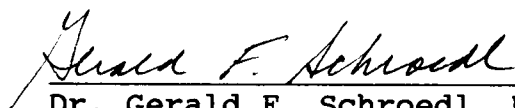


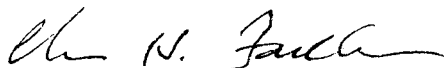
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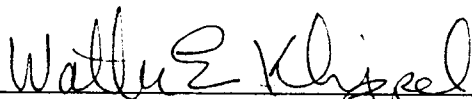


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SOIL CHEMICAL SIGNATURES OF PAST ACTIVITIES ON
HISTORIC FARMSTEADS IN THE UPLAND SOUTH

A Thesis
Presented for the
Master of Arts
Degree
The University of Tennessee, Knoxville

James Eugene Myster

May 1994

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ABSTRACT

This study was an attempt to document the usefulness of soil chemical analysis for activity detection and identification on late nineteenth and early twentieth century historic farmstead sites in the Upland South. Five historic house sites in Knox County, Tennessee were selected for study. These included the Mabry site (40KN86) in West Knoxville, and four sites in Toole Bend; the Oliver site (40KN103), the Bart Toole House site (no number), the Horace Jones House site (40KN105), and the John Jones House site (no number).

Research concentrated on defining building dimensions and function, locating and assessing areas of past activities through the identification of soil chemical signatures, and testing a yard proxemics model developed by Moir (1987). Total carbon, pH, and twenty chemical elements, assayed by an Inductively Coupled Plasma Optical Emission Spectrometer, were used in the analysis. Through ethnographic and ethnohistorical research of activities common to historic farms in the Upland South nine analytical "categories" were constructed. These categories represented the specific chemical portions of the possible activities. Using the background off-site soil as a control standard, the magnitude of soil chemical anomalies within these categories were mapped at each site sampling location. It was the spatially

distinct co-occurrence of soil chemical anomalies in the different categories that pointed to the detection and identification of soil chemical signatures of past activities.

The confirmation of the dimensions of the houses or cabins that were no longer standing at the Mabry, Oliver, and the John Jones House sites was adequate. However, the less specific identification of the interior versus the exterior was more satisfactory. Functionally, the standing outbuildings at the Horace Jones House site were speculated as industrial storage or multi-use structures.

Soil chemical anomalies were found on all the sites and were often spatially distinct. Soil chemical signatures could be determined and were directly related to specific areas of past activities. Possible smokehouses were identified on the Mabry and Oliver sites. In addition, one or many agricultural/industrial buildings were postulated on the Mabry site. Areas of generalized sheet midden deposition were found at many of the sites.

The yard proxemics model derived from Moir's (1987) work on free tenant farmers in the Upland South holds up fairly well on these sites, including Mabry, a slave plantation site. On all sites except Oliver, the Immediate Active Yard (within 6 m of the domicile) was fairly "clean" of soil chemical anomalies--at least in the front yard. Confirmation of the proxemics model in the back yard was more mixed. For

example, soil chemical anomalies were found in the Immediate Active Yard on the Bart Toole and John Jones House sites.

Despite the less than complete confirmation of Moir's (1987) proxemics model, it appears that the spatial arrangement of activities was similar around these house sites. This arrangement was fairly consistent across farmsteads in the Upland South during this time.

The results of this study showed that, though still in its infancy, the application of soil chemical research can be a valid, consistent complement to traditional object-orientated methods of activity area analysis.

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CHAPTER I

INTRODUCTION

The reconstruction of building location and function and the detection of other areas of past activities on archaeological sites is of prime importance to the archaeologist. Traditional object-orientated methods of activity area detection and identification on both historic and prehistoric archaeological sites have consistently proven to be useful. However, by themselves these methods provide an incomplete picture of the past. Many common activities, such as the processing of animals and plants, the deposition of organic wastes, and the construction of buildings can leave few durable artifacts for the archaeologist to recover.

Fortunately, either by depositing or removing organic and mineral products, many of these same activities can significantly alter, on a long time scale, the physiochemical properties of soils at archaeological sites. Soil chemical analysis, by being in the best position to identify these effects, can provide a complementary set of data to traditional methods of activity area research.

This study is an attempt to document the usefulness of soil chemical analysis for activity area detection and identification on late nineteenth century and early twentieth century historic farmstead sites in the Upland South. Five

historic house sites in Knox County, Tennessee, were chosen for study. These include the Mabry site (40KN86) in West Knoxville, and four sites in Toole Bend; the Oliver site (40KN103), the Bart Toole House site (no number), the Horace Jones House site (40KN105), and the John Jones House site (no number). An overtly deductive approach is taken in this study. Using comparative ethnographic and ethnoarchaeological research on activity areas, plus historical and archaeological background in the settlement patterns of the rural Upland South, expectations as to presumed building dimensions and the intra-site structure will be forwarded.

Moir (1987) has developed a yard proxemics model for free tenant farmers in the Upland South. This model will be tested on all five sites. Special attention will be placed on the applicability of this model to Mabry, a slave plantation site. The cumulative range of possible activities will be placed within five material groups: plant, animal, inorganic, structural, and anthropic. These material groups will be further subdivided into "analytical" categories which represent specific tangible activities potentially present on these sites. Z scores, representing the magnitude of soil chemical anomalies within each category, will be determined. These scores will be mapped as graduated circles. The identification of soil chemical "signatures" will involve the shifting co-occurrence of chemical anomalies between the

analytical categories. Correspondingly, expectations as to the presumed building dimensions and intra-site structure will be compared to these actual results and interpreted.

The use of an Inductive Coupled Plasma Optical Emission Spectrometer, a highly accurate and efficient multi-elemental assaying device, made it possible to measure a large number of macro and micro elements within each sample. The use of this technology was intended to reach far beyond the small suite of elements traditionally examined by archaeologists. The potential of most of these elements for the detection and identification of activity areas on archaeological sites is largely unknown.

Site Selection and Description

Except for a few studies (e.g. Custer et al. 1986; Woods 1988), historic sites have not been extensively studied using soil chemical analysis. This is surprising considering that at historic sites, unlike prehistoric sites, there is greater potential for identifying and controlling many of the natural and cultural variables influencing soil chemistry and its archaeological interpretation.

As a means of controlling these variables, sites included in this analysis met a narrow set of criteria: they had (1) either standing or fallen buildings still in place or clear evidence that they once existed; (2) ethnographic, historical or archaeological documentation that provided

reasonably reliable information on many of the activities previously performed on the site; (3) similar types of activities and structures represented; and (4) been located on landforms which have been subjected to minimal soil disturbance. The Mabry site (40KN86) in west Knoxville, and four house sites within an abandoned tenant farmstead in Toole Bend met the criteria (Figure 1).

The Mabry Site (40KN86)

The Mabry site takes its name from the Mabrys, a prominent East Tennessee family in the 1800s. Joseph Mabry established a homestead at this site in Grassy Valley by the first quarter of the nineteenth century (Peters 1894). He eventually became one of the middle to upper class gentleman farmers who lined the road from Knoxville to west Knox County (Goodspeed Publishing 1887; Roberts and Faulkner 1984).

He and his wife Alice (Scott) Mabry, raised six children, of which the eldest, George W. Mabry is closely associated with this farm in the middle to late 1800s. As with the other large farms of the rural Upland South during this time, the Mabry plantation relied on cattle, hogs, sheep, wheat and corn (Rothrock 1946).

Archaeological and historical evidence is unclear as to the exact location or composition of the house or intra-site structure of the farmstead during Joseph Mabry's life. However, it is known that the Mabry mansion house was built

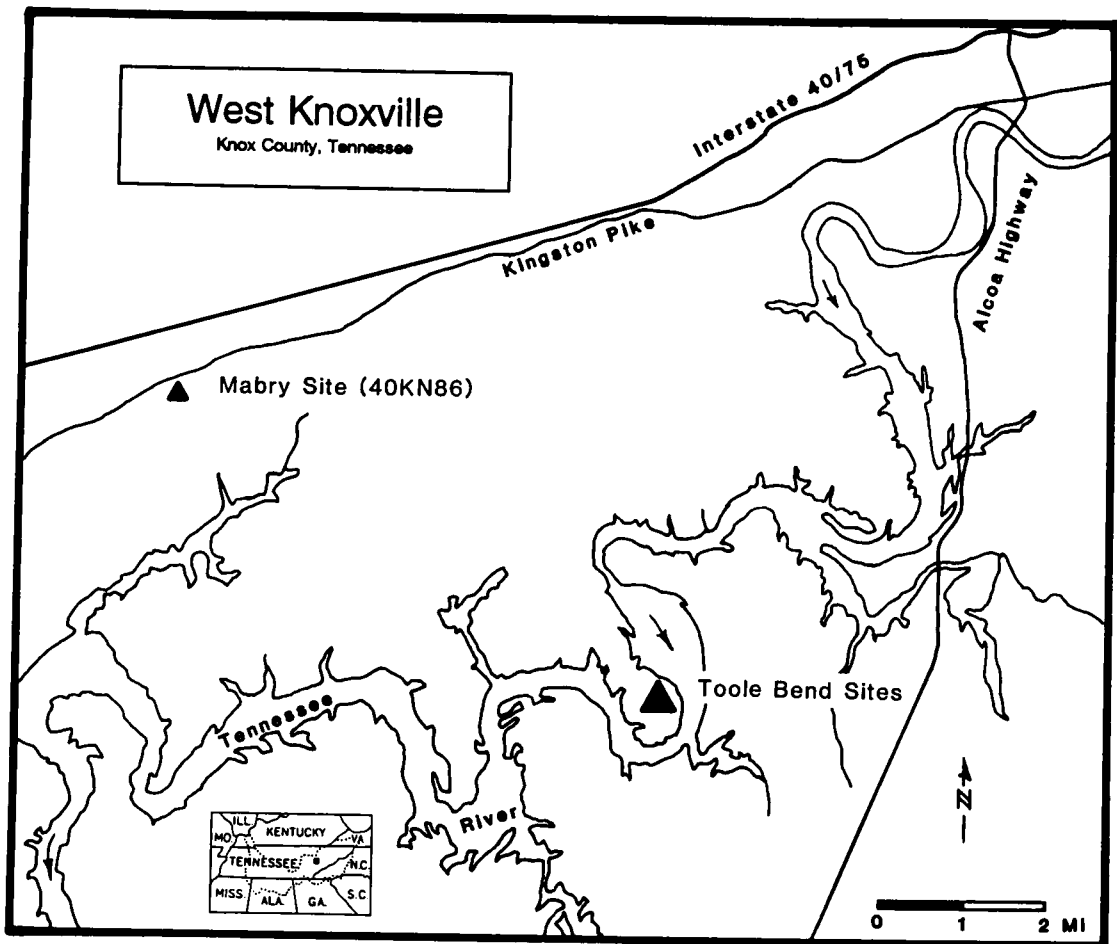


Figure 1. Map of West Knoxville. Adapted from Roberts and Faulkner (1984).

around the mid 1840s by George Mabry (Hicks 1964; Bentz 1990).

There is sufficient archaeological and historical evidence to suggest that outbuildings immediately surrounded the mansion and that two slave cabins were located several hundred yards to the south (Roberts and Faulkner 1984). Research by archaeologists from the Transportation Center at the University of Tennessee, Knoxville in 1990 and 1991 focused upon the area in and around the remains of these cabins. Excavation has shown that the remains of these two domestic structures lie within a few meters of each other (McKelway 1994).

The main construction and occupation of the cabins date securely between the 1830s and 1860s (McKelway 1994). It is unclear if the cabins were used, torn down or left to deteriorate after the Civil War. Regardless, by the late nineteenth century the farm seems to have lost much of its earlier prosperity. By the 1970s the mansion was vacant and the property unused. Increased vandalism caused the house to be razed in 1983. The fate of the other buildings on the property is unknown. None were visible during fieldwork in 1990.

Toole Bend Farmstead

Toole Bend received its name from the Toole family, who established a permanent settlement on this large bend in the

Tennessee River by the late eighteenth century (Anderson 1981; Craig and Craig 1984). By the late nineteenth century the farmstead in this study was owned by a man named Jones. He ran it as a diversified farming complex with a mixture of cash crops and animals (Terry Faulkner, personal communication 1990). Jones sold the property to W.A. Susong around 1910. Farm operations were continued with the help of many tenant farmers. An elderly local informant, Mr. Wiley Neely, helped reconstruct the layout of the farm in the 1910s (personal communication 1990) (Figure 2).

Sometime in the 1930s the State of Tennessee purchased the land for the construction of a working farm for patients of Eastern State Hospital. Over the years the property and its buildings were sold several times and leased out for a variety of agricultural endeavors. Currently all the domestic buildings are unused and a portion of the area is leased out for cattle raising.

From historical documents and informant interviewing, it is believed that the remains of at least seven different houses constructed between 1890 and 1915 are on the property. Four were selected, two with standing structures and two without, for study. These included the Oliver site (40KN103), the Bart Toole House site (no number), the Horace Jones House site (40KN105), and the John Jones House site (no number).

The Oliver site, known locally as the location of the

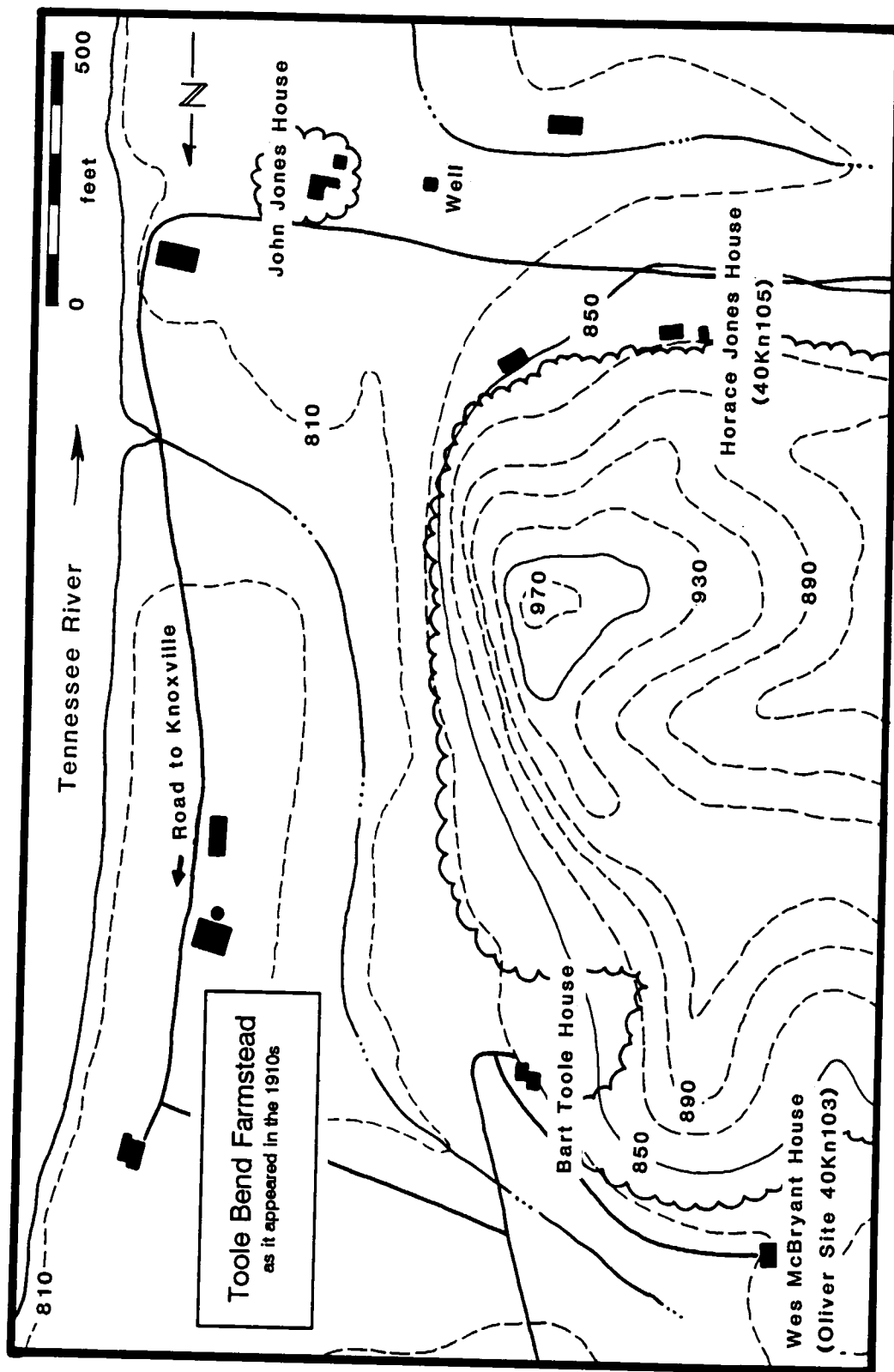


Figure 2. Map of Toole Bend Farmstead in the 1910s as recalled by Mr. Wiley Neely.

Wes McBryant House, is evidenced by a low house mound and the remains of limestone footers. Archaeologists from the Transportation Center at the University of Tennessee, Knoxville conducted Phase II and Phase III investigations at the site in 1989 and 1990.

Based upon the artifacts recovered, the dating of the house occupation fits tightly into a range of 1895 and 1936 (Bentz and Faulkner 1989). This confirms the recollections of the local informant (Wiley Neely, personal communication 1990).

The Bart Toole House, vacated sometime in the middle 1980s, is still standing, although it has been subjected to increased vandalism in recent years. Evidence indicates that this house was built sometime around 1910 when W.A. Susong acquired the property (Roberts and Faulkner 1984). Over the years it housed a number of tenant farmers and other renters.

The Horace Jones House also remains standing but has been vacant since the 1970s. An overwhelming growth of brush and thickets within the wooden fence surrounding the building have protected this house from severe damage by vandals. All evidence indicates that this house was built around 1910 (Roberts and Faulkner 1984).

The John Jones House was built in the late 1890s or early 1900s. The site was occupied into the 1940s by several different families (Wiley Neely, personal communication 1990). Aerial photographs show that the house was standing

in 1954 but was gone by 1967. The site is currently under pasture.

Activity Area Research

Ethnographic and ethnoarchaeological research has consistently shown that the use of space by humans is patterned and that these patterns are controlled by a number of specific natural and cultural factors (Kent 1987; Kramer 1979). The factors, which affect the location and relationship between activities, include, but are not limited to available technology, tasks performed, space available, and cultural norms or restraints (e.g. division of labor and taboos) acting upon the participants (Kent 1984). Research has also shown that activity areas tend to be spatially distinct. Over time, however, activity areas can overlap, especially if the space available for all tasks is severely restricted (Carr 1984).

Most activities (e.g. animal and plant processing, material storage, waste disposal) can be viewed as **accumulative**, producing a distinctive set of co-occurring objects and residues (e.g. specialized dumping) or **reductive**, removing objects or residues (e.g. clearing vegetation, plowing). Regardless of the form of the activity, activity area research at archaeological sites is an attempt to recognize and document patterns in the data set under consideration and to relate these patterns to the past

cultural activities responsible for them. This is in concordance with archaeology's premier task of establishing the link between the static, empirical facts of the archaeological record and the dynamics of past human behavior (Binford 1968).

Since its establishment as a scientific discipline, archaeology has worked primarily with information extracted from the spatial relationships between durable objects and features at sites of human activity (Grayson 1983; Willey and Sabloff 1980). Archaeologists have been confident in their ability to describe activity areas using objects and features because for the most part these are unquestionably culturally created, tend to survive relatively intact for long periods of time, and can be collected with simple, repetitive techniques (McManamon 1984). The interpretation of activity areas has ranged from straight-forward intuitive conclusions derived from the distributional mapping of artifacts and features to more sophisticated pattern-recognition statistical techniques (Blankholm 1991; Carr 1984; Kroll and Price 1991).

Regardless of the level of sophistication or even the materials considered, traditional object-orientated spatial research assumes a close, if not exact, correspondence between the patterns recognized and culturally-relevant behavior (Carr 1984). A growing number of studies, however, indicate that, in many cases, this assumption may be false

(Schiffer 1987). Archaeological sites may be drastically affected by natural or cultural processes which alter the objects and their relational properties (Gifford 1978). These processes can work on the objects in question in their systemic, archaeological, or recovery contexts (Schiffer 1987). For example, bone, a durable material with an organic component, can differentially decay with some bones of a skeleton surviving more frequently than others (Dowman 1970; Waldron 1987). Unfortunately, taphonomic processes may be difficult to determine depending upon site-specific environmental and cultural factors (Brain 1981). In fact, all artifacts are subjected to a full range of biomechanical, biochemical, geomechanical, and geochemical turbations (Foley 1981; Wood and Johnson 1981).

The chemical analysis of soils can potentially resolve more archaeological questions about spatial patterning than traditional, object-orientated methods. Chemical analysis has the potential of addressing both the accumulative and reductive effects of human occupation at archaeological sites. In addition, the soil chemical method of activity area research can possibly detect activities, such as the processing of soft organic materials, that produce few if any artifacts durable enough to visibly survive in the archaeological record.

Unlike the relationships between large durable objects, chemical remains may be less affected by the broad patterns

of cultural formation processes, such as recycling, reuse and reclamation (Schiffer 1987). Therefore, a researcher can study a data set formulated mainly by primary discard or loss, especially of non-durable materials of organic origin.

Soil chemical methods of activity area detection and identification investigate the chemical composition of the fine fraction of soils affected by human occupation. Whether looking at the inorganic or organic portion of the soil, it is assumed that all human occupation, regardless of length or manner of occupation, can modify the chemical composition of the soil within a site (Cook and Heizer 1965; Eidt 1985).

Since its application to archaeology in the 1920s and 1930s in Europe (Arrhenius 1931; Lorch 1939), soil chemical analysis has become a very productive interpretive technique used around the world. In addition to its well documented use in locating sites and detecting activity areas (Carr 1982; Griffith 1980, 1981; Lutz 1951; Myster et al. 1989), the chemistry of the soil has been used to answer questions about the type and extent of organic material deposition (Carr 1982; Dincauze 1976), the age of the site under study (Sokoloff and Carter 1952), and even the complex stratigraphic relationships present in wall profiles (Deetz and Dethlefsen 1963; Dorwin 1967) and pit features (Myster 1988; Stein 1984).

Inorganic elemental analysis has the longest history of chemical investigation in activity area research in

archaeology. Among all the elements tested, phosphorus has received the most attention (Arrhenius 1963; Cook and Heizer 1965; Eidt and Woods 1974; Provan 1971). Many other elements and inorganic chemical properties have been investigated (Anderson and Schuldenrein 1985; Bethell and Smith 1989; Cerreto 1986; Hamond 1985; Heidenreich et al. 1971; Heidenreich and Konrad 1973; Heidenreich and Navratil 1973; Konrad et al. 1983; Stein 1984; Stimmel et al. 1984; Woods 1984, 1988). Recent research has even investigated the potential of organic chemical analyses to activity area detection and site interpretation (Davies and Pollard 1988; Head 1987; Morgan et al. 1983, 1984).

It is expected that the soil chemistry will vary significantly across the Mabry and Toole Bend archaeological sites and that much of this variability can be attributed to culturally created areas of past activities. It is also anticipated that different types of activities will produce distinctive soil chemical signatures and that the signatures will be comparable between these sites.

Except for seminal work by Carr (1982), little work has been done to document or confirm soil chemical signatures for specific activities represented on archaeological sites. This can be fraught with difficulties if the site structure, material culture, and soil properties are largely unknown. The use of historic sites in this study and the attention paid to the processes of material decomposition in soil is

designed to address these complicated variables. In addition, it should not be surprising that the interpretation of chemical anomalies on archaeological sites must be done with the full consideration of the chemical and physical properties of "natural" (off-site) soils. This research was designed to use the background soil as a standard to help detect chemical anomalies that point to locations of past cultural activities on archaeological sites.

CHAPTER II

SITE STRUCTURE AND ANALYSIS STRATEGIES

The Two Spheres of Rural Life

Tennessee, as well as West Virginia, Kentucky, and parts of several neighboring states, is located within what has been referred to as the Upland South Material Folk Culture Region by Glassie (1968). This region has its ethnic roots in the German and Scotch-Irish immigrants moving in primarily from the states of Pennsylvania, Virginia, and Maryland. It is believed that the folk culture created and maintained by the coalescence of these immigrants in the late eighteenth century remained relatively unchanged throughout the nineteenth into the twentieth century (Adams 1990).

The diversification of the economic development of the rural Upland South in the nineteenth and early twentieth century was probably the single most influential factor in determining the types of activities present on historic farmsteads in Knox County. From his work in Tennessee, Pennsylvania, and Virginia, Glassie (1975) believes that two separate spheres of rural life, the domestic and the industrial/agricultural, structured the organization of these activities. The focus of the domestic sphere was the house. Associated outbuildings and other activity areas, such as smokehouses and other storage sheds, animal and plant

processing areas, privies, gardens, trash dumps, and roads/paths, all clustered around the house.

The barn (or potentially many barns depending upon the diversity of the farmstead) was the focus of the industrial/agricultural sphere. As with the house, activities directly associated with the function of the barn clustered around it. These activities may have included animal and plant storage, tool production and maintenance, and other processing. The various activities on both spheres were located in such a way as to increase the efficiency of each. This duality has proven to be a useful organizational concept for researchers interested in interpreting the spatial patterning of farmstead activities (e.g. McCorvie et al. 1989; Moir 1987).

While the occurrence of these activities on Upland South farmsteads can be quite regular, the actual location and direct associations between them can be greatly affected by topography and the nature of the farming complex. The boundaries between the domestic and industrial/agricultural sphere may become blurred and activities may overlap if useable space is limited or the size of the farm is small. Conversely, if the space is seemingly unlimited, or the farm is large and complex, tasks required to maintain the system may be performed at several locations. For example, the processing of plant and animal products and the production and maintenance of tools (including vehicles) may be found in both the domestic and industrial/agricultural spheres.

The interpretation of intra-site activities at the house sites at Toole Bend must take into account that this area was one large farming complex. As a result, each individual house site will probably contain the location of only a comparably small number of industrial activities. In addition, these sites may not contain all the range of possible domestic activities. Communal considerations between the residents of these houses may greatly alter expectations about intra-site activities.

Price (1985), for example, has documented the regular practice in rural nineteenth century Ozark life of slaughtering hogs near the smokehouse. Mr. Neely (personal communication 1990), however, believes that the slaughtering of hogs for domestic use at the Toole Bend farmstead was a cooperative activity with the participation of several of the tenant farmers. In the Fall, around a half a dozen hogs were brought, either dead or alive, to the location of the well in the shallow valley between four of the house sites (see Figure 2). They were processed in a manner similar to what has been described by Wigginton (1972). The meat and other products of the slaughter were subsequently distributed to the various tenants for storage and use (Wiley Neely, personal communication 1990).

In contrast, the limited space available for activities in the area with the two slave cabins on the Mabry site, coupled with the possibility of slaves living in close

proximity to their work place, may cause the spatial overlapping of the domestic and industrial/agricultural spheres. The concentration of this study upon the cabins guarantees the emphasis on the domestic sphere. However, some industrial/agricultural activities could be represented.

Upland South Yard Proxemics

The study of the relationship between activities around a primary structure over time and across space has been termed "Yard Proxemics" by Moir (1987). Generally, the comparison of yard proxemics on similar historic farmstead sites in the Eastern United States, especially the Upland South, seems to indicate that a majority of activities involving the domestic sphere are located within 15 to 20 m of the house. Moir (1987) has called this area the "Active Yard". Often the yard is spatially delimited by a fence which encloses many of the essential support structures, such as the well or cistern, a smokehouse or other storage shed, the privy (often times placed outside the fence), and perhaps an animal pen like a chicken coop (Moir 1987).

Many investigations support this conclusion. For example, excavations by Catts and Custer (1990) at the Williams-Stump House in Delaware, which dates from the 1850s to the 1930s, found that the fence line was only 15 m away and enclosed the remains of an ephemeral outbuilding, a cold storage shed, and a garden -- all bordering the fence. Of

the activity areas located, only the privy (shifted several times) was placed outside of the fence. McCorvie et al. (1989) determined that at the Fair View Farm site in the Shawnee National Forest of Southern Illinois a smokehouse, privy, cistern, chicken coop, and garden were located inside the fence and within 15 m of the log house. The distinctions between these activities and their locations stayed relatively the same over the eighty plus years the site was occupied in the nineteenth century (McCorvie et al. 1989).

Other nineteenth century historic house sites in Perry County, Illinois, such as the Davis, Huggins, and Baldrige sites, have outbuildings and many other activities occur within 15 to 20 m of the domicile (McCorvie 1987). The Huggins Site is interesting because over the life span of the farm the surrounding outbuildings were constantly abandoned and replaced with activities that were both the same as before or different depending upon the outbuilding (McCorvie 1987). Russ et al. (1987) also found that most activities clustered around the rear of the house at the nineteenth century Barger/Riddlebarger Farmstead site in Botetourt County, Virginia. The privy was placed only around 10 m away.

Guided by Glassie's (1968, 1975) work in the Upland South, and through his research into yard proxemics at numerous pre-modern (i.e. without indoor conveniences) farmstead house sites in Central Texas, especially in the

Richland Creek area, Moir (1987) has outlined a model of potential activity area artifact patterning zones in the domestic sphere at a hypothetical farmstead. This model has been visually summarized by Rotenizer (1992) in Figure 3.

In this model, Moir (1987) subdivides the Active Yard into an "Immediate Active Yard" and an "Outer Active Yard". The Immediate Active Yard extends approximately 6 m out from the dwelling and is where few activities take place. It is generally well maintained and swept periodically. Consequentially, the artifact density is low to moderate

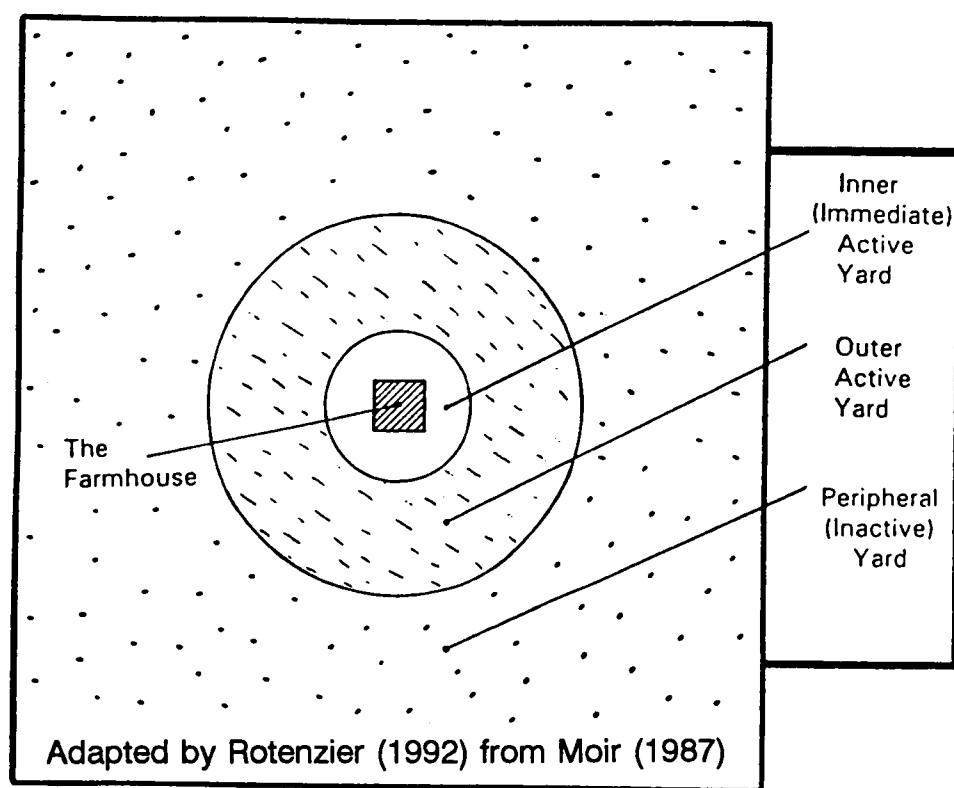


Figure 3. Hypothetical farmstead yard proxemics.

(Moir 1987). The Outer Active Yard which can extend nearly 20 m away, is where most if not all of the support structures are placed and other open air activities occur. This area is, in comparison, less well kept. Artifact density rises dramatically and many times will form a "horseshoe" shaped midden around the structures' entrances (Moir 1987).

Portnoy (1981) has forwarded an approach to further sort out the variability present in the location of activities around primary domestic structures. She supports the idea of "front" and "back" regions outlined by Goffman (1959). Goffman uses the theatrical concept of "performance" to explain the use of space by individuals in and around their houses. Performance describes the public and private actions by which people attempt to create and maintain their status. The front region would encompass the public realm and would include such areas as the front yard and porch, the living room, and the dining room. The back region, which, to Goffman, can be thought of as "back stage", is where people would be doing tasks that are not to be seen, such as preparing themselves for the front region. This region would include bedrooms, bathrooms, kitchen, and the back porch and yard (Goffman 1959).

Portnoy (1981) has directly applied this concept to archaeology. She believes that the front region serves primarily to receive and entertain non-family guests. It is a status marker and is generally well-kept. The back region

is where the much more socially and physically private activities occur, such as sexual behavior, family conflicts, waste deposition, and the long-term storage of relatively low-value items (Portnoy 1981).

Portnoy's ideas are supported by the ethnoarchaeological work on the Mott Farm site in Rhode Island by Brown (1973). She found that over the many, many years of usage much of the garbage generated in the house was thrown at or near a wall to the side and rear of the house. In addition, research indicates that very few structures are built to the front of houses on Upland South farmsteads (Faulkner 1987; Moir 1987; Rotenizer 1992).

The Mabry and Toole Bend Sites

It is unclear to what degree Moir's (1987) model, developed from research on free tenant farmers, is applicable to the slave cabins at the Mabry site. However, for purposes of testing this model, it is believed that the majority of activity areas at the Mabry site and the historic house sites at Toole Bend, are clustered within the Active Yard, 15 to 20 m away from the house. At the sites with either a natural or cultural barrier present, like a hill or fence, this distance likely will be shorter. In addition, it is believed that the location of structures and open air activity areas will cluster to the rear of the house. The deposition of general wastes in a midden will tend to surround the entrances of the

outbuildings, in the Outer Active Yard. The entrances to the structures should face the most probable path of approach by the site occupants (Moir 1987). The most offensive or private activities potentially will be the farthest away (Moir 1987; Portnoy 1981).

Field Sampling

Field sampling took into account the potential yard proxemics at all these sites. Unfortunately, given practical restraints on time, personnel, site access, equipment, and funding, it was not possible to completely surround structures at any of the sites with regularly spaced, grided sampling locations. However, the limited number of soil samples were placed where they could potentially produce as much information as possible about activities around the primary structure(s). Samples were also taken under any standing structure. As stated above, it is assumed that most activities at these domestic buildings occurred within 15 to 20 m of the domicile. Therefore, although the sample location intervals varied, site sampling was designed to stay within this boundary. Natural and cultural boundaries, however, such as hills and fences, which clearly demarcate the yards of a few of these house sites, often times made it unnecessary to sample as far as 20 m from the structure location.

As a control for soil chemical anomaly detection, soil

samples were also taken "off-site", that is, where no domestic activities associated with these sites were located. These samples were intended to provide a measure of the background soil chemistry of the natural soils immediately adjacent to each house site. Given the physical and chemical variability in soils (Beckett and Webster 1971; Hammond et al. 1958), extreme care was taken to sample on the same soil mapping units found at the house sites. The soil samples were located within these soil mapping units through consultations with Dr. John Foss, Professor of Plant and Soil Science, University of Tennessee (personal communication 1990), Foss and Timpson (1990) and Timpson (1990a, 1990b, 1990c). Wherever possible, as a precaution, background off-site soil samples were collected at least 10 to 15 m away from any site sample. See Appendix A for their exact locations.

In total, 300 soil samples were collected. The contamination of one background soil sample from the Horace Jones House Site resulted in only 299 soil samples being submitted for analysis. Due to the more intensive archaeological research at the Mabry site, nearly one-half of the total number of soil samples were taken at this site. The remaining samples were divided among the four other sites. Table 1 notes the total number of samples analyzed per site. The sample sizes are large and dispersed enough to permit statistical comparisons within and between sites.

Table 1. Total number of soil samples analyzed per site.

Site Name	On-Site	Background
Mabry Site	131	10
Oliver Site	34	6
Bart Toole House Site	31	6
Horace Jones House Site	33	4
John Jones House Site	38	6
TOTAL	267	32

The field sampling was carried out in July and August 1990. Depending upon the specific situation, soil sampling consisted of either grab sampling, soil probing, or bucket augering. A trowel was used to collect grab samples under the standing structures at the Bart Toole House and Horace Jones House sites and within the wall profiles of the test units at the Oliver site. A 3/4 inch soil probe was used when minimal soil disturbance was required, such as within the area of the two structures at the Mabry site where further excavation was to take place. However, for most of the sampling the three inch bucket auger was preferable and utilized more frequently. Bucket augering reduced field time by collecting more soil per application.

Because fairly stable landforms occur at all the sites and because the sites are recent in age, occupation layers were very shallow -- within 5 to 10 cm of the surface. Regardless of the collection method, the top three to five

centimeters of the sample, corresponding to the root mat, was discarded. It was believed that this would dramatically reduce the effects of any possible post-occupation chemical contamination on soils collected from on and off the site. A 100 to 150 g soil sample was then collected from the next 10 cm and placed in a sterile zip-lock plastic bag. All samples were transported to the archaeological soil laboratory at the Department of Anthropology, University of Tennessee, Knoxville for initial processing.

Site Specifics

As a result of extensive archaeological research, a meter grid system had been established over the Mabry and Oliver sites. Soil sample placement corresponded directly to the grid system. At the Mabry site, soil samples were taken to bisect the long axis of the presumed location of the two structures on the N 1002 line at two meter intervals (Figure 4). In addition, eight lines of samples at two or four meter intervals were placed perpendicular to this sample baseline. These were placed within and between Structure 1 and Structure 2 in order to more precisely define the building dimensions and to document any possible generalized activity areas within the Active Yard. Unfortunately, a shallow bulldozer scrape through the site could hamper these interpretations.

Results from archaeological investigations have

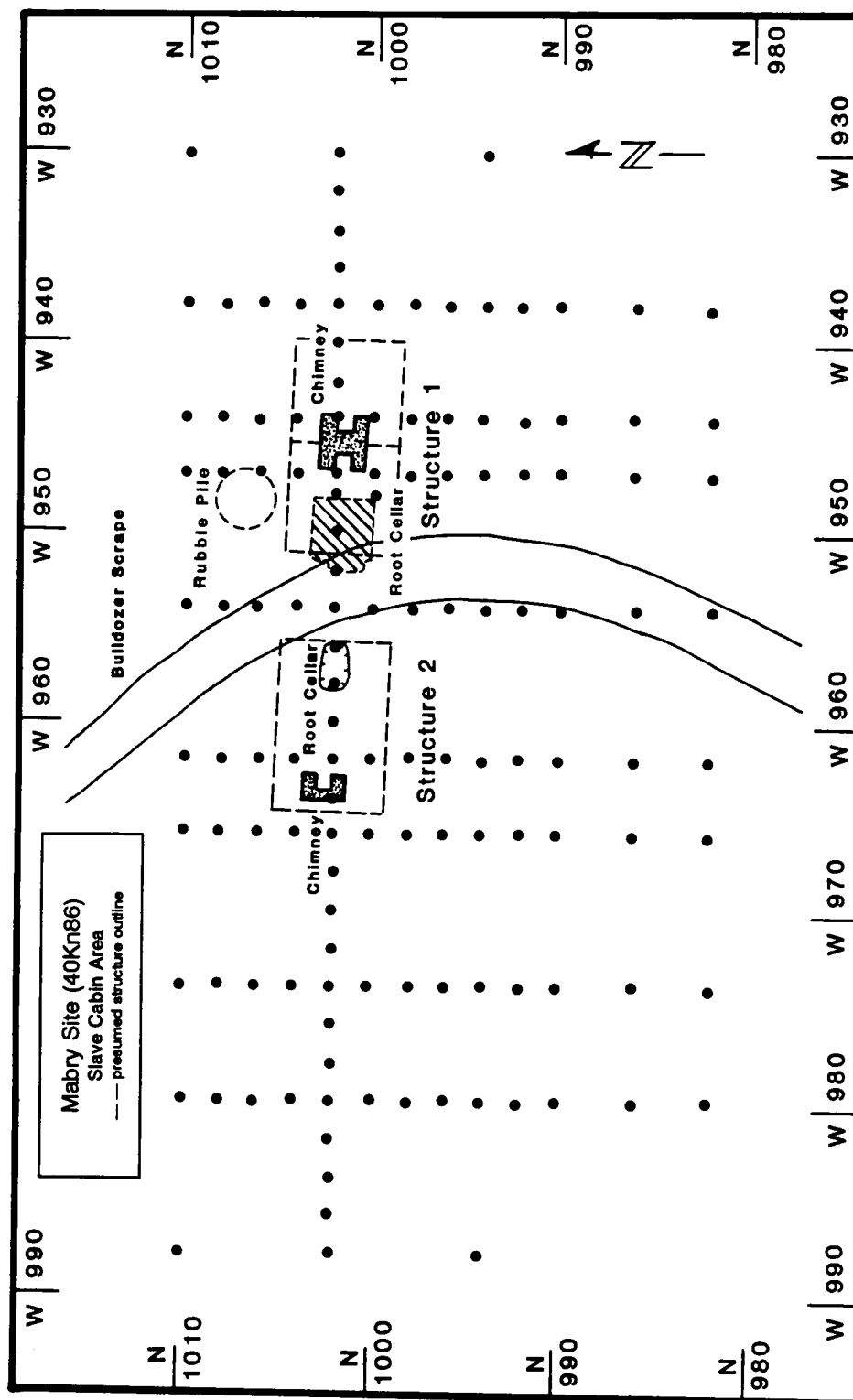


Figure 4. Soil sampling locations at the Mabry Site (40KN86).

indicated that Structure 1 was 18 by 36 ft and was subdivided into two pens. A central fireplace served both pens. A large, filled-in root cellar with an external entrance was located in the west pen (McKelway 1994). Structure 2 was a smaller, one penned building, 18 by 24 ft, with an end brick chimney. A small root cellar was noted in the eastern portion of the building (McKelway 1994). In addition, there is archaeological evidence to suggest the presence of outbuildings and other activity areas to the south and west of the Mabry slave structures (Henry McKelway, personal communication 1990).

According to the proxemics model, a majority of activities should have occurred directly to the south, the presumed rear, of these structures. Therefore, while sample locations extended only from 5 to 10 m to the north, they stretched 15 to 20 m to the south of these structures. Background sampling took place on grid points ten or more meters farther south than the last site samples and in an area where no evidence of cultural activity was found through archaeology (Henry McKelway, personal communication 1990). A total of 131 site and ten background samples was collected.

At the Oliver site, archaeological, archival, and ethnographic evidence has determined that the house was of board and batten frame construction with four rooms and a central chimney (Bentz and Faulkner 1989). In addition, shovel tests and formal test units located limestone footers

for a porch on the east side of the house and a diffuse occupational midden to the east and north of the house.

Soil samples were taken at two or four meter intervals along the presumed long axis of the house following the E997.5 line (Figure 5). In addition, samples were taken at intermittent intervals on two perpendicular lines to this base line and at other more randomized points around the structure. Due to the heightened variability in the soils at this site (mostly because of topography), background soil samples had to be taken on grid points fairly close to the site soil samples. Concern over the independence of these background samples was reduced when results produced useful information on cultural activities. Total soil sample collection at the Oliver site consisted of 34 site and six background samples.

The other three house sites, Bart Toole, Horace Jones, and John Jones, had no locational system in place from which to guide the soil sampling placement. Therefore, given the restraints on sample size while keeping in mind the goals of this study, a relatively simple and expedient "spoke" system was utilized. This system consisted of a series of eight spokes, orientated with the house, radiating outward at approximately 45 degree angles from the presumed center of the domicile. For the two sites with standing structures, sampling actually started from the edge of the house. In addition, soil samples were taken from under standing

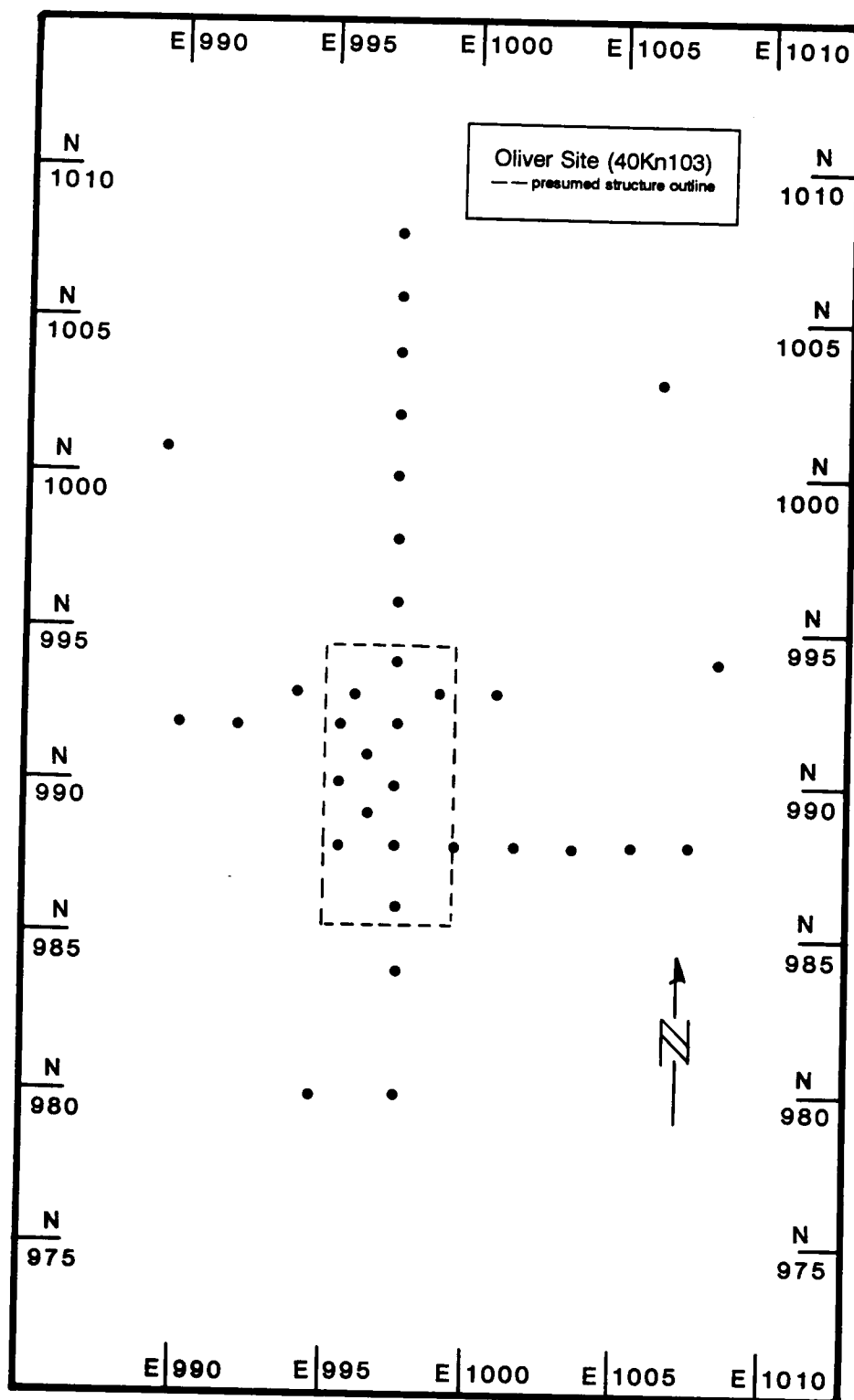


Figure 5. Soil sampling locations at the Oliver Site (40KN103).

structures where easy access was available.

Sampling from the edge of the houses proceeded at two meters, six meters, and ten meters then at five meter intervals until the edge of the yard was reached. The small increments next to the house itself were designed to sample any dumping next to the foundation in the Immediate Active Yard. At the John Jones House site, since no standing structure was present, sampling started at the center of the spokes and followed the same intervals. Here the initial close sampling was designed to allow the characterization of soils thought to have been under the structure at one time.

The Bart Toole House is a four room frame house with a porch off both the front and back doors. It is currently unoccupied and heavily vandalized. Clothes, appliances, and variety of other objects are strewn around the perimeter of the yard. A gravel driveway is located just to the south of the house. Junk, tire and brick piles are found to the south and west of the driveway. Traces of an abandoned dirt road to the Wes McBryant House (Oliver site) run through the front yard.

