VII. ARTIFACT ANALYSIS

A. INTRODUCTION

This chapter presents the results of analysis of archaeological materials recovered from the Whitby Branch Site. The excavations yielded a total of 15,598 artifacts, of which more than 95 percent were recovered during the Phase III data recovery program. The following section of this chapter (Section B) presents a description and analysis of the individual artifact classes, including bifaces, unifaces, cores, debitage, cobble tools, groundstone tools, minerals, ceramics, fire-cracked rock, and unmodified pebbles and cobbles (Tables 7 and 8). Flaked-stone artifacts dominate the collection; they were made from a variety of raw materials, but predominantly from locally available stone.

Table 7. Artifact Classes by Count and Weight, Site 7NC-G-151

ARTIFACT CLASS	COUNT	WEIGHT
Biface	140	2,252.7
Uniface	24	213.3
Core	143	12,728.8
Cobble Tool	13	31,774.8
Groundstone Tool	5	1,329.9
Ceramic	4	57.6
Debitage	12,806	32,403.2
FCR	2,179	131,775.4
Unmodified Cobble	67	35,550.4
Unmodified Pebble	6	412.0
Minerals	216	1,141.8
TOTAL	15,607	249,639.9

Section C deals with the analytical technique of classifying debitage by size grades, termed “mass analysis.” Bypassing standard trait attributes, mass analysis attempts to establish patterns of reduction technologies based on flake-size distributions. Two contrasting areas of the site were sampled and compared. The resulting data were used to contrast the two areas and evaluate the potential of this technique for yielding sound and reliable analysis relating to debitage production and deposition.

Section D is a discussion of pattern analysis and intrasite structure. Pattern analysis is a method that illustrates the spatial delineation of artifact and feature distributions and attempts the reconstruction of the human behaviors that may have produced the observed patterns.

Table 8. Flaked-Stone Artifacts by Raw Material, Site 7NC-G-151

ARTIFACT CLASS	RAW MATERIAL Chert	Jasper	Rhyolite	Argillite	Quartz	Quartzite	Other	TOTAL
Biface	18	29	6	4	50	33	.	140
Uniface	6	12	.	.	6	.	.	24
Core	23	15	.	1	53	49	2	143
Cobble Tool	1	.	.	.	1	5	6	13
Debitage	1,281	1,543	211	21	5,721	3,923	106	12,806
TOTAL	1,329	1,599	217	26	6,042	4,010	114	13,337

A detailed discussion of the analytical methods employed in the study of individual archaeological classes is presented in Chapter IV. An inventory of the recovered prehistoric artifacts is available (see Appendix E).

B. ARTIFACT CLASSES

1. Bifaces

A total of 140 bifaces were recovered from the Whitby Branch Site, including projectile points (or hafted bifaces), drills, early-, middle-, and late-stage bifaces, and indeterminate fragments. The last category includes specimens that are too fragmentary to be assigned to other types. The early-, middle-, and late-stage bifaces represent a production continuum of unfinished bifaces; most of these appear to be point production failures, that is, bifaces rejected during reduction because of mistakes or miscalculations that resulted in breakage or improper thinning and shaping. Projectile points are finished bifaces, designed to be hafted onto shafts, arrows, or handles and employed as projectiles or knives. Some of the unfinished bifaces may represent finished knives, or production failures that were recycled into knives. Table 9 presents a cross tabulation of biface types by raw material.

a. Projectile Points

Because of their haft modifications, projectile points are more temporally sensitive than other biface types. Of the 45 specimens identified, however, 18 are too fragmentary or too heavily weathered or reworked to be assigned to a specific point type. Several projectile points, although complete, did not conform to known point typology. For the remaining sample, typed specimens include Levanna (N=1), Jack's Reef Corner Notched (N=7), Poplar Island (N=11), Susquehanna Broadspear (N=1), and Pequea (N=1) (Plate 9a). Tables 10 and 11 present metrical data for the Poplar Island and Jack's Reef points. Measurements for the remaining points may be found in Appendix E.

The Poplar Island and Jack's Reef points are interesting because they represent the two most numerous types from the site and they exhibit distinct approaches to the manufacturing and raw

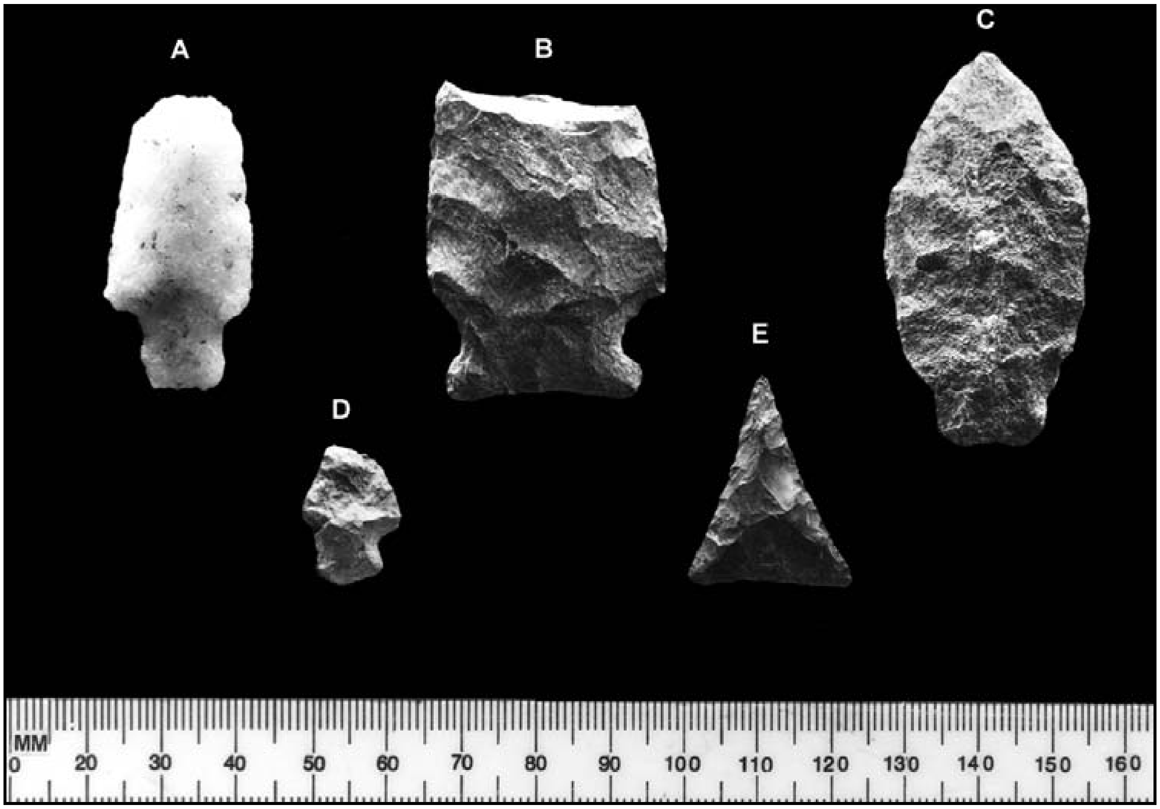

PLATE 9a: Projectile Points, Site 7NC-G-151. A: quartz stemmed point, possible Pequea (Cat. No. 96/333/511); B: rhyolite, possible Susquehanna Broadspear (Cat. No. 96/33/166); C: quartzite stemmed point (Cat. No. 96/33/143). D: small rhyolite point (Cat. No. 96/33/280); E: chert triangle (Cat. No. 96.33/293)

PLATE 9b: Enlarged View of Both Faces of Small Rhyolite Projectile Point Shown in Plate 9a (D)

Table 9. Biface Types by Raw Material, Site 7NC-G-151

Raw Material	Biface Type						Total
	Early-Stage	Middle-Stage	Late-Stage	Point	Indeterminate	Drill	
Chert	6	2	1	6	2	1	18 (13%)
Jasper	4	5	4	12	3	1	29 (21%)
Rhyolite	.	2	.	3	1	.	6 (04%)
Argillite	.	.	2	2	.	.	4 (03%)
Quartz	9	13	5	11	12	.	50 (36%)
Quartzite	17	5	1	10	.	.	33 (24%)
Total	36 (26%)	27 (19%)	13 (09%)	44 (31%)	18 (13%)	2 (01%)	140

material selection of hafted bifaces. The Poplar Island sample displays an expedient reduction technique based solely on percussion flaking to fashion a narrow, tapering projectile, with little emphasis placed on edge finishing. The sample registers a thickness-to-width ratio of 0.51. Their size and shape imply a spear-tipped weapon meant to deeply penetrate hide for a kill. The preferred raw material for this point type is quartz, with lesser numbers of quartzite specimens and one specimen of argillite. Four of the Poplar Island sample show some tip fracturing, indicative of breakage during use (Plate 10).

The Jack's Reef sample shows a high level of uniformity in raw material, size, shape, and manufacturing technique. Composed entirely of jasper, the specimens are tightly clustered around the sample mean of metrical dimensions (see Table 11). Characteristically corner notched, these points are well-thinned, with fine pressure flaking defining the edge margins (see Plate 10). The mean thickness-to-width ratio of 0.25 is half the value obtained from the Poplar Island sample, reflecting differences in modes of production as a response to hafting requirements and the mineral characteristics of the differing stone types. The Jack's Reef Corner Notched point is believed by some investigators to be the first true arrow point in the eastern United States (Custer 1996a; Justice 1987).

One unusual projectile point is Catalog No. 96/33/280 (see Plates 9a:D and 9b). Manufactured from rhyolite, this corner-notched point is curiously small, measuring 19 millimeters in length and weighing only 1.1 grams. One face of the blade is extensively fractured, beginning at the partially sheared tip and descending to a line even with the shoulders. This break is consistent with an impact fracture, which suggests that the specimen was hafted. However, its small size is incompatible with the requirements of a hunting weapon. It may have been made by a child or a novice flintknapper,

Table 10. Poplar Island Point Metrical Data and Raw Materials, Site 7NC-G-151

CAT. NO.	LENGTH	WIDTH	THICKNESS	RAW MATERIAL
96/33/24	NA	21	10	Quartz
96/33/63	NA	14	8	Quartz
96/33/72	45	15	9	Quartz
96/33/154	NA	18	8	Quartz
96/33/372	46	17	8	Quartz
96/33/516	44	19	11	Quartz
96/33/14	NA	16	9	Quartzite
96/33/192	49	16	9	Quartzite
96/33/223	47	15	8	Quartzite
96/33/517	NA	26	13	Quartzite
96/33/405	61	20	7	Argillite
Mean	48.7	17.9	9.1	
Standard Deviation	5.7	3.3	1.6	

Measurements in millimeters.

Table 11. Jack's Reef Corner Notched Point Metrical Data and Raw Materials, Site 7NC-G-151

CAT. NO.	LENGTH	WIDTH	THICKNESS	RAW MATERIAL
96/16/38	34	26	5	Jasper
96/33/36	NA	24	6	Jasper
96/33/97	31	24	7	Jasper
96/33/128	28	24	6	Jasper
96/33/280	33	23	6	Jasper
96/33/343	32	25	6	Jasper
96/33/509	31	22	6	Jasper
Mean	31.5	24	6	
Standard Deviation	1.9	1.2	0.5	

Measurements in millimeters.

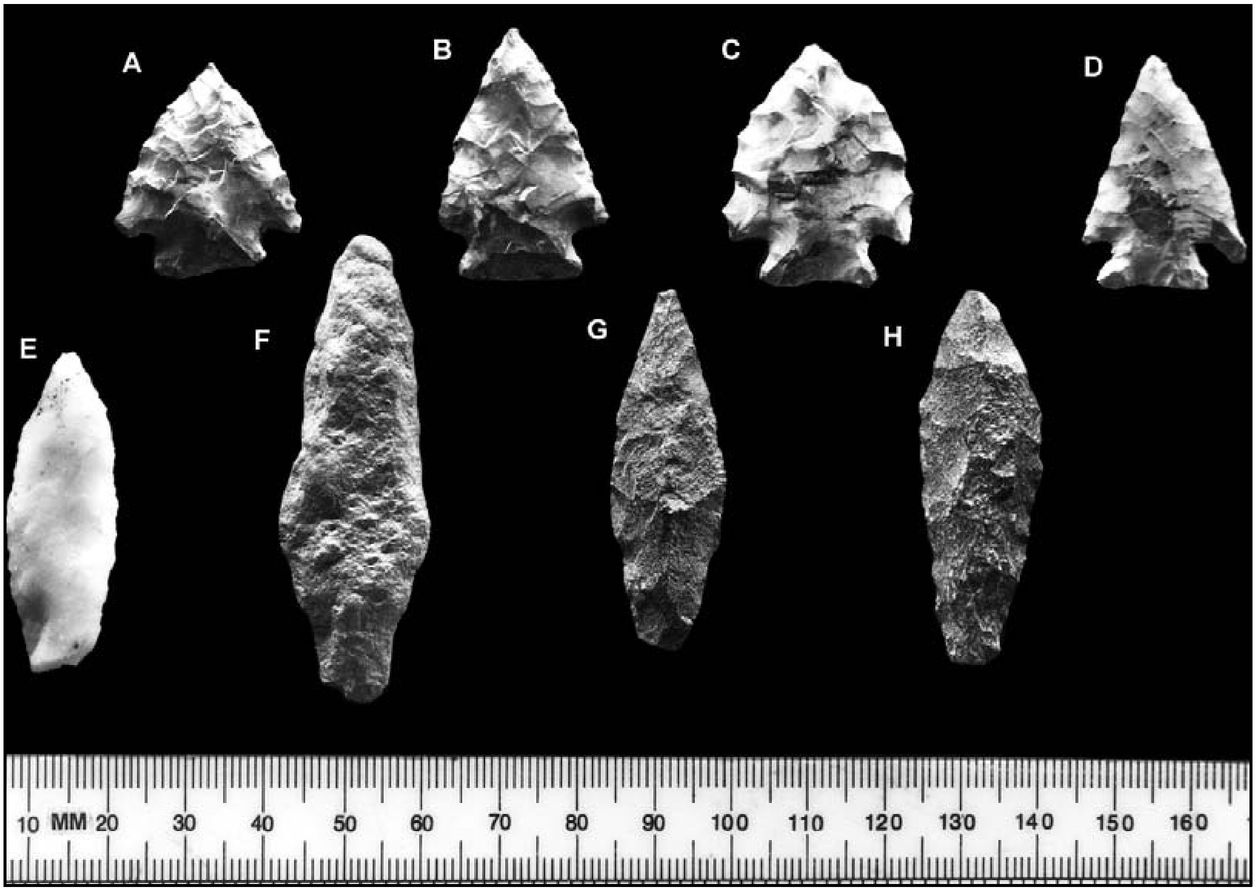

PLATE 10: Projectile Points, Jack's Reef Corner Notched (upper row) and Poplar Island (lower row), Site 7NC-G-151. A, B, C, D: jasper (Cat. Nos. 96/33/128, 96/33/280, 96/33/343, and 96/33/509). E: quartz (Cat. No. 96/33/63); F: argillite (Cat. No. 96/33/405); G, H: quartzite (Cat. Nos. 96/33/223 and 96/33/192)

although its general appearance is neither clumsy nor like the work of a beginner. Because rhyolite had to be transported from a distance, an inherently costly undertaking, a high value would have been attached to this material. The small rhyolite point was therefore possibly a prestige item, perhaps a toy or a charm.

b. Staged Bifaces

Fifty-four percent of the biface sample consist of staged, or unfinished, bifaces (Plate 11); the majority of these are production failures and rejects (see Table 9). Comparisons with other regional sites reveal that the Whitby Branch Site contains a relatively high proportion of broken or rejected bifaces, a finding which suggests close proximity to primary lithic sources, such as exposed cobble beds (Table 12). Comparative data shown in Table 12 were selected to reflect an emphasis on sites in the Middle Atlantic Coastal Plain, focusing on Delaware but also including Maryland and New Jersey; half of the collections were analyzed in Berger's archaeological laboratory, which ensures some measure of analytical comparability.

