APPENDIX K:

D-SHAPED PIT FORMATION

AN ALTERNATIVE HYPOTHESIS OF D-SHAPED PIT FORMATION

Introduction

Feature 6, in Block C at the Frederick Lodge Site Complex, strongly resembled a type of feature commonly identified on prehistoric archaeological sites in Delaware. These features are large (typically up to 3 m in length), and have been described as D-shaped, crescentic, or kidney-like in plan. Large numbers of these features were identified by the University of Delaware Center for Archaeological Research (UDCAR) during archaeological mitigation projects associated with previous SR1 construction. Major sites in north central Delaware on which these features have been reported include Carey Farm and Island Farm (Custer et al. 1995), Pollack (Custer et al. 1994a), Leipsic (Custer et al. 1994b), and Snapp (Custer and Silber 1994). On these sites, the D-shaped features were interpreted as the signature remains of semi-subterranean structures than had been truncated by plowing (Custer 1994). This interpretation, which will be referred to here as the Degraded Pit House Model, is critically reviewed in this appendix, and an alternative model of their formation is proposed. Specifically, it is proposed that the D-shaped features extensively documented on sites in Delaware from the Late Archaic and early portions of the Woodland represent the physical scars left by the active modification of the local forest environment by occupants of the site.

D-shaped Pit Formation Models

Degraded Pit House Model

Numerous D-shaped pits have been identified during archaeological mitigations undertaken by UDCAR along the SR1 right-of-way. In these investigations (Custer et al. 1995; Custer et al. 1994a; Custer et al. 1994b; Custer and Silber 1994), the pits were interpreted as component remains of semi-subterranean structures or “pit houses.” According to this interpretive model (Figure K-1), the anomalies represent storage facilities located inside shallow, semi-subterranean structures, from which most other below-ground evidence has been lost to plowing (Custer 1994). The conceptual template for this interpretation appears to be based on a single finding made on the Snapp site (Custer and Silber 1994). At this site, a complex of features was encountered at the foot of a minor slope. The addition of colluvial soil had protected the area from the extensive plow disturbance that was evident across the rest of the site. Designated Feature 153, the complex consisted of a narrow D-shaped pit set in one end of a much larger, shallow basin. A third pit was defined in the approximate center of the larger feature. The cluster of pits was roughly enclosed by a pattern of nine, irregularly spaced post holes. The Feature 153 complex is interpreted as a dwelling composed of a shallow “basement”, or living area, with a “sub-basement” storage facility located at one end. The central pit was interpreted as a hearth, with the post hole pattern representing a superstructure constructed over the below-grade house floor (Custer and Silber 1994:43-52).

