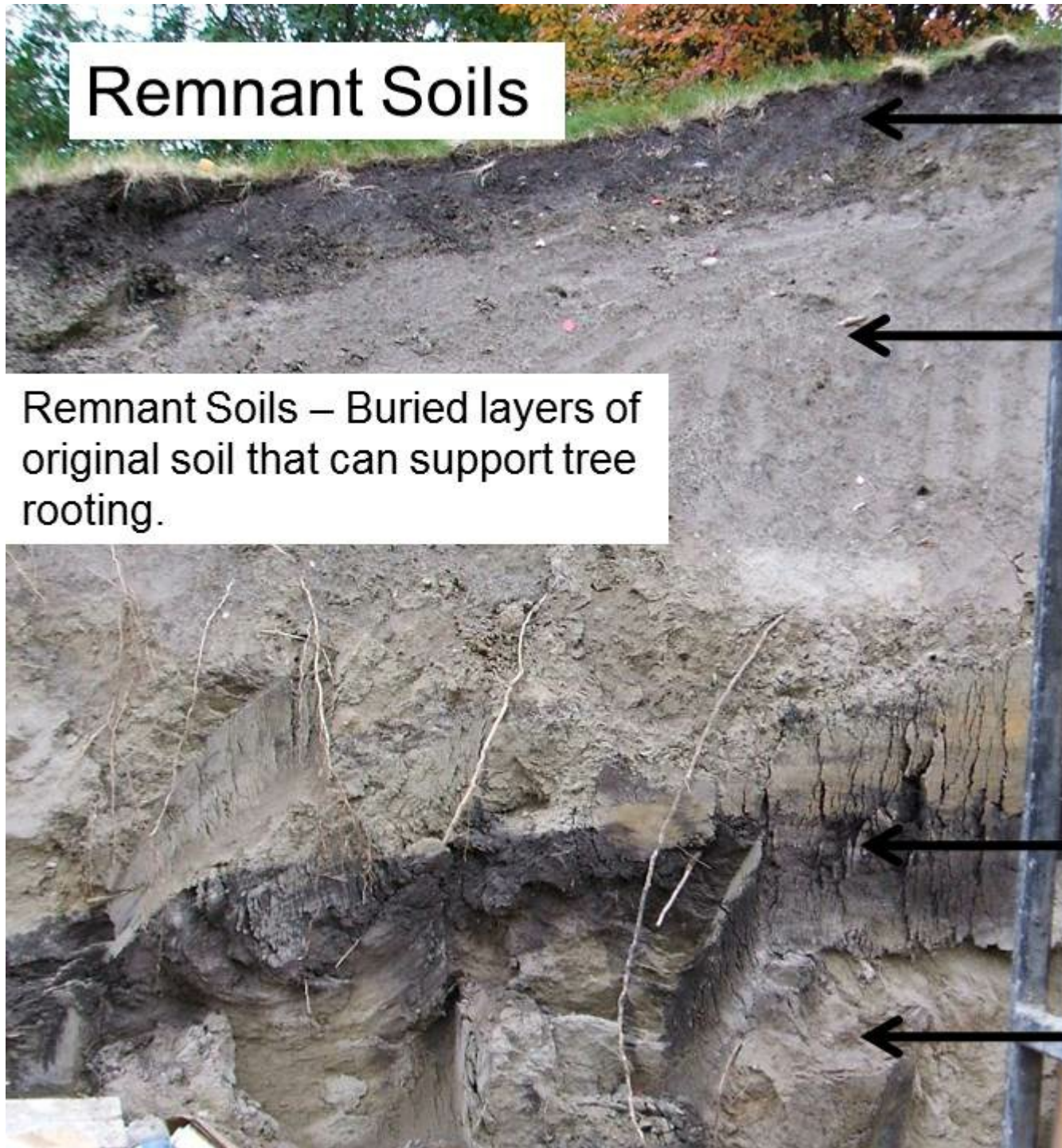
Imported topsoil

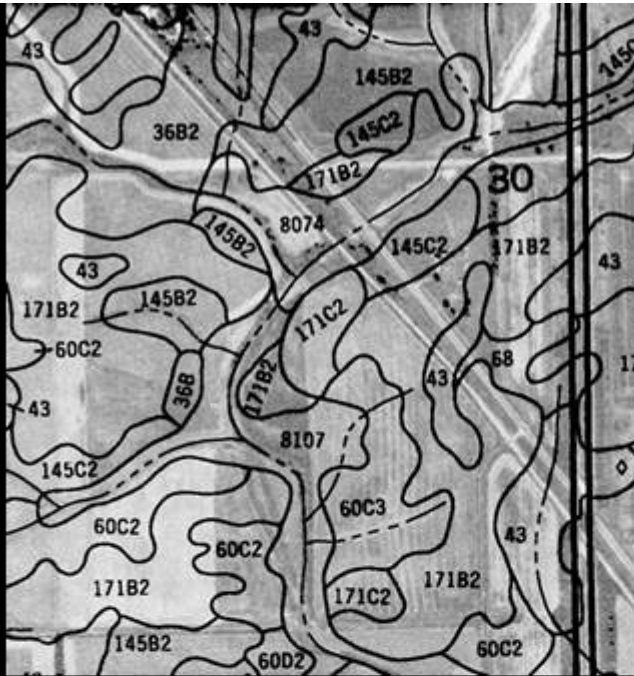
Fill soil

Remnant Soils – Buried layers of original soil that can support tree rooting.

