USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

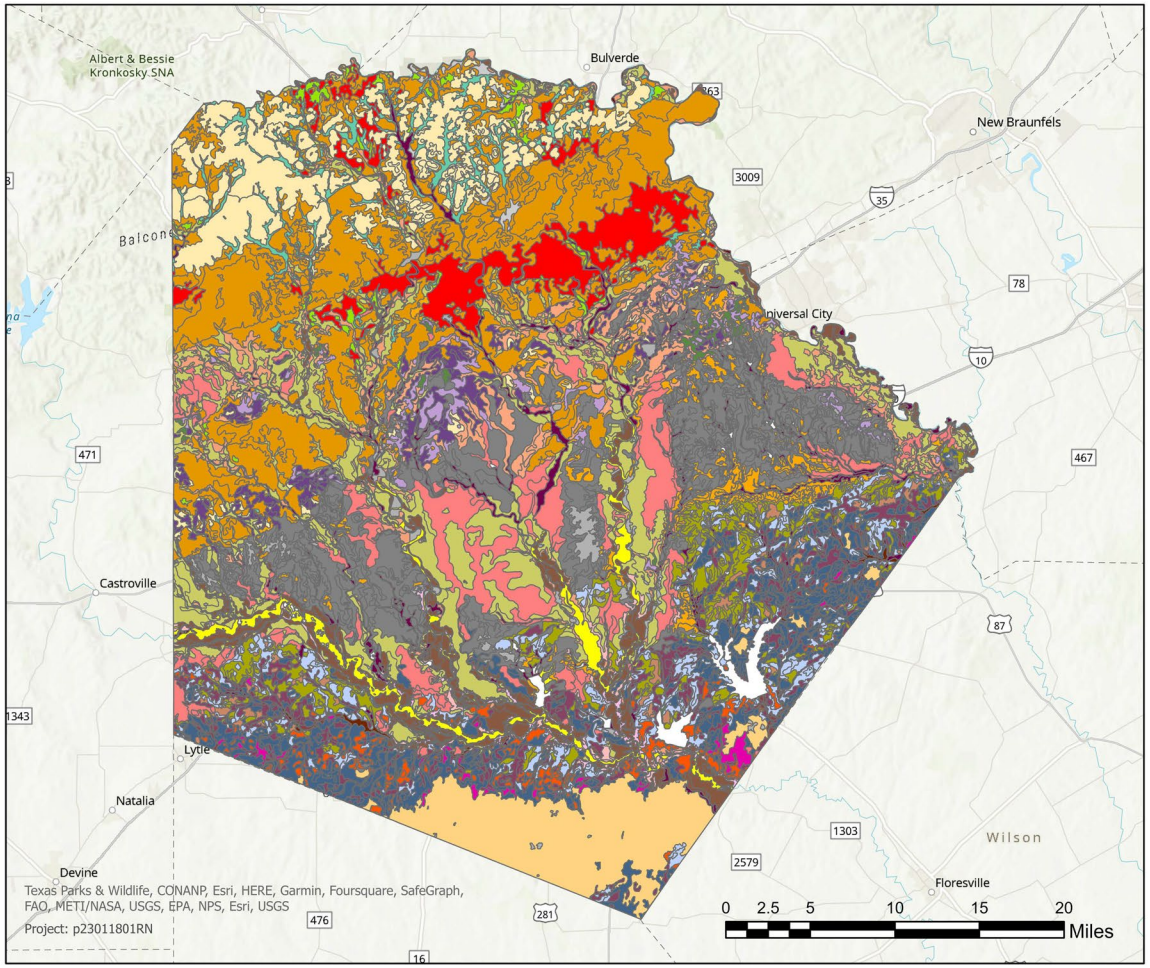
San Antonio Carbon Project

Soil and Plant Science Division | soils.usda.gov
SOIL SCIENCE AND RESOURCE ASSESSMENT

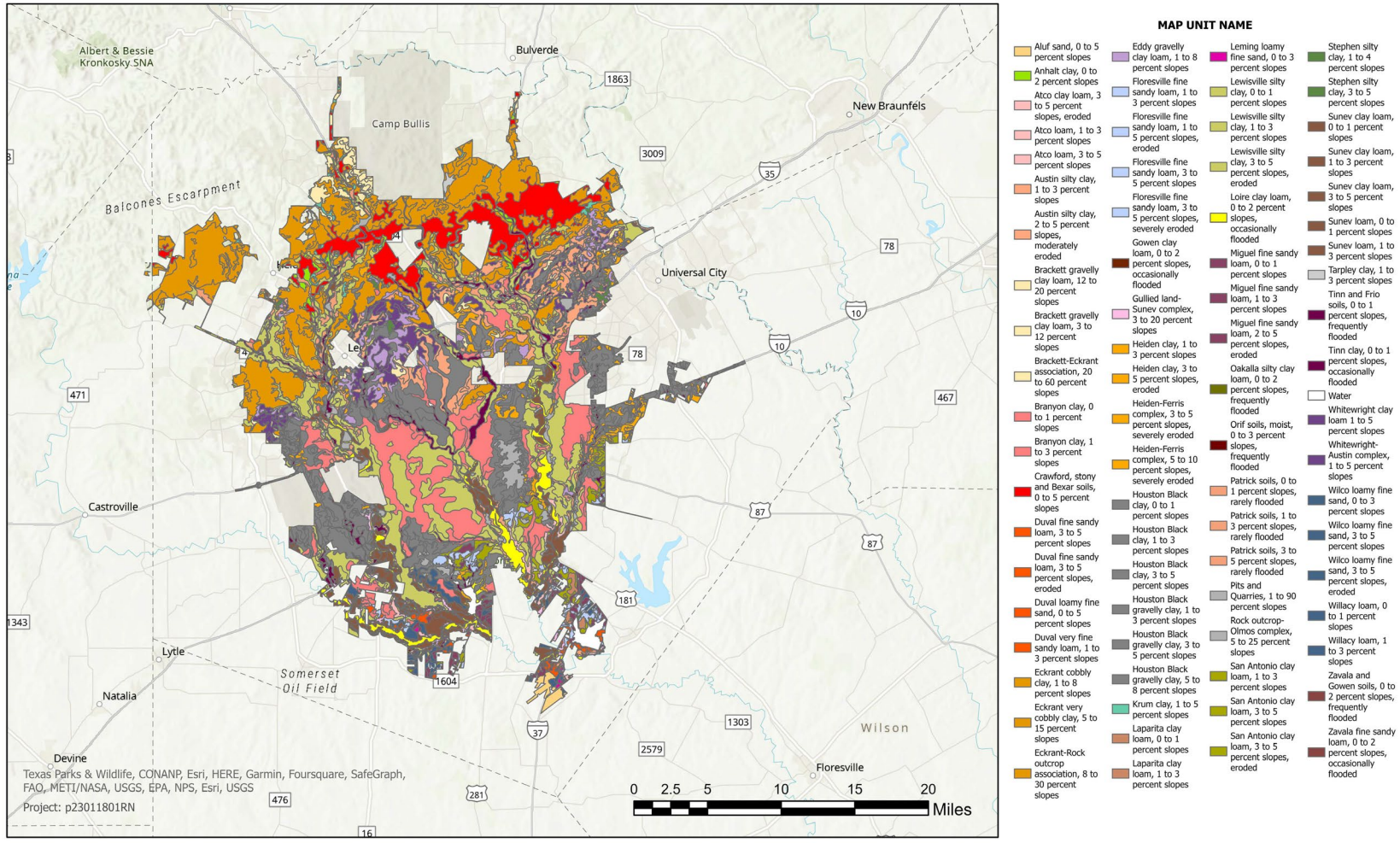
Background

- Meetings—Measure soil organic carbon (SOC) in San Antonio soils
  - Started in late 2018 and early 2019 with Edwards Aquifer Alliance, NRCS Texas, and Soil and Plant Science Division (Kerrville Major Land Resource (MLRA) Office)
  - Subsequent meetings included staff members from the City of San Antonio, such as Parks and Recreation, and a professor from the University of Texas at San Antonio
- Rapid Carbon Assessment Project (RaCA)
- Memorandum of Understanding needed to be created before project began