Thirty-one site and six background samples were collected (Figure 6). Both natural and cultural boundaries reduced the distance site sampling was needed. Soil samples were also taken from underneath the house. Access was made through the collapsed front porch. Background soil samples were collected on the spoke system from the field just to the

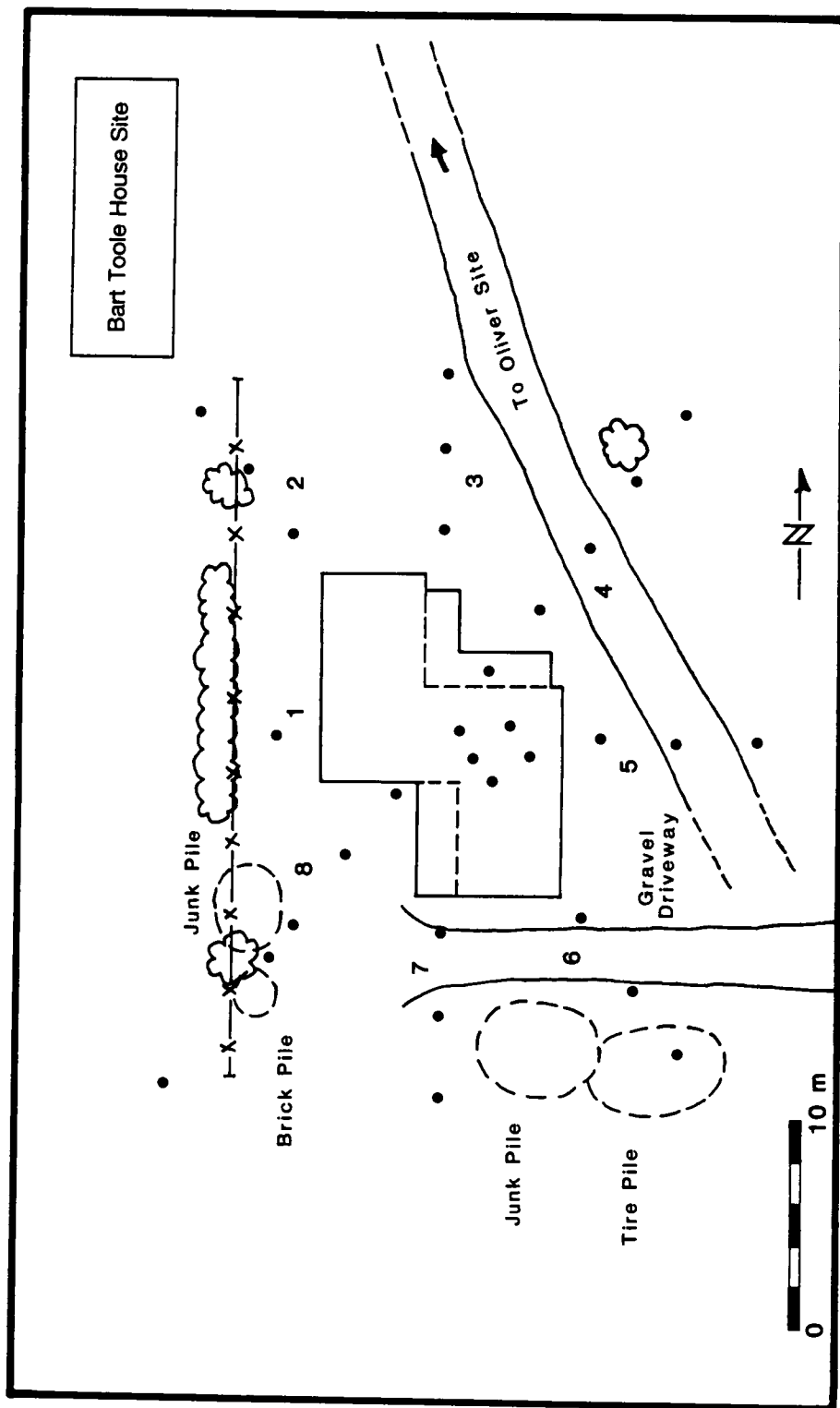


Figure 6. Soil sampling locations at the Bart Toole House Site.

south of the site itself. These were located over fifteen meters away from the nearest site samples.

The Horace Jones House is of frame construction with two end chimneys, an open front porch, and a small closed back addition. Since abandonment, the porch has collapsed. Presently there are four outbuildings still associated with the house. One is certainly a privy (but lies some distance outside of the fence to the west and was not sampled), and the other three buildings are presumed to be an assortment of storage sheds or garages (Roberts and Faulkner 1984).

Thirty-three site and four background soil samples were collected from the Horace Jones House site (Figure 7). Here the fence line provided a reliable boundary from which to define the Active Yard. Site samples did not extend more than twenty meters away from the house. Other site samples were taken from the dirt floors of three standing outbuildings and from beneath the floor of the house, with access being made from near the collapsed front porch. Background samples were collected on the spoke system from east of the site five to ten meters beyond the fence line.

From the descriptions, photo and map in a 1916 newspaper article (Knoxville Sentinel 1916), the John Jones House was L-shaped with the front porch facing the river. Currently, no structural remains are obviously visible above ground. A root cellar depression is present in the southeastern portion of the presumed outline of the structure. A cistern, still

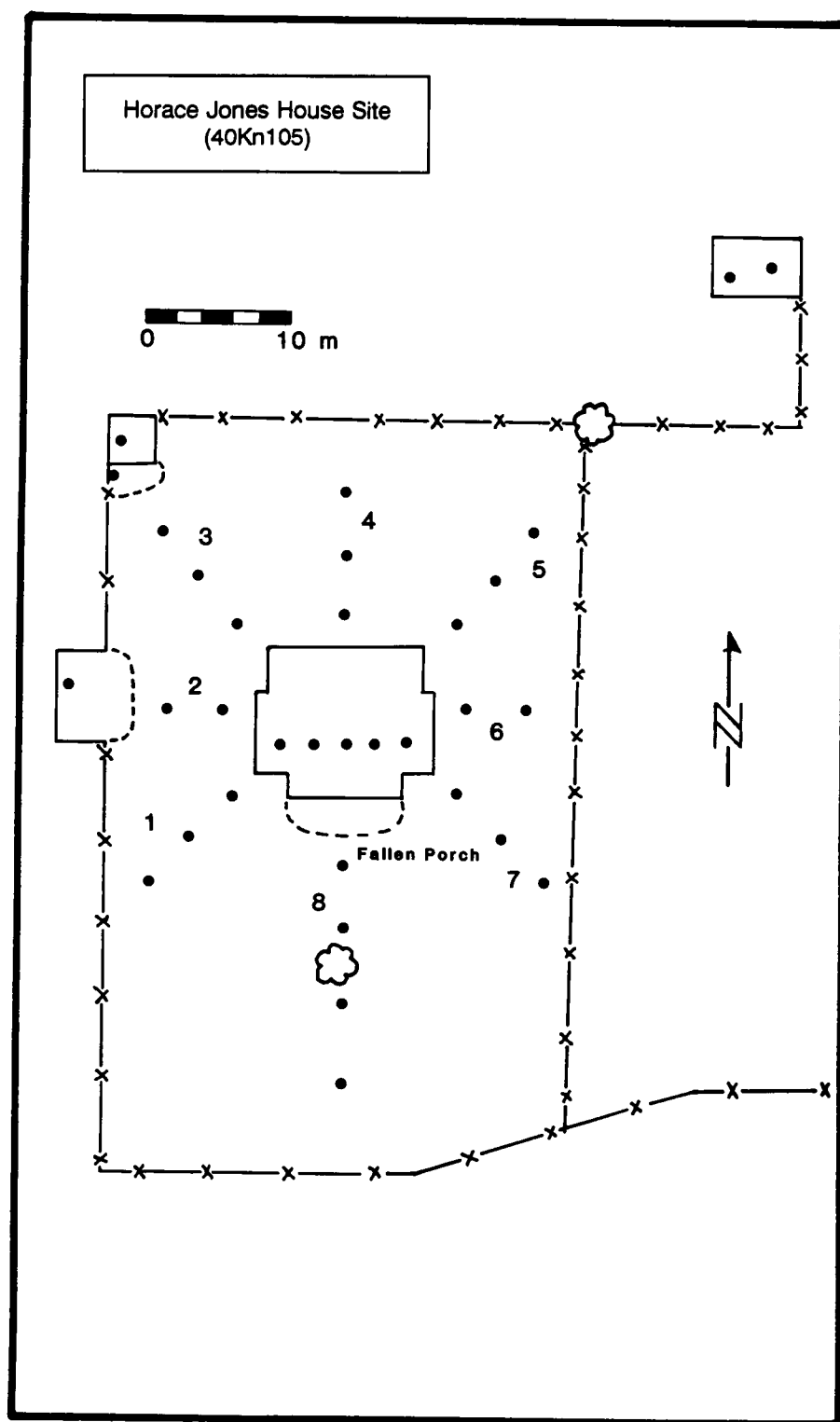


Figure 7. Soil sampling locations at the Horace Jones House Site (40KN105).

partially active, is located just to the southwest of the house.

At the John Jones House site, 38 site and six background samples were collected (Figure 8). At this site, as with some of the others, the fence line provided at least a portion of the Active Yard boundary. Samples were taken up to the fence to the south and east and as far as the road cut to the north. Sampling to the west extended as to match the distance covered by the samples from the spokes on either side. Background samples were collected on the spoke system beyond the fence lines to the south and east.

Laboratory Analyses

At the archaeological soil laboratory in the Department of Anthropology, University of Tennessee, Knoxville, each soil sample was removed from its plastic bag, placed in a paper bag, and allowed to air dry for five to seven days. When dry, the samples were lightly ground with a wax paper-covered rolling pin on a sheet of wax paper (the wax paper was replaced after each sample) and passed through a two millimeter (#10) geologic sieve. After mixing each sample to homogenize it, approximately 10 g were placed into a sterile two ounce plastic whirl-pak, sealed, and set aside (299 total samples) for transportation to the analytical laboratory for elemental analysis. The remaining air dried and ground samples were placed back into their dried plastic ziplock

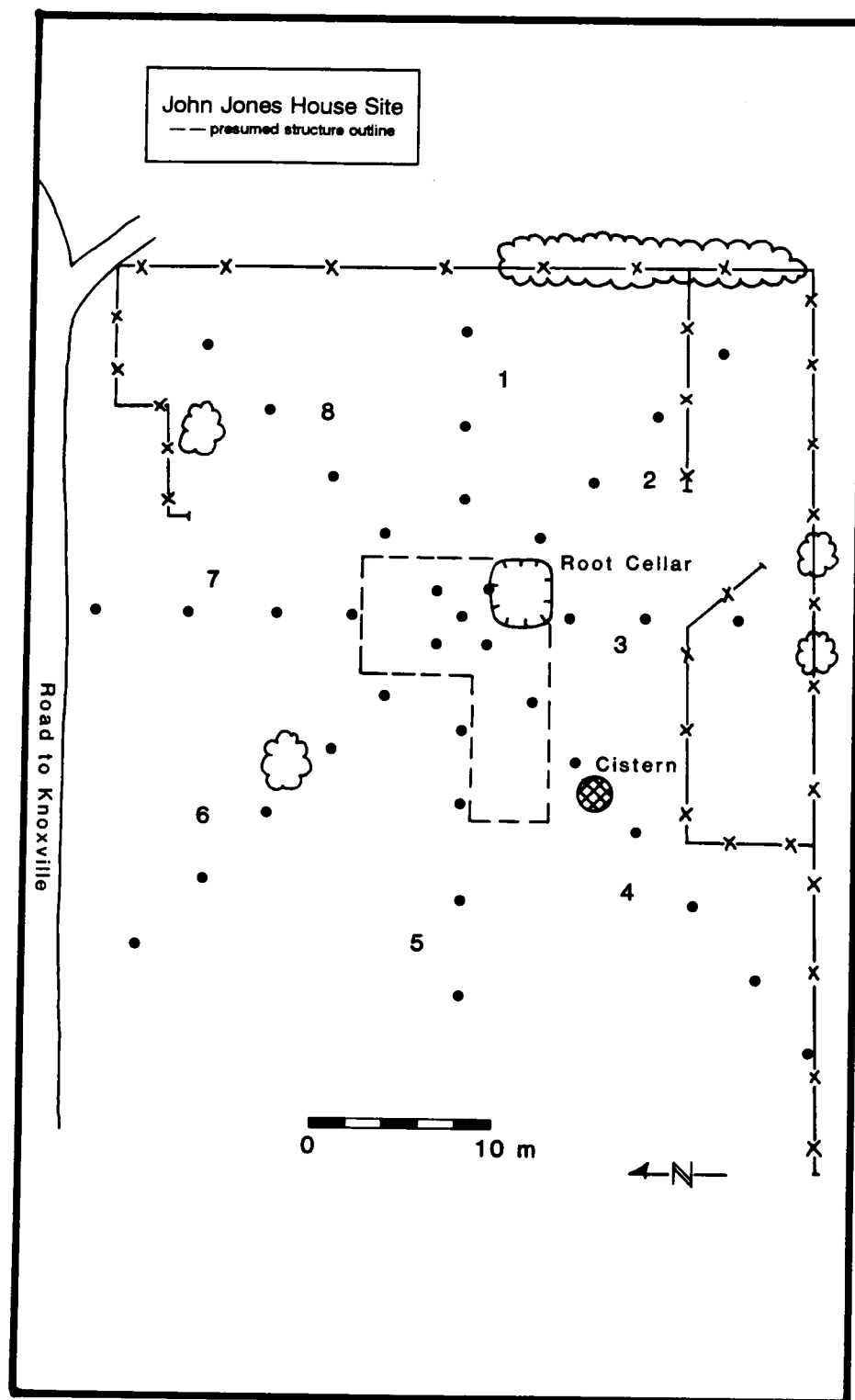


Figure 8. Soil sampling locations at the John Jones House Site.

bags and sent to the University of Tennessee's Department of Plant and Soil Science Laboratory for further processing.

Due to the wetness of many of these soils even after prolonged air drying (because of their high organic matter content), it became necessary to produce a moisture correction factor for each soil sample. Moisture makes soils heavier. Since all of the analyses are based upon soil weight, moisture corrections prevent the underestimating of elements or other chemical properties within the wetter soil samples. Logically, the drier a soil sample is, the smaller the correction factor will be.

The process for determining the moisture correction factor is as follows: a known weight of soil (40 g from each original air dried and ground soil sample was used here) is placed in a steel tin and allowed to dry overnight in an 105 centigrade degree oven. After drying overnight, the sample is weighed again. The moisture correction factor is then calculated using the formula: $((\text{air dried weight} - \text{oven dried weight}) / \text{oven dried weight}) + \text{one}$. Each sample has a unique number. The soil chemical results for that sample are then multiplied by that number.

Total carbon and pH were determined from the original air dried, ground soils and needed no moisture correction. Total carbon was determined because it is a close predictor of the amount of organic matter in a soil sample. Total carbon was determined by a LECO automated carbon analyzer.

After calibration with calcium carbonate, a two gram sample of air dried soil is placed in a small ceramic crucible and "burned" for 70 seconds within the controlled environment of the analyzer (Tabatabai and Bremner 1983). The results are printed by a computer as percentages. Acidity reflected through pH was also determined. Five grams of soil are combined with five milliliters of deionized water. The one to one soil/water mixture was allowed to equilibrate for a few minutes and then analyzed using an Orion Model 399A pH meter. The raw results for both total carbon (percentage) and pH (H⁺ acidity) are presented in Appendix A.

The 299 whirl-paks of approximately 10 g of air dried, ground soil were sent to the University of Minnesota Research Analytical Laboratory in St. Paul, Minnesota. The chemical assaying was conducted in September and October 1990. The soil samples were analyzed using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). This method of analysis was chosen because of its high speed, high precision, high sensitivity, low cost, and multi-element capability (Skoog and West 1986; Soltanpour et al. 1982). In addition, it had been shown to be useful in the chemical characterization of archaeological soils and other materials of archaeological interest (Bethell and Smith 1989; Heyworth et al. 1988; Konrad et al. 1983).

The soil samples were processed using a double acid extraction procedure. This procedure is as follows for each

sample: Three grams of soil are placed into a 50 milliliter centrifuge tube. Thirty milliliters of a 0.76 M HCL/HNO₃ solution are added to the sample. After being shaken for 30 minutes at 180 oscillations per minute, the solution is centrifuged for 20 minutes at 2500 revolution per minute. The supernatant is then poured into a polypropylene test tube. Chemical assaying was conducted by the use of an ARL 3560 ICP Spectrometer.

Assaying begins with the liquid sample being drawn through a capillary tube. It is vaporized thereby creating a fine aerosol spray. This spray is then directed through the excitation source. Within optical emission spectrometry, there can be different sources of excitation of the atoms in the sample. These include devices with either an arc, AC spark, or plasma source (Soltanpour et al. 1982). Plasma, used here, is the most preferred source as it provides high and stable temperatures and much less unwanted interference. An inductively coupled plasma spectrometer contains highly ionized inert argon gas kept within a copper coil with a strong electromagnetic field. Very high temperatures are produced, generally between 6,000 and 10,000 degree Kelvin (Soltanpour et al. 1982). As the sample is passed through the coil with the Argon gas, the excitation of the valence electrons in the sample's atoms produce distinctive wavelengths corresponding to specific elements. These wavelengths are recorded. The intensity of the wavelength

lines equals the concentration of the elements being read. Through the help of a computer program the machine prints out the concentrations of the elements (Soltanpour et al. 1982).

The Research and Analytical Laboratory at the University of Minnesota assayed a set of 25 different elements. These included: aluminum (Al), arsenic (As), boron (B), barium (Ba), beryllium (Be), calcium (Ca), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), iron (Fe), potassium (K), magnesium (Mg), manganese (Mn), molybdenum (Mo), sodium (Na), nickel (Ni), phosphorus (P), lead (Pb), sulfur (S), silicon (Si), strontium (Sr), titanium (Ti), vanadium (V), and zinc (Zn). The raw results (moisture corrected), in parts per million (ppm), are presented in Appendix A.

CHAPTER III

SOIL CHEMICAL CONSTITUENTS OF PAST ACTIVITIES

Material Groups

For the purposes of this study, the cumulative result of activities present within the domestic sphere are divided into five material groups: plant, animal, inorganic, structural, and anthropic. Most material groups, either from specific actions by house residents or directly through their chemical composition, have a tangible, measurable accumulative or reductive effect upon the soil.

Plant use on historic sites may involve the extraction, processing and storage of grains (e.g. corn and wheat), nuts (e.g. chestnuts, walnuts, acorns), starchy foods (e.g. potatoes) and dark green plants. Generally these plant materials are high in strontium, manganese, and magnesium (Whitmer et al. 1989). Dark green plants are especially rich in iron and magnesium. Magnesium is at the center of the chlorophyll complex. Wood is very high in potassium with various amounts of the earth cations calcium and magnesium (Courty et al. 1989; Sanderson and Hunter 1981). The burning of wood destroys its structure but the elements survive as mineral salts (Courty et al. 1989; Dowman 1970).

The stripping or wholesale removal of the topsoil reduces organic matter. In addition, the churning of the

soil brings up subsoil in large quantities. Regardless of soil location, generally, subsoil is much higher in silicon, titanium, and vanadium than topsoil (Alloway 1990c). Furthermore, prolonged gardening without extensive fertilization will reduce the amount of most elements especially the major elements nitrogen, phosphorus, calcium, magnesium, and sulfur (Eidt 1985). Vegetables and other plant eatables produced in the garden are harvested and sent to plant processing areas and/or storage areas. Remnant plant products, such as stalks and leaves, can be left in the garden or composted.

Animal flesh, fat and fluids released in processing, storage and disposal activities are highest in concentrations of metals such as iron, zinc, and copper (Whitmer et al. 1989). Bone, tooth, horn, and antler are similar in chemical composition. The hard, inorganic portion of the material consists of calcium and phosphorus apatite. Shell is almost entirely a carbonate which has a high amount of calcium. Animal holding pens, like pig pens and chicken coops, and human privies involve the production and deposition of animal feces and urine. Cook and Heizer (1965) have pointed out that these products are extremely high in phosphorus, carbon, nitrogen, and calcium.

The inorganic material group constitutes a great many materials found at archaeological sites. At both Mabry and Toole Bend, it appears that limestone bedrock provides the

most accessible and preferred source of footer stones. Limestone is very high in calcium and if dolomitic it is high in magnesium. Plaster and mortar are also very high in calcium. Decorative additions to structures can have a wide chemical composition. For example, hardware such as hinges and nails are fairly pure metals. Iron predominates. Paints, varnishes, and floor coverings are potentially made of more exotic chemicals such as lead. Glass is made mostly of silicon with sodium and potassium salts. By far the most stable materials used by humans in the historic period are the hydrocarbon polymers such as plastic and rubber. These products can take hundreds of years to show any signs of decay.

Except for incidental limited deposition, structures with floors (like houses) tend to seal the soil underneath them from residue deposition as well as reducing the effect of soil weathering. This fact did not go unnoticed by their inhabitants. In fact, according to Powers (1981:95), during the Civil War the production of saltpeter for gunpowder turned locally so that "large quantities of nitrates were mined from underneath old dwellings, slave quarters, cattle sheds and barns; almost any old building held a potential deposit of nitrous earth under its floors". The lack of leaching and normal biological activity under these structures produced nitrates. These nitrates serve to hold cations such as sodium and potassium in the soil.

Structures can also focus the long-term accumulation of materials specific to the activities performed in them. One prime example is the smokehouse. Besides animal products, processing in the smokehouse involves material for meat preservation, such as salt. Tindell (1973:60) noted that during the darkest times of the Civil War in East Tennessee "the dirt of smokehouse floors was frequently dug up and boiled for the salt which had been absorbed over the years when salted fresh meat had hung from the rafters and dripped briny grease on the dirt floors". Sodium is a prime constituent of salt.

After abandonment the structure can either fall into natural decay or be purposely demolished. Both occurrences add a significant amount of materials and thus chemicals to the soil environment (White and Kardulias 1985).

One difference between the study of soil chemistry on historic rather than prehistoric sites is that research can include elements that are largely associated with the industrial age. Elements such as lead, are continually brought into the home environment in household cleaners, paints, solvents, and detergents. In addition, air borne industrial contaminants with high levels of arsenic, cobalt, lead, cadmium, chromium, sulfur, and nickel are deposited continuously across the landscape (Alloway 1990c; Kabata-Pendias and Pendias 1984).

The slow accumulation of debris from the long-term

occupation of an area is an example of what Eidt (1985) calls an "anthropic" effect. The net result on the soil would be a higher pH and more organic matter and phosphorus. Organic matter has the ability to hold chemical elements in the soil for very long periods preventing their complete depletion (see below for a more detailed outline of this process). This is especially true for "heavy" trace metals, such as lead, cadmium, and chromium (Alloway 1990a, 1990b, 1990c).

Since many heavy trace metals are introduced mainly from the air it seems reasonable to assume that soil under standing structures will show a lower concentration or even a depletion of these minerals relative to the surrounding soil. However, structures that are decaying or have already become strictly archaeological will raise the amount of organic matter in soil. Again, the higher organic matter content should act to hold heavy metals.

Material Taphonomy

As Bethell and Smith (1989) point out, the resulting chemical composition of the soil found at archaeological sites may be quite different than only the sum total of the elements present in materials deposited or removed. The materials enter the soil environment and are subjected to the interplay of a variety of processes. As a result, the initial expectations of the archaeologist about the chemical composition of the soil can be quite wrong. An understanding

of these processes, therefore, is essential to help predict the possible chemical elements present when certain materials are deposited in soils at the Mabry and Toole Bend sites. These processes include the manner of material decomposition, the rate of material decomposition, and the retention/removal mechanisms in material decomposition.

Manner of Material Decomposition

Archaeological materials on historic sites enter and are processed within the soil environment just like other natural products. The amount of human alteration to their structure and chemical composition will affect the manner and rate of their decomposition. Materials can range from the highly resistant to the easily decomposed. Both physical and chemical decomposition can occur and most often they act in combination upon a certain material.

Inorganic materials can be made of highly stable material such as stone, metal, glass, ceramics, or plastic (Goodyear 1971). Not surprisingly, inorganic materials often are found well preserved on historic archaeological sites. Nevertheless, these materials are subject to decomposition. For example, freeze-thaw processes break down materials into smaller parts, creating more surface area subject to chemical weathering. The majority of the decomposition activity is chemical in nature and involves the dissolution of products by water. Specific components of a material can be brought

into solution.

The general process of organic decomposition is one of successive reduction. Larger materials are broken into smaller ones and more complex molecules are cleaved into simpler ones (Stein 1992). Soil organisms digest materials because they can extract energy from them -- energy that helps sustain their life functions (Keeney 1983). The materials that release this energy more efficiently will decompose quickest and most completely.

Carbone and Keel (1985) have outlined a useful three stage approach to track the decomposition sequence of plant and animal remains in aerated mineral soil. These are called the Comminution, Digestion, and Solution Stages. In the initial Comminution Stage, the larger fauna, such as rodents, insects and flies work in concert with the smaller soil animals (e.g. earthworms) to physically break down the material into progressively smaller bits until these bits become microscopic. This stage provides the bulk of the decomposition by volume (Jenkinson 1981; Payne et al. 1968).

The Digestion Stage consists mainly of smaller heterotrophic soil organisms, like insects, bacteria and fungi, ingesting, synthesizing and excreting the residues (Carbone and Keel 1985; Goodyear 1971). The soil biota is a highly diverse, incredibly resilient set of organisms that can lie dormant for years surviving on very limited amounts of food. Upon the application of potential energy sources

they literally spring to life and grow very rapidly to consume the residues (Keeney 1983). Jenkinson (1981) has called this phenomenon a "priming action". This allows the soil to deal with large, fresh additions of organic materials, such as at sites of human occupation where large amounts of organic material might be discarded in a single episode (Stein 1992).

Digestion can be internal, as with most insects and worms, or external, such as bacteria and fungi. Enzymes and acids are released by microbes that help further break the molecular bonds and make the material easier to consume (Carbone and Keel 1985; Goodyear 1971). The molecules that can be broken disintegrate to their soluble form and are absorbed by soil microorganisms. Those molecules that cannot be broken are available to be leached from the soil profile. The "final" result of all these actions is a mass of interconnected, assorted and countless number of fractured molecules called "Humus" (Bohn et al. 1985).

Rate of Material Decomposition

All materials go through some decomposition whether this is physical, chemical or both. Soil scientists, archaeologists, and conservators concerned with the decay of materials entering the soil have documented that the rate of decay manifests itself in a largely negative exponential curve (Dowman 1970; Jenkinson 1981; Meentemeyer 1984). By

volume, the majority of the material is decomposed in the very beginning of the decomposition process (Figure 9). Conversely, and most significant to soil chemical analysis, at least a small portion of the "material" survives for a very long time. The sharp turn on the graph can be thought of as when the material reaches equilibrium with its surroundings (Dowman 1970), when more resistant parts of the material is all that is left (Meentemeyer 1984), or when enough humus is created to effectively curtail the process (Jenkinson 1981). There seems no doubt that all three participate to create the curve seen.

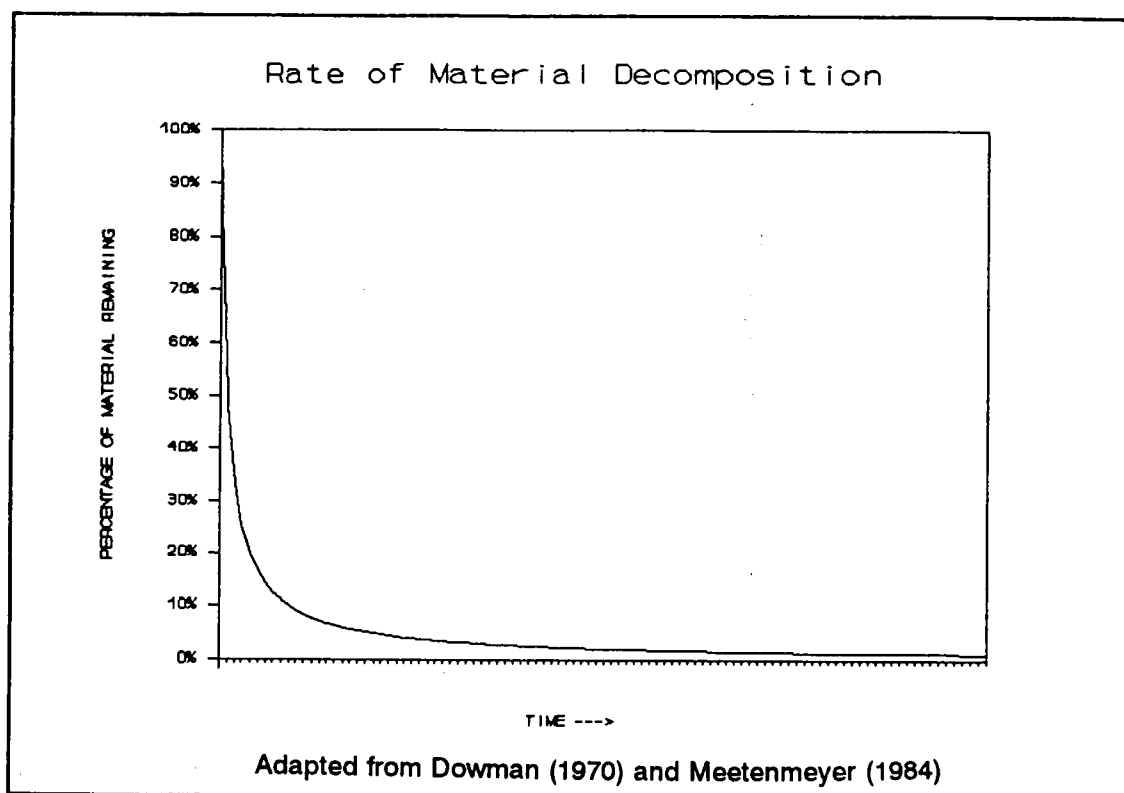


Figure 9. The Rate of Material Decomposition.

The time of this decomposition can vary depending upon the material itself and the natural conditions acting upon it (Keeney 1983). Organics generally decompose much quicker than inorganics. In addition, materials with initially simple structures decompose fastest. Inorganics, especially lithic material, can have a very long decay sequence.

There are factors of the soil that generally influence the rate and manner of natural decomposition. These are the soil's moisture, aeration, temperature, and physio-chemical properties. Generally, extremes in any of these factors can serve to limit faunal and even floral activity.

Soil with a finer texture will generally hold water and organic matter for longer periods. This allows the microorganisms to have a store of moisture and food upon which to operate. However, a soil with too much silt or clay in its texture can form impermeable layers which inhibit the draining of water. Conversely, structureless sandy soils have difficulty retaining any components of use to soil biota.

The two chemical properties of soil that can directly affect the manner and rate of decomposition are acidity, measured as pH, and elemental concentration and diversity (Carbone and Keel 1985). Decomposition takes place much more rapidly at pH near neutral than it does when conditions are too acid or alkaline. Jenkinson (1981) speculates that this is due to the limiting of soil organisms available for

decomposition at either end of the continuum. However, bone and shell survives well in highly alkaline conditions (Dowman 1970; Henderson 1987).

A plentiful supply and wide array of elements are needed to keep decomposition proceeding. Nitrogen and carbon are two of the most important elements in helping organisms decay materials. A low carbon to nitrogen ratio will help insure more rapid decomposition (Jenkinson 1981). However, other elements, such as calcium, phosphorus, sulfur, and potassium are also important in this regard. The presence of micronutrients have also been shown to be essential to soil flora and faunal growth (Kabata-Pendias and Pendias 1984). However, toxic levels of most any element, especially metals, will inhibit organism activity (Alloway 1990b). Organic materials have been preserved in archaeological contexts merely because of their close proximity to metal objects (Cronyn et al. 1985).

Retention/Removal Mechanisms in Material Decomposition

After materials decompose and reach the molecular and atomic level, their chemical products are subjected to the dynamic interplay between the solid, liquid, and gaseous phases in the soil. These phases are constantly seeking equilibrium in an everchanging situation (Alloway 1990b).

Chemicals are continuously moving into and out of the soil solution. The "master variable" pH, as it has been

called, has significant influence over chemical mobility. Generally, the lower the pH (the greater the acidity) the more mobile ions will be in solution, especially metals (Alloway 1990b; Emmerich et al. 1982; Jurinak and Santillan-Medrano 1974; Kabata-Pendias and Pendias 1984).

Redox (reduction-oxidation) potential also effects solubility and thus mobility. Generally, the more oxidation occurring the more mobile ions will become (Alloway 1990b; Eidt 1985; Kabata-Pendias and Pendias 1984). Oxidation dominates when a plentiful supply of air is present in a well-drained soil. In addition, the size, shape and charge of the ion will determine its potential for movement in the soil (Eidt 1985; Kabata-Pendias and Pendias 1984).

Broadly, there are two entirely different forces acting in the soil: ones trying to retain chemical products and others trying to remove them. Figure 10 outlines the many mechanisms at work within each force.

Chemicals can be retained in the soil by three different mechanisms (Kabata-Pendias and Pendias 1984). First, they can be precipitated as one of the many insoluble compounds in soil. Aluminum, iron and manganese oxides and carbonates are the main products of this process (Alloway 1990b). Secondly, chemicals can be bonded to the inorganic fraction of soil. For example, clay particles have a permanent negative charge on their surface which attracts and holds cations. Cations can exchange with each other and even be substituted within

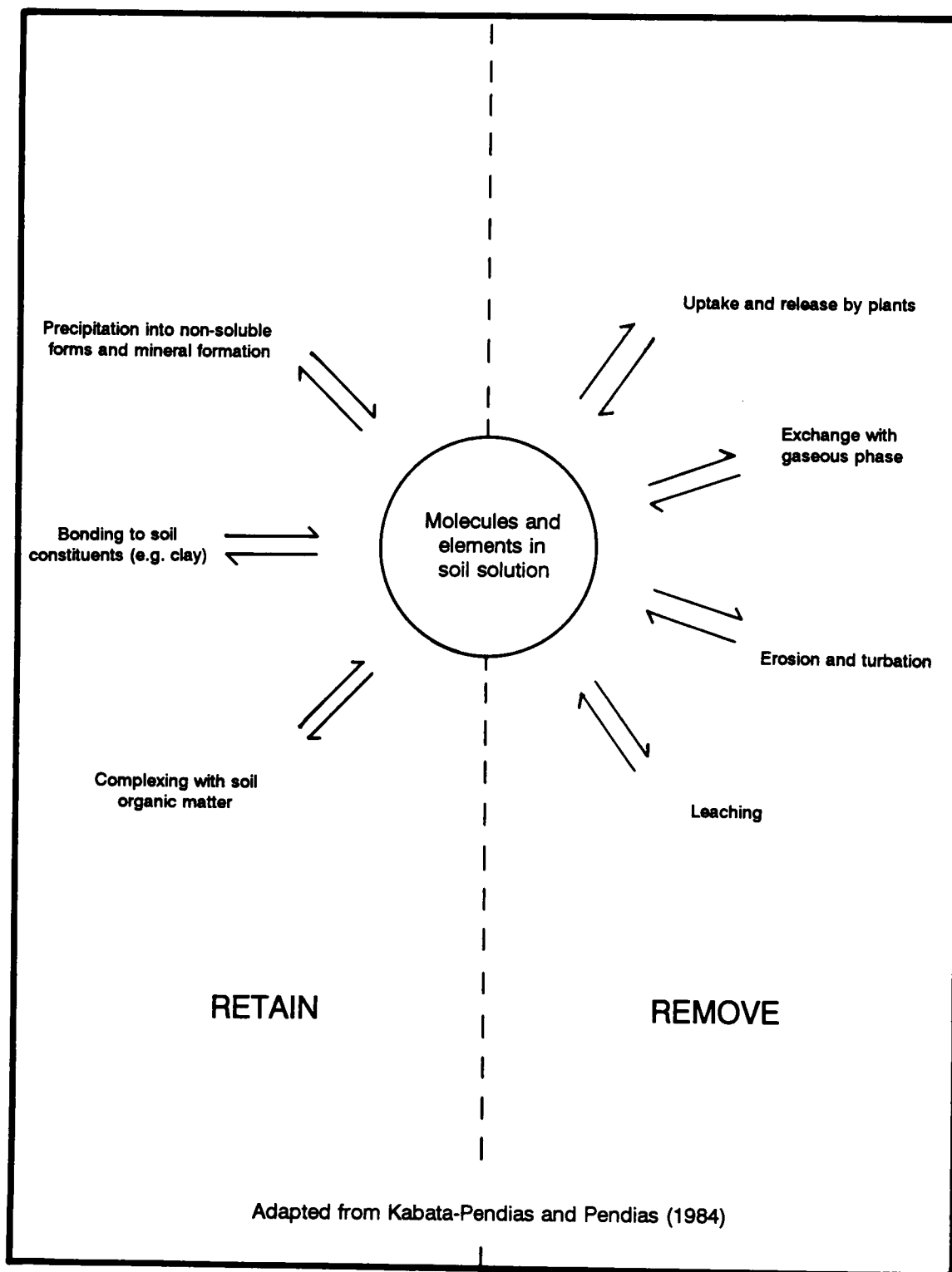


Figure 10: Soil Retention and Removal Mechanisms.

the lattice of the clay minerals and protected from removal. Cations can also provide the bridge between anion and clay bonding (Alloway 1990b; Kabata-Pendias and Pendias 1984). And thirdly, chemicals can be complexed into the relatively stable, yet altered, portion of the organic matter (i.e. humus). Like clay, humus also has a negative charge associated with it that attracts cations to form organo-mineral complexes (Alloway 1990b; Jenkinson 1981; Kabata-Pendias and Pendias 1984; Keeney 1983).

The removal of chemicals from the soil can be accomplished by four different mechanisms. First, organisms in the soil can fix nutrients and make them available for uptake by plants (Kabata-Pendias and Pendias 1984). Secondly, processes in the soil can shift chemical elements into the gaseous phase. The aerobic respiration of soil organisms turns the carbon in organic materials into carbon dioxide gas (Stein 1992). Anaerobic metabolism releases nitrogen and hydrogen gases (Jenkinson 1981; Keeney 1983). Thirdly, soil moving processes such as erosion and turbation can remove chemicals by the wholesale transport of soil (Kabata-Pendias and Pendias 1984). And lastly, chemicals can be moved down and removed from the profile by transport with the soil water. This process is termed "leaching" (Alloway 1990b; Kabata-Pendias and Pendias 1984).

The above discussion highlights the many natural soil factors that must be considered when interpreting the results

from soil chemical research on all archaeological sites. In addition, the particularistic nature of soils at every site must also be addressed.

Soils at Toole Bend and Mabry

Most of East Tennessee lies within the Ridge and Valley Physiographic Province as defined by Fenneman (1938). In Knox County, the Ridge and Valley Province is composed of steeply-folded resistant sandstone, cherty limestone, and siltstone ridges underlain by softer clayey limestone and shale exposed in the valleys (Miller 1974). Soils in the valley range from poorly to highly productive. The Tennessee Valley generally has a climate consisting of hot, moist summers with mild, wet winters. Springs and autumns are usually much drier in comparison (Dickson 1978).

The soil at the Mabry site has developed on residuum limestone under Structure 2 and residuum shale under Structure 1 (Timpson 1990a). Auger holes were dug just to the north of both structures to examine the soil profile. The upper horizon is typified by loam to silt loam which overlays a series of argillic horizons. A field analysis of the pH reveals the lower horizons to vary from slightly acidic at 6.5 to moderately acidic at 5.0 (Timpson 1990a).

At the Oliver site, no specific deep soil profile could be examined before the site was destroyed for the Pellissippi Parkway Project. However, this soil is formed on calcareous

shale intermixed with acid shale and limestone colluvium deposited from the steeper slopes to the west of the site (United States Department of Agriculture 1955). There may have been some alluvium from a small intermittent stream just to the east of the house mound.

The Bart Toole House site is also situated on shale and limestone colluvium. Foss and Timpson (1990) dug two auger holes in the formerly cultivated field, now under grass, just to the south of the site. The top of the profile was dominated by silt loam to silty clay loam texture. The thickness of the A horizon increased moving east and away from the foot of the slope. The lower horizons were argillic with silty clay and clay being the dominant texture. The pH at the lowest portion of the holes at approximately 110 cm was 6.4, slightly acidic (Foss and Timpson 1990).

The Horace Jones House site is situated on shale and limestone colluvium collecting at the base of a steep slope to the north of the site. Shale outcroppings are present throughout the site. Two auger holes were placed outside of the fenceline to the east of the house. The upper portion of the profile is a loam while, as with the other sites, the lower portion is characterized by clay-rich argillic horizons. At approximately 85 cm the pH was slightly acidic at 6.4 (Timpson 1990b).

The John Jones House site is situated on a mixed general alluvium stream terrace escarpment five to fifteen feet above

the Tennessee River. Timpson (1990c) sank two auger holes to the south of the site outside the fenceline to determine the soil profile. Silt loam and loam dominate the upper portion of the profile while, again, argillic horizons are present below them. At 100 cm the pH was moderately acidic with a reading of 5.2 (Timpson 1990c).

Generally, the upper portions of the soils at the Mabry and Toole Bend sites are fine-grained. Loams to silt loams are underlain by argillic (clay) horizons. They are slightly to moderately acidic. They also appear to be fairly mature soils with good organic matter amounts and rich in all the essential diverse nutrients for soil organisms. With consideration of all the potential soil chemical retention and removal mechanisms, these site soils should retain ions from materials derived from cultural activities fairly well.

However, moderate acidity (causing increased mobility of ions) and high moisture content (causing increased leaching) in the soils should eliminate any dramatic ion differentials on the sites. This should not be surprising since, regardless of soil type, soil tends to buffer any input, additive or subtractive. Therefore, the chemical distinctiveness of cultural activities will become more and more difficult to detect and interpret as time goes on (Sokoloff and Carter 1952). The use of off-site soil samples will help to note even the slightest anomalies across the sites.

Summary of Soil Chemical Expectations

The five material groups with either accumulative or reductive potential is summarized in Figure 11. Because their reduction potential is so similar, plant, animal and inorganic activities are thought to be very difficult to separate chemically. Therefore, they are combined as a single series of additive and subtractive chemical effects. In addition, anthropic by its very definition does not reduce materials at an archaeological site. Therefore, this space is considered "Not Applicable". Within each box in Figure 11 cumulative additive and subtractive chemical effects are indicated. The identification of soil chemical signatures

Domestic Sphere		
Material Group	Accumulation Activ.	Reduction Activity
Plant	ADD: Fe, K, Mg, Mn, Sr, pH	ADD: Si, Ti, V SUBTRACT: Mg, P, S, Total C
Animal	ADD: Ca, Cu, Fe, Zn, pH	
Inorganic	ADD: Ca, Pb, pH	
Structural	Smokehouse = ADD: Na, pH	ADD: K, Na, pH SUBTRACT: Total C, As, Cd, Co, Cr, Ni, Pb, S
Anthropic	ADD: Ca, P, Total C, pH, As, Cd, Co, Cr, Ni, Pb, S	Not Applicable

Figure 11. Accumulation and Reduction potential of Material Groups.

involves examining the co-occurrence of different additive or subtractive chemical effects. A fuller explanation of the identification of soil chemical signatures at the five historic house sites is outlined in Chapter IV.

CHAPTER IV

RESULTS AND DISCUSSION

Statistical Analysis

Twenty of the 25 assayed elements plus total carbon and pH were placed into nine "analytical" categories derived from the accumulative or reductive effects in the material groups detailed in Chapter III (Figure 12). Five elements, aluminum (Al), boron (B), barium (Ba), beryllium (Be), and molybdenum (Mo), were not included in the categories since background research failed to uncover any soil chemical signature

Domestic Sphere		
Material Group	Accumulation Activ.	Reduction Activity
Plant	1 ADD: Fe, K, Mg, Mn, Sr, pH	6 ADD: Si, Ti, V 7 SUBTRACT: Mg, P, S, Total C
Animal	2 ADD: Ca, Cu, Fe, Zn, pH	
Inorganic	3 ADD: Ca, Pb, pH	
Structural	4 Smokehouse = ADD: Na, pH	8 ADD: K, Na, pH 9 SUBTRACT: Total C, As, Cd, Co, Cr, Ni, Pb, S
Anthropic	5 ADD: Ca, P, Total C, pH, As, Cd, Co, Cr, Ni, Pb, S	Not Applicable

Figure 12. Analytical Categories.

distinction potential in these elements. Two sets of four analytical categories (6, 7, and 8, 9) are part of the reductive activity of two groups: the Structural Group, and the combined Plant, Animal, and Inorganic Group.

Each analytical category represents a specific, tangible accumulative or reductive activity for each material group. Category 1, for example, indicates plant-based material accumulation, such as plant processing, wood ash disposal, composting, or even the storage of animal feed. The identification of soil chemical signatures for specific past activities involves the examination of the shifting co-occurrence of these nine analytical categories. For example, the identification of a soil chemical signature for a smokehouse is based upon the co-occurrence of categories 2, 4 and 8. These categories represent, in order, animal-based material deposits, salt drippings, and the chemical remains of a structure. The presence of these three categories (thus the chemicals within them) at a sampling location would point to the potential chemical remains of a smokehouse.

The co-occurrence of many categories would point to the location of a generalized sheet midden. Logically, readings would be highest in category 5 (anthropic accumulation). A similar situation would exist for the deterioration or razing of a structure in place. Gardening or other topsoil activity should be revealed by the addition of the chemicals in category 6 and the subtraction of the chemicals in category

7.

To produce base-line values from which to determine soil chemical anomalies, a comparison of site versus off-site soils was needed. In order to better normalize the distribution of the populations from small sample sizes, all values were logarithmically transformed (natural log). The logged elemental values from the on-site soil samples were then transformed (standardized) into Z scores from the grouped mean and standard deviation of the logged values of comparable off-site soil samples. Both the original and the logged mean and standard deviations for the control samples from all sites are outlined in Appendix B.

Standardization has the effect of making the mean equal to zero and each full standard deviation equal to one. The Z score for on-site chemical values at each sampling location, then, represents a varied, quantitative distance from the mean of the off-site values. For example, a positive Z score of one indicates that a chemical value is one standard deviation greater than the mean of the comparable off-site soil. The same would apply for a negative Z score whereas the chemical value would be less than the off-site soil.

Since it is on a logarithmic and not an arithmetic scale, pH tends to be effected differently by this method of standardization than other chemical properties. The Z scores tend to lose interpretive resolution as they proceed farther

from the mean. However, after examining the pH readings from all the sites, it was felt that the standard deviations were small enough that the loss of resolution was minimal. This analytical approach (based upon Z scores) has been used successfully by other archaeologists to detect soil chemical anomalies at prehistoric and historic sites in North America (e.g. Ahler 1973; Anderson and Schuldenrein 1985; Griffith 1980, 1981; Heidenreich et al. 1971; Heidenreich and Konrad 1973; Heidenreich and Navratil 1973; Konrad et al. 1983; Woods 1984, 1988).

The Z scores for each of the elements in the nine analytical categories were then added together and divided by the number of elements present in that category (Figure 13).

$$\text{CATEGORY 1} = ((\text{FeZ} + \text{KZ} + \text{MgZ} + \text{MnZ} + \text{SrZ} + \text{pHZ}) / 6)$$

$$\text{CATEGORY 2} = ((\text{CaZ} + \text{CuZ} + \text{FeZ} + \text{ZnZ} + \text{pHZ}) / 5)$$

$$\text{CATEGORY 3} = ((\text{CaZ} + \text{PbZ} + \text{pHZ}) / 3)$$

$$\text{CATEGORY 4} = ((\text{NaZ} + \text{pHZ}) / 2)$$

$$\text{CATEGORY 5} = ((\text{CaZ} + \text{PZ} + \text{TOTAL CZ} + \text{pHZ} + \text{AsZ} + \text{CdZ} + \text{CoZ} + \text{CrZ} + \text{NiZ} + \text{PbZ} + \text{SZ}) / 11)$$

$$\text{CATEGORY 6} = ((\text{SiZ} + \text{TiZ} + \text{VZ}) / 3)$$

$$\text{CATEGORY 7} = ((\text{MgZ} + \text{PZ} + \text{SZ} + \text{TOTAL CZ}) / 4)$$

$$\text{CATEGORY 8} = ((\text{KZ} + \text{NaZ} + \text{pHZ}) / 3)$$

$$\text{CATEGORY 9} = ((\text{TOTAL CZ} + \text{AsZ} + \text{CdZ} + \text{CoZ} + \text{CrZ} + \text{NiZ} + \text{PbZ} + \text{SZ}) / 8)$$

Figure 13. Z Score production for each analytical category.

The range of these average Z scores within each category were then further grouped into five ordinal values. These values represent proportional concentrations of the analytical categories (Figure 14). "Negative" concentrations represent soil chemical depletions from natural, off-site soils. "Positive" concentrations represented soil chemical enrichments. It was felt that an average Z score between 1.99 and -1.99 (slightly greater than a 95 % confidence level) showed no significant soil chemical differences between the site sample and the off-site soil. The ordinal values for each category at each sampling point on each site are listed in Appendix C (they are given in their truncated version: 0, 1 to 5 and -1 to -5 , where 5 and -5 are the

Average Z Score Range	Ordinal Value
Lowest thru -10.00	Extreme Depletion (E)
-9.99 thru -8.00	High Depletion (H)
-7.99 thru -6.00	Moderate Depletion (M)
-5.99 thru -4.00	Low Depletion (L)
-3.99 thru -2.00	Slight Depletion (S)
-1.99 thru 1.99	Not Different (X)
2.00 thru 3.99	Slight Enrichment (S)
4.00 thru 5.99	Low Enrichment (L)
6.00 thru 7.99	Moderate Enrichment (M)
8.00 thru 9.99	High Enrichment (H)
10.00 thru Highest	Extreme Enrichment (E)

Figure 14. Ordinal values from average Z Score range.

extreme values). The expression of these ordinal values were then mapped as graduated circles for each site centered on the sample location. A separate map for each category was produced for each archaeological site tested for a total of 45 maps.

Site Interpretation

In examining the plots of the ordinal values it is quite apparent that soil anomalies exist on these sites and they are spatially distinct. As expected, the magnitude of enrichment or depletion on these sites, for the most part, is small. For example, except for the John Jones House site, very few depletions were recorded on any site. This may be largely due to the natural buffering effect of the soil previously discussed. Any slight depletions might have been ameliorated until they are not statistically different from the background soil. As a result, the plots of category 7 (removal of topsoil) and category 9 (shielding of soil under structures from airborne heavy metal deposition) which were anticipated to hold the most, if not all, the depletion readings were spurious. Category 6, which was to represent the bringing up of subsoil to the surface, also proved to be inconclusive.

The Mabry Site (40KN86)

At the Mabry site, a strong enrichment of many chemicals exist within the defined boundaries of both Structure 1 and 2 (Figures 15 - 23). This is probably due to the collapse of the structures after use, either by demolition or natural decay. For example, it is presumed that after the occupation, an assortment of materials filled in the low spots, especially the two root cellars (McKelway 1994). The high deposition of organic materials caused by this action would also serve to capture heavy metals (categories 5 and 9 -- enrichment in category 9 is an unintended result since it was designed to hold many depletions).

