Chapter 6
Geoarchaeological Investigation of New Philadelphia: Soil Core Testing of Thermal Infrared Anomalies[1]

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Background

The New Philadelphia town site was designated as a National Historic Landmark in January 2009. Field research began at this town site in 2002 and continues to the present. A special volume of *Historical Archaeology* dedicated to New Philadelphia details the background history and research activities (Fennell et al. 2010).

The town site is located near the center of Pike County, Illinois in an upland position on the landscape with nearby streams. During the Illinoisan glaciation, only the north and northeastern portion of Pike County were glaciated and the Wisconsinan glaciation did not reach Pike County. However, given the proximity to the glacial margins, loess was deposited in varying thicknesses throughout the county, providing the medium for vegetation. Erosion of these deposits has shaped the landscape into rolling hills and valleys. Small tributaries to the Mississippi River border the town site on the west and slightly more distant to the east. This region lies in the mixed forest-prairie transition zone between the Prairie Peninsula and the Eastern Broadleaf Forest to the south and east (USFS 2008). Studies of past vegetation indicate that the dominant vegetation shifted between forest and prairie in response to climate change (Nelson et al. 2006; Williams et al. 2008). Pike County lies within the Central Mississippi Valley Wooded Slopes major land resource area (MLRA) classification with prairie openings in upland positions and total annual precipitation of 38.46 inches (USDA-NRCS 2006). This environment provided abundant and diverse resources for humans.

In 2008 Tommy Hailey and Bryan S. Haley conducted a thermal infrared survey of New Philadelphia and identified several thermal anomalies (Figure 6.1) and the report details the methods for obtaining thermal infrared images and their interpretation (Haley 2008). All of the thermal infrared (TIR) anomalies investigated in 2009 at New Philadelphia were targets identified in Haley's evening data (Figure 6.1). Buried archaeological features will typically produce diurnal thermal anomalies that are either cold in the morning and hot in the evening or vice versa. In addition, several singular thermal anomalies were consistent with known locations for buried foundations (Fennell 2008). Therefore, the minimal overlap of the thermal anomalies identified in the morning data with those from the evening data is somewhat puzzling (Figure

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6.2). For these reasons, anomalies identified in the morning data were selected for soil core sampling during the summer of 2010.

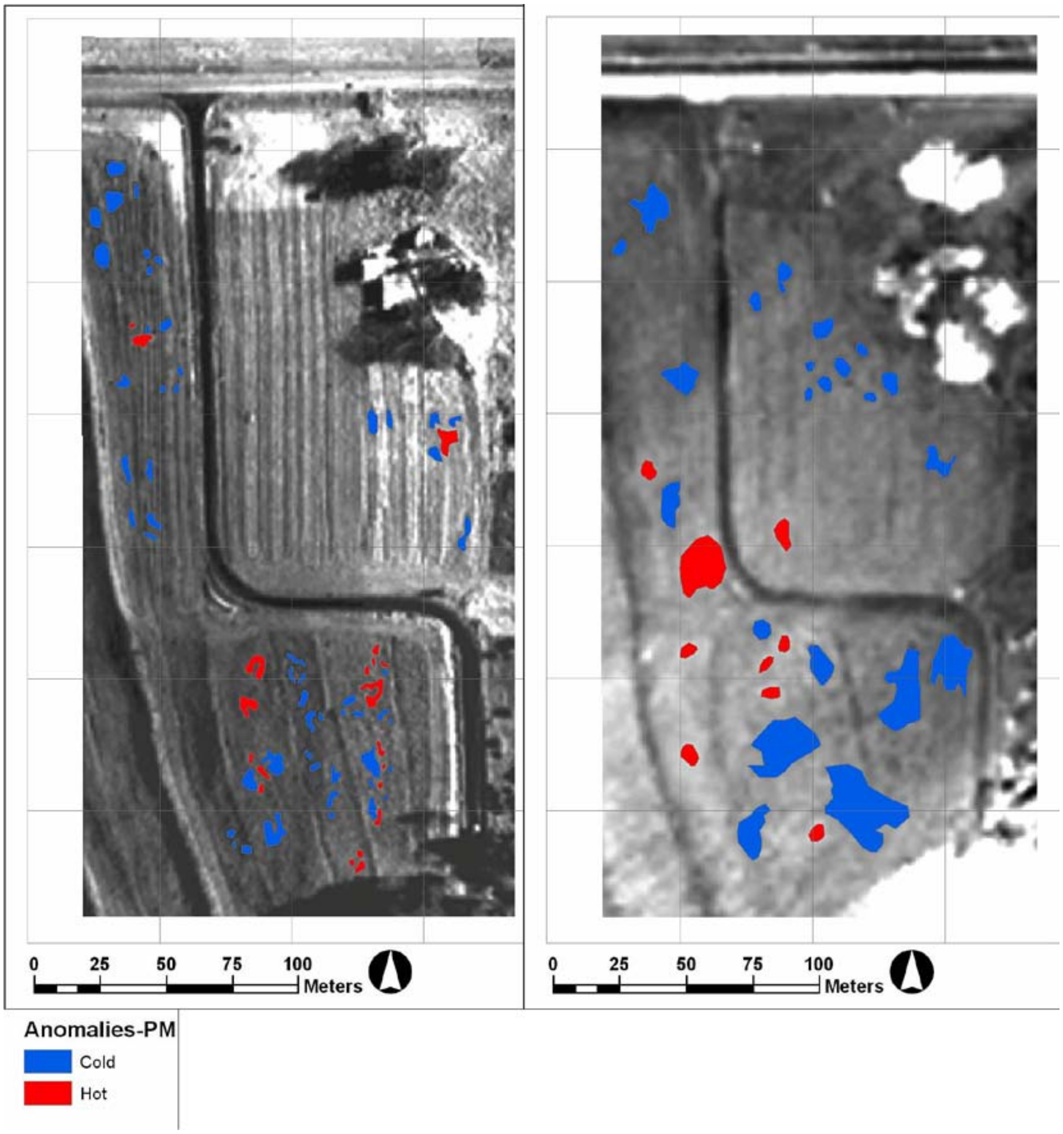

Figure 6.1. *Morning (left) and evening (right) thermal infrared composite images with anomalies identified (Image courtesy of Bryan S. Haley).*