Soils of Bexar County, Texas



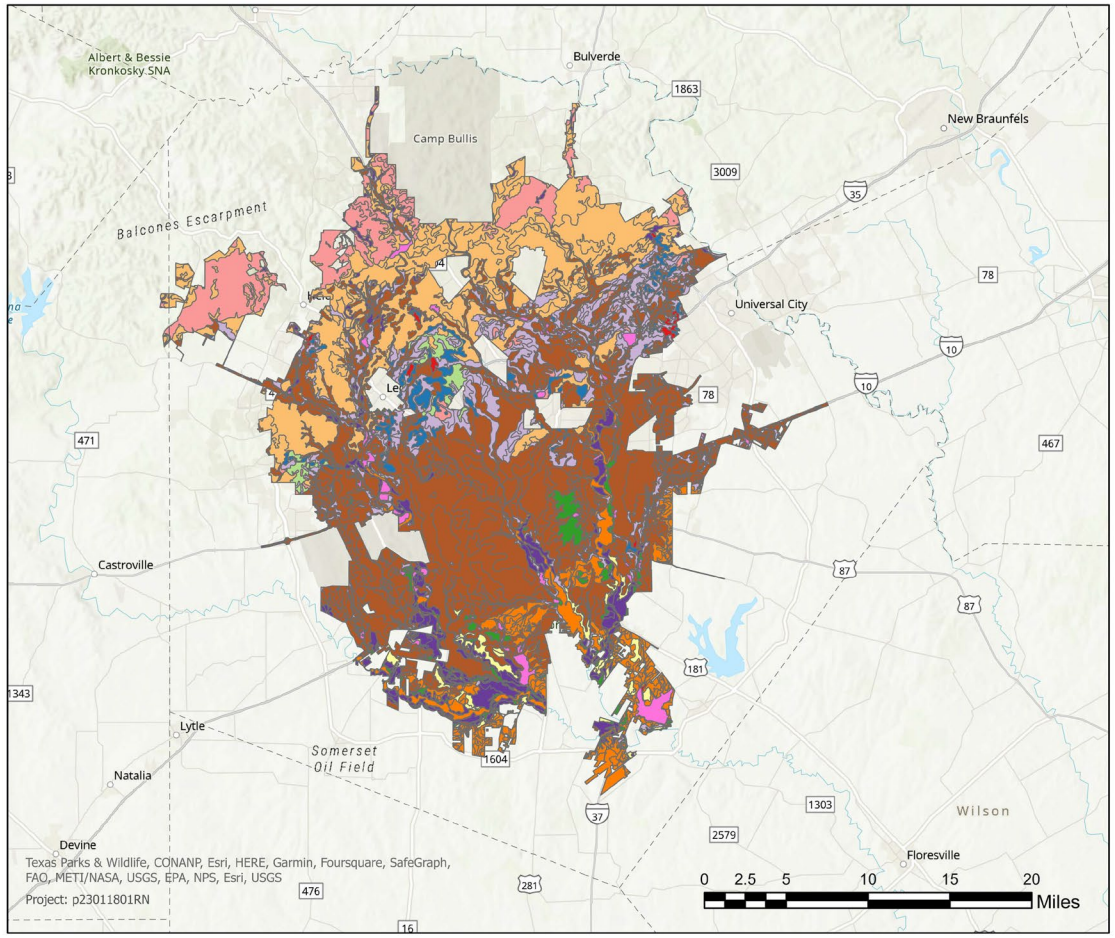
Soils of San Antonio, Texas



MAP UNIT NAME

- Aluf sand, 0 to 5 percent slopes
- Anhalt clay, 0 to 2 percent slopes
- Atco clay loam, 3 to 5 percent slopes, eroded
- Atco loam, 1 to 3 percent slopes
- Atco loam, 3 to 5 percent slopes
- Austin silty clay, 1 to 3 percent slopes
- Austin silty clay, 2 to 5 percent slopes, moderately eroded
- Brackett gravelly clay loam, 12 to 20 percent slopes
- Brackett gravelly clay loam, 3 to 12 percent slopes
- Brackett-Eckrant association, 20 to 60 percent slopes
- Branyon clay, 0 to 1 percent slopes
- Branyon clay, 1 to 3 percent slopes
- Crawford, stony and Bexar soils, 0 to 5 percent slopes
- Duval fine sandy loam, 3 to 5 percent slopes
- Duval fine sandy loam, 3 to 5 percent slopes, eroded
- Duval loamy fine sand, 0 to 5 percent slopes
- Duval very fine sandy loam, 1 to 3 percent slopes
- Eckrant cobbly clay, 1 to 8 percent slopes
- Eckrant very cobbly clay, 5 to 15 percent slopes
- Eckrant-Rock outcrop association, 8 to 30 percent slopes
- Eddy gravelly clay loam, 1 to 8 percent slopes
- Floresville fine sandy loam, 1 to 3 percent slopes
- Floresville fine sandy loam, 1 to 5 percent slopes, eroded
- Floresville fine sandy loam, 3 to 5 percent slopes
- Floresville fine sandy loam, 3 to 5 percent slopes, severely eroded
- Gowen clay loam, 0 to 2 percent slopes, occasionally flooded
- Gullied land-Sunev complex, 3 to 20 percent slopes
- Heiden clay, 1 to 3 percent slopes
- Heiden clay, 3 to 5 percent slopes, eroded
- Heiden-Ferris complex, 3 to 5 percent slopes, severely eroded
- Heiden-Ferris complex, 5 to 10 percent slopes, severely eroded
- Houston Black clay, 0 to 1 percent slopes
- Houston Black clay, 1 to 3 percent slopes
- Houston Black clay, 3 to 5 percent slopes
- Houston Black gravelly clay, 1 to 3 percent slopes
- Houston Black gravelly clay, 3 to 5 percent slopes
- Houston Black gravelly clay, 5 to 8 percent slopes
- Krum clay, 1 to 5 percent slopes
- Laparita clay loam, 0 to 1 percent slopes
- Laparita clay loam, 1 to 3 percent slopes
- Leming loamy fine sand, 0 to 3 percent slopes
- Lewisville silty clay, 0 to 1 percent slopes
- Lewisville silty clay, 1 to 3 percent slopes
- Lewisville silty clay, 3 to 5 percent slopes, eroded
- Loire clay loam, 0 to 2 percent slopes, occasionally flooded
- Miguel fine sandy loam, 0 to 1 percent slopes
- Miguel fine sandy loam, 1 to 3 percent slopes
- Miguel fine sandy loam, 2 to 5 percent slopes, eroded
- Oakalla silty clay loam, 0 to 2 percent slopes, frequently flooded
- Orif soils, moist, 0 to 3 percent slopes, frequently flooded
- Patrick soils, 0 to 1 percent slopes, rarely flooded
- Patrick soils, 1 to 3 percent slopes, rarely flooded
- Patrick soils, 3 to 5 percent slopes, rarely flooded
- Pits and Quarries, 1 to 90 percent slopes
- Rock outcrop-Olmos complex, 5 to 25 percent slopes
- San Antonio clay loam, 1 to 3 percent slopes
- San Antonio clay loam, 3 to 5 percent slopes
- San Antonio clay loam, 3 to 5 percent slopes, eroded
- Stephen silty clay, 1 to 4 percent slopes
- Stephen silty clay, 3 to 5 percent slopes
- Sunev clay loam, 0 to 1 percent slopes
- Sunev clay loam, 1 to 3 percent slopes
- Sunev clay loam, 3 to 5 percent slopes
- Sunev loam, 0 to 1 percent slopes
- Sunev loam, 1 to 3 percent slopes
- Tarpley clay, 1 to 3 percent slopes
- Tinn and Frio soils, 0 to 1 percent slopes, frequently flooded
- Tinn clay, 0 to 1 percent slopes, occasionally flooded
- Water
- Whitewright clay loam 1 to 5 percent slopes
- Whitewright-Austin complex, 1 to 5 percent slopes
- Wilco loamy fine sand, 0 to 3 percent slopes
- Wilco loamy fine sand, 3 to 5 percent slopes
- Wilco loamy fine sand, 3 to 5 percent slopes, eroded
- Willacy loam, 0 to 1 percent slopes
- Willacy loam, 1 to 3 percent slopes
- Zavala and Gowen soils, 0 to 2 percent slopes, frequently flooded
- Zavala fine sandy loam, 0 to 2 percent slopes, occasionally flooded