In addition, from the placement of anomalies, it is surmised that a structure collapse resulted in material being deposited to the west and northwest of Structure 2. A collapsed chimney would help explain the enrichment of category 1 in this area. This event has the potential of adding wood ash to the soil. There might also have been a organic sheet midden just behind the chimney to the west of Structure 2. Unfortunately, archaeological investigations found relatively few artifacts in this area to confirm this possibility (McKelway 1994).

Soil chemical anomalies seem to define the boundaries of Structure 1 quite well, concentrating around the fireplace pad. Despite some slight anomalies, chemically, the soil is fairly "natural" within 6 m around the boundaries of the

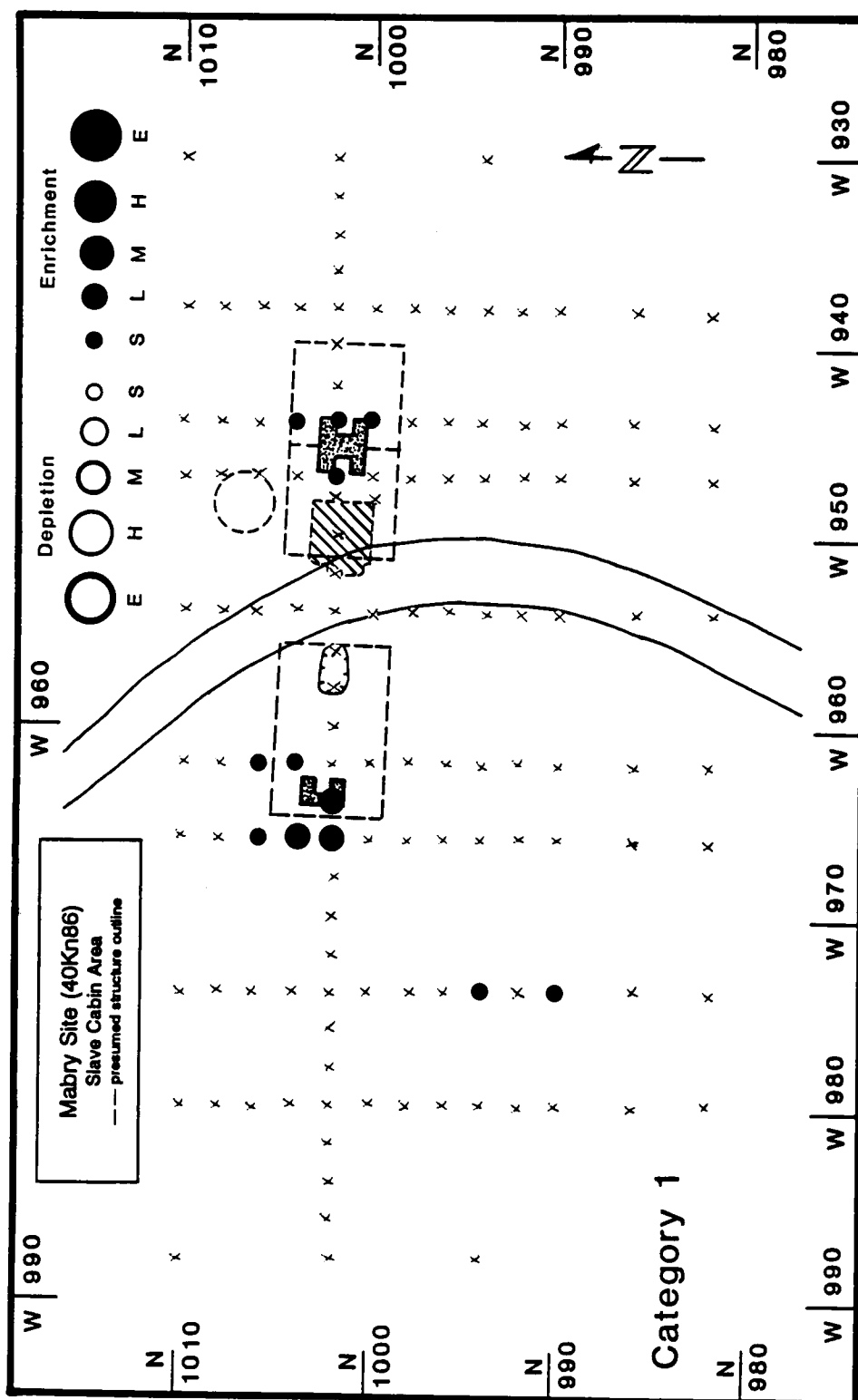


Figure 15. Chemical anomalies on the Mabry Site (40KN86), Category 1.

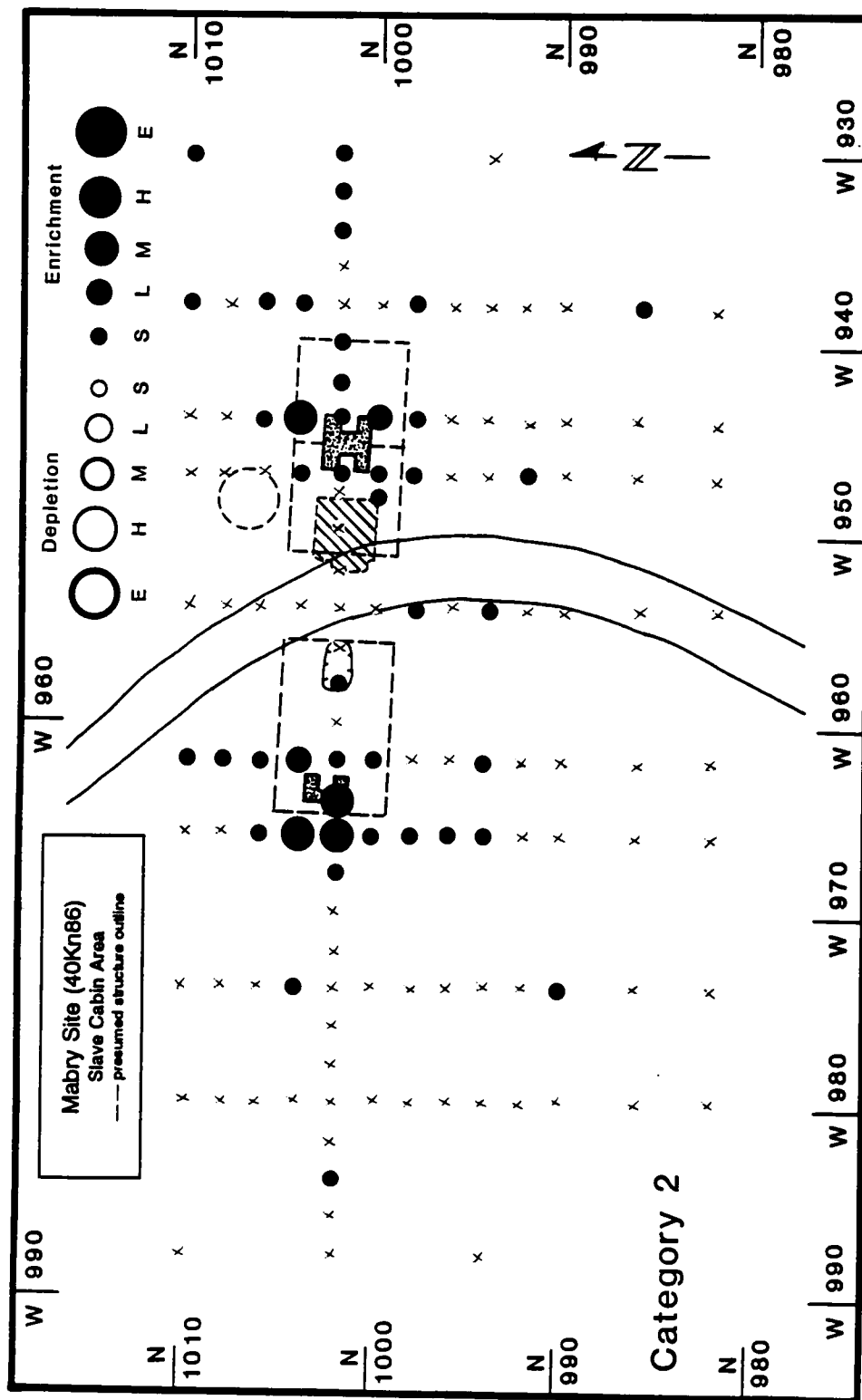


Figure 16. Chemical anomalies on the Mabry Site (40KN86), Category 2.

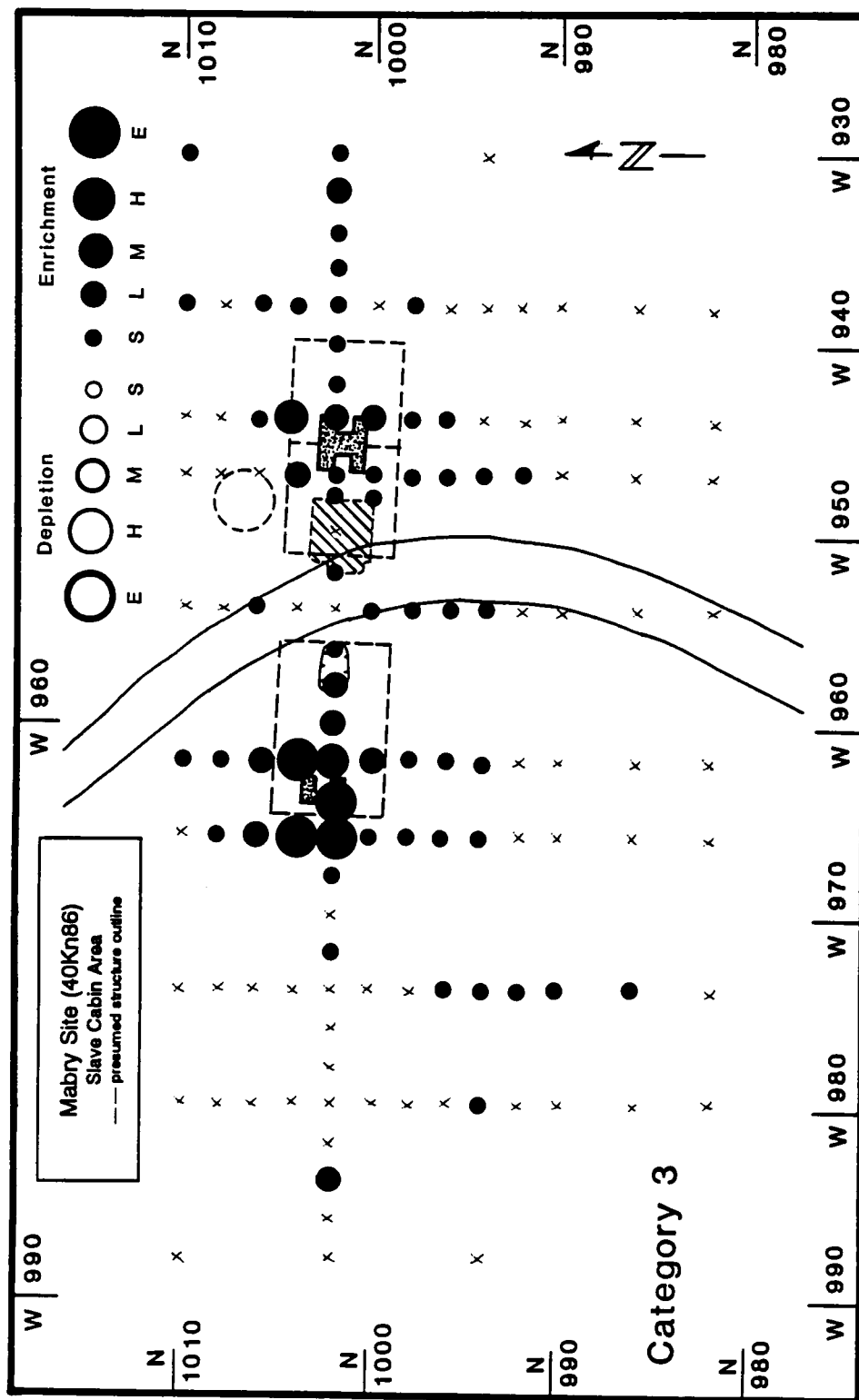


Figure 17. Chemical anomalies on the Mabry Site (40KN86), Category 3.

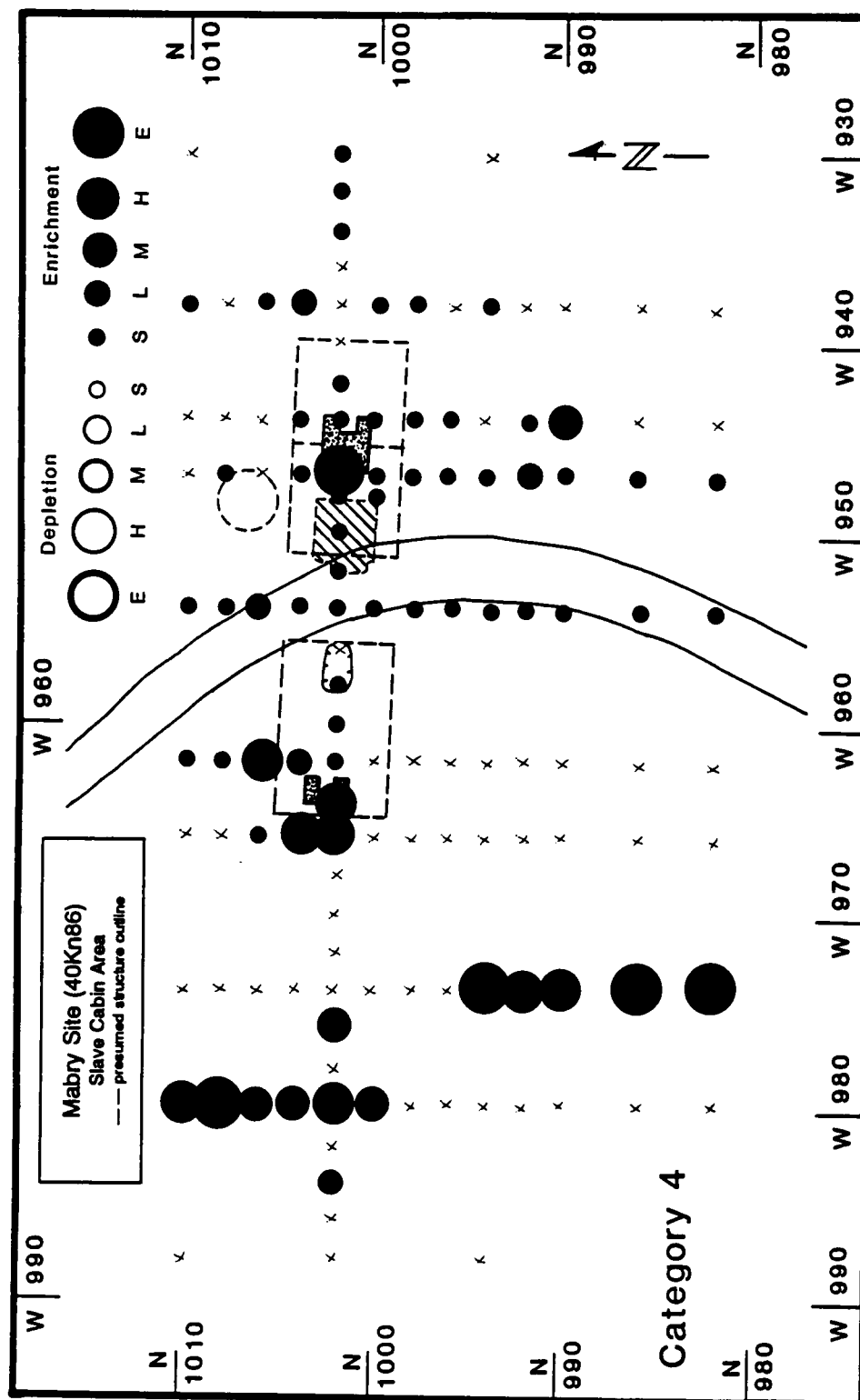


Figure 18. Chemical anomalies on the Mabry Site (40KN86), Category 4.

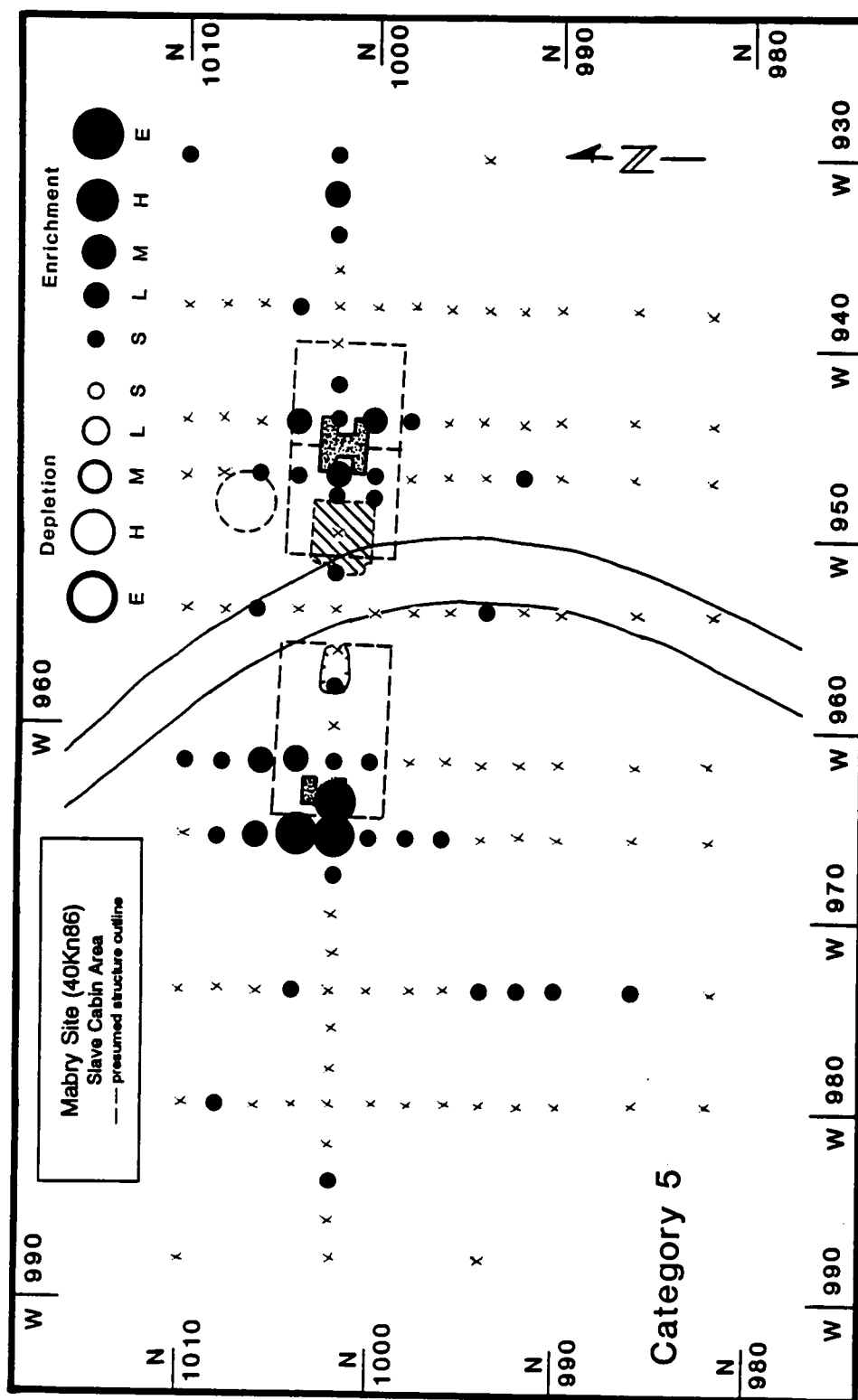


Figure 19. Chemical anomalies on the Mabry Site (40KN86), Category 5.

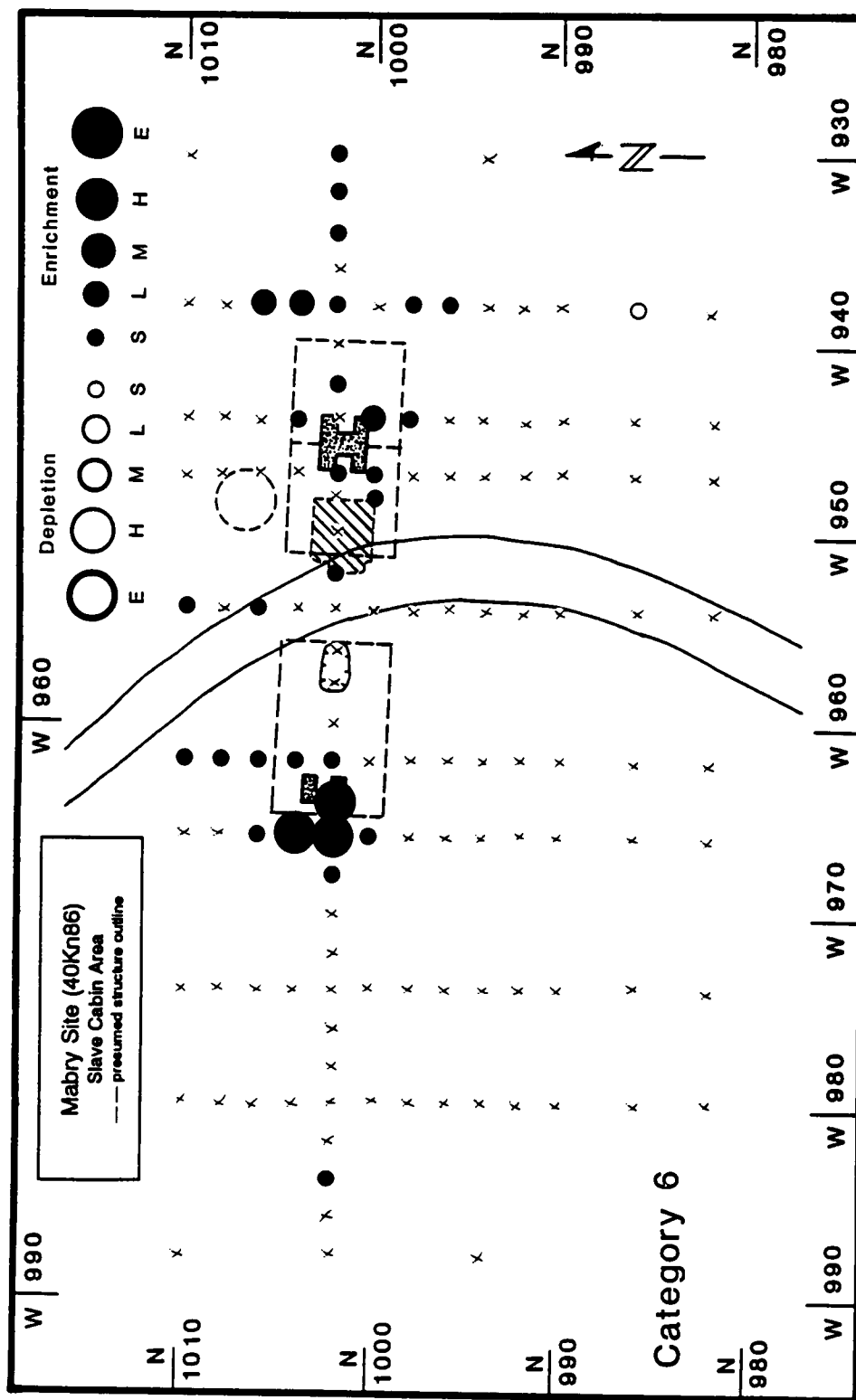


Figure 20. Chemical anomalies on the Mabry Site (40KN86), Category 6.

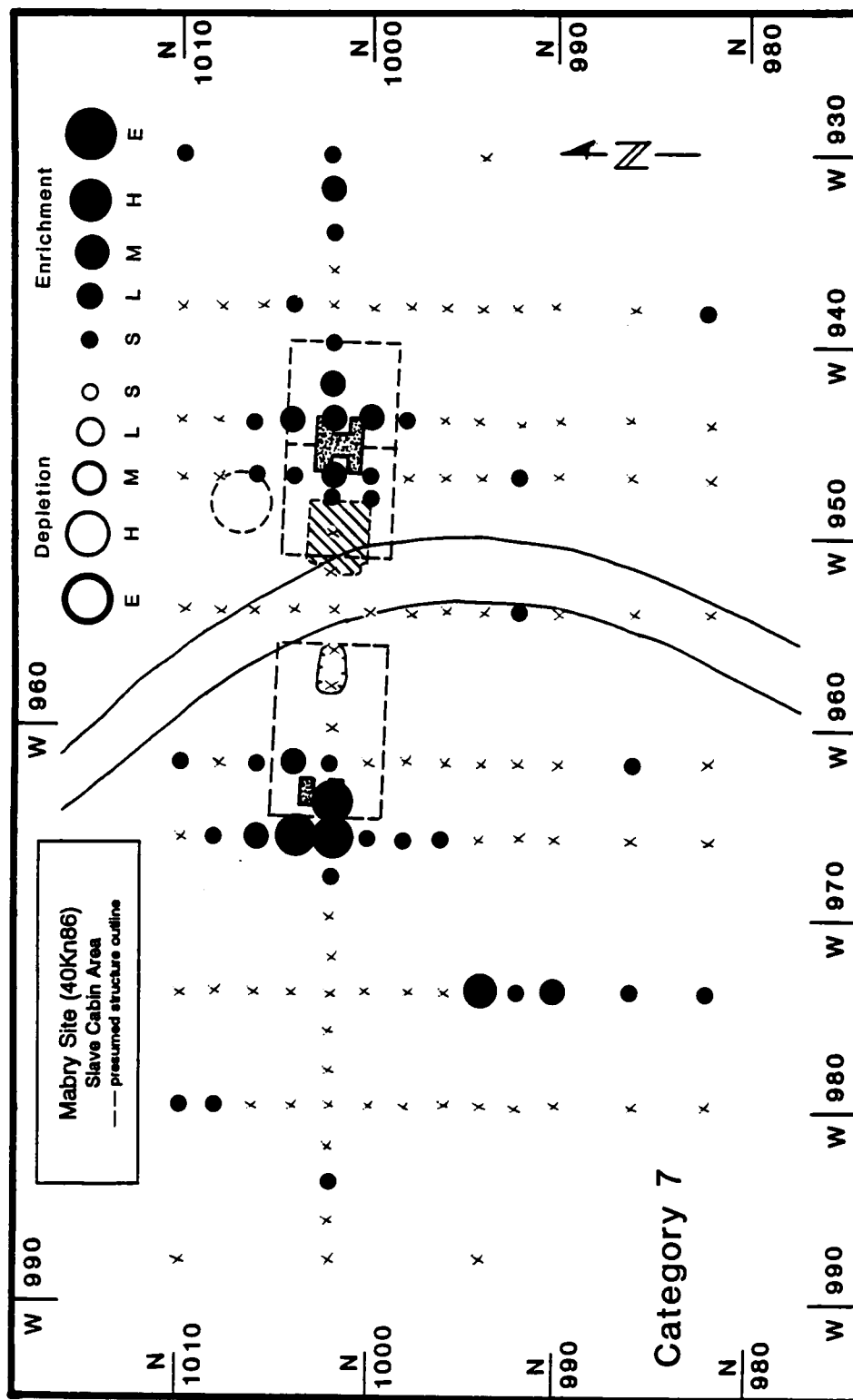


Figure 21. Chemical anomalies on the Mabry Site (40KN86), Category 7.

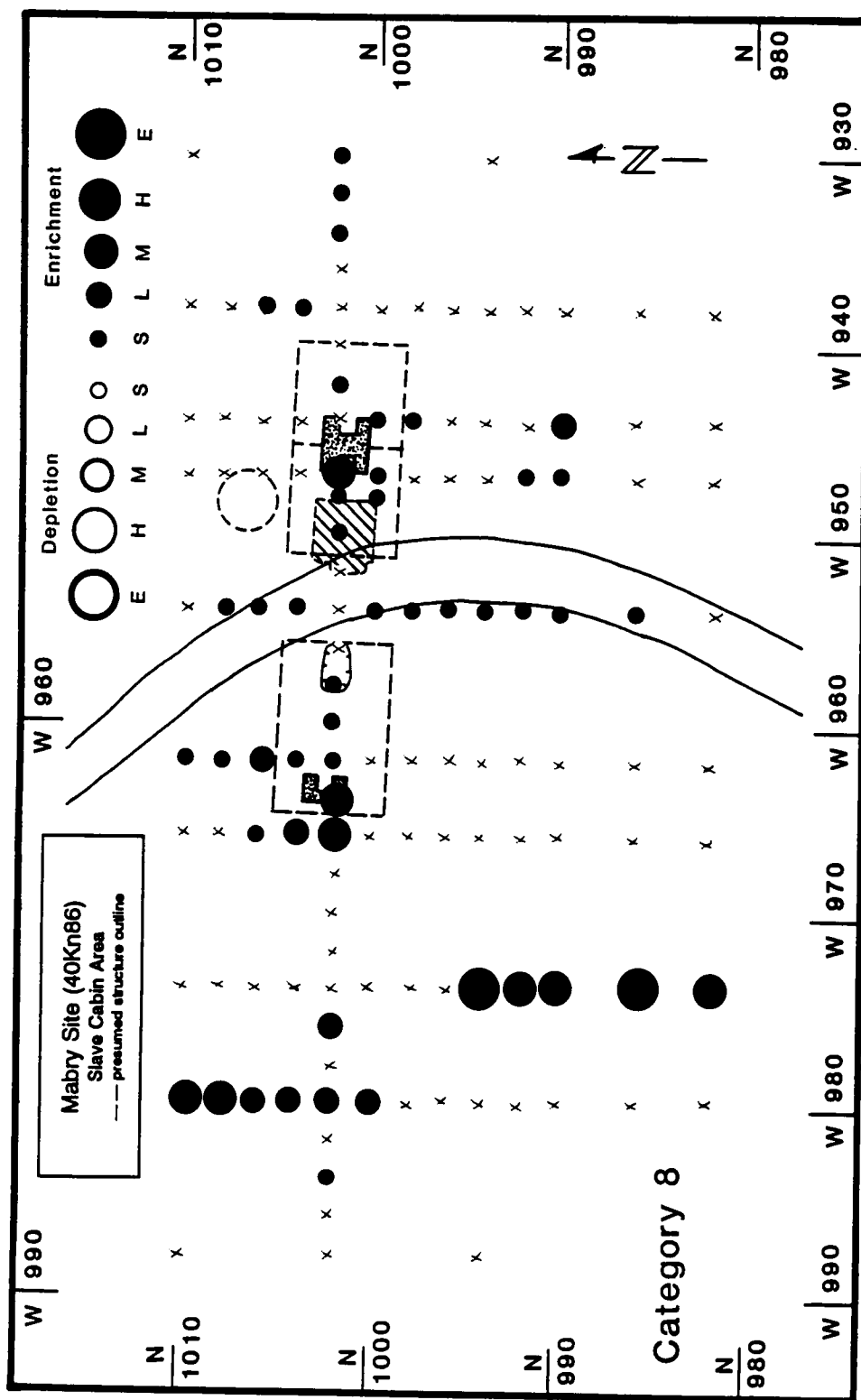


Figure 22. Chemical anomalies on the Mabry Site (40KN86), Category 8.

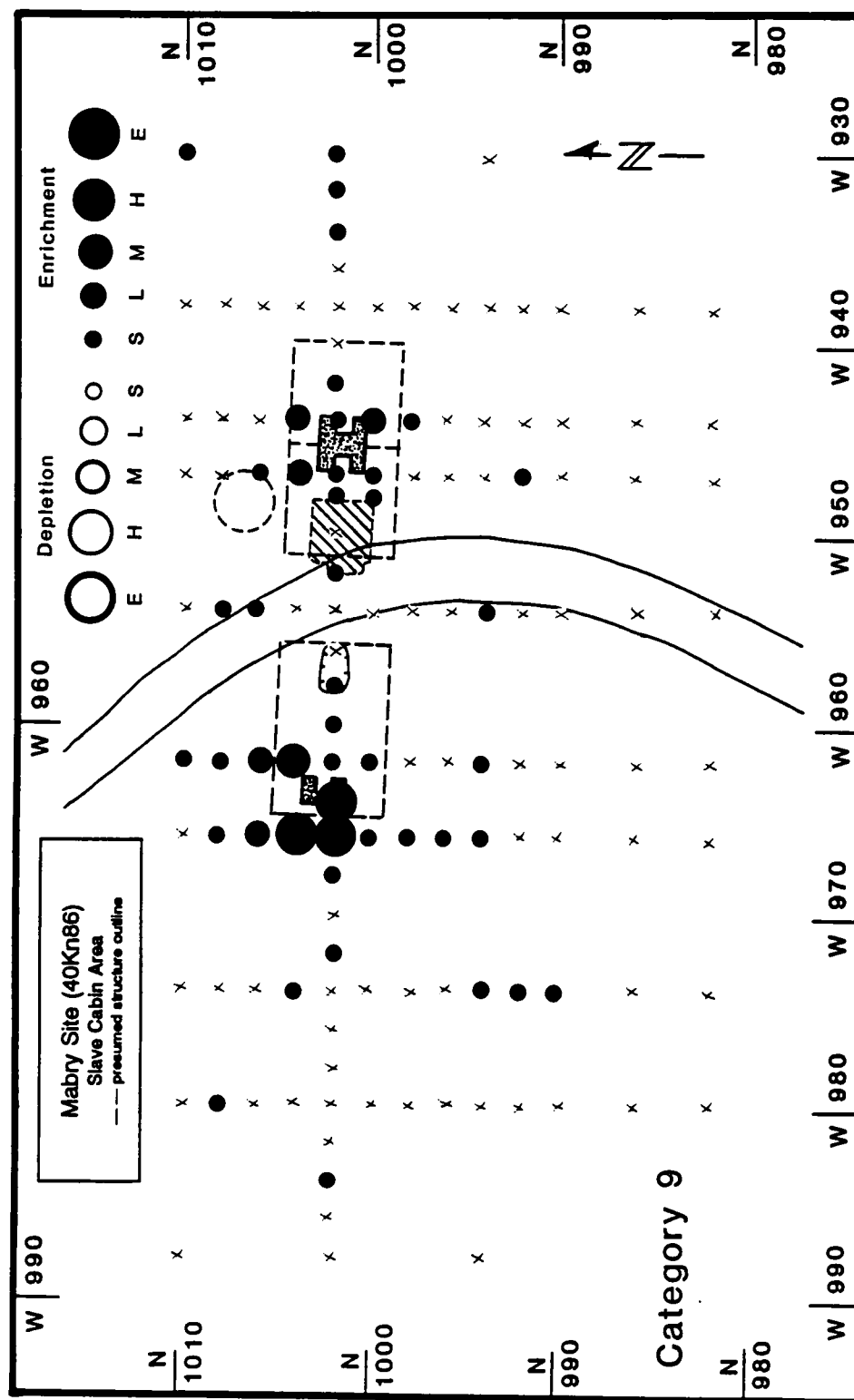


Figure 23. Chemical anomalies on the Mabry Site (40KN86), Category 9.

structure. Anomalies exist beyond this boundary but not far beyond 10 m. Therefore, applying Moir's (1987) model, expectations on yard proxemics for this slave site seem to hold true. It appears that the immediate active yard has been kept fairly clean.

Although only a few chemical anomalies are noted to the north of Structure 1, during archaeological investigations a large ash feature was found running from the northwest corner to a presumed fenceline to the north (McKelway 1994). The soil sampling strategy appears to have missed this feature entirely. Slight to low soil chemical anomalies exist to the east of Structure 1. A soil chemical signature points to generalized undifferentiated trash dumping.

To the south of Structure 1, slight to moderate chemical enrichments in categories 2, 4, 5 and 8 are noted around N990-992 and W944-947. The co-occurrence of these enrichments is interpreted as possibly the chemical signature of a smokehouse. This is extremely significant for the confirmation of the usefulness of soil chemical analysis on sites, since no smokehouse or other peripheral structures were noted during the archaeological work in this area (Henry McKelway, personal communication 1993).

As noted above, in Structure 2, the chemical anomalies do not define the interior as well as they do in Structure 1. A soil chemical signature indicates generalized trash dumping or the remnants of structure collapse to the north of the

presumed boundaries of the structure. Except for some slight animal and inorganic deposition, there are few chemical anomalies to the south of the structure. Therefore, like Structure 1, Moir's (1987) yard proxemics model seems to hold around Structure 2.

To the west of Structure 2, high to extreme chemical enrichments of categories 4 and 8, plus consistent enrichments of categories 3, 5 and 9 seem to indicate one or more agricultural/industrial structural remains. These remains are either aligned from the northwest to the southeast or staggered north to south. An enrichment in category 1 in this area is also interesting. Perhaps these anomalies are the chemical remains of barns used for the tending and feeding of animals and/or industrial sheds used for the maintenance of farmstead implements. Archaeological excavation in this area uncovered a cobblestone path overlaying coal cinders terminating at a possible pier stone (Henry McKelway, personal communication 1993).

Finally, in the sampling line between the two cabins, categories 4 and 8, as well as category 3, show slight enrichment anomalies. Unfortunately, a bulldozer scrape through this part of the site limits the possibility of an activity interpretation.

The Oliver Site (40KN103)

At the Oliver site, the smaller number of samples plus a hit or miss sampling strategy was found to hinder the detection of chemical anomalies. Despite this, several soil anomalies were noted (Figures 24 - 32). In addition, the attempt to sample on every side of the presumed structure location helped test the yard proxemics model.

Like the Mabry site, there is generalized deposition within the presumed boundaries of the structure. Archaeologically, a house mound was found in this area (Henry McKelway, personal communication 1994). Chemical enrichments in all categories especially category 1 is interpreted as a chemical signature of the demolition of a wood structure, with a fireplace.

There is little deposition around the immediate south, west and north sides of the building. Conversely, soil chemical enrichments in all categories are noted immediately to the east, continuing to the end of the sampling line more than eight meters away. If the yard proxemics model holds at this site then this should be the rear of the house. However, a local informant revealed that this was the front of the house. The only door opened onto a porch facing a small creek to the east. Approach was made from a road which stretched from this site east around a hill past the Bart Toole house (Wiley Neely, personal communication 1990). It is unclear why there is so much deposition in this area.

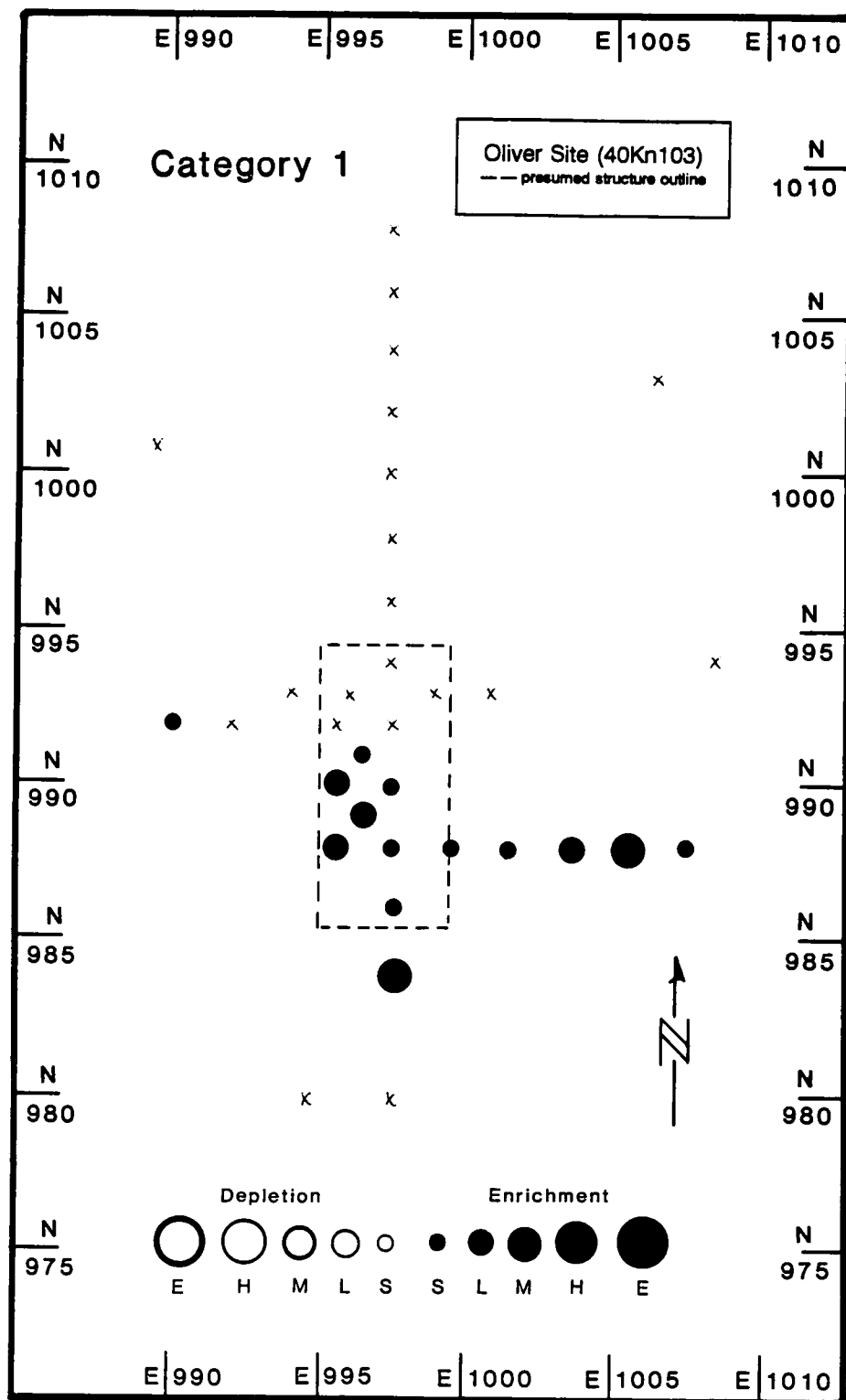


Figure 24. Chemical anomalies on the Oliver Site (40KN103), Category 1.

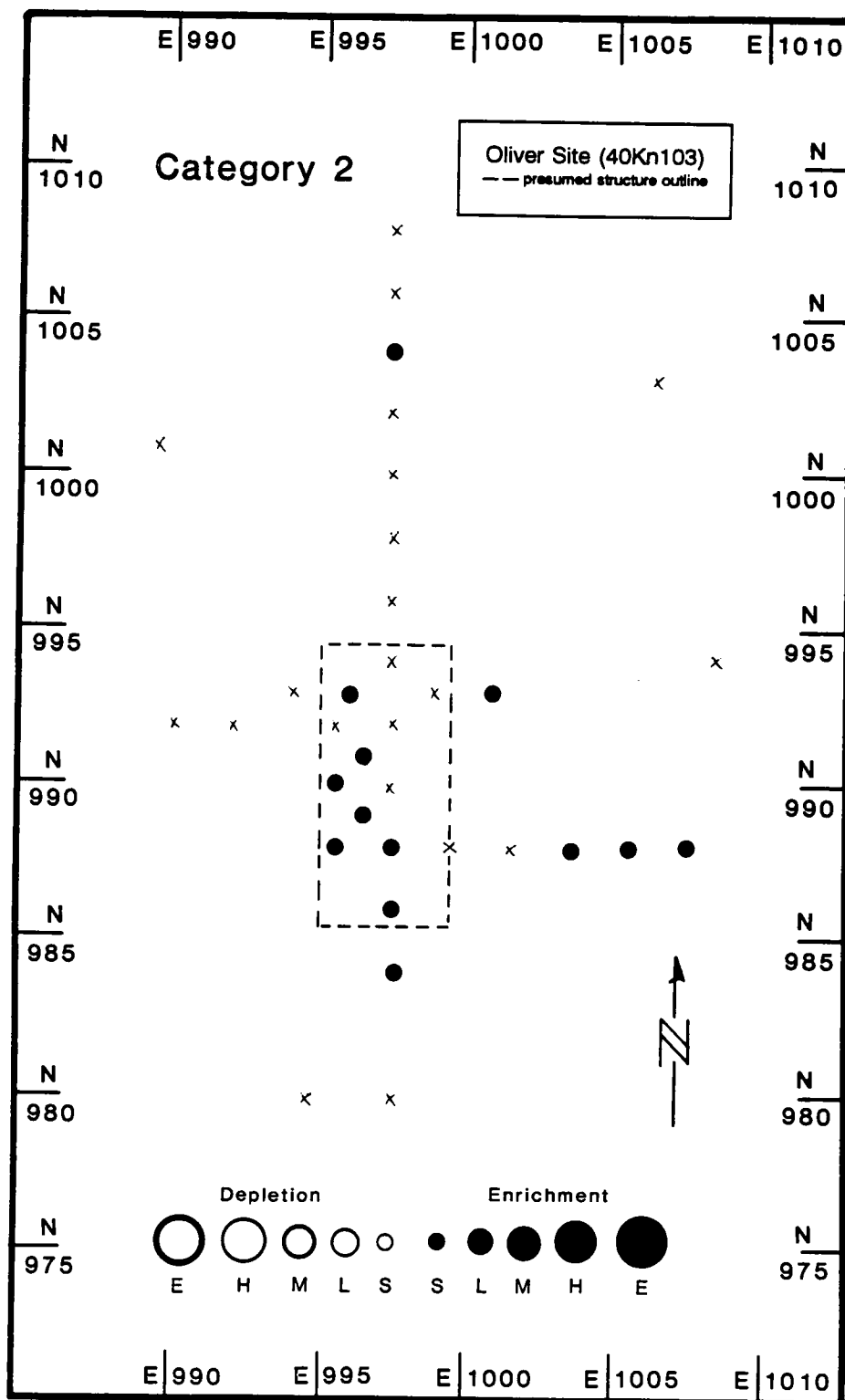


Figure 25. Chemical anomalies on the Oliver Site (40KN103), Category 2.

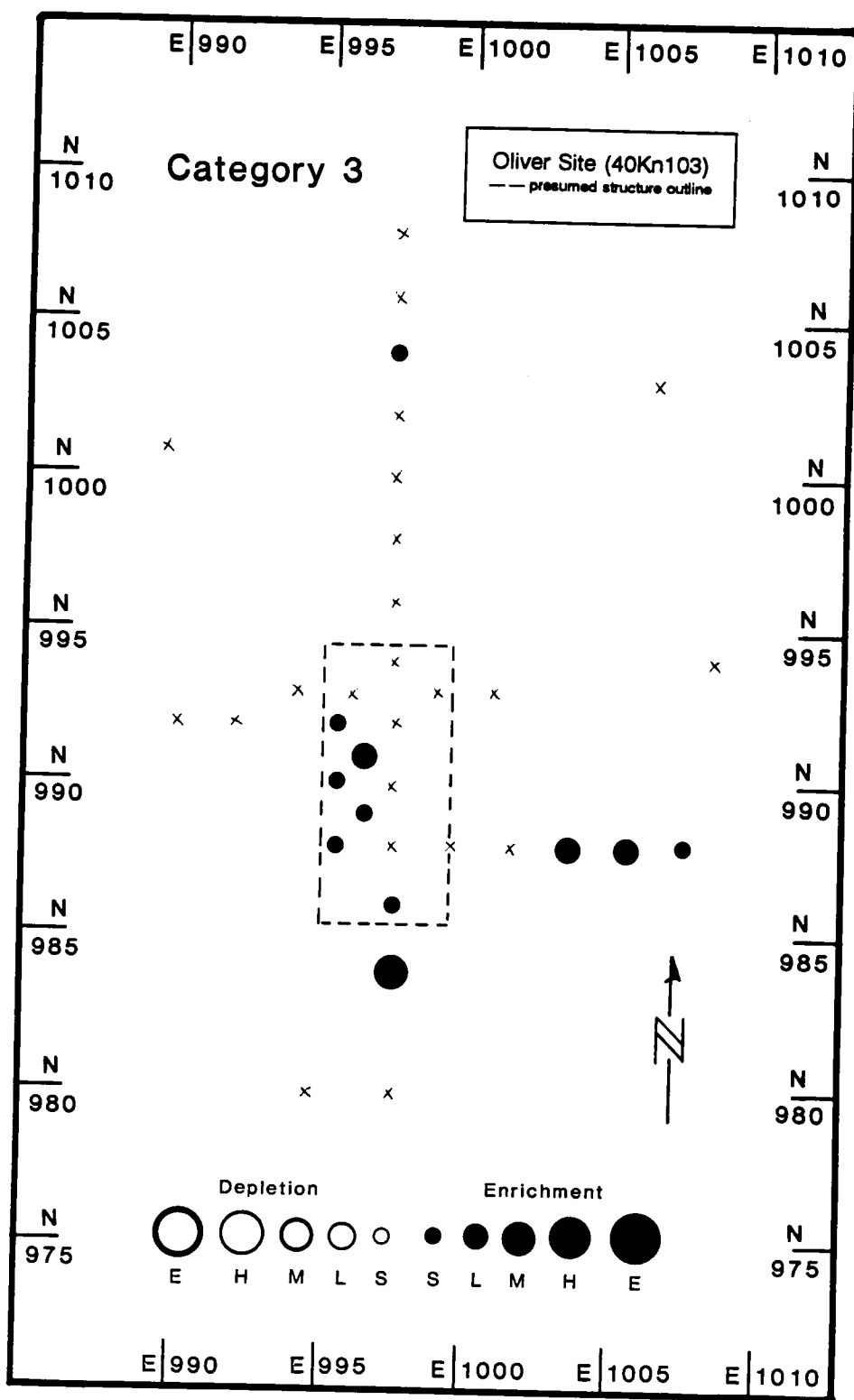


Figure 26. Chemical anomalies on the Oliver Site (40KN103), Category 3.