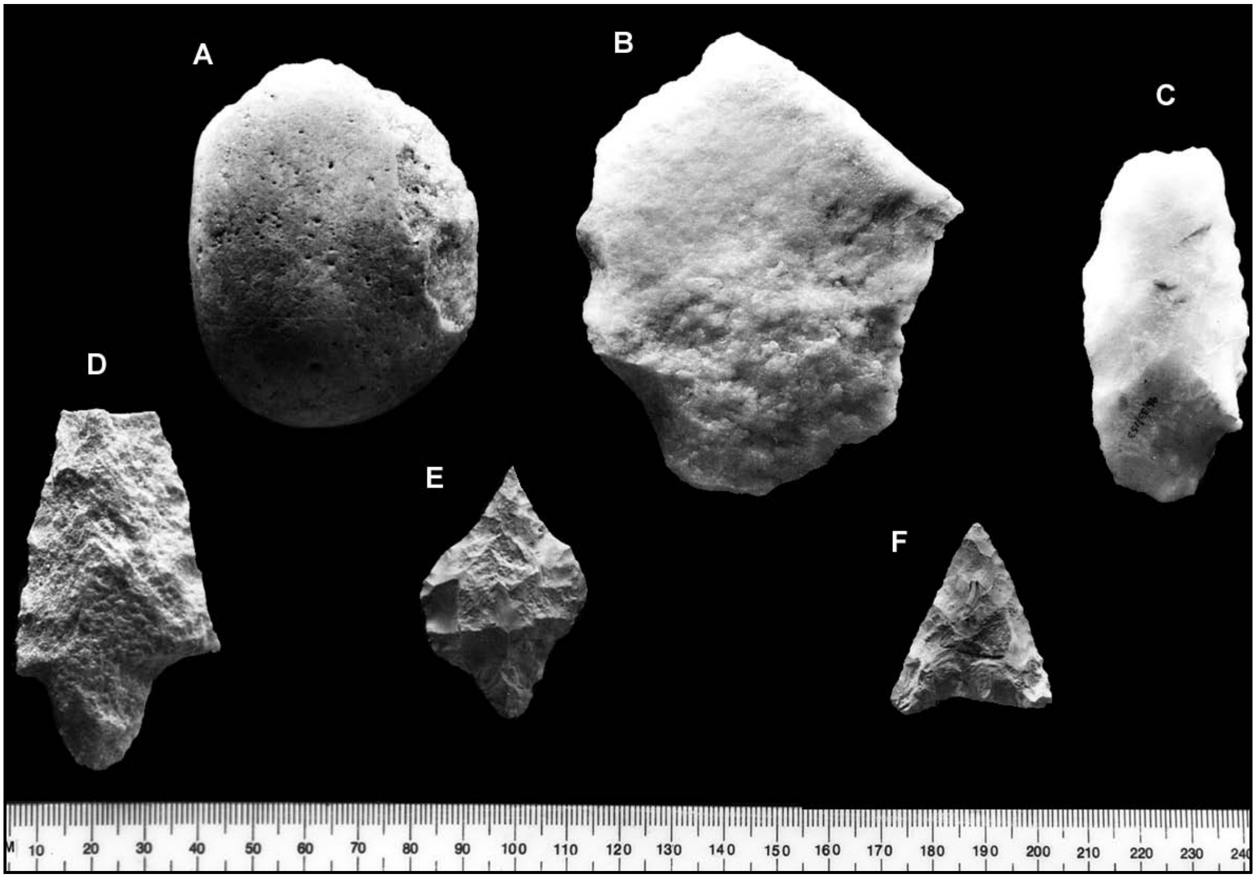

PLATE 11: Staged Bifaces, Site 7NC-G-151. A: quartz early-stage (Cat. No. 96/33/547); B: quartzite early-stage (Cat. No. 96/16/49); C: quartz middle-stage (Cat. No. 96/33/153); D: quartzite late-stage or knife (Cat. No. 96/33/293); E: jasper drill (Cat. No. 96/33/404); F: jasper late-stage (Cat. No. 96/33/329)

Several bifaces are noteworthy. A quartz early-stage biface (Catalog No. 96/33/547) was fashioned from a split cobble and shows distinctive edge wear associated with grinding activities. Catalog No. 96/16/49 is a large quartzite early reduction flake with limited bifacial reduction on one edge. Weighing 133 grams, it retains cobble cortex as a striking platform. The minimal bifacial chipping has provided this piece with a very workable knife-like edge, although 20X magnification does not reveal any use-wear. Catalog No. 96/33/153 is a quartz middle-stage biface that has undergone pressure flaking to create a serrated knife edge. Evidence of use-wear at 20X magnification was not detected.

Quartz (43%) and quartzite (25%) are the most frequently utilized raw materials among the staged bifaces, followed by jasper (16%) and chert (12%). Nonlocal materials, represented by rhyolite and argillite, comprise only 3 percent and 2 percent, respectively, of the staged biface sample. Jasper for the most part is not considered a true nonlocal raw material in this assemblage because cobble cortex was identified on 88 percent (by weight) of the jasper debitage sample, an indication of local sourcing. Jasper obtained from the well-known quarry sites of eastern Pennsylvania and from the Iron Hill region near Newark, Delaware, typically exhibit block cortex, when cortex is present.

Table 12. Biface Data from Selected Regional Sites

Site Name and Location	Total Bifaces	Percentage of Staged Bifaces	Reference
Whitby Branch Site (7NC-G-151)	*140*	*54*	
Two Guys Site (7S-F-68), Sussex County, Delaware	125	14	LeeDecker et al. 1996
Abbott Farm, Area B (Site 28ME1-B), Mercer County, New Jersey	261	27	Cavallo 1987
Snapp Site (7NC-G-101), New Castle County, Delaware	112	32	Custer and Silber 1995
Baldwin Site (18AN-55), Anne Arundel County, Maryland	86	37	McNamara 1982
Leipsic Site (7K-C-194A), Kent County, Delaware	176	53	Custer, Riley, and Mellin 1996
Sample Mean	150	37	

c. Drills

Two drills were recovered during the Whitby Branch Site investigations. Catalog No. 96/33/404 is a hafted jasper drill weighing 12.1 grams. A chert drill tip weighs 1.0 gram and exhibits edge smoothing (at 20X magnification), which is consistent with use as a perforator for boring hide or wood (Catalog No. 96/16/26). Both drills were found in the eastern section of the site.

2. Unifaces

Investigations at the Whitby Branch Site yielded a total of 24 unifaces, including endscrapers, sidescrapers, retouched flakes, utilized flakes, graver flakes, and other implements (Table 13). Half of the sample was manufactured from jasper (N=12), and the rest from chert (N=6) and quartz (N=6).

The retouched and utilized flakes are expedient flake tools, flakes that were struck from cores or bifaces and used to perform various cutting and scraping tasks with little or no prior modification. Often, these simple tools were produced and used for single tasks and then discarded after the task was completed. Utilized flakes are unmodified tools, save for edge damage accrued during use. Retouched flakes differ from utilized flakes in that limited unifacial flaking was applied to one or more edges prior to use. Endscrapers and sidescrapers are more formalized tools in which the flintknapper has invested greater time and energy. Scrapers tend to have plano-convex cross sections which allows for steep-angled working edges to be created. Tools with edge angles greater

Table 13. Uniface Types by Raw Material, Site 7NC-G-151

RAW MATERIAL	UNIFACE TYPE					TOTAL
	Scraper	Graver Flake	Retouched Flake	Utilized Flake	Other	
Chert	1	.	3	1	1	6
Jasper	3	.	2	7	.	12
Quartz	1	1	.	3	1	6
TOTAL	5	1	5	11	2	24

than 50 degrees are believed to have been most efficient for working hard materials, such as bone, antler, and hardwoods (Cavallo 1987:113; Stewart 1994:64). Tools with sharper edges would have been more appropriate for soft materials such as meat, hide, and edible plants.

The Whitby Branch Site scraper edge angles range from 60 to 68 degrees, with a mean of 64 degrees. Based on the model described above, these specimens were probably meant to plane hard materials. An assemblage of seven endscrapers from the South Sector of Site 28ME1-B near Trenton, New Jersey, yielded edge angles of 45 to 75 degrees, with a mean of 63 degrees (Cavallo 1987:115).

Unifacial tools are a common tool type found at archaeological sites from all periods and geographic locations in North America. Task requirements for basic subsistence activities such as meat and hide preparation led to the production of generalized cutting and scraping implements with unifacial edges. Although tool form alone has been shown to be a poor indicator of tool function (Yerkes 1987:129), the size (quantity) of a tool class relative to the overall flaked-stone tool assemblage may be viewed as a measure of significance for the functions *generally* ascribed to that tool class.

Table 14 presents data from selected regional sites on the quantities of unifacial tools recovered relative to total flaked-stone tools. The table figures indicate a much lower percentage of unifaces from the Whitby Branch Site than from the other site assemblages. When the Whitby Branch Site data are compared with the mean figures from the selected sites, the results are statistically significant (chi square=102.72, degree of freedom=1, probability=.001). One implication of this finding is that subsistence tasks requiring the production and use of scrapers and expedient flake tools were not a major component of site activities at Whitby Branch. A proviso should be offered here concerning the inherent difficulty of identifying edge wear on quartz and quartzite debitage, the prevalent raw materials at the Whitby Branch Site. Quartz is an extremely hard material and is particularly abrasion resistant, meaning that striations, polish, and smoothing are not readily apparent (Boudreau 1981; Hayden and Kamminga 1979). Quartzite, although not as hard as quartz, is very granular, and evidence of use-wear is also difficult to detect. Nonetheless, the limited frequencies of the more easily identified formal scrapers and retouched flakes of all raw material types tend to mitigate this problem.

Table 14. Unifacial Tools as a Percentage of All Flaked-Stone Tools at Selected Regional Sites

Site	Total Flaked Tools (FT)	Total Unifaces (U)	U/FT (%)	References
Whitby Branch Site (7NC-G-151)	*307*	*24*	*8*	
Lister Site (28Me1-A), Mercer County, New Jersey	208	34	16	Stewart 1986
Delaware Park Site (7NC-E-41), New Castle County, Delaware	444	82	18	Thomas 1981
Abbot Farm, Area B (Site 28ME1-B), Mercer County, New Jersey	418	94	22	Cavallo 1987
Baldwin Site (18AN-55), Anne Arundel County, Maryland	129	33	26	McNamara 1982
Two Guys Site (7S-F-68), Sussex County, Delaware	245	66	27	LeeDecker et al. 1996
Leipsic Site (7K-C-194A), Kent County, Delaware	1,286	633	49	Custer, Riley, and Mellin 1996
Snapp Site (7NC-G-101), New Castle County, Delaware	416	260	63	Custer and Silber 1995

3. Cores

A total of 143 cores were recovered from the Whitby Branch Site, representing 47 percent of the flaked-stone tool assemblage (Plate 12). Table 15 presents data on core types broken down by raw material.

Tested cobbles are cobble masses that have had a few flakes removed to examine raw material quality. These cobbles were either rejected for further reduction or cached for further use.

Freehand cores are cobbles that have undergone a greater degree of reduction; the core is hand-held while flakes are driven off in multiple directions (Figure 13). Bifacial cores are also hand-held but have had flakes driven off both sides of the cobble, producing a bifacially prepared edge for the purpose of flake-tool production. By contrast, bipolar cores are cobbles or pieces of raw material that were subjected to bipolar percussion between a hammerstone and an anvil (see Figure 13). Flake removals originating from opposite points on these cores are the primary evidence of this reduction technique. Flake cores are made from large tabular flakes with reduction on one surface taking on a distinctively uniform flaking pattern. This technique is appropriate for the production of flake-based scrapers. A generalized reduction sequence is illustrated in Figure 14.

As the reduction sequence progresses, the core becomes shaped into a bifacial implement. During the shaping of a bifacial tool from a core, the nucleus is transformed through a series of staged biface

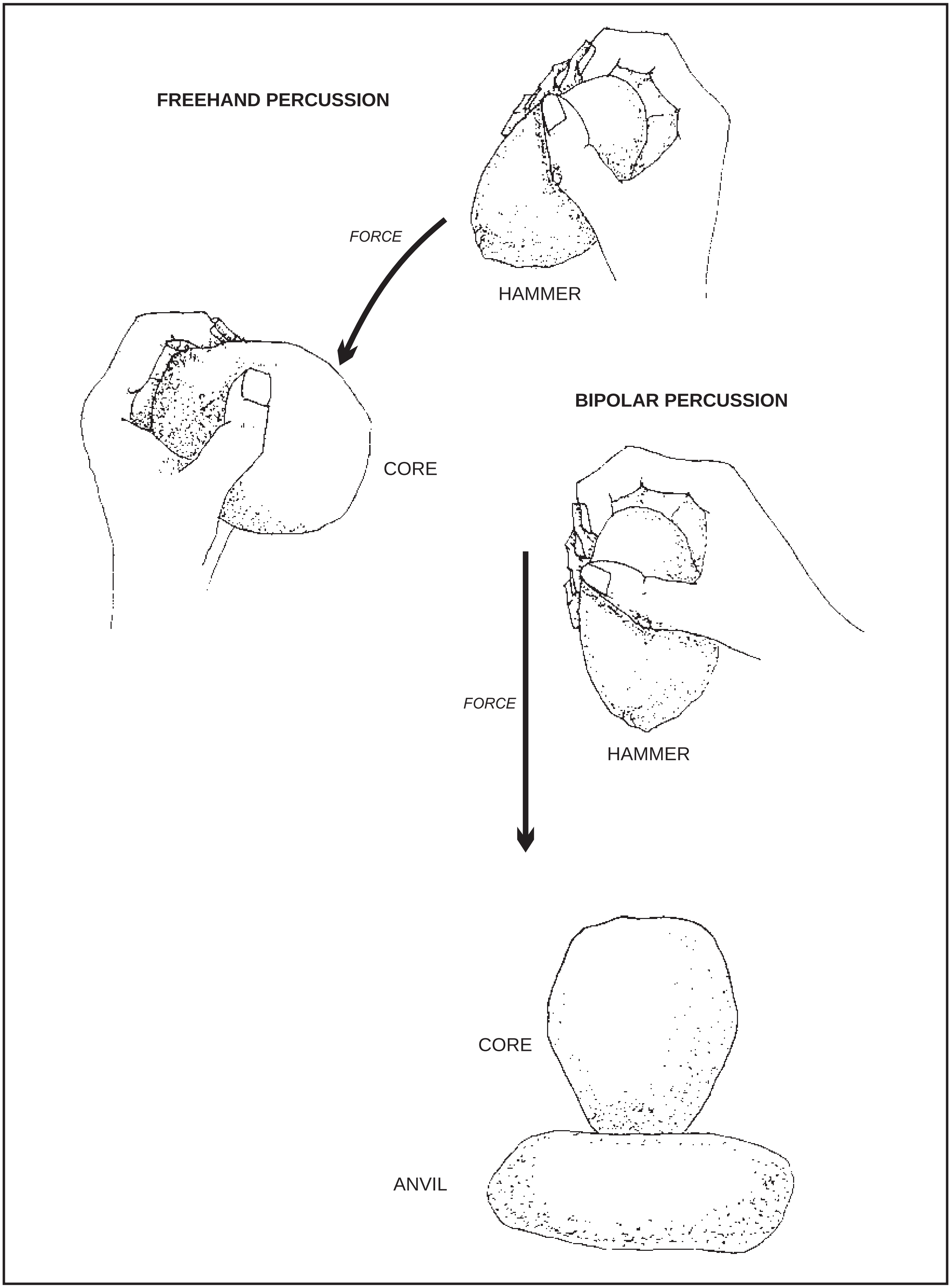

FIGURE 13: Basic Core Reduction Techniques *SOURCE: Adapted from Henry 1989*

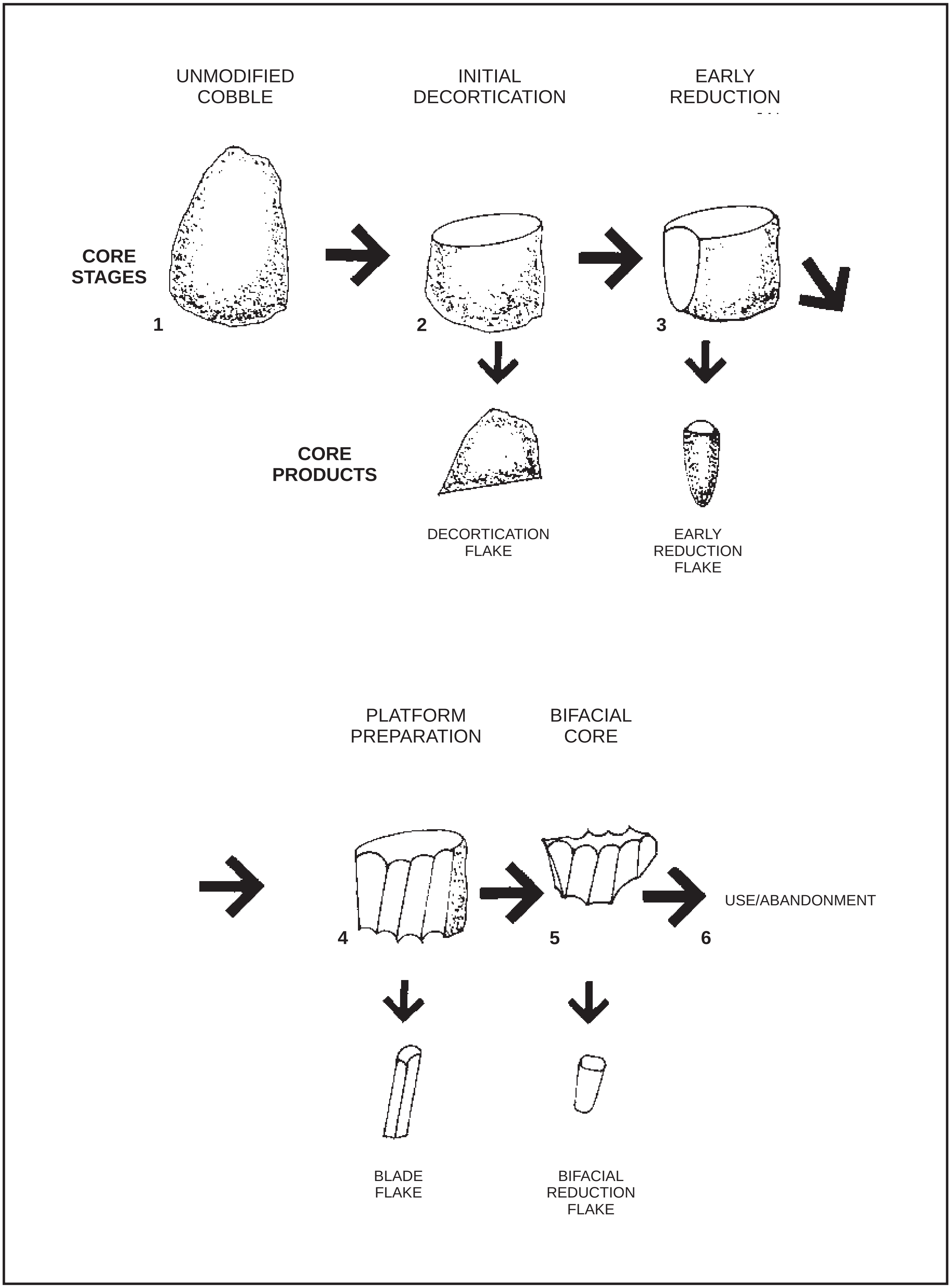

FIGURE 14: Generalized Reduction Sequence of a Core *SOURCE: Adapted from Henry 1989*