Research Methodology

Soil core samples were collected using a one-inch diameter Oakfield soil sampler and a two-inch diameter AMS slide hammer core sampler. The collection was lead by the author, with Andrew Agha, Christopher Fennell, and various members of the 2010 NSF-REU field school, but especially Tyquin Washington. Soil cores obtained with the Oakfield sampler were to a depth of

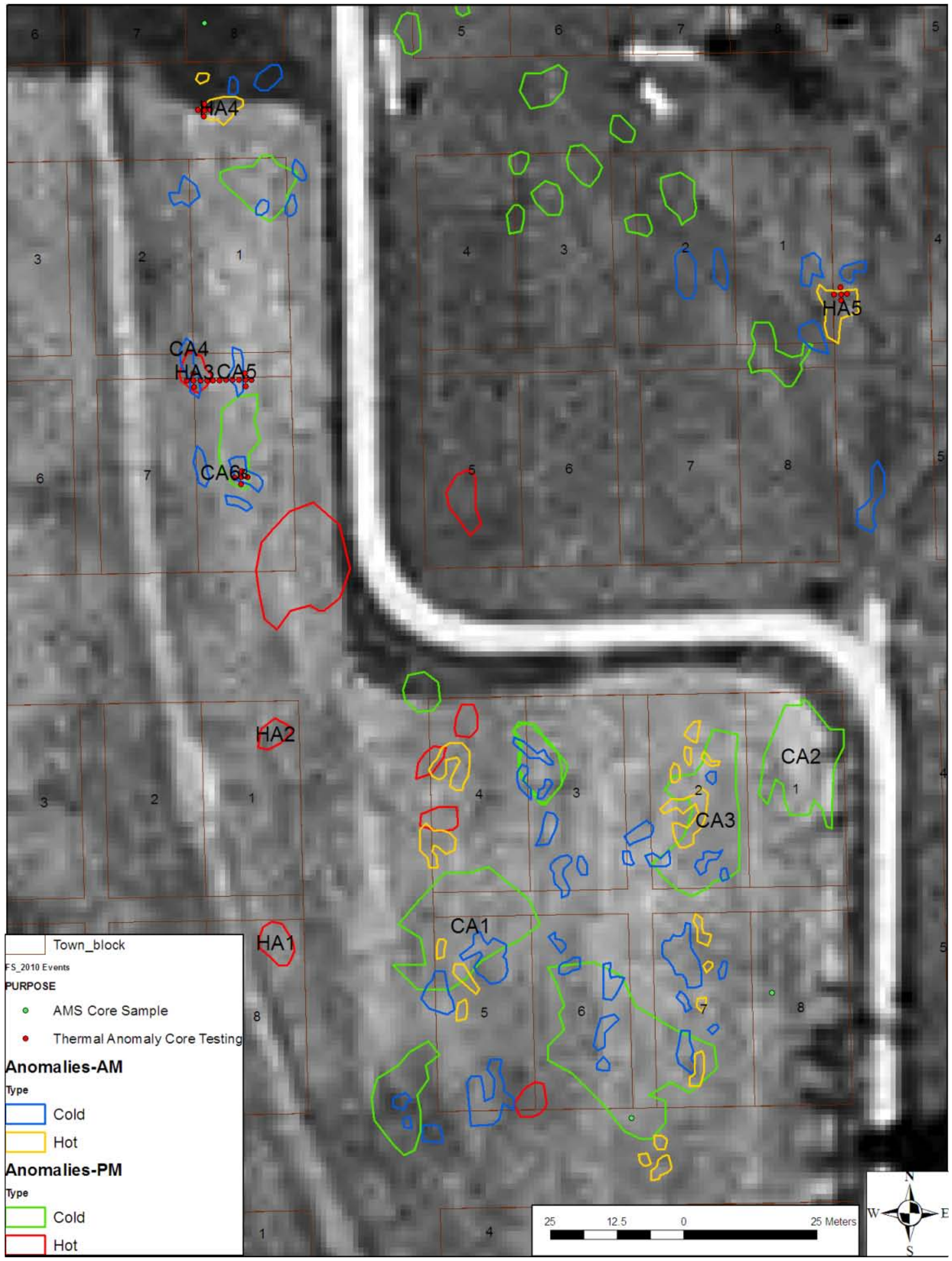

Figure 6.2. *Selected soil core survey locations of aerial thermal anomalies identified by Bryan Haley, overlain on an image of the town blocks and lots and 1998 aerial photo of town site from USGS (image data overlays courtesy of M. Kathryn Rocheford, Bryan Haley and the Aerial Photographs Collection of the USGS).*

three feet and were described in the field under varying sunlight intensity (slight color variations may be observed on an overcast day from those of a bright clear day). The AMS core samples were obtained to a depth of six feet, except where noted. The AMS 30-pound slide-hammer assembly compresses the soil sample as the equipment is hammered into the earth. Soils that are initially less compacted have less bulk density and will compact more readily during this process than soils of higher bulk density. Therefore, the depth of drilling is compared to the length of sample obtained to determine the compression ratio for each sample. Five additional AMS core locations for initial investigation of soils in the town site were chosen based on landscape position and soil classification (green dots on Figure 6.2). The AMS cores were labeled for subsequent description and analysis in the Quaternary Materials Laboratory at the University of Iowa.

