Exploring Residential Arsenic Concentrations

Maximum Arsenic Concentration / Residential Property

Because residential development after the termination of site activity could potentially mask elevated residential arsenic concentrations (eg, application of clean fill material), only residential properties constructed prior to 1963 were included in this analysis.

TOTAL NUMBER OF RESIDENTIAL PROPERTIES (PRE-1963): 1,761

The size (ft^2) of residential properties during this time were highly variable (range: 1,050 – 18,846 ft^2). The dataset was trimmed (winsorized) by removing observations below the 1^{st} percentile and above the 99^{th} percentile to create a dataset that better represents the average size of residential properties during this time. As such, properties less than 2,000 ft^2 or greater than 10,000 ft^2 in size were removed from the dataset. This resulted in a dataset that approaches a normal distribution (see Figures 1 & 2).

TOTAL NUMBER OF RESIDENTIAL PROPERTIES (2,000 – 10,000 ft^2): 1,722

THE TRIMMED DATASET (N = 1,721) WAS USED IN ALL SUBSEQUENT ANALYSES.

All analyses presented from Figures 3 – 12 were conducted on ln-transformed arsenic concentrations.

SUMMARY:

Scatter plots show weak directional correlations between arsenic concentration and distance from the site. The strongest negative concentration-distance correlation occurs in the Northwest quadrant (Figure 7), where the Pearson r = -0.235 and the Spearman r = -0.355 ($P < 0.001$ in both cases). In the Southeast quadrant, there appears to be a positive concentration-distance correlation, where concentrations *increase* with increasing distance from the CMC site (Figure 9). Consistent with the findings of CH2M Hill, the scatter plots presented herein show that a relationship does exist between distance from CMC and low / background arsenic concentrations (~ 20 mg/kg).

The error bar plots were created in attempts to graphically filter the noise represented by the scatter plots. These error bar plots support the correlations / scatter plots, indicating that, within the Northwest quadrant, arsenic concentrations *decrease* with increasing distance from the CMC site (Figure 12); within the Southeast quadrant, arsenic concentrations *increase* with increasing distance from the CMC site (Figure 14).

Overall, the results in the Northwest quadrant support the aerial deposition model; results in the Southeast quadrant contradict the aerial deposition model.

FIGURE 1

South Minneapolis Soil Contamination Site

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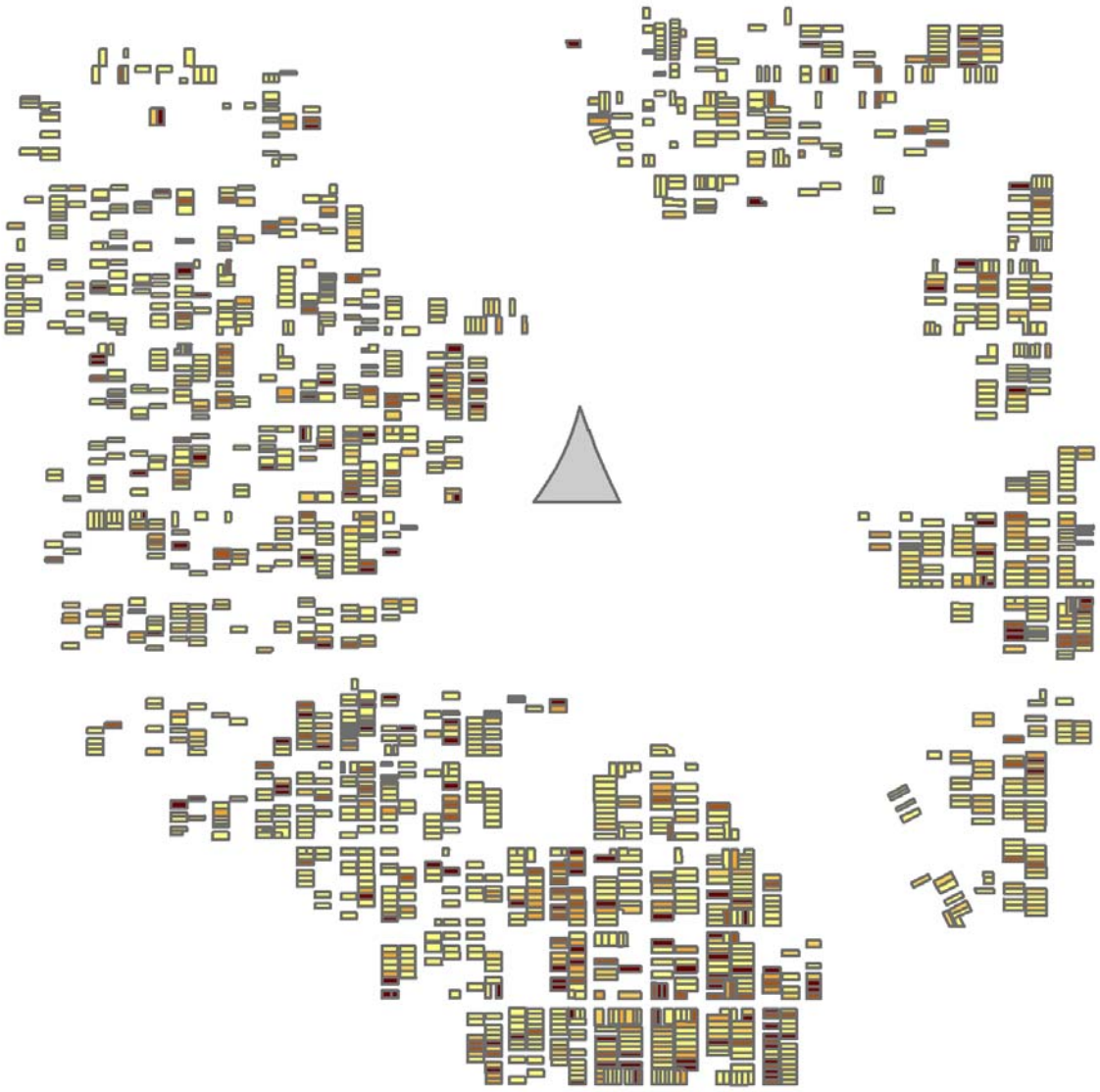
Querying P1 – P99 property sizes (2,000 – 10,000 ft^2)