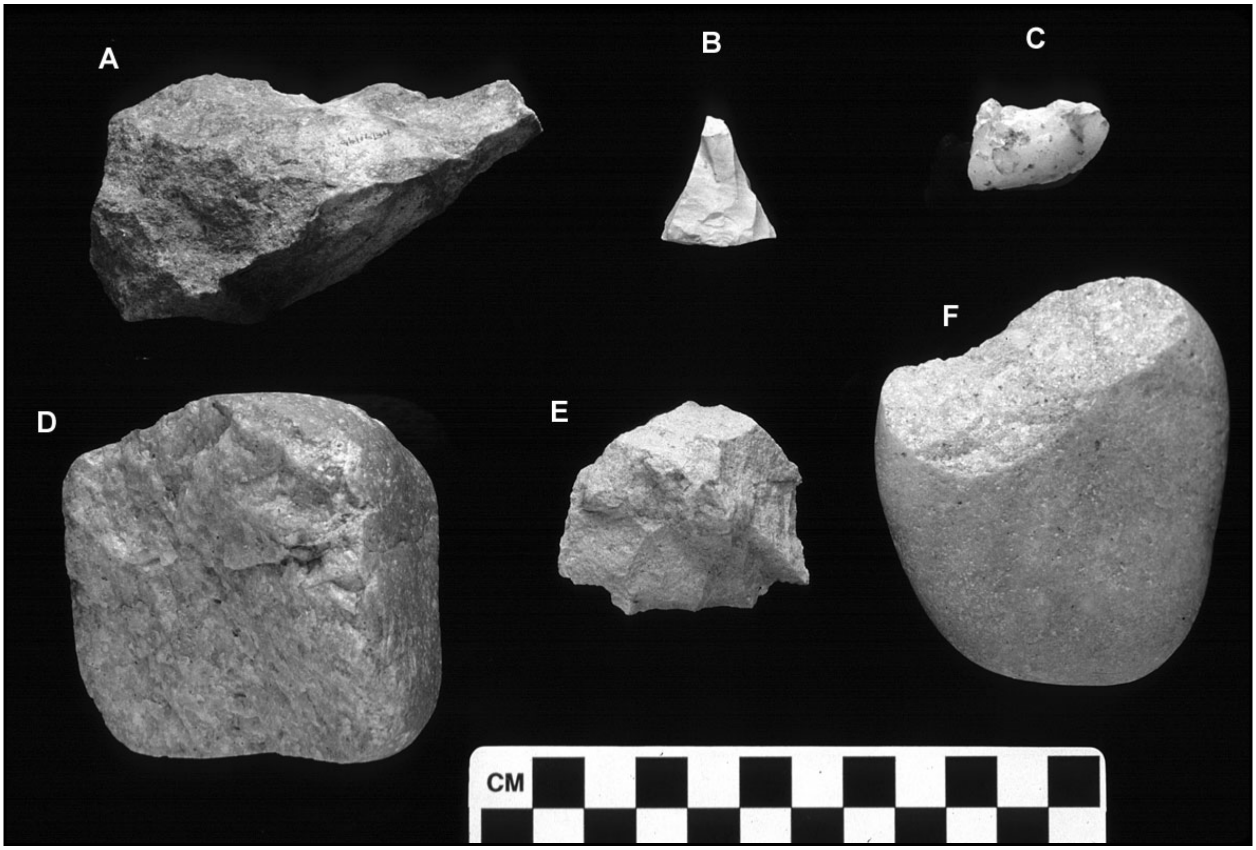

PLATE 12: Cores, Site 7NC-G-151. A: quartzite bifacial core (Cat. No. 96/16/34); B: jasper bipolar core (Cat. No. 96/33/131); C: quartz bipolar core (Cat. No. 96/33/91); D: quartz freehand core (Cat. No. 96/33/165); E: quartzite freehand core (Cat. No. 96/33/457); F: quartz tested cobble (Cat. No. 96/33/461)

forms. Biface reduction flakes, illustrated in Figure 14, are generated during the middle and late stages of biface reduction and also during biface maintenance or the rejuvenation of bifacial tool edges.

Some cores are specially prepared for the production of blade flakes, as shown in Figure 14. The classic or true blade flake form is usually defined as a flake that is twice as long as it is wide, with relatively parallel lateral edges. Evidence of this technology is only occasionally found in the Middle Atlantic region, and rarely in Coastal Plain settings.

Bipolar cores registered the lowest mean weight of the sample at 12.1 grams; tested cobbles were the highest at 135.2 grams (see Table 15). Low mean weight is an expected attribute of bipolar cores because of their extensive reduction as a technique for maximizing raw materials, especially small cobbles (Hayden 1980). Bipolar core reduction is, in particular, an expected technique on the Coastal Plain, where lithic raw materials are generally sparse (Custer and Galasso 1980). Tested cobbles, at the opposite end of the continuum, have undergone limited reduction and retain most of their mass and weight. The sample of bipolar cores is composed of cryptocrystalline jasper, chert,

Table 15. Core Types by Raw Material, Site 7NC-G-151

RAW MATERIAL	CORE TYPE					TOTAL	MEAN WEIGHT (g)
	Bipolar	Bifacial	Freehand	Flake	Tested Cobble		
Chert	4	1	13	1	4	23 (16%)	32.0
Jasper	4	1	9	1	.	15 (10%)	14.3
Quartz	3	6	27	2	15	53 (37%)	98.0
Quartzite	.	8	28	5	8	49 (34%)	128.5
Other	.	.	2	.	1	3 (02%)	96.3
TOTAL	11 (08%)	16 (11%)	79 (55%)	9 (06%)	28 (20%)	143	.
Mean Weight (g)	12.1	70.5	92.5	41.9	135.2	.	89.0

and high-quality quartz, materials valued for their flaking properties and more likely to have been maximally reduced to extract workable flakes. The low mean weights of jasper and chert bipolar cores are consistent with more intensive efforts to extract more desirable raw materials (see Table 15).

Low mean weights may also reflect indirect procurement of valued raw material through exchange with nonlocal groups. However, 87 percent of the Whitby Branch Site chert and jasper cores exhibit cobble cortex. Owing to the high cost of transporting rock beyond local group territories, cortex is almost always removed from cores and blanks at the primary source in order to reduce the weight of the raw material (cf. Hatch 1994). The presence of cobble cortex is therefore a good indicator of a local origins for these materials.

The limited number of bipolar cores found at this coastal plain site suggests that prehistoric flintknappers at Whitby Branch had minimal need to conserve and maximize their lithic raw materials, thus signaling the relative quantity of the resources available at the site. Another method of gauging the scale of the available lithic resources is to rank the size of the core sample against the total flaked-stone tool sample, and to compare this value against data from selected regional sites (Table 16). Forty-seven percent of the total flaked-stone tool sample from the Whitby Branch Site consists of cores; this figure is much higher than those obtained from the group of regional sites, which ranged from 8 to 22 percent. Clearly, there is a statistically significant difference between the proportions of cores found at Whitby Branch and those found at the other sites (chi square=147.88, degrees of freedom=7, probability=.001).

Table 16. Cores as a Percentage of All Flaked-Stone Tools at Selected Regional Sites

Site	Total Flaked Tools (FT)	Total Cores (C)	C/FT (%)	Reference
Whitby Branch Site (7NC-G-151)	*307*	*143*	*47*	
Baldwin Site (18AN-55), Anne Arundel County, Maryland	129	10	8	McNamara 1982
Snapp Site (7NC-G-101), New Castle County, Delaware	416	44	11	Custer and Silber 1995
Leipsic Site (7K-C-194A), Kent County, Delaware	1,286	112	9	Custer, Riley, and Mellin 1996
Lister Site (28ME1-A) Mercer County, New Jersey	208	19	9	Stewart 1986
Abbott Farm, Area B (28ME1-B) Mercer County, New Jersey	418	34	8	Cavallo 1987
Delaware Park Site (7NC-E-41) New Castle County, Delaware	444	65	15	Thomas 1981
Two Guys Site (7S-F-68) Sussex County, Delaware	245	54	22	LeeDecker et al. 1996

4. Cobble Tools

Table 17 presents data on the cobble tool assemblage from the Whitby Branch Site. The majority of artifacts are interpreted as implements used in the extraction of useful lithic tools from cobble masses obtained on-site. Hammerstones and anvils are the primary implements employed in the bipolar reduction of cores to flake tools. Hammerstones and anvils characteristically exhibit surface pitting where contact was made with the cobble core or biface (Plate 13).

Catalog No. 96/33/164 is a split quartz cobble exhibiting edge grinding along the periphery of its exposed surface. The type of wear observed on this specimen is consistent with use as a grinding stone in the preparation of striking platforms on cores and bifaces.

5. Groundstone Tools

Four groundstone tools were recovered at the Whitby Branch Site. A quartzitic three-quarter-grooved axe was retrieved from Level 3 in the eastern sector of the site (Catalog No. 96/16/3). Weighing 1,040 grams, this specimen was ground and pecked to shape and displays little wear along the bit edge (see Plate 13).

Catalog No. 96/33/86 and Catalog No. 96/33/102 are groundstone artifacts which have been longitudinally drilled (see Plate 13). The former is made of a greenstone and weighs 22.7 grams;

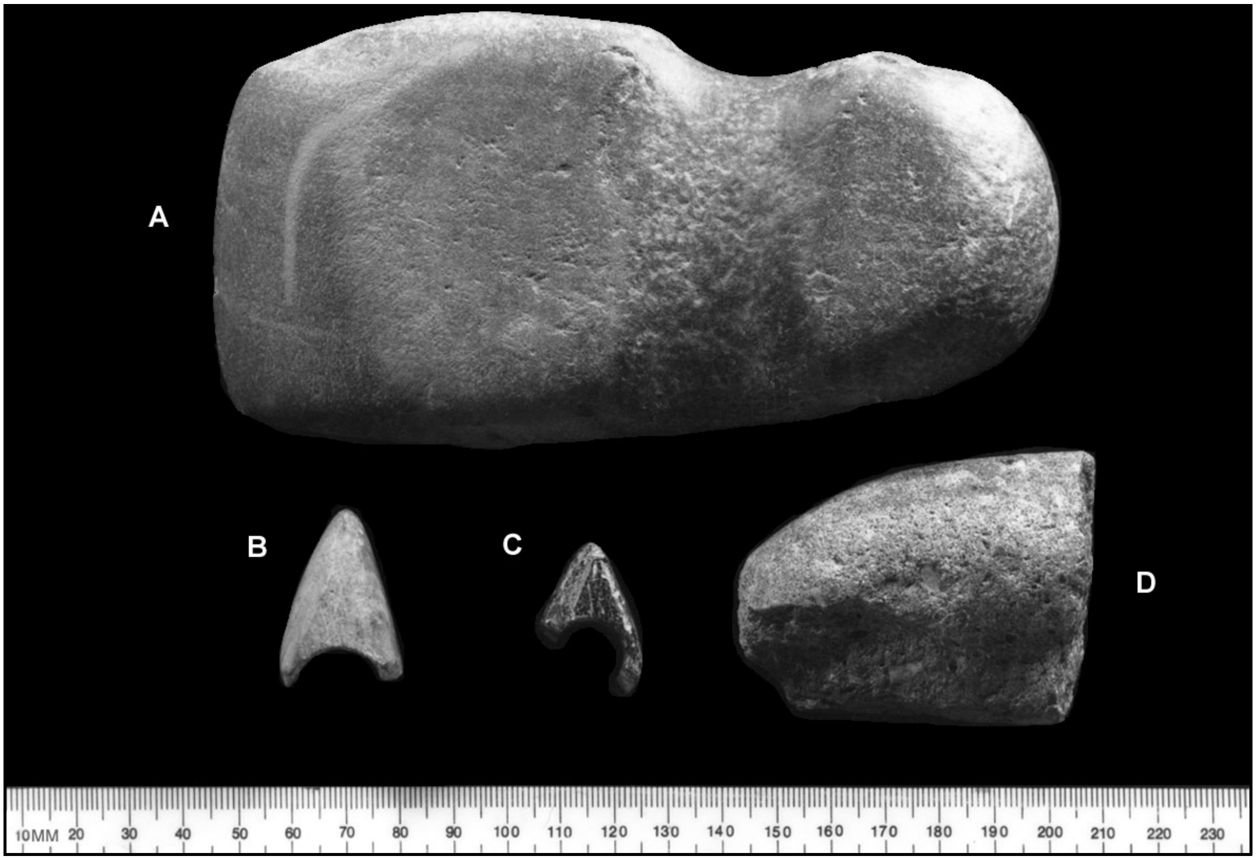

PLATE 13: Cobble and Groundstone Tools, Site 7NC-G-151. A: quartzite axe (Cat. No. 96/16/3); B: metasedimentary bannerstone fragment (Cat. No. 96/33/102); C: igneous bannerstone fragment (Cat. No. 96/33/86); D: quartzite hammerstone (Cat. No. 96/10/48)

the latter is a metasedimentary stone weighing 64.5 grams. In both cases, the artifact has broken along the axis of the drilled hole. Circular drill marks proceed down the length of each hole, a sign that the drilling process was successfully completed before breakage occurred. Bifacial grinding of Catalog No. 96/33/102 has produced an edge exhibiting small step fractures, suggesting that it was the working edge of a tool. In contrast, Catalog No. 96/33/86 displays a blunter edge, with striated wear patterns along its two extant faces. This wear may be the product of use as a whetstone or sinew stone. Neither artifact, however, has the necessary weight or heft of a hafted percussive tool. It is more likely that the drilled holes allowed these artifacts to be fitted on to atlatls, or throwing sticks, where they functioned as counterweights, or bannerstones.

A high investment of labor would have been required to drill the very precise holes in these artifacts, endowing these items with a high value, and possibly their owners with a degree of prestige. Their value, even broken, may have dictated re-use rather than discard. The observed wear may be the product of such secondary use. Both artifacts were recovered from Level 2 in the West Block Excavation.

Table 17. Cobble Tools by Raw Material, Site 7NC-G-151

RAW MATERIAL	COBBLE TOOL TYPE				TOTAL
	Abrader	Anvil	Hammerstone	Other	
Chert	.	.	.	1	1
Quartz	1	.	.	.	1
Quartzite	.	2	3	.	5
Sandstone	.	1	3	.	4
Other	.	.	.	1	1
TOTAL	1	4	6	2	13

A large steatite bowl fragment weighing 202.7 grams was also recovered from Level 3 in the East Block Excavation (Catalog No. 96/33/382) (see Plate 5). The low curvature of the piece is an indicator of large vessel size. Wear in the form of pitting and scraping is observable on the interior face.

6. Debitage

Table 18 presents data on debitage type frequencies and weights correlated with raw materials. By count, quartz represents the most frequently utilized raw material (45%), followed by quartzite (31%), with smaller quantities of jasper (12%), chert (10%), rhyolite (2%), and others. Tallied by weight, however, quartzite has greater overall mass than quartz, 47 percent to 40 percent, distantly followed by jasper (7%), chert (4%), rhyolite (0.6%), and sandstone (0.5%). Diagnostic flake types and frequencies indicate that early-stage lithic reduction was the primary site activity, although biface production and maintenance were important secondary tasks.

a. Quartz

With 5,721 specimens, quartz is the most common of the raw material types in the debitage sample from the site. Exclusive of flake fragments, debitage types indicative of specific reduction activities are best represented by early reduction flakes, followed in descending order of frequency by block shatter and decortication flakes. When combined, early reduction and decortication flakes constitute nearly half (47%) of the sample, suggesting that early-stage lithic reduction was an important activity at the Whitby Branch Site. The 183 examples of biface reduction flakes (3% of the quartz sample) indicate that the manufacture of projectile points or knives was also an important element of quartz reduction activities. The high frequencies of block shatter, flake shatter, and flake fragments, together representing 50 percent of the sample, reflect the tendency of quartz to shatter when struck during reduction.