In addition, soil samples were collected for future analysis of the micromorphology of the soils within two of the excavation units. Micromorphology is the microscopic study of in situ soil components, features and fabrics, including evidence of human activities. For example, microscopic bioarchaeological remains such as articulated plant material can be used to

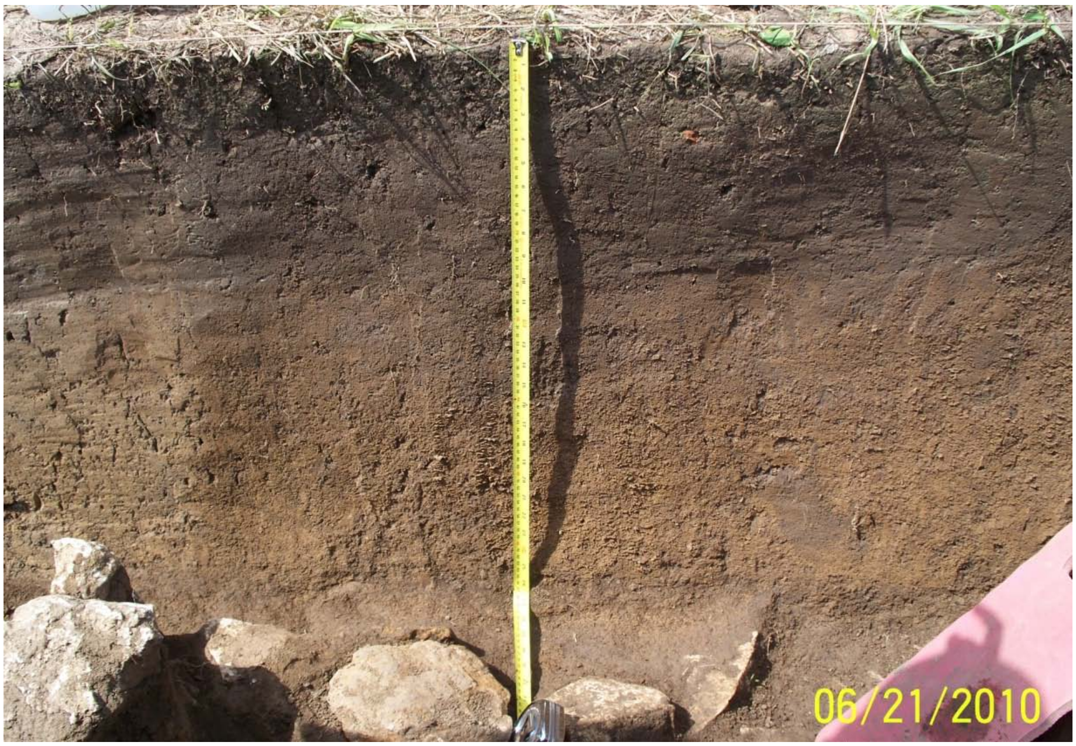

Figure 6.3. *Block 13, Lot 4, EU 7, north wall before removal of micromorphology samples. Note soil color change, the distinction between the dark, organic-rich plow zone and the reddish brown, clay-rich, but undisturbed, culturally sterile zone. Photo by M. Kathryn Rocheford.*

distinguish between natural and cultural vegetation and their distribution across the site. In addition, the spatial distribution of different types of vegetation could aid the interpretation of use patterns within New Philadelphia. The first series of micromorphology samples is from the north wall of excavation unit 7, Block 13, Lot 4, part of the excavation of a building foundation (Figure 6.3). The north wall appears to represent the original soil horizon below the plow zone and could potentially serve as a baseline for micromorphological analyses throughout the town site. The second series is from the west wall of excavation unit 7, Block 13, Lot 3, in the center of feature 40, the remnants of a well. The well structure clearly contained historic fill and has been subjected to natural soil forming processes since its filling. These analyses have the potential to constrain the length of time required for soil forming processes to manifest in this environment. These samples were collected using 2" x 4" standard plastic electrical conduit box, wrapped in saran wrap, then aluminum foil, and labeled for future processing.

Current Research Efforts

Five TIR anomalies were selected for evaluation during the summer of 2010 from those identified by Haley (2008) as cold anomalies (CA) and hot anomalies (HA) (Figure 6.2): (1) CA4/HA3, an area that exhibited both a negative or cold target in the morning and positive or hot target in the evening (thermal signatures that a pit structure might produce). However, this location is positioned on a slope, and landscape position is a known contributor to differences in soil development (Birkland 1999), therefore an eastward transect upslope was taken between this anomaly and (2) another morning cold target (CA5); and (3) CA6, an evening negative or cold target (a signature that may indicate a buried foundation). The final two anomalies are in areas platted as streets: (4) HA4 and (5) HA5, both morning positive or hot targets (a thermal signature that may indicate a buried foundation). A central position was mapped for each anomaly and an AMS two-inch soil core was extracted for analysis at the Quaternary Materials Lab, University of Iowa. Oakfield one-inch soil cores were extracted four feet from each central core location in each of the cardinal directions (small red dots on Figures 6.2 & 6.6). In addition, five Oakfield cores were extracted along the east-west line between CA4/HA3 and CA5 at distance intervals of four feet. The characteristics of the collected Oakfield cores were recorded in the field.

Soil Core Descriptions

Two factors need to be considered when comparing the AMS cores with their associated Oakfield cores. First, the AMS cores were described indoors under fluorescent lighting, whereas the Oakfield cores were described in the field under full daylight, which may result in slight differences in the reported color. Therefore interpretation of differences based solely on color change may be misleading. Second, all AMS core descriptions are reported by thickness of soil horizons in feet, whereas the Oakfield cores are described by depth below surface in feet (ftbs). The mechanical process for obtaining AMS cores utilizes a thirty pound slide-hammer which compresses the soil, increasing its bulk density, as the sample is being collected. Table 1 contains the thickness of each core section, the depth to which the AMS assembly was pushed, and the degree of compaction for each section of core. Susceptibility to mechanical compaction varies for soils of different organic/inorganic compositions and structures (Birkland 1999). For example, soils with high organic matter content have high porosity and lower bulk density, which impede the formation of blocky, platy, or prismatic structure in soil horizons. Conversely, soils with high inorganic particles including an abundance of clay minerals have lower porosity and under the alternating presence/absence of water produce these structures. However, given the small size of the AMS cores and the mechanical compression, interpretable soil structures are not preserved.

Table 6.1 – *AMS core drill depths and compaction ratios*

Thermal Anomaly Core ID	Core top (cm)	Core base (cm)	Core Thickness (ft)	Push depth (ft)	Compaction Ratio
CA4/HA3-1	0	60	1.97	3.80	1.93
CA4/HA3-2	60	125	2.13	2.20	1.03
CA5-1	0	46	1.51	3.80	2.52
CA5-2	46	98	1.70	2.20	1.29
CA6-1	0	42	1.38	3.80	2.76
CA6-2	42	98	1.85	2.20	1.19
HA4-1	0	42	1.38	3.80	2.76
HA4-2	42	60	0.59	0.70	1.19
HA5-1	0	48.5	1.59	3.80	2.39
HA5-2	48.5	98	1.64	2.20	1.34

The soil classification for the locations of CA4/HA3, HA4, and HA5 is mapped as Downsouth Series which is characterized as a mesic Oxyaquic Hapludalf (USDA-NRCS 2006). This classification is for soils that develop minimal horizonation under broadleaf forest in humid, temperate climate conditions. Oxyaquic is best exemplified by the abundant mottling and iron (Fe) and manganese (Mn) concretions observed in the cores for these locations. Mottling and concretions indicate oxidizing and reducing processes due to alternating cycles of wet and dry conditions (Schaetzl and Anderson 2005).