Residential Properties Sampled (Pre-1963):

N = 1,722

Size (ft^2):
Mean: 5,540 ft^2
Minimum: 2,003 ft^2
Maximum: 9,817 ft^2

Maximum Arsenic Concentration (mg/kg):
Mean: 33.6 mg/kg
Minimum: 1.8 mg/kg
Maximum: 2,880.0 mg/kg
UCLM95: 39.0 mg/kg
LCLM95: 28.2 mg/kg

RESIDENTIAL_PROPERTIES_SUMMARY
Maximum Concentration (mg/kg)
1.80 - 9.99
10.00 - 29.99
30.00 - 49.99
50.00 - 94.99
95.00 - 2880.00

FIGURE 2

South Minneapolis Soil Contamination Site

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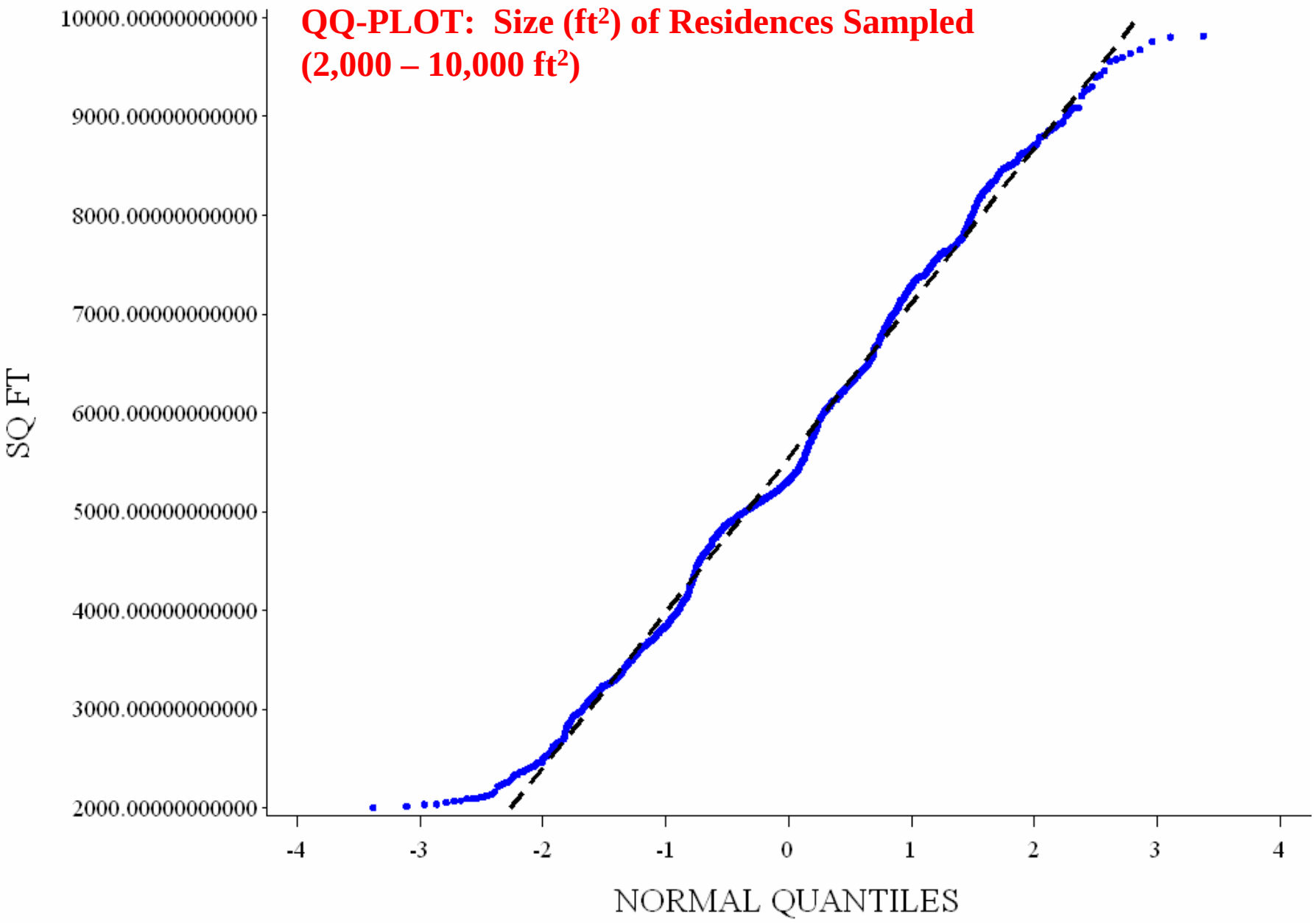

SCATTER PLOTS (continuous variables)

Maximum residential arsenic concentration (mg/kg)
vs
Distance (meters) from CMC Heartland