Table 18. Debitage Types by Raw Material, Site 7NC-G-151

Debitage Type		Raw Material: Chert	Jasper	Rhyolite	Quartz	Quartzite	Other	Total
bf	count	192	153	41	183	228	10	807 (06%)
	weight	56.4	48.8	23	136.3	386.3	5.9	656.7 (02%)
bp	count	4	3	.	1	.	.	8 (<01%)
	weight	3.0	2.8		2.9			8.7 (<01%)
bs	count	118	195	7	734	412	10	1,476 (12%)
	weight	506.7	1,291.8	25.7	4,590.3	6,292.2	170.0	12,876.7 (40%)
df	count	108	277	5	265	181	6	842 (07%)
	weight	179.2	529.5	4.5	1,747.7	1,831.5	28.1	4,320.5 (13%)
er	count	450	525	101	2,422	1,938	53	5,489 (43%)
	weight	460.7	390.4	132	5,177.4	5,723.4	111.8	11,995.7 (37%)
ff	count	344	279	47	1,864	1,034	34	3,602 (28%)
	weight	100.8	63.1	13.3	1,275.1	893.5	10.9	2,356.7 (07%)
fs	count	21	14	5	234	112	4	390 (03%)
	weight	3.5	2.3	0.8	49.2	24.1	0.6	80.5 (02%)
pf	count	14	13	4	6	5	1	43 (<01%)
	weight	1.5	1.8	0.5	0.7	0.6	0.4	5.5 (<01%)
if	count	30	84	1	12	13	7	149 (01%)
	weight	23.1	53.0	1.2	4.8	12.0	6.5	102.2 (<01%)
TOTAL	count	1,281 (10%)	1,543 (12%)	211 (02%)	5,721 (45%)	3,923 (31%)	125 (01%)	12,806
	weight	1,334.9 (04%)	2,383.5 (07%)	201 (0.6%)	12,984.4 (40%)	15,163.6 (47%)	334.2 (01%)	32,403.2

Key: bf=bifacial reduction flake; bp=bipolar reduction flake; bs=block shatter; df=decortication flake; er=early reduction flake; ff=flake fragment; fs=flake shatter; pf=pressure flake; if=indeterminate flake. Weights expressed in grams.

Nineteen percent of the quartz debitage specimens exhibit cobble cortex, an indicator that core reduction based on quartz cobbles was being conducted at the site. When calculated by weight, 48 percent of the quartz debitage display cobble cortex, further evidence of early-stage lithic reduction.

b. Quartzite

Quartzite is the second most common raw material by count found in the debitage sample. Early reduction flakes and decortication flakes account for 54 percent of the quartzite sample, an indication that early-stage lithic reduction was a common site activity. The high level of cobble cortex present in the quartzite sample (51% by weight) indicates that the lithic industry was based largely on core reduction of local cobble sources.

Quartzite exhibits the highest mean weight of any raw material, 3.9 grams, compared with 2.3 grams for quartz and an overall sample mean of 2.5 grams. The high mean weight may be a product of the general poor quality of the cobble quartzite found at the site and of the flintknappers' lessened ability to control the patterns of breakage for this material. Consistent with this finding is the great quantity of quartzite block shatter, amounting to 41 percent by weight of the sample. With a mean weight of 15.3 grams, the quartzite block shatter is more than double the average size of quartz block shatter, and more than triple that of chert.

Two conclusions can be drawn from these data. First, because of the mineral flaws and impurities inherent in the available quartzite, a relatively high level of investment would have been necessary to extract workable quartzite flakes and tools from the cobble masses. Despite the greater costs involved, the high utility rate of the material in biface manufacture (24%) suggests that quartzite was considered a suitable raw material for tool manufacture. Secondly, the large numbers of quartzite waste flakes attest to the easy availability and great abundance of the material in cobble form on-site.

c. Jasper

The jasper debitage is made up of 1,543 specimens and comprises the third most common raw material at the Whitby Branch Site. Early-stage reduction activities are represented by a high proportion of decortication flakes and early reduction flakes, together accounting for 52 percent of the jasper sample by count (see Table 18). Alongside this industry is substantial evidence of point manufacture and biface maintenance activities. Ten percent of the jasper debitage is composed of biface reduction flakes, nearly twice the proportion of the complete sample. This figure is consistent with the recovery of 13 jasper points (29% of the site total).

Cobble cortex is observed on 89 percent, by weight, of the jasper sample, a surprisingly high proportion of cortical presence. Two implications can be drawn from this figure. The first is that most, if not all, of the jasper recovered at the Whitby Branch Site was procured from local cobble sources. Jasper is often thought of as a valued nonlocal raw material transferred through exchange networks, sometimes at great distances from its source (cf. Hatch 1994; Stewart 1989). In this instance, however, jasper sourcing may have been simplified by the exploitation of exposed cobble beds. The significance of this finding with regard to prehistoric settlement and economic systems will be addressed in Chapter VIII.

The second implication of the high cortex values of jasper debitage is in the estimation of cobble size. Since surface to volume ratios increase with decreasing spherical size, it is reasonable to infer that small cobbles or pebbles will yield a greater percentage of cortex per flake than larger cobble cores. Small cobble size is also correlated with bipolar reduction techniques, as a means of maximizing workable stone. Indeed, 27 percent of jasper cores were created by bipolar reduction, the highest levels of any raw material at the Whitby Branch Site. By way of comparison, only 7 percent of quartz cores are bipolar types, while no quartzite bipolar cores were identified. Derived from these data is the inference that cobble sizes are somewhat co-variant with raw material type.

d. Chert

Chert accounts for 10 percent of the site debitage sample, with 1,281 recovered specimens. Decortication and early reduction flakes comprise 43 percent of the chert sample, indicating that early-stage lithic reduction was one important focus of chert procurement. Biface production and maintenance are also evidenced in the data via bifacial flake frequencies. This diagnostic flake type represents 15 percent of the chert debitage sample, much higher than the overall mean value of 6 percent (see Table 18). Chert use for point and uniface production is well documented in the site assemblage, and procurement of tool-quality chert appears to have been a targeted activity of the site occupants. Biface reduction and tool maintenance activities are also reflected in the low mean weight of the chert sample, which at 1.04 grams per flake is less than any other raw material except rhyolite.

The chert debitage also exhibits a high degree of cobble cortex, manifested in 71 percent of the sample by weight. As was observed for the jasper debitage, this high amount of cortex probably reflects the small size of chert nodules. Chert is identified in 36 percent of the bipolar core sample, supporting this assertion.

e. Rhyolite

While rhyolite makes up less than 2 percent of the debitage sample, it represents the largest sample of nonlocal lithic raw material. Rhyolite does not occur in cobble form on the Coastal Plain (Custer 1984, 1994), and must be transported from the South Mountain region on the Maryland-Pennsylvania border (Stewart 1984a, 1984b). Long-distance movement of stone generally necessitates the decortication and trimming of cores into lighter blanks to reduce transport costs and maximize the amount of workable stone that can be carried. One implication of the use of nonlocal stone is an expectation of low cortex frequency; most cortex will have been removed at the lithic source to reduce weight and transport costs. The Whitby Branch Site rhyolite sample conforms to this model of lithic procurement, with only 4 percent of the debitage exhibiting cortex. This figure is by far the lowest registered by any raw material at Whitby Branch.

A second implication of nonlocal lithic procurement is the high number of expected bifacial reduction flakes; the expense of transporting stone, whether obtained directly or through exchange with another group, dictates that such material will most likely be in the form of prepared blanks for biface production. Again, the rhyolite sample accommodates this model by exhibiting the highest frequency among all raw materials of bifacial reduction flakes (see Table 18). As expected, a corollary finding of very low rates of decortication flakes was established for the rhyolite sample.

7. Fire-Cracked Rock (FCR)

Table 19 presents the counts and weights of collected FCR cross tabulated by raw material. Eighteen percent of the total FCR was recovered from feature contexts. Fire-cracked rock may have been used as stone boilers in containers or as heating elements in hearths. Large quantities of rock were available on the site surface for both lithic reduction and heat transfer. Analysis of the patterns of raw material utilization indicates that prehistoric site occupants readily discriminated between

Table 19. Fire-Cracked Rock by Raw Material, Site 7NC-G-151

Raw Material	Count	Weight (g)	Mean Weight (g)
Chert	184 (8%)	2,150 (2%)	12
Jasper	329 (15%)	1,638 (1%)	5
Quartz	159 (7%)	10,970 (11%)	69
Quartzite	639 (29%)	45,379 (34%)	71
Ironstone	154 (7%)	8,335 (6%)	54
Sandstone	417 (19%)	44,727 (34%)	107
Metamorphic	20 (1%)	1,993 (2%)	100
Igneous	2 (<1%)	333 (<1%)	167
Meta-igneous	13 (<1%)	489 (<1%)	38
Other	15 (<1%)	271 (<1%)	18
Unidentified	247 (11%)	15,491 (12%)	62
Total	2,179 (100%)	131,775 (100%)	60

cobbles for reduction and for heating purposes, based on a well-honed knowledge of rock characteristics.

The most frequently utilized raw materials by weight are quartzite (34%) and sandstone (34%), with smaller quantities of quartz (11%) and ironstone (6%). Sandstone comprises a minuscule proportion of the debitage sample (0.5% by weight) and is easily distinguished from other rock types that can be conchoidally fractured and fashioned into chipped-stone tools. Most of the quartzite utilized as FCR was grainier or less vitreous than the quartzite generally found in the debitage and core samples. None of the ironstone and little of the quartz identified as FCR were suitable for lithic reduction. Far from being valueless, however, these raw materials were intensively used, while the higher-quality rock was reserved for tool production.

The very low mean weight of jasper (5g) and chert (12g) FCR sharply contrasts with the mean weight of 79.3 grams per rock for the remainder of the sample (minus unidentified materials) (see Table 19). The apparent wide availability of cobbles suitable only for heating suggests that the small-sized FCR elements are the byproducts of attempts to thermally alter and enhance the flaking properties of cryptocrystalline raw material, and are not the characteristic hearth elements or stone boilers generally termed “fire-cracked rock.” Jasper and chert were most likely placed in hearths, allowed to slowly cool, and then removed to be eventually worked for tool production. Much of the block shatter from these heated masses may have retained traits characteristic of FCR, such as potlidding, cracking, and color altering. Typologically these specimens straddle a middle ground between FCR and heat-altered debitage.

8. Minerals

Two hundred and sixteen pieces of petrified wood weighing 1,141.8 grams were recovered from the Whitby Branch Site (Plate 14). Tentatively identified as genus *Taxodium*, the specimens are most likely lithified pieces of Miocene-age (17-25 million years BP) bald cypress (sp. *Taxodium distichum*), a tree species well adapted to the warm, marshy environments of that epoch (J. Frett and T. Pizzalato, Department of Plant and Soil Sciences, University of Delaware, personal communication 1997). Sediments dating to this period are represented in the Calvert Formation, a deposit of unconsolidated marine clay and silt lying beneath the surficial Columbia Formation from Odessa to Smyrna, Delaware (Pickett and Spoljaric 1971; W. Schenck, Delaware Geological Survey, personal communication 1997). The boundary between the two formations is irregular, with Columbia sediments often intrusive into the older formation. Calvert sediments, however, are not found to be naturally reworked into the overlying Columbia Formation (N. Spoljaric, Delaware Geological Survey, personal communication 1997). The presence of petrified wood in the culture-bearing horizons at the Whitby Branch Site is very likely the result of deliberate human transport.

Miocene-age outcroppings containing petrified wood may have been exposed along the steeply incised northern bank of the Appoquinimink River, where specimens could have been collected and brought to the site. Elsewhere in the region, petrified wood has been found at the Indian Head Site in Cumberland County, New Jersey (Cross 1941), and at the Savich Farm Site in southern New

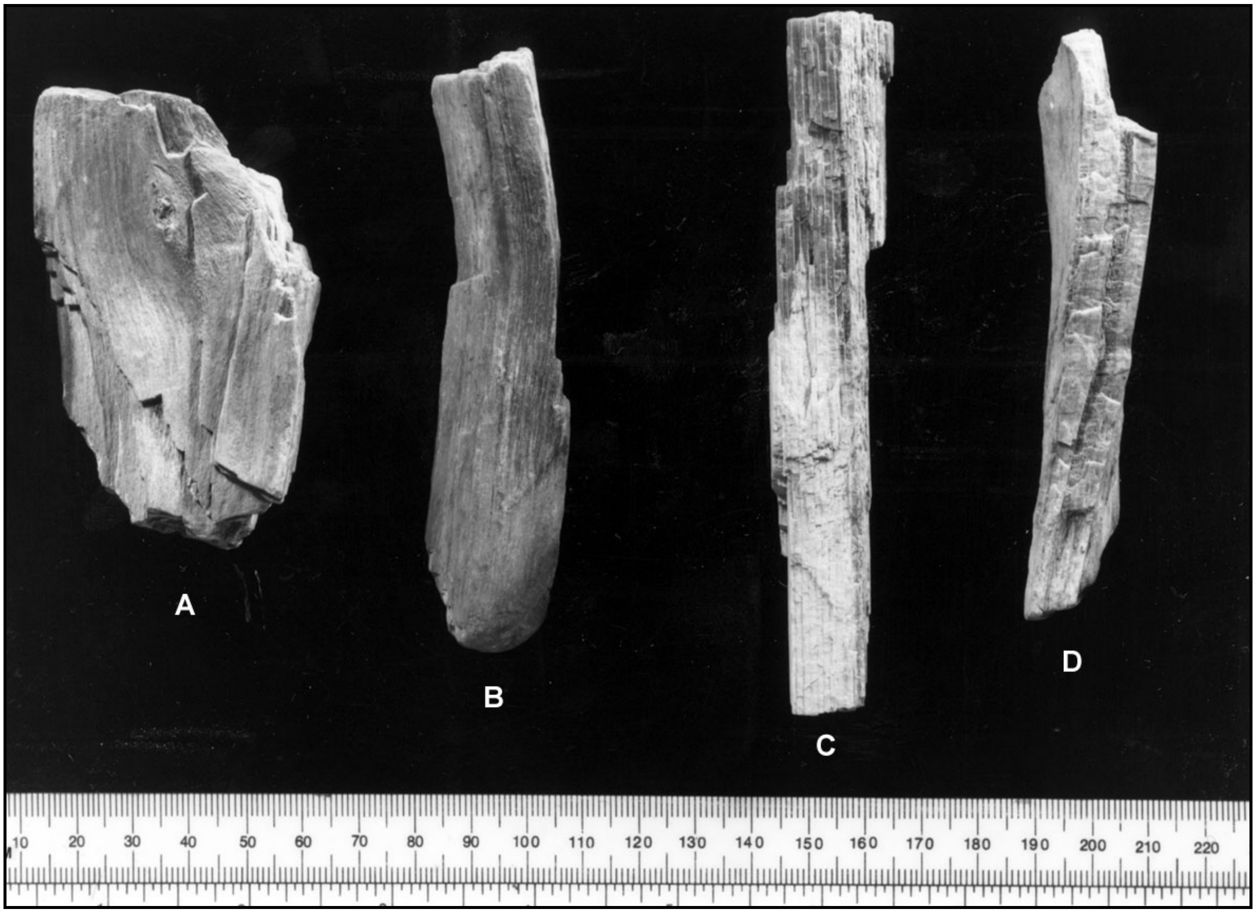

PLATE 14: Petrified Wood, Site 7NC-G-151. A: Cat. No. 96/33/453; B: Cat. No. 96/33/270; C: Cat. No. 96/33/151; D: Cat. No. 96/33/317

Jersey (Mounier 1974; Regensburg 1971, 1974). Inferences about the use to which this material was put are speculative, though Mounier has suggested a religious or magical purpose. Evidence of lithic reduction was not observed on any of the specimens, and marked cleavage along the closely arrayed growth rings made this material unsuitable for tools.

9. Archaeobotanical Material

The collection and processing of plants for both food and material resources is one subsistence task that may have been undertaken by Native American occupants of the site. Activities of this kind would have resulted in the disposal of seeds, nutshells, wood, and other fibrous remains that can be recovered from archaeological contexts and identified by taxa to investigate possible prehistoric use of plants (Minnis 1981). However, plant material enters the archaeological record through a variety of processes, and it does not necessarily follow that all plant remains recovered from archaeological sites resulted from subsistence activities.

During excavation, soil samples were collected from various contexts, including features, excavation units, and off-site areas, to obtain archaeobotanical data that might provide information pertinent to subsistence activities and general environmental conditions. The samples were processed through a closed-tank flotation device, separating microfloral remains from soil particles so that identification could be facilitated.

Upon completion of the processing task, 40 flotation samples were submitted to the Ethnobotany Lab of the State Historical Society of Wisconsin for analysis. The majority of microfloral remains consisted of charred shell fragments from the walnut family (Juglandaceae) and from hickory (*Carya* sp.). These remains were recovered from FCR clusters (Features 3, 4, 6, 8, 11, 12, 13, 15, 16, and 18), pit hearths (Features 20 and 22), cobble caches (Features 5 and 7), and the pit house (Features 19 and 21). The recovery of seeds was very limited, with one unidentifiable seed from an FCR cluster (Feature 11) and one seed identified as *Chenopodium* sp. from off-site Sample No. 4. Overall, smaller quantities of charred nutshell were retrieved from non-feature and off-site contexts, suggesting that features were the general locus of food subsistence activities.

The results suggest that nuts were a targeted resource during the late summer and fall (see Appendix C). The presence of oak, hickory, and white ash wood charcoal among the archaeobotanical remains is also generally indicative of a dry-mesic oak-hickory forest cover at, or adjacent to, the site at the time of prehistoric occupation.

C. MASS ANALYSIS

1. Introduction

Analysis of flaked debris from the Whitby Branch Site has proceeded from an examination of flake attributes vis-à-vis a lithic reduction sequence that is sometimes conceived as a continuum. This continuum is implicit in the classification of unfinished tools as early-stage, middle-stage, and late-stage bifaces. Flake types, such as decortication, early reduction, bifacial reduction, and pressure flakes, are assumed to be the diagnostic products of specific modes of lithic reduction. Proportional frequencies of flake types have been used as the basis for interpreting tool production technologies and the identification of distinct industries (see Section B.6).

