Category	Site	Sample
Raised bed	1	1-RB
Raised bed	3	3-RB
Raised bed	4	4-RB
Raised bed	5	5-RB
Raised bed	6	6-RB
Raised bed	7	7-RB
Cultivated native soil	1	1-CN
Cultivated native soil	2	2-CN
Cultivated native soil	5	5-CN
Cultivated native soil	7	7-CN
Uncultivated native soil	1	1-UN
Uncultivated native soil	2	2-UN
Uncultivated native soil	3	3-UN
Uncultivated native soil	4	4-UN
Parking lot	3	3-PL
Parking lot	4	4-PL
Compost	2	2-C
Compost	3	3-C
Compost	6	6-C
Hotspot	1	HS-1
Hotspot	1	HS-2
Hotspot	1	HS-3
Hotspot	1	HS-4

Table S1. Sample description and nomenclature used in the manuscript.

**Table S2.** Concentration of 1M HNO<sub>3</sub> extracted metals for soil samples collected from Sites 1-7 and comparison to New Jersey Department of Environmental Protection (NJDEP) Residential Direct Contact Soil Remediation Standard (RDCSRS) values.

Community	Average Metal Concentration							
Sample	(mg kg-1)							
	Cd	Cu	Zn	Pb				
NJDEP RDCSRS	78	3100	23,000	400				
1-RB	0.03	19.22	20.86	173.65				
1-UN	0.32	31.08	106.35	830.29				
1-CN	0.61	86.56	173.13	141.28				
2-UN	0.22	10.03	90.66	163.47				
2-CN	0.09	14.97	34.77	82.32				
2-C	0.00	14.56	66.16	71.9				
3-RB	6.04	207.68	2332.05	60.65				
3-UN	7.80	359.92	2776.84	423.11				
3-PL	8.92	296.61	3410.15	438.07				
3-C	3.62	159.53	452.12	368.91				
4-RB	0.30	7.88	44.83	30.48				
4-UN	0.49	6.80	66.02	127.03				
4-PL	0.35	8.96	54.7	86.19				
5-CN	0.05	3.73	103.96	23.94				
5-RB	0.09	2.52	408.38	23.18				
6-RB	0.04	1.82	72.61	38.85				
6-C	0.05	4.43	253.61	309.51				

7-RB	0.06	2.32	391.04	21.64
7-CN	0.03	1.28	77.63	539.89

Anthropogenic Pb extracted using 1 M HNO<sub>3</sub> can be correlated to total Pb (Pb<sup>Total</sup>), as determined by a standard acid digestion technique, by the equation [50]:

**Pb** (total) = 1.317 Pb (1 M HNO<sub>3</sub>) + 0.606 
$$r^2 = 0.933$$
 (1)

Using Equation 1 as a guideline, 1 M HNO<sub>3</sub> concentrations are likely to underestimate Pb<sup>Total</sup>. By ~33%. Therefore, all samples with 1 M HNO<sub>3</sub> extractable Pb > 400 mg kg<sup>-1</sup> are also likely to have Pb<sup>Total</sup> > 400 mg kg<sup>-1</sup>, exceeding the NJDEP RDCSRS limit. Overall, the results from the 1 M HNO<sub>3</sub> extraction represent a potential minimum Pb concentration and are therefore compared with the NJDEP RDCSRS limit throughout the manuscript.



Figure S1. Single-step (1 M HNO<sub>3</sub>) extractable concentration of (a) Cd, (b) Cu, and (c) Zn in samples.

CF	Extent of contamination	Class Igeo		Classification
<2	None	0	<0	Uncontaminated
1–3	Moderate	1	0–1	Uncontaminated to moderately contaminated
3–6	Considerable	2	1–2	Moderately contaminated
>6	Very high	3	2–3	Moderate to strongly contaminated
		4	3–4	Strongly contaminated
		5	4–5	Strongly to extremely contaminated
		6	>5	Extremely contaminated

Table S3. Classification based on Contamination factor (CF) and geoaccumulation index (Igeo).