Soils Groups of San Antonio, Texas

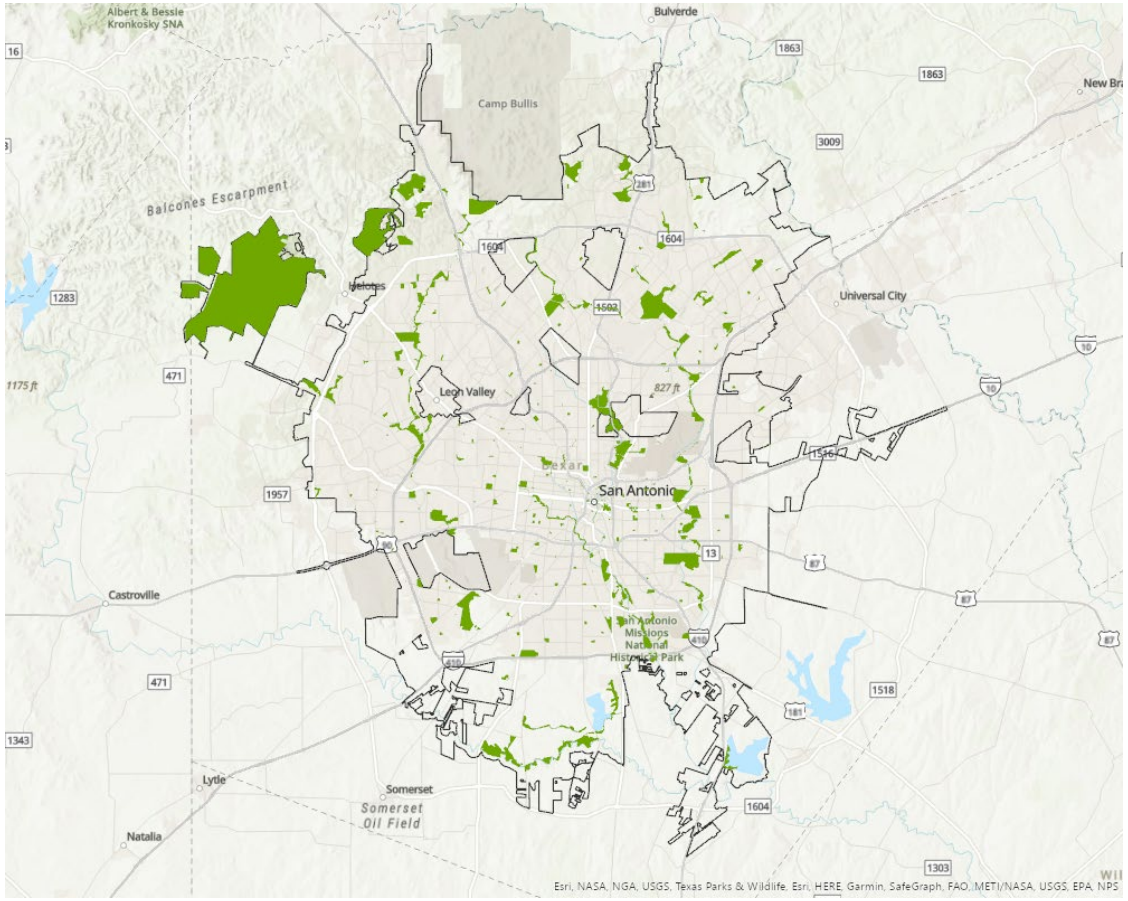


SOIL GROUP

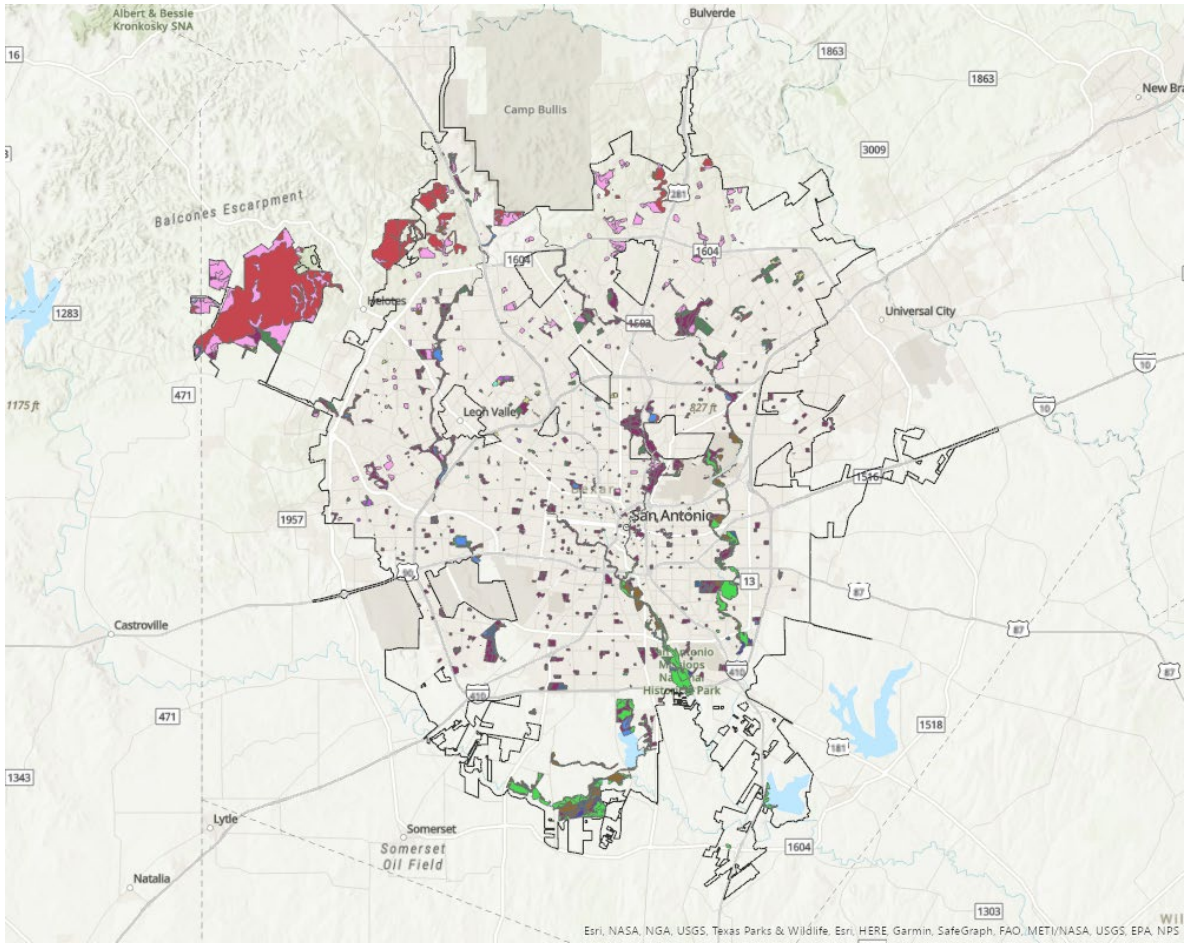
16	41	56
26	43	57
29	46	61
31	51	99
36	53	

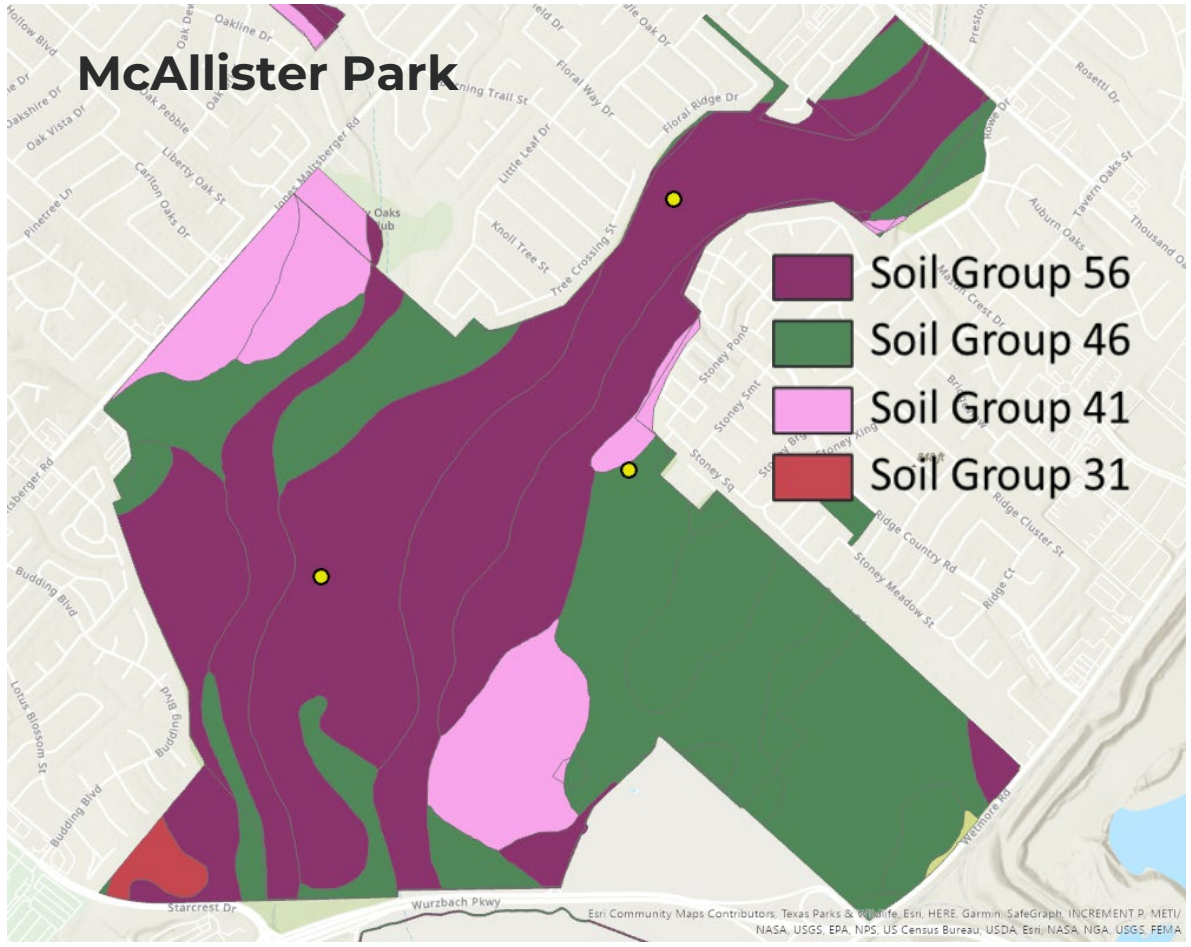
16 – MLRA 86 Shallow Very Low SOC
26 –MLRA 86 Shallow Low SOC
29 – MLRA 81 Low SOC/Rock Outcrop
31 – MLRA 81 Shallow Moderate SOC
36 – MLRA 86 Shallow Moderate SOC
41 – MLRA 81 Shallow Moderately High SOC
43 – MLRA 83 Deep Moderately High SOC
46 – MLRA 86 Deep Moderately High SOC
51 – MLRA 81 Deep High SOC
53 – MLRA 83 Deep High SOC
56 – MLRA 86 Very Deep High SOC
57 – MLRA 87 Very Deep High SOC
61 – MLRA 81 Very Deep High SOC
99 – Miscellaneous Areas (Not Soil)