Although formal flake attributes are commonly employed by many archaeologists for interpretive and organizational purposes, their use has been criticized because of the inherent subjectivity in assigning individual specimens to specific attribute types (Ahler 1989; Shott 1994). In addition, the ability of diagnostic attributes—such as platform faceting, dorsal scar frequency, or bulb morphology—to reveal information about human behavior is based on inferences, not empirical data.

An alternative approach to the analysis of lithic debris comes from viewing flakes in the aggregate, rather than individually. This has two chief advantages. First, large sets of flaked debris can be analyzed quickly, without the great expense of individually examining and coding each flake. Second, this approach eliminates the subjective characterization of flake attributes, relying instead on objective, replicable traits such as size and weight. The method that has gained the most attention is one based on the distribution of size grades in flake assemblages, and which has been termed "mass analysis" by Ahler (1989:89). Utilizing selected flake-size grade intervals, Ahler was able to demonstrate relationships between flake-size ratios and lithic reduction techniques in both experimental and archaeological assemblages.

2. Methodology

The Whitby Branch Site debitage assemblage was initially coded using Lithica, Berger's formalized flake attribute system. Data obtained by this method were useful in delineating distinct reduction technologies undertaken by the site occupants. However, the rather dramatic differences in artifact densities found in the West Block Excavation focused attention on the use of a purely quantitative analytical approach that relied on non-interpretive artifact attributes such as size, weight, and frequency. Two areas were sampled to compare flake-size distributions in an attempt to answer questions about the relationships of flake production and deposition from contrasting areas of the site. Excavation Units 109, 126, 131, and 132 represent an area of extremely high artifact density at the northern margin of the West Block Excavation, and were collectively grouped and referred to as the "Supercluster." A comparison group was selected from an area of clustered features toward the southern end of the excavation block (Feature Nos. 5, 6, 8, 9, and 11). Excavation Units 33, 34, 37, and 38 were grouped together and referred to as the "Feature Cluster." By comparing artifact deposits from these two contrasting regions of the site by means of a mass analysis approach, it was hoped that information relating to the identification of specific activity areas might be obtained.

All debitage from the two clusters was measured and sorted by five size grades: 11-20 mm, 21-30 mm, 31-40 mm, 41-50 mm, and 51+ mm. Debitage less than 10 millimeters in length is not generally recoverable from field excavations because the standard 0.25-inch hardware cloth used for soil screening has a diagonal opening of approximately 9 millimeters. This recovery procedure has the unfortunate weakness of eliminating a potentially sizable proportion of manufactured flake debris, but because this size grade is excluded from every sample it should not unduly skew the comparative results. In fact, only a minuscule number of flakes smaller than 10 millimeters were recorded from the sampled clusters; four were recovered from the Supercluster, while none were found in Feature Cluster excavation units.

Counts and weights by size grade (numbered 1 to 5) were obtained for each cluster (Table 20) and for each raw material type within the clusters (Table 21). Following Patterson (1990), these values were plotted on log-linear graphs, where the *Y* axis is a logarithmic scale for the percentage of total flakes, and the *X* axis is a linear scale of flake size. Flake-size grades were plotted at the mid-point of their range—for instance, size grade 1 (11 mm-20 mm) was plotted at 15 mm. Patterson demonstrated a relationship between the curve of the plot and the mode of lithic reduction; a straight-line curve represented bifacial reduction, whereas an irregularly shaped curve was obtained from core reduction experiments. Patterson's experimental data were obtained from a variety of central Texas flints.

Table 20. Flake-Size Grade Distributions for Feature Cluster and Supercluster, Site 7NC-G-151

	Feature Cluster			Supercluster		
Size Grade	Count	Weight	Mean Weight	Count	Weight	Mean Weight
1 (11-20 mm)	71	9.2	0.13	431	49.7	0.12
2 (21-30 mm)	126	36.8	0.29	1,291	336.0	0.26
3 (31-40 mm)	88	66.8	0.76	1,060	683.2	0.64
4 (41-50 mm)	39	67.9	1.74	568	816.4	1.44
5 (>50 mm)	66	612.2	9.28	902	6,323.9	7.01
TOTAL	390	792.9	2.03	4,256	8,209.8	1.93

Note: Weights are measured in grams.

Table 21. Flake-Size Grade Distributions by Raw Material, Site 7NC-G-151

		Feature Cluster		Supercluster	
Size Grade	Raw Material	Count	Weight	Count	Weight
1 (11-20 mm)	Chert	9	1.1	25	2.5
	Jasper	24	3.0	16	1.9
	Quartz	18	2.8	317	36.4
	Quartzite	14	1.7	73	8.9
2 (21-30 mm)	Chert	16	3.7	24	3.8
	Jasper	40	10.9	38	6.5
	Quartz	43	14.2	894	234.8
	Quartzite	19	6.1	332	89.9
3 (31-40 mm)	Chert	9	5.9	16	8.9
	Jasper	10	5.2	23	13.4
	Quartz	49	43.4	690	448.4
	Quartzite	13	9.2	329	210.7
4 (41-50 mm)	Chert	1	0.7	5	5.5
	Jasper	3	6.6	6	9.7
	Quartz	18	36.9	367	519.9
	Quartzite	12	18.7	189	279.7
5 (>50 mm)	Chert	5	18.5	6	34.3
	Jasper	10	74	11	35.4
	Quartz	30	361.1	499	2,981.6
	Quartzite	19	152.9	385	3,263.8

Note: Weights are measured in grams.

A second series of graphs was plotted on linear scale using an accumulated percentage (ogival curve) to represent the distributional curves of flake-size frequencies. Data derived from Patterson's (1990:553) replications of bifacial reduction and platformed core reduction were transformed into this format for comparison with the Whitby Branch Site data.

3. Results

The plot of flake-size distributions by frequency (Figure 15, graph A) produced comparable irregularly shaped log-linear curves for both the Feature Cluster and the Supercluster. On the basis of Patterson's findings, these curves should be more indicative of core reduction activities than of biface production. Interestingly, the Whitby Branch Site plots are not as irregular as those generated by Patterson to describe platformed core reduction, a reflection perhaps of multiple reduction trajectories smoothing out the curve.

The two clusters contrast sharply in their proportional representation of the smallest flakes (size grade 1), with the Feature Cluster registering 82 percent more of them than the Supercluster. This difference may mean that tool maintenance and modification activities were of greater importance in the Feature Cluster assemblage than in the Supercluster (Ahler 1989:109). These findings confirm the standard flake-attribute analysis, which found an 83 percent higher frequency of bifacial reduction flakes in the Feature Cluster than in the Supercluster.

When plots of the flake-size distributions are graphed by accumulated percentages (ogival curves), the resultant curves from both the Feature Cluster and the Supercluster are more similar to Patterson's core-reduction data than to his biface-reduction experiments (see Figure 15, graph B). Application of this method to individual raw materials confirms this finding but indicates that bifacial reduction was more commonly undertaken on jasper and chert specimens than on quartz and quartzite (Figure 16, graphs A and B). This finding holds true for both the Supercluster and the Feature Cluster.

None of the graphed trajectories for individual raw materials replicates Patterson's proposed straight-line curve for bifacial reduction (see Figure 15, graph A; and Figure 16, graphs A and B). The size-sorting effect of trampling and secondary discard may be responsible for the lower than expected proportion of the smallest debitage, while the upswing on the right side of the graph is likely the result of combining together all debitage greater than 50 millimeters in length. Utilizing additional size grades in the 61-70 mm, 71-80 mm, and 81+ mm ranges would probably result in a downward shift of the right-side deviation, bringing it closer to Patterson's straight-line log-linear curve. Adjusting the curves for these biases might bring them closer to Patterson's model for bifacial reduction than is indicated by the current data.

Useful indices of the differences between raw materials can be gleaned from the graphs in Figure 16, comparing flake-size distributions within each cluster. Chert and jasper contain higher proportions of the smallest flakes in both clusters than do quartz and quartzite, while the reverse holds true for the largest flakes. This size ordering by raw material can be interpreted in two

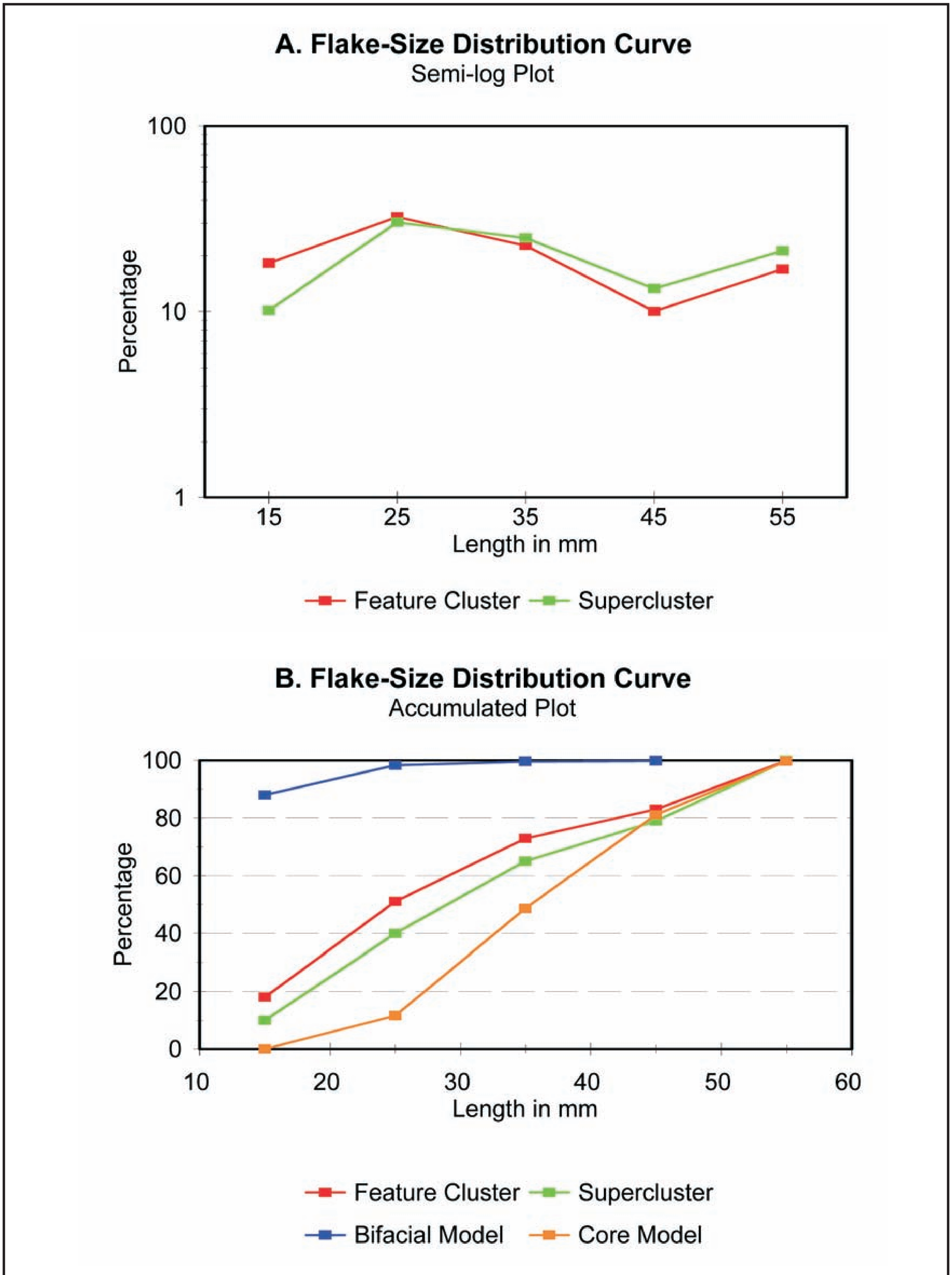

FIGURE 15: Mass Analysis Flake Distribution Curves, Site 7NC-G-151

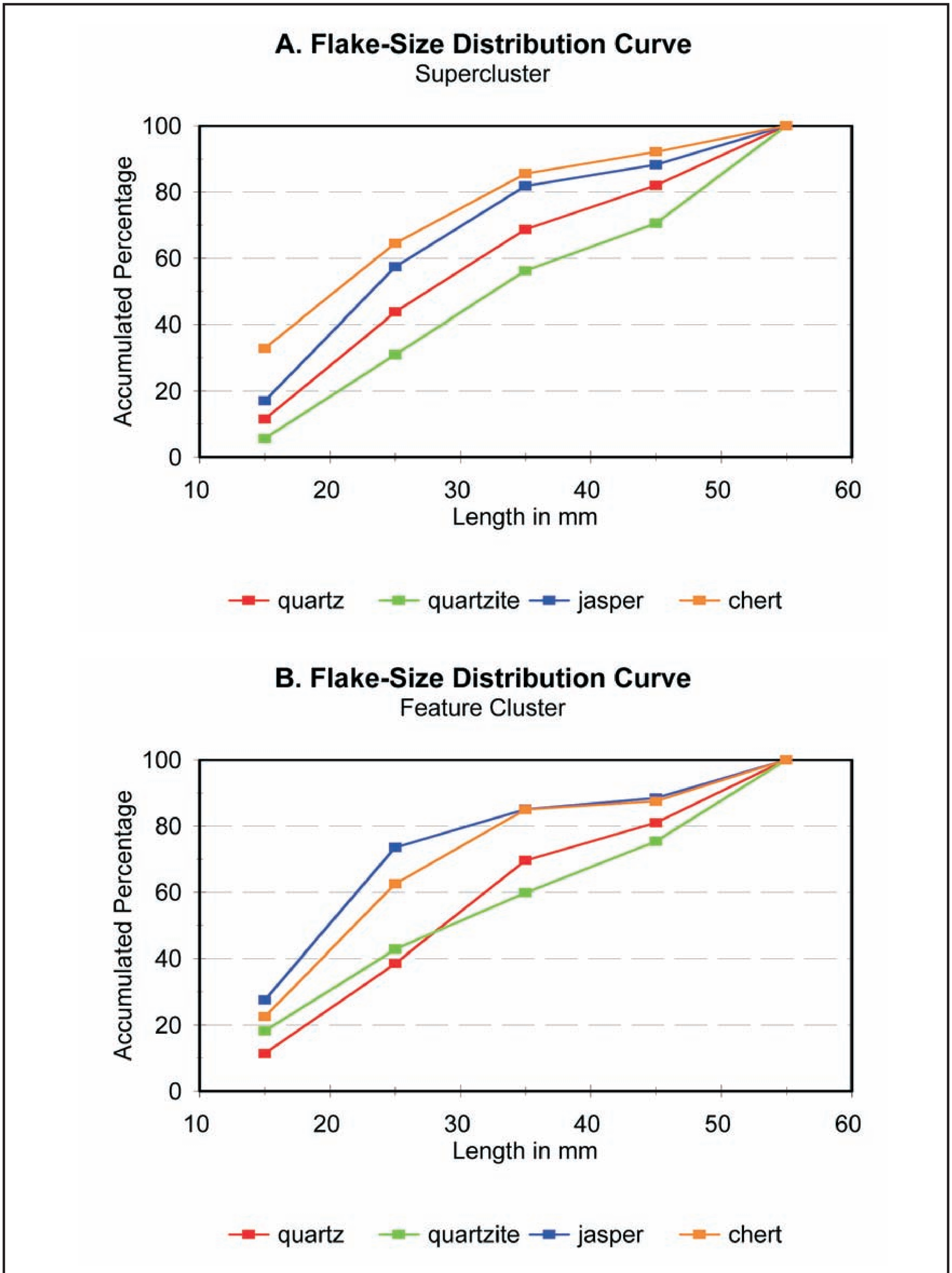

FIGURE 16: Mass Analysis Flake Distribution Curves for Raw Materials, Site 7NC-G-151

Table 22. Mean Weights of Selected Flake Types, Site 7NC-G-151

FLAKE TYPE	RAW MATERIAL			
	Chert	Jasper	Quartz	Quartzite
Bifacial reduction	0.3	0.3	0.7	1.7
Early reduction	1.0	0.7	2.1	2.9
Decortication	1.7	1.9	6.6	10.1

All weights expressed in grams; data based on entire site assemblage.

interrelated ways: first, chert and jasper were the preferred raw materials with which to produce bifacial tools, resulting in a higher proportion of biface reduction flakes and a lower mean weight (i.e., size) per flake for these materials; and second, the differing mechanical properties of the raw materials largely determined flake size regardless of the reduction strategy utilized, resulting in larger flakes for quartz and quartzite and smaller flakes for chert and jasper. The latter conclusion is strongly supported by the mean flake weights of selected major flake types (Table 22).

4. Summary

Mass analysis of debitage from the Supercluster and from a control sample in the Feature Cluster of the West Block Excavation revealed contrasts between clusters as well as between raw materials. A somewhat higher degree of bifacial reduction activities is believed to have occurred in the Feature Cluster than in the Supercluster, based on differential proportions of the smallest flake-size grades and on the overall curves generated by accumulated percentage plots. Using the same general assumptions, chert and jasper are interpreted to have been utilized for bifacial reduction more often than quartz and quartzite due to their finer grain, which allowed for more controlled flaking during lithic reduction.

While the curves of plotted data do not conform to Patterson's (1990) expected outcome for bifacial reduction, biases in the data collection and coding may have obscured a more robust bifacial reduction industry than is apparent in the numbers. Despite this limiting factor, the data seem to support the findings of flake-attribute analyses that the cluster assemblages are the result of multiple episodes of both core reduction and biface reduction technologies.