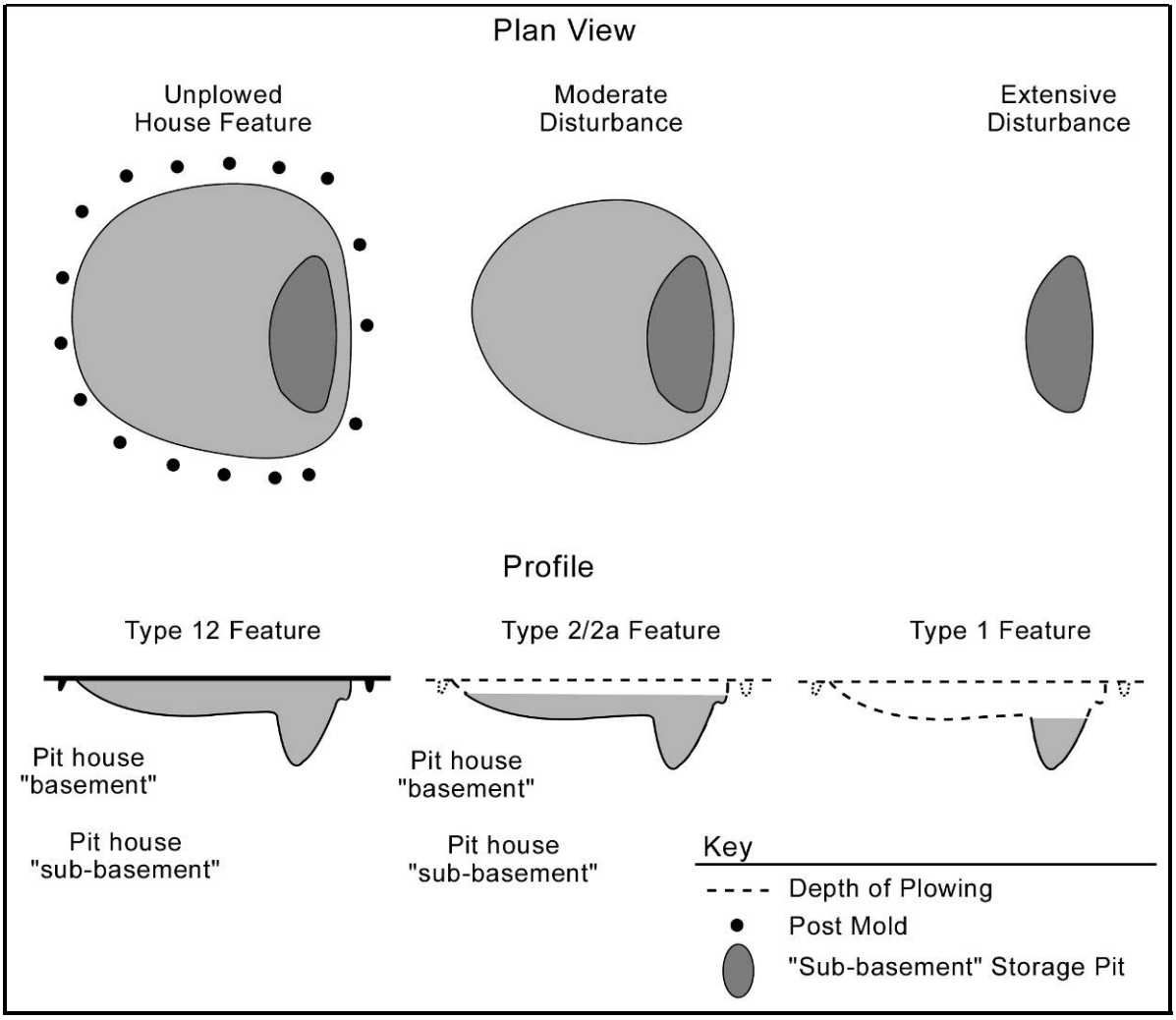

Figure K-1. The Degraded Pit House Model.
(Custer 1994:57)

Subsequently a large number of D-shaped pits at the Snapp site were interpreted as remnants of sub-basements within structures. Most did not contain an accompanying shallow basin, central hearth, or post molds, which were presumed to have been plowed away (Custer and Silber 1994). Based on data from UDCAR's SR1 excavations and from other sites in the state (e.g., Thomas 1981), Custer categorized the range of pit features found in Delaware on the basis of details of shape and depth, proposing a typology with 12 forms that generally corresponded to presumed function (Custer 1994). Several of the forms, including Types 1 and 2 (Figure K-2), were considered to have been the remnants of house structures. Analysis of UDCAR's SR1 data in particular suggested that hundreds of Type 1 and Type 2 features have been identified on sites in north-central Delaware, that they consist of house locations, and thus that they represent a form of community residential patterning throughout this part of the state.

The D-shaped Pit Formation Debate: Cultural or Natural

In addition to the features identified at the various UDCAR excavations, D-shaped anomalies have recently been documented at a number of other sites in Delaware, including the Gabor site, in northern Delaware (Mueller and Cavallo 1995), the Puncheon Run (LeeDecker et al. 2005) and Hickory Bluff sites (Petraglia et al. 2002), both located along the St. Jones River in Dover, and at the Glasgow School site, in northern New Castle County (Bowen et al. 2003). Considerable controversy surrounds these entities. In fact, many researchers working in the state have been unable to agree on whether the features are cultural or natural in origin. Mueller and Cavallo (1995), for example, have argued that the anomalies primarily represent the remains of tree throws. While acknowledging that some may have been utilized or modified by aboriginal populations, Mueller and Cavallo reasoned that the features were not domestic structures, and indicating that both direct and ancillary evidence for intensive prehistoric settlement, such as would be implied by hundreds of structure locations, is completely lacking in the greater region. LeeDecker et al. (2005) also viewed the house remains theory with skepticism, noting the general lack of posts or other recognizable feature types normally associated with structure locations.

