Chapter 3

ANALYSIS OF RESULTS AND EVALUATION OF MODEL

A. ANALYSIS OF THE MODEL

As described in the model, the cart road alignment runs across four main types of environmental settings or zones within the U.S. Route 301 corridor (Figure 1.3):

Zone 1: Essentially level farm fields,

Zone 2: Farm fields with slight slopes trending towards drainages and wetlands,

Zone 3: Wetlands, underlain by clay and lying adjacent to drainages, and

Zone 4: Drainage crossings.

In order to test the validity of the model, all four zones were tested using a combined ground penetrating radar and gradiometer survey followed up with ground-truthing in the form of mechanical test trenches and penetrometer readings. Detailed mapping of the crossing was also employed to record sight differences in the landscape topography which may have been the result of the former cart road.

1. Zone 1

As time and budget permitted, one trench (Trench R) was placed in Zone 1 where the cart road was projected to cross level farm fields and where ground penetrating radar (GPR) and gradiometer survey had detected linear traces. These were hypothesized to be in line with the cart road alignment. Ground-truthing failed to identify any visual stratigraphic remains that could be related to the cart road. The negative results are thought to be directly related to deflation of the soils brought on, as the model suggests, by over two centuries of agricultural activities. Deflation of the topsoil has resulted in the mixing of the remaining topsoil with the underlying B horizon. This mixing essentially erased any visible remains of the cart road. Penetrometer testing failed to reveal any areas of compacted soils that might be related to the cart road traffic.

The relative clarity of the features on the GPR survey contrasts with the apparent absence of observable contrasts in soil color or texture, and with the lack of variation in the penetrometer readings. Keith Seramur of Seramur & Associates, PC, explains this contrast as follows:

> The radar energy transmitted into the ground by the GPR system reflects off of the contact or boundary between soils with different dielectric properties. These contacts are shown on the GPR record as anomalies and layered strata. Dielectric property of a soil material is dependent on soil conductivity, which is strongly influenced by clay content, soil moisture and the presence of iron oxides. Areas with higher B-horizon clay content will retain moisture and iron oxides will precipitate onto the surface of the clay minerals. The 400 mHz antenna used in this survey is very sensitive and can image small changes in dielectric properties within the soil profile (Seramur 2013).

The Reedy Island cart road would have made several changes to the top of the soil profile. Use of the cart road would initially compact the soil and then carve ruts into the road. This type of disturbance will change soil formation processes (eluviation and illuviation) at depth. Water ponding up in ruts infiltrates into the subsoil, increasing the translocation of clays and iron oxides down into the soil profile below the footprint of the rut. Ditches excavated along the cart

road would have a similar effect. This could have resulted in slight changes in clay and iron oxide content in the soil profile below the cart road.

Plow zone stripping did not identify visual evidence of the two linear GPR anomalies that extend across the central and eastern portion of the survey grids. It was possible to process the GPR data in order to map very subtle changes in the dielectric properties of soil just below the plow zone. The subtle reflections of the two linear anomalies were difficult to distinguish from background noise on vertical profiles or cross-section of the radar data. It was only after assembling the radar data into a three dimensional grid that the linear anomalies were evident. The reflections are only visible on a thin slice of the radar data. The depth to the linear anomalies varied across the study area, so each grid had to be processed separately in order to image the anomalies at different depths.

These anomalies were not present in the GPR data at depths less than 45 to 50 cm. The depth of these two linear anomalies on the GPR record appears to correlate with the base of the plow zone or the top of the undisturbed soil profile. The depth slices are used to rule out the possibility that these linear anomalies were an artifact of recent plow zone disturbance.

We attribute these linear anomalies to one or more changes in soil properties including clay content, percent iron oxides and soil moisture. The most likely explanation for the linear anomalies imaged on the radar slices is a historic disturbance along the top of the soil profile that affected pedogenic processes at depth. This disturbance could have been the Reedy Island cart road or some other type of travel extending from the southwestern corner of the field at Spring Branch up to the northeast. Erosion and plowing removed visual evidence of the soil disturbance that produced these anomalies." (Keith Seramur, 4/15/14).

2. Zone 2

Zone 2 was one of the primary foci of the investigations, and therefore a total of 11 trenches were dedicated to testing the predictive model in this zone (Trenches B-A-H, F-G, I, J, K, N, O, P, Q, S and V) on the east side of the Spring Mill Branch and one trench on the west side (Trench W). These trenches were strategically placed to detect linear traces identified by the ground penetrating radar and gradiometer survey. As with the Zone 1 testing program, ground-truthing here produced negative visual results. However, in contrast to the situation in Zone 1, penetrometer readings in Trenches I, K, N, O, and Q recorded what could be interpreted as remnant traces of one of the former alignments of the cart road.