D. PATTERN ANALYSIS AND INTRASITE STRUCTURE

1. Introduction

This section examines the internal patterning of the site, focusing on the spatial distribution of lithic raw materials, artifact types, and features. Analysis of the site's internal patterning focuses on the identification and spatial delineation of activity areas within the site, proceeding from the basic assumption that patterning in the archaeological record reflects patterns of cultural behavior. Given the long period of prehistory during which the site was repeatedly used, and the relatively shallow depth of the site, there is no doubt that many different activities were carried out within the same relatively restricted space. Because there was little soil accretion during this period, material related to different occupational episodes has been mixed on an essentially stable occupation surface. While some episodes of site use may have been quite restricted spatially, the total succession of occupational episodes has produced a complex of overlapping deposits.

Interpretations of site function should proceed from descriptive statements of artifact morphology and manufacture to include analyses of artifact distributions in an attempt to identify spatial patterns of site occupation and use. Discrete site activity areas are believed to reflect the patterned behavior of site occupants as they performed a variety of subsistence-related tasks, such as plant processing, food preparation, lithic procurement, and tool production and maintenance.

The initial archaeological investigations at the Whitby Branch Site revealed two distinct areas of artifact concentration: one occupying the toeslope at the western site edge, and the other on the upland summit at the eastern end of the site. These two areas became the focus of the final data recovery program, wherein excavation focused on areas with the greatest concentration of cultural material and extractable data. The two areas of concentration, designated the West Locus and the East Locus, are located on the most level portions of the site landform. The intervening area of slope is nearly devoid of artifacts, indicating a preference by the site occupants for level surfaces.

As described in Chapter V, the processes involved in site formation have resulted in a mixing or compression of the occupational surfaces, so that there was no apparent vertical separation of the material left during the various episodes of site occupation. Although it was not possible to analyze the artifact assemblage according to vertical provenience, there were a number of horizontal clusters and concentrations of specific artifact types and raw materials.

It is known that there are many processes that result in postdepositional displacement of artifacts from their discard location, distorting the original patterns that would have been visible when artifacts first entered the archaeological record as a result of loss, discard, or abandonment. During analysis of intrasite patterning, one must be aware not only of natural postdepositional distortions, but also of the various cultural behaviors associated with the disposal of refuse. Schiffer's (1972) classification of primary, secondary, and de facto refuse indicates that material may enter the archaeological record through a broad range of behaviors. In particular, it is important to realize that some items may enter the archaeological record at their location of use (e.g., by loss or abandonment), while other items may be discarded away from their location of use (e.g., by the deposition of refuse away from a habitation area). It cannot be assumed that use locations correspond to discard locations.

The methodology used to examine the site's internal structure involved a combination of computer-assisted statistical techniques and visual examination of manually plotted distribution maps. The lithic artifact classes (e.g., bifaces, cores, and debitage) were used as the principal analytical categories for examination of intrasite patterning. Concentrations of various raw materials were identified from visual examination of density distribution maps for each raw material, which were in turn based on computer summaries indicating the amounts of debitage according to provenience.

Definition of specific concentrations was based on the computed mean and standard deviation values for each excavation unit.

2. Results

Distribution plots for various raw materials and tools are illustrated in Figures 17a and b through 25a and b.

The site mean for all debitage is 88 pieces per 1x1-meter excavation unit, with a standard deviation of 210. The data indicate a high degree of variation in the density distribution of debitage across the site, and a visual examination of the frequency maps confirms this finding. Areas with high debitage frequencies are located in the northwestern quadrant of the possible pit house feature (Feature 19); Excavation Unit 102 of the East Block Excavation; the southeastern corner of the West Block Excavation; and the northern end of the West Block Excavation, which has been termed the Supercluster (Figure 17a).

The distribution of quartz and quartzite debitage exhibits very high frequency levels in the northern end of the West Block Excavation; quartzite displays a secondary locus in the southeast corner of the West Block Excavation (Figures 18a and 19a). Jasper debitage shows three high concentrations, located in the northern end of the West Block Excavation, in Excavation Unit 49, and in the northwestern quadrant of Feature 19 (Figure 20a). Chert, ubiquitous across the site, is most densely concentrated around Excavation Unit 53, while rhyolite exhibits the most restricted horizontal distribution of any of the major raw materials, with a single locus of high density in Excavation Units 93 and 100, two contiguous units (Figures 21a and 22a). The highly localized distribution of rhyolite may have resulted from a single event of site occupation.

Despite the patterned distribution and discrete clustering of flaked debris across the site, each of the 142 excavation units at the Whitby Branch Site yielded some debitage. The ubiquity of reduction debris, even in the marginal zones of the site, suggests that lithic reduction activities occurred over a broad span of time, and, to varying degrees, across the entire site landform. Long-term site use can obscure discrete activity zones by the actions of multiple individuals, variable activities, and disturbances to the original deposits, creating a confusing array of overlying artifact distributions (Bodu 1996; McMillan 1985; Schiffer 1983). In the case of the Whitby Branch Site with its limited aggregation of soil, the blending of disparate activity residues can be particularly difficult to interpret.

The sample of seven Jack's Reef Corner Notched points, all manufactured from jasper, is an interesting example of an artifact set with a clearly bounded distribution. All seven are located either within or adjacent to the West Block Excavation (Figure 23a). Keeping in mind the admonition that use locations do not necessarily correspond to discard locations (Schiffer 1972, 1983), the Jack's Reef sample appears to reflect an activity use area dating to Webb complex (AD 500-1000) times. Assuming that these points were produced on-site, defining production areas based on debitage frequencies is difficult due to the broad distribution of jasper debitage across the