The locations of thermal anomalies CA5 and CA6 is classified as Wakenda Series, which is characterized as mesic Typic Argiudoll (USDA-NRCS 2006). This classification is for soils that develop in grassland areas of humid, temperate climate that have weathered sufficiently to produce a horizon that is enriched in clays transported by water and gravity down profile. Grassland soils also have a characteristic thick, dark (organic rich) overlying horizon that is highly desirable for agriculture.

Each core is described in the following tables which are grouped by the thermal anomaly being tested. Following the description of each AMS core is a photo or two of the split core to illustrate the description. The photos are followed by a brief interpretation of the cores for each thermal anomaly. Finally, the core descriptions of the surrounding Oakfield cores conclude each thermal anomaly subsection.

TIR CA4/HA3 – on north border of Lots 7 & 8, Block 7, elevation: 761.6592 ft. (see Figure 6.6 for map of location.)

Table 6.2 - T1-C AMS 2 inch core

Thickness (ft)	Color	Texture	Redox/Other
0 – 0.51	10YR 3/2	Loam	Many fine roots; clear boundary
0.51 – 1.28	10YR 4/2	Silt loam	Mottled, 10YR 5/1 and 7.5YR 5/6; many coarse, filled burrow traces 10YR 3/2; few fine roots; abrupt boundary
1.28 – 1.64	10YR 4/4	Silt loam	Mottled, 10YR 3/1 and 5YR 4/6, many, medium, and distinct; many fine Mn concretions, Fe depletions 10YR 5/1; diffuse boundary
1.64 – 2.26	10YR 4/4	Silty clay loam	Mottled, 10YR 3/1 and 7.5YR 4/6; filled burrow 10YR 3/1 at 65-569 cm; clear boundary
2.26 – 3.57	10YR 6/1	Silty clay loam	Mottled, 7.5YR 4/6, common, medium, pronounced streaks; few, fine Mn concretions; gradual boundary
3.57 – 4.10	7.5YR 5/4	Silt loam	Mottled, 10YR 6/1, few, fine, and faint

Figure 6.4. *AMS soil core from TIR CA4/HA3 0-1.97 ft., top at left, described in Table 2. Photo by M. Kathryn Rocheford*

Figure 6.5. *AMS soil core from TIR CA4/HA3 1.97-4.10 ft, bottom at right, described in Table 2. Photo by M. Kathryn Rocheford.*

The soil in the area of CA4/HA3 was classified as that which forms under broadleaf forest. The expected soil horizons would include, in succession, a thin, dark, organic-rich layer, a light-colored zone of leaching, and a darker, reddish zone of accumulation. Leaching is the result of mineral and organic material being moved down profile by water percolation. However, the thin, dark layer observed in Figure 6.4 is the modern plow zone and not a natural soil horizon. Instead of a light-colored zone, this is followed by a highly mixed (turbation) layer with a large burrow that has been filled in with the overlying organic-rich material. At ~1.3 ft. is evidence of additional compression, most likely from heavy equipment during construction of the ridge and swale erosion features. The compaction ratio from the coring process was ~2 times for the first four feet below the surface but negligible for the last two feet (Table 1), which can be attributed to the higher clay content. The gray and red streaking (Figure 6.5) is due to repeated inundation of water and is culturally sterile.

Table 6.3 – T1-1 Oakfield 1” Core (Four feet north of AMS core for TIR CA4/HA3)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.7	10YR 3/2	Loam	
0.7 – 2.0	10YR 4/4	Silt loam	Mottled, 10YR 4/3; common, fine Fe and Mn concretions
2.0 – 3.0	10YR 5/4	Heavy silt loam	Mottled, 10YR 6/3; common, fine Fe and Mn concretions; few fine charcoal

Table 6.4 – T1-2 Oakfield 1" Core (Four feet south of AMS core for TIR CA4/HA3)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.6	10YR 3/2	Loam	
0.6 – 1.7	10YR 4/4	Silt loam	Mottled, 10YR 4/3; common, fine Fe and Mn concretions
1.7 – 2.5	10YR 5/4	Heavy silt loam	Mottled, 10YR 6/3; common, fine Fe and Mn concretions; rare fine charcoal
2.5 – 3.0	10YR 5/3	Heavy silty clay loam	Depletions, 10YR 6/2; few fine charcoal

Table 6.5 – T1-3 Oakfield 1" Core (Four feet west and downslope of AMS core for TIR CA4/HA3)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.23	10YR 3/3	Silt loam	
0.23 – 0.55	10YR 4/3	Silt loam	Mottled, 10YR 3/3
0.55 – 1.2	10YR 4/6	Silt loam	Mottled, 10YR 6/2, 10YR 3/3, and 10YR 4/4, common, fine Fe and Mn concretions
1.2 – 1.45	10YR 4/3	Heavy silt loam	
1.45 – 2.0	10YR 4/6	Heavy silt loam	Mottled, 10YR 5/4, common, fine Fe and Mn concretions
2.0 – 3.0	10YR6/1	Silty clay loam	Mottled 10YR 5/6

Table 6.6 – T1-4 Oakfield 1" Core (Four feet east and upslope of AMS core for TIR CA4/HA3)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.3	10YR 3/1	Silt loam	Common, medium brick fragments
0.3 – 0.5	10YR 4/3	Silt loam	Mottled, 10YR 3/2
0.5 – 0.8	10YR 6/4	Silt loam	Mn lined pores
0.8 – 1.48	10YR 5/4	Silt loam	Mottled, 10YR 5/2 and 10YR 4/4, common, fine Fe and Mn concretions
1.48 – 1.83	10YR 5/4	Silt loam	Abundant, medium Fe and Mn concretions
1.83 – 2.4	10YR 4/4	Heavy silt loam	
2.4 – 2.83	10YR 5/4	Heavy silt loam	
2.83 – 3.0	10YR 5/4	Silty clay loam	Mottled, 10YR 5/1; few, fine charcoal