The previous work on the Zone 2 topography on the west side of the Spring Mill Branch showed accretion of the plowzone as predicted by the model. By contrast, the plowzone soils on the east side had suffered much more deflation than anticipated, reducing the maximum thickness of the plowzone to a mere six inches across Zone 2. GPR and penetrometer readings in Trenches I, K, N, O, and Q recorded what could be interpreted as remnant traces of one of the former alignments of the cart road. Even so, indications of linear features were detected by two of the three testing methods.

On the west side of Spring Mill Branch, Zone 2 had been tested by Hunter Research, Inc. and Seramur & Associates, PC in 2011 as part of Phase II investigations of the Reedy Island Cart Road Site 4 [7NC-F-153]. The combined ground penetrating radar and gradiometer survey had revealed two well-defined, parallel linear traces that were readily visible beneath the plowzone at the top of the B horizon (Hunter Research, Inc. 2014). Transects across the cart road alignment were subjected to penetrometer testing in the current investigations (Trench W) . These readings revealed that not only were the ditches or ruts signifi-

cantly more compacted than the adjacent B-horizon soils, but so was the berm area between them. This is consistent with the interpretation of these features (see Hunter Research, Inc. 2014: Figure 4.1).

3. Zone 3

The wooded wetlands, underlain by clay and lying adjacent to the Spring Mill Branch, were tested employing two trenches (Trenches T & U). Closer to the creek the underlying clays lie closer to the surface. What appear to be traces of the cart road exhibited intentional infilling with gravel. This may have been done to provide traction in the slippery mud for the team of animals used to haul the heavy loads out of the wetlands, although similar material was not found on the berm area where it would have been even more useful for this purpose. It was assumed that most of these clay areas adjacent to the stream would have been plowed with the advent of mechanized plowing in the 20th century, taking advantage of marginal areas and thus erasing any traces of the roadbed. Testing within this area revealed thin remnants of the cart road, changing the model slightly.

4. Zone 4

Testing of the Spring Mill Branch took the form of clearing the understory vegetation so that a detailed map could be constructed of the crossing area. The actual stream crossing exhibited densely packed gravels that were likely placed in the stream where clays had provided a solid surface thus creating an informal ford. Clearing of the vegetation suggested there was probably more than one approach to the crossing. This makes perfect sense given fluctuating levels of the stream, developing ruts or potholes and the potential for traffic arriving at the crossing simultaneously from two different directions.

B. EVALUATION

Overall the model proved to be helpful in identifying the ephemeral traces of the Reedy Island Cart Road. As predicted, no physical signs of the road were identified in Zone 1 (although the GPR survey did identify anomalies). Only slight traces survived within Zone 2 where it had been felt the chances were best to identify visual remains of the cart road. Zone 3, which was previously thought to retain little or no chance of identifying remains of the cart road, exhibited the shallow remains of the gravel-filled ruts within the woods adjacent to Zone 4, the stream crossing.

The development of the soils within Zone 3 proved to be more complex than originally hypothesized. The model should therefore be adjusted by dividing Zone 3 into two parts with the first part consisting of the wooded margin adjacent to the agricultural field where unchecked successional growth of the woods has reclaimed part of the agricultural field and the other part confined to the essentially old-growth woodlands adjacent to the stream, which would have been subjected to alluvial erosion but would have also been protected from plowing. This area would also have been capped by continual development of the O horizon (Figure 3.1).