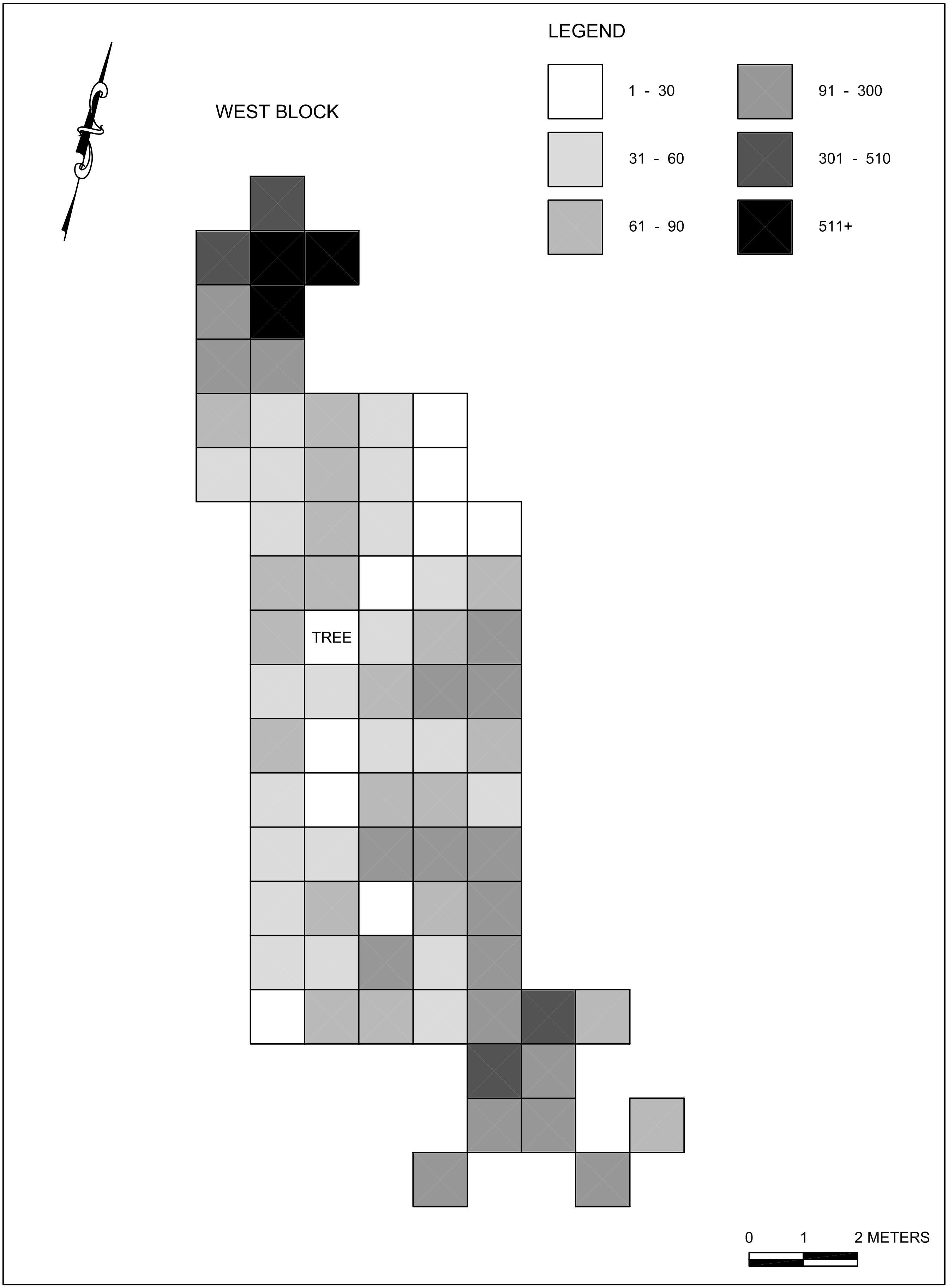

FIGURE 17a: Debitage Distribution, Site 7NC-G-151

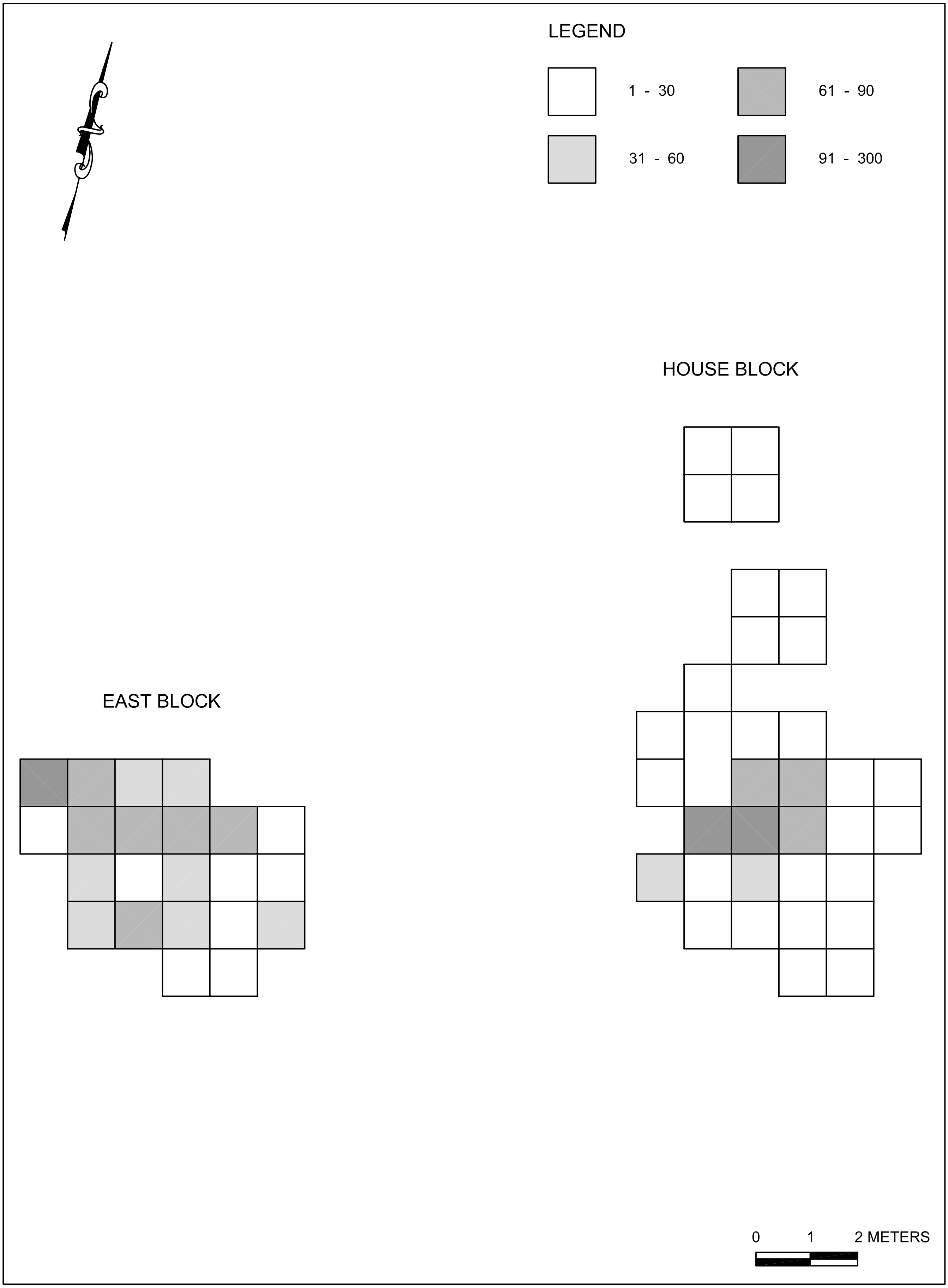

FIGURE 17b: Debitage Distribution, Site 7NC-G-151

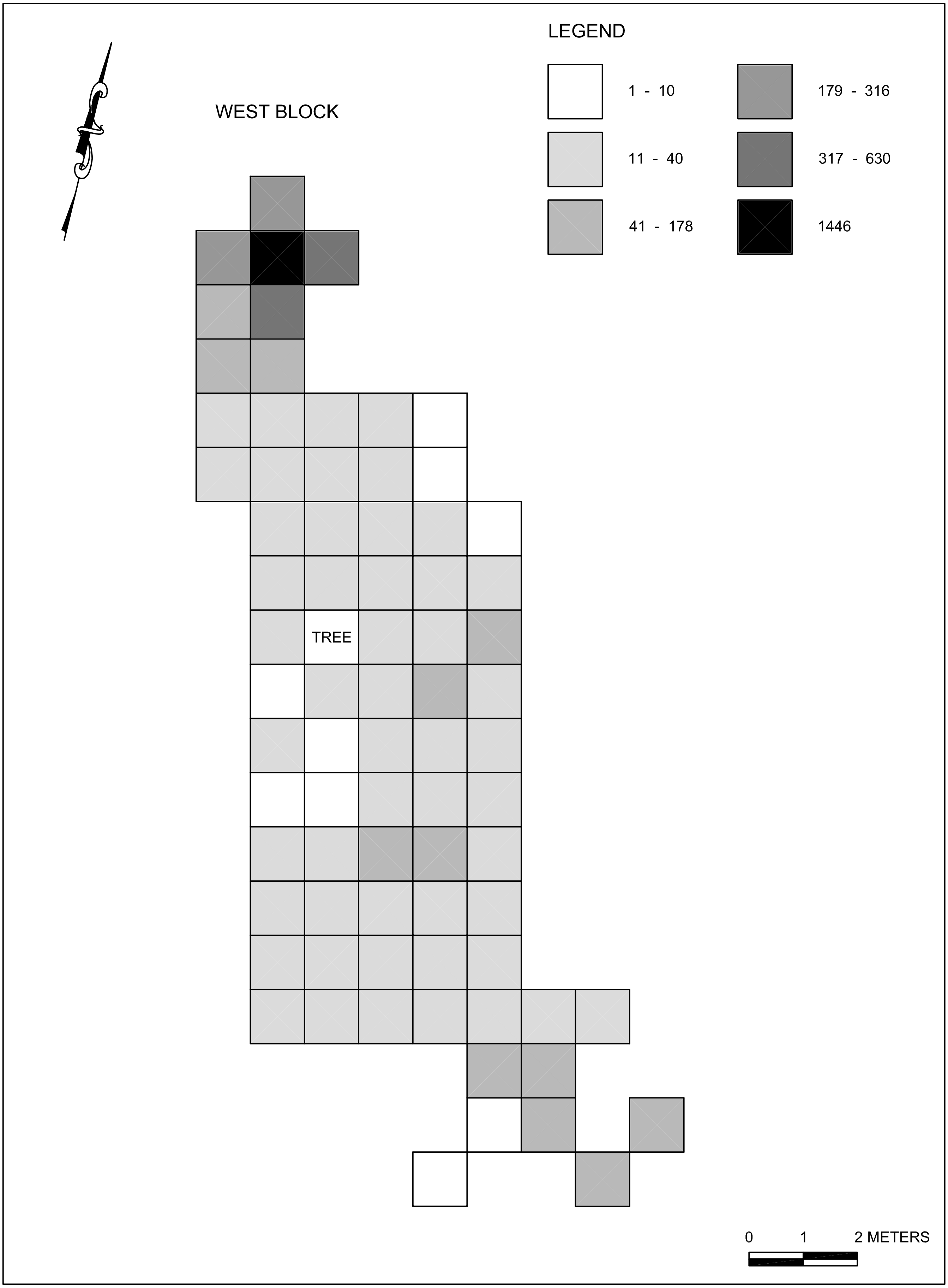

FIGURE 18a: Quartz Distribution, Site 7NC-G-151

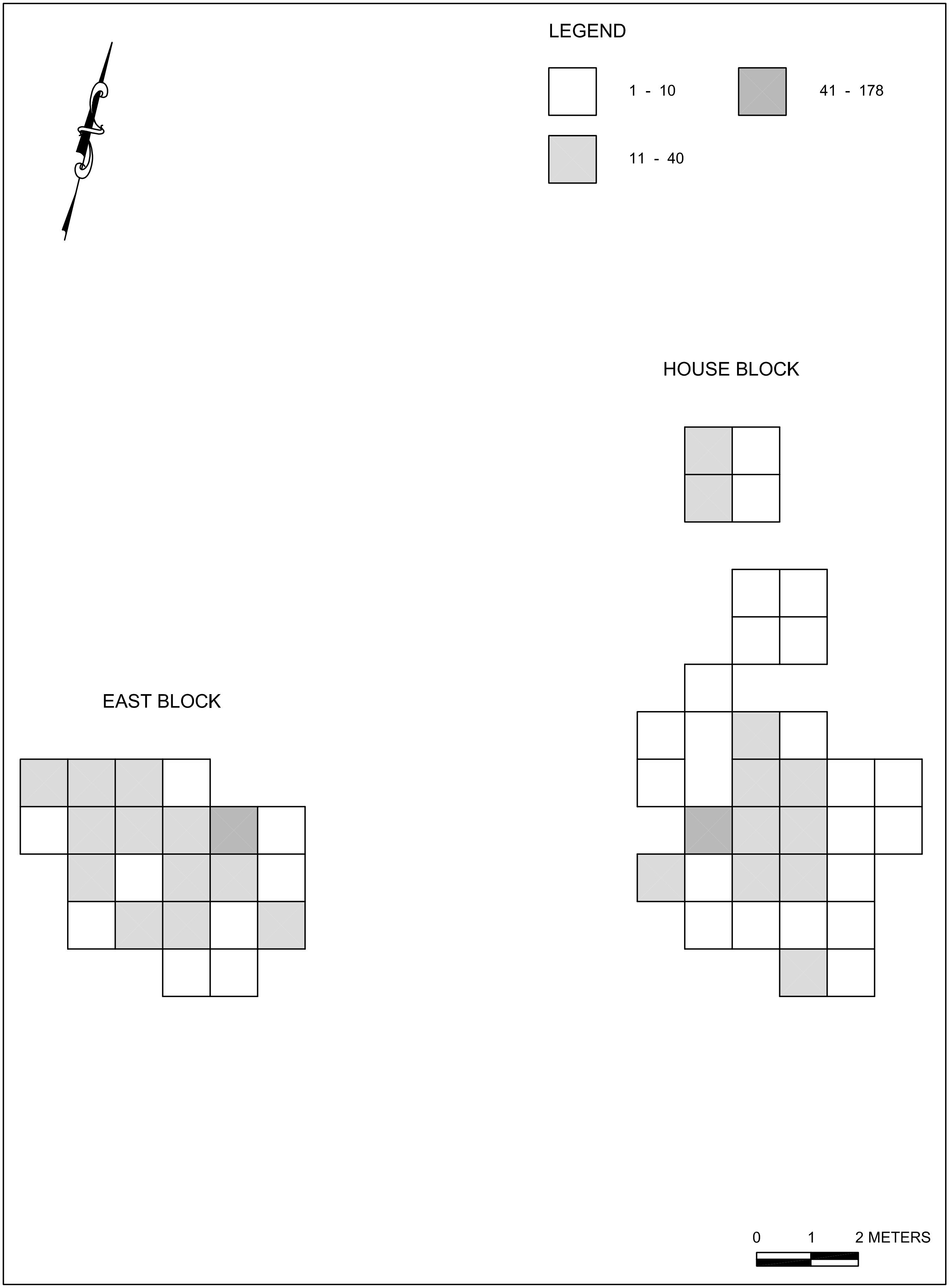

FIGURE 18b: Quartz Distribution, Site 7NC-G-151

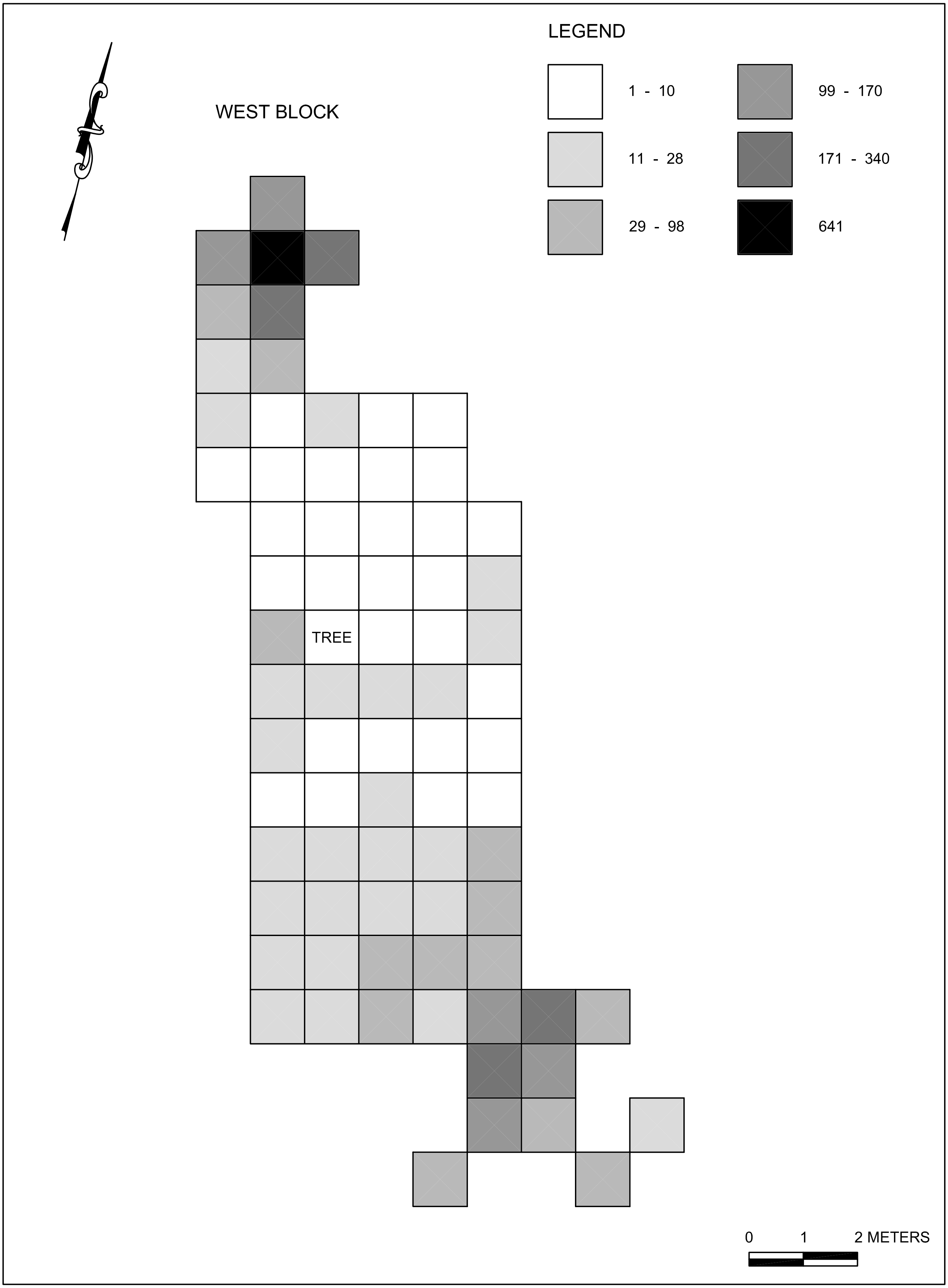

FIGURE 19a: Quartzite Distribution, Site 7NC-G-151

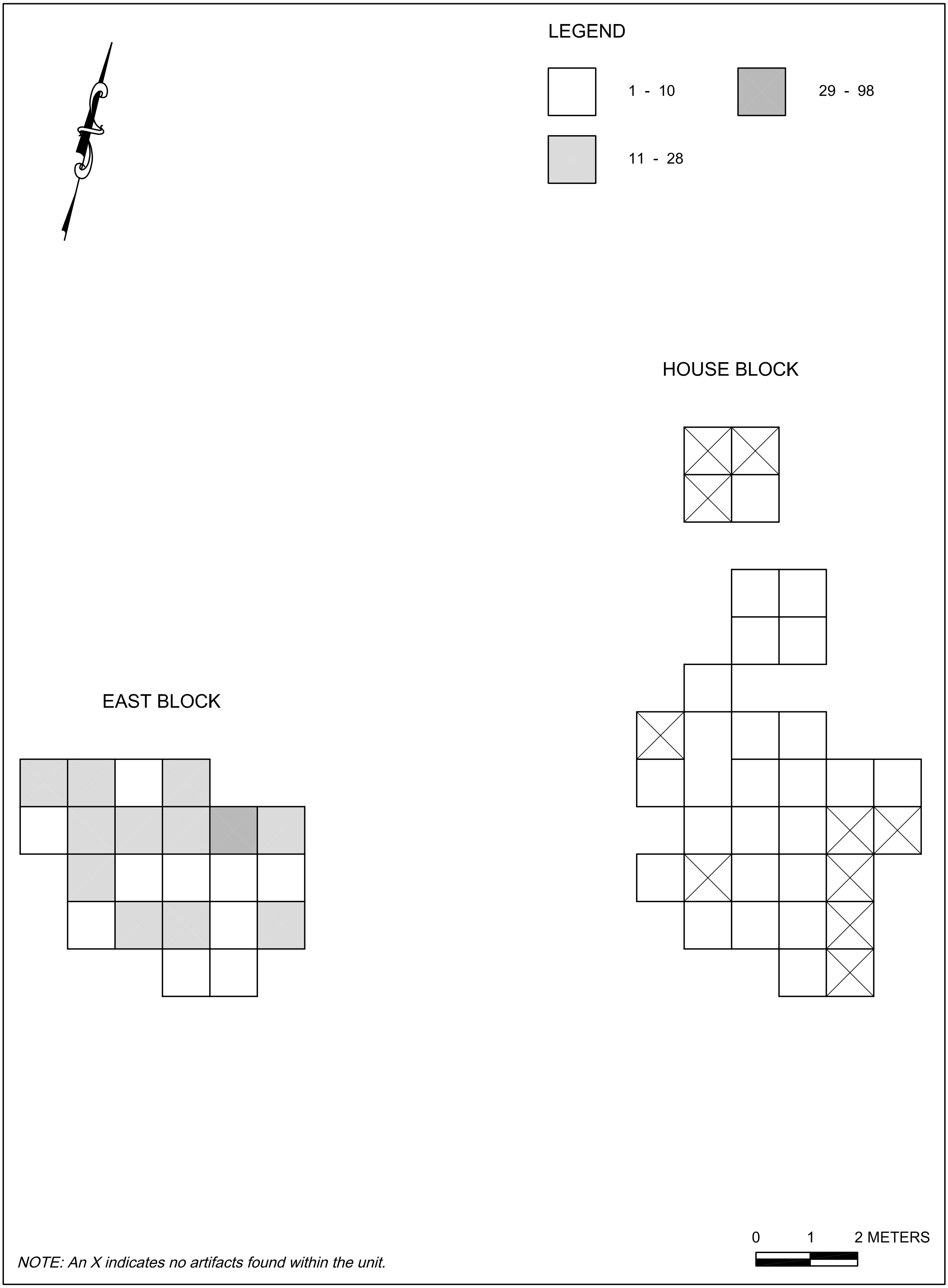

FIGURE 19b: Quartzite Distribution, Site 7NC-G-151