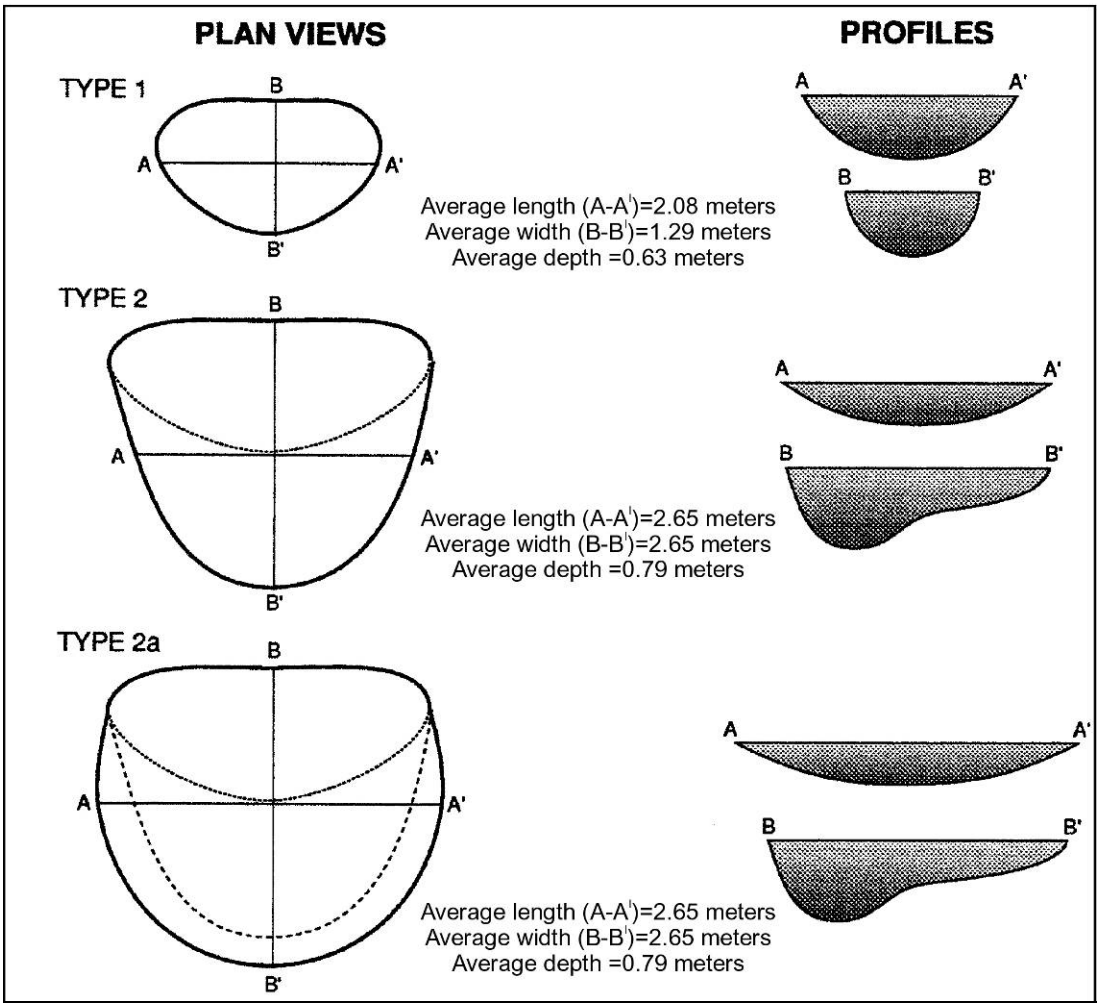

Figure K-2. Woodland I Feature Typology.
(Custer 1994:58)