FIGURE 3

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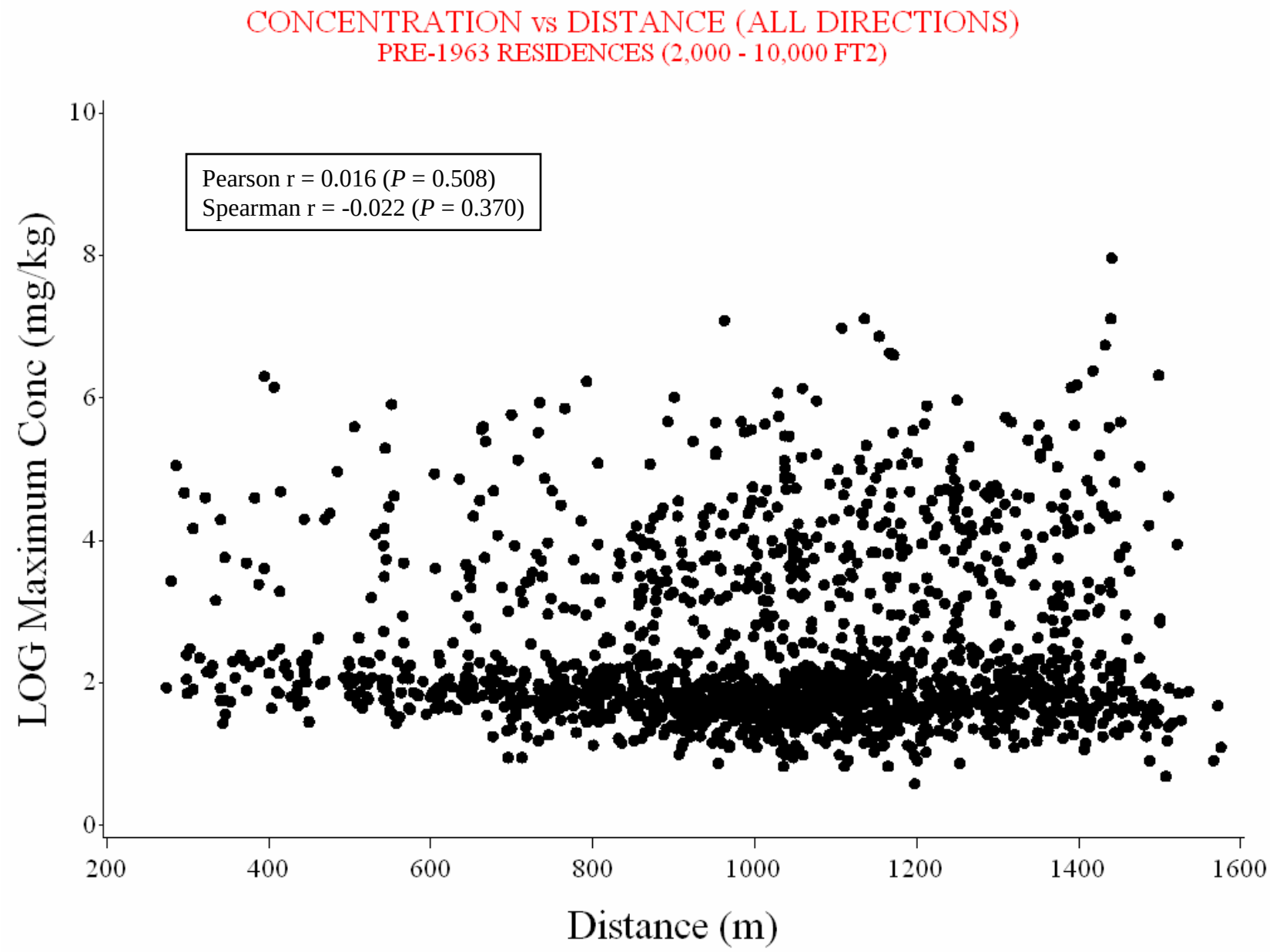

FIGURE 4

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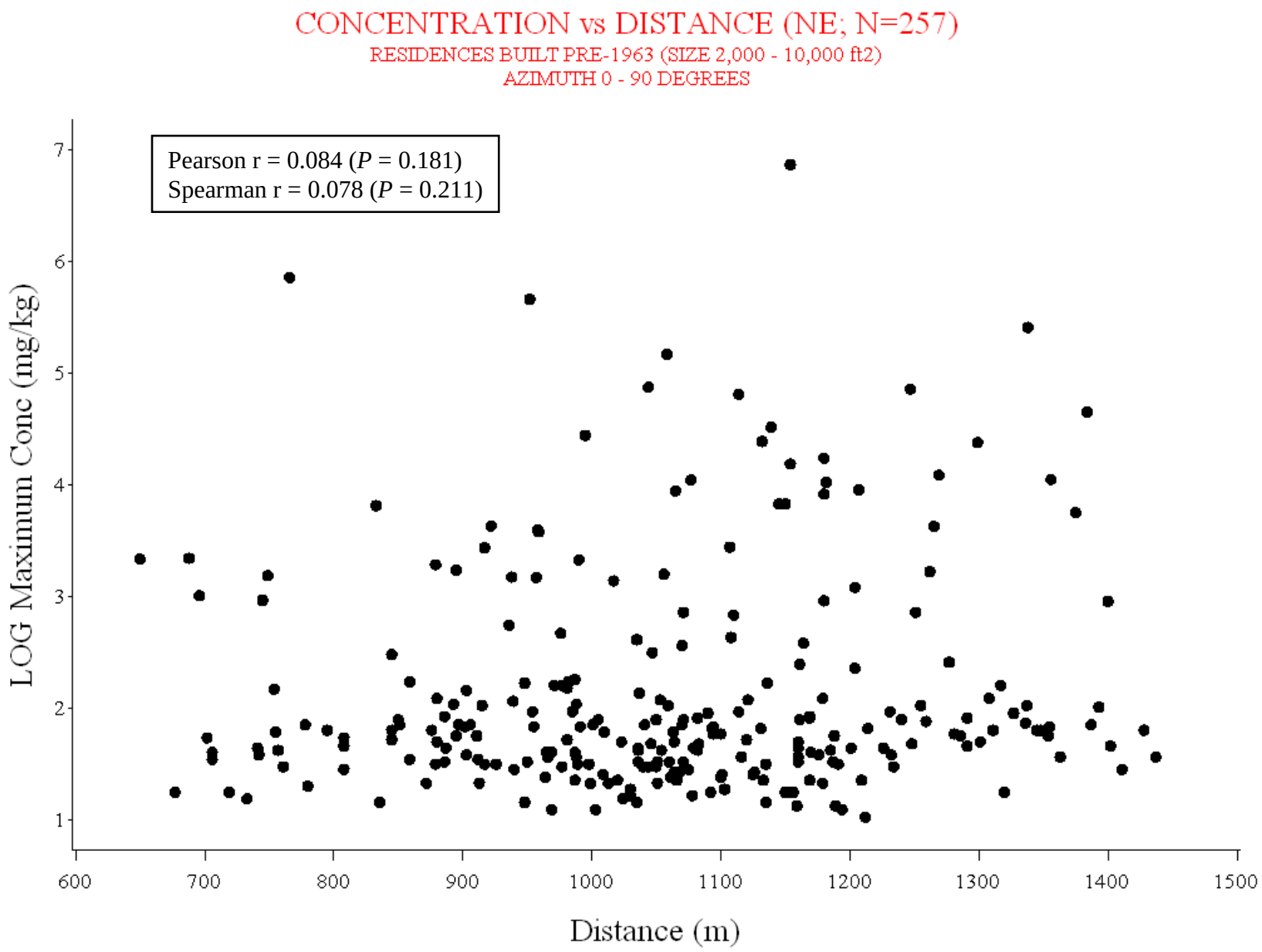