**Table S4.** Calculated mean and median concentration of Pb (in mg kg<sup>-1</sup>) across sites and categories for single-step extractions. The mean and median value for all samples is indicated in italics.

Calculated Pb Concentration (mg kg <sup>-1</sup> )								
Site	Mean	Median	Category	Mean	Median			
1	381.74	173.65	С	250.10	309.50			
2	105.89	82.32	CN	196.85	111.80			
3	322.68	396.01	PL	262.13	262.13			
4	81.23	86.19	RB	57.93	34.24			
5	23.56	23.56	UN	385.97	293.29			
6	173.75	173.75	All Commlas	Mean	Median			
7	280.76	280.76	All Samples	208.07	127.03			

Table S5. Average Pb concentration in soil fractions for all samples collected in the study.

Sample	Average Pb Concentration (mg kg <sup>-1</sup> )						
	Exchangeable	Acid-soluble	Reducible	Oxidizable			
1-RB	44.40	538.00	298.35	121.44			
1-UN	210.60	625.13	666.40	290.68			

1-CN	105.04	555.25	257.45	63.20
2-UN	169.56	558.88	255.40	44.12
2-CN	140.16	544.50	238.2	32.28
2-C	161.36	551.13	200.85	19.68
3-RB	1.18	88.73	425.61	214.15
3-UN	5.33	948.28	1935.94	303.94
3-PL	14.16	703.34	3001.59	1246.13
3-C	14.83	322.39	1494.99	2226.53
4-RB	0.14	0.00	0.00	0.04
4-UN	30.66	19.16	11.66	10.33
4-PL	10.99	7.31	55.63	57.38
5-CN	0.00	0.00	2.39	8.25
5-RB	0.00	0.00	2.11	8.39
6-RB	0.00	0.00	1.05	6.06
6-C	0.00	0.00	10.24	20.49
7-RB	0.00	0.00	90.03	14.11
7-CN	10.76	32.94	2.11	87.05

**Table S6.** Calculated median concentration of Pb (in mg kg<sup>-1</sup>) across categories for sequential extractions. The median values for all samples in each fraction is indicated in italics.

Category	Median Pb in Soil Fractions (mg kg <sup>-1</sup> )						
	Exchangeable	Acid-soluble	Reducible	Oxidizable			
С	14.83	322.38	200.85	20.49			
CN	57.89	288.72	120.29	47.74			
PL	12.57	355.32	1528.61	651.75			
RB	0.10	0.00	46.01	11.24			
UN	100.11	592	460.90	167.40			
All Samples	10.99	88.72	200.85	44.12			

Ň



**Figure S2.** Sampling scheme implemented in Site 1 to generate samples (HS 1-4) for identifying Pb hotspot.

**Table S7.** Extractable Pb concentration, and Pb associated with soil fractions collected for hotspot(HS) identification.

Sample	Pb concentration (mg kg <sup>-1</sup> )									
	1 M HNO3	Exchangeable	Acid-soluble	Reducible	Oxidizable					
HS-1	390.34	7.40	20.45	113.65	101.36					
HS-2	3405.39	57.13	410.19	1181.68	625.31					
HS-3	142.27	19.91	12.35	47.20	12.01					
HS-4	73.30	1.44	3.23	15.25	21.53					

Table S8. Extractable Pb concentration in various particle size fractions of selected samples.

Sample		Pb in Particle Size Fraction (mg kg-1)							
	2 mm	1 mm	0.6 mm	0.25 mm	0.125 mm	<0.125mm			
1-UN	830.29	N/A*	842.96	862.74	848.02	809.99			
3-UN	423.11	N/A*	422.61	366.67	427.49	535.95			
3-PL	438.07	N/A*	377.75	372.35	486.31	532.57			
HS-2	3405.39	4197.24	3135.51	3791.80	4258.41	4375.00			

\*Quantity of 1 mm fraction obtained after sieving was negligible to use in extraction.