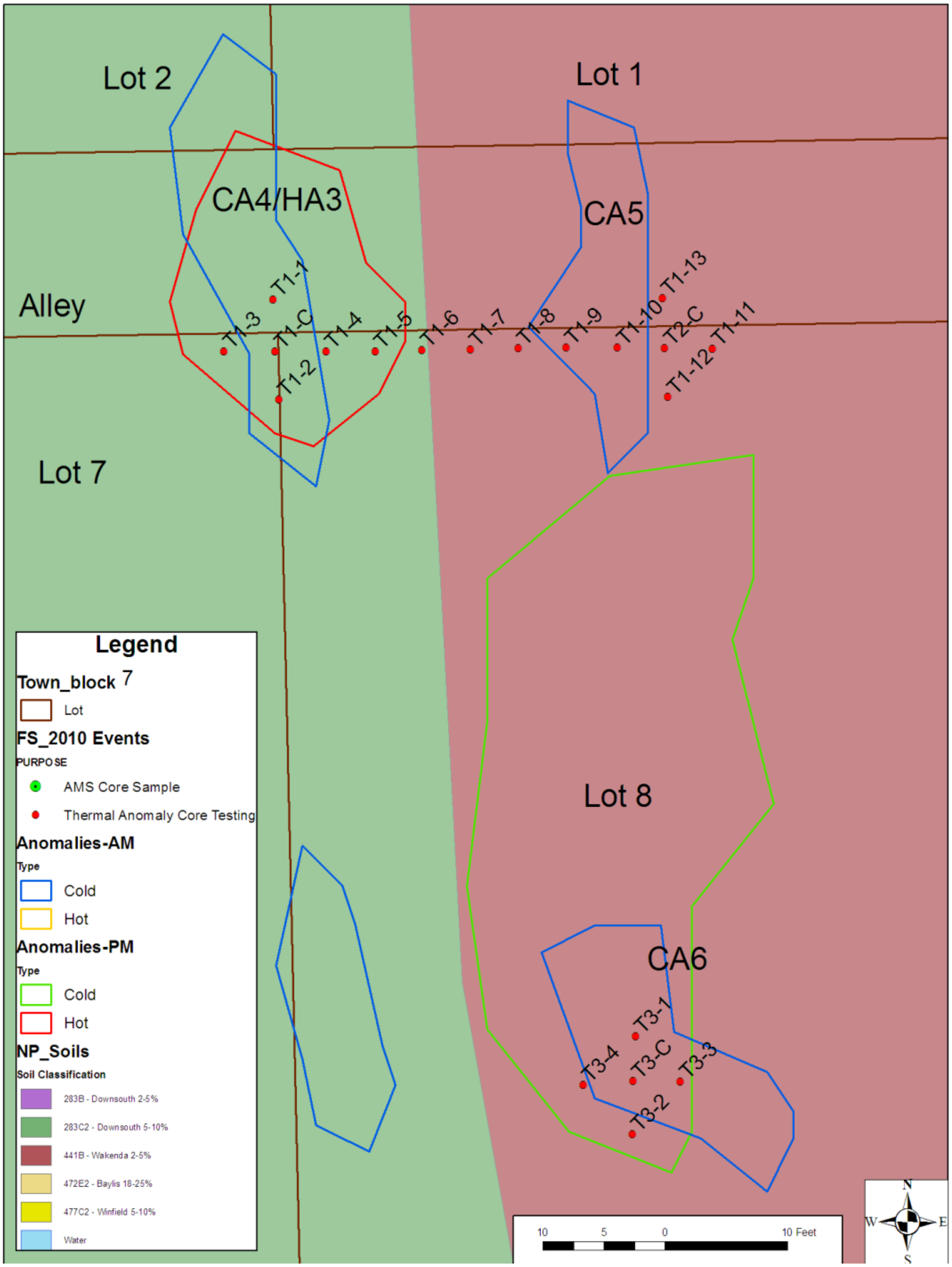

Figure 6.6. *Close-up map of soil core testing locations in Block 7 (image data overlays courtesy of M. Kathryn Rocheford, Bryan Haley and the USDA-NRCS SURGO database)*

Interstitial East-West Line TIR CA4 – CA5 along north border of Lot 8, Block 7 between CA4/HA3 and CA5 (see Figure 6.6 for map of location)

Table 6.7 – T1-5 Oakfield 1" Core (Western most point, four feet east of T1-4 Oakfield core location)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.35	10YR 3/3	Loam	
0.35 – 1.25	10YR 4/4	Silt loam	Mottled, 10YR 5/4, common, fine Fe and Mn concretions
1.25 – 1.70	10YR 5/4	Silt loam	Mottled, 10YR 6/3, common, fine Fe and Mn concretions
1.70 – 2.5	10YR 5/3	Silt loam	
2.5 – 3.0	10YR 5/4	Heavy silt loam	Mottled, 10YR 6/1, Fe depletions

Table 6.8 – T1-6 Oakfield 1" Core (Four feet east of T1-5 Oakfield core location)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.3	10YR 3/2	Loam	
0.3 – 0.7	10YR 4/2	Silt loam	
0.7 – 1.65	10YR 4/4	Silt loam	Mottled, 10YR 5/6 and 10YR 3/2
1.65 – 3.0	10YR 5/6	Silty clay loam	Mn lined root traces

Table 6.9 – T1-7 Oakfield 1" Core (Four feet east of T1-6 Oakfield core location)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.4	10YR 3/2	Loam	
0.4 – 1.6	10YR 4/2	Loam	
1.6 – 2.55	10YR 4/4	Silt loam	Mottled, 10YR 3/2; Mn lined root traces
2.55 – 3.0	10YR 5/6	Silt loam	Mn lined root traces

Table 6.10 – T1-8 Oakfield 1" Core (Four feet east of T1-7 Oakfield core location)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 1.5	10YR 3/1	Loam	Few, medium brick fragments to 0.5 ft
1.5 – 2.5	10YR 4/6	Silt loam	Common, fine Fe and Mn concretions
2.5 – 3.0	10YR 5/6	Silt loam	