FIGURE 5

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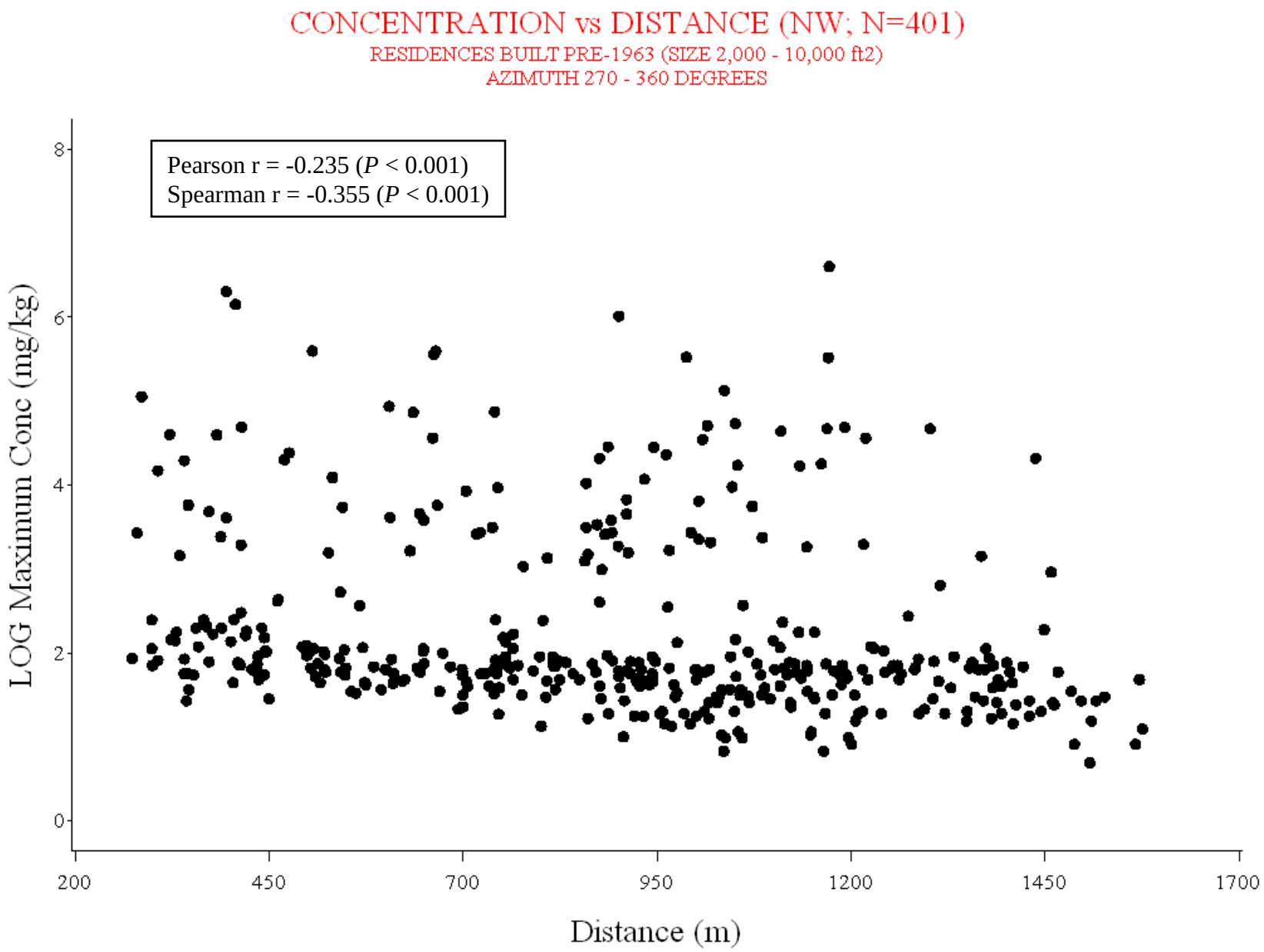