**Table 9.** The structural parameters derived from EXAFS analysis of samples including error reported in analysis (shown in italics).

Sample	Shell CN		R (Å) $\sigma^2$ (Å <sup>2</sup> )		Eo	<b>R</b> Factor
	0	1	2.16 (0.023)	0.005 (0.001)		
1-UN	0	1	2.36 (0.017)	0.006 (0.001)	-3.84	0.018
	С	1	3.34 (0.071)	0.010 (0.008)		

110.0	0	1	2.24 (0.010)	0.0007 (0.001)	2 (0	0.000
H5-2	Ο	2	2.41(0.012)	0.006 (0.001)	-3.60	0.006
LIC 2 Tession 1	Ο	1	2.25 (0.018)	0.001 (0.001)	( )5	0.012
H5-2 Tessier I	Ο	2	2.43 (0.024)	0.008 (0.001)	-6.35	0.013
UC 2 Tossion 2	Ο	1	2.23 (0.015)	0.003 (0.001)	-9 72	0.006
115-2 Tessiel 2	0	2	2.42 (0.015)	0.009 (0.001)	-0.75	0.000
	Ο	1	2.16 (0.000)	0.004 (0.000)		
HS-2 Tossior 3	Ο	1	2.38 (0.000)	0.007 (0.000)	_9 90	0.019
115-2 1655161 5	Pb	1	2.96 (0.022)	0.008 (0.002)	).)0	0.017
	Pb	1	4.04 (0.050)	0.008 (0.006)		
HS-2 Tessior 4	0	2	2.30 (0.036)	0.008 (0.003)	-8 16	0.07
110 2 1035101 4	0	2	2.47 (0.022)	0.014 (0.001)	0.10	0.07
HS-2.1 mm	0	1	2.23 (0.010)	0.001 (0.0009)	-4 71	0.001
	0	2	2.40 (0.011)	0.006 (0.001)	1.7 1	0.001
	0	1	2.23 (0.013)	0.001 (0.001)		
HS-2 0.6 mm	0	2	2.39 (0.014)	0.007 (0.001)	-5.32	0.010
	Pb	1	3.83 (0.024)	0.009 (0.002)		
HS-2 0.25 mm	Ο	1	2.24 (0.018)	0.002 (0.001)	-5.47	0.011
	0	2	2.40 (0.018)	0.008 (0.002)	0.17	0.011
HS-2 0 125 mm	0	1	2.26 (0.012)	0.001 (0.001)	-5.12	0.008
	0	2	2.42 (0.016)	0.008 (0.001)	0.12	0.000
HS-2 <0 125 mm	Ο	1	2.25 (0.016)	0.002 (0.001)	-4 14	0.017
	0	2	2.42 (0.018)	0.008 (0.001)	1.1.1	0.017
7-CN	Ο	1	2.19 (0.043)	0.017 (0.010)	-7.37	0.019
	0	2	2.30 (0.017)	0.010 (0.002)		01015
3-UN	Ο	1	2.25 (0.019)	0.003 (0.001)	-6.01	0.019
	0	1	2.40 (0.034)	0.008 (0.003)	0.01	
	0	2	2.28 (0.000)	0.006 (0.000)		
3-UN 0.6 mm	Ο	2	2.53 (0.019)	0.019 (0.004)	-5.63	0.019
	Pb	1	2.89 (0.037)	0.008 (0.004)	0100	01015
	Pb	1	3.29 (0.025)	0.009 (0.003)		
	0	1	2.23 (0.019)	0.004 (0.001)		
3-UN 0.125 mm	0	1	2.39 (0.029)	0.007 (0.003)	-6.67	0.017
	Pb	1	3.74 (0.043)	0.014 (0.005)		
3-UN <0.125 mm	0	1	2.23 (0.012)	0.001 (0.001)	-5.011	0.019
	0	1	2.40 (0.000 )	0.003 (0.002)		
	0	1	2.21 (0.000)	0.004 (0.000)		
3-PL	0	1	2.37 (0.019)	0.010 (0.001)	-1.93	0.015
	Pb	1	3.66 (0.029)	0.008 (0.003)		
	0	2	2.32 (0.004)	0.004 (0.0003)		
3-PL 0.6 mm	O	1	2.54 (0.000)	0.003 (0.000)	-4.59	0.016
	Pb	1	2.94 (0.039)	0.013 (0.004)		
	Pb	1	3.18 (0.016)	0.008 (0.002)		
	0	2	2.33 (0.004)	0.005 (0.0003)		
3-PL 0.125 mm	0	1	2.56 (0.000)	0.006 (0.000)	-2.611	0.006
	Pb	2	2.97 (0.021)	0.016 (0.002)		
	Pb	1	3.21 (0.008)	0.004 (0.001)		
	0	1	2.21 (0.010)	0.003 (0.0008)		
3-PL <0.125 mm	0	1	2.42 (0.000)	0.010 (0.000 )	1.62	0.019
-	Pb	1	3.72 (0.038)	0.009 (0.004)		
	Pb	1	4.01 (0.065)	0.013 (0.009)		