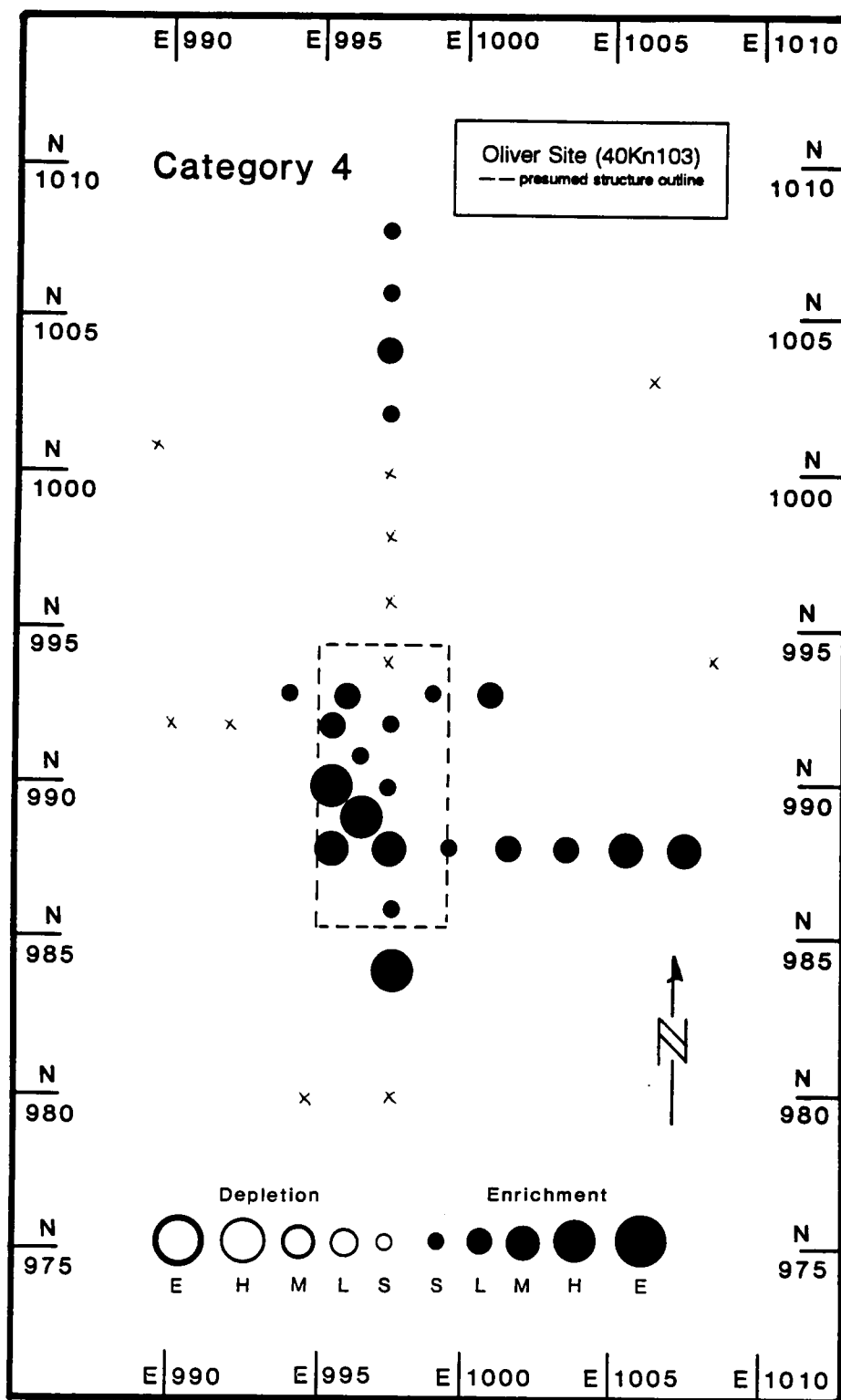


Figure 27. Chemical anomalies on the Oliver Site (40KN103), Category 4.

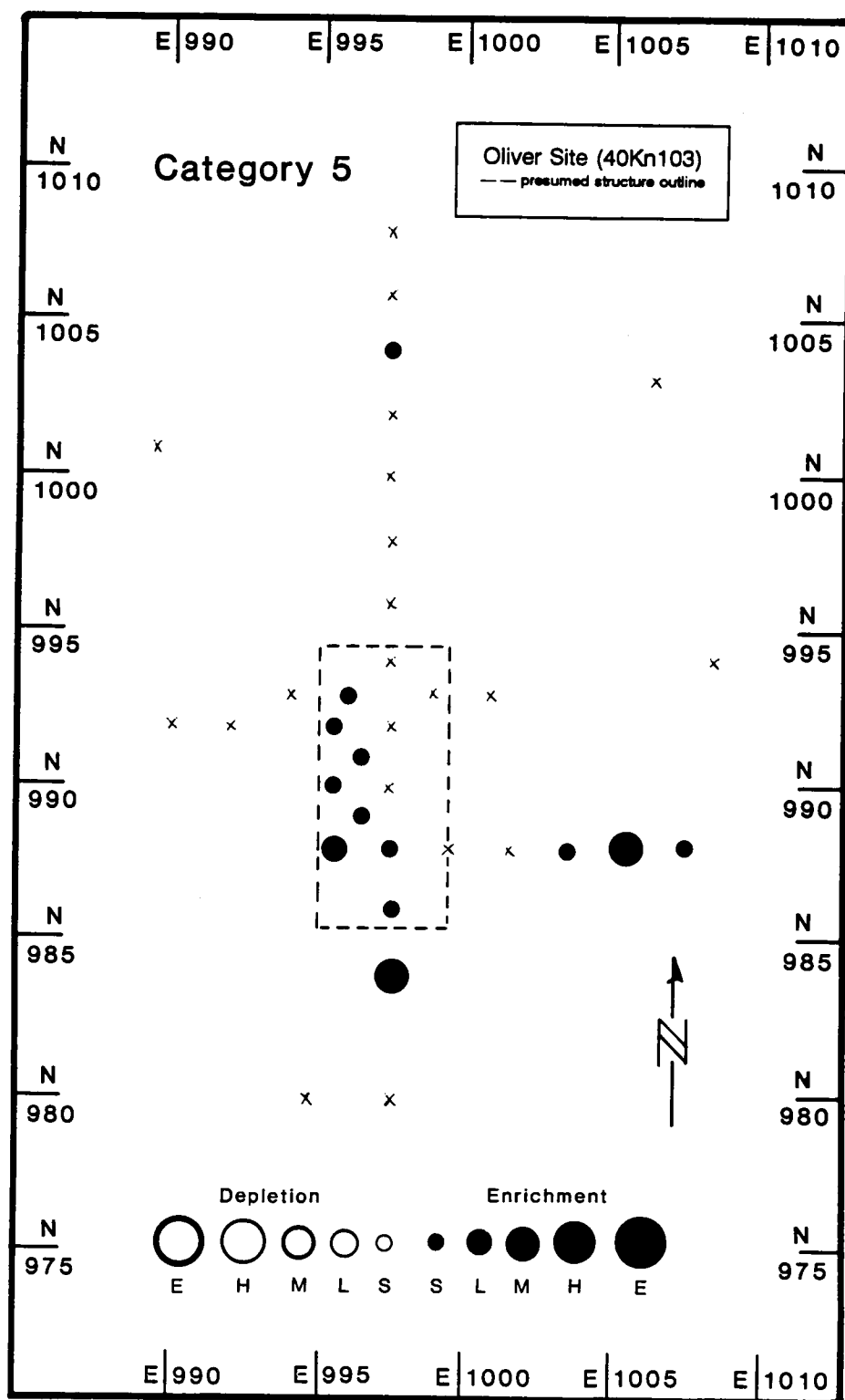


Figure 28. Chemical anomalies on the Oliver Site (40KN103), Category 5.

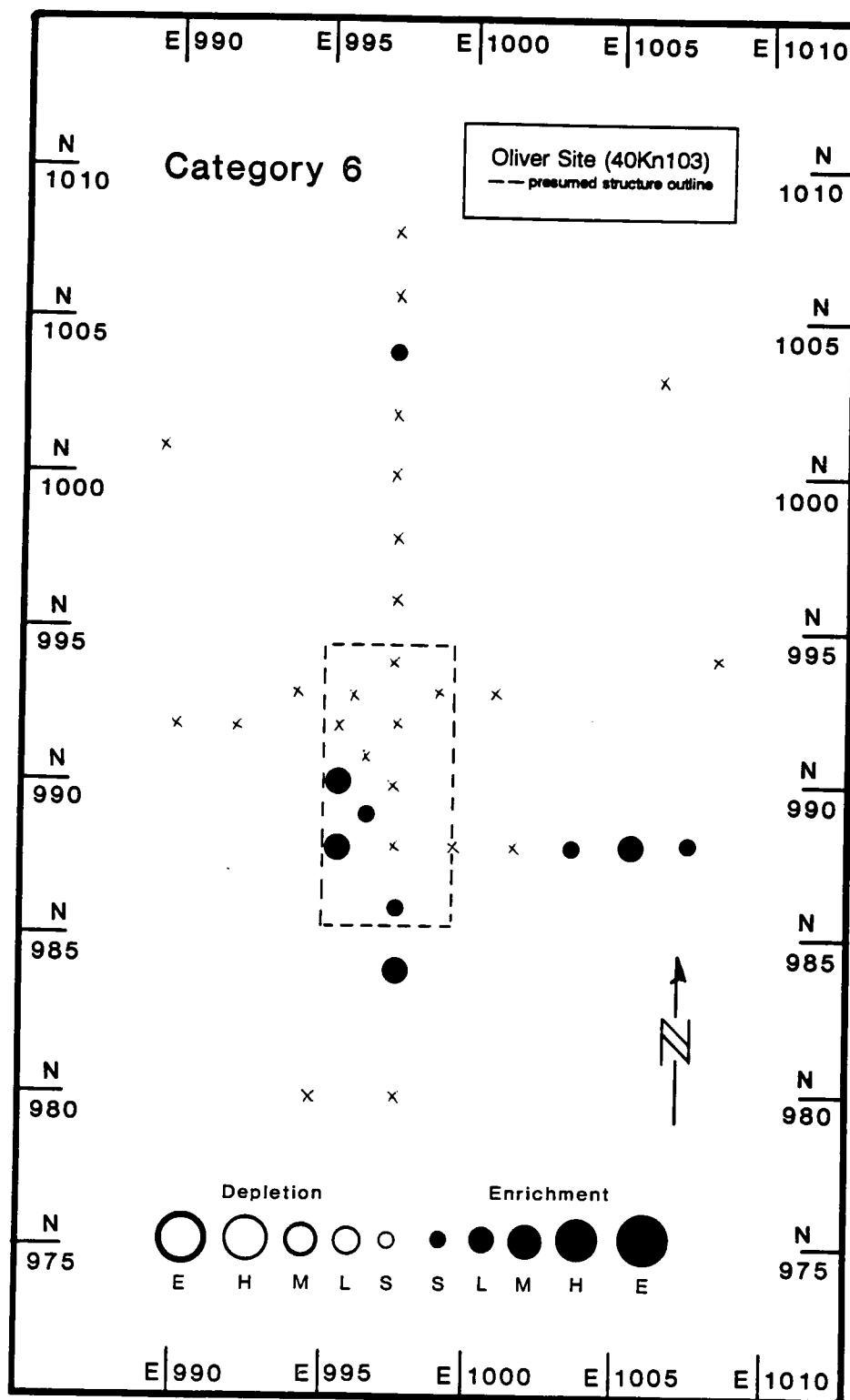


Figure 29. Chemical anomalies on the Oliver Site (40KN103), Category 6.

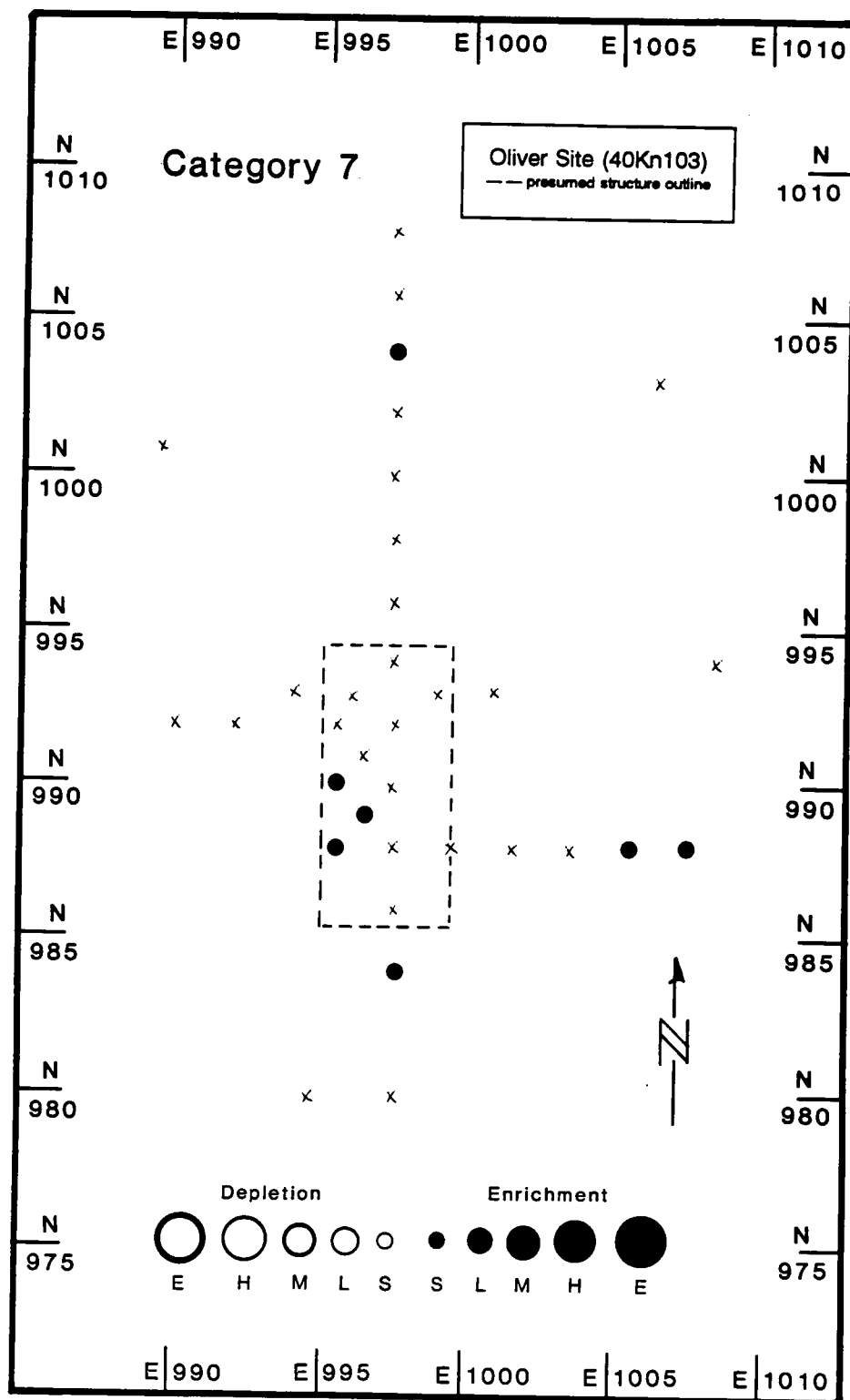


Figure 30. Chemical anomalies on the Oliver Site (40KN103), Category 7.

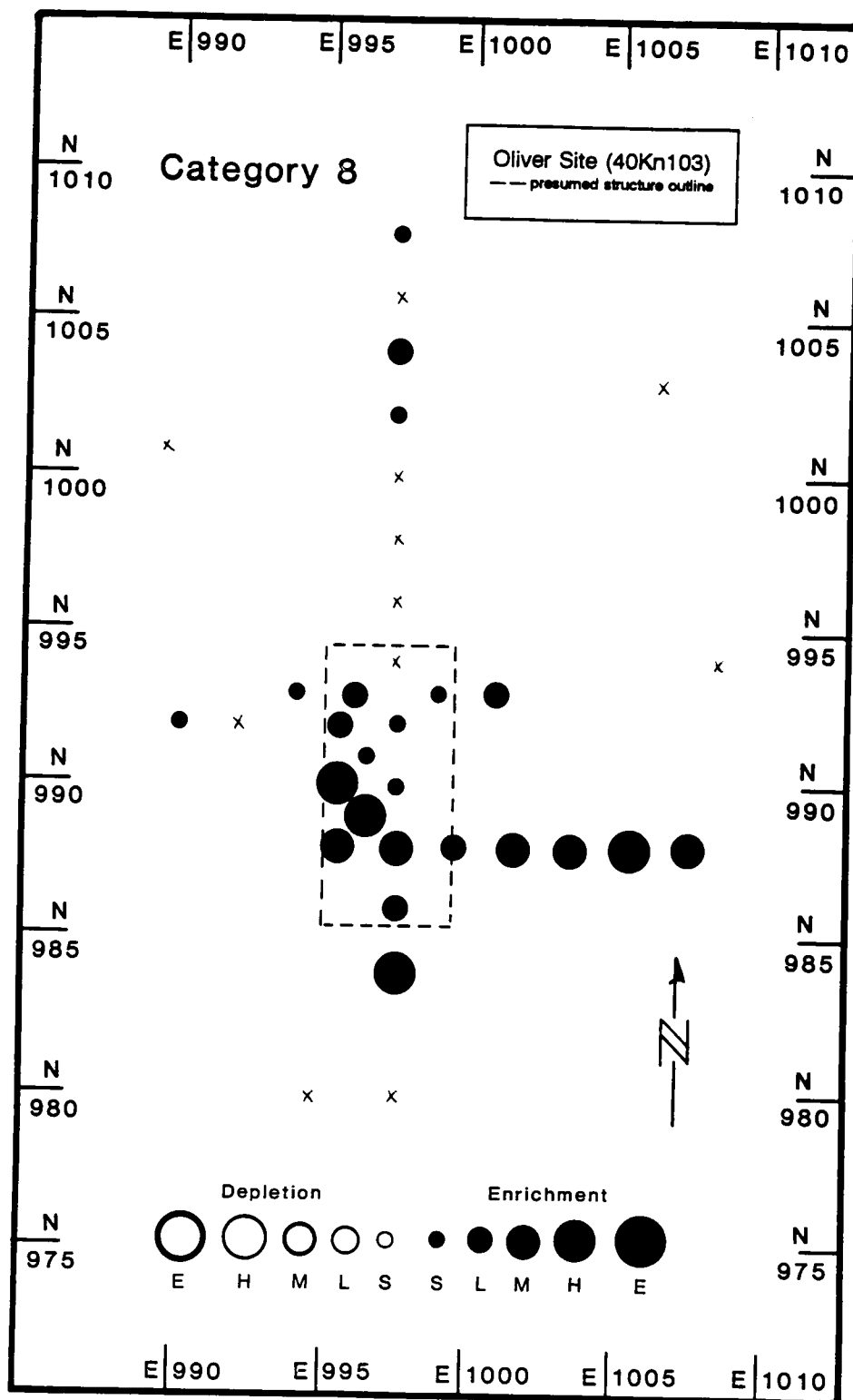


Figure 31. Chemical anomalies on the Oliver Site (40KN103), Category 8.

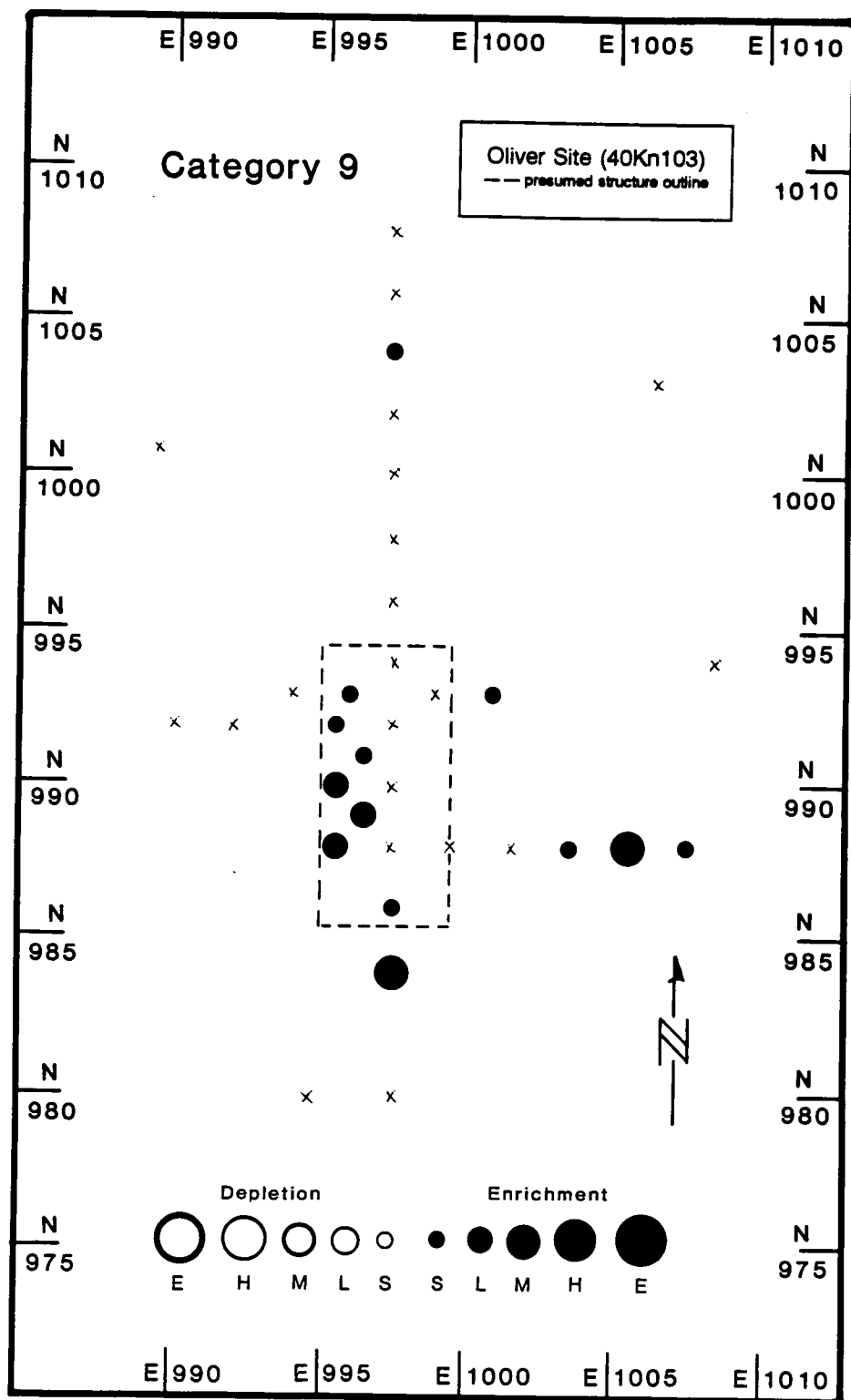


Figure 32. Chemical anomalies on the Oliver Site (40KN103), Category 9.

Perhaps demolition spread material over this area. Except for this area east of the house, the immediate active yard was still fairly clean.

There is one very interesting soil chemical anomaly at this site. To the north of the structure there are spatially distinct slight to low chemical enrichments in categories 4 and 8 between N1002-1008, E997.5. Chemical enrichments in categories 2, 3, and 5 are also noted. As postulated at the Mabry site, this may be the soil chemical signature of a smokehouse. A secondary use as an industrial shed is also surmised. The local informant, Mr. Neely, vaguely remembered an outbuilding near the house, but could not remember its location or function (personal communication 1990). As with Mabry, archaeological investigations did not detect this possible outbuilding (Henry McKelway, personal communication 1994).

The Bart Toole House Site

Investigation at the Bart Toole House site concentrated on the yard proxemics model and the possibility of finding any specialized dumping areas or locations of previously removed structures (Figures 33 - 41). Mr. Neely (personal communication 1990) recalled an outbuilding on the backside (the southwest) on the house. In addition, sampling focused upon detecting any chemical signatures under the house. Samples under the standing house revealed distinct

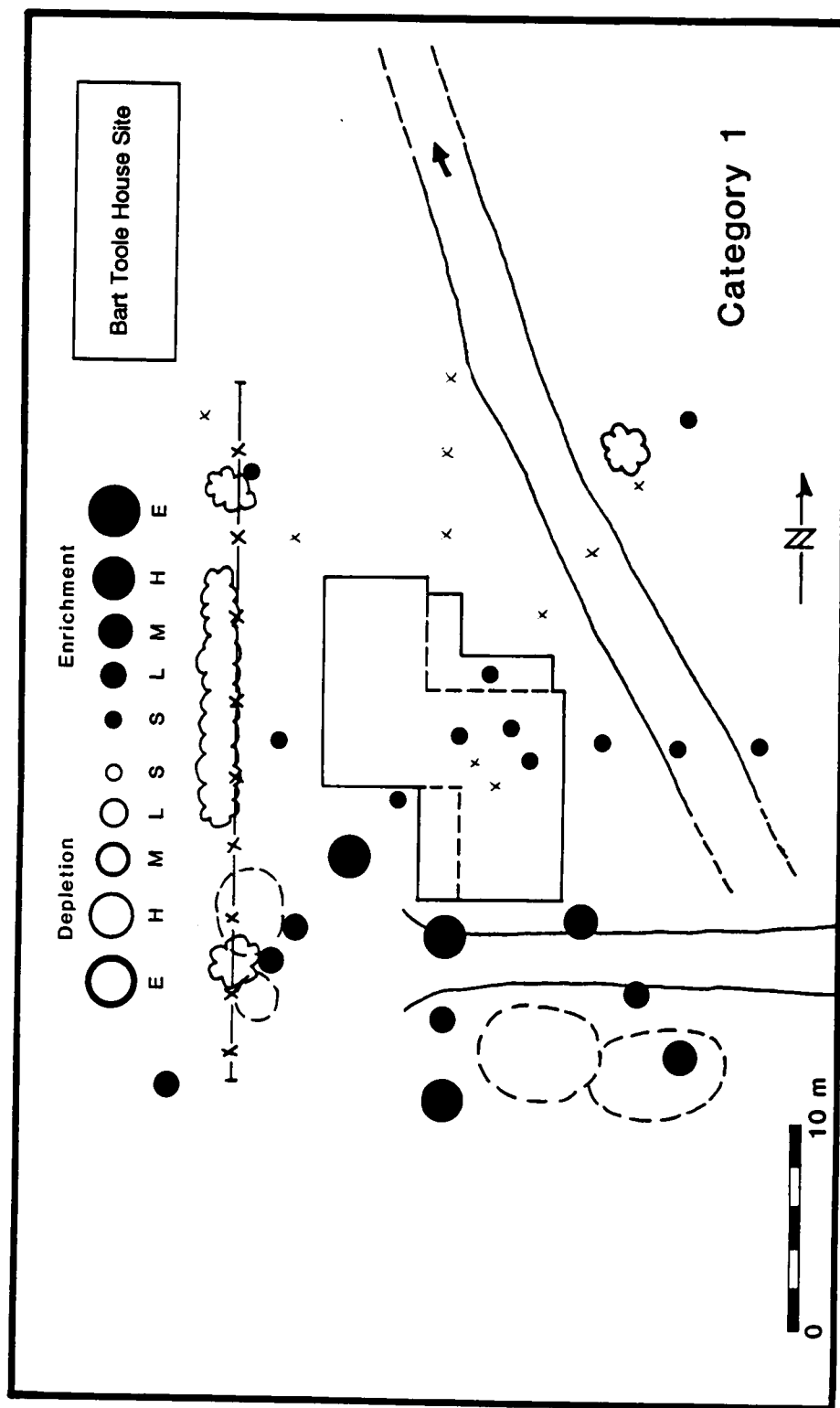


Figure 33. Chemical anomalies on the Bart Toole House Site, Category 1.

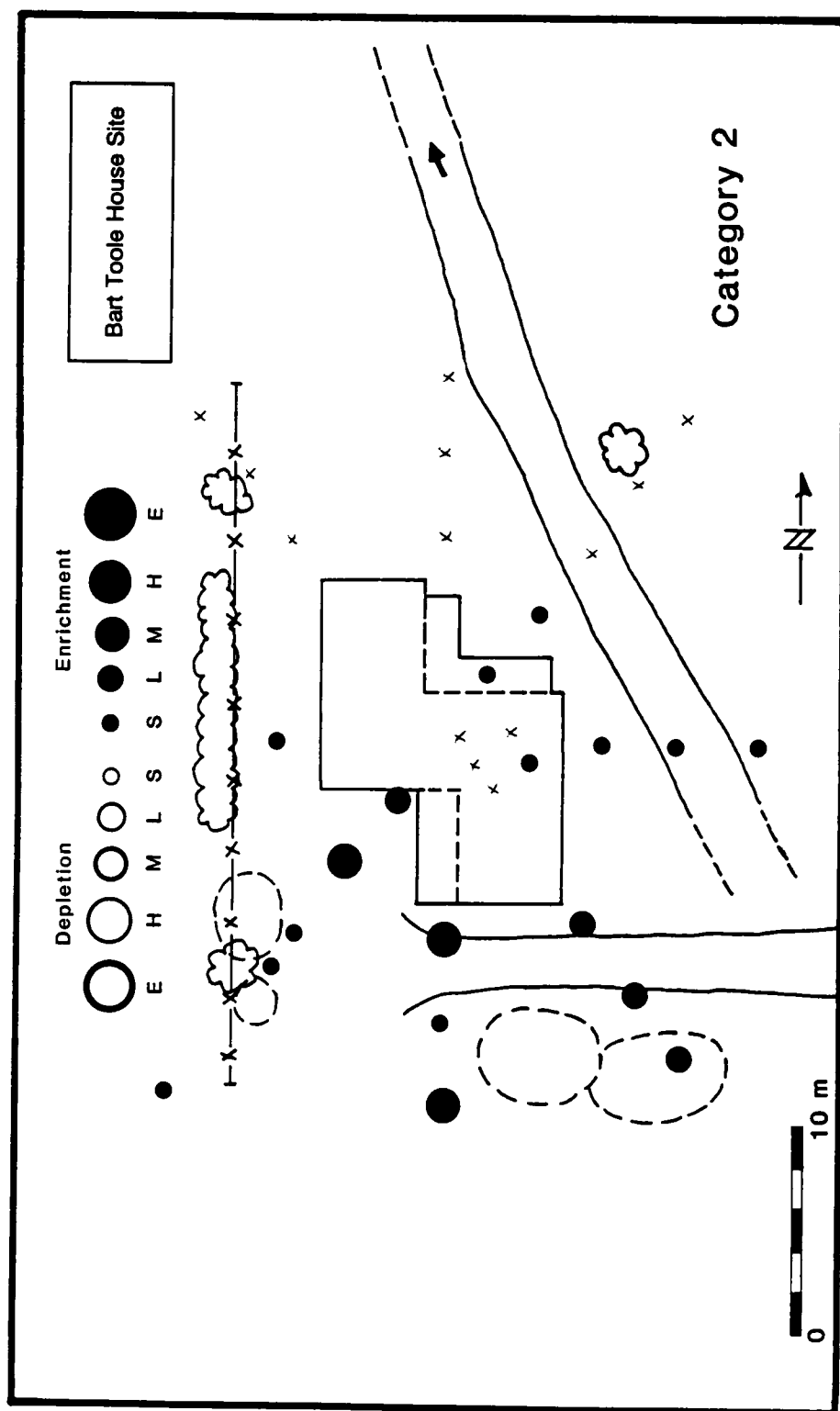


Figure 34. Chemical anomalies on the Bart Toole House Site, Category 2.

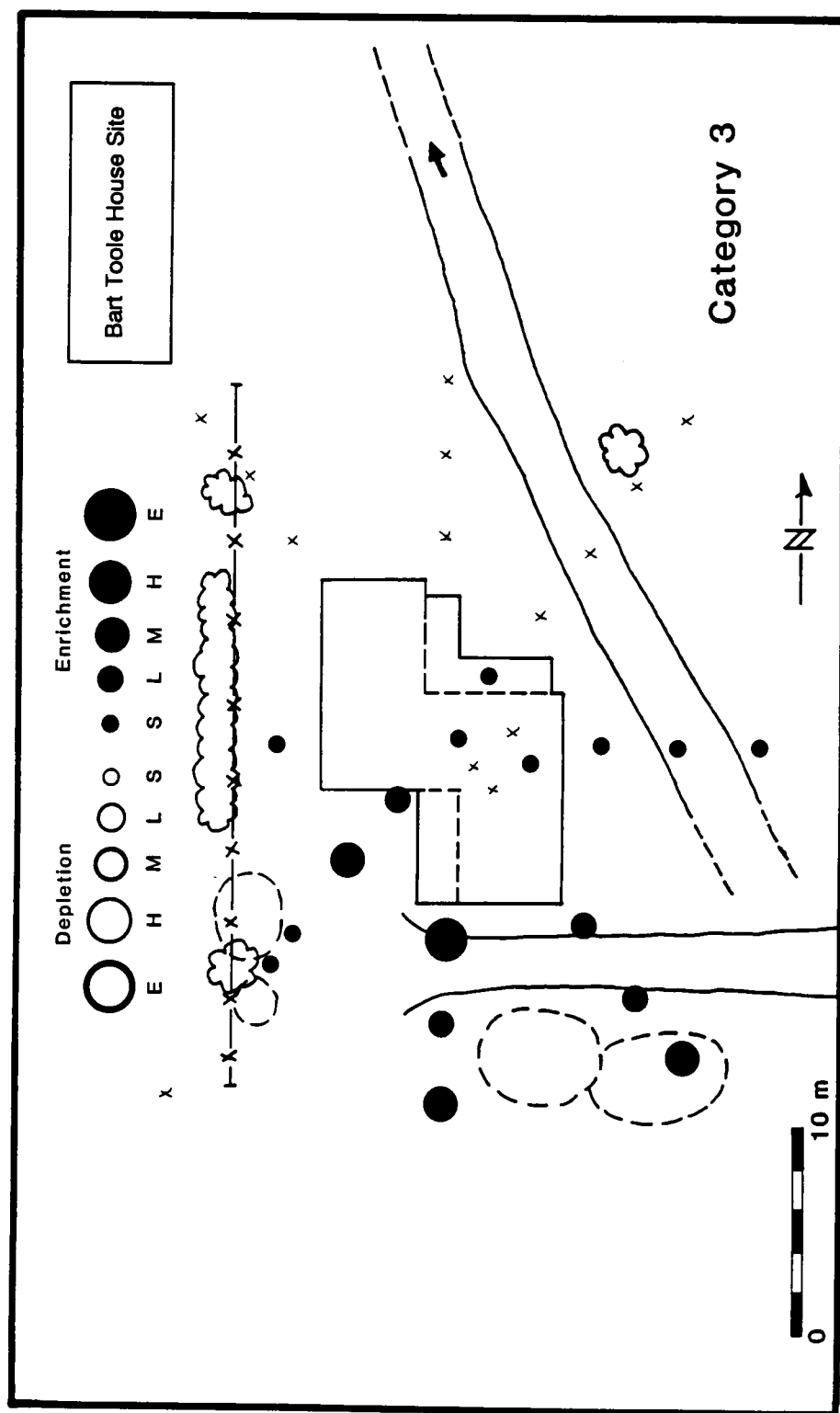


Figure 35. Chemical anomalies on the Bart Toole House Site, Category 3.

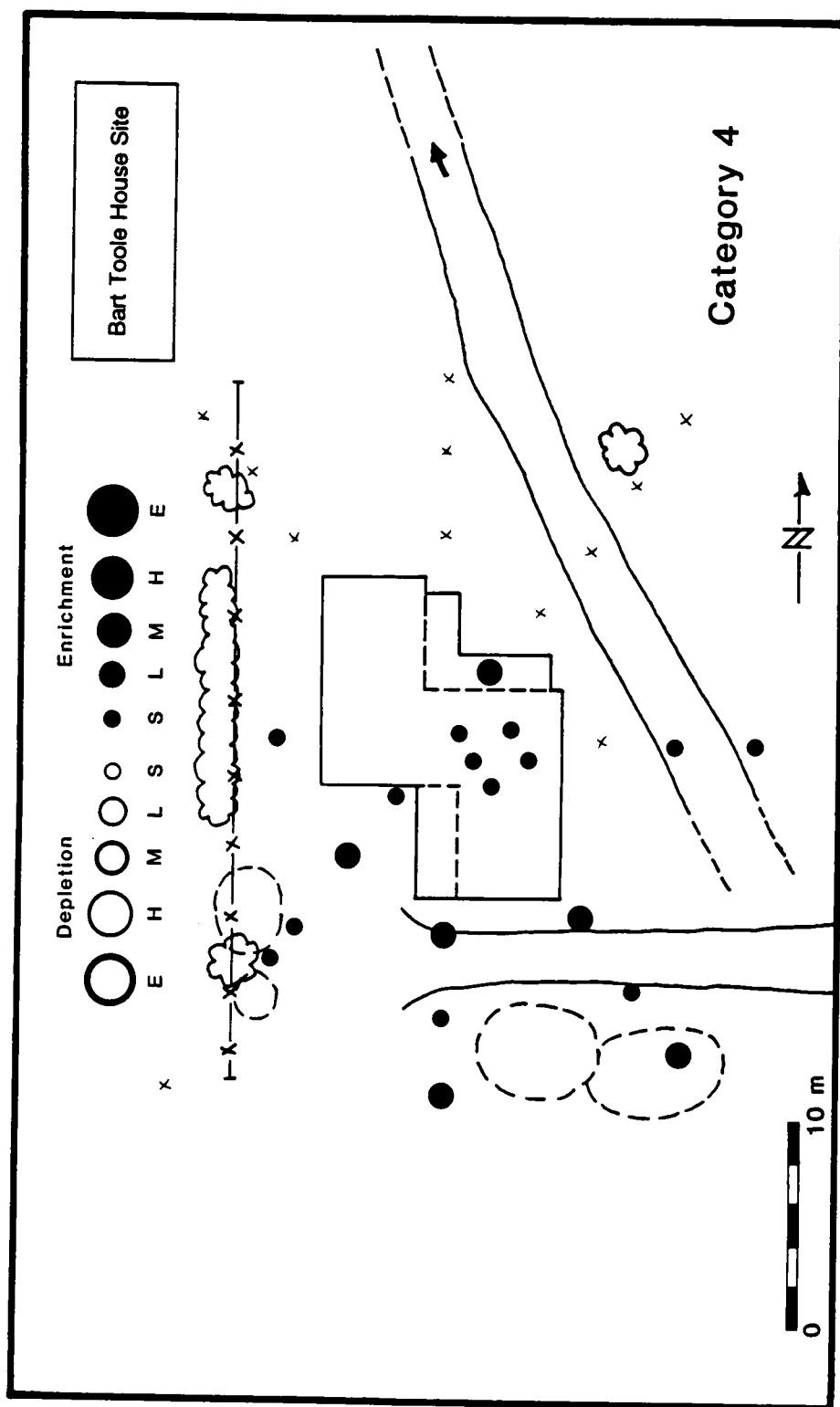


Figure 36. Chemical anomalies on the Bart Toole House Site, Category 4.

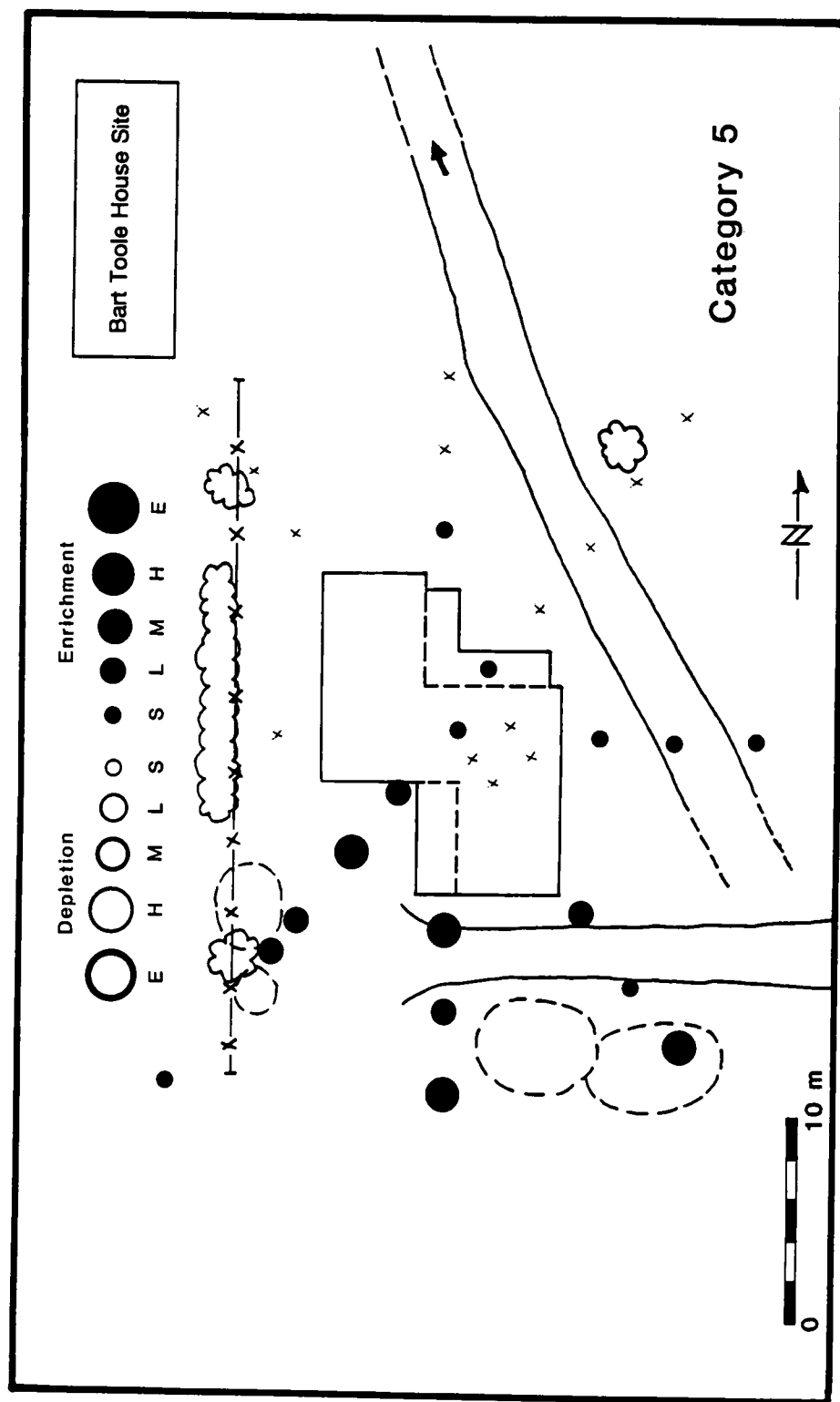


Figure 37. Chemical anomalies on the Bart Toole House Site, Category 5.

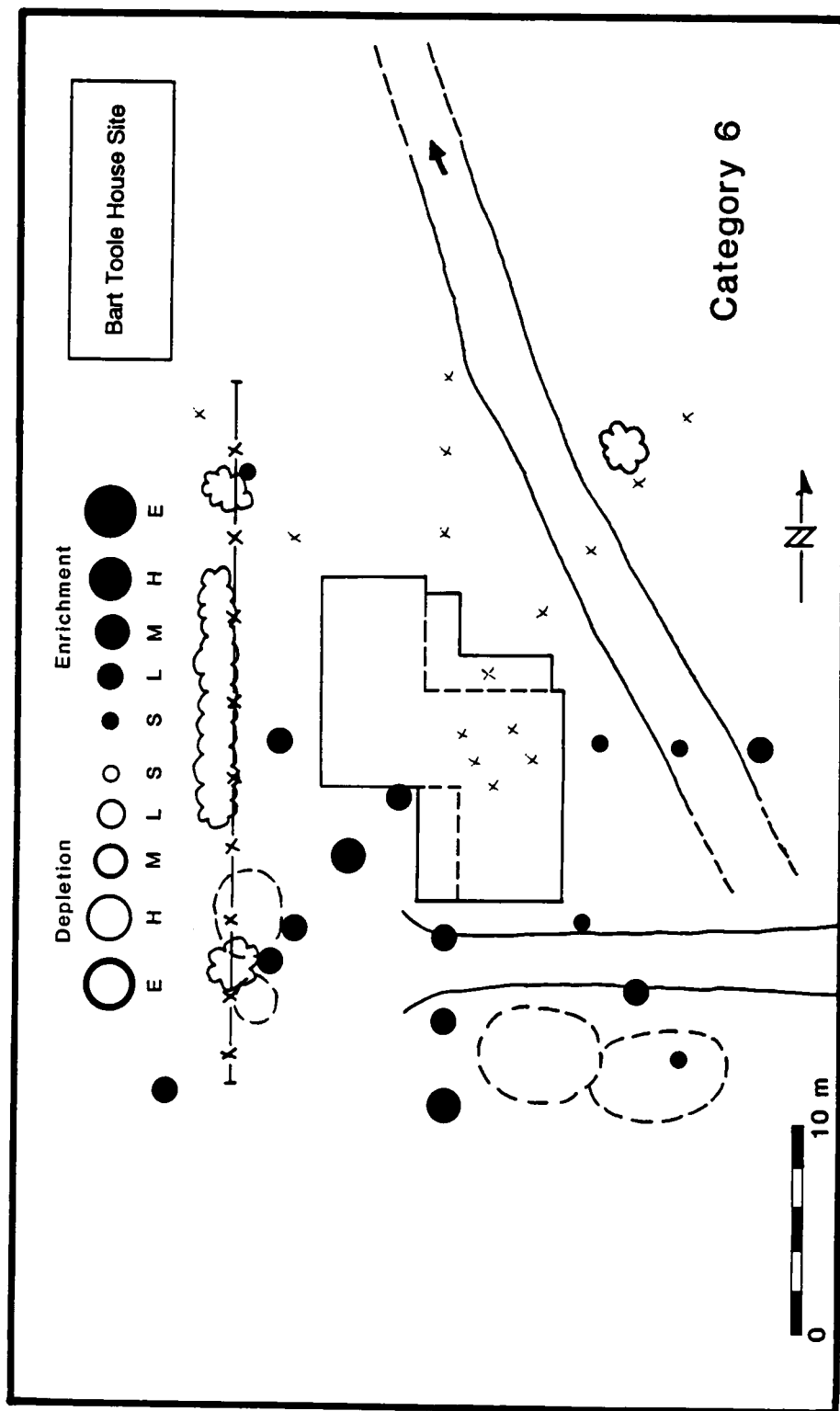


Figure 38. Chemical anomalies on the Bart Toole House Site, Category 6.

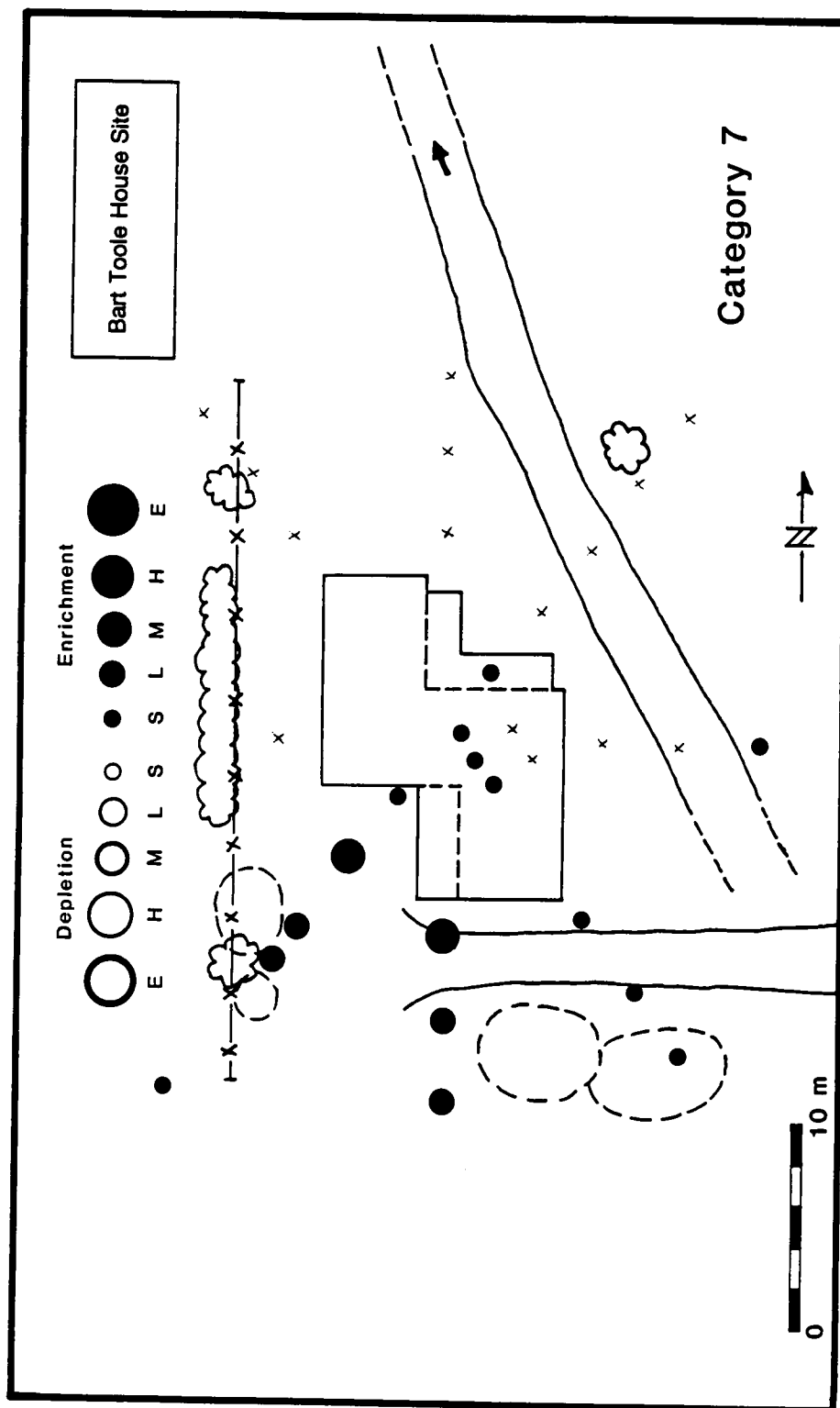


Figure 39. Chemical anomalies on the Bart Toole House Site, Category 7.