In terms of other possible functions, it seems unlikely that the pits served as storage facilities. The wide orifice in relation to volume that is typically seen would have made them unsuited to such a purpose, either inside a structure, where they would have taken up large areas of valuable floor space, or in the open, where their configuration would have served to capture soil moisture or run-off. By contrast, large cylindrical features, whose form was better suited for use in storage, are extensively documented in Delaware. These features, often dubbed silo pits for their configuration and presumed use, have been identified at sites in Kent and New Castle counties (Thomas 1981; Custer 1994; Petraglia et al. 1998; Petraglia et al. 2002; LeeDecker et al. 2005).

As for the tree-throw formation hypothesis, for the most part, the morphology of the pits does not conform to shapes left by tree throws in contemporary settings. These common natural disturbances typically have a shallow, saucer-like profile. Evidence from natural resource studies (Schaetzl et al. 1989; Langhor 1993) and from the archaeological assessment of modern tree disturbances (Petraglia et al. 2002) suggests that the pit that results from a fallen tree is not particularly deep—typically less than 50 cm—and that it lacks the trench-like contour seen in the D-shaped pits.

The D-shaped pits do, however, consistently exhibit cultural attributes when investigated archaeologically. These attributes are variously expressed as occupation-period radiocarbon dates, elevated artifact counts, and elevated levels of certain elements that are considered characteristic of human occupation, particularly available phosphorus (Eidt 1984; Schuldenrein 1995). It appears, then, that the pits were in some way associated with cultural activity. To further investigate the degree to which cultural signatures are present in the features, data from several major excavations were reviewed

Site Data

UDCAR Excavations (Custer et al. 1995; Custer et al. 1994b; Custer and Silber1994)

As noted above, a large number of D-shaped pits were documented during several UDCAR excavation projects. Extensive soil chemistry analysis was not undertaken as part of these investigations. Neither were artifact counts in the features reported in relation to surrounding non-feature contexts that would allow assessment of relative artifact frequencies. However, radiocarbon dates were obtained from several of the pits. The dates were not only consistently of prehistoric in age (Table K-1), but they were largely contemporary with the primary occupation components at the sites. In addition, some of the pits contained substantial numbers of artifacts, with the implication that artifact frequencies in the pits were different from those in the surrounding deposits. Both sets of data suggested that the features were open at the time of the occupations.

Hickory Bluff Site (Petraglia et al. 2002)

At the Hickory Bluff site, five D-shaped pits were intensively investigated (Table K-2). Carbonized organic material from two of the features was subjected to AMS dating, and both samples yielded dates contemporary with major occupation periods at the site. Analysis of soil chemistry was conducted on four of the features. Each feature registered elevated levels

of phosphorus (P) in relation to control samples. Two of the pits also contained notably elevated artifact counts in relation to adjacent non-feature contexts.

Table K-1. Radiocarbon Dates from D-shaped Features on Delaware SR1 Sites.

Carey Farm (7K-D-3) (Custer et al. 1995:146)				
Feature	***Date years BP***	***Calibrated Date***	***Notes***	***Lab Number***
623	*1640±70*	*AD 370 – 530*	*D-shaped*	*Beta-76845*
371	*1240±60*	*AD 695 – 880*	*D-shaped*	*Beta-76837*
427	*1680±60*	*AD 535 – 635*	*D-shaped*	*Beta-76838*
440	*1720±60*	*AD 245 – 410*	*D-shaped*	*Beta-76839*
686	*1260±70*	*AD 680 – 875*	*D-shaped*	*Beta-76842*
Leipsic Site (7K-C-194A) (Custer et al. 1994b:69)				
353 Area A	3650±100	2192 BC-1890 BC	D-shaped	Beta-42878
314 Level 4	2070±70	199 BC – AD 1	D-shaped	Beta-42879
255/256 A	1080±130	AD 778 – AD 114	D-shaped	Beta-42881
255/256 D	770±170	AD 1040 –1390	D-shaped	Beta-42882
77 Level 3	1820±110	AD 60 – 340	D-shaped	Beta-42883
266	1400±80	AD 576 – 674	D-shaped	Beta-42884
Snapp Site (Custer and Silber 1994:103)				
105	1410±70	AD 576 – 666	D-shaped	Beta-56802
142/193	1150±80	AD 775 – 984	D-shaped	Beta-56361
153	2420±70	BC 350 -72	Snapp House	Beta-56803
206	1640±70	AD 262 - 531	D-shaped	Beta-56360

Table K-2. Hickory Bluff D-shaped Pit Attribute Summary.