FIGURE 6

South Minneapolis Soil Contamination Site

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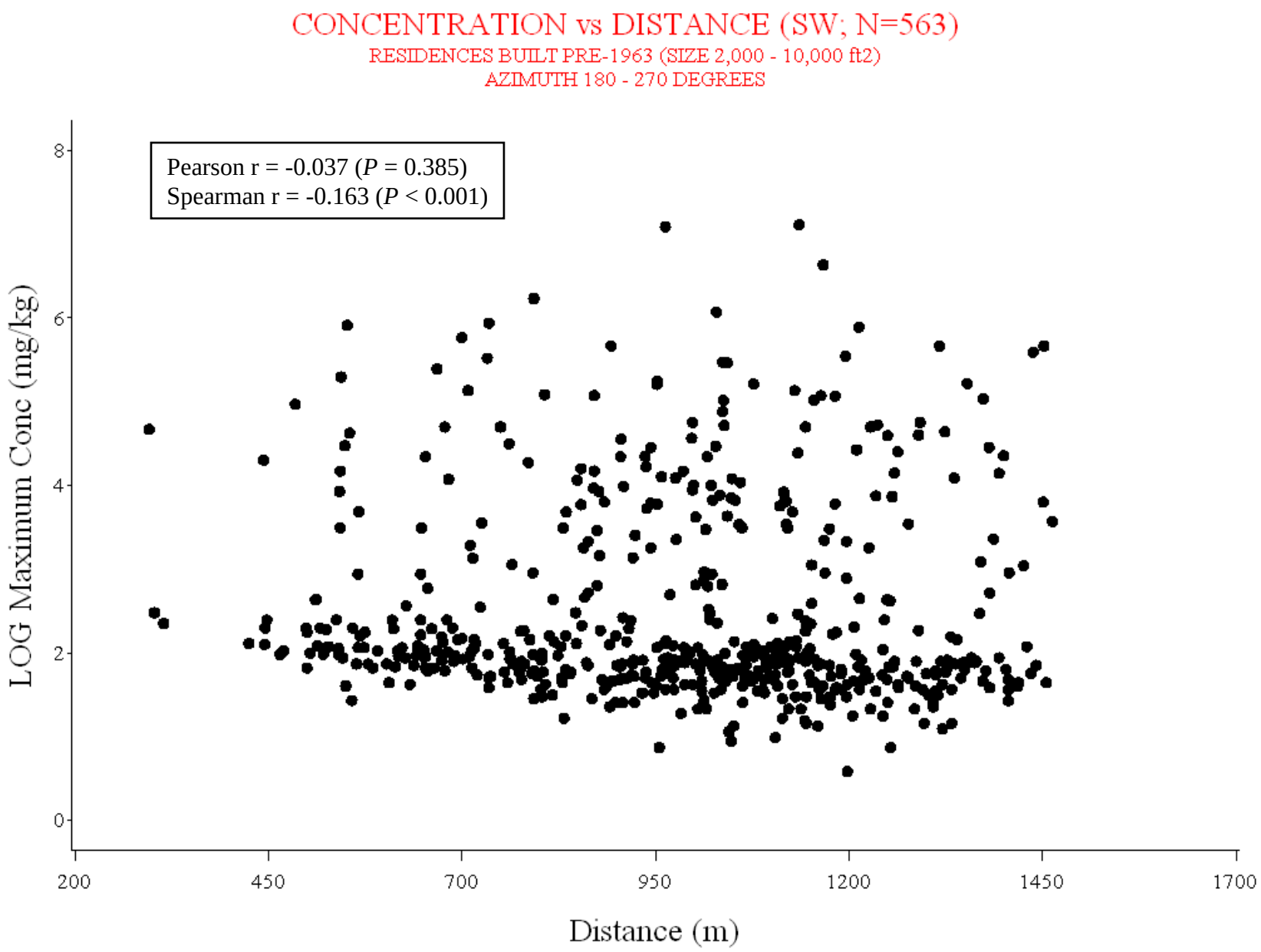

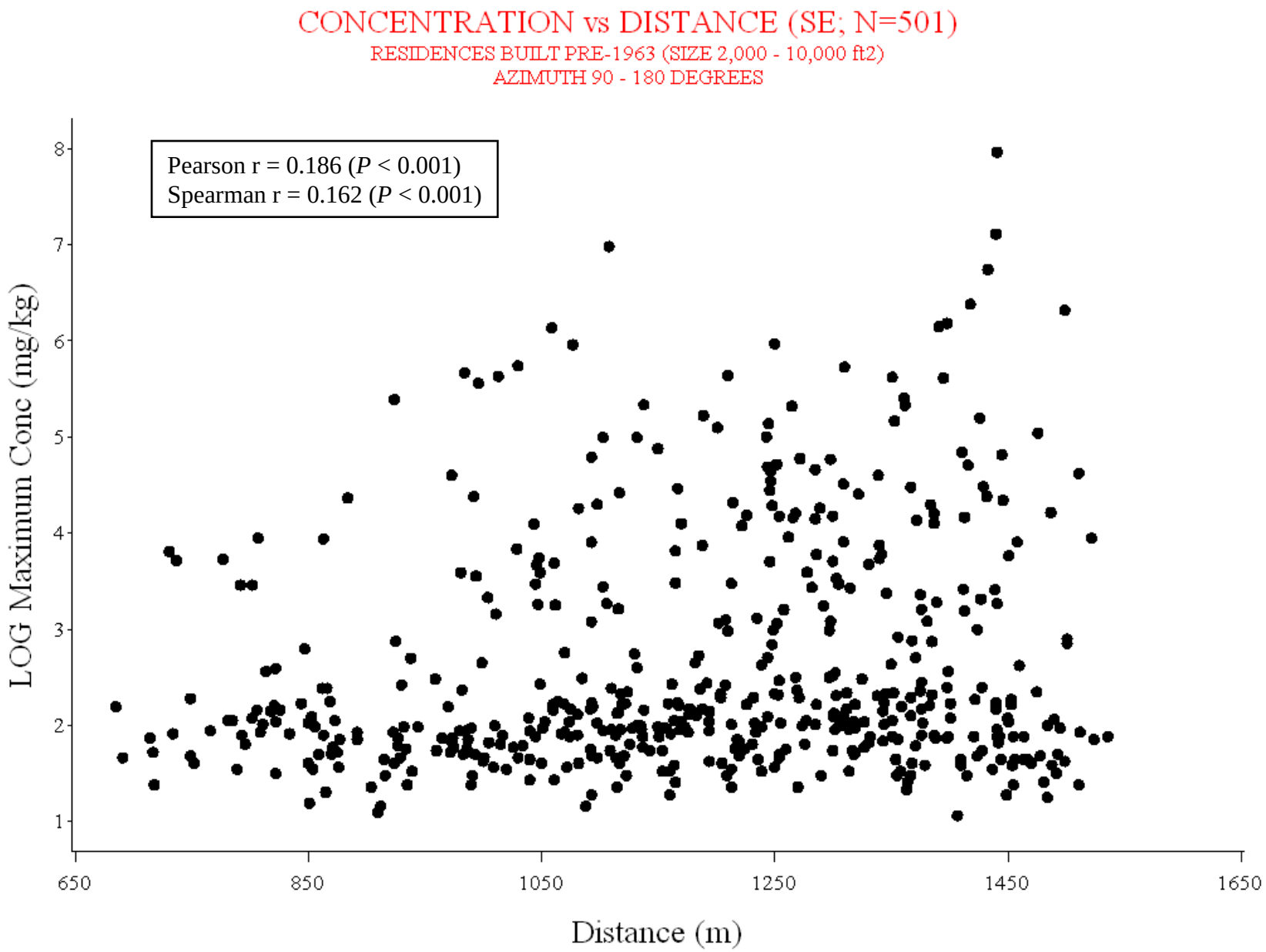
CONCENTRATION vs DISTANCE (SE; N=501)
RESIDENCES BUILT PRE-1963 (SIZE 2,000 - 10,000 ft2)
AZIMUTH 90 - 180 DEGREES
Pearson r = 0.186 (P < 0.001)
Spearman r = 0.162 (P < 0.001)
LOG Maximum Conc (mg/kg)
1
2
3
4
5
6
7
8
650
850
1050
1250
1450
1650
Distance (m)