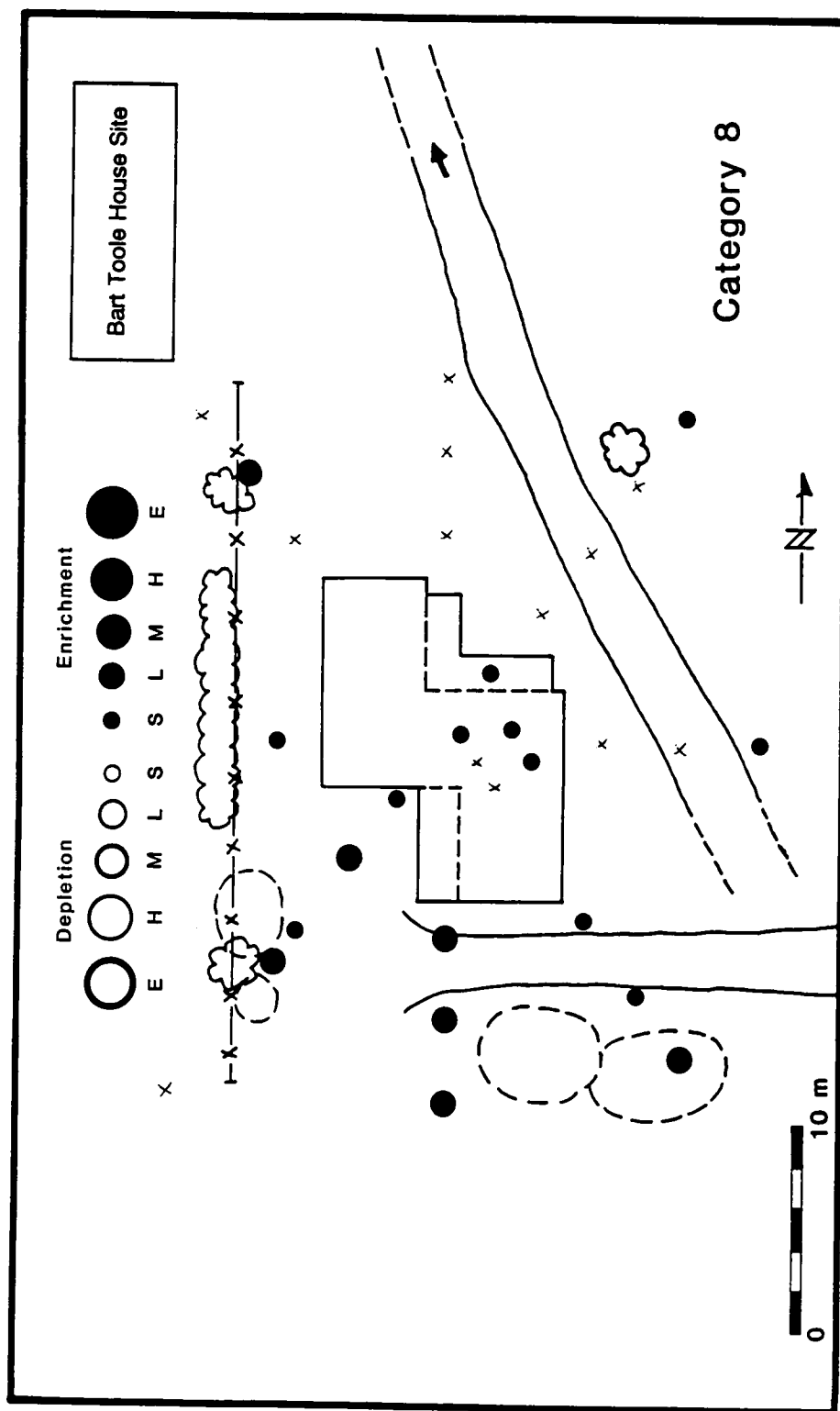


Figure 40. Chemical anomalies on the Bart Toole House Site, Category 8.

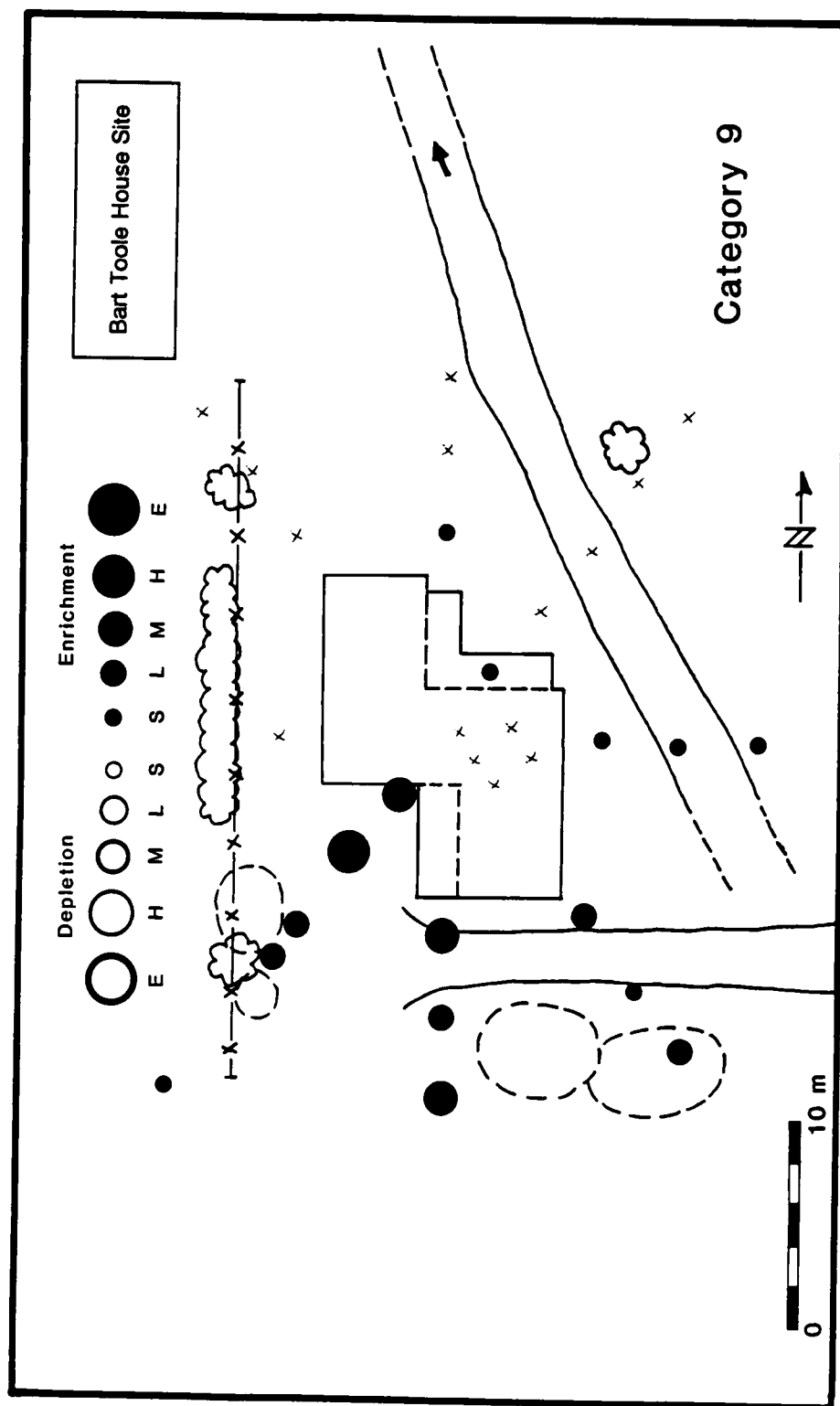


Figure 41. Chemical anomalies on the Bart Toole House Site, Category 9.

enrichments in categories 4 and 8. An enrichment in category 1 is also present. This was expected because sodium (Na) and potassium (K) are captured by nitrates forming under relatively sealed structural foundations on Upland South farmsteads. The enrichment in category 1 (as well as the lack of enrichments in category 6) was interesting because this might mean that the ground was not entirely stripped of vegetation before the foundation was built. Perhaps the ground was merely leveled. Not surprisingly, enrichments in category 1 as well as almost all the rest of the categories are also found under the collapsed front porch.

The yard proxemics model holds fairly well, at least for the front yard. The front yard is quite clear of chemical anomalies, while the side and back yards have consistently high enrichments in every category. The immediate active yard in the front is very clean while the side and back yards are full of deposits of every kind. This may be largely due to the spread of debris after the site was occupied.

Other than under the structure, no spatially distinct chemical anomalies were found at this site. Unfortunately, no outbuilding could be discerned from the constant high readings to the southwest of the house. Furthermore, the construction of a gravel driveway to the south of the building is thought to have impeded the possible discovery of many distinct anomalies.

The Horace Jones House Site (40KN105)

Sampling at the Horace Jones House site focused on the chemical characterization of the soil under the house and the investigations into the functions of the standing outbuildings. The yard proxemics model and other depositional episodes were also investigated (Figures 42 - 50).

Like the Bart Toole house, soil chemical enrichments in categories 4 and 8 are found under the standing house. In addition, enrichments in categories 1 and 3 are well represented. The outbuilding to the west of the house has chemical enrichments in all categories. Visual inspection during sampling noted a wide assortment of trash on the dirt floor of this dilapidated structure. It is not surprising then that category 5 (anthropic accumulation) and category 3 (inorganic accumulation) are the highest enrichments present.

The outbuilding to the northwest of the house also shows a mixture of enrichments immediately in front of and directly under the building. Interpretation points to a multiple use building with a generalized midden at the point of entry. The outbuilding out of the active yard to the northeast only shows an enrichment in category 3. Perhaps this was an industrial storage building.

Except category 3, the immediate active yard is relatively clear of chemical anomalies to the north, east and south of the house. The manifestation of slight enrichments

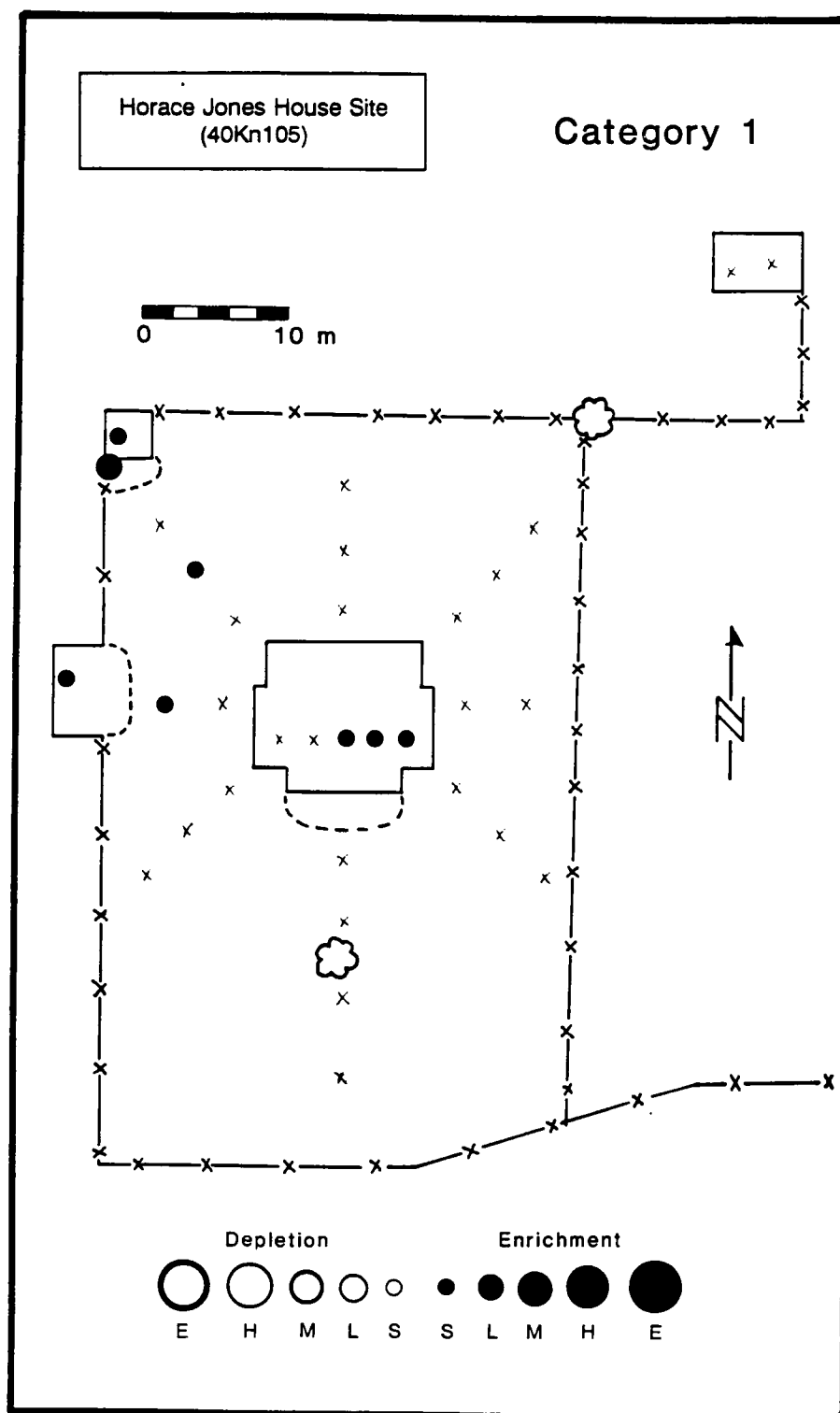


Figure 42. Chemical anomalies on the Horace Jones House Site (40KN105), Category 1.

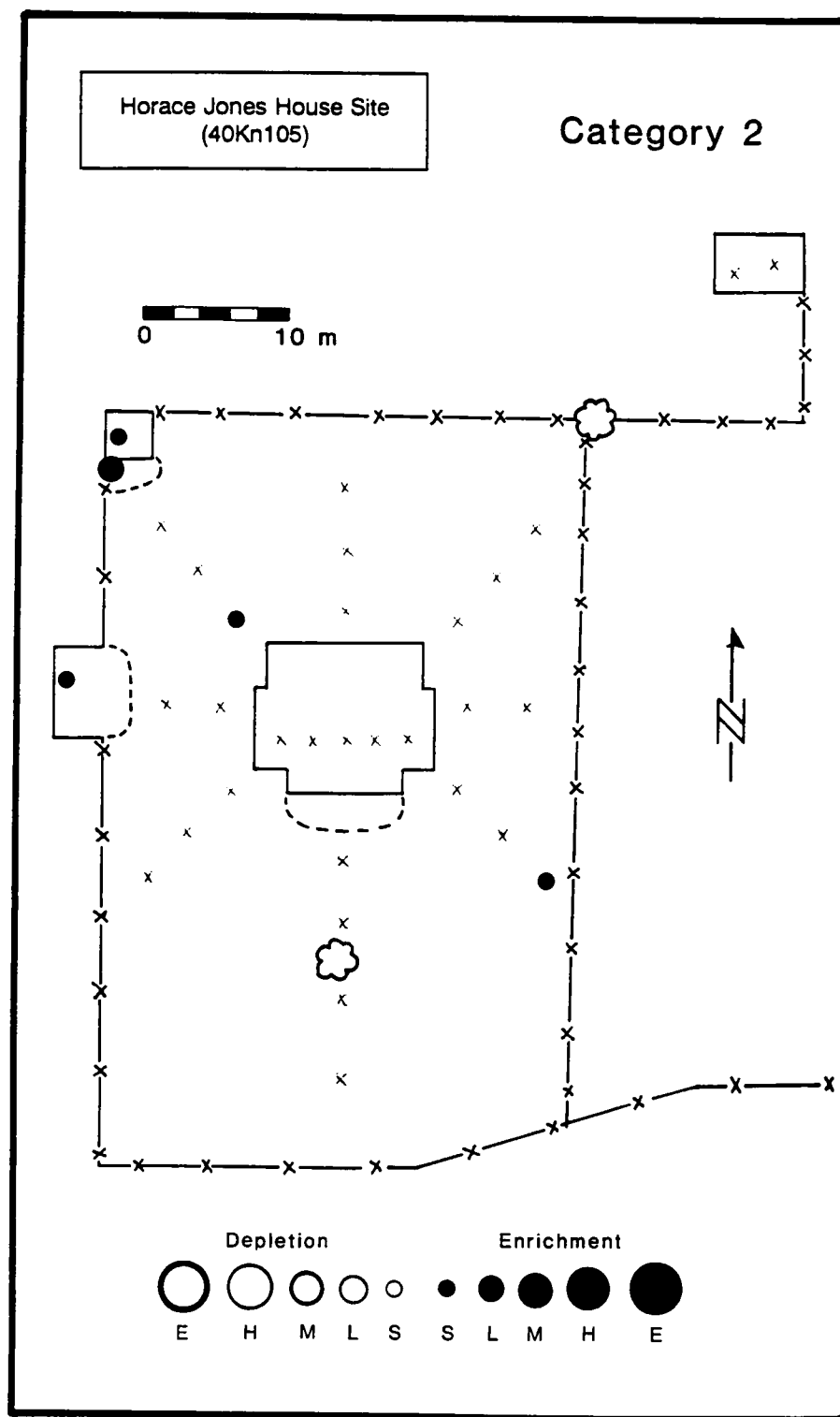


Figure 43. Chemical anomalies on the Horace Jones House Site (40KN105), Category 2.

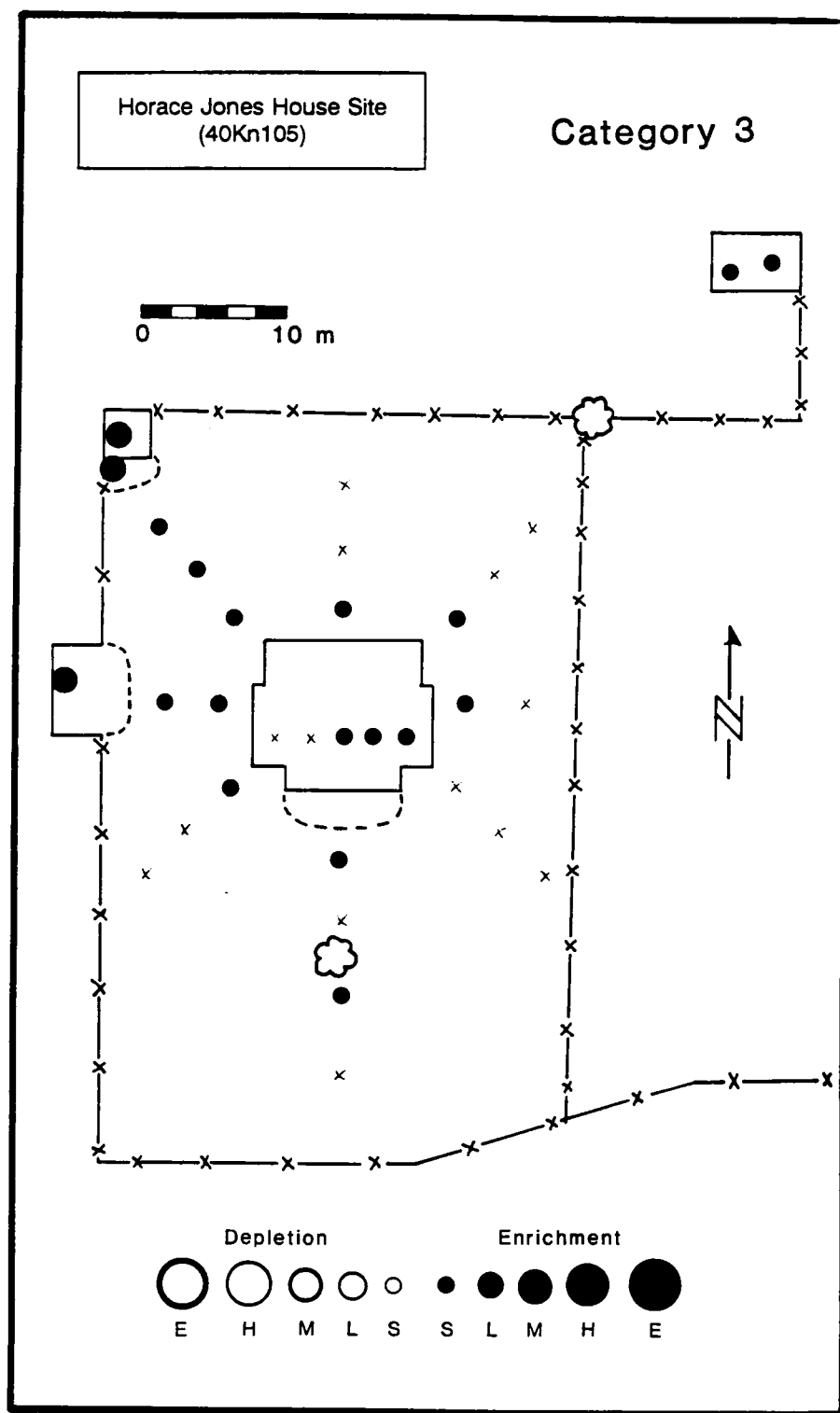


Figure 44. Chemical anomalies on the Horace Jones House Site (40KN105), Category 3.

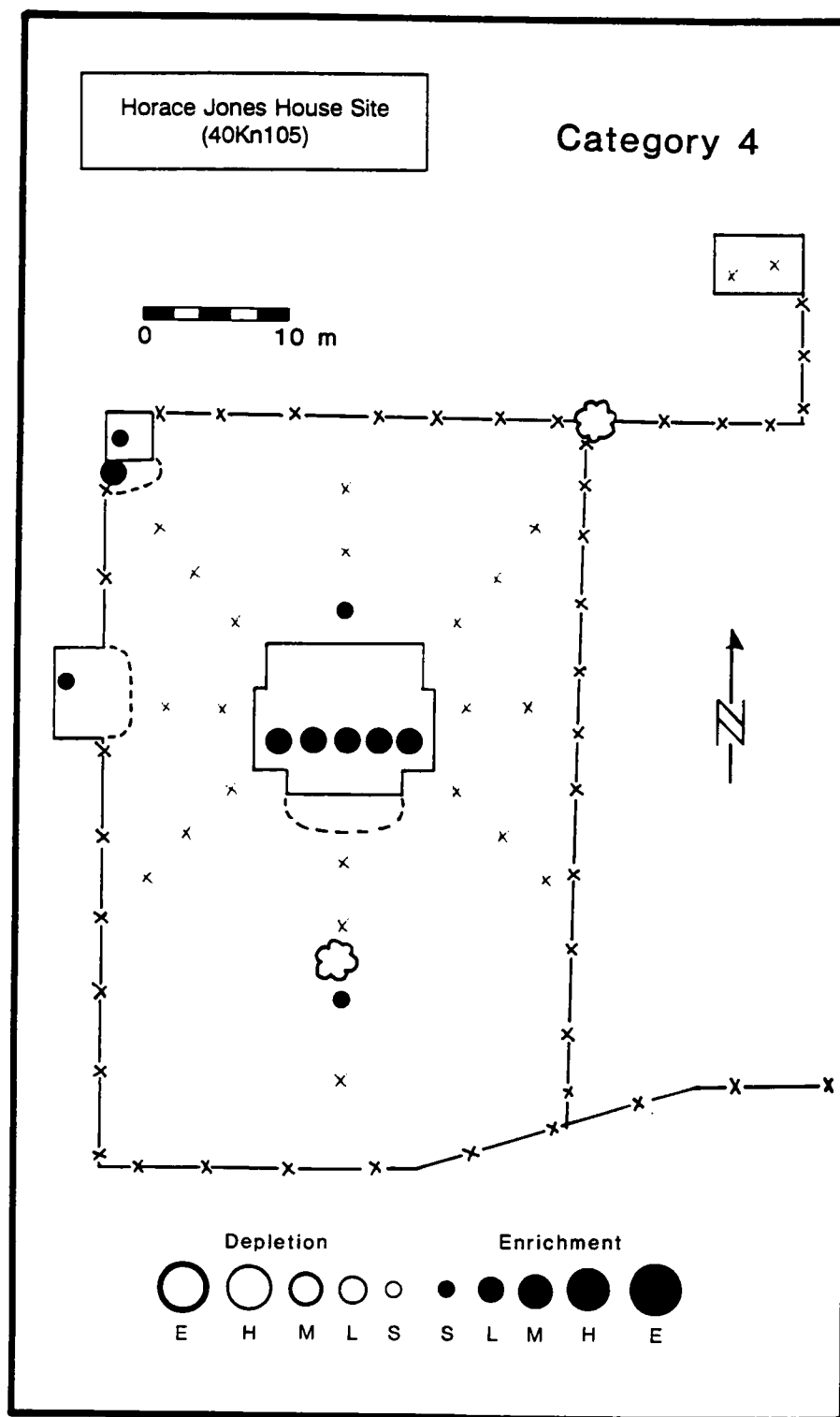


Figure 45. Chemical anomalies on the Horace Jones House Site (40KN105), Category 4.

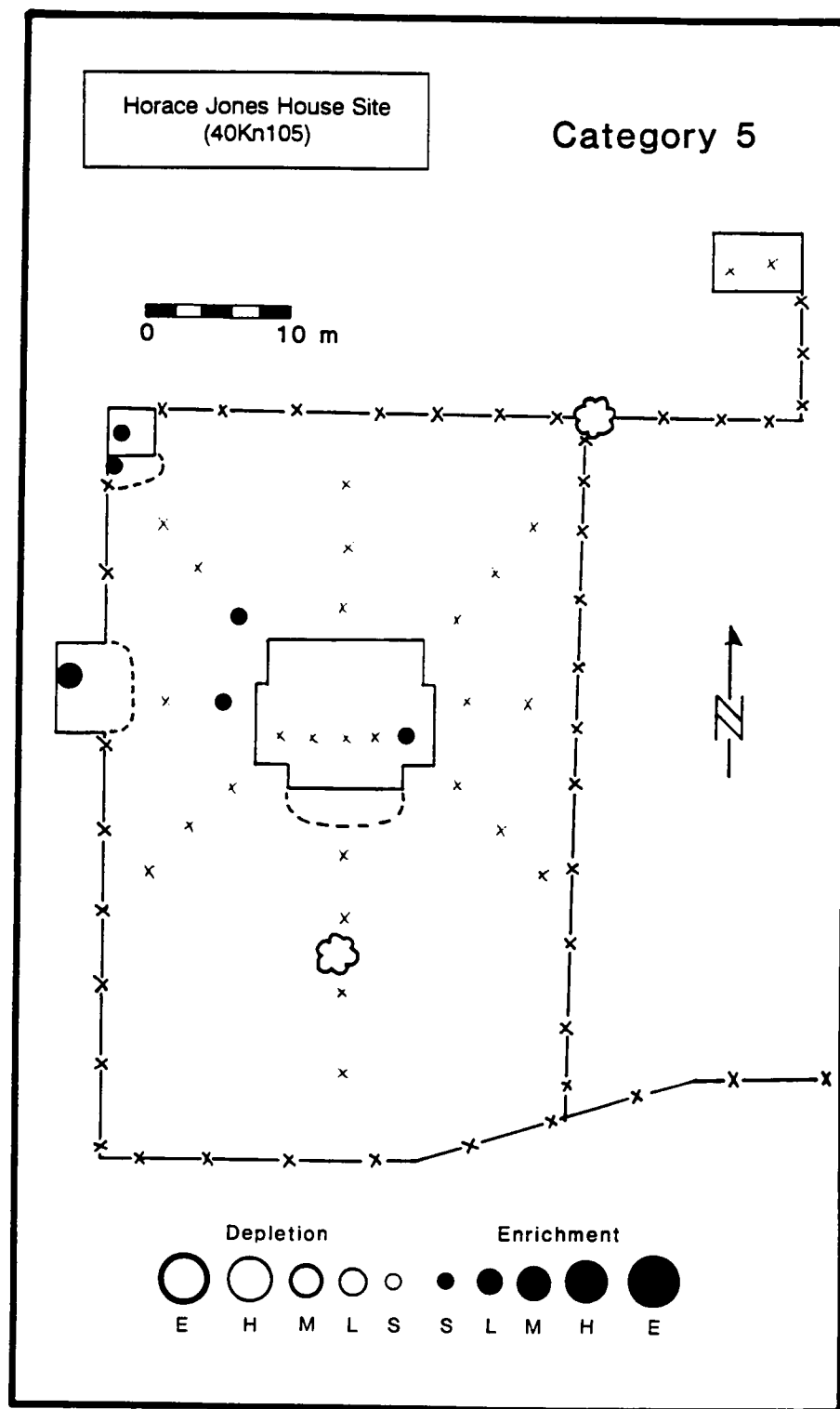


Figure 46. Chemical anomalies on the Horace Jones House Site (40KN105), Category 5.

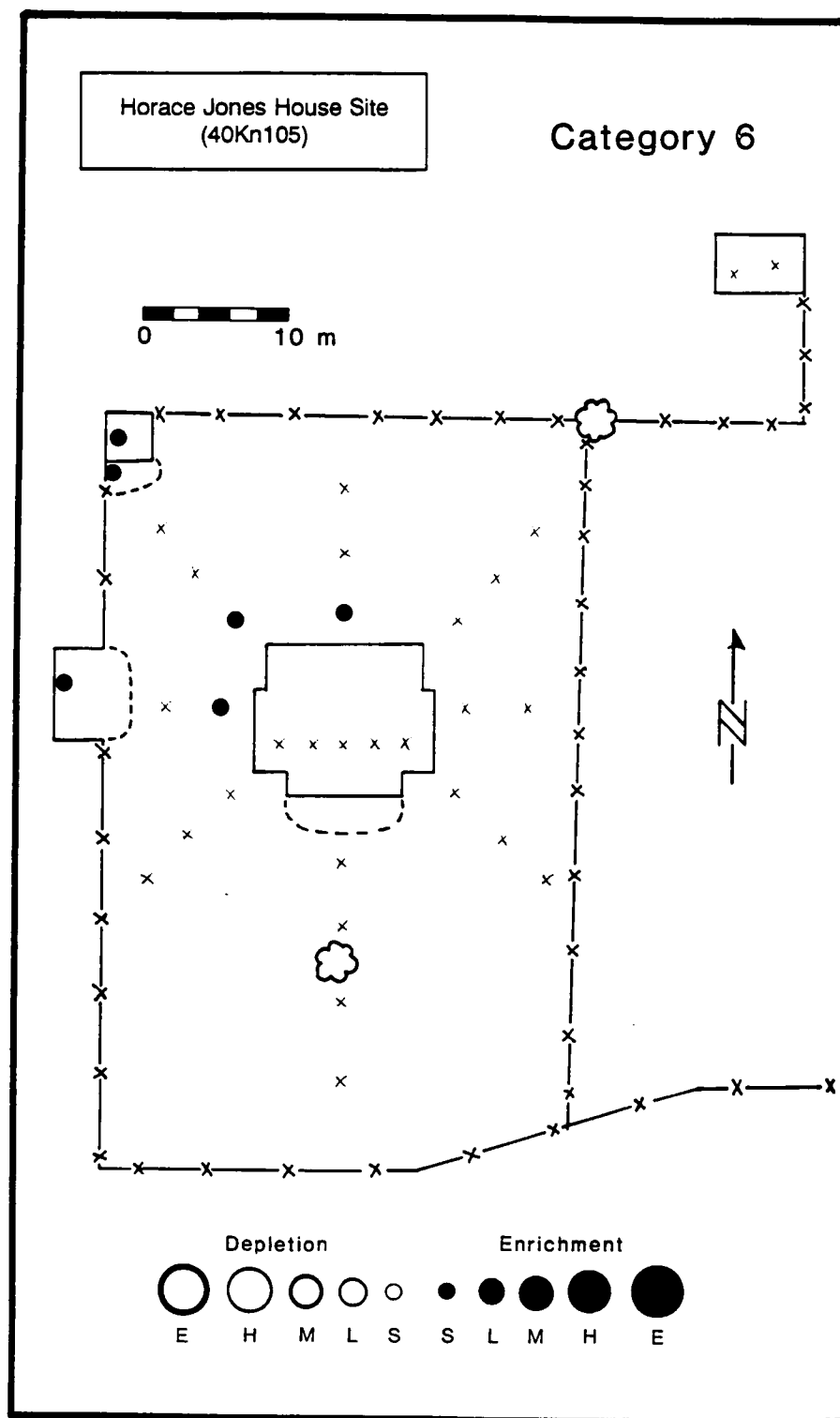


Figure 47. Chemical anomalies on the Horace Jones House Site (40KN105), Category 6.

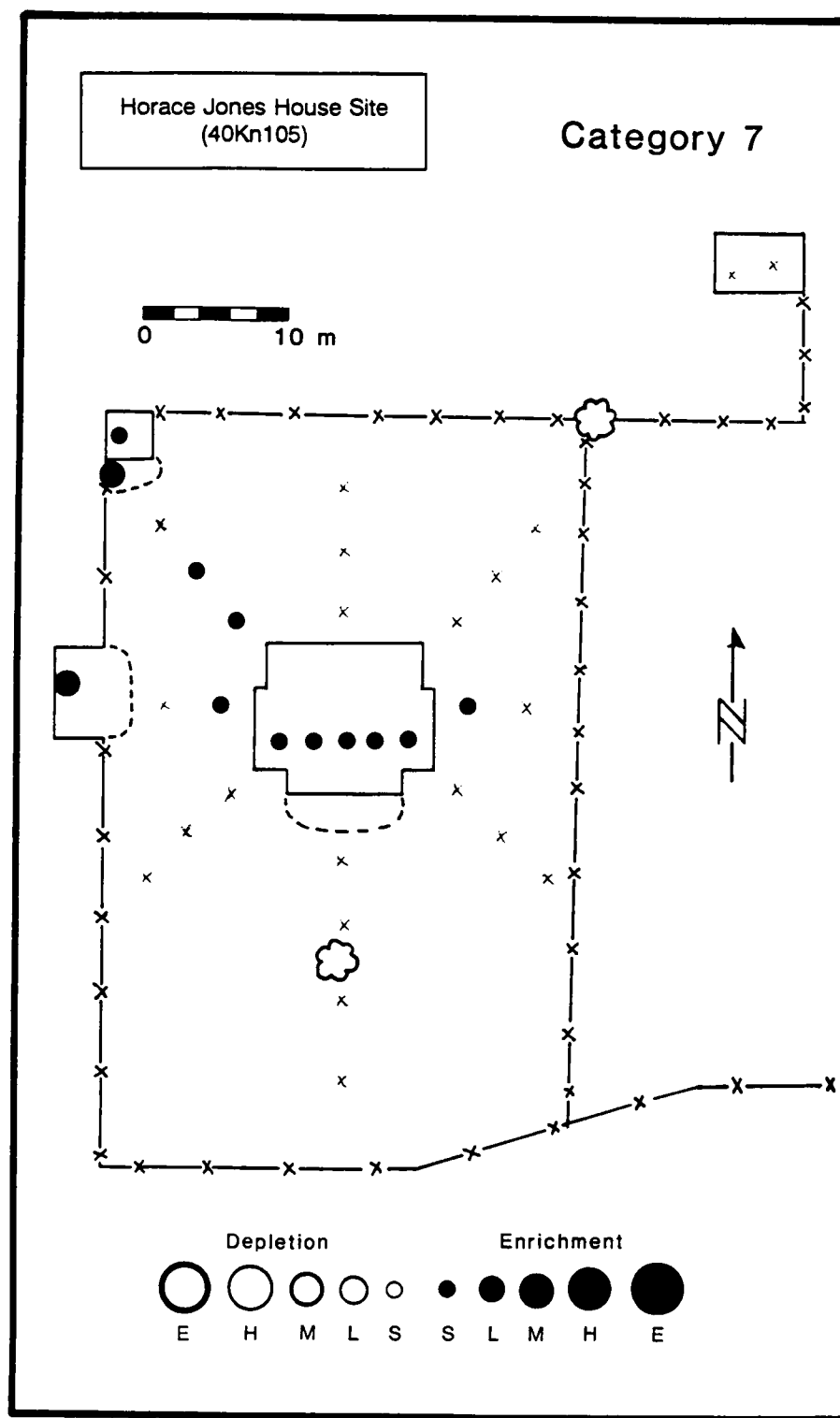


Figure 48. Chemical anomalies on the Horace Jones House Site (40KN105), Category 7.

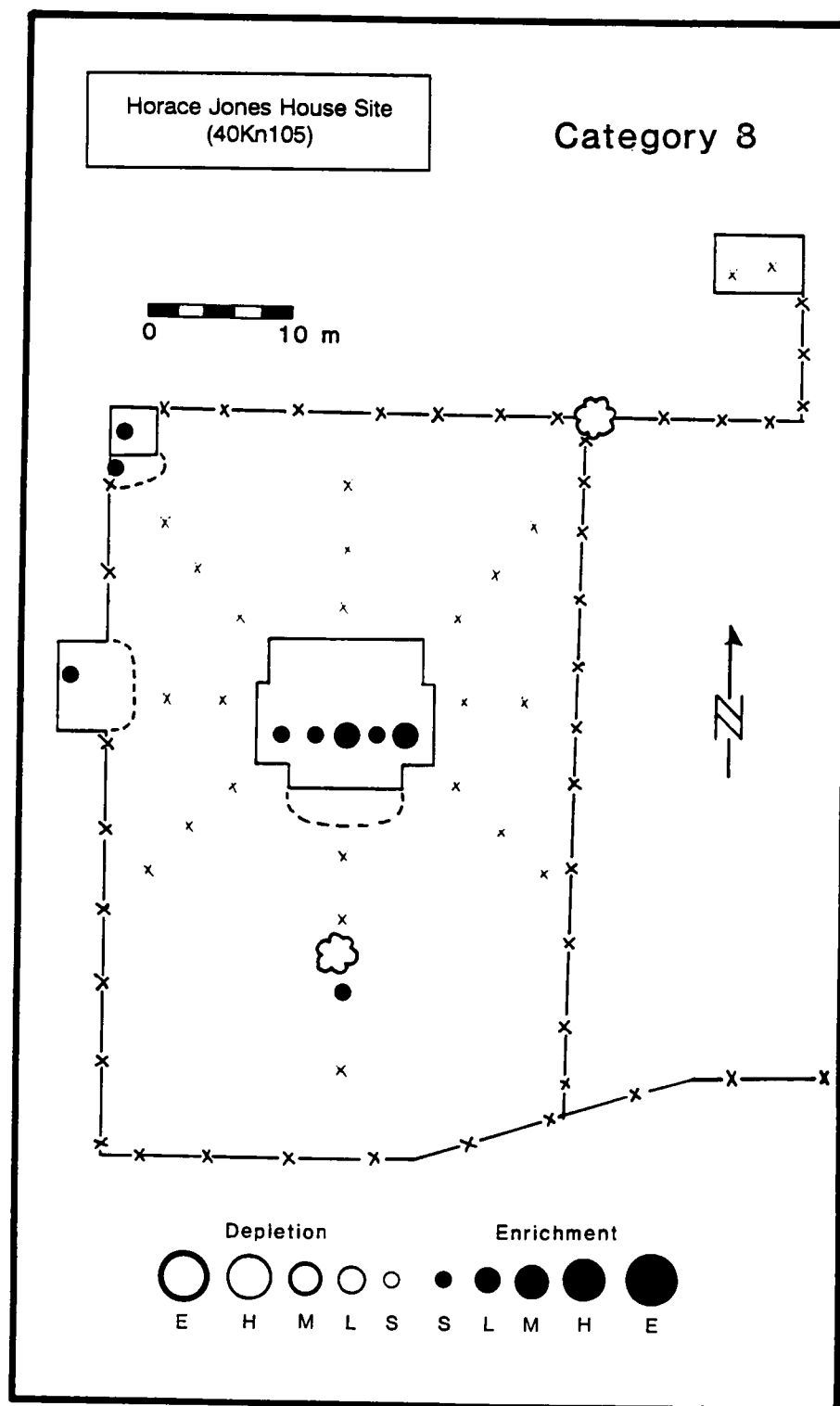


Figure 49. Chemical anomalies on the Horace Jones House Site (40KN105), Category 8.

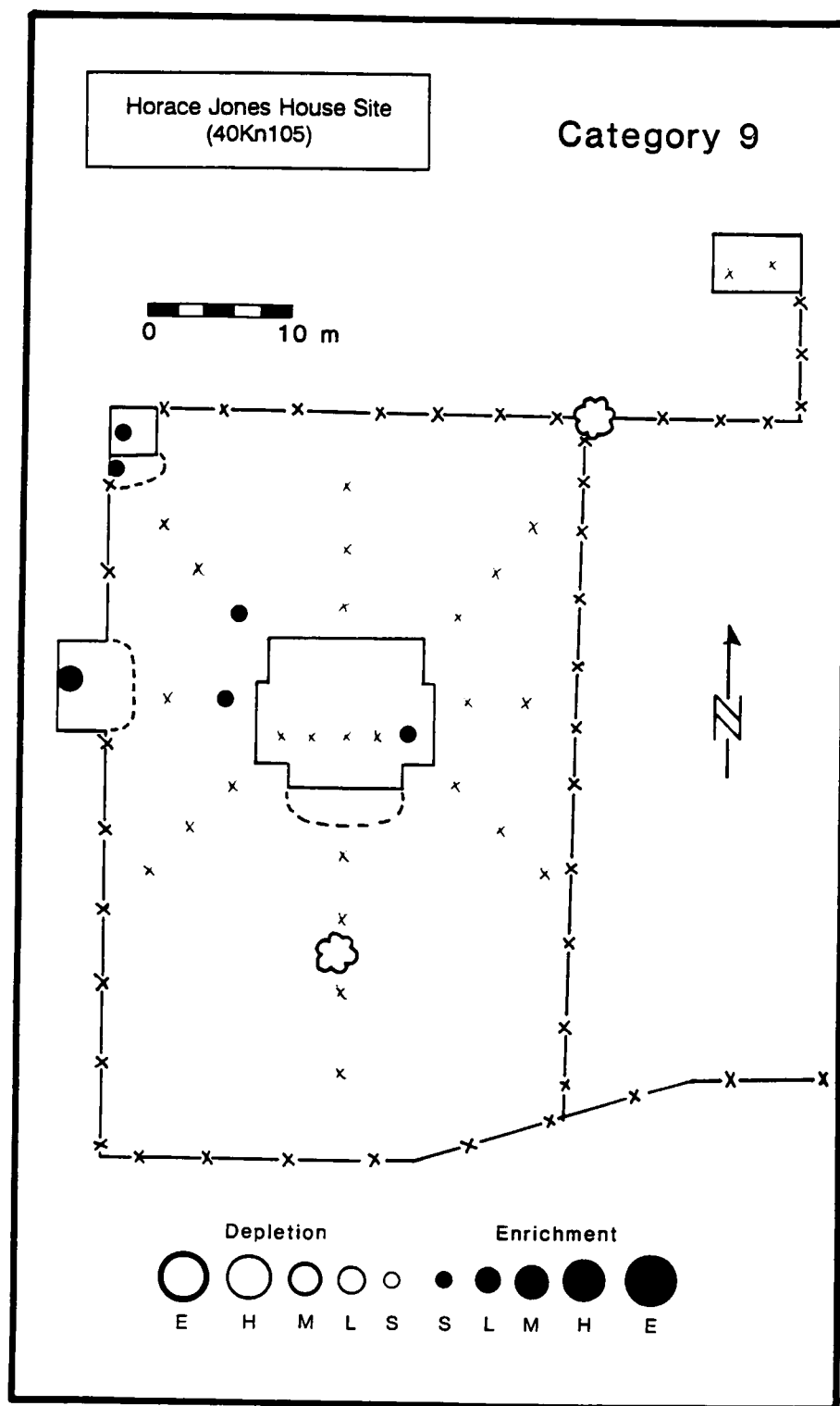


Figure 50. Chemical anomalies on the Horace Jones House Site (40KN105), Category 9.

in category 3 is the quite interesting. It is the only category that has enrichments immediately surrounding the building. No interpretation except for specialized inorganic material accumulation can be forwarded.

The John Jones House Site

The soil sampling strategy at the John Jones House site was to define the presumed dimensions of the structure, test the yard proxemics model, and ascertain any possible activity areas in the Active Yard (Figures 51 - 59). Enrichments in categories 3, 5, and 9 are generally high to extreme around the presumed center of the structure. This fact points to the deposition of a large amount of organic matter. This material has the effect of capturing and holding the elements from anthropic and airborne heavy metal deposition.

In reference to yard proxemics, there is a lack of deposition to the north and east of the structure. According to the local informant the house faced the east, toward the Tennessee River. Visitors approached mainly from the north (Wiley Neely, personal communication 1990). This would make the north and east the front yard. Deposition is consistently high to the south and especially the southwest around the remains of a cistern. During sampling it was apparent that cows actively grazed on the site. The deposition of cow waste around the partially filled in cistern may account for many of these high anthropic chemical

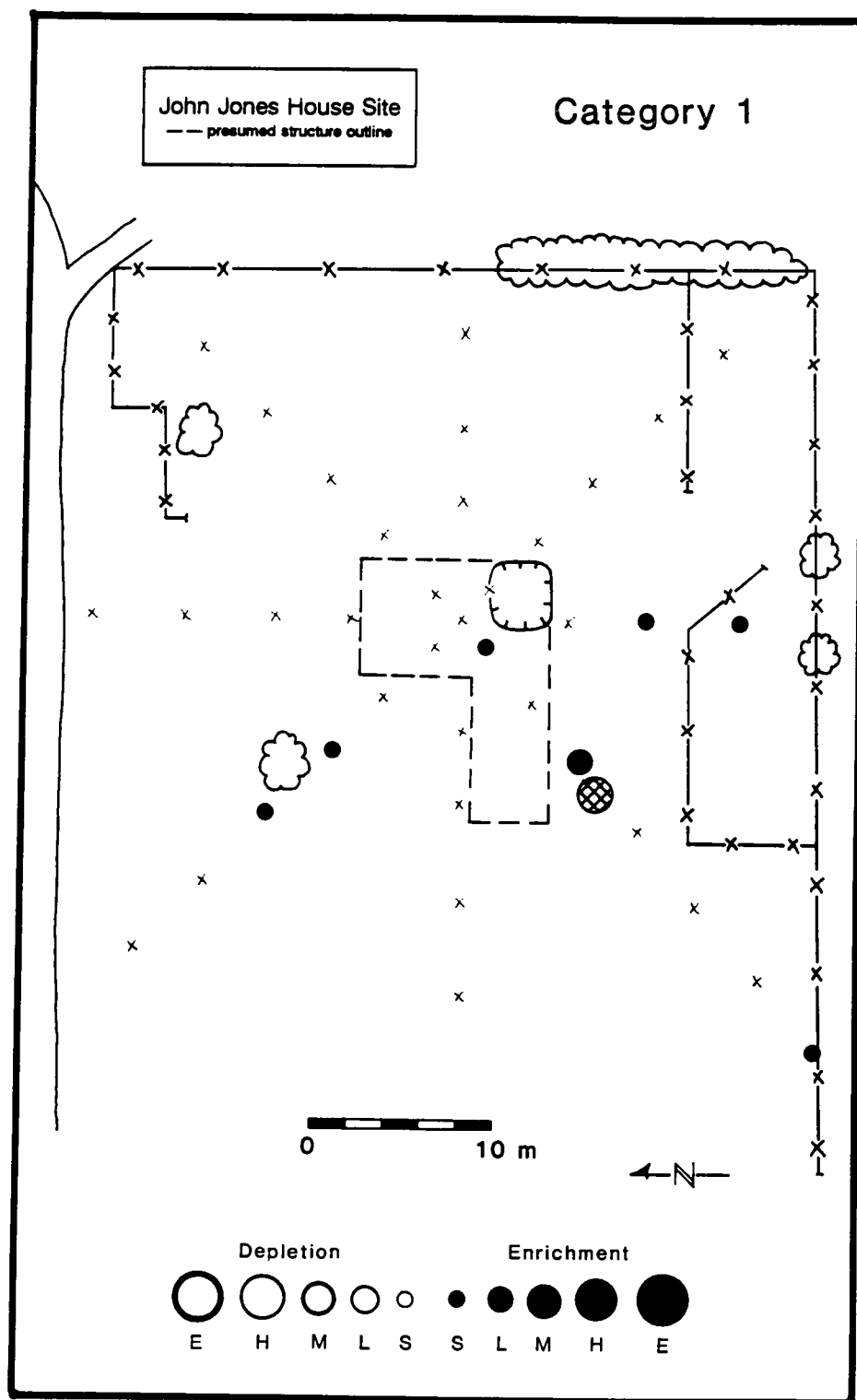


Figure 51. Chemical anomalies on the John Jones House Site, Category 1.