Table 6.11 – T1-9 Oakfield 1" Core (Eastern most point, four feet east of the T1-8 and four feet west of the T1-10 Oakfield core locations)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 1.3	10YR 3/1	Loam	
1.3 – 1.7	10YR 4/3	Silt loam	Mn lined root traces
1.7 – 2.6	10YR 5/3	Heavy silt loam	Mottled, common Fe and Mn depletions
2.6 – 3.0	10YR 5/4	Silty clay	Common, medium Fe and Mn concretions

		loam	

There is a distinct difference in the thickness of the first soil layer between cores T1-7 (Table 9) and T1-8 (Table 10); the top layer in T1-8 is three times thicker. This may indicate that the darker topsoil has been removed down slope of T1-8, or that upslope of T1-7, fill was deposited. Both scenarios are plausible given that ridge/swale erosion control features are evident on the landscape (Figure 6.7). An investigation of the ridge construction in a trench profile is planned for the Fall of 2010 to evaluate its geologic history and archaeological potential.

Figure 6.7. *A 2005 Aerial photograph of New Philadelphia showing ridge/swale erosion control features with an overlay of the town site boundary. Image courtesy of Tommy Hailey.*

TIR CA5 - on the north border of Lot 8, Block 7, elevation 764.4074 ft. (see Figure 6.6 for map location)

Table 6.12 – T2-C AMS 2 inch core

Thickness (ft)	Color	Texture	Redox / Other
0 – 1.21	10YR 3/1 to 3/2	Silt loam	Many, medium roots; brick fragment at 0.13 ft; clear boundary
1.21 – 1.57	10YR 4/3	Silt loam	Many, coarse, filled burrows 10YR 3/2; few, fine roots; clear boundary
1.57 – 2.33	10YR 5/3	Silty clay	Many, fine Mn concretions and few,

		loam	medium Fe concretions; diffuse boundary
2.33 – 3.21	10YR 5/4	Silty clay loam	Mottled, 10YR 5/2 and 7.5YR 4/6; few, medium Mn concretions

Figure 6.8. *AMS soil core from TIR CA5 (T2-C) 0-1.51 ft, top at left, described in Table 12. Photo by M. Kathryn Rocheford.*

Figure 6.9. *AMS soil core from TIR CA5 (T2-C) 1.51-3.21 ft, bottom at right, described in Table 12. Photo by M. Kathryn Rocheford.*

The compaction ratio for T2-C is ~2.5, making the black to brownish black (10YR 3/1 to 3/2) soil horizon ~3 ft thick (Figure 6.8). While a soil with an over-thickened A-horizon of this depth and coloration is typical of a mature prairie soil, this thick, dark layer that contains brick fragments more likely represents historic fill in a cultural feature. That the surrounding Oakfield cores (Tables 13-16) also demonstrate this thick, dark soil layer, also with brick fragments, supports the latter explanation.

Table 6.13 – T1-10 Oakfield 1" Core (Four feet west of AMS Core for CA5)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 1.35	10YR 3/1	Loam	
1.35 – 1.65	10YR 4/3	Silt loam	Mn lined root traces
1.65 – 2.6	10YR 4/6	Heavy silt loam	Few, fine Fe and Mn concretions
2.6 – 3.0	10YR 5/4	Silty clay loam	Mottled, 10YR 6/2; Common, fine Fe and Mn concretions

Table 6.14 – T1-11 Oakfield 1" Core (Four feet east of AMS Core for CA5)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.7	10YR 3/2	Loam	medium brick fragments to 0.5 ft
0.7 – 1.6	10YR 3/2	Silt loam	Mottled, 10YR 2/1
1.6 – 2.6	10YR 4/4	Silt loam	Mottled, 10YR 3/2
2.6 – 3.0	10YR 5/4	Silty clay loam	

Table 6.15 – T1-12 Oakfield 1" Core (Four feet south of AMS Core CA5)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 1.35	10YR 3/2	Loam	medium brick fragments to 0.2 ft
1.35 – 1.65	10YR 4/3	Silt loam	
1.65 – 2.7	10YR 5/4	Silt loam	Common, fine Fe and Mn concretions
2.7 – 3.0	10YR 5/4	Silty clay loam	

Table 6.16 – T1-13 Oakfield 1" Core (Four feet North of AMS Core CA5)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 1.2	10YR 3/2	Loam	Medium brick fragments to 0.5 ft
1.2 – 1.6	10YR 4/2	Silt loam	Mn lined root traces
1.6 – 2.6	10YR 4/4	Silt loam	
2.6 – 3.0	10YR 5/4	Silty clay loam	Fe and Mn depletions

TIR CA6 - north of center of Lot 8, Block 7, elevation: 762.9554 ft. (see Figure 6.6 for map location.)

Table 6.17 – T3-C AMS 2 inch core

Thickness (ft)	Color	Texture	Redox / Other
0 – 0.46	10YR 3/1	Silt loam	Many, medium roots; gradual boundary
0.46 – 0.82	10YR 3/1 and 5/3	Silt loam	Many, fine roots; many, medium burrows; diffuse boundary
0.82 – 1.25	10YR 4/4	Silty clay loam	Mn lined root traces, some with Fe depletion halos 10YR 5/2; diffuse boundary
1.25 – 2.30	10YR 5/4	Silty clay loam	Large burrow at 1.70-1.77 ft, lined with 10YR 3/2 and filled with organic matter; few, medium Fe concretions and many, medium Mn concretions; gradual boundary
2.30 – 2.85	10YR 5/4	Silty clay loam	Mottled, 10YR 5/3 and 7.5YR 5/6; few, fine Mn concretions; gradual boundary
2.85 – 3.21	10YR 5/2 and 7.5YR 4/6	Silt loam	Banded, possible laminae

Figure 6.10. *AMS soil core from TIR CA6 (T3-C) 0-1.38 ft., top at left, described in Table 17. Photo by M. Kathryn Rocheford.*

Figure 6.11. *AMS soil core from TIR CA6 (T3-C) 1.38-3.23 ft., bottom at right, described in Table 17. Photo by M. Kathryn Rocheford.*

The thickness of the dark, organic rich layers of T3-C (~2.26 feet) is similar to the ~3 feet of T2-C from CA5. However, there is much more bioturbation evident at a shallower depth and that continues much deeper than in T2-C (Figures 6.8-6.11). Bioturbation is the mixing of soil materials by rooting of plants and/or burrowing of animals. In this case, the over-thickened, organic rich layers appear to be the result of bioturbation, rather than mixing by humans.