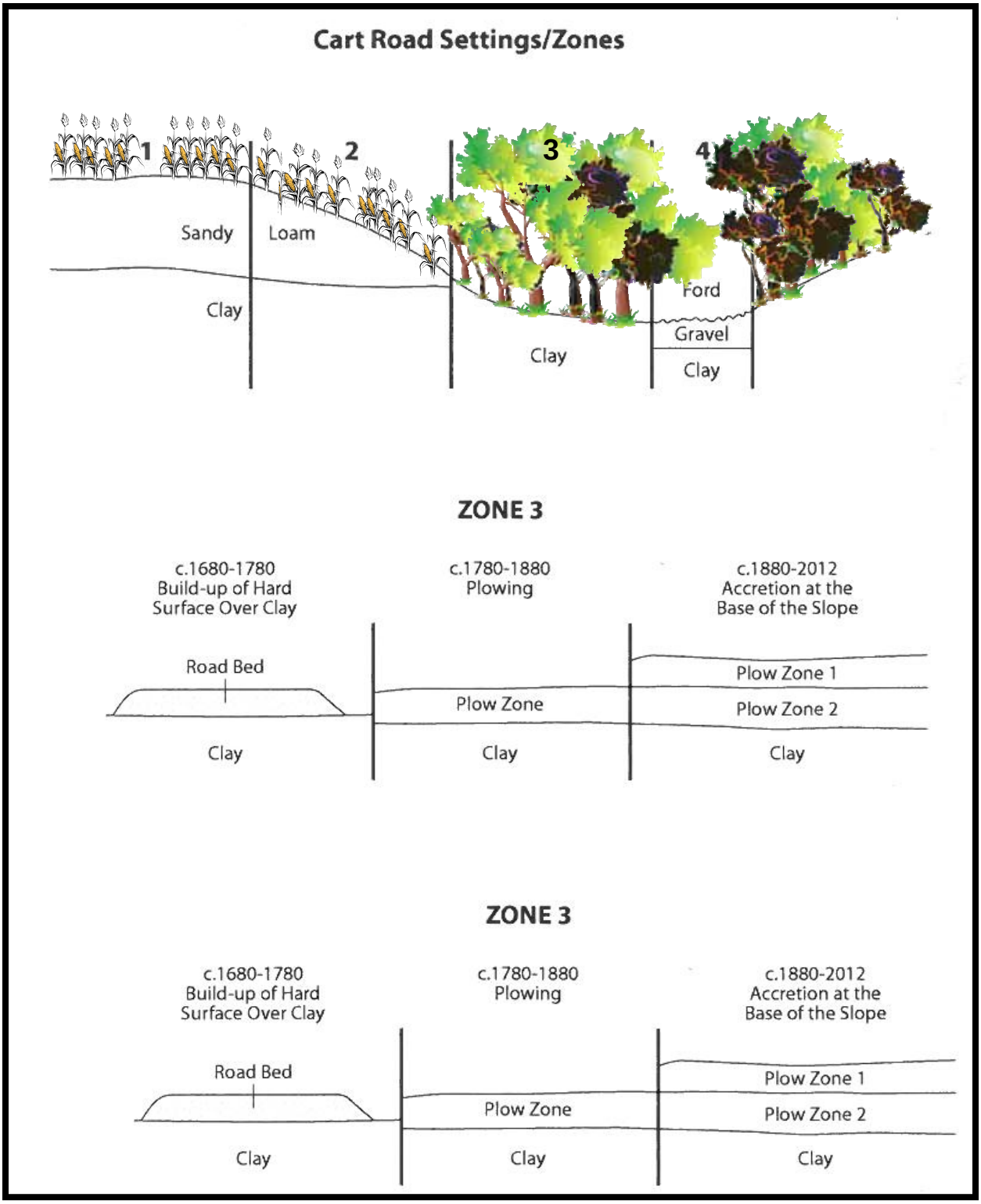

Figure 3.1. Adjusted Model of Cart Road Setting Zones Based on Data Gleaned From the Project.

Chapter 4

CONCLUSIONS AND RECOMMENDATIONSACKGROUND

The predictive model proved to be helpful and worthy of future consideration when looking for early historic ephemeral pathways. With adjustments to Zone 3, the predictive model should be a more reliable tool for future investigators.

The use of LIDAR data provided only minor supplemental information to what was physically observed in the field. LIDAR was minimally useful in this instance but as seen on sites elsewhere it can be instrumental in locating otherwise hidden features across the landscape. As the technology improves finer resolution could provide more useful digital elevation models. Examination of areas wider than the project area may be helpful in locating the trajectory of former roadways no longer present within project boundaries.

The Ground Penetrating Radar and Gradiometer Surveys conducted by Seramur & Associates, P.C. were effective at showing subtle changes in the physical properties of the soils such as moisture and compaction across the landscape. Linear traces provided specific target areas to be tested or ground-truthed. Mechanically excavated trenches placed over the geophysical anomalies provided mixed results. One prehistoric pit was immediately visible when the plowzone was removed from Anomaly B, but there were no visible signs of the cart road.

One-foot-interval soil compaction testing along the entire length of each trench using a hand-held penetrometer provided immediately informative data that was useful in the field and in the overall interpretation of the probable path or paths of the cart road. Traces of the former alignments of the cart road in the form of compacted pathways were observed in Trenches I, K, N, O, and Q on the east side of the Spring Mill Branch and in Trench W, on the west side of the Spring Mill Branch. In the future if similar former roadways are suspected or possibly detected, the use of an inexpensive, easy-to-use pocket penetrometer is recommended.