Feature Number	**Elevated Artifact Count**	**Elevated P Content**	**Absolute Dating (AMS)**
2	No	Yes	2790±40 years BP
77	No	Yes	n/a
90	Yes	Yes	4070±40 years BP
118	Yes	n/a	n/a
169	No	Yes	n/a

(Petraglia et al. 2002)

All of the D-shaped features at the Hickory Bluff site exhibited one or more of these cultural indicators. Of the two features for which all three analyses were undertaken, Feature 90 yielded consistently positive results. The findings suggested that the D-shaped features were present and open at the tine of the site occupations.

Frederick Lodge Site, Feature 6

A single D-shaped pit, designated Feature 6, was identified at the Frederick Lodge site. The feature was excavated in bisection and subjected to detailed chemical and sediment analysis. The feature was located outside of the main artifact concentration, and it contained a limited number of artifacts, making statistically meaningful comparison of feature and non-feature contexts impractical. No radiocarbon dating was undertaken. Chemical analysis of the fill revealed strong evidence for cultural association in the form of elevated phosphorous levels

(Table K-3, Figure K-3). Peak readings at the base of the fill were 700 percent higher than readings for control samples, suggesting that the feature had been open during occupation of the site.

Table K-3. Feature 6 Fill Soil pH and Trace Chemical Analysis.

Sample location	Sample #	pH	P	Ca	Mg	K
Control 1 Outside pit rim 70-80cm bd	--	5.3	1.4	321.8	136.5	92.6
70-80 cm bd	4	5.6	6.4	173.8	47.4	54.0
80-90 cm bd	5	5.6	5.1	203.1	50.8	58.2
90-100cm bd	6	5.4	5.5	160.2	39.4	54.4
100-110cm bd	7	5.5	6.7	153.4	40.4	57.0
110-120 cm bd	8	5.7	10.5	110.9	35.2	53.0
120-130 cm bd	9	5.8	4.1	124.8	42.1	63.5
130-140 cm bd	10	5.7	0.9	220.4	104.3	86.9
Control 2 below pit 140-150 cm bd	11	5.3	1.5	156.7	67.1	58.1

P=phosphorus, Ca=calcium, Mg=magnesium, K=potassium, all noted in mg/kg

An Alternative Hypothesis: The Culturally Induced Tree Fall Model

While the D-shaped pit features recorded at various sites in Delaware bear some resemblance to tree-fall disturbances, their deep, trench-like profiles do not conform to commonly observed contemporary tree-throw morphology. Yet, the cultural attributes documented for these features, and the sheer numbers and frequencies with which they occur on or adjacent to archaeological sites from the Late Archaic and Early Woodland period in Delaware, are issues that require addressing in any meaningful discussion of archaeological findings in the state. The following model is presented as an alternative theory as to the origin of these features. The model suggests that the D-shaped pits represent the physical scars of tree falls that were generated intentionally by prehistoric site occupants. That is, trees were felled in a particular manner to disrupt the climax forest cover and the activity resulted in the features recorded archaeologically across the state.