San Antonio City Parks



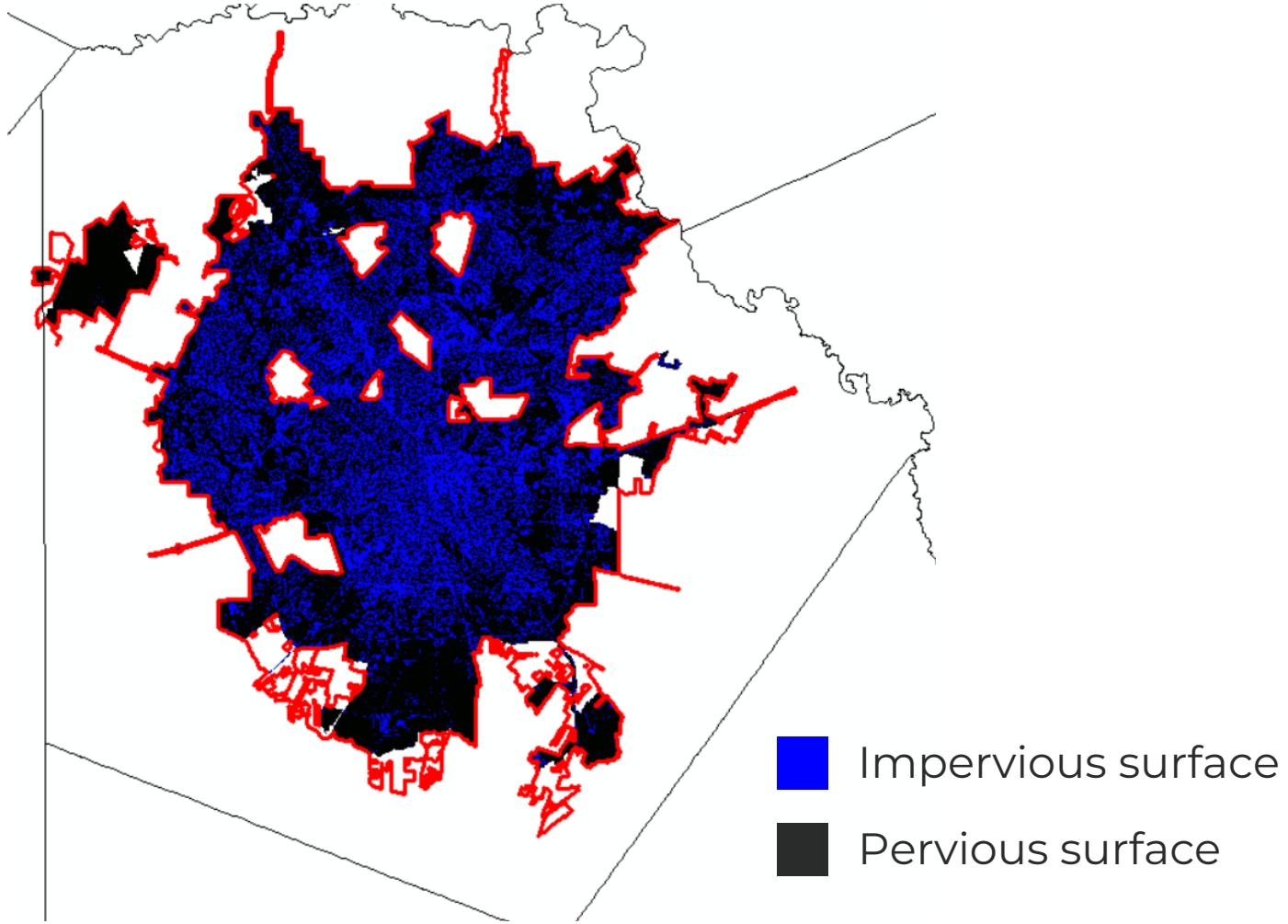
San Antonio City Parks, Schools, Natural Area with Soil Layer





Impervious Surfaces

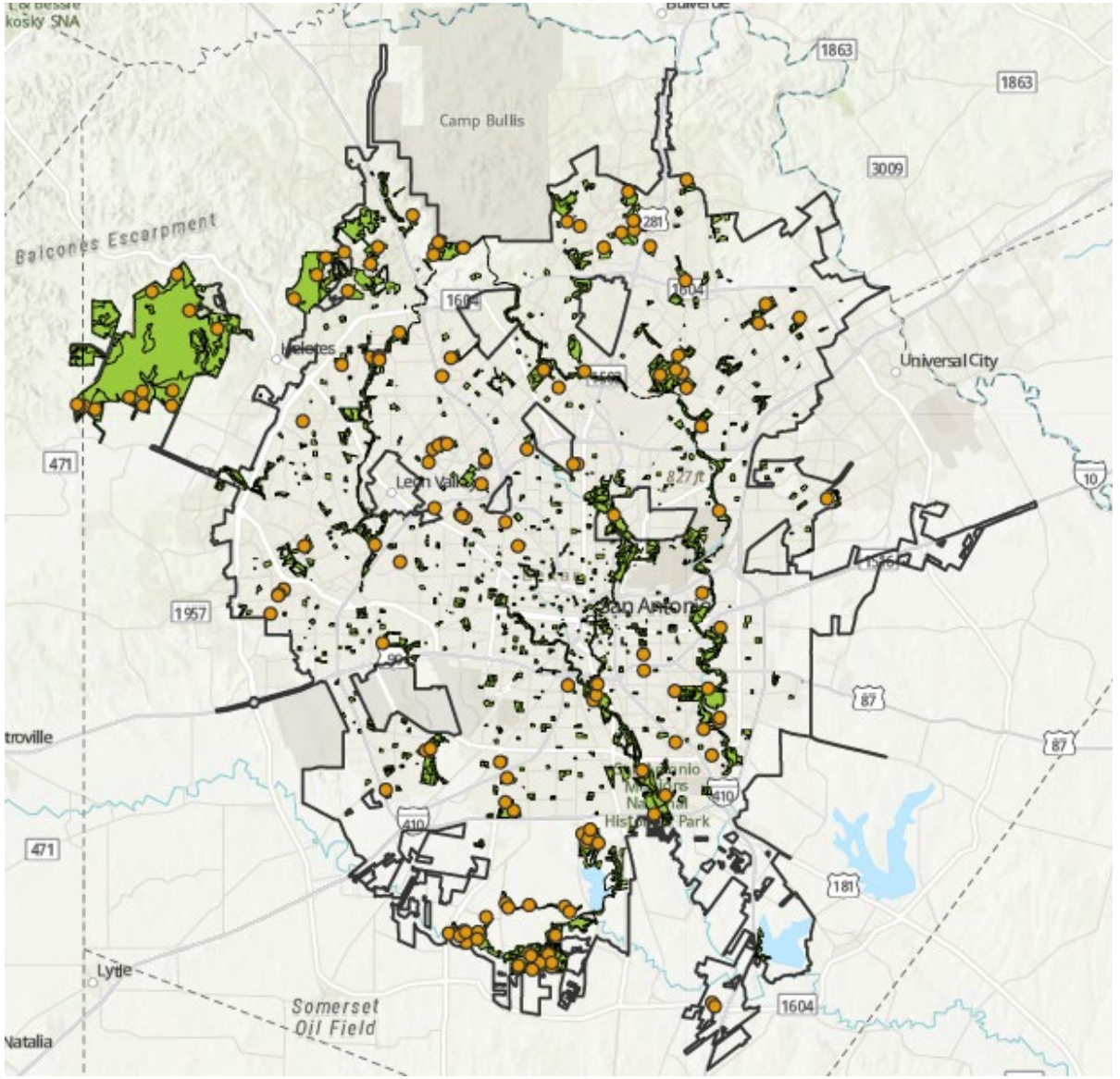
- Impervious 34.2 %
- Pervious 65.8 %



Cultural Resources

Sampling Points

- 13 Soil groups
- 3 land uses
  - Parks
  - Schools
  - Nature reserves
- 35 sites (parks, schools and nature reserves)
  - 32 pits in parks
  - 12 pits in schools
  - 18 pits in nature reserves
- 62 soil pits with 2 satellite pits each for a total of 186 samples
- 766 horizons tested for SOC and inorganic carbon (IC)