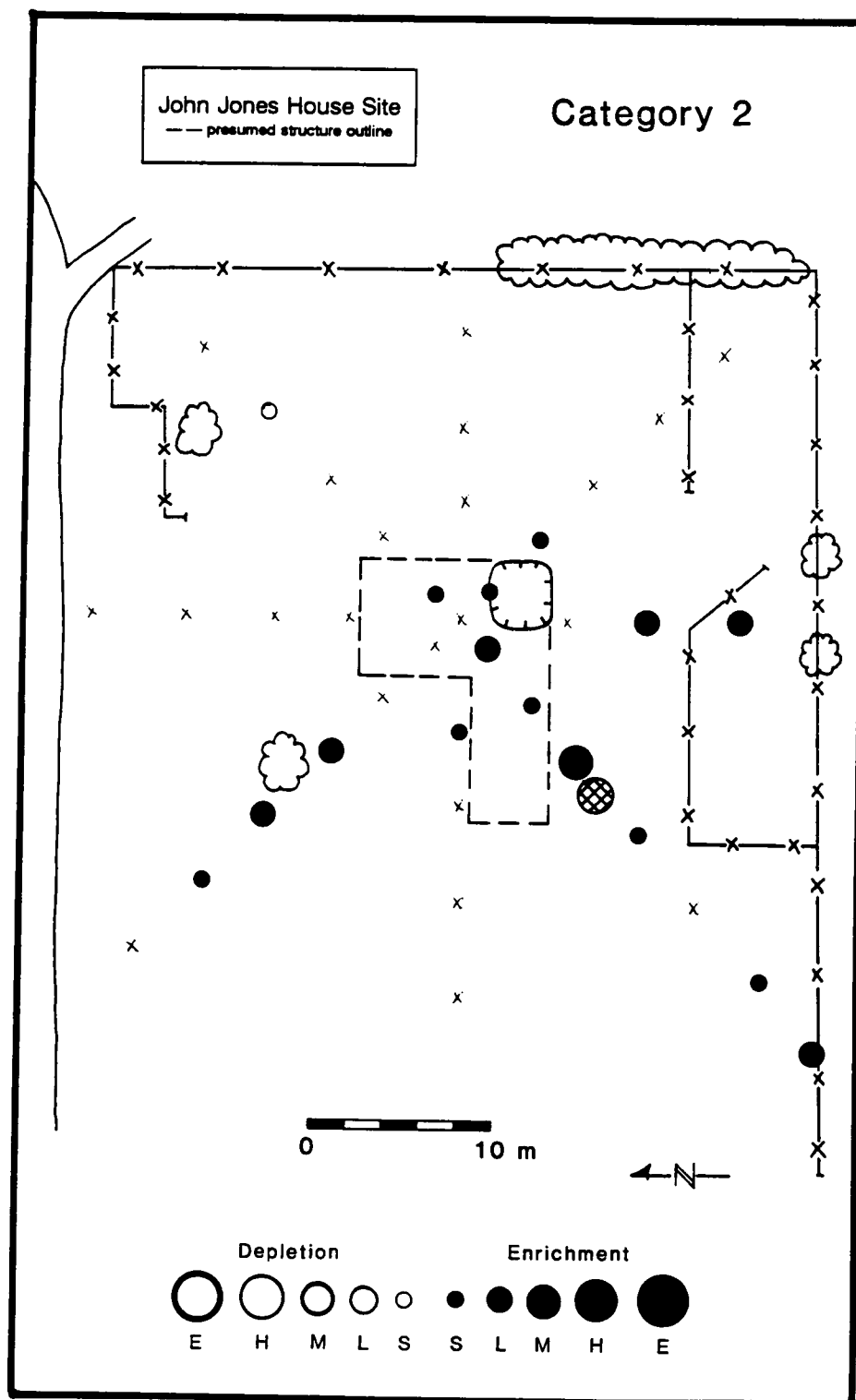


Figure 52. Chemical anomalies on the John Jones House Site, Category 2.

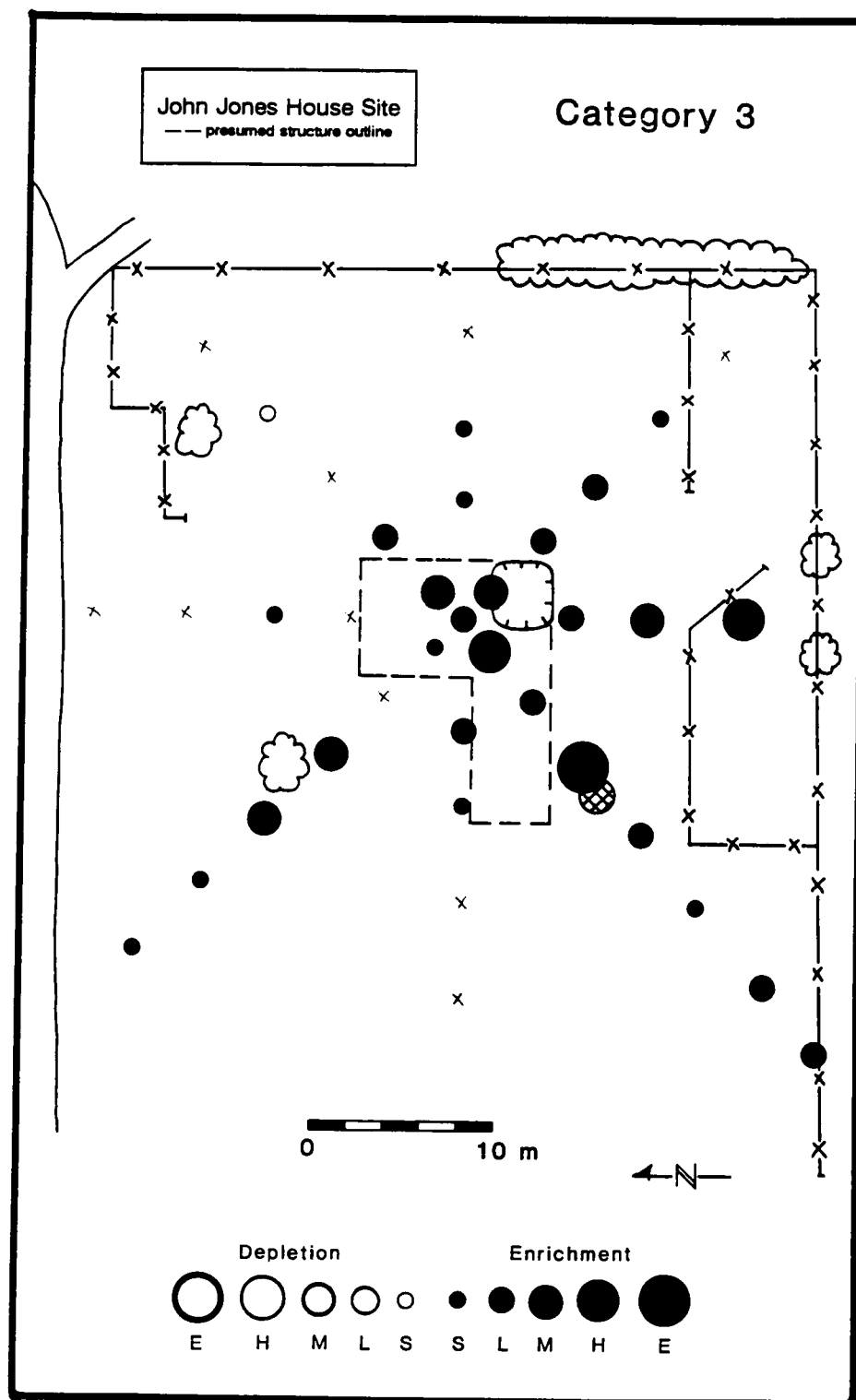


Figure 53. Chemical anomalies on the John Jones House Site, Category 3.

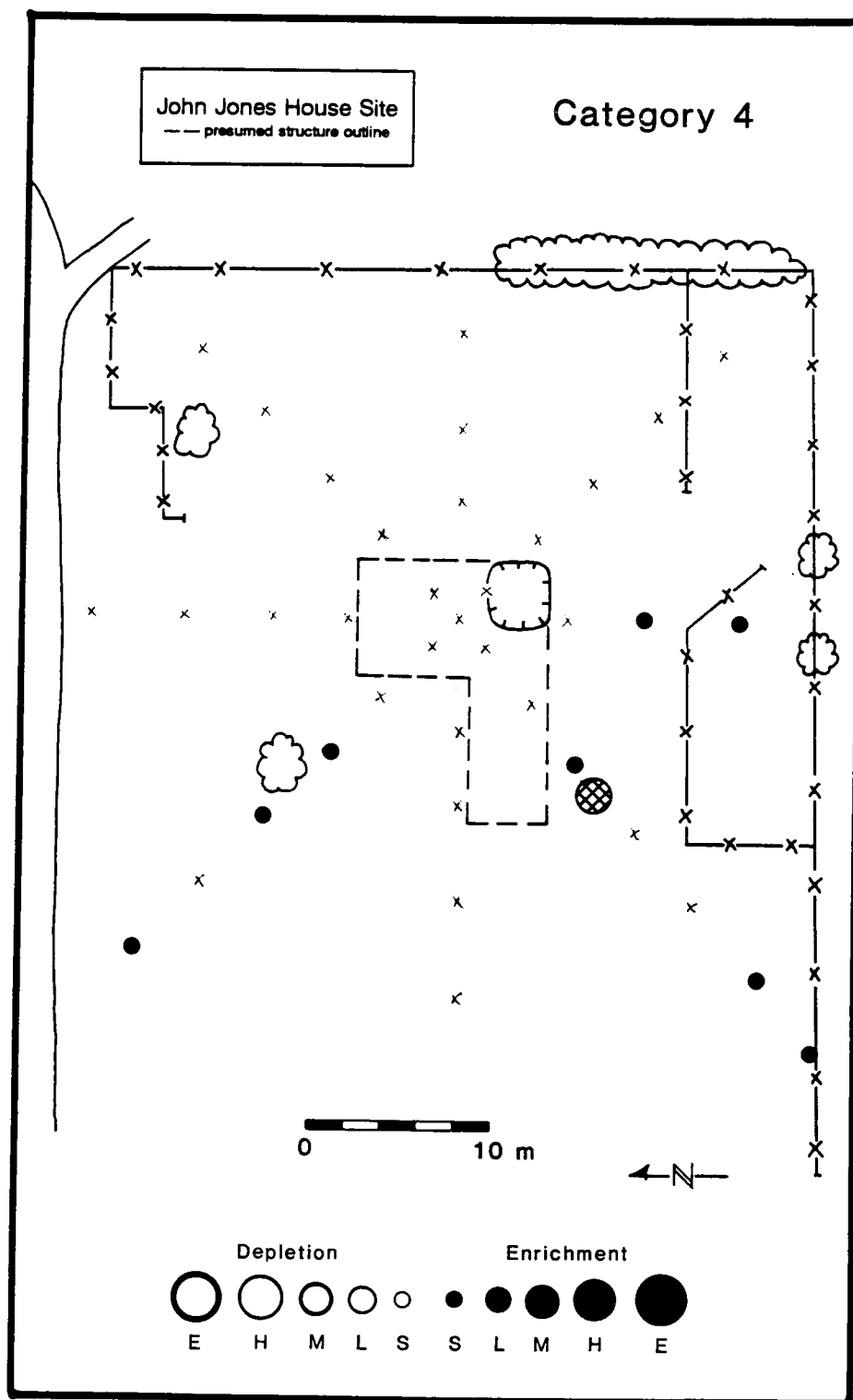


Figure 54. Chemical anomalies on the John Jones House Site, Category 4.

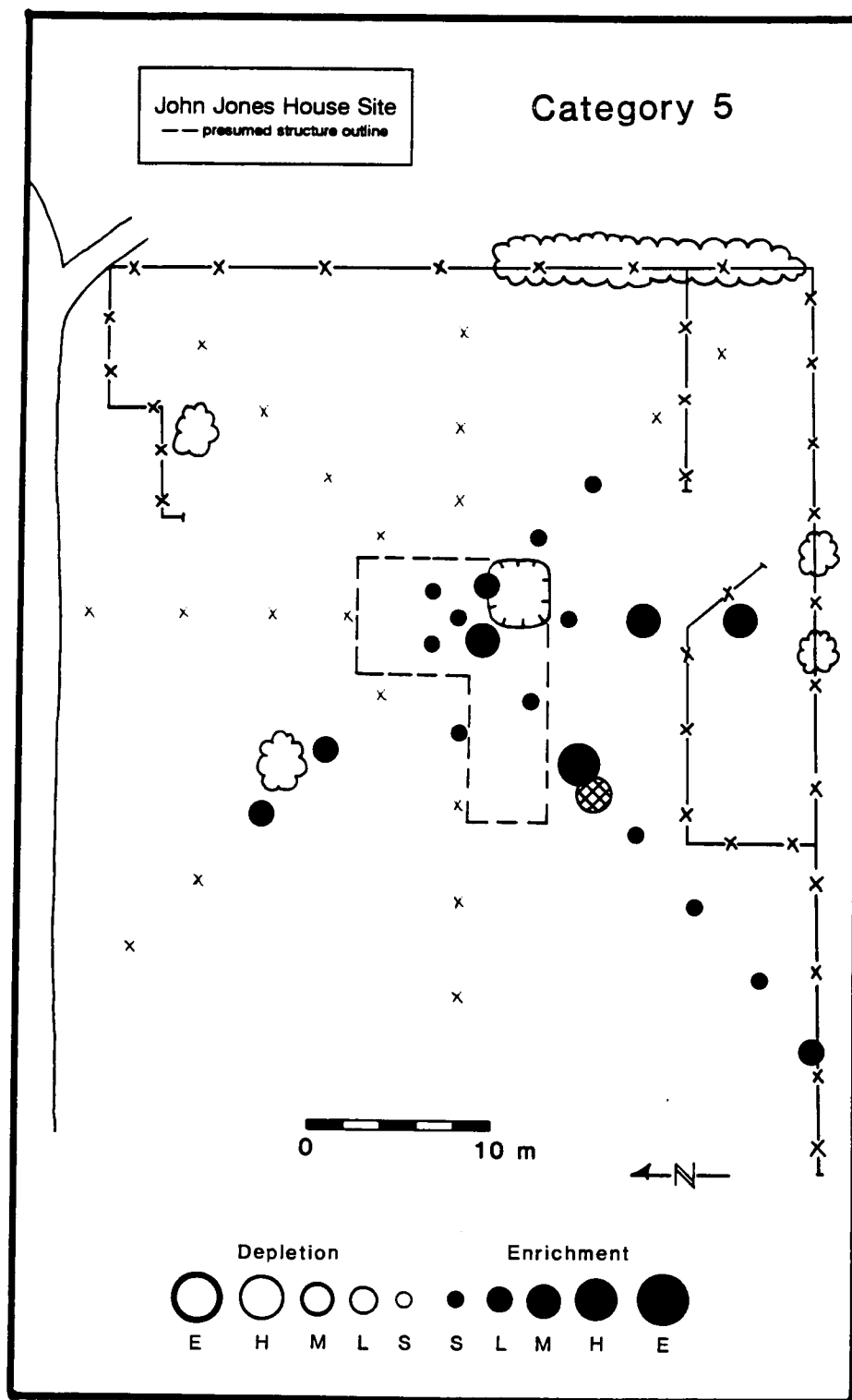


Figure 55. Chemical anomalies on the John Jones House Site, Category 5.

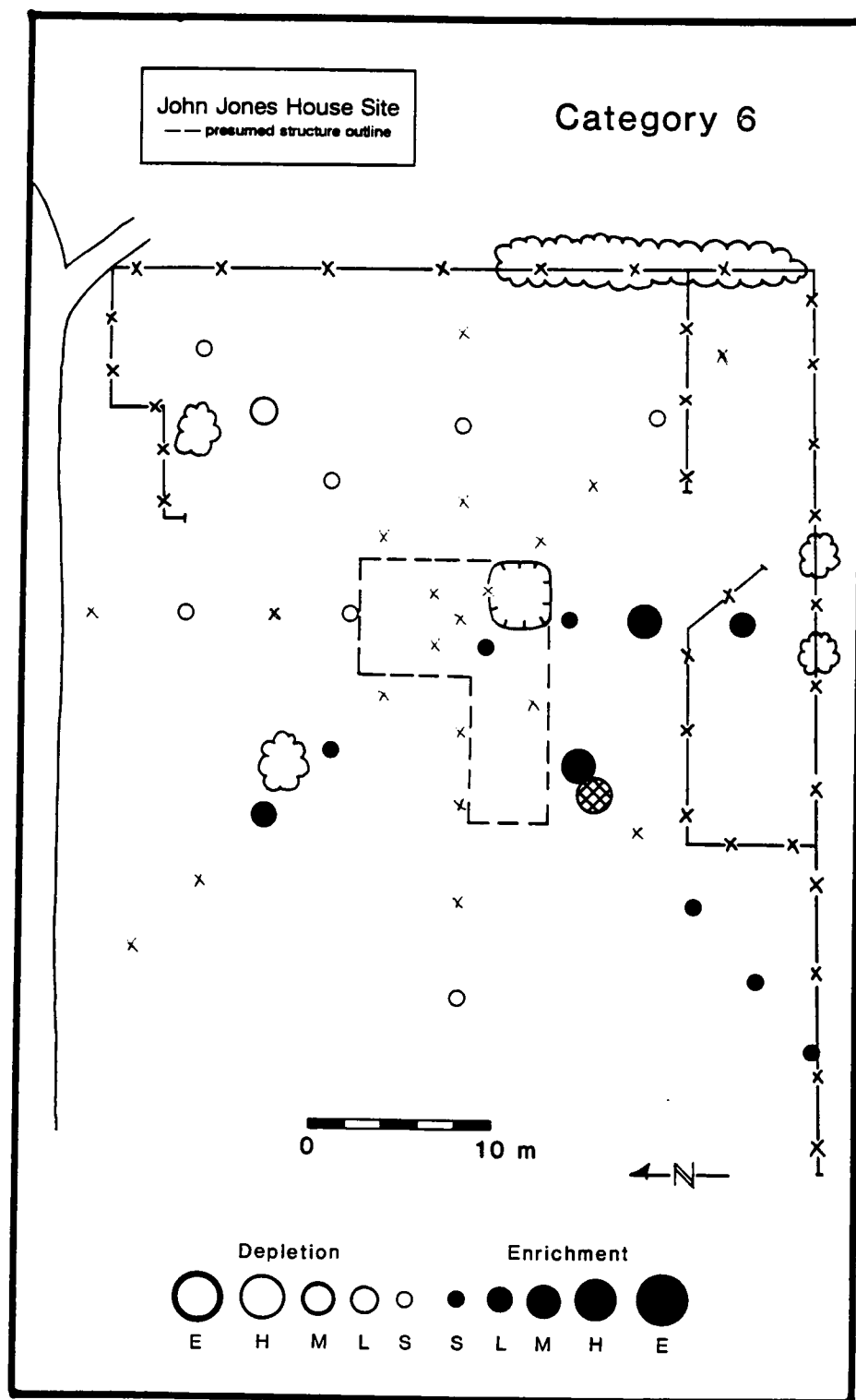


Figure 56. Chemical anomalies on the John Jones House Site, Category 6.

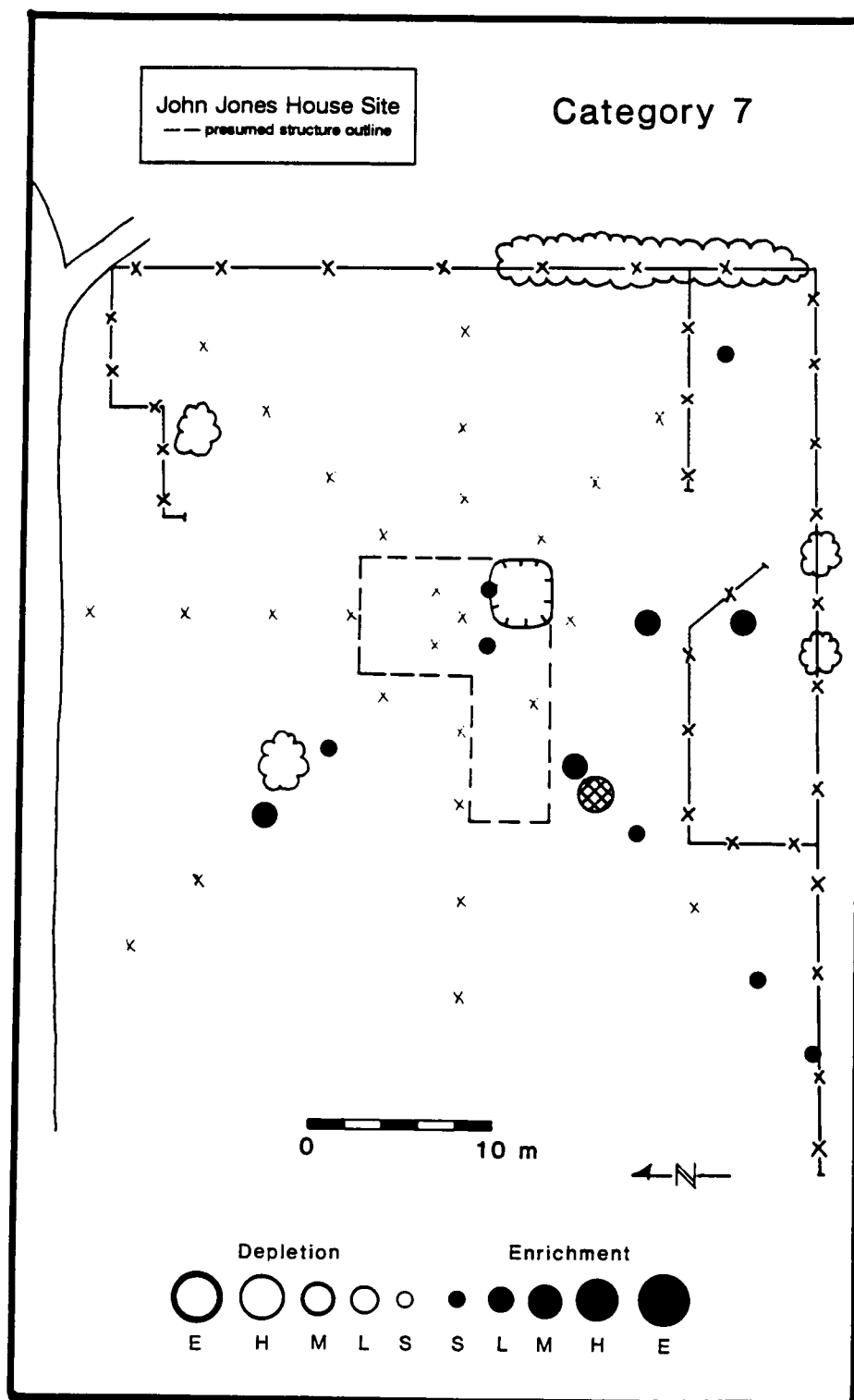


Figure 57. Chemical anomalies on the John Jones House Site, Category 7.

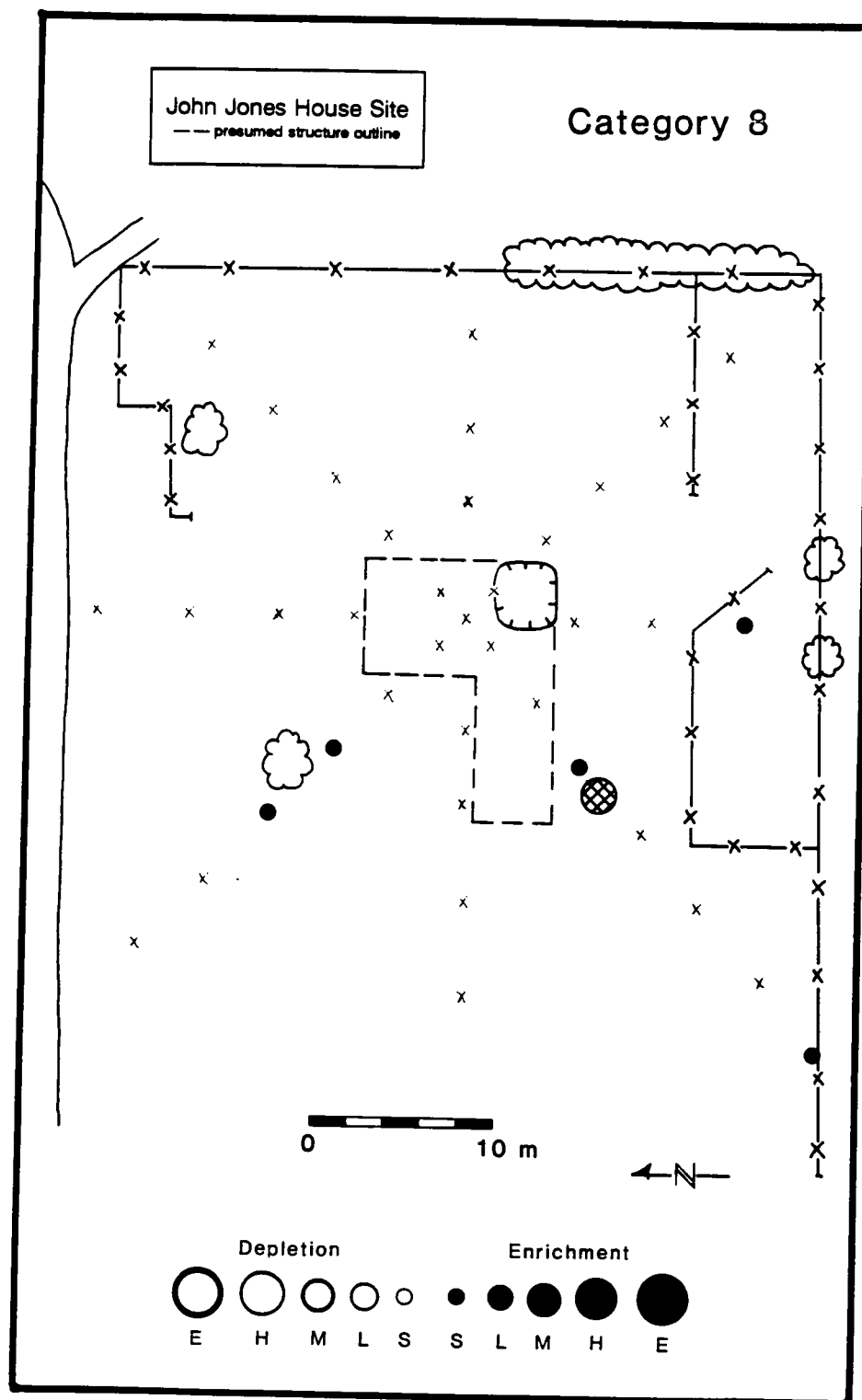


Figure 58. Chemical anomalies on the John Jones House Site, Category 8.

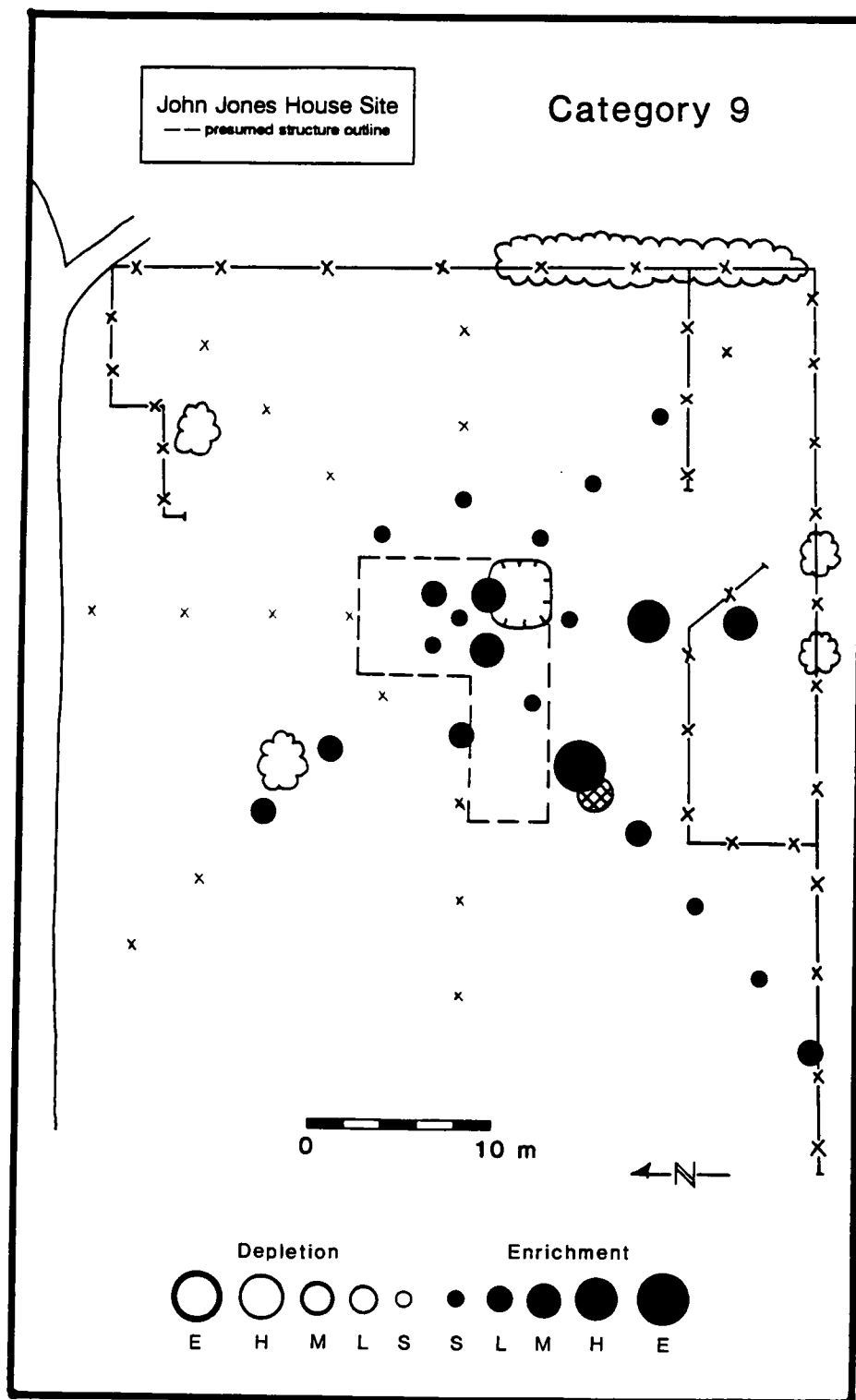


Figure 59. Chemical anomalies on the John Jones House Site, Category 9.

enrichments. This phenomenon would include enrichments to the northwest of the structure near a large tree as well. Cows would periodically rest under this tree.

Mr. Neely (personal communication 1990) indicated the possibility of a smokehouse to the southwest of the structure next to the fence. Although soil sample placement passed through this area, no consistent smokehouse chemical signature could be found.

The slight depletion in the elements in category 6 to the north and east of the structure is enigmatic. Intuitive reasoning points to the possibility that off-site soil samples were taken lower in the profile. Theoretically, this would sample soil with a heightened level of the elements silicon (Si), titanium (Ti) and vanadium (V). Therefore, the on-site soil which was sampled higher on the profile would show a statistical depletion.

CHAPTER V

CONCLUSION

This study was an attempt to document the usefulness of soil chemical analysis for activity area detection and identification on late nineteenth century and early twentieth century historic farmstead sites in the Upland South. Five historic house sites in Knox County, Tennessee were selected for study. These included the Mabry site (40KN86) in west Knoxville, and four sites in Toole Bend; the Oliver site (40KN103), the Bart Toole House site (no number), the Horace Jones House site (40KN105), and the John Jones House site (no number).

Using archaeological, historical, and ethnohistorical research on comparable sites in the Upland South, the possible structure and range of activities on these farmsteads were outlined. Five material groups were constructed to incorporate the accumulative or reductive effects of the activity range. These material groups were then further subdivided into "analytical" categories representing the specific additive or subtractive chemical portions of these groups. Consideration of the taphonomic processes that affect inorganic and organic materials and the specifics of the soils at each site helped to understand what should remain, chemically, for detection.

Twenty elements, assayed by an Inductive Coupled Plasma Optical Emission Spectrometer, pH, and total carbon were assigned to nine analytical categories according to presumed cumulative chemical effects of these activity portions. Average Z scores of chemical concentrations were determined for each category from the mean and standard deviation of off-site, control samples. These Z scores were then mapped as graduated circles proportional to the ordinal level magnitude of the anomaly. An anomaly could be either positive (enrichment) or negative (depletion). The spatially distinct co-occurrence of enrichment or depletion anomalies (especially high to extreme) in different categories pointed to the detection and identification of soil chemical signatures of past activities.

Research concentrated on defining building dimensions and function, locating and assessing areas of past activities, and testing a yard proxemics model developed by Moir (1987). Although the confirmation of the dimensions of the houses or cabins that were no longer standing at the Mabry, Oliver and John Jones House sites was adequate, the less specific identification of the interior versus the exterior of the structures worked out much better. The anomalies immediately to the north and west of Structure 2 at the Mabry site may signal the potential direction of building collapse or demolition. Speculation as to the function of the outbuildings at the Horace Jones House site as industrial

storage or multi-use was also forwarded.

Soil chemical anomalies were found on all these sites and were often spatially distinct. Soil chemical signatures could be determined and were directly related to specific areas of past activities. Standing structures with limited access under their foundations at the Bart Toole House and Horace Jones House sites showed a very distinctive chemical signature. They met expectations for sodium (Na) and potassium (K) enrichments from nitreous earth. Unfortunately, evidence of their shielding of the soil from airborne heavy metal deposition was not conclusive. The co-occurrence of categories 2, 4, 5, and 8 pointed to the possibility of a smokehouse south of Structure 1 on the Mabry Site and north of the presumed building location on the Oliver site. In addition, one or many agricultural/industrial buildings were postulated west of the cabins at the Mabry site. They may represent barns or animal/plant storage areas. Areas of generalized sheet midden deposition were found at many of the sites.

The yard proxemics model derived from Moir's (1987) work on free tenant farmers in the Upland South holds up fairly well on these sites, including Mabry, a slave plantation site. On all sites but one, the Immediate Active Yard was fairly "clean" of soil chemical anomalies--at least in the front yard. Anomalies that were present were either slight or low enrichments. One exception was at the Oliver site,

where a large amount of material accumulated in the front of the house. It is unclear whether this accumulation was during occupation or associated with the post-site destruction of the structure.

Confirmation of the proxemics model in the back yard was more mixed. High soil enrichment anomalies were present in the Immediate Active Yard in the back of the Bart Toole House site. A generalized sheet midden is postulated as responsible for this. In addition, the John Jones House site displayed high soil enrichment anomalies next to a partially filled cistern and a shade tree. Given that evidence of cattle activity was noticed during sampling, it is surmized that they are responsible for these anomalies. Despite the less than complete confirmation of Moir's (1987) proxemics model, it appears that the spatial arrangement of activities is similar within these house sites. Researchers believe that this arrangement was fairly consistent across farmsteads in the Upland South during this time (Adams 1990; Glassie 1968, 1975).

The application of soil chemical analysis on these archaeological sites produced two important tangible results. First, it pointed to possible areas of human activity not found during formal archaeological investigations. For example, evidence points to the possibility of a smokehouse on the Mabry site and a smokehouse/industrial storage shed on the Oliver site. It is unfortunate that these results came

too late in the research process. Perhaps these areas could have been more fully investigated before destruction of the sites. It is hopeful that results from soil chemical analysis can be incorporated into other archaeological work sooner in the process to guide excavation strategies.

Second, soil chemical results helped fill out interpretations hinted at by archaeological excavations or ethnographic recollections. For example, archaeological evidence of potential buildings were discovered on the west side of Structure 2 at the Mabry site. Soil chemistry pointed to the identification of these buildings as agricultural/industrial structures. A similar situation occurred at the Oliver site where Mr. Neely recalled the presence of an outbuilding in the 1910s but could not remember its location or function (personal communication 1990). Soil chemical results pointed to a possible smokehouse/storage shed to the north of the house. On the other hand, outbuildings recalled by Mr. Neely on the Bart Toole and John Jones sites were not identified by soil chemistry. Perhaps the sampling strategy missed these locations entirely.

Looking at the larger picture, soil chemical analysis can be applied to any archaeological site. It is an expedient, virtually non-invasive field technique. Furthermore, it can be a valid, consistent complement to traditional object-orientated methods of activity area

analysis. For example, it can establish patterns of material deposition patterning and building location and function for archaeological excavations to investigate. In addition, soil chemical analysis may be the only way to approach the full range of activities possible on archaeological sites. Since they affect the soil differently, both reductive and accumulative activities can be addressed. Soil chemical analysis can deal with the primary loss or discard of material especially organics. Therefore, its data set is less likely to be drastically altered by cultural formation processes. For example, a visually clean yard may still have remnants of chemical deposits that can be detected. Soil chemical analysis can also possibly identify the location of buildings that have been moved or torn down, especially buildings that housed activities dealing with non-durable organics, like smokehouses.

Future work in soil chemical analysis should concentrate on testing these results on comparable historic sites not only in the Upland South but in eastern North America in general. Are there separate proxemics models for other historic site types such as urban houselots? Are the soil chemical signatures accurate for specific known activities? Perhaps soil under standing or recently removed smokehouses can be chemically studied to accumulate a database of possible signatures.

It is important to note that this approach based upon Z

score anomalies grouped into analytical categories can be applied to any archaeological site, including prehistoric sites. However, if this is attempted the cultural variables that affect interpretation such as site structure and material culture must be addressed with the utmost care. In addition, regardless of the site type, the sensitivity of the analytical categories should be refined as the chemical constituents of archaeologically relevant materials are more closely assessed. The use of more sophisticated statistical analyses, such as Cluster and Factor Analysis, may help in the discovery of additional or even different analytical categories from which to interpret the chemical remains of past activities at archaeological sites.

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APPENDIX A

Mabry Site (40KN86) chemical raw results.

NORTH	WEST	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
1010	930	999.75	1.44	1.92	112.64	0.38	2292.63	0.50	3.09	0.48	8.23	1062.32	429.31	211.27	312.72
1002	930	1128.84	1.60	4.30	179.37	0.40	3964.54	0.31	4.84	0.50	13.25	525.84	514.74	262.33	512.39
994	930	863.85	1.34	1.57	83.66	0.30	1912.02	0.17	2.85	0.31	5.13	366.03	417.60	184.75	263.76
1002	932	1094.25	1.85	5.61	170.85	0.40	5518.61	0.33	6.48	0.57	9.07	554.98	506.60	322.84	677.43
1002	934	1192.30	1.88	4.98	131.53	0.43	4890.33	0.40	5.50	0.57	8.08	925.35	480.15	272.17	603.34
1002	936	1078.43	1.61	2.79	112.03	0.43	2854.48	0.28	2.94	0.44	7.01	645.75	409.17	214.59	350.87
1010	938	1068.28	1.26	1.68	97.06	0.39	2047.45	0.32	2.21	0.42	7.93	629.71	314.39	172.78	244.15
1008	938	1074.77	1.25	1.77	117.06	0.36	2395.18	0.25	2.62	0.40	6.66	687.05	274.33	163.41	291.63
1006	938	1118.11	1.30	3.60	147.71	0.34	3668.53	0.19	3.65	0.51	6.33	472.28	378.59	178.96	467.93
1004	938	1247.36	1.68	4.83	173.51	0.43	4650.76	0.24	3.47	0.61	7.46	659.00	449.27	168.92	543.70
1002	938	1159.52	1.47	2.94	144.08	0.44	3017.28	0.22	2.50	0.43	6.12	531.73	436.39	205.00	329.47
1000	938	1073.19	1.44	2.41	114.42	0.39	2767.46	0.26	2.77	0.45	6.34	525.93	405.44	195.22	324.84
998	938	972.16	1.53	2.43	107.05	0.33	3845.73	0.25	2.81	0.40	6.27	572.71	420.65	210.12	263.55
996	938	929.54	1.34	2.52	103.89	0.32	2925.55	0.23	2.45	0.41	6.24	639.70	522.85	224.10	251.88
994	938	852.62	1.34	2.10	86.78	0.30	2213.06	0.18	2.37	0.28	4.80	312.36	403.10	182.92	225.72
992	938	849.04	1.26	2.08	80.54	0.29	2228.53	0.20	3.21	0.30	4.90	422.61	384.55	203.75	262.90
990	938	827.31	0.92	1.68	67.12	0.28	2017.97	0.15	2.36	0.25	4.25	501.28	373.37	186.54	199.49
986	938	843.19	0.83	1.40	58.01	0.25	1809.95	0.11	3.08	0.21	38.53	321.66	293.27	186.70	174.57
982	938	870.32	0.92	2.33	63.26	0.25	2734.94	0.20	3.08	0.30	4.62	612.52	532.67	311.61	200.08
1002	940	1260.99	1.22	3.46	129.21	0.38	3594.70	0.30	3.00	0.42	7.56	545.42	400.87	218.40	376.01
1000	942	1166.50	1.35	6.12	164.20	0.41	5504.55	0.27	4.93	0.47	11.01	437.67	578.86	263.93	591.40
1010	944	1019.63	0.93	1.47	81.37	0.35	1706.48	0.15	1.79	0.40	5.51	439.98	347.66	171.38	218.09
1008	944	1116.52	0.96	1.62	101.41	0.37	2078.28	0.21	1.86	0.41	6.54	603.11	361.33	178.84	230.59
1006	944	1075.96	1.20	2.76	133.62	0.39	3201.91	0.21	2.80	0.44	7.80	572.05	353.89	232.63	380.97
1004	944	1103.78	1.59	6.67	140.49	0.37	6759.31	0.44	6.10	0.68	61.16	1463.47	340.55	258.00	765.63
1002	944	1187.12	1.70	4.87	135.61	0.42	5547.00	0.31	5.52	0.57	9.54	364.31	366.77	472.01	608.59
1000	944	1441.91	2.21	6.91	226.06	0.51	6111.42	0.32	5.01	0.81	11.44	559.62	531.12	340.36	806.41
998	944	1041.15	1.86	3.64	140.50	0.41	3748.85	0.30	3.65	0.56	9.20	798.10	518.92	245.12	422.51
996	944	970.45	1.81	2.58	110.58	0.37	2941.01	0.23	2.65	0.42	6.27	439.78	353.42	182.15	306.49
994	944	979.05	1.62	2.09	106.34	0.37	2496.25	0.21	2.82	0.43	6.14	407.87	381.44	185.15	316.12
992	944	1007.89	1.50	1.96	105.84	0.39	2528.16	0.22	3.38	0.43	5.10	516.53	355.18	180.18	386.62
990	944	976.98	1.76	2.28	101.29	0.41	2521.99	0.26	4.55	0.57	5.08	531.55	377.27	202.43	490.04
986	944	986.19	1.75	1.92	95.85	0.40	2201.61	0.23	4.80	0.50	5.05	447.66	267.67	199.64	474.70
982	944	1010.26	1.68	1.63	87.07	0.39	1865.34	0.23	3.67	0.48	3.83	421.91	276.51	180.73	368.59
1010	947	1139.48	1.57	1.92	77.81	0.38	1976.28	0.28	4.05	0.65	6.11	591.61	326.14	193.59	494.75
1008	947	1095.53	1.68	1.65	86.37	0.37	1680.46	0.29	3.37	0.65	8.49	750.15	258.29	172.53	450.42
1006	947	1131.43	1.73	2.13	104.28	0.40	2061.58	0.30	3.62	0.64	7.97	721.72	331.93	197.13	477.10
1004	947	1192.21	1.86	4.66	139.16	0.42	4594.54	0.35	5.53	0.72	11.87	422.63	355.53	229.76	726.80
1002	947	1182.96	2.22	3.39	139.97	0.49	3619.28	0.27	6.99	0.82	6.06	562.14	472.03	202.37	909.64
1000	947	1194.79	2.00	3.22	140.04	0.43	3545.42	0.23	6.37	0.78	8.06	520.46	444.78	219.73	754.87
998	947	1147.63	1.90	2.39	134.38	0.40	2419.28	0.22	3.29	0.61	15.27	503.90	396.34	160.16	393.34
996	947	1023.31	1.91	2.12	100.89	0.39	2532.98	0.28	3.20	0.60	7.14	699.26	318.02	175.88	394.09
994	947	987.85	1.72	2.15	99.24	0.38	2596.46	0.24	3.49	0.56	6.06	488.27	361.36	174.87	398.33
992	947	1097.83	1.93	2.41	117.03	0.44	2926.17	0.30	4.24	0.62	6.14	625.25	380.98	213.75	537.86
990	947	1156.12	1.86	2.02	111.95	0.47	2381.35	0.31	4.19	0.56	5.87	609.65	310.78	187.93	588.86
986	947	1082.20	1.68	1.51	97.41	0.42	1491.62	0.23	3.28	0.46	4.28	392.06	239.78	138.73	394.12
982	947	1074.16	1.83	1.33	93.49	0.42	1485.65	0.24	3.15	0.47	3.97	438.07	230.26	175.88	372.88
1002	948	1194.23	1.68	3.36	128.49	0.41	3128.46	0.26	5.90	0.65	5.93	374.83	452.19	218.68	720.51
1000	948	1294.58	1.82	3.43	150.16	0.45	3360.24	0.33	5.41	0.70	8.43	558.28	406.15	202.74	707.27
1002	950	1214.41	1.88	2.14	108.55	0.49	1924.87	0.29	3.58	0.53	5.29	478.89	416.42	184.72	560.15
1002	952	1211.07	1.68	2.24	96.18	0.42	2346.56	0.33	4.55	0.66	6.45	946.84	391.18	209.47	612.97
1010	954	1738.95	1.69	1.93	82.17	0.43	2034.00	0.41	3.27	0.77	7.22	809.07	339.64	190.59	400.66
1008	954	1262.36	1.89	2.07	94.19	0.42	2164.14	0.39	3.99	0.67	7.20	806.83	368.65	198.45	517.05
1006	954	1254.64	2.07	1.90	99.04	0.44	2202.74	0.36	4.13	0.69	6.93	831.44	375.32	202.40	540.11
1004	954	1053.57	1.53	1.40	66.29	0.31	1449.64	0.25	2.70	0.47	4.43	357.70	335.80	150.63	252.86
1002	954	877.71	1.17	0.94	41.20	0.21	1205.60	0.22	2.74	0.44	3.75	427.44	382.32	152.04	135.35
1000	954	1022.55	1.69	1.84	87.42	0.38	1909.73	0.24	2.23	0.50	7.19	283.94	404.91	175.68	244.01
998	954	1054.61	1.80	2.57	108.20	0.41	2695.75	0.30	3.27	0.57	7.08	534.46	415.82	209.95	435.08
996	954	1021.87	1.78	2.26	108.33	0.40	2630.20	0.31	3.00	0.65	7.32	551.27	453.62	194.60	402.50
994	954	1050.44	1.93	2.55	107.12	0.41	3082.10	0.35	4.13	0.58	7.58	630.09	411.02	217.14	537.99
992	954	1057.47	1.69	2.64	118.95	0.42	2962.50	0.29	3.62	0.53	5.26	623.54	483.97	218.15	497.48
990	954	1163.69	2.17	2.18	128.91	0.46	2648.62	0.30	3.73	0.62	5.78	566.96	393.94	201.34	543.94
986	954	1175.30	1.96	1.48	132.39	0.53	1560.82	0.23	2.02	0.56	4.89	429.25	493.83	152.17	315.26
982	954	1279.29	1.98	1.83	101.62	0.46	1847.48	0.35	4.16	0.81	6.48	772.75	386.86	190.08	617.48
1002	956	981.20	1.27	1.35	70.98	0.33	1482.03	0.24	1.72	0.40	5.33	326.98	269.12	132.61	185.40
1002	958	1043.38	1.76	3.40	96.71	0.37	3527.97	0.36	3.34	0.52	7.52	435.50	535.64	212.10	433.11

Mabry Site (40KN86) chemical raw results. (continued)