The Culturally Induced Tree Fall Model for D-shaped pit formation postulates that trees were felled by the excavation of an arcing trench along the base of one side of a mature tree, initially leaving the roots in place. Soils on the Delaware Coastal Plain are by and large sandy and unconsolidated, allowing for easy excavation. A fire would then be constructed in the trench to burn through the exposed roots, either downing the tree outright, or leaving it unstable enough to fall as a result of the next high wind. Figure K-4 illustrates this procedure schematically. The pit that resulted from the excavation and fall of the tree would in fact be D-shaped, with the long or straight side oriented perpendicular to the direction in which the tree fell. If the tree were to fall away from the excavated trench, the roots that had not been exposed and burned through would simply twist or fold over, leaving little additional ground disturbance (Figure L-4). The ground disturbance would remain D-shaped, and it would conform closely to Custer's (1994) Type 1 pit feature. If the tree were to fall in the opposite direction, towards the excavated trench, the uncut portion of the root system would splay upwards 90 degrees, forming a rounded, ventral hump and a shallow, semi-lunar ground

disturbance of a sort typically observed in association with contemporary tree falls. When seen archaeologically, the ground disturbance would comprise the deep, narrow trench and a wide and shallow tree throw that would conform closely to Custer's Type 2 feature, or the "basement/sub-basement" configuration of the Pit House Model. The pits may eventually have been used for the disposal of unwanted occupation debris, thus accounting for chemical and artifactual signatures.

