"What's In Your Soil?"

A Comparison of Soil Quality in Two Chicago Neighborhoods

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Introduction

Cities have complex land use histories that give rise to heterogeneous soils lacking in organic matter and enriched in nutrients and heavy metals. To date no comprehensive assessment of soil quality has been conducted on soils in the city of Chicago. This poster presents **preliminary results** of comparison of soil quality in two Chicago neighborhoods , Lincoln Park **(LP)** and Grand Crossing **(GC) (Figure 1)**, that are vastly different racially, socio-economically and culturally. Lincoln Park is located on the North Side of Chicago, has a median household income of $84,000, and contains abundant green space. Grand Crossing is a low-income minority neighborhood on Chicago's South Side, has a median household income of $48,000, is located in a food desert and contains abundant abandoned residential lots and a significant lack of green space.

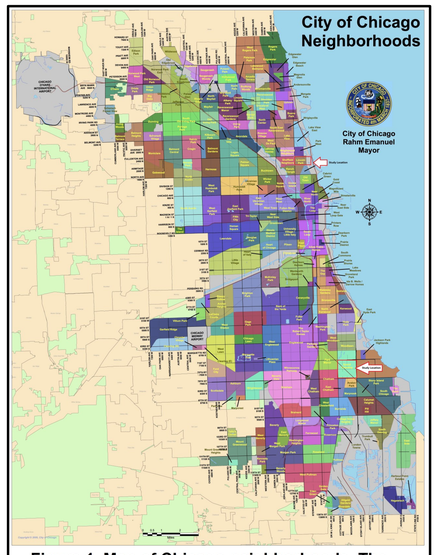


Figure 1. Map of Chicago neighborhoods. The Lincoln Park and Grand Crossing neighborhoods are indicated by the arrows ⇦
(Source: http://www.concingimage.tk/chicago-neighborhood-map-2/

Project Goal

To assess and map spatial patterns in soil quality indicators in residential lawns and gardens in each of Chicago's 77 official neighborhoods using the USDA-NRCS Soil Quality Test Kit (2001).

Figure 2a. Abandoned residential lot littered with demolition debris in Grand Crossing.

Methods

- 124 soil samples were collected from 64 single-family occupied residential properties and 60 parkway locations in LP. 116 soil samples were collected from 4 abandoned residential lots in GC. These lots were littered with glass, metal, bricks, concrete rubble, and other anthropogenic refuse ***(Figure 2A).*** Residential properties in LP are exquisitely landscaped and often professionally maintained ***(Figure 2B),*** while city-owned parkways are variably managed with respect to maintaining soil quality, depending on the neighborhood and homeowner ***(Figure 2C).***
- Soils were analyzed for pH, N-NO_3^-, Mehlic 3 P, microbial respiration (Solvita™)[1] ; texture (hydrometer)[1]; C:N[1], and total Pb and bioavailable (PBET) following the USEPA nitric acid digestion procedure (USEPA Method 3050B, 1996) and a simplified version of the standard Physiologically Based Extraction Test procedure (pH 2.0) developed by Brown and Chaney (1997), respectively. Pb extracts were analyzed using FL-AAS (Varian AA240FS; Agilent Technologies; Santa Clara, CA). Heat maps showing spatial patterns of soil quality indicators were created using Arc-GIS.

Figure 2b. Chicago high school student intern Tyler Shimada collects a soil sample from a professionally landscaped and maintained property in Lincoln Park.

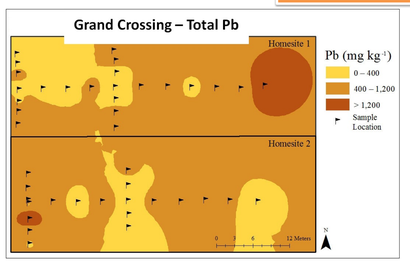
Figure 2c-DePaul environmental science major Jen Thompson collects a soil sample from a parkway in Lincoln Park. This site showed evidence of poor soil quality management.

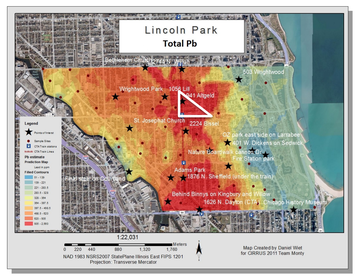
Results

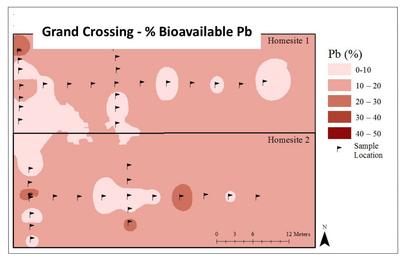
	Total Pb† (mg/kg)		% Bioavailable Pb		pH†		Mehlic 3 P (mg/kg)		NO_3-N† (mg/kg)		C:N	
	LP	GC	LP	GC	LP	GC	LP	GC	LP	GC	LP	GC
Mean	774[a]	535[b]	15.9	11.9	7.57[a]	8.22[b]	128.1	152	16.5[a]	13.2[b]	26.8	29.6
Median	66.3	389	7.9	10.1	7.55	8.25	62.3	97.4	11.5	12.2	19.0	30.3
Sd. Error	579	50.6	2.1	1.2	0.06	0.02	12.5	9.8	1.9	0.7	3.4	1.2
Max.	4446	3023	75.5	1.5	9.66	8.84	995	818.1	176.1	43.9	167.2	55.1
Min.	7.3	23.3	0.0	57.5	6.50	7.46	4.1	16.3	5.2	1.6	9.7	3.7