NORTH	WEST	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
1002	960	1115.73	1.61	2.75	109.75	0.40	2722.50	0.34	2.80	0.55	7.59	412.37	394.30	157.47	393.58
1010	962	1180.59	1.81	3.61	97.86	0.39	4042.16	0.40	4.76	0.67	7.01	582.04	380.78	164.92	686.27
1008	962	1155.67	1.94	3.86	107.42	0.41	3695.50	0.41	4.75	0.70	8.54	783.49	408.05	172.26	660.53
1006	962	1255.70	2.03	4.06	130.47	0.44	4213.93	0.43	7.22	0.85	7.39	881.25	371.13	157.09	1157.62
1004	962	1352.19	2.01	7.04	190.44	0.47	6548.96	0.39	6.69	0.85	11.36	475.42	350.62	180.13	1368.15
1002	962	1350.06	1.44	4.78	185.79	0.46	5134.59	0.26	5.31	0.67	7.37	468.90	423.52	175.82	1063.67
1000	962	1206.23	1.35	2.55	128.92	0.44	3028.68	0.24	3.35	0.45	10.89	467.59	416.61	153.76	524.52
998	962	1101.97	1.43	2.28	108.46	0.39	2820.97	0.23	3.67	0.38	5.88	456.88	372.70	146.48	551.04
996	962	1101.31	1.35	1.92	92.57	0.40	1998.14	0.19	3.42	0.38	5.09	305.58	448.40	164.82	482.89
994	962	1156.96	1.36	2.22	99.07	0.43	2255.97	0.27	4.06	0.48	5.74	598.63	438.57	213.32	602.81
992	962	1106.46	1.23	1.69	92.22	0.41	1825.95	0.18	2.73	0.35	4.45	307.43	373.24	164.50	416.09
990	962	1188.60	1.34	1.55	94.64	0.43	1656.50	0.17	2.75	0.34	4.42	336.99	335.82	177.81	420.73
986	962	1204.08	1.51	2.39	102.49	0.45	2579.41	0.22	4.71	0.46	4.95	468.75	560.17	241.72	760.44
982	962	1212.58	1.49	2.34	98.83	0.45	2448.06	0.17	3.58	0.42	3.99	310.23	434.80	198.55	598.43
1002	964	3338.32	2.82	3.97	254.85	0.57	25264.76	0.51	16.37	2.42	10.60	1344.00	642.92	544.01	2972.92
1010	966	1417.88	1.25	2.45	93.75	0.45	2198.13	0.26	4.04	0.51	5.23	489.51	425.41	168.25	659.53
1008	966	1358.99	1.42	2.93	113.87	0.45	2841.45	0.24	4.29	0.46	5.37	442.12	489.64	170.26	710.25
1006	966	1430.33	1.60	5.92	200.20	0.49	5631.80	0.29	7.12	0.72	9.25	473.09	501.40	246.78	1523.63
1004	966	3298.55	3.52	5.68	435.21	0.68	32632.05	0.62	17.96	2.42	14.19	1255.75	489.26	971.88	4907.58
1002	966	3402.43	3.24	4.98	417.17	0.66	30290.11	0.59	17.09	2.49	12.40	1444.14	664.31	435.91	4315.86
1000	966	1290.88	1.50	3.98	161.53	0.46	3799.33	0.26	5.57	0.63	7.12	530.29	457.12	183.03	1104.31
998	966	1219.81	1.47	2.70	106.16	0.44	2812.73	0.28	5.56	0.55	6.60	466.69	500.04	220.88	932.84
996	966	1223.26	1.88	2.21	99.61	0.46	2985.13	0.31	4.00	0.53	8.16	749.04	376.64	207.33	598.05
994	966	1240.28	1.54	1.70	94.82	0.47	1879.05	0.35	3.22	0.45	6.41	514.49	339.41	182.89	505.14
992	966	1235.06	1.53	1.70	92.00	0.45	1915.72	0.24	3.35	0.47	6.27	526.46	357.30	181.12	521.13
990	966	1239.89	1.53	1.45	89.90	0.45	1707.17	0.21	2.83	0.38	5.51	504.14	302.67	175.82	460.35
986	966	1212.91	1.46	1.43	84.70	0.44	1462.04	0.18	2.06	0.48	4.56	376.32	413.52	168.16	343.85
982	966	1245.82	1.53	1.44	84.54	0.45	1585.74	0.20	2.38	0.45	4.77	518.96	362.47	192.09	393.75
1002	968	1404.69	1.86	3.91	192.99	0.50	4363.85	0.27	5.57	0.61	7.77	504.35	458.21	258.42	1147.62
1002	970	1233.38	1.36	2.52	114.23	0.44	2555.22	0.23	3.83	0.44	5.18	445.62	557.24	253.40	647.67
1002	972	1181.11	2.22	2.47	95.09	0.42	2552.65	0.22	3.45	0.41	5.98	336.74	517.44	226.94	586.29
1010	974	1432.68	1.33	1.37	88.63	0.44	1292.65	0.24	2.73	0.45	5.55	545.67	257.76	177.47	477.87
1008	974	1486.72	1.24	1.67	104.17	0.47	1867.16	0.23	2.62	0.43	4.82	391.54	282.67	204.62	485.31
1006	974	1412.69	1.29	1.51	83.70	0.44	1454.26	0.23	2.23	0.37	4.19	390.33	261.52	174.32	395.35
1004	974	1367.26	1.42	2.74	104.58	0.44	2745.12	0.35	4.06	0.48	7.56	394.47	449.40	232.27	704.10
1002	974	1318.72	1.21	2.10	97.60	0.43	2283.84	0.26	3.87	0.47	4.55	451.36	469.89	202.40	663.80
1000	974	1118.21	1.24	2.48	90.91	0.37	2639.24	0.21	3.80	0.48	4.90	390.84	492.30	256.94	595.74
998	974	1110.82	1.28	2.09	87.41	0.39	2562.74	0.20	3.40	0.42	4.54	397.02	388.87	245.40	529.84
996	974	1165.73	1.34	2.92	91.03	0.40	3203.45	0.25	4.62	0.49	5.04	428.25	430.17	264.50	665.16
994	974	1215.29	1.60	3.75	101.76	0.39	3726.28	0.25	6.30	0.60	4.84	492.24	613.07	562.24	847.29
992	974	1139.69	1.42	2.32	86.97	0.39	2300.07	0.25	3.69	0.42	5.49	396.67	563.76	278.43	513.92
990	974	1248.81	1.53	2.82	98.72	0.42	2946.23	0.25	4.75	0.52	5.58	588.05	675.08	353.93	731.29
986	974	1219.46	1.31	2.13	91.90	0.42	2055.39	0.20	3.64	0.45	4.28	350.69	512.30	278.22	585.80
982	974	1191.16	1.29	1.63	87.67	0.41	1510.94	0.16	2.57	0.38	3.66	325.07	481.42	213.82	423.30
1002	976	1402.05	1.16	1.51	86.69	0.39	1564.97	0.23	3.15	0.45	3.99	429.18	427.77	206.86	487.25
1002	978	1224.80	1.12	1.43	85.36	0.38	1755.85	0.20	3.34	0.38	3.61	403.98	272.24	169.14	539.15
1010	980	1259.45	1.70	1.27	87.90	0.45	979.67	0.23	2.64	0.58	3.84	478.08	313.32	126.04	440.55
1008	980	1341.62	1.93	1.49	100.18	0.49	1244.04	0.27	2.75	0.63	4.37	508.45	426.07	158.22	488.59
1006	980	1305.60	1.75	1.30	87.65	0.46	881.68	0.20	1.82	0.48	3.51	305.41	351.90	134.18	339.98
1004	980	1318.39	1.85	1.76	97.22	0.47	1566.82	0.49	2.57	0.54	3.97	454.11	360.03	159.85	470.86
1002	980	1153.80	1.55	1.18	72.29	0.38	1420.95	0.20	2.41	0.49	2.72	305.94	342.51	113.49	383.39
1000	980	1161.62	1.61	2.00	95.60	0.35	2338.14	0.26	4.26	0.57	3.98	416.01	315.14	178.37	556.08
998	980	1150.26	1.20	1.54	83.10	0.35	1847.85	0.20	2.78	0.37	4.62	315.98	304.09	168.90	391.36
996	980	1121.08	0.98	1.24	65.81	0.32	1355.63	0.16	2.79	0.34	3.24	330.04	305.46	186.21	376.93
994	980	1049.30	0.97	1.14	74.03	0.30	1317.00	0.17	2.68	0.33	5.70	340.42	384.08	205.11	284.68
992	980	1090.11	0.92	1.14	69.23	0.32	1360.02	0.17	2.53	0.30	3.49	422.90	349.83	220.18	342.37
990	980	1070.23	0.97	1.22	66.82	0.32	1383.08	0.16	2.23	0.29	3.12	373.83	361.93	204.73	300.56
986	980	1070.71	0.91	1.19	66.87	0.33	1161.34	0.15	1.93	0.28	3.54	319.96	356.18	209.43	278.46
982	980	1031.10	1.08	1.00	70.67	0.36	1017.28	0.16	1.56	0.26	3.23	366.44	350.92	201.12	255.27
1002	982	1203.09	1.05	1.06	74.56	0.42	1658.12	0.15	2.46	0.34	2.45	367.42	280.08	76.79	426.58
1002	984	1259.15	2.12	2.43	89.20	0.42	19388.94	0.26	3.67	0.59	4.45	437.54	296.24	177.52	670.09
1002	986	1211.54	1.22	1.60	83.75	0.42	1495.18	0.18	2.67	0.40	3.18	323.26	444.78	141.45	502.16
1010	988	1267.31	1.22	1.40	84.49	0.39	1628.51	0.24	2.89	0.50	5.15	590.10	346.78	179.04	414.95
1002	988	1275.36	1.35	1.27	84.56	0.44	1199.70	0.18	2.39	0.35	3.25	345.54	304.14	123.41	487.86
994	988	981.88	0.71	0.95	50.55	0.25	1080.27	0.12	2.28	0.23	3.15	228.01	338.80	209.21	256.48

Mabry Site (40KN86) chemical raw results. (continued)

NORTH	WEST	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
970	926	838.52	1.09	1.75	71.38	0.27	2005.94	0.19	3.20	0.34	5.98	549.50	443.15	312.28	240.25
970	930	869.40	1.08	1.28	63.94	0.29	1610.88	0.21	2.39	0.27	5.08	552.53	276.50	244.24	172.70
970	934	868.46	0.97	1.71	59.84	0.28	1829.61	0.21	2.87	0.31	5.41	490.49	426.26	302.73	200.53
960	926	1258.74	1.59	1.65	93.01	0.47	1635.76	0.21	2.55	0.44	4.84	489.07	366.31	234.85	411.53
960	930	1154.52	1.53	1.48	87.02	0.45	1507.69	0.20	2.32	0.40	4.39	465.69	345.95	221.77	361.97
960	934	1226.93	1.63	1.67	99.40	0.50	1697.03	0.24	2.87	0.50	5.36	624.27	389.14	227.99	431.73
954	930	1553.51	2.18	1.54	113.46	0.62	1349.29	0.21	2.05	0.44	4.89	403.81	413.01	217.98	433.11
950	926	1404.61	1.82	0.92	89.07	0.53	836.68	0.15	1.72	0.33	3.47	268.74	376.80	221.71	311.44
950	930	1539.91	2.09	1.03	99.33	0.59	959.24	0.20	1.85	0.40	3.97	411.41	317.67	188.30	367.10
950	940	1668.24	2.22	1.09	110.66	0.69	771.21	0.18	1.46	0.41	4.42	305.24	281.41	147.64	350.71

Mabry Site (40KN86) chemical raw results. (continued)

NORTH	WEST	MO	MA	MI	P	PB	S	SI	SR	TI	V	ZN	TOTAL_C	PH
1010	930	0.38	4.14	4.89	104.11	85.03	14.40	212.46	7.93	3.66	3.48	40.70	2.67	6.15
1002	930	0.38	6.01	6.62	228.13	43.13	20.19	297.52	14.72	4.07	3.32	33.24	3.34	6.60
994	930	0.32	3.15	3.15	14.95	20.86	9.96	216.37	6.81	2.33	3.08	9.40	1.75	6.50
1002	932	0.39	4.98	8.19	271.03	46.34	23.75	309.82	18.40	3.72	3.64	29.82	4.92	6.80
1002	934	0.43	5.47	7.21	151.75	36.70	22.11	398.81	15.60	3.81	4.29	18.08	4.35	6.80
1002	936	0.40	3.87	4.61	50.20	29.09	13.29	279.20	9.66	3.29	3.29	13.18	2.70	6.50
1010	938	0.35	6.50	3.78	29.06	46.18	14.39	177.44	6.42	2.94	2.69	20.06	2.75	5.85
1008	938	0.36	3.44	4.34	72.46	31.97	13.60	234.72	8.63	3.85	3.05	12.39	2.57	6.00
1006	938	0.34	3.35	5.69	96.19	23.81	14.06	484.50	13.72	4.92	3.49	10.10	2.01	7.45
1004	938	0.40	5.26	6.37	201.59	28.75	16.11	475.72	16.47	6.17	3.79	13.41	2.43	7.55
1002	938	0.37	3.04	4.37	98.71	27.67	12.27	324.57	10.48	4.13	3.36	11.76	2.29	6.80
1000	938	0.36	7.13	4.37	43.02	29.05	14.71	269.61	9.23	3.05	3.05	14.41	2.83	6.25
998	938	0.35	4.05	3.74	116.91	24.46	12.89	304.68	9.69	2.99	3.68	11.79	2.09	6.90
996	938	0.33	4.32	3.49	51.80	23.83	12.70	289.57	9.76	2.98	3.81	11.03	2.22	6.50
994	938	0.31	4.58	2.96	17.48	22.54	11.05	228.82	7.82	2.11	3.02	7.10	2.06	6.30
992	938	0.30	3.62	3.37	14.82	23.25	11.80	182.51	8.01	2.17	3.09	8.26	2.46	6.35
990	938	0.24	2.95	2.48	12.70	19.94	11.77	169.72	7.03	2.00	2.99	7.62	2.37	6.25
986	938	0.24	3.54	2.05	10.17	21.90	11.08	140.14	6.57	1.56	2.70	10.48	2.08	6.00
982	938	0.27	3.57	2.68	28.85	22.21	16.70	176.88	9.02	1.95	3.45	8.23	3.41	6.25
1002	940	0.40	2.56	4.66	77.74	30.48	15.34	335.95	11.78	3.11	3.16	19.90	3.38	6.50
1002	942	0.36	4.36	7.50	181.92	40.89	23.14	361.50	16.60	3.65	3.25	25.43	4.58	6.80
1010	944	0.30	2.76	2.82	21.10	19.07	9.23	201.77	5.07	2.47	2.46	7.01	1.67	6.05
1008	944	0.34	3.08	3.30	68.38	31.99	11.00	214.99	6.62	3.05	2.78	10.74	2.10	6.10
1006	944	0.33	3.39	4.91	92.60	46.09	15.39	268.41	9.97	4.01	2.91	16.10	2.94	6.40
1004	944	0.36	3.65	9.51	151.38	112.92	29.07	373.15	19.47	4.52	3.38	19.32	6.24	6.95
1002	944	0.46	3.75	7.70	154.08	39.20	19.73	330.07	12.70	3.42	3.03	20.72	3.81	7.15
1000	944	0.56	5.49	10.01	475.06	60.45	22.94	505.04	19.26	6.34	3.83	25.31	3.16	7.20
998	944	0.45	6.52	5.63	185.75	35.33	17.12	356.38	11.77	3.77	4.15	15.75	2.86	6.65
996	944	0.42	5.02	4.08	56.17	28.95	11.35	332.11	9.34	2.77	3.53	9.81	2.22	6.60
994	944	0.44	3.78	4.10	37.30	24.57	11.13	288.44	8.12	2.45	3.24	9.63	2.09	6.30
992	944	0.40	4.69	4.52	51.16	25.53	11.96	244.21	8.77	2.77	3.32	8.72	2.34	6.50
990	944	0.46	25.15	5.47	32.58	26.39	12.59	244.77	8.78	2.94	3.58	8.75	2.39	6.65
986	944	0.45	4.37	5.16	18.32	25.37	12.01	212.90	8.04	2.51	3.21	7.61	2.19	6.50
982	944	0.44	3.85	4.15	15.07	23.67	9.58	188.24	6.89	2.31	3.03	6.64	2.02	6.45
1010	947	0.49	4.50	5.98	19.52	26.96	12.05	247.52	5.70	2.69	3.09	9.34	2.59	6.20
1008	947	0.48	5.69	5.75	44.95	32.52	13.06	181.18	5.18	3.13	3.05	11.94	2.14	5.85
1006	947	0.49	5.97	6.30	69.19	42.24	16.39	205.91	6.33	3.28	3.14	13.44	2.55	5.80
1004	947	0.50	5.00	9.10	94.47	78.06	21.18	284.20	11.59	3.13	2.90	34.15	4.31	6.75
1002	947	0.53	51.77	10.20	136.67	30.51	37.01	369.06	11.53	3.58	3.45	10.02	2.65	7.40
1000	947	0.50	4.99	9.04	207.41	38.12	15.57	378.52	11.55	3.76	3.66	10.10	2.15	7.00
998	947	0.48	5.17	5.17	168.10	38.31	11.49	300.70	8.90	3.81	3.14	13.14	1.56	6.65
996	947	0.45	4.53	4.85	56.90	30.00	12.34	259.57	7.94	2.84	3.73	13.69	2.24	6.60
994	947	0.47	4.87	4.75	39.52	28.40	12.40	263.12	7.77	2.50	3.50	8.64	1.97	6.75
992	947	0.53	10.92	6.07	114.05	32.08	16.27	237.20	9.65	3.04	3.68	15.09	2.74	6.80
990	947	0.54	6.50	6.21	49.34	26.69	11.25	265.22	8.40	3.14	3.45	9.81	2.31	6.60
986	947	0.52	7.32	4.38	18.68	24.68	10.92	187.55	6.06	2.59	2.67	6.89	1.67	6.10
982	947	0.53	7.32	4.12	20.26	22.37	10.42	198.05	5.93	2.47	2.84	7.80	1.57	6.35
1002	948	0.55	6.97	8.45	125.34	26.03	14.29	324.59	10.50	3.72	2.76	11.12	2.55	6.70
1000	948	0.60	7.71	8.74	155.51	46.83	15.84	312.96	10.24	3.74	3.39	15.86	2.92	6.65
1002	950	0.60	7.25	5.93	49.67	28.33	12.17	229.67	6.63	2.83	2.86	9.46	2.20	6.40
1002	952	0.56	5.17	6.55	56.29	31.81	13.56	295.12	7.27	3.31	3.99	9.90	2.22	6.75
1010	954	0.80	7.88	5.14	84.41	28.53	11.23	433.90	6.60	3.60	3.69	12.64	2.41	6.10
1008	954	0.66	7.71	5.89	47.02	31.19	13.02	261.07	6.77	3.11	3.72	11.96	2.43	6.40
1006	954	0.67	8.77	6.07	60.34	29.98	12.17	296.16	6.78	3.31	3.89	10.32	2.33	6.60
1004	954	0.60	8.41	3.41	24.45	35.05	9.69	202.14	4.80	1.85	2.15	6.91	1.60	5.95
1002	954	0.52	6.97	2.00	22.98	21.93	9.28	202.31	3.96	1.65	2.29	2.47	0.85	6.20
1000	954	0.57	7.91	3.41	28.88	35.25	7.58	201.13	6.60	2.03	2.32	8.13	1.94	6.50
998	954	0.61	6.93	5.22	59.58	34.30	8.93	239.34	8.24	2.50	2.86	25.47	2.36	6.70
996	954	0.58	7.44	4.99	55.81	32.63	9.13	223.10	8.67	2.72	3.32	14.21	2.51	6.50
994	954	0.58	6.22	6.18	72.20	30.13	12.54	237.88	10.19	2.60	3.56	12.35	2.95	6.65
992	954	0.49	5.90	5.49	119.66	23.58	13.82	265.15	10.33	3.18	3.60	12.51	2.37	6.80
990	954	0.61	7.51	6.04	120.34	26.51	11.74	280.35	9.52	3.46	3.53	8.74	2.26	6.65
986	954	0.62	5.67	3.65	43.74	36.58	6.25	273.99	7.56	3.84	2.77	5.22	1.24	6.55
982	954	0.66	5.46	6.55	57.03	24.54	12.27	256.71	6.40	3.18	3.52	9.05	2.03	6.45
1002	956	0.50	6.61	2.75	15.57	55.20	9.22	166.84	5.02	1.85	2.00	7.10	1.83	5.75
1002	958	0.58	7.29	5.29	33.35	67.02	12.53	257.33	10.07	2.38	2.81	17.10	3.69	6.65

Mabry Site (40KN86) chemical raw results. (continued)

NORTH	WEST	MO	NA	NI	P	PB	S	SI	SR	TI	V	ZN	TOTAL	C	PH
1002	960	0.63	7.43	4.97	21.92	70.22	11.55	268.01	8.30	2.32	2.54	16.12	2.95	6.30	
1010	962	0.67	7.44	7.33	56.00	30.14	14.41	402.98	11.68	2.76	3.84	14.58	3.58	6.55	
1008	962	0.65	7.25	7.31	49.42	40.32	15.50	386.95	11.04	3.14	4.12	15.82	3.38	6.65	
1006	962	0.72	22.45	10.49	60.32	67.53	26.13	482.26	13.33	3.49	4.48	15.21	3.43	7.45	
1004	962	0.61	6.39	12.53	118.22	232.96	26.71	482.67	17.90	4.18	3.78	30.43	4.55	7.40	
1002	962	0.43	4.21	9.88	78.51	99.43	22.54	530.58	13.86	4.16	3.45	18.75	2.85	7.45	
1000	962	0.38	2.61	5.84	37.12	131.92	16.20	296.44	9.30	2.65	2.79	17.37	3.06	6.60	
998	962	0.35	3.01	5.90	26.53	30.82	15.74	279.07	8.76	2.47	2.79	16.33	2.59	6.50	
996	962	0.36	3.01	5.20	19.33	39.13	15.76	197.69	7.88	2.12	2.46	17.64	2.51	6.20	
994	962	0.42	2.40	6.33	23.56	33.16	17.68	253.42	8.82	2.49	3.31	24.79	2.62	6.50	
992	962	0.37	2.46	4.35	22.12	23.15	12.25	229.09	6.69	2.13	2.54	11.36	1.87	6.55	
990	962	0.37	1.80	4.40	28.80	22.81	12.19	217.59	6.20	2.20	2.39	8.30	1.79	6.30	
986	962	0.40	3.84	7.33	51.45	23.25	19.49	233.44	9.20	2.31	2.97	10.53	2.78	6.55	
982	962	0.40	2.48	5.79	45.30	19.23	15.44	220.01	9.27	2.12	2.62	7.47	2.25	6.65	
1002	964	1.05	22.11	27.42	303.02	120.23	74.51	878.56	45.31	6.35	6.90	33.33	4.62	7.75	
1010	966	0.46	1.80	6.56	23.64	26.95	17.55	281.34	6.85	2.42	3.05	12.99	2.46	6.40	
1008	966	0.45	2.55	7.12	57.60	28.25	19.02	326.31	9.29	2.67	3.21	15.93	2.83	6.55	
1006	966	0.47	3.74	13.84	84.60	46.74	30.09	456.86	18.24	4.02	3.95	24.00	4.35	7.10	
1004	966	1.12	17.87	51.47	457.48	92.78	86.30	1026.20	85.16	9.69	5.39	48.18	4.92	7.75	
1002	966	1.13	18.93	45.33	447.83	81.76	75.05	981.48	88.41	9.77	5.23	41.21	3.96	7.90	
1000	966	0.43	3.10	10.35	65.05	31.72	21.81	450.00	12.87	4.03	3.76	18.08	2.91	7.05	
998	966	0.40	2.33	8.72	39.29	33.78	23.21	266.54	10.06	2.63	3.38	21.53	3.80	6.40	
996	966	0.43	2.72	6.36	31.66	36.05	18.07	264.38	9.88	3.25	3.78	16.69	3.57	6.60	
994	966	0.42	3.80	5.47	25.83	49.67	17.13	221.21	8.11	2.58	3.03	51.77	2.49	6.10	
992	966	0.43	4.00	5.56	29.40	26.08	15.04	212.42	6.71	2.36	2.91	12.92	2.31	6.25	
990	966	0.39	3.17	4.86	32.18	22.66	15.10	210.56	6.11	2.30	2.67	9.47	2.08	6.10	
986	966	0.38	2.17	3.75	27.36	18.68	11.70	206.38	5.77	2.14	2.44	6.96	1.63	6.55	
982	966	0.42	2.45	4.11	57.21	18.29	12.83	186.28	5.95	2.30	2.76	6.62	1.81	6.50	
1002	968	0.45	2.66	11.10	75.66	42.17	24.72	338.92	15.41	4.22	3.57	23.12	3.83	6.75	
1002	970	0.41	2.23	6.50	21.91	24.77	17.31	215.63	8.82	2.27	2.88	27.50	2.88	6.45	
1002	972	0.38	1.99	5.77	17.82	64.07	15.51	233.18	9.16	2.06	2.75	18.75	2.63	6.65	
1010	974	0.45	3.23	4.97	20.53	23.45	16.11	187.77	4.77	2.45	2.65	10.81	2.30	6.00	
1008	974	0.47	1.80	5.10	17.50	23.06	14.20	216.57	6.82	2.31	2.51	15.07	2.58	6.10	
1006	974	0.49	2.44	4.16	15.72	19.50	14.56	231.94	5.06	2.18	2.42	15.77	2.03	5.95	
1004	974	0.47	2.65	7.06	22.08	27.64	17.91	234.26	9.76	2.21	2.87	26.67	3.17	6.45	
1002	974	0.43	2.61	6.65	21.66	22.88	14.77	218.17	8.26	2.31	2.95	15.79	2.50	6.45	
1000	974	0.37	2.77	6.00	22.48	20.38	14.85	300.97	8.87	2.11	3.14	15.19	2.34	6.85	
998	974	0.39	2.66	5.42	16.64	19.38	14.30	274.69	8.15	2.06	2.94	11.00	2.53	6.70	
996	974	0.39	2.24	6.81	18.39	24.32	17.08	266.08	10.76	2.18	3.07	13.43	3.37	6.70	
994	974	0.41	87.05	8.49	68.56	29.46	49.15	262.30	12.32	2.02	3.10	13.55	3.76	7.35	
992	974	0.40	45.81	5.40	39.99	32.93	27.06	275.42	8.74	2.23	3.21	14.52	2.49	7.10	
990	974	0.41	51.64	7.37	47.47	29.13	35.81	251.77	10.94	2.33	3.38	12.33	3.51	7.10	
986	974	0.41	72.75	5.82	46.43	21.67	36.36	290.06	7.44	2.26	2.82	9.40	2.12	7.55	
982	974	0.36	68.66	4.26	31.46	17.86	32.53	251.25	5.53	1.96	2.64	7.58	1.91	7.35	
1002	976	0.45	29.65	5.01	23.46	22.09	21.03	289.04	5.93	2.36	2.87	13.07	2.03	6.65	
1002	978	0.39	1.80	5.40	14.51	22.64	14.89	215.30	6.12	2.15	2.58	13.83	2.45	6.10	
1010	980	0.54	50.16	4.63	29.27	19.73	30.01	197.47	3.63	2.55	2.96	6.15	1.59	7.00	
1008	980	0.56	78.78	5.18	55.46	21.36	36.23	228.16	4.39	2.62	3.13	9.08	1.77	7.25	
1006	980	0.56	36.70	3.61	18.95	16.20	23.85	191.41	3.36	2.34	2.47	5.15	1.47	6.70	
1004	980	0.57	31.93	5.07	26.02	21.70	18.26	248.88	6.01	2.75	2.96	15.83	1.87	6.80	
1002	980	0.48	35.44	4.07	19.15	16.62	18.25	247.68	4.07	2.23	2.89	6.05	1.26	7.15	
1000	980	0.50	24.24	5.82	22.45	25.25	18.90	308.93	7.33	2.30	3.36	18.16	2.23	6.70	
998	980	0.39	2.93	4.28	12.50	23.24	12.31	216.97	6.36	2.01	2.45	16.39	2.17	6.15	
996	980	0.37	2.51	3.87	6.01	17.06	10.97	232.55	5.27	1.78	2.30	6.23	1.70	6.00	
994	980	0.36	2.60	3.27	6.64	98.19	11.87	224.64	5.37	1.71	2.51	12.11	1.90	6.20	
992	980	0.35	2.78	3.64	12.05	16.04	12.77	215.03	4.94	1.79	2.49	6.65	1.89	6.00	
990	980	0.34	2.00	3.20	6.15	15.39	11.99	196.80	5.15	1.71	2.30	5.59	1.97	6.10	
986	980	0.37	2.86	3.00	5.34	17.68	12.91	181.28	4.41	1.70	2.13	6.72	1.77	6.00	
982	980	0.36	2.33	2.73	6.51	14.97	12.66	182.07	3.90	1.83	2.12	5.50	1.64	5.95	
1002	982	0.41	1.98	4.13	53.26	13.37	8.45	301.79	3.94	2.47	2.66	4.63	1.18	6.65	
1002	984	0.46	7.56	6.58	92.81	21.33	24.39	411.56	11.78	2.96	3.56	13.31	2.53	7.70	
1002	986	0.43	3.38	4.99	8.90	20.25	12.46	197.90	5.55	2.39	2.41	9.07	2.06	6.20	
1010	988	0.45	3.16	4.59	19.08	25.42	12.55	270.25	5.85	2.72	3.00	12.79	2.32	6.00	
1002	988	0.44	2.65	4.89	7.82	20.20	11.42	195.18	4.80	2.55	2.31	8.19	1.92	5.80	
994	988	0.35	2.18	2.70	8.43	13.50	9.78	209.91	3.87	1.39	2.11	4.20	1.21	5.95	

Mabry Site (40KN86) chemical raw results. (continued)

NORTH	WEST	MO	NA	NI	P	PB	S	SI	SR	TI	V	ZN	TOTAL_C	PH
970	926	0.32	3.15	3.16	13.82	17.16	9.40	265.03	6.03	2.07	3.04	7.89	2.23	6.35
970	930	0.34	3.31	2.72	5.54	19.44	9.85	193.89	5.49	1.95	2.49	6.54	2.25	5.95
970	934	0.33	3.08	2.93	15.58	19.33	10.00	200.49	5.98	1.66	2.66	7.47	2.16	6.35
960	926	0.46	3.00	4.34	17.23	19.82	10.11	204.70	5.59	2.53	2.64	7.38	2.10	6.20
960	930	0.41	2.61	3.91	12.09	18.18	9.27	207.33	5.41	2.36	2.52	6.66	1.83	6.30
960	934	0.42	2.20	4.59	17.16	20.15	12.39	206.51	6.64	2.63	2.80	8.24	2.22	6.05
954	930	0.52	2.42	4.44	12.16	19.96	10.75	232.50	4.86	2.88	2.30	7.00	1.87	6.10
950	926	0.47	2.26	3.13	6.14	13.49	12.83	240.33	3.26	2.38	2.19	4.46	1.26	5.90
950	930	0.52	1.80	3.78	8.59	16.09	10.73	250.52	3.65	2.83	2.36	5.98	1.37	5.75
950	940	0.58	2.41	3.60	10.29	13.76	11.04	235.54	3.03	2.94	1.91	5.20	1.52	5.55

Oliver Site (40KN103) chemical raw results.

NORTH	EAST	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
984	997.5	2789.60	2.44	3.21	145.67	0.73	16795.12	0.70	16.76	2.54	13.13	2107.42	402.51	388.23	2749.23
986	997.5	1412.18	1.88	4.03	112.39	0.64	6138.67	0.56	4.22	1.29	12.57	1849.57	420.07	207.87	618.70
988	997.5	1455.03	1.87	3.44	80.99	0.56	6986.62	0.45	3.95	0.86	12.45	1320.75	377.81	214.45	586.23
990	997.5	1255.96	1.17	2.69	79.89	0.63	4743.79	0.25	2.93	0.84	10.74	516.04	249.48	150.46	457.36
992	997.5	1271.65	1.16	1.87	70.66	0.62	3818.89	0.30	2.73	0.63	10.62	800.75	225.20	129.60	429.31
994	997.5	1278.92	1.18	1.27	57.84	0.55	2687.32	0.37	2.20	0.56	29.19	1020.91	117.91	129.98	335.93
996	997.5	1299.14	1.03	1.49	61.47	0.55	2763.33	0.28	2.13	0.42	14.14	806.38	114.20	124.75	358.68
998	997.5	1320.14	1.09	1.42	62.48	0.53	3151.34	0.32	2.11	0.47	8.84	1012.95	76.22	132.54	361.41
1000	997.5	1616.95	1.18	2.23	98.59	0.78	4357.84	0.29	2.05	0.46	6.86	542.06	105.45	159.49	448.16
993	994	1533.22	1.30	2.28	72.98	0.64	4865.31	0.33	2.53	0.59	9.89	911.33	251.79	250.59	349.94
993	996	1513.37	1.72	2.64	99.39	0.76	5610.80	0.56	3.29	0.92	182.00	1475.22	256.39	198.60	621.71
993	999	1277.91	1.39	1.57	57.49	0.51	3451.76	0.40	3.26	0.78	8.28	1362.33	184.16	152.86	435.40
993	1001	1384.47	1.77	2.49	71.54	0.59	5816.73	0.73	3.31	0.81	8.90	1132.60	290.75	296.17	509.91
991	996.5	1199.95	1.51	4.14	105.12	0.56	6008.81	0.36	3.86	0.81	10.56	583.43	156.64	121.57	613.52
989	996.5	1607.84	2.19	5.21	95.44	0.62	10406.47	0.54	7.55	1.26	9.65	1377.92	457.66	250.91	1314.94
992	995.5	1716.01	3.15	2.89	111.15	0.78	5419.25	0.47	4.25	1.04	20.95	1080.41	268.18	193.42	736.30
990	995.5	1797.27	2.46	4.66	107.36	0.67	12374.94	0.63	5.25	1.53	10.21	1778.29	517.92	284.28	769.82
988	995.5	1804.45	2.59	5.56	133.04	0.76	10482.56	0.69	5.50	3.23	13.18	2300.00	398.50	201.69	902.80
988	999.5	1371.63	1.54	2.36	67.17	0.66	4614.17	0.38	4.98	0.85	5.73	1170.63	371.25	244.75	744.22
988	1001.5	1594.87	1.77	3.03	63.64	0.63	7332.99	0.30	5.75	0.68	4.84	693.07	507.10	580.77	562.25
988	1003.5	1332.82	1.98	7.58	96.38	0.56	10022.85	0.45	7.80	1.04	8.50	852.49	568.94	510.31	1277.72
988	1005.5	2498.82	2.54	3.67	127.12	0.69	17187.42	0.72	17.91	2.64	10.67	1988.19	576.45	392.28	2862.09
988	1007.5	1475.53	2.20	4.41	104.43	0.66	8487.47	0.58	4.47	1.57	12.86	1529.42	476.35	359.54	775.86
992	992	1279.16	1.16	2.72	64.28	0.55	4013.20	0.24	3.86	0.48	4.10	450.37	239.11	226.64	569.36
992	990	1458.59	1.40	3.56	88.95	0.67	4903.97	0.33	3.96	0.72	5.39	748.19	328.99	365.89	639.93
1001	989.5	1690.74	1.01	2.05	81.30	0.67	4729.31	0.26	2.64	0.51	3.58	463.64	95.17	340.79	452.31
1003	1006.5	1400.00	1.10	1.80	78.75	0.59	3940.56	0.30	2.96	0.61	5.04	539.03	106.09	318.01	512.92
994	1008.5	1220.61	1.11	1.59	70.17	0.64	2967.07	0.32	2.66	0.52	3.59	833.02	122.67	214.18	485.53
1002	997.5	1805.06	1.60	2.23	89.06	0.75	4947.98	0.45	3.73	0.89	8.40	1326.33	125.43	236.71	626.29
1004	997.5	1831.83	2.00	2.97	101.71	0.78	7350.92	0.54	3.68	1.36	9.08	1824.21	143.70	354.17	590.96
1006	997.5	1947.82	1.56	2.94	101.11	0.82	6287.45	0.45	3.20	1.78	5.34	1050.24	131.08	309.34	582.92
1008	997.5	1714.43	1.46	3.37	98.17	0.73	6211.86	0.42	3.98	0.82	5.96	1281.25	119.12	302.82	664.81
980	997.5	1359.61	1.24	2.24	76.79	0.57	4117.60	0.26	3.50	0.58	3.91	624.28	150.55	305.62	473.14
980	994.5	1327.02	1.40	2.25	68.47	0.58	3885.66	0.39	4.10	0.66	4.21	1324.74	149.39	319.76	530.10
NORTH	EAST	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
977	998.5	1198.32	0.96	1.69	73.46	0.56	2970.06	0.23	3.09	0.47	7.62	381.98	83.88	256.23	535.50
991	980.5	1395.18	1.05	1.43	60.68	0.50	3501.94	0.24	2.73	0.46	3.23	494.69	72.56	260.63	358.02
1012	997.5	1454.78	1.21	1.67	72.44	0.65	3844.60	0.29	2.77	0.54	3.79	818.30	98.44	301.21	430.85
1016	997.5	1423.02	1.31	1.93	61.35	0.57	4856.01	0.37	3.54	0.72	4.57	1347.64	99.26	924.12	404.56
976	997.5	1295.63	1.16	1.92	66.93	0.56	3363.63	0.32	3.40	0.56	4.51	861.64	119.35	405.70	497.32
976	994.5	1211.27	0.86	1.68	56.12	0.48	3034.19	0.28	2.65	0.44	3.70	712.51	96.10	352.50	341.74

Oliver Site (40KN103) chemical raw results. (continued)

NORTH	EAST	MO	NA	NI	P	PB	S	SI	SR	TI	V	ZN	TOTAL_C	PH
984	997.5	0.97	31.60	27.82	1156.56	55.18	56.31	540.74	29.32	3.92	3.51	49.45	3.43	7.70
986	997.5	0.50	17.06	8.03	1130.15	37.78	32.41	264.27	12.72	3.46	3.46	39.80	3.15	6.70
988	997.5	0.51	29.55	7.09	1762.40	22.38	42.74	245.75	12.64	2.42	2.96	43.29	2.82	6.55
990	997.5	0.41	9.54	5.48	375.43	13.70	17.31	294.20	12.52	1.93	1.96	17.26	1.27	7.60
992	997.5	0.44	13.34	5.45	695.90	19.63	20.34	164.35	8.31	1.82	1.94	24.21	1.81	6.50
994	997.5	0.45	9.14	4.62	478.03	23.84	16.58	114.51	5.72	1.72	1.85	35.09	1.58	5.90
996	997.5	0.44	7.67	5.06	303.15	16.86	16.32	111.72	5.58	1.44	1.74	18.09	1.81	5.75
998	997.5	0.43	10.68	4.99	377.20	18.60	17.28	134.31	6.41	1.63	2.04	15.09	1.90	5.90
1000	997.5	0.53	11.92	6.91	392.70	10.14	15.78	170.06	8.72	1.44	1.59	14.81	2.20	6.30
993	994	0.49	15.46	5.00	791.79	19.81	22.65	197.00	9.52	1.51	2.33	24.15	2.53	6.15
993	996	0.56	22.04	8.91	1301.25	37.29	30.92	190.14	10.90	2.31	2.64	66.47	2.74	6.20
993	999	0.46	11.82	5.34	679.25	25.76	17.68	150.29	6.86	2.18	2.62	19.76	1.62	6.50
993	1001	0.51	24.45	6.58	1172.51	28.53	34.01	208.13	10.38	2.11	3.14	134.35	2.93	6.30
991	996.5	0.43	9.80	7.26	354.82	105.60	18.55	314.10	13.50	2.35	2.29	61.05	1.75	7.80
989	996.5	0.60	47.52	13.75	2221.99	30.21	54.59	445.46	17.75	2.90	3.91	35.23	3.66	7.10
992	995.5	0.61	20.47	10.17	1107.73	75.00	29.02	297.31	10.72	1.85	2.52	40.56	2.45	6.35
990	995.5	0.66	71.42	9.88	3857.99	36.16	65.95	356.72	22.17	3.53	3.92	48.76	3.64	6.65
988	995.5	0.66	38.48	11.59	2977.83	32.87	52.84	370.07	21.47	3.59	3.56	57.46	3.11	6.75
988	999.5	0.48	12.88	8.32	606.54	21.05	24.38	285.82	8.01	2.06	3.31	13.00	2.07	6.70
988	1001.5	0.52	23.19	6.44	983.83	20.57	32.31	381.59	10.93	1.09	3.39	13.81	2.82	6.80
988	1003.5	0.47	14.43	13.24	646.69	47.71	36.10	419.39	18.52	2.56	3.50	33.44	3.10	7.60
988	1005.5	0.89	24.58	29.00	1374.72	47.46	69.50	528.57	29.90	3.58	4.10	61.81	3.68	7.60
988	1007.5	0.56	31.78	10.01	2000.04	44.23	40.14	316.41	16.26	2.75	3.24	96.18	3.37	6.80
992	992	0.44	5.71	7.01	78.05	17.21	18.60	209.84	7.61	1.28	1.89	10.32	2.59	6.70
992	990	0.51	7.65	8.40	355.20	19.61	19.30	318.60	10.43	1.93	2.45	24.31	2.38	6.95
1001	989.5	0.53	10.24	6.26	41.57	12.39	13.56	295.09	9.56	1.27	2.07	6.48	2.21	6.90
1003	1006.5	0.49	7.05	6.32	32.55	17.24	12.10	271.70	8.12	1.21	2.33	14.17	2.05	6.70
994	1008.5	0.42	4.58	6.93	86.10	23.32	13.36	179.79	6.69	1.67	2.17	11.33	1.95	6.20
1002	997.5	0.62	15.19	8.84	632.04	18.65	22.08	264.59	9.79	1.76	2.49	22.16	2.70	6.25
1004	997.5	0.67	25.33	8.54	1301.89	38.30	32.43	348.17	13.36	2.49	3.24	32.88	3.28	6.60
1006	997.5	0.67	11.68	9.07	289.01	18.49	22.06	372.70	12.11	1.71	2.79	52.09	3.23	6.70
1008	997.5	0.58	14.89	8.62	419.30	21.41	25.24	385.87	12.39	1.91	3.16	24.37	2.89	6.90
980	997.5	0.46	7.47	6.28	226.74	17.99	16.54	276.18	8.93	1.50	2.28	11.38	2.11	6.70
980	994.5	0.51	8.65	6.87	235.18	21.13	22.62	215.03	7.12	1.90	2.86	12.33	3.06	6.35
NORTH	EAST	MO	NA	NI	P	PB	S	SI	SR	TI	V	ZN	TOTAL_C	PH
977	998.5	0.42	6.33	6.94	24.55	18.76	12.48	204.40	7.41	1.45	1.69	8.78	1.79	6.45
991	980.5	0.48	7.69	4.67	31.37	13.57	11.32	235.44	6.87	1.14	1.95	4.01	1.64	6.85
1012	997.5	0.49	6.91	5.94	195.58	17.81	14.67	244.83	7.41	1.47	2.24	8.45	1.95	6.85
1016	997.5	0.51	6.92	5.37	96.53	17.49	19.42	308.41	7.30	1.51	3.17	9.69	2.83	7.00
976	997.5	0.44	6.18	6.58	59.59	21.67	19.36	214.36	6.48	1.55	2.37	11.93	2.84	6.50
976	994.5	0.40	5.36	4.71	48.81	17.48	15.34	175.94	5.75	1.46	2.10	14.78	2.62	6.40

Bart Toole House Site chemical raw results.

SPOKE	METERS	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
1	2	1530.18	1.59	2.62	138.24	0.65	6900.31	0.59	3.50	0.71	5.19	1259.35	366.56	383.44	468.29
2	2	1163.62	1.74	2.46	94.89	0.52	4241.75	0.69	3.64	0.62	6.44	1430.68	180.12	373.52	386.00
2	6	1267.08	2.00	3.16	91.31	0.61	3969.28	0.71	4.43	0.81	6.44	2687.65	1197.00	394.13	528.16
2	10	1187.84	1.32	1.80	65.45	0.46	3220.64	0.40	2.96	0.62	5.06	1638.92	107.44	205.37	249.00
3	2	1265.19	1.84	3.04	129.60	0.62	4896.19	1.15	3.16	0.79	9.10	1274.88	236.27	272.97	398.87
3	6	1346.16	1.18	1.80	74.16	0.51	3147.62	0.51	2.28	0.49	6.89	1611.15	135.92	226.43	248.93
3	10	1741.60	1.76	2.51	108.88	0.75	4653.21	0.63	3.30	0.72	8.33	1836.68	203.28	379.39	359.98
4	-6	1506.78	1.61	3.35	118.64	0.70	6198.77	0.63	3.62	1.22	11.06	990.18	222.31	237.08	372.55
4	-2	1413.70	1.49	1.78	168.35	0.60	3655.70	1.15	2.10	0.82	37.74	1178.56	107.07	250.06	273.86
4	2	1343.50	1.42	1.97	92.85	0.59	3816.88	0.63	2.33	0.49	6.20	1068.79	208.70	353.44	270.38
4	6	1531.52	1.28	2.18	91.37	0.64	4207.11	0.43	1.76	0.49	4.54	620.92	400.49	498.77	203.86
4	10	1392.95	1.50	2.51	110.99	0.72	4653.61	0.47	3.26	0.57	5.64	1134.48	365.12	389.69	459.46
5	2	1445.46	2.34	3.09	155.58	0.74	4999.30	1.31	4.30	1.13	10.04	3270.40	123.65	302.10	545.80
5	6	1795.35	1.97	3.02	111.38	0.75	5609.74	0.80	3.50	0.91	7.26	2155.16	135.05	322.60	501.05
5	10	1604.03	2.89	4.37	130.04	0.85	6605.40	1.15	5.19	1.33	12.24	4300.24	214.53	353.68	636.76
6	2	2751.18	2.91	2.15	141.42	0.87	17670.21	0.97	11.82	2.39	10.08	2724.36	252.06	590.07	1753.57
6	6	1391.93	2.58	6.92	139.06	0.66	16754.41	0.74	3.55	1.18	13.80	2091.25	293.04	469.83	507.23
6	10	2488.79	2.96	3.11	177.83	0.84	18881.99	1.30	11.66	2.52	18.74	2961.84	361.40	635.90	1949.84
7	2	1515.50	7.03	4.78	140.99	0.67	88267.54	1.12	4.69	1.60	27.94	1789.54	257.70	2352.85	1068.69
7	6	1366.26	3.99	6.63	215.09	0.72	10442.95	1.27	4.98	1.48	18.57	3440.28	475.14	677.95	640.07
7	10	2834.68	4.60	6.10	284.93	0.94	29004.26	1.15	10.51	2.44	67.41	2595.68	538.72	655.40	1955.06
8	-6	1765.82	3.52	3.02	198.57	0.75	6920.22	4.11	5.93	3.11	21.06	3462.21	385.59	360.77	633.03
8	-2	1881.17	5.75	4.95	167.91	0.74	34299.74	1.93	12.07	2.67	31.24	3692.02	396.42	3097.71	1822.74
8	2	1421.69	4.11	4.57	131.24	0.70	7605.31	0.94	4.35	1.19	14.66	2855.44	287.78	396.16	641.58
8	4	1441.52	5.01	6.56	133.29	0.78	9093.53	1.21	6.26	1.20	13.65	3327.12	964.54	589.43	677.47
8	10	1508.40	2.80	3.46	125.17	0.84	4963.51	0.98	5.39	1.16	22.68	3967.51	328.52	221.82	582.40
HOUSE	1	1653.42	1.28	1.90	101.17	0.68	4013.82	0.38	2.00	0.80	5.45	813.19	356.90	185.22	214.10
HOUSE	2	1822.27	0.95	2.57	130.36	0.74	4231.57	0.50	1.67	0.84	6.54	786.58	333.96	170.20	254.38
HOUSE	3	1770.22	1.02	2.10	153.48	0.78	5175.65	0.58	1.83	1.25	6.60	870.73	394.38	209.68	279.00
HOUSE	4	1737.79	1.08	2.01	187.93	0.76	4972.47	0.71	1.91	1.20	7.28	870.11	398.73	184.96	273.41
HOUSE	5	1868.30	0.98	1.97	158.38	0.81	4659.11	0.52	2.20	0.96	6.34	909.84	377.19	177.21	348.58
SPOKE	METERS	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
6	25	1410.77	1.05	1.39	86.38	0.57	3317.94	0.33	1.95	0.49	5.44	982.47	113.54	311.07	224.99
6	30	1380.73	1.18	1.86	87.89	0.64	3409.29	0.48	1.56	0.51	6.18	1719.78	161.37	314.82	176.48
7	30	1486.43	1.41	1.77	108.22	0.70	3408.18	0.49	1.55	0.53	6.49	1406.51	139.34	208.38	201.69
7	40	1545.11	1.50	1.75	90.32	0.70	3753.41	0.52	1.76	0.63	5.12	1582.87	92.39	188.39	245.92
8	30	1659.42	1.20	2.18	89.32	0.68	4218.94	0.50	2.28	2.42	6.40	1371.21	162.64	246.91	288.33
8	40	1893.83	1.03	1.49	84.62	0.49	5125.45	0.25	1.82	0.44	2.72	655.17	147.57	326.70	146.55

Bart Toole House Site chemical raw results. (continued)

SPOKE	METERS	MO	NA	NI	P	PB	S	SI	SR	TI	V	ZN	TOTAL_C	PH
1	2	0.58	35.85	6.46	98.16	39.69	17.42	756.42	16.03	1.65	4.89	45.51	2.30	7.40
2	2	0.50	10.03	5.79	190.87	167.93	20.30	308.13	9.76	2.22	3.46	105.51	3.77	6.00
2	6	0.55	6.72	7.30	156.20	38.92	20.53	483.18	9.91	2.47	4.75	39.42	2.68	6.70
2	10	0.49	9.12	3.86	36.92	22.36	14.05	340.16	8.51	1.90	3.54	14.27	2.05	6.30
3	2	0.54	14.88	6.58	212.08	279.89	24.73	312.62	12.06	2.43	3.57	280.66	3.81	6.10
3	6	0.49	9.98	4.49	60.51	59.24	19.33	184.81	7.10	2.10	3.36	51.03	3.02	5.55
3	10	0.63	10.97	6.46	115.48	55.37	23.91	348.11	14.24	2.52	4.89	61.45	4.80	5.80
4	-6	0.55	104.23	6.35	339.97	142.62	105.35	429.13	15.27	2.06	2.64	147.83	2.26	7.20
4	-2	0.56	11.52	5.24	52.08	273.93	17.76	270.20	8.86	1.85	3.12	278.11	3.96	6.20
4	2	0.49	14.14	5.07	78.45	68.58	19.57	223.61	8.82	1.66	2.94	112.70	3.49	5.80
4	6	0.53	15.58	4.40	46.15	22.28	17.60	270.16	9.76	1.35	2.34	49.07	3.01	6.00
4	10	0.51	8.52	6.80	63.57	20.52	18.10	370.59	11.00	1.68	3.27	24.52	3.26	6.50
5	2	0.66	18.59	9.35	205.60	265.01	25.14	411.53	12.83	3.14	5.37	204.97	3.88	6.45
5	6	0.72	32.90	7.91	37.70	88.79	19.91	568.04	13.35	2.14	4.40	65.79	2.83	6.95
5	10	0.74	25.65	10.19	341.69	62.04	29.25	631.41	14.79	3.52	6.92	78.53	3.88	7.00
6	2	1.50	30.06	20.54	180.87	92.10	46.00	643.26	24.28	1.89	3.74	89.24	3.21	8.15
6	6	0.56	17.97	7.43	404.61	46.08	33.24	722.49	28.62	3.65	5.01	73.51	2.21	7.75
6	10	0.93	27.90	22.76	471.22	63.61	49.82	710.44	32.08	2.76	4.11	98.38	3.22	8.10
7	2	0.82	49.66	12.82	429.38	294.58	132.83	778.79	57.21	3.49	5.06	136.88	8.53	7.75
7	6	0.66	27.41	9.46	1084.57	134.78	42.92	772.83	23.49	4.84	6.82	140.75	6.60	7.50
7	10	1.11	37.08	22.84	1180.97	314.60	79.71	1014.90	80.93	8.48	6.49	268.21	5.05	8.00
8	-6	0.95	30.79	10.00	474.62	1666.85	41.26	687.48	14.90	3.19	6.80	946.16	4.21	7.00
8	-2	0.93	41.01	22.34	955.28	448.86	105.74	953.97	55.19	4.95	7.40	347.97	9.80	7.50
8	2	0.62	17.39	10.01	420.20	81.68	40.39	686.36	20.84	3.45	5.96	75.44	22.00	7.35
8	4	0.67	14.99	10.23	652.41	86.14	49.38	775.37	22.93	3.02	6.51	99.98	9.53	7.10
8	10	0.69	15.16	8.61	263.06	75.39	32.49	631.14	25.02	5.48	8.18	45.58	5.94	6.30
HOUSE	1	0.59	57.13	4.22	632.45	36.98	31.33	246.97	10.61	1.81	2.27	64.68	1.60	6.25
HOUSE	2	0.54	30.30	5.17	813.12	43.30	20.73	259.00	11.50	1.78	2.01	118.92	1.76	6.50
HOUSE	3	0.56	29.64	4.85	852.59	74.93	41.11	351.64	14.00	1.98	2.40	157.33	1.96	7.20
HOUSE	4	0.54	20.90	5.04	792.07	95.67	26.09	310.65	13.77	1.91	2.29	255.58	2.01	6.85
HOUSE	5	0.56	19.17	6.25	659.36	47.26	23.11	361.46	13.30	1.88	2.18	133.92	1.82	6.80
SPOKE	METERS	MO	NA	NI	P	PB	S	SI	SR	TI	V	ZN	TOTAL_C	PH
6	25	0.48	8.84	4.00	4.54	12.32	12.17	312.00	8.38	1.33	2.66	5.47	1.68	6.40
6	30	0.51	9.00	4.22	30.87	21.44	18.23	236.40	8.12	2.19	3.25	15.58	3.07	5.60
7	30	0.58	9.62	5.07	25.24	17.23	16.04	257.62	9.18	2.23	3.12	14.36	2.22	5.80
7	40	0.60	24.35	4.91	12.38	43.48	16.88	287.40	9.31	2.07	3.20	7.66	2.06	6.00
8	30	0.60	7.61	6.08	14.55	32.84	18.97	264.68	9.33	2.06	2.81	14.22	3.30	5.95
8	40	0.60	6.29	2.55	3.49	11.56	17.91	318.31	9.51	0.81	2.45	3.99	2.23	6.00

Horace Jones House Site (40KN105) chemical raw results.