Sampling Design

- 1 Site
  - 1 Center Pedon
    - Described to 200-cm or root limiting layer
    - A-horizon: 0–5 cm, 5–10 cm, 10 cm to bottom of A-horizon
    - Sampled by horizon below A
  - 2 Satellite Pedons
    - Described to 50-cm or root limiting layer
    - 3.5 to 10 meters from center pedon
    - A-horizon: 0–5 cm, 5–10 cm, 10 cm to bottom of A-horizon
    - Sampled by horizon below A to 50-cm

Sampling Methods—Soil

- Soil
  - Described to 200-cm or root limiting layer
  - A-horizon: 0–5 cm, 5–10 cm, 10 cm to bottom of A-horizon
  - Sampled by horizon below A

Sampling Methods—Bulk Density

- Bulk Density
  - By sampled layer 0–50 cm
  - Core Method
  - Compliant Cavity Method

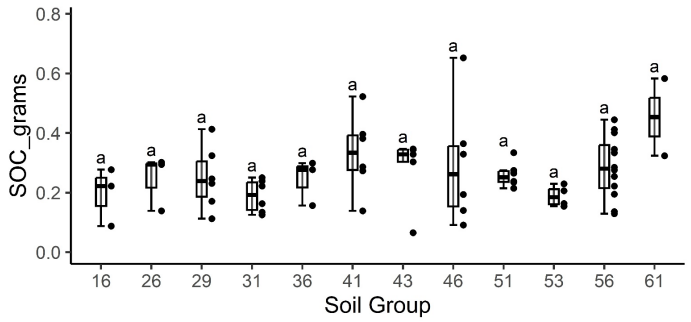
Sample Analysis

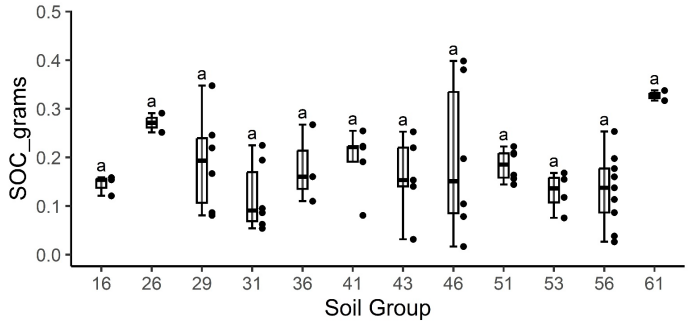
- Incorporated all satellite pit values into the central pit
- Soil Data
  - SOC
  - IC (or $CaCO_3$)
  - Total carbon (Total C or TC)
- Comparison
  - Soil groups
  - Land uses

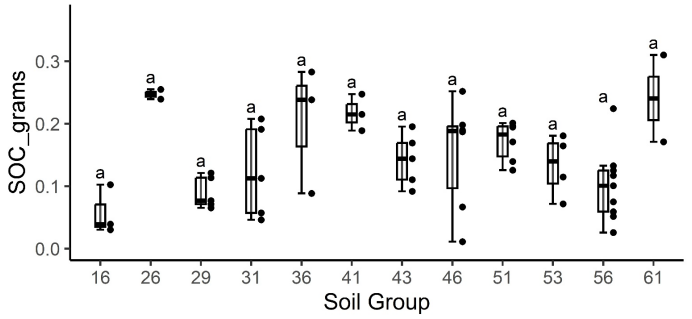
Sample Analysis—Lab Methods

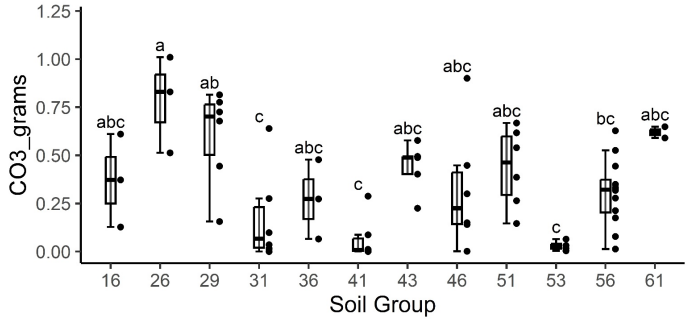
- IC measured using Pressure Calcimeter
- TC measured using Elemental Carbon Analyzer
- OC calculated using TC minus IC