ERROR BAR PLOTS

Maximum residential arsenic concentration (continuous)
vs
Distance from CMC Heartland (categorical)

Plots represent the average (mean) maximum residential arsenic concentration / error bars represent +/- 1 standard error (SE)

Number of observations within a particular distance category (N) is shown above each bar

FIGURE 10

South Minneapolis Soil Contamination Site

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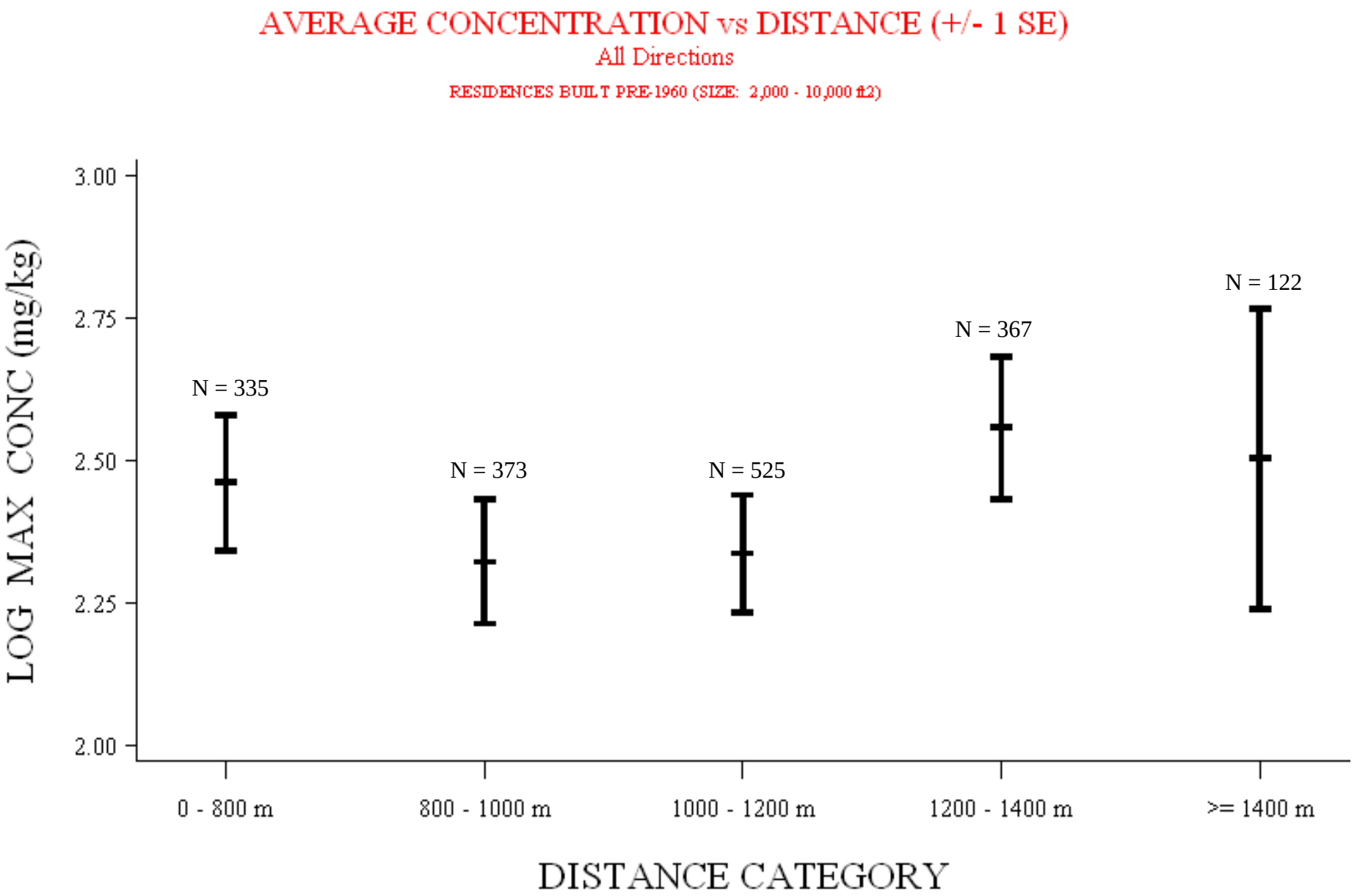