Table 6.18 – T3-1 Oakfield 1" Core (Four feet north of AMS Core for TIR CA6)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.4	10YR 3/1	Loam	
0.4 – 0.7	10YR 3/3	Loam	Mottled, 10YR 3/1
0.7 – 1.1	10YR 4/4	Silt loam	
1.1 – 1.75	10YR 4.4	Heavy silt loam	Mottled, 10YR 6/1; Fe and Mn depletions
1.75 – 3	10YR 4/6	Heavy silt loam	Common, fine Fe and Mn concretions

Table 6.19 – T3-2 Oakfield 1" Core (Four feet south of AMS Core for TIR CA6)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.5	10YR 3/1	Loam	
0.5 – 0.7	10YR 3/3	Loam	
0.7 – 1.5	10YR 4/4	Silt loam	Mottled, 10YR 3/3; Common, fine Fe and Mn concretions
1.5 – 2.7	10YR 5/4	Heavy silt	Mottled, 10YR 6/1; common, fine Fe and

		loam	Mn concretions
2.7 – 3.0	10YR 5/4	Silty clay loam	

Table 6.20 – T3-3 Oakfield 1” Core (Four feet east of AMS Core for TIR CA6)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.6	10YR 3/1	Loam	
0.6 – 0.85	10YR 3/3	Loam	Mottled, 10YR 3/1
0.85 – 1.4	10YR 4/4	Silt loam	Mottled, 10YR 3/3; common, fine Fe and Mn concretions
1.4 – 1.8	10YR 4/4	Silt loam	Mn lined root traces
1.8 – 3.0	10YR 4/5	Heavy silt loam	Fe and Mn depletions

Table 6.21 – T3-4 Oakfield 1” Core (Four feet west of AMS Core for TIR CA6)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.4	10YR 3/1	Loam	
0.4 – 0.7	10YR 3/3	Loam	
0.7 – 1.4	10YR 4/4	Silt loam	Mottled, 10YR 3/3; common, fine Fe and Mn concretions
1.4 – 2.7	10YR 4/6	Heavy silt loam	Common, fine Fe and Mn concretions
2.7 – 3.0	10YR 5/4	Silty clay loam	

TIR HA4 - between Block 4, Lot 8 and Block 7, Lot 1; elevation: 763.9185 ft. (see Figure 6.2 for map location).

Table 6.22 – AMS T4-C

Thickness (ft)	Color	Texture	Redox / Other
0 – 0.86	10YR 2/1 to 3/1	Silt loam	Abundant, medium roots; gradual boundary
0.86 – 1.25	10YR 4/4	Silt loam	Many, fine roots; abundant filled burrow traces 10YR 3/2; gradual boundary
1.25 – 1.51	10YR 4/4	Silt loam	Few, fine Mn concretions; possible laminae 39-41 cm; large, filled burrow 10YR 3/2; abrupt boundary
1.51 – 1.67	10YR 4/4	Silt loam	Laminae 46 cm; few, medium Mn concretions; gradual boundary
1.67 – 1.97	10YR 5/2	Silt loam	Laminae 46 cm; mottled, few, coarse, and pronounced 10YR 4/6; few, coarse Fe concretions and many, fine Mn

			concretions; unfilled insect trace; impenetrable at 4.5 ftbs

Figure 6.12. *AMS soil cores from TIR HA4 (T4-C) 0-4.50 ft., top at left, described in Table 22. Photo by M. Kathryn Rocheford.*

The 0.86 foot compacted thickness of the dark, organic rich layer translates to ~2.37 feet, similar to CA5 and CA6, all of which are in similar landscape positions. Like CA6 there is abundant bioturbation evident. However, this activity ceases abruptly at 1.6 feet where what appear to be thin, laminated layers begin (Figure 6.12). As this location is in an area that was platted as a road, it is possible that these laminations are the result of compression due to repeat foot and/or wagon traffic. Further evaluation of this thermal anomaly could be accomplished by obtaining a larger core using a Giddings® drill rig, where the impenetrability of the soil at 4.5 feet by the semi-mechanical AMS method was not possible.

Table 6.23 – T4-1 Oakfield 1” Core (Four feet north of AMS core for TIR HA4)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.75	10YR 3/1	Loam	
0.75 – 1.5	10YR 3/2	Loam	
1.5 – 1.7	10YR 3/3	Silt loam	
1.7 – 2.0	10YR 4/4	Silt loam	Mottled, 10YR 3/3
2.0 – 2.5	10YR 5/4	Silt loam	Mottled, 10YR 5/2; Fe and Mn depletions; Mn lined root traces
2.5 – 2.9	10YR 5/4	Silt loam	Common, fine Fe and Mn concretions

Table 6.24 – T4-2 Oakfield 1” Core (Four feet south of AMS core for TIR HA4)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.5	10YR 3/1	Loam	
0.5 – 1.25	10YR 3/2	Loam	
1.25 – 1.8	10YR 4/3	Silt loam	Mn lined root traces
1.8 – 2.4	10YR 4/6	Silt loam	Fe and Mn depletions
2.4 – 2.9	10YR 4/6	Silt loam	Common, fine Fe and Mn concretions

Table 6.25 – T4-3 Oakfield 1” Core (Four feet west of AMS core for TIR HA4)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.3	10YR 3/1	Loam	
0.3 – 0.8	10YR 3/2	Loam	
0.8 – 1.45	10YR 3/2	Loam	Mottled, 10YR 4/4
1.45 – 1.75	10YR 4/4	Silt loam	Mn lined root traces
1.75 – 2.65	10YR 5/6	Silt loam	Mottled, 10YR 5/2; Fe and Mn depletions
2.65 – 3.0	10YR 5/6	Silt loam	Mottled, 10YR 5/2; Common, fine Fe and Mn concretions; Mn lined traces

Table 6.26 – T4-4 Oakfield 1” Core (Four feet east of AMS core for TIR HA4)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.6	10YR 3/1	Loam	
0.6 – 1.3	10YR 3/2	Loam	
1.3 – 1.6	10YR 4/4	Silt loam	Mottled, 10YR 5/6; Mn lined root traces
1.6 – 2.6	10YR 5/6	Silt loam	Mottled, 10YR 6/1; Common, fine Fe and Mn concretions; Mn lined root traces
2.6 – 2.8	10YR 5/6	Silt loam	Mottled, 10YR 6/1

TIR HA5 on east edge of Block 8, Lot 1; elevation: 762.5749 ft. (see Figure 6.2 for map location).