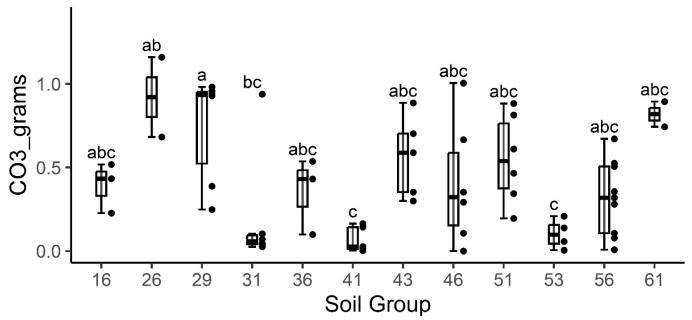
Soil Group Analysis 0 to 30 cm

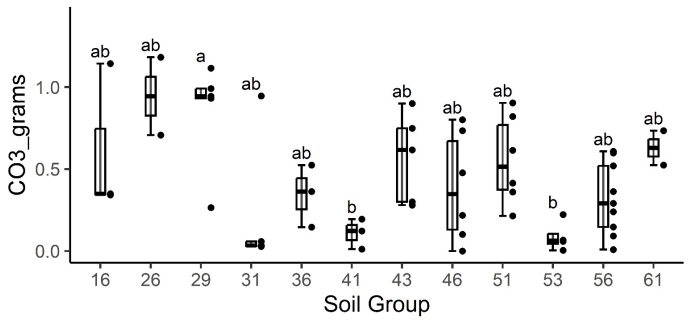


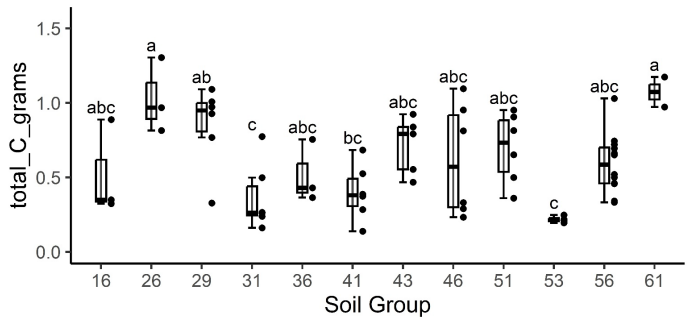


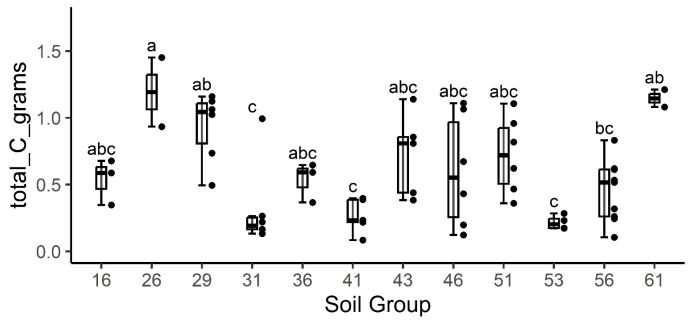


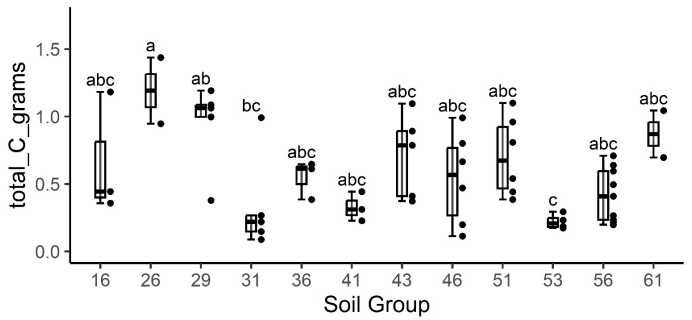






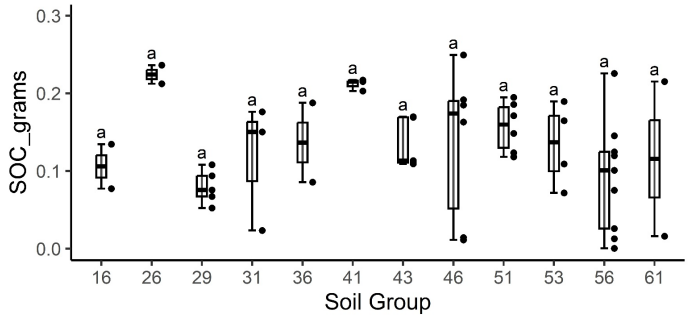


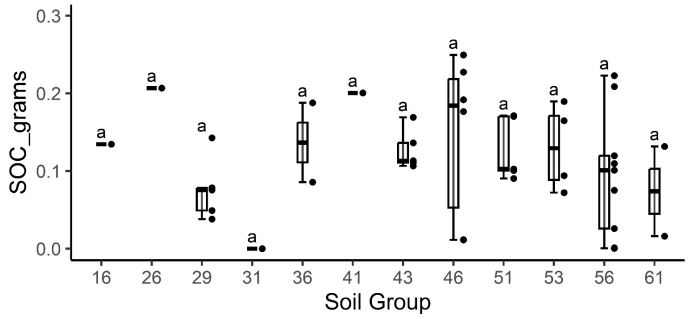


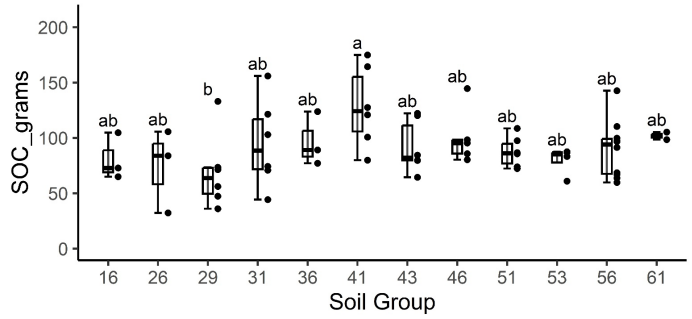


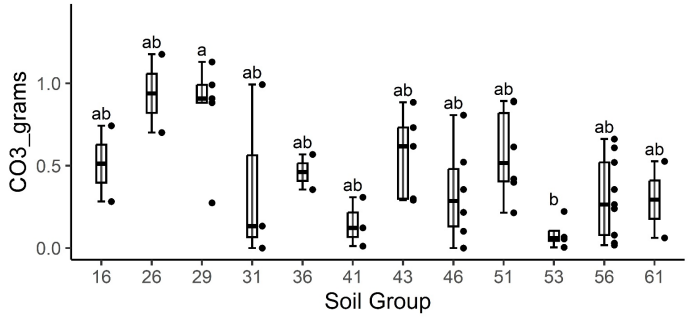
0–10 cm **10–20 cm** **20–30 cm**

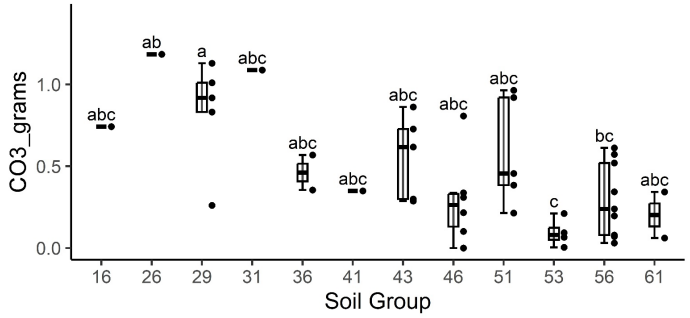
Soil Group Analysis 0 to 50 cm

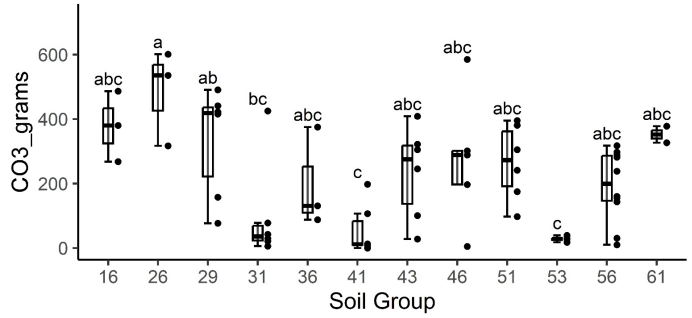


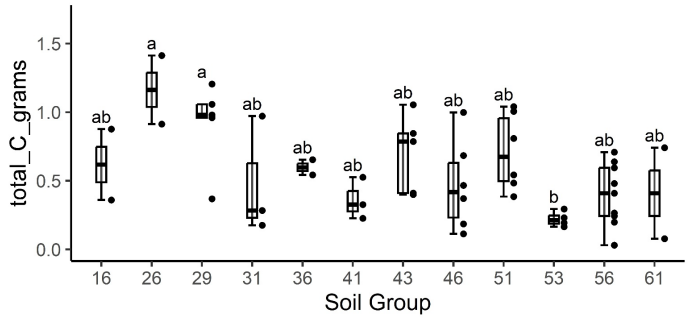


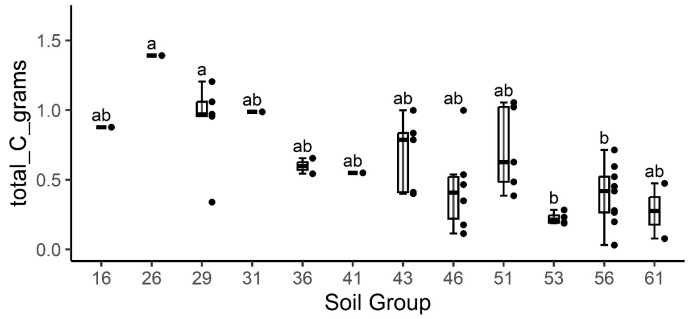


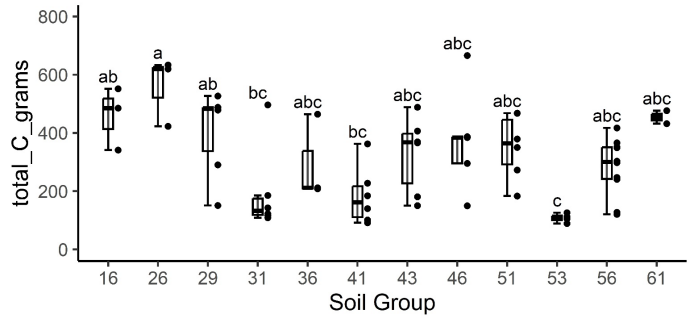