FIGURE 11

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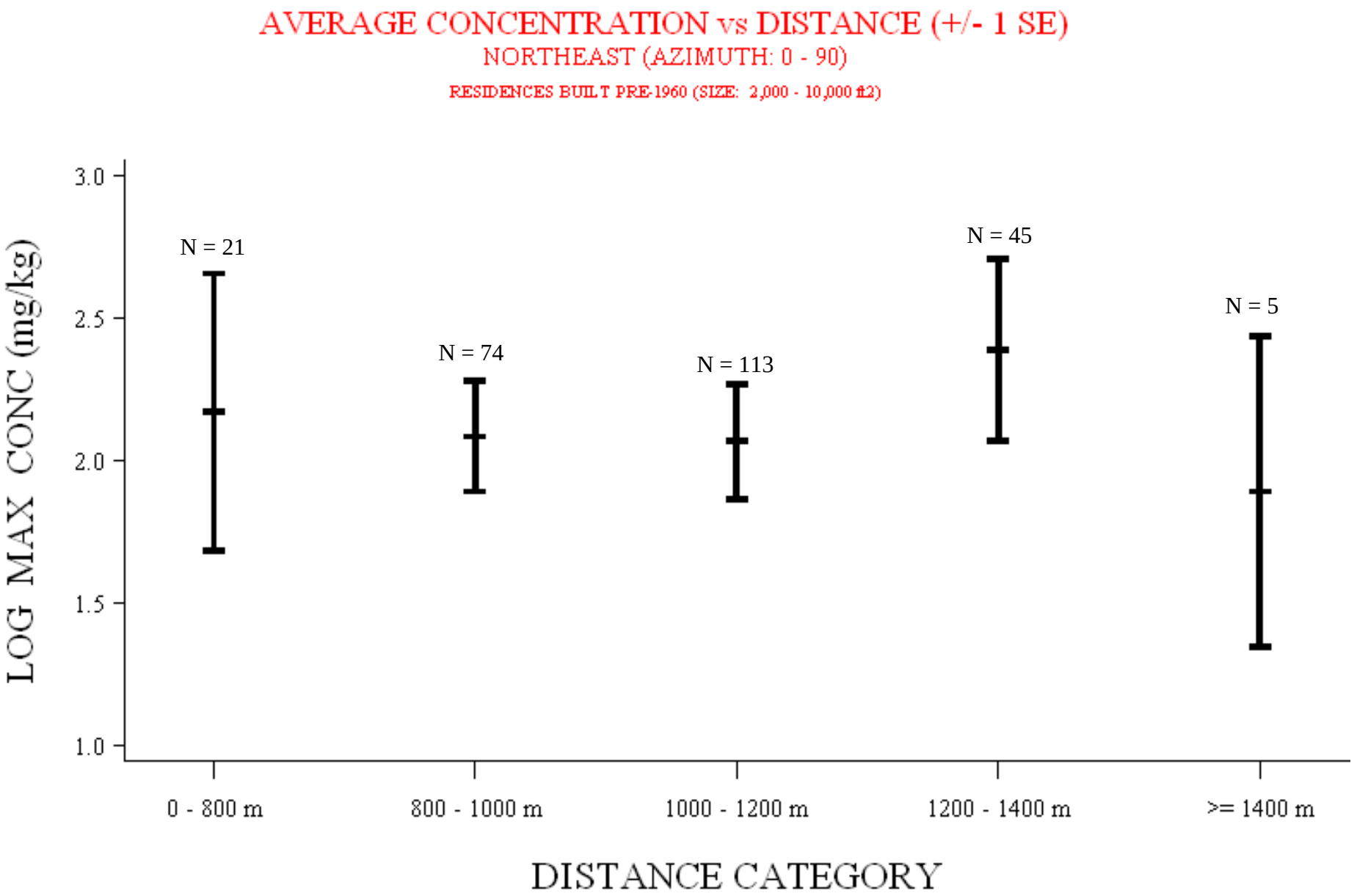

FIGURE 12

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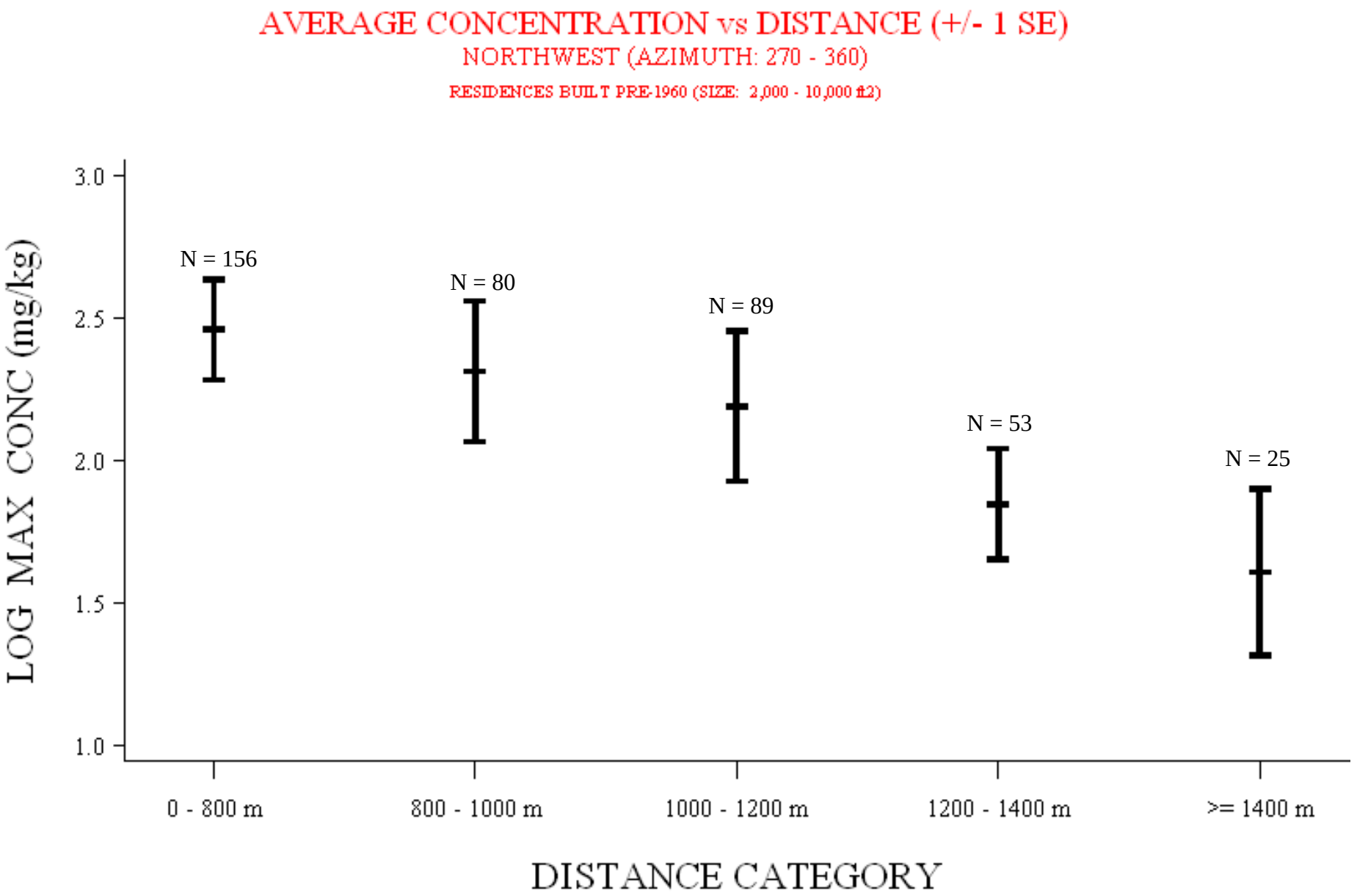