Table 6.27 – AMS T5-C

Thickness (ft)	Color	Texture	Redox / Other
0 – 0.61	10YR 3/2	Loam	Abundant roots to 6 cmbs; clear boundary
0.61 – 1.10	10YR 3/3	Silt loam	Mottled, many, coarse, and distinct 7.5YR 3/3; few, fine roots; gradual boundary
1.10 – 1.59	10YR 5/4	Silty clay loam	Mottled; many, fine Mn concretions from 38 cmbs and few, medium Fe concretions from 44 cmbs; few, fine roots; clear boundary
1.59 – 2.10	10YR 4/4	Silty clay loam	Water saturated; organic matter from 1.93 to 2.03 ft; few, fine roots; clear boundary
2.10 – 2.66	10YR 5/4	Silty clay	Mottled, many, fine, and faint 10YR 3/3,

		loam	5/6, and 6/2; few, fine Mn concretions; few, fine roots; gradual boundary
2.66 – 3.21	10YR4/4	Silty clay loam	Mottled, many, fine, and faint 10YR 5/6 and 6/2; few, medium Fe concretions

Figure 6.13. *AMS soil core from TIR HA5, 0-1.59 ft., top at left, described in Table 27. Photo by M. Kathryn Rocheford.*

Figure 6.14. *AMS soil core from TIR HA5, 1.59-3.23 ft., bottom at right, described in Table 27. Photo by M. Kathryn Rocheford.*

Similar to T2-C (Figure 6.7), HA5 (T5-C) has an over-thickened organic rich layer to a thickness of 1.1 feet or 2.63 ftbs, given the compaction ratio of 2.39. The major difference between these two locations is that T5-C is located in an area classified as soils produced by broadleaf forest. It also has a constrained zone of saturation between 1.59 and 2.10 feet where the moisture content is distinctly less both above and below. This saturated zone is potentially a perched water table, where the underlying area is less permeable interfering with the drainage of the overlying horizon. Water has a high thermal inertia, retaining heat longer than bare earth, which may have resulted in the positive or hot thermal signature in the morning at this location. This zone of saturation lies deeper than the depth of the surrounding Oakfield cores, warranting further investigation of this area to the depth of this saturated layer to better determine its nature as well as its extent in relation to the thermal anomaly observed.

Table 6.28 – T5-1 Oakfield 1" Core (Four feet north of AMS core for TIR HA5)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.7	10YR 3/2	Loam	
0.7 – 1.2	10YR 4/4	Silt loam	Mottled, 10YR 3/2
1.2 – 1.85	10YR 4/4	Silt loam	Fe and Mn depletions
1.85 – 2.3	10YR 4/4	Silt loam	Common, fine Fe and Mn concretions
2.3 – 3.0	10YR 4/6	Silt loam	Common, fine Fe and Mn concretions

Table 6.29 – T5-2 Oakfield 1" Core (Four feet south of AMS core for TIR HA5)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.3	10YR 3/1	Loam	
0.3 – 0.7	10YR 3/2	Loam	
0.7 – 1.75	10YR 4/3	Silt loam	Mottled, 10YR 3/2; Fe and Mn depletions; Mn lined root traces
1.75 – 2.7	10YR 4/4	Silt loam	Common, fine Fe and Mn concretions
2.7 – 3.0	10YR 5/4	Silt loam	Common, fine Fe and Mn concretions

Table 6.30 – T5-3 Oakfield 1" Core (Four feet west of AMS core for TIR HA5)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.5	10YR 3/1	Loam	
0.5 – 1.0	10YR 4/3	Loam	
1.0 – 2.2	10YR 4/3	Silt loam	Mottled, 10YR 5/2; Fe and Mn depletions; Few, fine charcoal 1-1.3 ft
2.2 – 3.0	10YR 5/6	Silt loam	Common, fine Fe and Mn concretions

Table 6.31 – T5-4 Oakfield 1" Core (Four feet east of AMS core for TIR HA5)

Depth (ftbs)	Color	Texture	Redox / Other
0 – 0.7	10YR 3/1	Loam	
0.7 – 1.3	10YR 4/3	Loam	
1.3 – 1.75	10YR 4/4	Silt loam	
1.75 – 3.0	10YR 5/6	Silt loam	Mottled, 10YR 6/1; Common, fine Fe and Mn concretions

Recommendations

Soil core testing of thermal anomalies has proven to be a cost effective method to define the extent of a potential archaeological feature, thereby enabling maximum discovery with limited excavation. For example, soil core testing surrounding TIR CA5 indicates an area of historic fill that extends further downslope (between T1-7 and T1-8) and further east than the outline of the thermal anomaly. In addition, soil core testing of CA4/HA3 revealed no archaeological feature, other than a potential borrow area for the construction of the erosion control ridge features. To investigate this hypothesis, the relationship between observations from CA4/HA3 and the nearest ridge will be explored by bisecting the ridge with a trench during the Fall of 2010.

The results for a particular anomaly classification (e.g. hot anomalies) varied at this site, indicating that something other than archaeological features alone is producing the thermal signatures. An example of this is found in comparing TIR anomalies HA4 and HA5 which are in areas that share the same soil classification and similar landscape positions (Figure 6.2). However, the AMS core from HA4 has a much thinner dark, organic-rich layer than that of HA5, along with a relatively shallow zone of impenetrability. Therefore, obtaining soil cores that are larger in diameter (up to 5 inches) with a Giddings® drill rig, which can penetrate deeper, will enhance the ability to interpret soil characteristics at these locations and to identify any potential for future archaeological investigations.

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