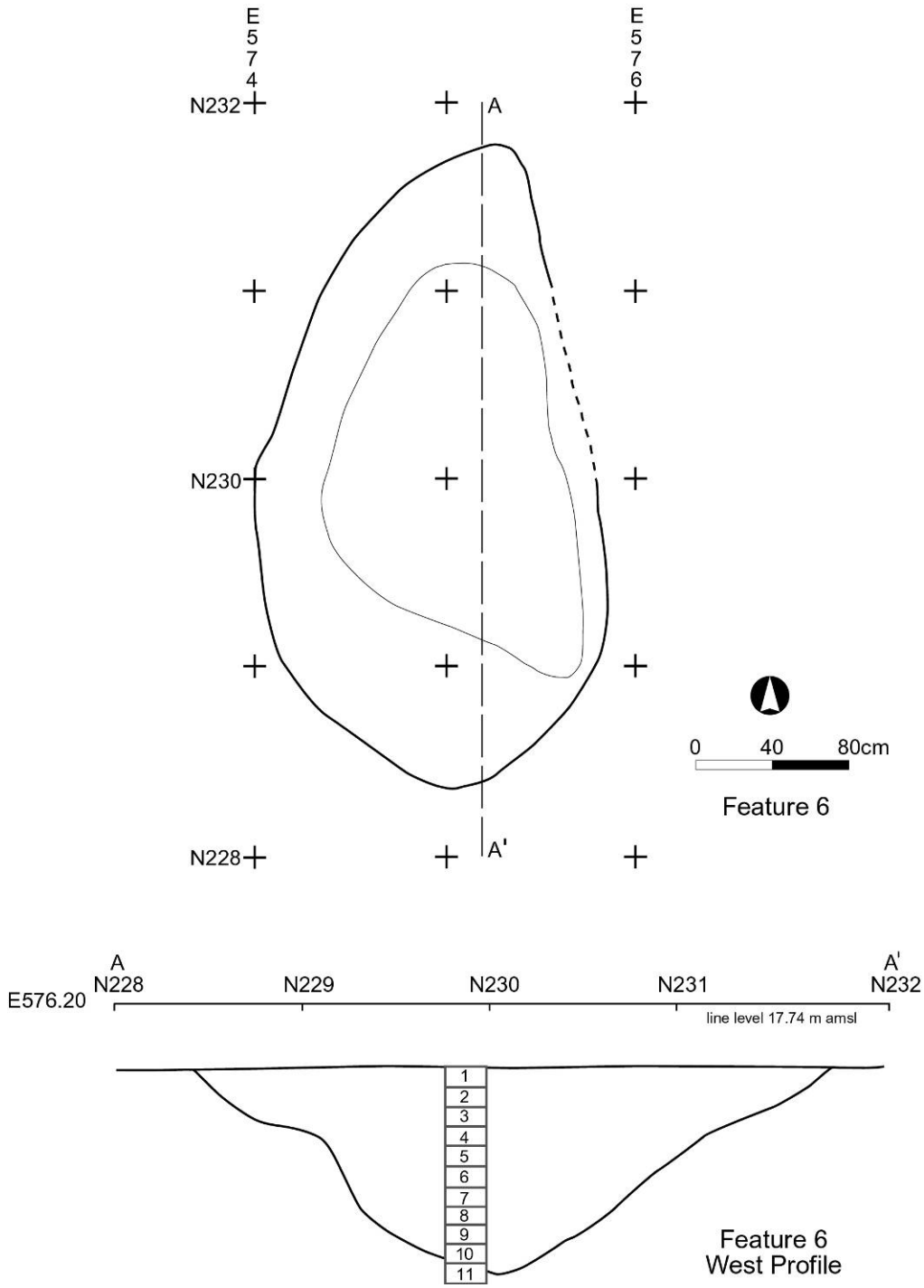

Figure K-4. Feature 6 at Frederick Lodge.