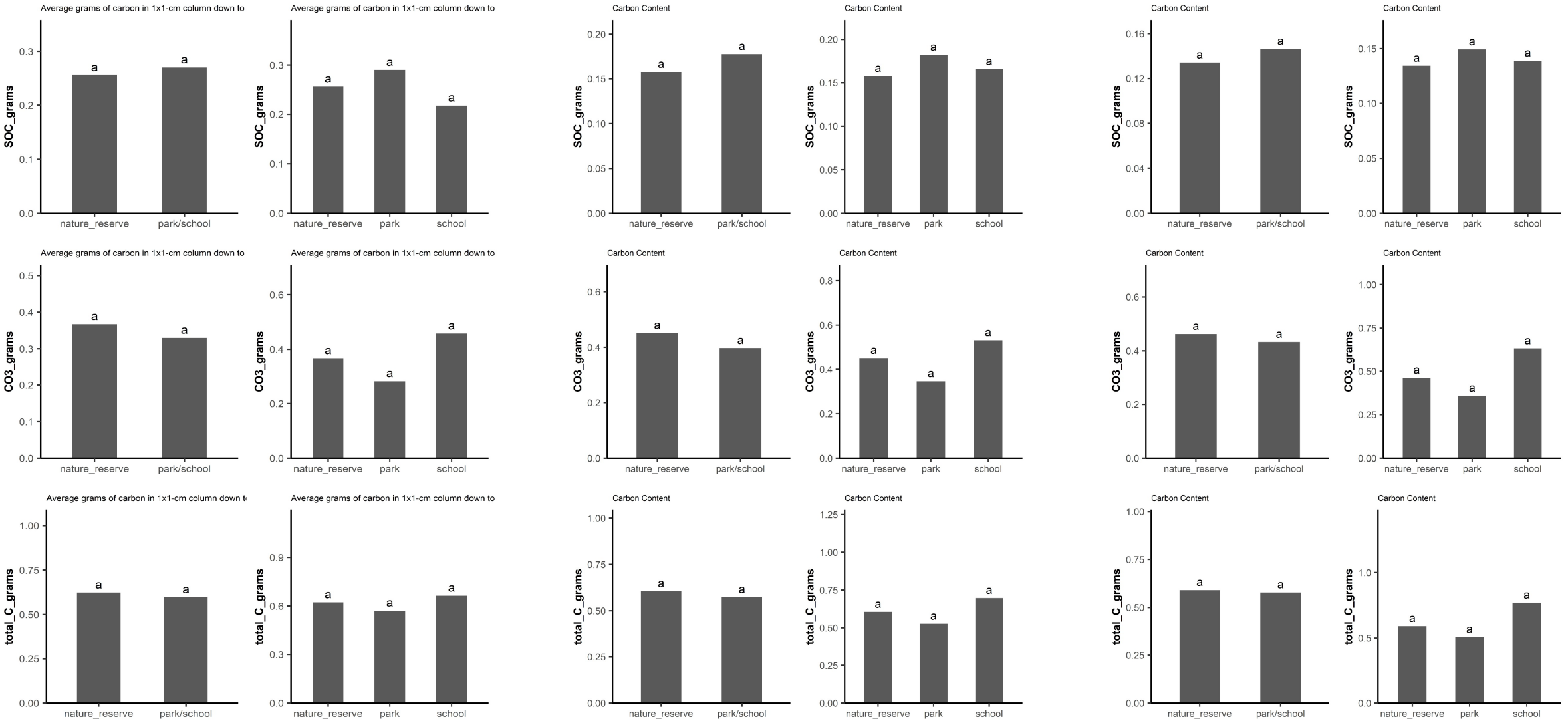






30–40 cm **40–50 cm** **0–50 cm**

Land Use Analysis 0 to 30 cm

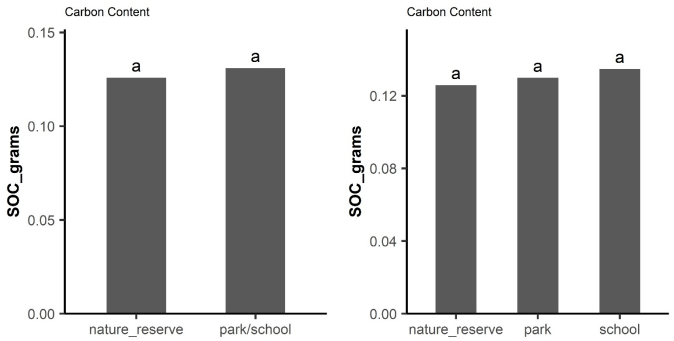


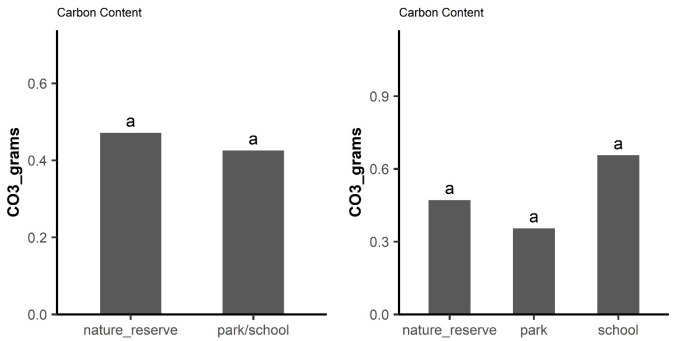
0–10 cm

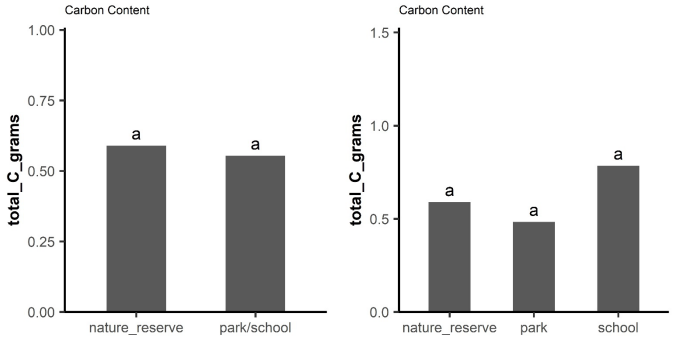
10–20 cm

20–30 cm

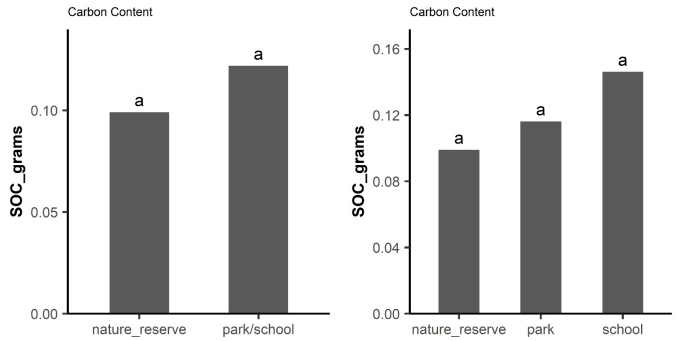
Land Use Analysis 0 to 50 cm

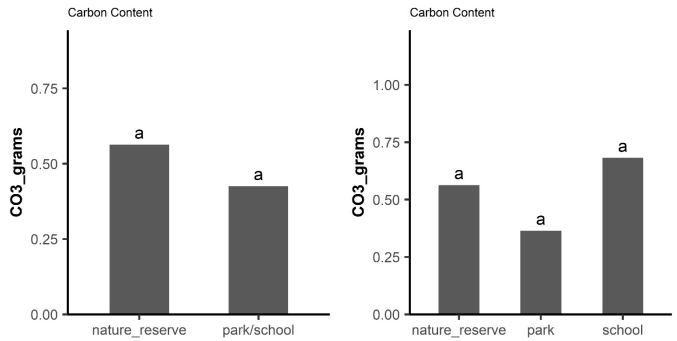


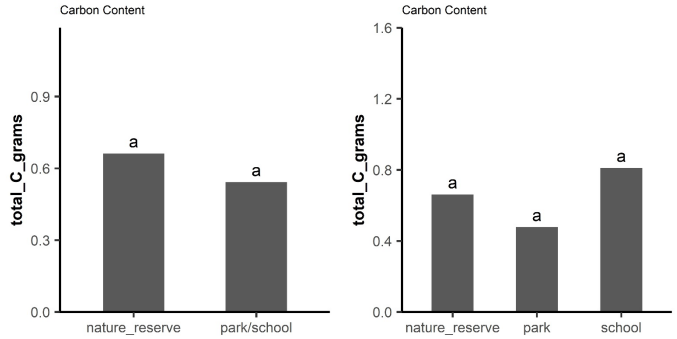




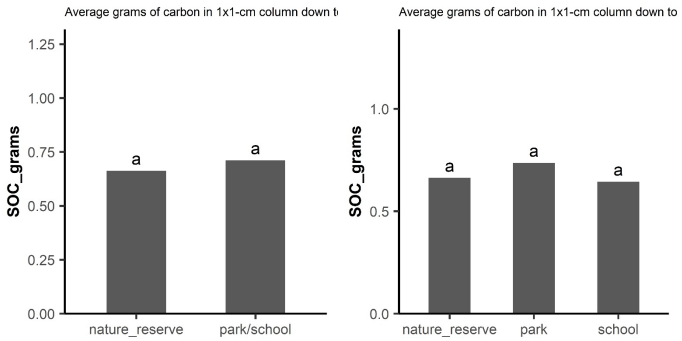
30–40 cm

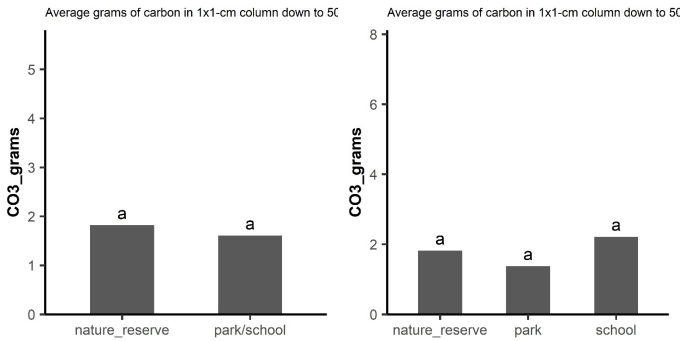


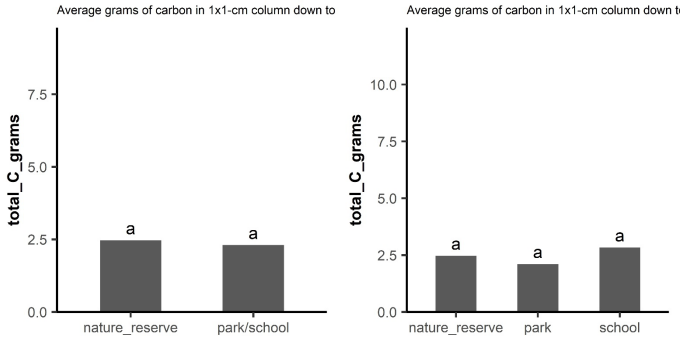




40–50 cm

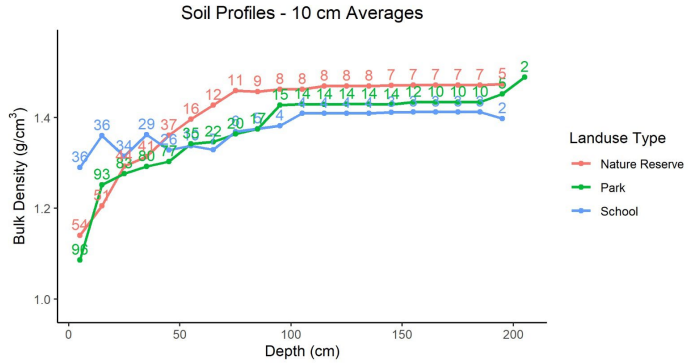


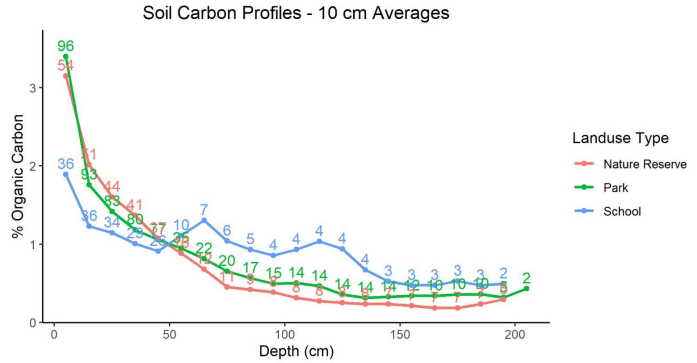