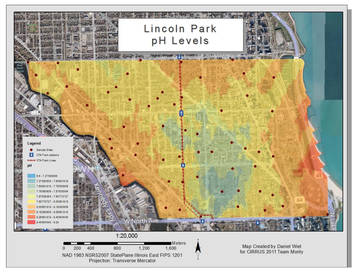
LP = Lincoln Park; GC = Grand Crossing. † indicates significant difference ($p < 0.05$) in mean soil quality indicator values between the neighborhoods. Letters indicate which means are different.

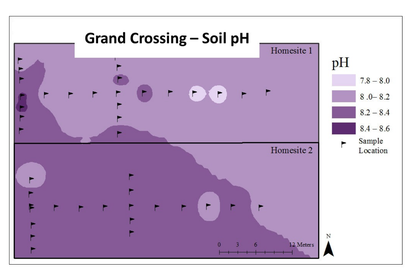
GIS Heat Maps

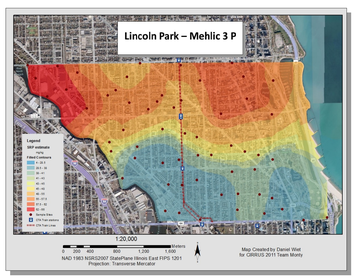


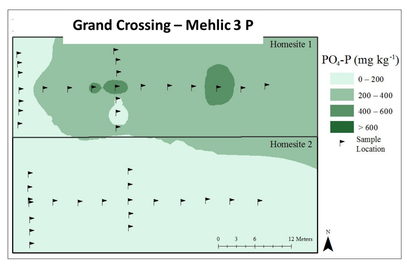


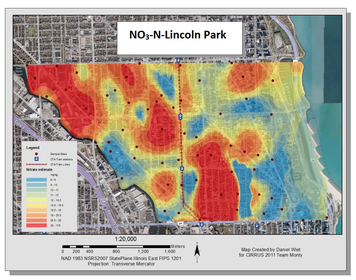


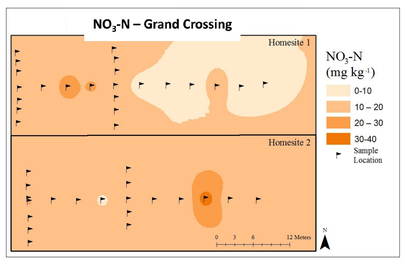












Discussion

- Soils on all lots are classified as urban land-orthents and have developed in earthy fill material on Wisconsin-age ground moraines and lake plains (Soil Survey Staff-Web Soil Survey).
- **Summary statistics and significant differences are shown in the Table.**
- **Heat maps** of soil quality indicators show multi-scalar spatial patterns (individual lot vs neighborhood) reflecting variations in historical land use variable soil management practices by the homeowner. Both LP and GC have a legacy of industrial contamination.
- **Total Pb** - significantly greater in LP compared to GC. The GC heat map shows an isolated region of > 1200 mg kg^{-1} in the NE corner of Homesite 1. This area was a fly dump for lead-acid automobile batteries. The LP heat map **(red region)** shows concentrations > 900 mg kg^{-1}. This region is traversed by three highly trafficked roads and the elevated tracks of the Chicago Transit Authority Red Line train. Sources of Pb include leaded gasoline and sloughing exterior Pb paint from century old homes and elevated track stanchions. The area within the white triangle contains multimillion dollar homes with total Pb > 3500 mg kg^{-1}.
- **% bioavailable Pb** – no significant difference between LP and GC. < 20% of total Pb is bioavailable in both LP and GC.
- **Soil pH** – significantly greater in GC than LP. The GC heat map shows greater pH in Homesite 2. Homesite 2 contained more concrete demolition debris than Homesite 1. The LP heat map shows pH > 8.45 in the eastern portion of the neighborhood, adjacent to Lake Shore Drive, and in the northwest corner of the neighborhood, on the grounds of the Lathrop Homes public housing complex.
- **Mehlic 3 P** – no significant difference between LP and GC. The GC heat map shows a greater concentration throughout Homesite 1 compared to Homesite 2, perhaps reflecting differences in lawn maintenance. The heat map for LP shows an isolated region of > 60 mg kg^{-1} in the northwest corner of the neighborhood, on the grounds of the Lathrop Homes public housing complex noted for its well manicured and fertilized lawns!
- **NO_3-N** – significantly greater in LP than in GC. The LP heat map shows isolated patches of elevated (35-180 mg kg^{-1}) NO_3-N. Patchiness may be related to site variation in lawncare practices. The GC heat map shows a large patch of < 10 mg kg^{-1} NO_3-N in the northeast corner of Homesite 1. This area is a bare patch of soil covered with demolition debris.

References

[1] Data not shown in this poster
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4. **USDA-NRCS. Soil Survey Staff. Web Soil Survey**. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

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