FIGURE 13

South Minneapolis Soil Contamination Site

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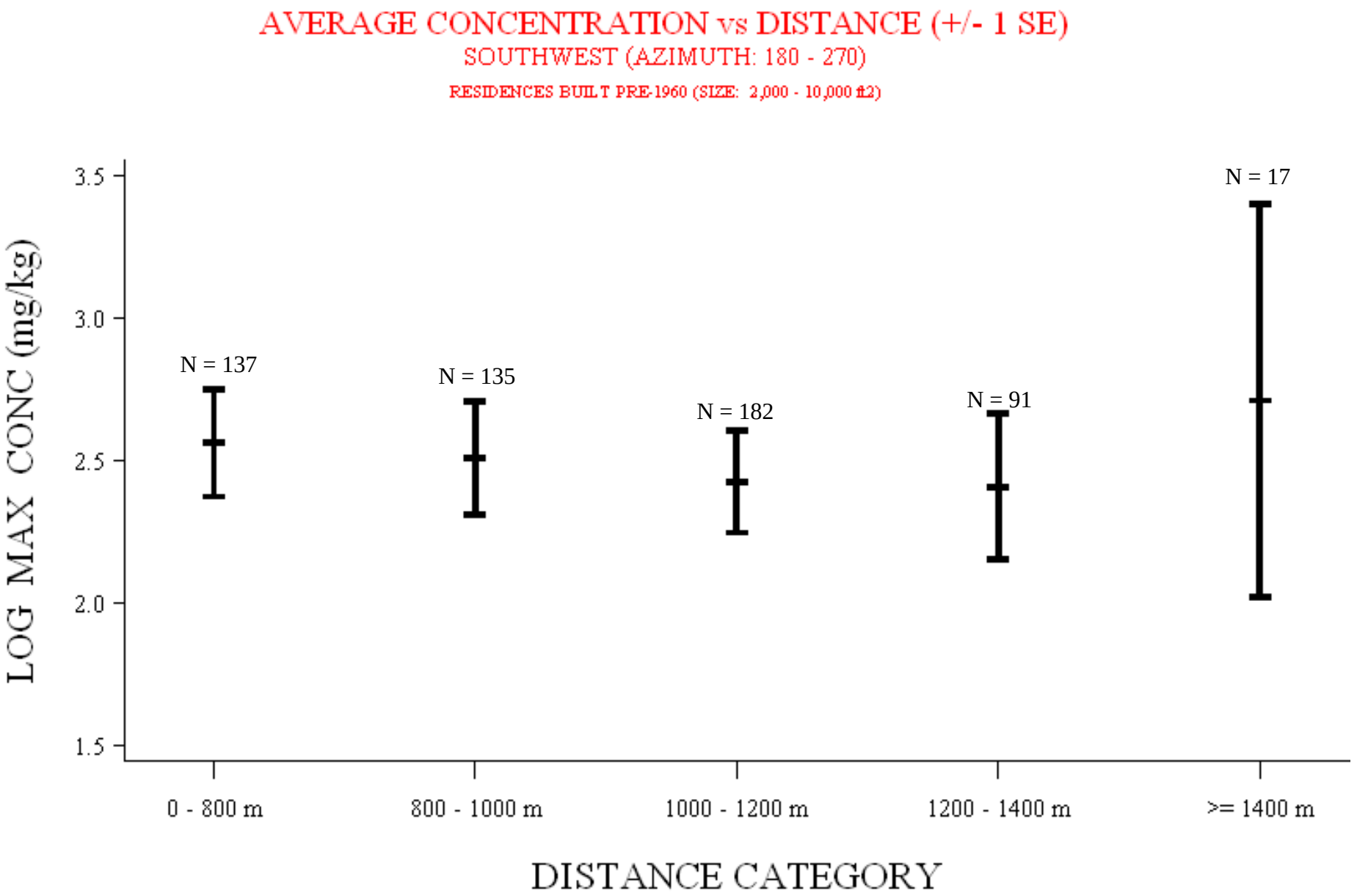

FIGURE 14

South Minneapolis Soil Contamination Site

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