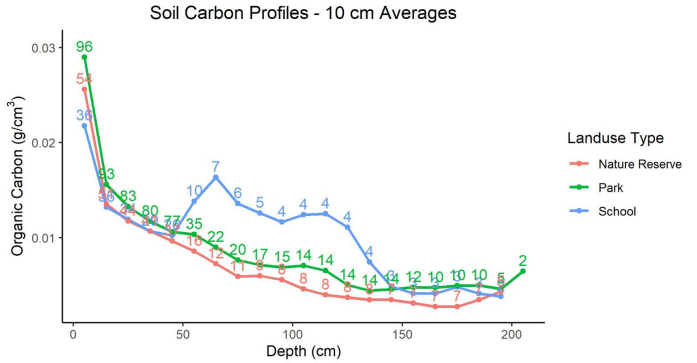


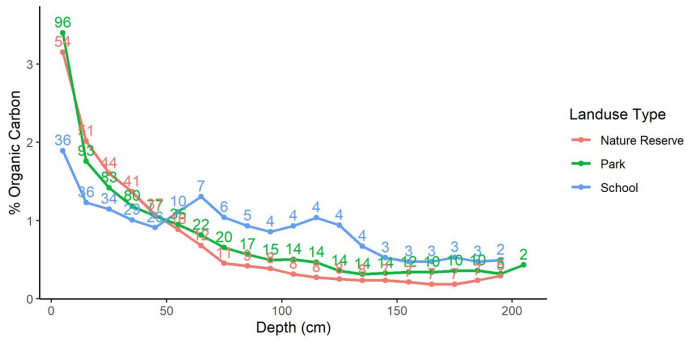
0–50 cm

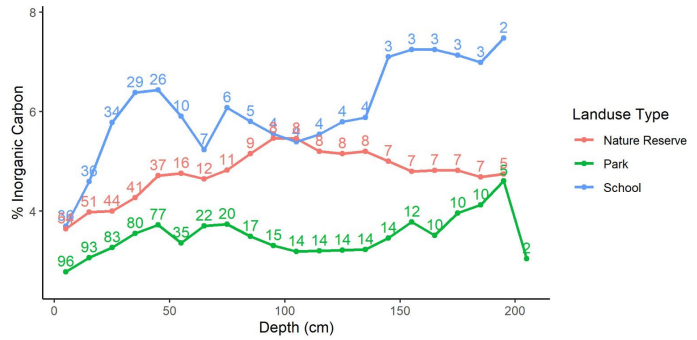
Land Use Analysis 0 to 200 cm

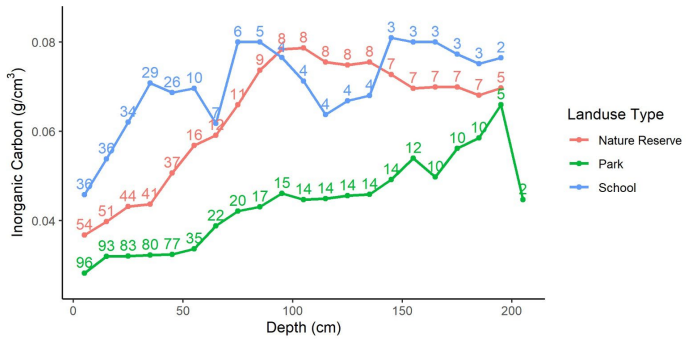


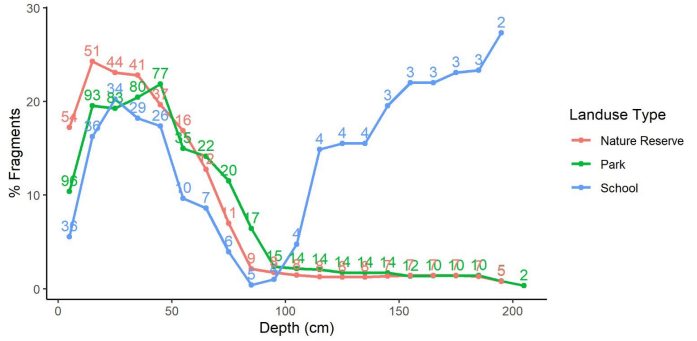


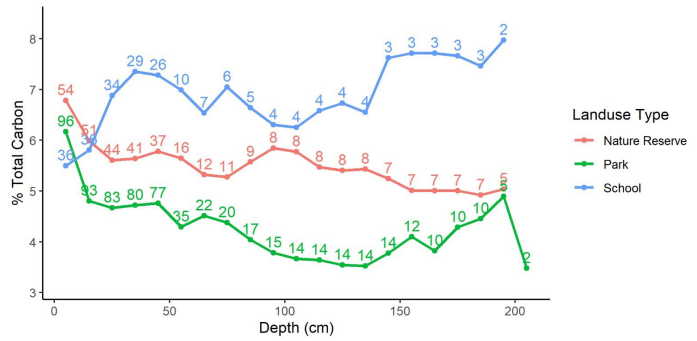


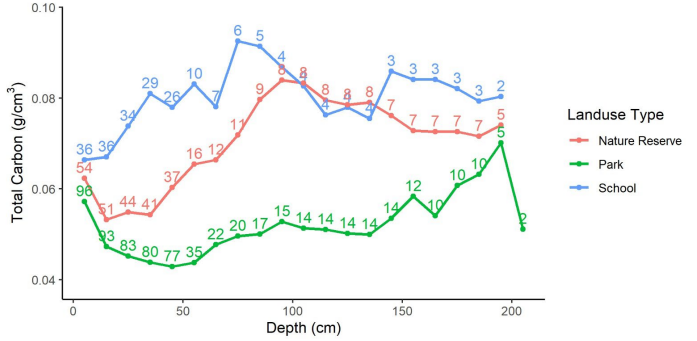












Landuse Type
Nature Reserve
Park
School

Estimated Total Carbon in San Antonio Soils (U.S. tons)

- SOC 5,766,633
- IC 13,758,690
- TC 19,525,324

Questions

Travis Waiser
travis.waiser@usda.gov

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- Check out our YouTube channel @nrcssoilandplantscience

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