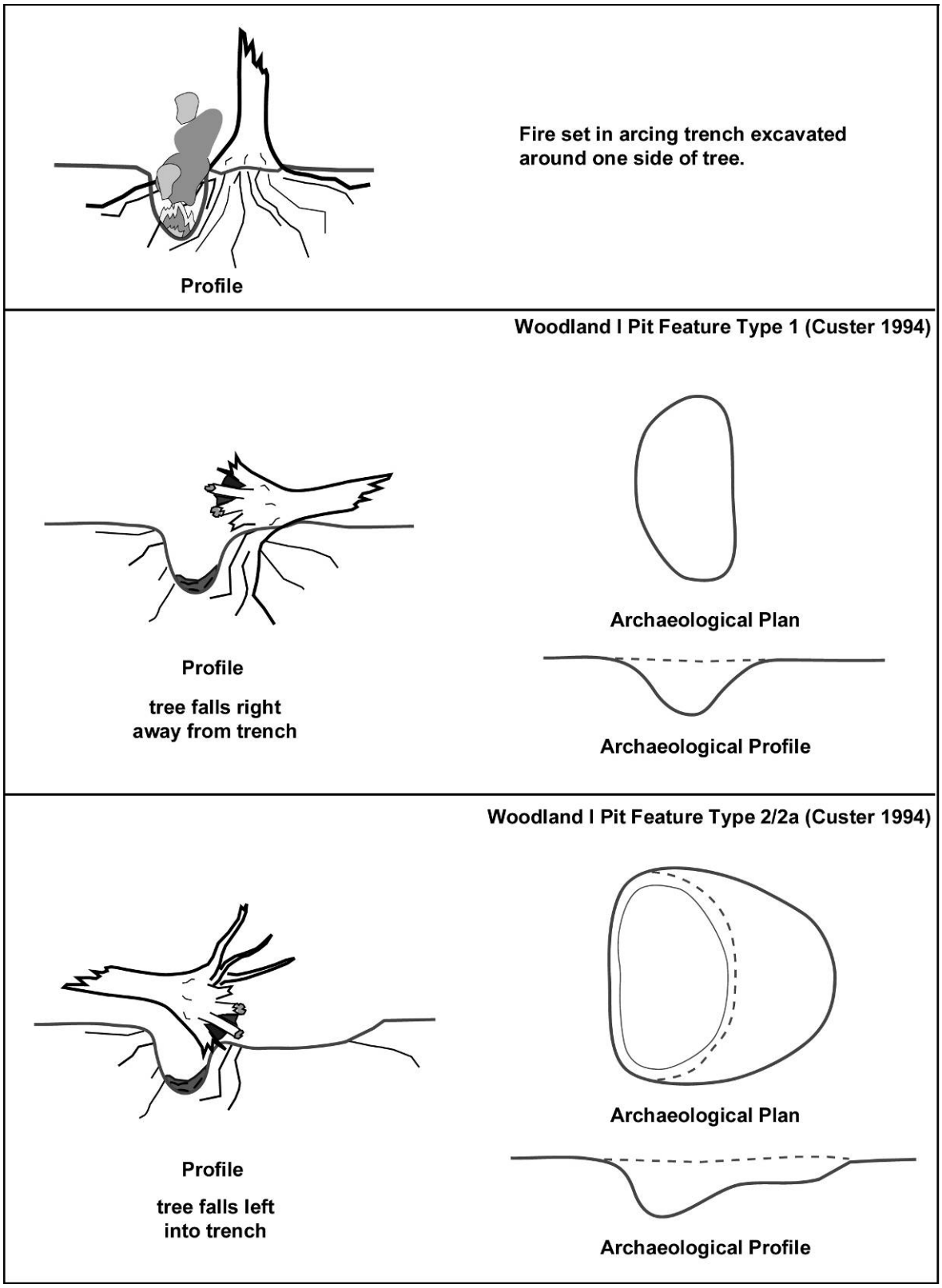

Figure K-4. The Culturally Induced Tree Fall Model.

It is proposed that the practice of inducing tree falls would have been undertaken within the context of repeated site visits, as part of regular settlement/subsistence rounds. Such activity would conform well with several existing settlement models, including the Woodland I scenario articulated by Custer (1994), the Diffuse Forager Settlement Pattern presented by LeeDecker et al. (2005), and the Watershed Range Model described in this volume. Localized modification of the climax forest cover can be considered a form of forest management undertaken expressly to enhance the surrounding resource base. These activities would be seen as part of a wider process that Custer (1994) has referred to as *productive intensification*, and which he presented as one of the hallmarks of subsistence practices during the Delaware Woodland I period. Felling trees in this manner may have been undertaken for a variety of specific reasons. For example, the output of prime mast-producing tree specimens near occupation sites would be enhanced by eliminating adjacent and competing trees that were less economically important. Open areas would promote the growth of plants, such as *chenopodium* and *Iva annua*,that require open environs and disturbed ground in order to thrive, and whose seeds were a potential source of food. Downed trees would also furnish a ready supply of seasoned limb/branch fire wood for return site visits, while the clearings formed would maximize solar exposure for winter occupations.

In some instances, downed trees may have been burned off. The resulting open space would be well-suited for colonization by edible pioneering plants, such as blueberry, raspberry, blackberry, and other species that thrive in or are partially dependant on burned areas (Farb 1961). Localized but on-going disruption of the forest cover throughout the settlement range would also have the effect of improving game habitat. Ecologically diverse forests in various stages of succession that have burn areas, extensive fringes, and ample snags and dead trunks constitute better game habitats than those in homogenous climax state.

The concept of fire used to promote tree falls is not without ethnohistorical precedent. Among Powahatan groups in Coastal Virginia, for example, Rountree (1989:47) describes the manner in which large trees were downed by Native Americans “by alternately burning and chipping away at the charcoal...The entire field was then burned over.” Immature trees were cleared by “debarking or simply chopping all around the trees’ roots.” The next year when the trees were dead, the trunks were uprooted with levers of “crooked peece[s] of wood,” and crops were planted in the soft earth of the depressions left by the trees’ roots” (Rountree 1989:47). While specifically aimed at preparing ground for horticulture, these accounts clearly detail the use of fire in downing trees and in clearing site areas.

Summary

In summary, it is suggested that the D-shaped pits documented on numerous Woodland I period sites in Delaware, including the Frederick Lodge site complex, share a common, cultural formation process. This interpretation is predicated on the repetition with which the D-shaped pit form occurs archaeologically, and the fact that the pits do not clearly conform to readily observed, contemporary tree-throw morphologies. An interpretation of the cultural formation of the D-shaped features is supported by the repeated documentation of cultural attributes, including occupation-period radiocarbon dates, elevated artifact counts, and anthropogenic chemical signatures in the fill sediments. The Culturally Induced Tree Fall Model is presented to accommodate these cultural attributes. The D-shaped pits are held to

represent the remains of the purposeful modification of the local forest cover by prehistoric site occupants. It is proposed that part of the base of mature tree was excavated, and the roots were burned through, causing the tree to fall. This activity would primarily have been undertaken as a form of forest management to promote or enhance the growth of economically useful species in and around seasonal occupation locales. During the various occupations, some of the trench-like, D-shaped ground disturbances produced by the culturally induced tree falls were likely used for refuse disposal or perhaps modified to accommodate a particular site need.

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