SPOKE	METERS	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
1	2	1069.76	2.89	3.07	175.53	1.40	4933.54	1.55	3.54	1.28	32.01	2808.68	146.88	401.81	138.76
1	6	1246.50	3.41	4.07	209.23	1.43	5882.24	1.10	2.69	0.97	21.75	2050.70	217.86	368.75	175.23
1	10	1215.13	2.06	3.16	144.96	1.47	5052.43	0.58	2.00	0.54	14.95	870.63	282.81	358.26	146.79
2	2	1357.78	3.88	5.23	171.34	1.89	9146.91	1.55	4.36	1.25	29.87	3714.42	334.45	535.76	232.58
2	6	1356.06	2.43	6.27	109.42	1.66	6239.67	0.84	2.78	1.04	31.11	991.79	631.42	670.89	245.11
2	OUT	2611.65	7.42	11.89	256.50	0.93	23639.19	7.81	4.42	23.15	87.91	5182.04	780.01	847.24	418.17
3	2	2195.60	3.22	4.06	319.89	1.80	9872.61	3.88	3.63	6.64	41.57	3078.10	280.06	567.31	205.11
3	6	1304.67	1.62	4.20	160.07	0.92	6662.87	0.53	2.73	0.56	14.69	634.47	329.08	837.31	223.14
3	10	1162.68	1.58	5.10	141.19	1.72	7229.18	0.70	4.41	0.45	18.36	1077.82	393.28	333.71	179.26
3	15	3375.51	3.83	8.36	244.73	1.08	31397.39	1.33	7.71	3.12	57.95	2159.55	743.52	996.77	1463.26
3	OUT	2114.55	2.80	9.97	264.11	0.97	12156.71	7.04	4.08	2.70	34.38	1972.93	492.48	739.63	605.54
4	2	1277.00	1.83	3.66	174.53	1.36	5121.74	0.75	2.91	1.14	19.39	1607.23	348.70	497.59	284.48
4	6	902.25	1.96	2.97	80.03	2.63	5137.13	0.34	2.65	0.33	12.14	1040.33	258.87	389.25	95.54
4	10	922.47	1.32	5.10	65.94	1.15	6899.87	0.42	2.80	0.30	12.83	1266.22	256.49	289.86	163.84
5	2	1275.64	1.98	5.05	117.23	1.22	9143.58	0.43	3.64	0.41	12.64	1148.20	275.33	557.95	249.52
5	6	985.29	0.39	2.37	61.66	0.63	4439.90	0.17	1.92	0.14	8.57	647.92	201.29	359.62	99.43
5	10	1457.77	1.61	2.61	103.83	1.85	6123.52	0.34	3.25	0.44	6.31	1452.79	221.51	507.01	161.97
5	OUT1	1621.20	2.35	2.78	173.17	1.02	7771.41	1.69	3.03	1.23	7.80	3876.08	168.63	334.10	252.66
5	OUT2	1643.91	2.47	2.87	144.36	1.05	7772.13	1.37	3.47	1.66	9.91	4048.92	209.73	318.64	263.71
6	2	1355.50	2.18	4.02	197.53	1.62	7599.54	0.94	3.54	0.69	13.62	971.54	222.07	641.33	204.01
6	6	1202.36	1.63	3.12	146.87	1.40	5981.85	0.95	3.03	0.44	12.79	1181.66	285.52	426.91	162.23
7	2	1125.92	2.34	2.39	215.28	1.40	4407.83	1.06	1.73	0.89	12.58	1906.88	162.49	263.31	106.73
7	6	1173.50	1.25	2.34	123.96	1.40	4799.27	0.49	1.68	0.30	8.12	951.65	161.94	412.66	94.89
7	10	910.38	0.67	1.94	64.87	0.93	4066.39	0.26	2.30	0.23	406.39	768.06	144.26	284.54	115.37
8	6	1211.12	1.80	3.46	211.99	1.06	6436.04	0.70	4.56	0.77	19.25	1812.10	165.66	363.00	303.85
8	10	1161.87	1.56	3.32	195.92	1.28	5897.81	0.62	3.26	0.55	12.91	1377.16	163.77	334.10	215.87
8	15	1027.16	1.13	9.85	81.06	0.93	10035.62	0.30	5.55	0.38	11.88	647.23	717.72	341.47	435.48
8	20	1022.31	0.39	2.87	47.18	0.50	5231.99	0.15	1.95	0.14	6.81	710.48	243.13	356.43	124.39
HOUSE	1	694.85	0.87	2.49	47.66	0.91	5793.29	0.14	3.38	0.78	4.63	629.86	1041.85	519.00	138.26
HOUSE	2	699.67	0.98	3.50	53.31	0.99	6394.30	0.16	4.84	0.88	4.74	751.45	1003.44	474.26	192.72
HOUSE	3	829.37	1.26	3.82	68.17	1.31	8416.39	0.22	6.01	0.74	4.81	707.04	1349.51	557.98	261.11
HOUSE	4	862.85	1.41	3.81	67.53	1.38	9276.18	0.22	6.89	0.65	5.30	686.27	1260.89	617.88	269.04
HOUSE	5	782.38	2.23	4.71	61.04	1.48	8243.15	0.39	8.00	0.93	5.45	649.95	1373.99	603.98	254.32
SPOKE	METERS	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
6	20	1151.18	0.39	3.70	62.70	0.44	6458.23	0.35	1.77	0.14	8.72	1280.24	342.45	422.67	109.00
6	25	1088.56	0.64	1.75	44.61	0.32	4148.55	0.89	1.47	0.24	5.30	842.68	164.05	332.35	72.92
7	20	1069.77	1.57	3.41	66.79	0.52	5393.97	1.00	1.41	0.83	9.72	3584.04	356.28	404.79	96.98
7	25	1243.57	0.39	1.18	35.69	0.25	3473.48	0.31	0.55	0.33	4.29	1246.93	171.94	390.44	44.01

Horace Jones House Site (40KN105) chemical raw results.
(continued)

SPOKE	METERS	MO	NA	NI	P	PB	S	SI	SR	TI	V	ZN	TOTAL C	PH
1	2	0.45	45.35	4.72	269.08	437.20	26.21	396.12	11.70	3.77	4.70	305.39	7.48	6.80
1	6	0.47	19.33	6.37	489.36	157.44	28.03	468.74	18.54	4.82	5.13	163.62	9.61	6.50
1	10	0.40	11.29	5.94	177.61	62.81	20.92	365.49	14.24	3.19	3.39	103.87	5.32	6.15
2	2	0.54	34.45	8.34	1099.11	292.27	45.71	487.55	17.72	5.06	5.91	183.70	8.04	6.50
2	6	0.43	8.82	6.69	199.48	73.29	23.59	543.17	14.09	3.42	3.95	72.30	5.08	6.90
2	OUT	1.17	264.49	17.89	10423.89	426.47	216.17	412.88	68.42	10.65	7.41	1716.90	19.91	6.40
3	2	0.78	50.68	8.14	3872.22	221.21	46.28	551.18	34.62	8.16	4.14	570.17	6.91	6.40
3	6	0.31	11.33	7.63	263.33	83.01	23.47	580.75	16.97	3.61	2.87	93.52	7.97	6.95
3	10	0.33	9.28	6.59	187.24	93.96	26.32	568.96	19.10	2.89	3.36	103.77	6.58	6.95
3	15	1.10	133.38	19.38	1219.42	119.32	104.78	1034.67	79.38	6.75	7.00	610.14	9.36	8.10
3	OUT	0.80	61.64	10.26	1278.89	217.35	75.41	819.47	33.64	4.47	4.97	1770.96	4.92	7.55
4	2	0.40	14.95	7.70	335.35	90.31	18.06	749.64	14.72	4.07	4.02	156.72	2.66	7.10
4	6	0.33	10.20	6.21	54.28	53.02	18.41	359.17	10.96	3.61	2.65	50.21	5.11	6.55
4	10	0.22	10.42	4.85	133.09	32.30	27.39	458.64	13.82	1.74	2.83	43.89	6.14	6.50
5	2	0.31	24.34	7.20	238.55	75.50	32.05	520.45	19.68	3.55	3.33	75.25	8.15	6.60
5	6	0.14	7.73	2.91	24.33	40.14	16.86	178.95	9.67	1.05	1.20	21.31	4.04	5.95
5	10	0.38	8.66	6.07	75.02	32.12	19.56	489.40	13.20	4.61	2.81	24.83	4.49	6.00
5	OUT1	0.54	24.83	6.42	1552.94	121.87	36.44	417.44	17.21	3.89	4.54	299.18	5.06	6.70
5	OUT2	0.53	25.83	6.37	1812.14	70.96	39.55	441.11	18.70	4.79	4.61	214.21	5.11	6.90
6	2	0.31	13.02	6.35	295.44	228.68	28.30	462.82	16.97	4.35	3.20	205.43	6.84	6.75
6	6	0.31	15.50	4.81	226.19	92.17	22.69	424.91	14.98	2.90	3.15	219.98	5.00	6.45
7	2	0.32	11.89	4.85	243.84	220.70	23.06	313.89	11.69	3.66	3.92	225.72	6.58	6.00
7	6	0.27	12.79	4.53	58.75	55.02	18.69	355.40	11.09	2.97	2.57	78.28	4.83	6.00
7	10	0.19	10.50	70.71	101.92	31.95	13.94	255.34	8.55	1.84	1.93	112.52	3.16	6.20
8	6	0.32	13.15	6.52	169.13	152.73	25.14	485.83	13.78	4.14	4.55	89.08	7.83	6.70
8	10	0.26	10.70	5.94	136.69	107.65	23.57	388.82	12.93	3.80	4.00	90.99	7.30	6.40
8	15	0.17	8.80	6.75	60.06	41.47	41.08	499.64	15.79	2.32	3.14	32.91	7.25	7.40
8	20	0.11	6.19	2.52	11.90	17.63	17.69	349.31	9.25	1.14	2.13	12.05	4.33	6.50
HOUSE	1	0.11	886.63	3.04	465.03	39.69	224.03	382.07	10.90	1.31	1.71	34.87	1.56	7.15
HOUSE	2	0.12	641.04	3.56	492.18	37.51	191.81	424.78	12.47	1.55	1.98	32.24	2.05	7.25
HOUSE	3	0.17	764.41	4.62	483.05	51.86	230.68	483.05	13.80	1.72	2.33	49.94	2.47	7.20
HOUSE	4	0.19	690.77	4.78	513.74	38.36	212.93	498.57	14.79	1.78	2.43	48.50	2.55	7.25
HOUSE	5	0.35	678.86	5.17	622.35	57.19	313.64	451.99	14.52	1.81	2.71	45.88	2.68	7.25
SPOKE	METERS	MO	NA	NI	P	PB	S	SI	SR	TI	V	ZN	TOTAL C	PH
6	20	0.23	5.95	2.82	29.60	37.73	23.85	325.16	15.35	1.60	2.99	30.35	6.52	6.25
6	25	0.28	6.70	1.75	6.45	17.87	15.07	215.91	9.28	0.88	1.96	43.76	3.41	6.10
7	20	0.29	17.34	3.29	666.75	33.54	28.72	308.50	12.59	2.35	4.41	101.51	4.96	6.20
7	25	0.25	45.77	1.25	53.46	14.73	20.54	190.46	6.75	0.60	2.11	17.17	2.60	5.70

John Jones House Site chemical raw results.

SPOKE	METERS	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
CENTER	1	1104.55	2.05	3.26	173.14	0.42	4125.40	0.99	4.11	1.36	17.87	1177.35	310.86	321.44	393.98
1	6	1055.20	2.25	2.49	134.58	0.44	2249.85	0.63	2.83	1.35	8.59	1509.10	385.80	229.72	251.48
1	10	936.84	1.37	2.15	118.36	0.28	1725.95	0.45	2.19	1.02	11.21	1079.15	356.04	187.24	147.28
1	15	940.75	1.33	4.21	94.42	0.33	3277.35	0.43	3.41	0.78	7.74	1103.05	761.60	477.84	245.28
2	2	1186.85	2.46	4.22	286.52	0.39	5038.80	2.93	4.07	3.12	22.44	1682.39	386.20	615.53	389.08
2	6	989.17	2.47	3.70	114.80	0.44	5947.00	0.88	4.45	1.93	10.12	1694.08	188.63	499.70	403.09
2	10	1062.29	2.26	4.77	130.90	0.39	4848.35	0.69	3.42	1.08	13.76	1030.54	460.02	393.69	265.85
2	15	873.64	1.34	2.78	128.91	0.33	2291.92	0.66	0.83	2.04	9.11	1095.27	612.09	361.43	219.52
2	20	1083.33	1.29	4.20	98.47	0.34	3662.48	0.44	4.19	1.06	7.43	1129.91	641.86	552.74	389.63
3	6	1194.46	1.76	4.64	140.11	0.43	5055.53	0.88	6.18	1.51	9.53	1220.26	367.54	355.75	576.63
3	10	3583.58	12.42	9.11	234.35	1.02	8802.78	2.60	7.37	4.01	79.02	3146.07	444.11	679.34	598.93
3	15	2914.56	3.53	8.58	304.03	0.60	25621.32	1.71	10.06	4.31	24.83	2402.55	633.76	677.95	1408.91
4	2	1382.73	3.37	5.05	296.30	0.43	9830.86	3.37	6.11	3.57	68.32	2469.91	401.82	888.87	621.27
4	6	1145.06	1.82	4.04	144.90	0.42	5424.07	0.89	6.45	1.58	12.97	1214.89	589.88	319.44	572.35
4	10	3060.49	9.47	4.04	222.91	0.61	17686.97	6.50	8.48	13.13	30.30	6887.27	461.43	1507.77	499.69
4	15	1265.95	2.73	6.85	198.09	0.46	5148.44	1.31	6.16	1.62	16.17	2036.05	374.41	289.63	455.97
4	20	1815.71	1.94	5.53	235.88	0.58	4345.17	0.76	5.59	1.84	17.02	1357.02	321.53	274.02	544.01
4	25	1356.08	2.28	8.41	205.46	0.50	12769.93	0.70	6.28	1.89	13.93	1865.08	392.55	316.03	619.78
4	30	1435.68	2.63	7.05	160.94	0.53	10394.58	1.07	6.75	2.91	25.83	2842.39	847.39	337.80	668.26
5	6	1076.29	1.46	3.24	218.11	0.38	3516.63	1.69	4.98	2.63	27.17	1004.79	352.99	269.43	451.28
5	10	1203.57	1.21	2.24	134.41	0.43	1993.47	0.78	3.31	1.16	12.27	908.97	395.26	203.88	307.35
5	15	1323.26	1.23	2.49	108.47	0.42	2440.24	0.39	3.42	0.96	8.34	953.08	424.01	194.03	317.18
5	20	994.21	1.11	2.09	61.85	0.35	1435.63	0.28	2.89	0.63	5.24	804.02	605.28	146.00	232.21
6	2	1088.36	1.40	3.03	176.52	0.45	2941.27	0.98	4.95	1.27	13.41	1289.58	381.89	259.61	487.78
6	6	1093.50	1.28	2.43	125.38	0.39	2190.11	0.50	4.04	1.23	7.93	1259.84	338.67	227.19	369.95
6	10	2680.16	2.66	4.64	292.36	0.58	21295.37	0.85	11.57	4.90	16.59	1968.43	753.70	675.05	1795.27
6	15	1878.48	3.45	8.81	433.38	0.53	42151.03	0.61	7.69	1.90	17.23	1121.17	982.19	900.15	1994.61
6	20	1118.39	1.59	6.99	201.54	0.49	7035.49	0.39	3.49	0.95	9.87	1004.90	299.41	303.22	524.92
6	25	904.21	1.77	4.02	77.24	0.37	5190.18	0.46	3.64	0.82	8.17	1570.74	490.57	427.63	263.37
7	6	773.92	1.28	2.34	119.64	0.31	2375.79	0.69	2.26	0.67	7.52	1188.77	347.67	212.43	226.84
7	10	800.81	1.25	1.81	106.45	0.34	2450.36	0.49	2.32	0.85	21.62	905.51	273.97	286.02	215.98
7	15	998.35	1.49	2.83	95.93	0.39	4174.42	0.51	3.41	0.78	7.42	1172.90	606.80	352.94	337.61
7	20	811.29	1.41	2.24	81.33	0.34	3130.94	0.58	3.17	0.87	8.43	1569.02	377.17	299.24	278.99
8	2	819.45	1.78	2.42	216.32	0.36	3904.75	1.56	2.92	1.52	14.93	1341.07	205.28	384.88	301.07
8	6	804.56	1.23	1.64	232.91	0.34	1694.05	0.99	2.01	0.80	5.63	1072.83	362.13	254.68	197.32
8	10	912.72	1.40	1.66	99.28	0.35	2109.73	0.46	2.26	0.47	5.56	1236.68	332.17	207.82	235.95
8	15	950.27	1.04	1.10	50.25	0.32	1242.94	0.27	1.99	0.51	3.94	834.14	342.70	168.15	180.39
8	20	959.27	1.18	1.53	71.69	0.33	2515.48	0.36	2.34	0.59	5.72	1119.96	404.76	282.93	234.14
SPOKE	METERS	AL	AS	B	BA	BE	CA	CD	CO	CR	CU	FE	K	MG	MN
1	30	787.22	1.41	3.25	68.75	0.29	2509.42	0.35	2.91	0.68	5.17	1369.31	736.99	409.42	230.02
2	40	943.36	1.45	2.29	54.72	0.32	2278.80	0.38	4.62	0.87	4.42	1443.33	249.60	408.19	401.90
3	30	785.09	1.08	2.20	49.51	0.27	1882.08	0.28	3.32	0.58	4.07	1134.78	548.77	222.02	232.94
3	40	881.00	1.30	1.74	36.18	0.26	2010.34	0.34	3.61	0.75	3.87	1363.57	261.06	521.21	193.79
4	45	1010.94	1.67	3.19	67.51	0.33	3132.66	0.48	5.42	0.88	8.72	1830.56	494.95	226.74	333.03
4	50	948.42	1.32	2.77	53.57	0.32	2285.34	0.41	4.23	0.80	6.27	1532.26	321.87	165.42	242.06

John Jones House Site chemical raw results. (continued)

SPOKE CENTER	METERS	MO	NA	NI	P	PB	S	SI	SR	TI	V	ZN	TOTAL C	PH
1	1	0.48	12.60	5.03	472.38	212.74	36.48	261.25	25.81	6.01	5.30	220.27	3.98	6.10
1	6	0.47	9.24	3.47	383.81	146.25	29.47	199.65	13.72	7.04	5.61	103.19	2.86	5.75
1	10	0.41	8.81	2.12	438.01	302.82	29.02	140.48	4.79	3.56	3.50	47.49	2.32	5.55
1	15	0.41	8.25	3.38	687.75	55.98	32.41	199.45	9.04	4.24	3.98	45.69	4.49	6.15
2	2	0.62	11.61	5.48	931.81	923.23	73.32	357.52	30.57	6.63	4.73	958.31	4.72	6.70
2	6	0.43	8.58	4.60	417.96	115.52	34.60	382.78	40.32	7.60	6.87	86.70	3.28	7.75
2	10	0.42	16.07	3.58	458.11	243.68	40.02	351.29	34.23	5.95	5.64	104.10	4.17	7.05
2	15	0.37	6.57	3.04	481.08	169.16	31.95	165.03	6.83	3.29	3.89	151.69	3.35	5.90
2	20	0.39	7.61	4.66	702.70	47.21	38.14	258.24	10.17	3.86	4.32	57.23	5.03	5.85
3	6	0.47	10.14	6.57	524.47	115.28	38.60	469.05	24.64	6.55	5.67	104.63	3.10	7.40
3	10	1.34	28.08	9.11	1533.11	575.01	110.53	1056.34	72.17	16.45	11.13	562.50	13.01	7.00
3	15	1.13	87.02	17.66	4165.25	484.63	115.58	723.50	60.94	12.43	7.33	484.63	5.89	7.05
4	2	0.71	16.30	7.89	1034.85	601.55	91.78	527.72	47.38	9.22	6.61	1179.31	4.94	7.10
4	6	0.45	12.44	6.58	624.65	123.68	52.06	389.68	30.77	6.15	4.90	164.51	3.42	7.05
4	10	1.48	38.51	9.63	2094.35	4933.50	154.94	770.30	164.19	16.05	11.70	1852.04	5.54	7.80
4	15	0.53	20.38	6.74	716.42	296.94	44.54	386.78	15.67	6.49	6.45	208.95	6.57	6.20
4	20	0.63	13.59	7.76	1024.85	107.03	37.07	441.96	67.25	7.72	6.64	115.11	3.64	6.25
4	25	0.49	19.61	8.22	1581.20	59.15	51.36	551.67	34.53	8.52	5.99	98.40	3.94	7.50
4	30	0.60	30.99	8.69	2069.29	49.76	57.25	577.73	29.97	8.01	7.08	141.79	4.31	7.45
5	6	0.50	11.84	5.64	585.85	513.55	48.96	336.78	10.74	4.69	5.37	536.91	2.28	6.50
5	10	0.47	8.18	4.39	616.87	104.29	21.33	230.00	6.99	4.43	3.34	199.36	1.64	6.05
5	15	0.46	8.57	4.41	646.77	40.05	19.51	223.84	7.24	4.15	3.36	45.38	2.02	5.95
5	20	0.39	6.83	3.13	207.52	127.23	20.40	180.58	3.93	2.78	3.48	13.82	1.56	5.90
6	2	0.44	5.26	6.13	427.91	266.05	30.56	279.20	8.32	6.22	4.84	244.90	2.93	6.05
6	6	0.43	7.23	4.90	564.59	80.89	22.78	236.68	6.74	7.02	4.20	73.14	2.26	6.20
6	10	0.94	25.91	20.48	1392.44	99.71	85.61	605.82	54.32	13.67	6.49	112.68	3.65	7.50
6	15	0.74	39.19	22.65	1916.48	47.17	113.37	738.82	104.94	16.24	4.68	70.46	5.69	7.50
6	20	0.42	12.08	7.00	937.31	27.62	37.35	367.37	20.69	8.33	4.27	31.53	2.84	7.60
6	25	0.37	27.06	3.82	1087.05	29.33	32.35	235.15	13.39	5.59	5.50	36.99	3.93	7.20
7	6	0.35	7.82	3.35	305.53	114.67	23.79	135.20	5.65	4.46	4.17	130.63	3.08	5.70
7	10	0.32	11.96	3.03	436.44	93.05	18.98	205.25	5.44	4.90	4.22	85.20	1.65	6.75
7	15	0.40	22.18	4.45	899.20	42.43	31.14	151.97	10.55	4.70	4.18	37.86	4.17	6.35
7	20	0.37	15.49	3.92	737.55	38.81	27.13	177.24	8.14	5.43	4.66	43.54	2.97	6.20
8	2	0.42	15.11	4.44	563.30	565.19	48.52	190.37	20.41	5.41	4.68	466.61	3.75	6.50
8	6	0.37	10.43	3.21	316.66	567.67	44.18	147.07	5.04	5.45	4.41	252.19	2.14	5.85
8	10	0.33	13.50	3.27	343.25	80.91	25.47	115.36	5.93	4.62	4.38	50.20	3.31	5.40
8	15	0.33	10.81	2.39	425.60	25.34	21.56	78.30	3.43	3.34	2.69	16.85	2.08	5.50
8	20	0.36	15.75	3.13	669.15	28.49	23.97	117.43	6.10	4.47	3.99	24.60	2.64	6.05
SPOKE CENTER	METERS	MO	NA	NI	P	PB	S	SI	SR	TI	V	ZN	TOTAL C	PH
1	30	0.34	6.22	2.87	462.46	18.85	19.35	277.64	6.43	5.85	5.44	14.26	1.94	7.10
2	40	0.40	5.26	4.38	212.28	18.32	20.70	252.80	4.35	4.94	6.02	10.99	2.67	6.65
3	30	0.33	5.30	2.82	234.43	16.33	17.31	206.10	4.63	3.49	5.25	9.03	1.94	6.55
3	40	0.37	3.92	2.44	139.41	15.83	15.27	250.92	3.18	3.50	6.45	5.70	1.46	7.30
4	45	0.45	9.29	4.37	388.31	27.98	26.79	262.49	8.73	4.49	7.03	25.06	3.63	6.45
4	50	0.39	9.79	3.25	141.55	21.13	17.07	303.55	5.98	3.44	7.46	12.98	2.88	6.65

APPENDIX B

Site background soil values (ppm) except Total C (%) and pH (H+); * n=5 , ** n=3.

	Mabry		Oliver		Bart Toole		Horace Jones		John Jones	
	n = 10		n = 6		n = 6		n = 4		n = 6	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Al	1238.30	306.10	1329.70	110.53	1562.72	190.43	1138.27	78.35	892.67	92.19
As	1.62	0.46	1.09	0.17	1.23	0.19	0.75	0.56	1.37	0.20
B	1.41	0.31	1.72	0.19	1.74	0.28	2.51	1.24	2.57	0.60
Ba	88.71	18.53	65.16	6.95	91.13	8.62	52.45	14.75	55.04	12.10
Be	0.47	0.15	0.55	0.06	0.63	0.08	0.38	0.12	0.30	0.03
Ca	1420.33	429.08	3595.07	695.66	3872.20	698.83	4868.56	1325.11	2349.77	443.07
Cd	0.20	0.02	0.29	0.05	0.43	0.11	0.64	0.36	0.37	0.07
Co	2.33	0.56	3.03	0.38	1.82	0.27	1.30	0.52	4.02	0.92
Cr	0.38	0.07	0.53	0.10	* 0.52	* 0.07	0.39	0.31	0.76	0.12
Cu	4.78	0.74	4.57	1.58	5.39	1.42	7.01	2.62	5.42	1.84
Fe	456.08	111.19	769.46	338.84	1286.34	397.03	1738.47	1246.35	1445.64	230.16
K	363.62	58.02	94.93	15.82	136.14	27.95	258.68	104.92	435.54	192.44
Mg	231.95	48.37	416.73	255.02	266.05	59.68	387.56	39.10	325.50	140.19
Mn	328.11	94.47	428.00	76.50	213.99	50.54	80.73	28.71	272.29	78.61

Site background soil values (ppm) except Total C (%) and pH (H+); * n=5 , ** n=3. (continued)

	Mabry		Oliver		Bart Toole		Horace Jones		John Jones	
	n = 10		n = 6		n = 6		n = 4		n = 6	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Mo	0.44	0.09	0.46	0.04	0.56	0.05	0.26	0.03	0.38	0.04
Na	2.62	0.49	6.57	0.80	10.95	6.67	18.94	18.63	6.63	2.38
Ni	3.66	0.66	5.70	0.95	4.47	1.19	2.28	0.94	3.36	0.83
P	11.86	4.22	76.07	63.83	15.18	11.00	**29.84	**23.51	263.07	133.34
Pb	17.74	2.53	17.80	2.61	23.15	12.62	25.97	11.37	19.74	4.46
S	10.64	1.19	15.43	3.39	16.70	2.45	22.05	5.74	19.42	4.08
Si	223.68	24.21	230.56	45.21	279.40	32.19	260.01	66.78	258.92	32.39
Sr	4.99	1.26	6.87	0.66	8.97	0.58	10.99	3.76	5.55	1.95
Ti	2.42	0.43	1.43	0.15	1.78	0.58	1.36	0.78	4.29	0.99
V	2.49	0.32	2.25	0.51	2.92	0.33	2.87	1.12	6.28	0.87
Zn	6.68	1.19	9.61	3.62	10.21	5.10	48.20	37.16	13.00	6.64
Tot C	1.88	0.38	2.28	0.55	2.43	0.62	4.37	1.73	2.42	0.79
pH	6.05	0.27	6.68	0.25	5.96	0.27	6.06	0.25	6.78	0.34

Site background soil, logged values; * n=5, ** n=3.

	Mabry		Oliver		Bart Toole		Horace Jones		John Jones	
	n = 10		n = 6		n = 6		n = 4		n = 6	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Al	7.09	0.26	7.19	0.08	7.35	0.12	7.04	0.07	6.79	0.10
As	0.44	0.31	0.08	0.16	0.20	0.15	-0.47	0.66	0.31	0.14
B	0.32	0.24	0.54	0.11	0.54	0.16	0.82	0.55	0.92	0.24
Ba	4.46	0.22	4.17	0.11	4.51	0.09	3.93	0.29	3.99	0.24
Be	-0.81	0.35	-0.60	0.11	-0.47	0.14	-1.00	0.33	-1.21	0.10
Ca	7.21	0.34	8.17	0.18	8.25	0.17	8.46	0.27	7.75	0.18
Cd	-1.62	0.12	-1.26	0.18	-0.88	0.30	-0.58	0.61	-1.00	0.18
Co	0.82	0.25	1.10	0.12	0.59	0.15	0.18	0.52	1.37	0.23
Cr	-0.97	0.19	-0.65	0.18	*-0.66	*0.13	-1.17	0.75	-0.28	0.16
Cu	1.55	0.16	1.48	0.30	1.65	0.33	1.89	0.39	1.65	0.31
Fe	6.09	0.27	6.57	0.44	7.11	0.36	7.30	0.62	7.27	0.16
K	5.88	0.17	4.54	0.17	4.89	0.22	5.49	0.42	6.00	0.44
Mg	5.43	0.21	5.92	0.48	5.56	0.24	5.96	0.10	5.70	0.45
Mn	5.75	0.33	6.04	0.18	5.34	0.24	4.33	0.40	5.57	0.27

Site background soil, logged values; * n=5, ** n=3.
(continued)

	Mabry		Oliver		Bart Toole		Horace Jones		John Jones	
	n = 10		n = 6		n = 6		n = 4		n = 6	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
Mo	-0.85	0.21	-0.79	0.10	-0.58	0.10	-1.34	0.11	-0.97	0.11
Na	0.95	0.19	1.88	0.12	2.28	0.47	2.59	0.95	1.84	0.36
Ni	1.28	0.18	1.73	0.17	1.46	0.30	0.75	0.44	1.19	0.24
P	2.41	0.40	4.09	0.76	2.44	0.89	**3.08	**1.09	5.47	0.50
Pb	2.87	0.15	2.87	0.15	3.02	0.53	3.18	0.46	2.96	0.21
S	2.36	0.11	2.72	0.22	2.81	0.16	3.07	0.27	2.95	0.20
Si	5.41	0.11	5.43	0.19	5.63	0.12	5.54	0.26	5.55	0.13
Sr	1.58	0.28	1.92	0.10	2.19	0.07	2.35	0.36	1.66	0.35
Ti	0.87	0.19	0.35	0.11	0.52	0.41	0.17	0.61	1.43	0.22
V	0.91	0.13	0.79	0.21	1.06	0.11	1.00	0.37	1.83	0.14
Zn	1.88	0.19	2.19	0.44	2.20	0.58	3.66	0.74	2.46	0.49
Tot C	0.61	0.22	0.80	0.25	0.86	0.25	1.41	0.41	0.84	0.33
pH	1.80	0.04	1.90	0.04	1.78	0.04	1.80	0.04	1.91	0.05

APPENDIX C

Mabry Site (40KN86) truncated ordinal values.

NORTH	WEST	CATEGORY1	CATEGORY2	CATEGORY3	CATEGORY4	CATEGORY5	CATEGORY6	CATEGORY7	CATEGORY8	CATEGORY9
1010	930	0	1	1	0	1	0	1	0	1
1002	930	0	1	1	1	1	1	1	1	1
994	930	0	0	0	0	0	0	0	0	0
1002	932	0	1	2	1	2	1	2	1	1
1002	934	0	1	1	1	1	1	1	1	1
1002	936	0	0	1	0	0	0	0	0	0
1010	938	0	1	1	1	0	0	0	0	0
1008	938	0	0	0	0	0	0	0	0	0
1006	938	0	1	1	1	0	2	0	1	0
1004	938	0	1	1	2	1	2	1	1	0
1002	938	0	0	1	0	0	1	0	0	0
1000	938	0	0	0	1	0	0	0	0	0
998	938	0	1	1	1	0	1	0	0	0
996	938	0	0	0	0	0	1	0	0	0
994	938	0	0	0	1	0	0	0	0	0
992	938	0	0	0	0	0	0	0	0	0
990	938	0	0	0	0	0	0	0	0	0
986	938	0	1	0	0	0	-1	0	0	0
982	938	0	0	0	0	0	0	1	0	0
1002	940	0	1	1	0	0	0	1	0	0
1002	942	0	1	1	1	1	1	2	1	1
1010	944	0	0	0	0	0	0	0	0	0
1008	944	0	0	0	0	0	0	0	0	0
1006	944	0	1	1	0	0	0	1	0	0
1004	944	1	3	3	1	2	1	2	0	2
1002	944	1	1	2	1	1	0	2	0	1
1000	944	1	2	2	1	2	2	2	1	2
998	944	0	1	1	1	1	1	1	1	1
996	944	0	0	1	1	0	0	0	0	0
994	944	0	0	0	0	0	0	0	0	0
992	944	0	0	0	1	0	0	0	0	0
990	944	0	0	0	3	0	0	0	2	0
986	944	0	0	0	0	0	0	0	0	0
982	944	0	0	0	0	0	0	0	0	0
1010	947	0	0	0	0	0	0	0	0	0
1008	947	0	0	0	1	0	0	0	0	0
1006	947	0	0	0	0	1	0	1	0	1
1004	947	0	1	2	1	1	0	1	0	2
1002	947	1	1	1	5	2	1	2	3	1
1000	947	0	1	1	1	1	1	1	1	1
998	947	0	1	1	1	0	0	0	0	0
996	947	0	0	1	1	0	0	0	0	0
994	947	0	0	1	1	0	0	0	0	0
992	947	0	1	1	2	1	0	1	1	1
990	947	0	0	0	1	0	0	0	1	0
986	947	0	0	0	1	0	0	0	0	0
982	947	0	0	0	1	0	0	0	0	0
1002	948	0	0	1	1	1	0	1	1	1
1000	948	0	1	1	1	1	1	1	1	1
1002	950	0	0	0	1	0	0	0	1	0
1002	952	0	0	1	1	1	1	0	0	1
1010	954	0	0	0	1	0	1	0	0	0
1008	954	0	0	0	1	0	0	0	1	1
1006	954	0	0	1	2	1	1	0	1	1
1004	954	0	0	0	1	0	0	0	1	0
1002	954	0	0	0	1	0	0	0	0	0
1000	954	0	0	1	1	0	0	0	1	0
998	954	0	1	1	1	0	0	0	1	0
996	954	0	0	1	1	0	0	0	1	0
994	954	0	1	1	1	1	0	0	1	1
992	954	0	0	0	1	0	0	1	1	0
990	954	0	0	0	1	0	0	0	1	0
986	954	0	0	0	1	0	0	0	1	0
982	954	0	0	0	1	0	0	0	0	0
1002	956	0	0	1	0	0	0	0	0	0
1002	958	0	1	2	1	1	0	0	1	1

Mabry Site (40KN86) truncated ordinal values. (continued)

NORTH	WEST	CATEGORY1	CATEGORY2	CATEGORY3	CATEGORY4	CATEGORY5	CATEGORY6	CATEGORY7	CATEGORY8	CATEGORY9
1002	960	0	0	2	1	0	0	0	1	1
1010	962	0	1	1	1	1	1	1	1	1
1008	962	0	1	1	1	1	1	0	1	1
1006	962	1	1	2	4	2	1	1	2	2
1004	962	1	2	4	2	2	1	2	1	3
1002	962	0	1	3	1	1	1	1	1	1
1000	962	0	1	2	0	1	0	0	0	1
998	962	0	0	1	0	0	0	0	0	0
996	962	0	0	1	0	0	0	0	0	0
994	962	0	1	1	0	0	0	0	0	1
992	962	0	0	0	0	0	0	0	0	0
990	962	0	0	0	0	0	0	0	0	0
986	962	0	0	0	0	0	0	1	0	0
982	962	0	0	0	0	0	0	0	0	0
1002	964	2	3	4	4	4	4	4	3	4
1010	966	0	0	0	0	0	0	0	0	0
1008	966	0	0	1	0	1	0	1	0	1
1006	966	1	1	2	1	2	1	2	1	2
1004	966	2	3	4	4	4	4	4	2	4
1002	966	2	3	4	4	4	4	4	3	4
1000	966	0	1	1	0	1	1	1	0	1
998	966	0	1	1	0	1	0	1	0	1
996	966	0	1	1	0	1	0	1	0	1
994	966	0	1	1	0	0	0	0	0	1
992	966	0	0	0	0	0	0	0	0	0
990	966	0	0	0	0	0	0	0	0	0
986	966	0	0	0	0	0	0	0	0	0
982	966	0	0	0	0	0	0	0	0	0
1002	968	0	1	1	0	1	1	1	0	1
1002	970	0	0	0	0	0	0	0	0	0
1002	972	0	0	1	0	0	0	0	0	1
1010	974	0	0	0	0	0	0	0	0	0
1008	974	0	0	0	0	0	0	0	0	0
1006	974	0	0	0	0	0	0	0	0	0
1004	974	0	1	0	0	1	0	0	0	1
1002	974	0	0	0	0	0	0	0	0	0
1000	974	0	0	0	0	0	0	0	0	0
998	974	0	0	0	0	0	0	0	0	0
996	974	0	0	1	0	0	0	0	0	0
994	974	1	0	1	5	1	0	3	4	1
992	974	0	0	1	4	1	0	1	3	1
990	974	1	1	1	4	1	0	2	3	1
986	974	0	0	1	5	1	0	1	4	0
982	974	0	0	0	5	0	0	1	3	0
1002	976	0	0	0	3	0	0	0	2	0
1002	978	0	0	0	0	0	0	0	0	0
1010	980	0	0	0	4	0	0	1	3	0
1008	980	0	0	0	5	1	0	1	3	1
1006	980	0	0	0	3	0	0	0	2	0
1004	980	0	0	0	3	0	0	0	2	0
1002	980	0	0	0	4	0	0	0	2	0
1000	980	0	0	0	3	0	0	0	2	0
998	980	0	0	0	0	0	0	0	0	0
996	980	0	0	0	0	0	0	0	0	0
994	980	0	0	1	0	0	0	0	0	0
992	980	0	0	0	0	0	0	0	0	0
990	980	0	0	0	0	0	0	0	0	0
986	980	0	0	0	0	0	0	0	0	0
982	980	0	0	0	0	0	0	0	0	0
1002	982	0	0	0	0	0	0	0	0	0
1002	984	0	1	2	2	1	1	1	1	1
1002	986	0	0	0	0	0	0	0	0	0
1010	988	0	0	0	0	0	0	0	0	0
1002	988	0	0	0	0	0	0	0	0	0
994	988	0	0	0	0	0	0	0	0	0

Oliver Site (40KN103) truncated ordinal values.

NORTH	EAST	CATEGORY1	CATEGORY2	CATEGORY3	CATEGORY4	CATEGORY5	CATEGORY6	CATEGORY7	CATEGORY8	CATEGORY9
984	997.5	3	1	3	4	3	2	1	4	3
986	997.5	1	1	1	1	1	1	0	2	1
988	997.5	1	1	0	3	1	0	0	3	0
990	997.5	1	0	0	1	0	0	0	1	0
992	997.5	0	0	0	1	0	0	0	1	0
994	997.5	0	0	0	0	0	0	0	0	0
996	997.5	0	0	0	0	0	0	0	0	0
998	997.5	0	0	0	0	0	0	0	0	0
1000	997.5	0	0	0	0	0	0	0	0	0
993	994	0	0	0	1	0	0	0	1	0
993	996	0	1	0	2	1	0	0	2	1
993	999	0	0	0	1	0	0	0	1	0
993	1001	0	1	0	2	0	0	0	2	1
991	996.5	1	1	2	1	1	0	0	1	1
989	996.5	2	1	1	4	1	1	1	4	2
992	995.5	0	0	1	2	1	0	0	2	1
990	995.5	2	1	1	4	1	2	1	4	2
988	995.5	2	1	1	3	2	2	1	3	2
988	999.5	1	0	0	1	0	0	0	2	0
988	1001.5	1	0	0	2	0	0	0	3	0
988	1003.5	2	1	2	2	1	1	0	3	1
988	1005.5	3	1	2	3	3	2	1	4	3
988	1007.5	1	1	1	3	1	1	1	3	1
992	992	0	0	0	0	0	0	0	0	0
992	990	1	0	0	0	0	0	0	1	0
1001	989.5	0	0	0	0	0	0	0	0	0
1003	1006.5	0	0	0	0	0	0	0	0	0
994	1008.5	0	0	0	0	0	0	0	0	0
1002	997.5	0	0	0	1	0	0	0	1	0
1004	997.5	0	1	1	2	1	1	1	2	1
1006	997.5	0	0	0	1	0	0	0	0	0
1008	997.5	0	0	0	1	0	0	0	1	0
980	997.5	0	0	0	0	0	0	0	0	0
980	994.5	0	0	0	0	0	0	0	0	0

Bart Toole House Site truncated ordinal values.

SPOKE	METERS	CATEGORY1	CATEGORY2	CATEGORY3	CATEGORY4	CATEGORY5	CATEGORY6	CATEGORY7	CATEGORY8	CATEGORY9
1	2	1	1	1	1	0	2	0	1	0
2	2	0	0	0	0	0	0	0	0	0
2	6	1	0	0	0	0	1	0	2	0
2	10	0	0	0	0	0	0	0	0	0
3	2	0	0	0	0	1	0	0	0	1
3	6	0	0	0	0	0	0	0	0	0
3	10	0	0	0	0	0	0	0	0	0
4	-6	1	1	1	2	1	0	1	1	1
4	-2	0	1	0	0	0	0	0	0	0
4	2	0	0	0	0	0	0	0	0	0
4	6	0	0	0	0	0	0	0	0	0
4	10	1	0	0	0	0	0	0	1	0
5	2	1	1	1	0	1	1	0	0	1
5	6	1	1	1	1	1	1	0	0	1
5	10	1	1	1	1	1	2	1	1	1
6	2	3	2	2	2	2	1	1	1	2
6	6	2	2	2	1	1	2	1	1	1
6	10	3	2	3	2	3	1	1	2	2
7	2	4	3	4	2	3	2	3	2	3
7	6	2	1	2	1	2	2	2	2	2
7	10	4	3	3	2	3	3	2	2	3
8	-6	1	2	2	1	2	2	1	1	3
8	-2	4	3	3	2	3	3	3	2	4
8	2	2	1	1	1	2	2	2	1	2
8	4	2	1	1	1	2	2	2	2	2
8	10	2	1	0	0	1	2	1	0	1
HOUSE	1	0	0	0	1	0	0	1	0	0
HOUSE	2	0	0	0	1	0	0	1	0	0
HOUSE	3	1	0	1	1	1	0	1	1	0
HOUSE	4	1	1	1	1	0	0	0	1	0
HOUSE	5	1	0	0	1	0	0	0	1	0

Horace Jones House Site (40KN105) truncated ordinal values.

SPOKE	METERS	CATEGORY1	CATEGORY2	CATEGORY3	CATEGORY4	CATEGORY5	CATEGORY6	CATEGORY7	CATEGORY8	CATEGORY9
1	2	0	0	1	0	0	0	0	0	0
1	6	0	0	0	0	0	0	0	0	0
1	10	0	0	0	0	0	0	0	0	0
2	2	0	0	1	0	1	1	1	0	1
2	6	1	0	1	0	0	0	0	0	0
2	OUT	1	1	2	1	2	1	2	1	2
3	2	0	1	1	0	1	1	1	0	1
3	6	1	0	1	0	0	0	1	0	0
3	10	0	0	1	0	0	0	0	0	0
3	15	2	2	2	2	1	1	2	1	1
3	OUT	1	1	2	1	1	1	1	1	1
4	2	0	0	1	1	0	1	0	0	0
4	6	0	0	0	0	0	0	0	0	0
4	10	0	0	0	0	0	0	0	0	0
5	2	0	0	1	0	0	0	0	0	0
5	6	0	0	0	0	0	0	0	0	0
5	10	0	0	0	0	0	0	0	0	0
5	OUT1	0	0	1	0	0	0	0	0	0
5	OUT2	0	0	1	0	0	0	0	0	0
6	2	0	0	1	0	0	0	0	0	0
6	6	0	0	0	0	0	0	1	0	0
7	2	0	0	0	0	0	0	0	0	0
7	6	0	0	0	0	0	0	0	0	0
7	10	0	1	0	0	0	0	0	0	0
8	6	0	0	1	0	0	0	0	0	0
8	10	0	0	0	0	0	0	0	0	0
8	15	0	0	1	1	0	0	0	0	0
8	20	0	0	0	0	0	0	0	1	0
HOUSE	1	0	0	0	2	0	0	1	1	0
HOUSE	2	0	0	0	2	0	0	1	1	0
HOUSE	3	1	0	1	2	0	0	1	2	0
HOUSE	4	1	0	1	2	0	0	1	1	0
HOUSE	5	1	0	1	2	1	0	1	2	1

John Jones House Site truncated ordinal values.

SPOKE	METERS	CATEGORY1	CATEGORY2	CATEGORY3	CATEGORY4	CATEGORY5	CATEGORY6	CATEGORY7	CATEGORY8	CATEGORY9
CENTER	1	0	0	2	0	1	0	0	0	1
1 6		0	0	1	0	0	0	0	0	1
1 10		0	0	1	0	0	-1	0	0	0
1 15		0	0	0	0	0	0	0	0	0
2 2		0	1	3	0	2	0	1	0	3
2 6		0	1	2	0	1	0	0	0	1
2 10		0	0	2	0	1	0	0	0	1
2 15		0	0	1	0	0	-1	0	0	1
2 20		0	0	0	0	0	0	1	0	0
3 6		0	0	2	0	1	1	0	0	1
3 10		1	2	3	1	3	3	2	0	4
3 15		1	2	4	1	3	2	2	1	3
4 2		1	2	4	0	3	1	1	0	3
4 6		0	1	2	0	1	0	0	0	1
4 10		2	3	5	1	4	3	2	1	5
4 15		0	1	2	0	1	0	1	0	2
4 20		0	0	1	0	1	1	0	0	1
4 25		0	1	2	1	1	1	1	0	1
4 30		1	2	2	1	2	1	1	1	2
5 6		0	1	2	0	1	0	0	0	2
5 10		0	0	1	0	0	0	0	0	0
5 15		0	0	0	0	0	0	0	0	0
5 20		0	0	0	0	0	-1	0	0	0
6 2		0	0	1	0	1	0	0	0	1
6 6		0	0	0	0	0	0	0	0	0
6 10		1	2	3	1	2	1	1	1	2
6 15		1	2	3	1	2	2	2	1	2
6 20		0	1	1	0	0	0	0	0	0
6 25		0	0	1	1	0	0	0	0	0
7 6		0	0	0	0	0	-1	0	0	0
7 10		0	0	1	0	0	0	0	0	0
7 15		0	0	0	0	0	-1	0	0	0
7 20		0	0	0	0	0	0	0	0	0
8 2		0	1	3	0	1	0	0	0	2
8 6		0	0	2	0	0	0	0	0	1
8 10		0	0	0	0	0	-1	0	0	0
8 15		0	-1	-1	0	0	-2	0	0	0
8 20		0	0	0	0	0	-1	0	0	0

VITA

James Eugene Myster was born in Bucyrus, Ohio on June 2, 1962. His family moved to Minnesota in 1963. Graduating from Mayo High School in Rochester, Minnesota in 1980, he entered the University of Minnesota that September. In 1984 he was awarded a Bachelor of Arts degree in Anthropology. Having received a Rotary Foundation International Scholarship in 1986, James studied Archaeology at the Univerisity of Glasgow, Scotland, in the United Kingdom. He was awarded a Graduate Diploma of Proficiency in Archaeology in 1987. In the Fall of 1987, he entered the University of Tennessee in Knoxville. A Master of Arts degree in Anthropology was awarded in May 1994.

James married Susan M. Thurston on June 4, 1988 in Brooklyn Park, Minnesota. He has been employed as an archaeologist for the Minnesota Historical Society since 1991.