**Figure S3.** Raw (solid) and corresponding fitted (dashed) (a)  $k^3$ -weighted  $\chi$  spectra, and (b) radial structure functions obtained via Fourier transforming the raw  $k^3$ -weighted spectra for samples (\*marked samples denote composite 2 mm fractions).

Table S10. EXAFS parameters for Pb compounds from the literature and analyzed soil samples.

Surface	Pb-O refer- ence (Å)	Refer- ence	Sample	Pb-O Sample (Å)	Sorption Model	Pb-X Sam- ple (Å)
PbSiO₃	2.27	73	1-UN	2.32	Birnessite + hydroxy pyromorphite	√- X = C, 3.32

Pb (CH <sub>3</sub> ) <sub>4</sub>	2.24		HS-2 Tessier 2	2.37	Humic acid	
Goethite	2.27	74	HS-2	2.32	Birnessite + hydroxy- pyromorphite	
Hematite	2.28		HS-2 Tessier 1	2.34	Hydroxypyromor- phite	
Feldspar	2.28		HS-2 Tessier 3	2.27	Geothite	X = Pb, 3.50
Birnessite	2.30		HS-2 Tessier 4	2.38	Humic acid	
Humic-acid	2.38		HS-2 1 mm	2.31	Birnessite + hydroxy- pyromorphite	
Hydrocer- rusite	2.29	75	HS-2 0.6 mm	2.31	Hydroxypyromor- phite	X = Pb, 3.83
Litharge	2.30		HS-2 0.25 mm	2.32	Birnessite + hydroxy- pyromorphite	
Cerussite	2.66	-	HS-2 0.125 mm	2.34	Hydroxypyromor- phite	
Hydroxypy- romorphite	2.33	25	HS-2 <0.125 mm	2.33	Hydroxypyromor- phite	
Chloropy- romorphite	2.42	- 35	7-CN	2.24	Pb (CH <sub>3</sub> ) <sub>4</sub>	
			3-UN	2.32	Birnessite + hydroxy- pyromorphite	
			3-UN 0.6 mm	2.40	Humic acid + chloro- pyromorphite	X = Pb, 3.09
			3-UN 0.125 mm	2.31	Birnessite	X = Pb, 3.74
			3-UN <0.125 mm	2.31	Birnessite	
			3-PL	2.29	Hydrocerrusite	X = Pb, 3.66
			3-PL 0.6 mm	2.43	Humic acid + chloro- pyromorphite	X = Pb, 3.06
			3-PL 0.125 mm	2.44	Humic acid + chloro- pyromorphite	X = Pb, 3.09
			3-PL <0.125 mm	2.31	Birnessite	X = Pb, 3.86