Remnant topsoil

Remnant subsoil





Find a **reference soil** in or near the site that might be undisturbed.

Under old trees, at property lines, cemeteries, parks etc.

Use this to find remnant soils.



Planter with and without a remnant soil



Back ache
compaction test



Soil interface in profile



Dutch auger Soil
investigations

Clayey or silty soils?

Shoe test

The harder to clean your shoes, tools, trucks; the greater the % clay

Truck test

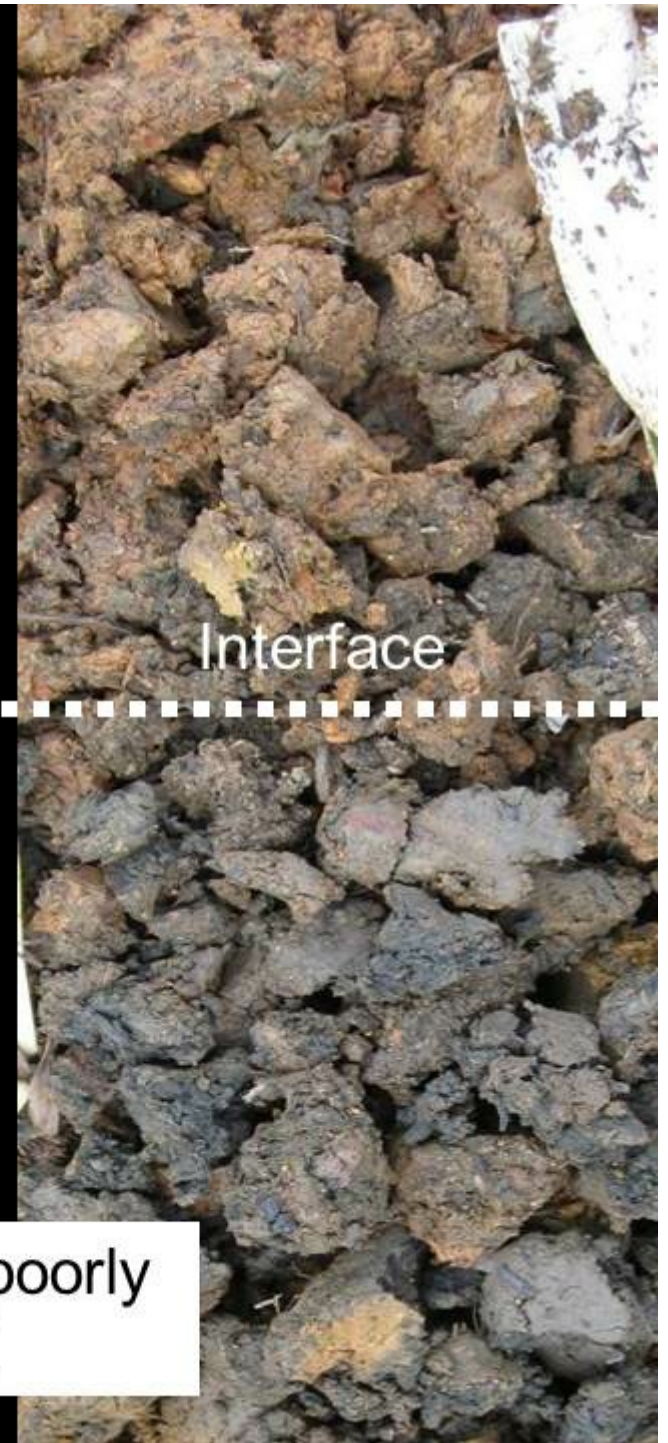


Feel test

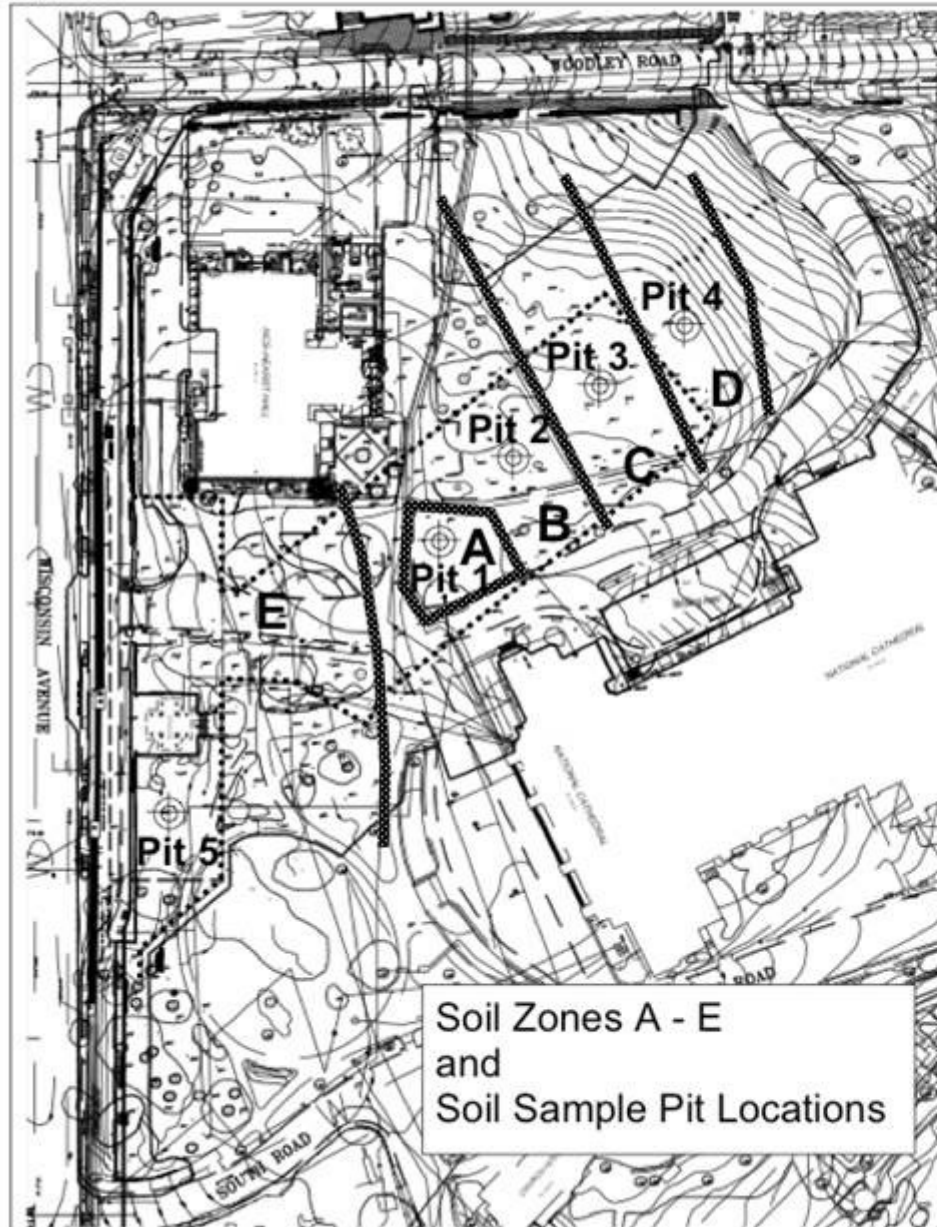




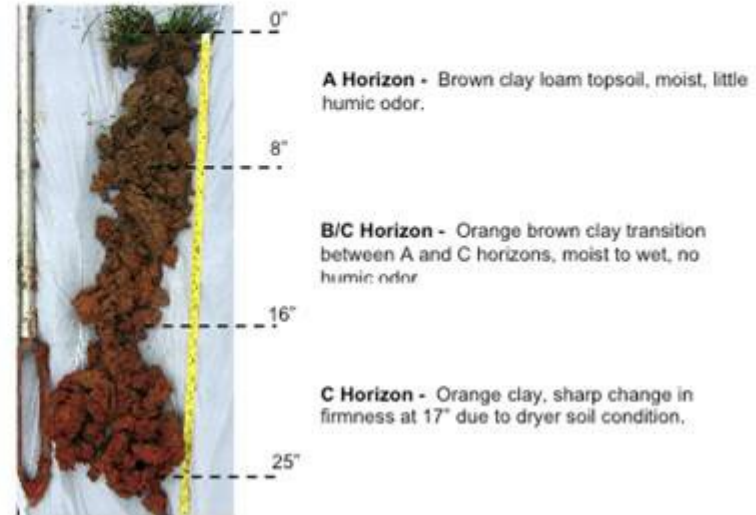
Constantly smell the soil! Sour odor indicates poor drainage



Grey color, poorly draining soil



Pit 3 - Soil Zone C: Good quality lawn, no trees. Soil is poorly drained but not anaerobic.



Soil test results and evaluations:

- Pit 3 - A horizon:** Clay loam soil, low pH (5.8)
This soil is similar to the topsoil found in zone and D. These topsoils are usable as deep soils for trees and for lawns that are not expected to have significant compaction forces or as a base material for sand/soil mix for compaction resistant lawn
- Pit 3 - B/C horizon:** Clay.
This soil could be a useful base to mix with sand and compost in areas of trees, shrubs and or lawns.
- Pit 3 - C horizon:** Soil determined at field evaluation to have too much clay and too compacted to be useful.

Make a soil survey map
Record all the information on a drawing to show the different soil types and soil issues