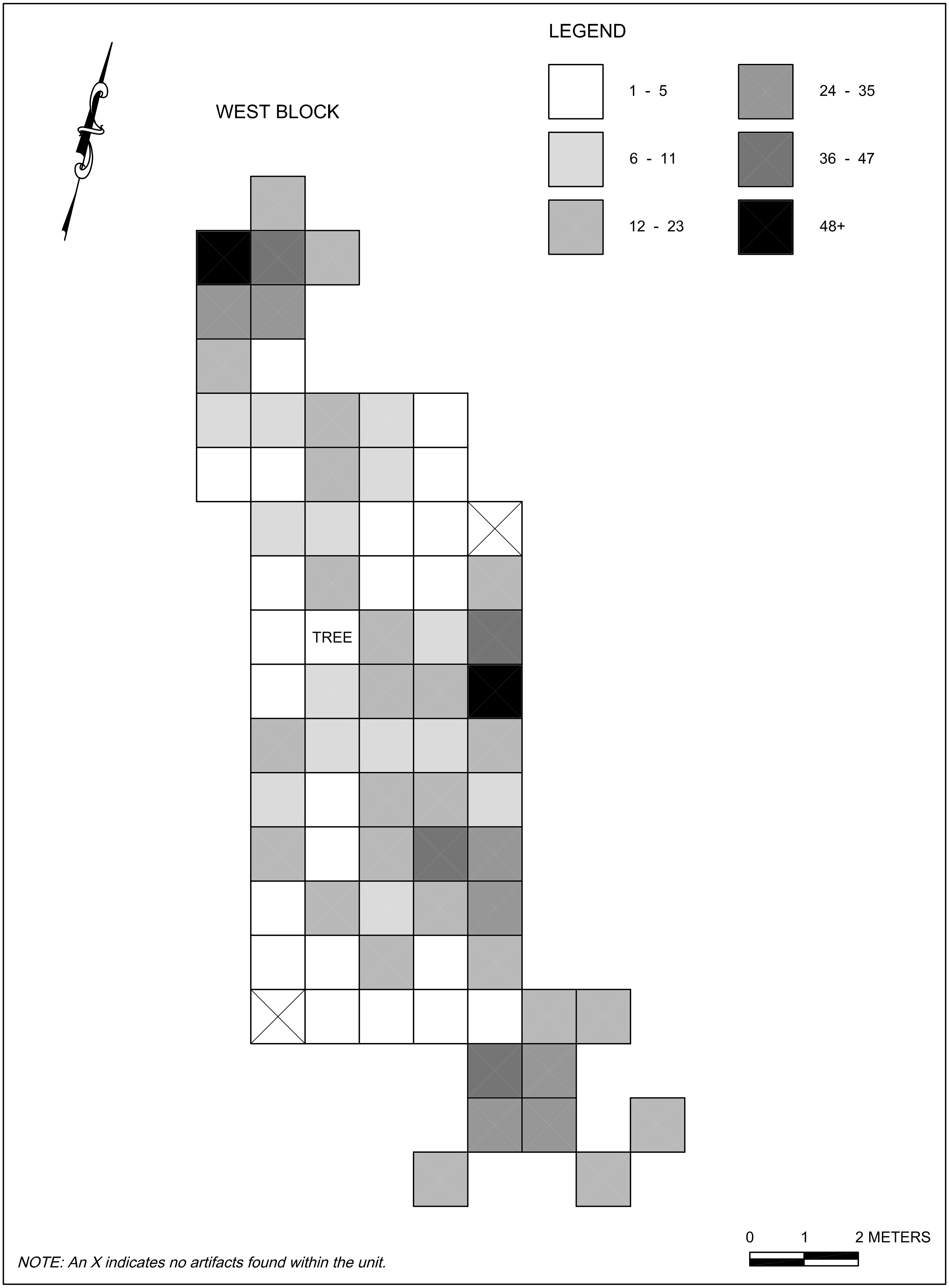

FIGURE 20a: Jasper Distribution, Site 7NC-G-151

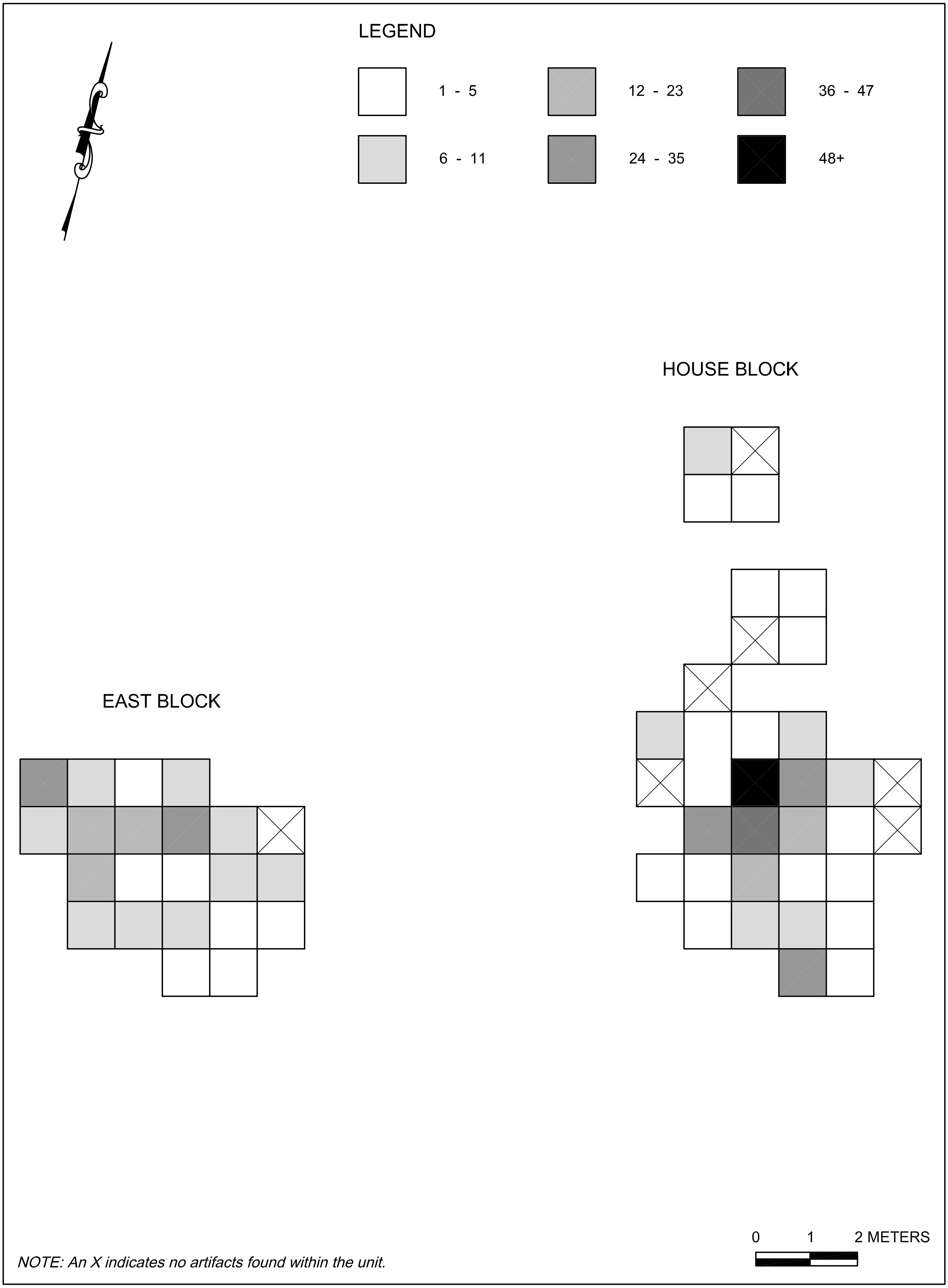

FIGURE 20b: Jasper Distribution, Site 7NC-G-151

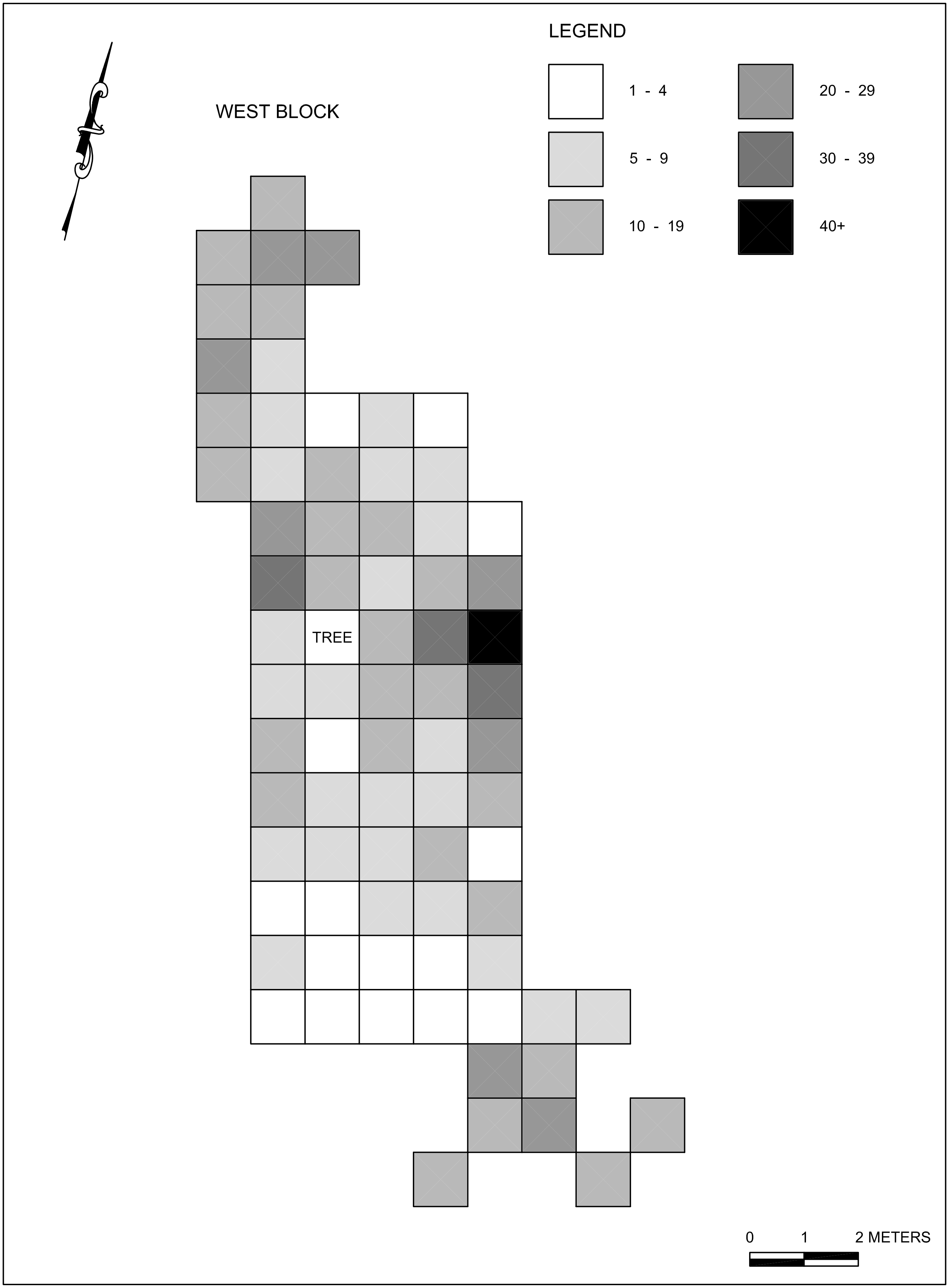

FIGURE 21a: Chert Distribution, Site 7NC-G-151

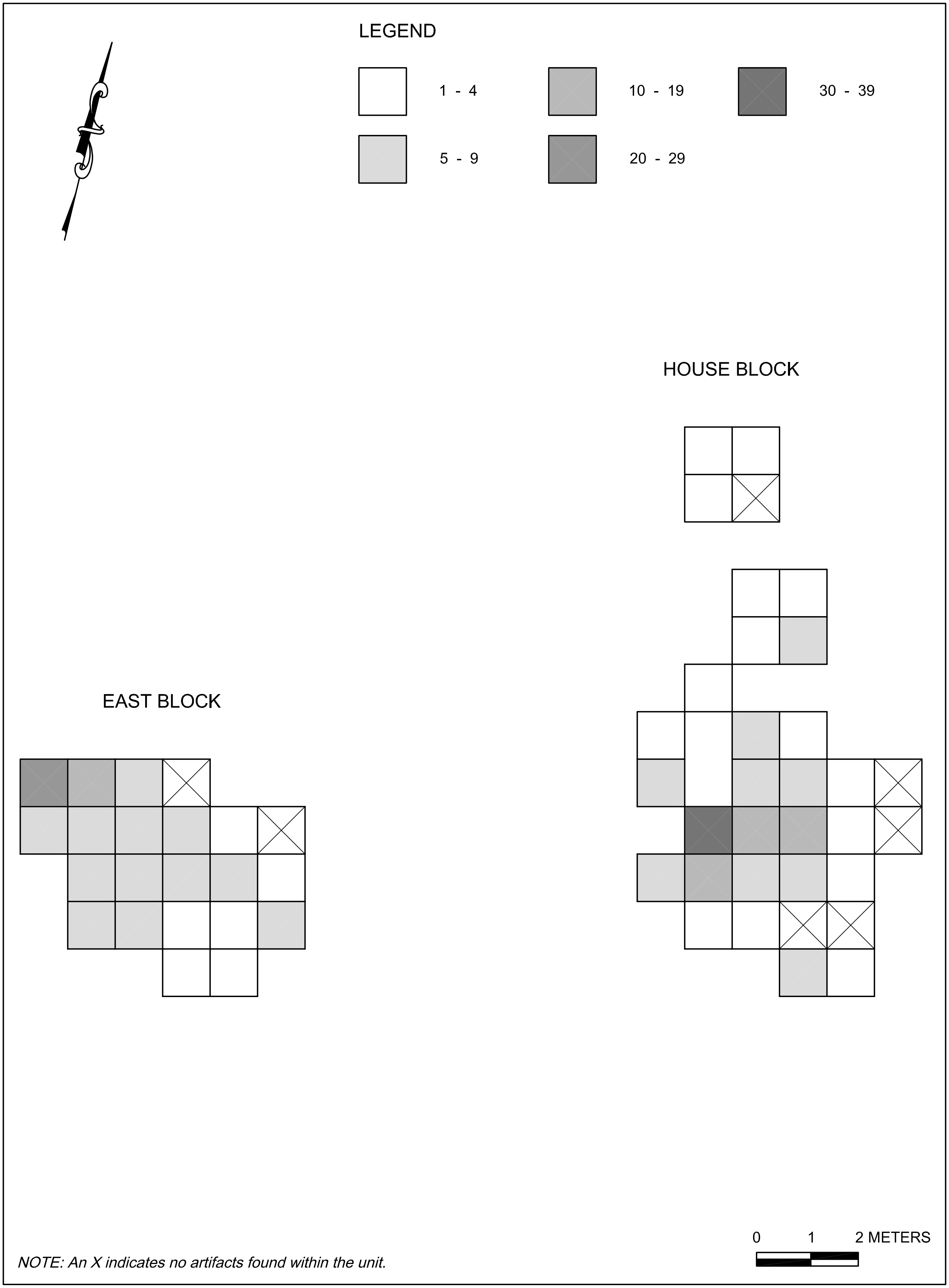

FIGURE 21b: Chert Distribution, Site 7NC-G-151

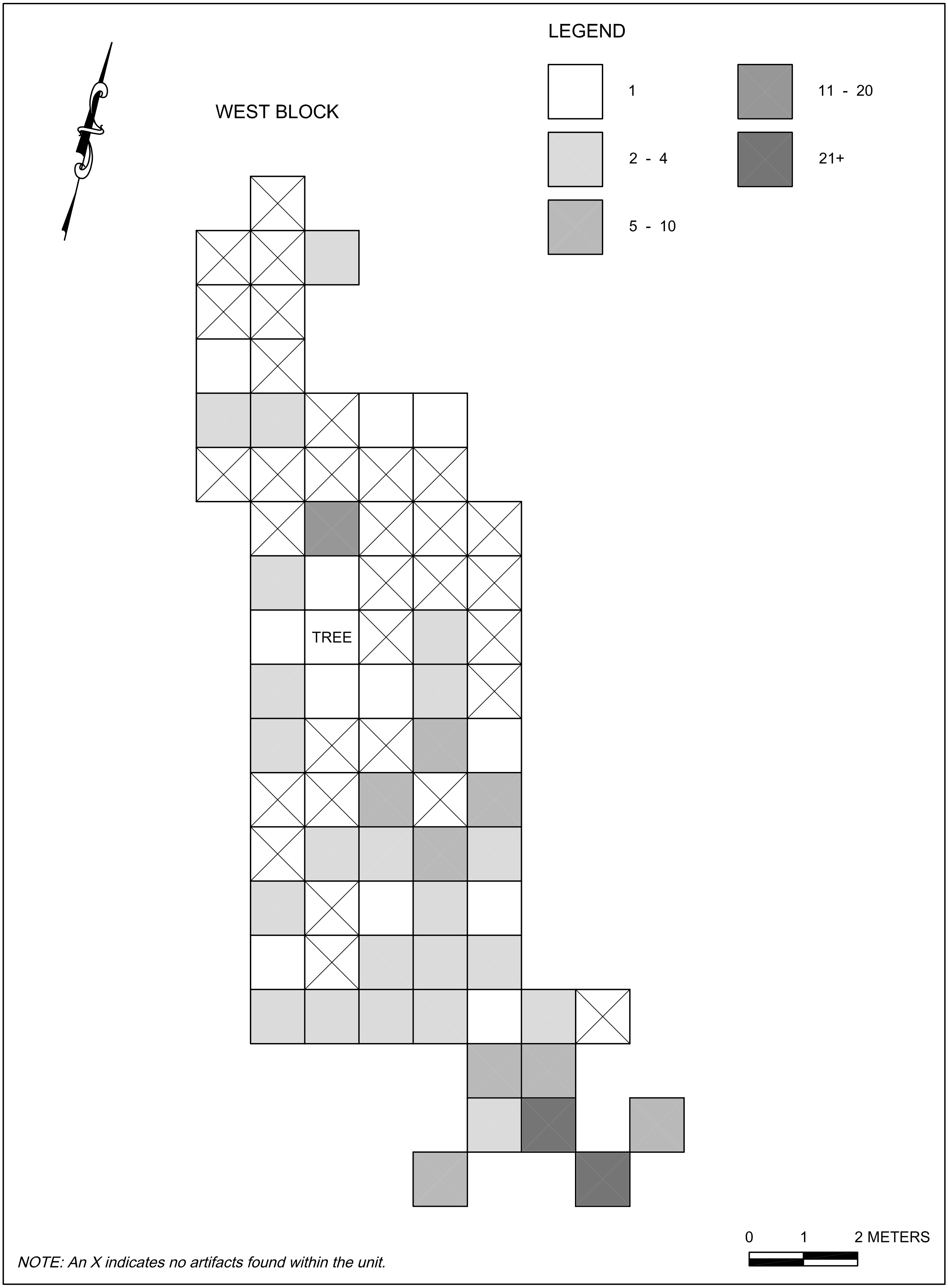

FIGURE 22a: Rhyolite Distribution, Site 7NC-G-151

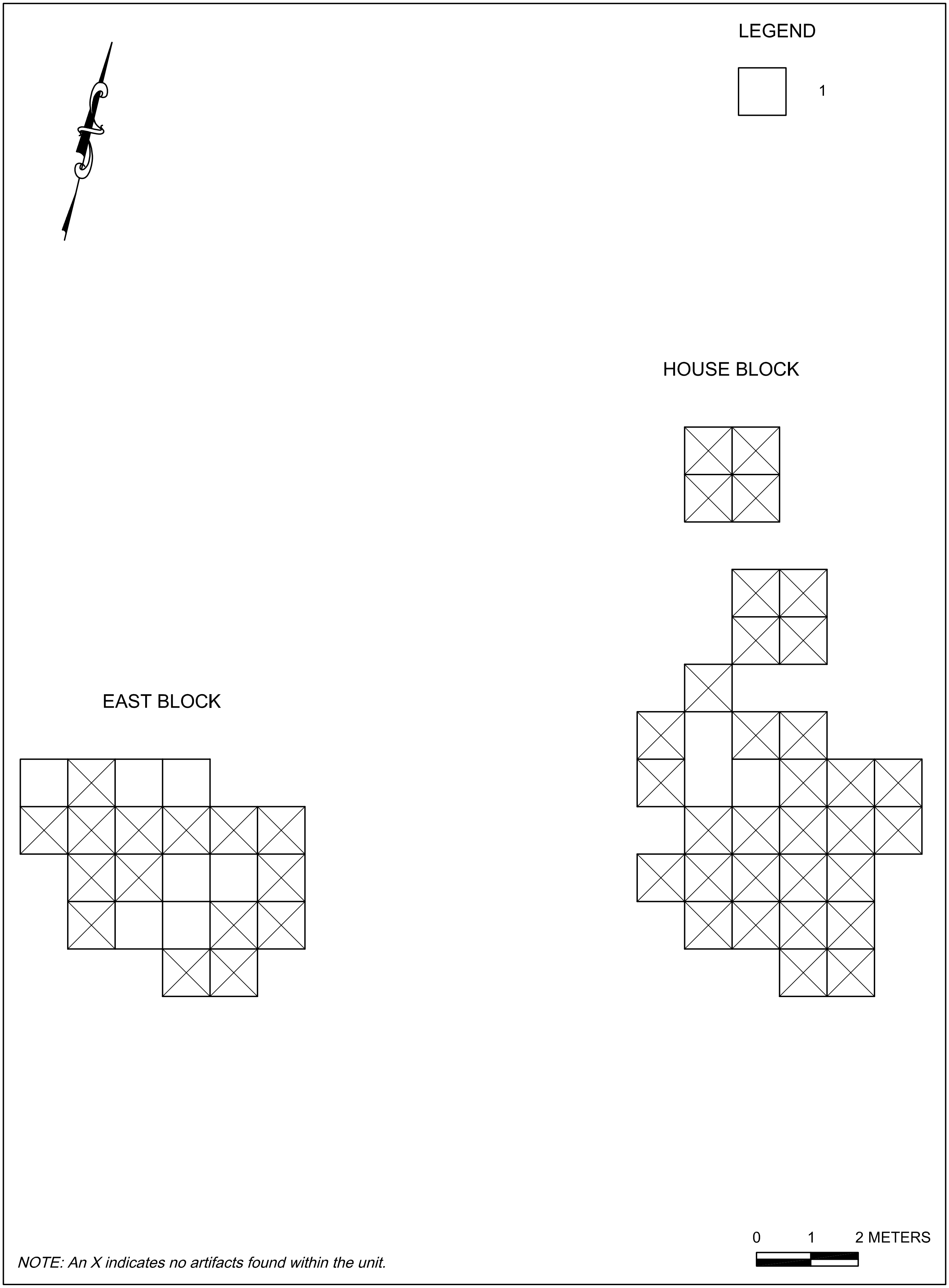

FIGURE 22b: Rhyolite Distribution, Site 7NC-G-151

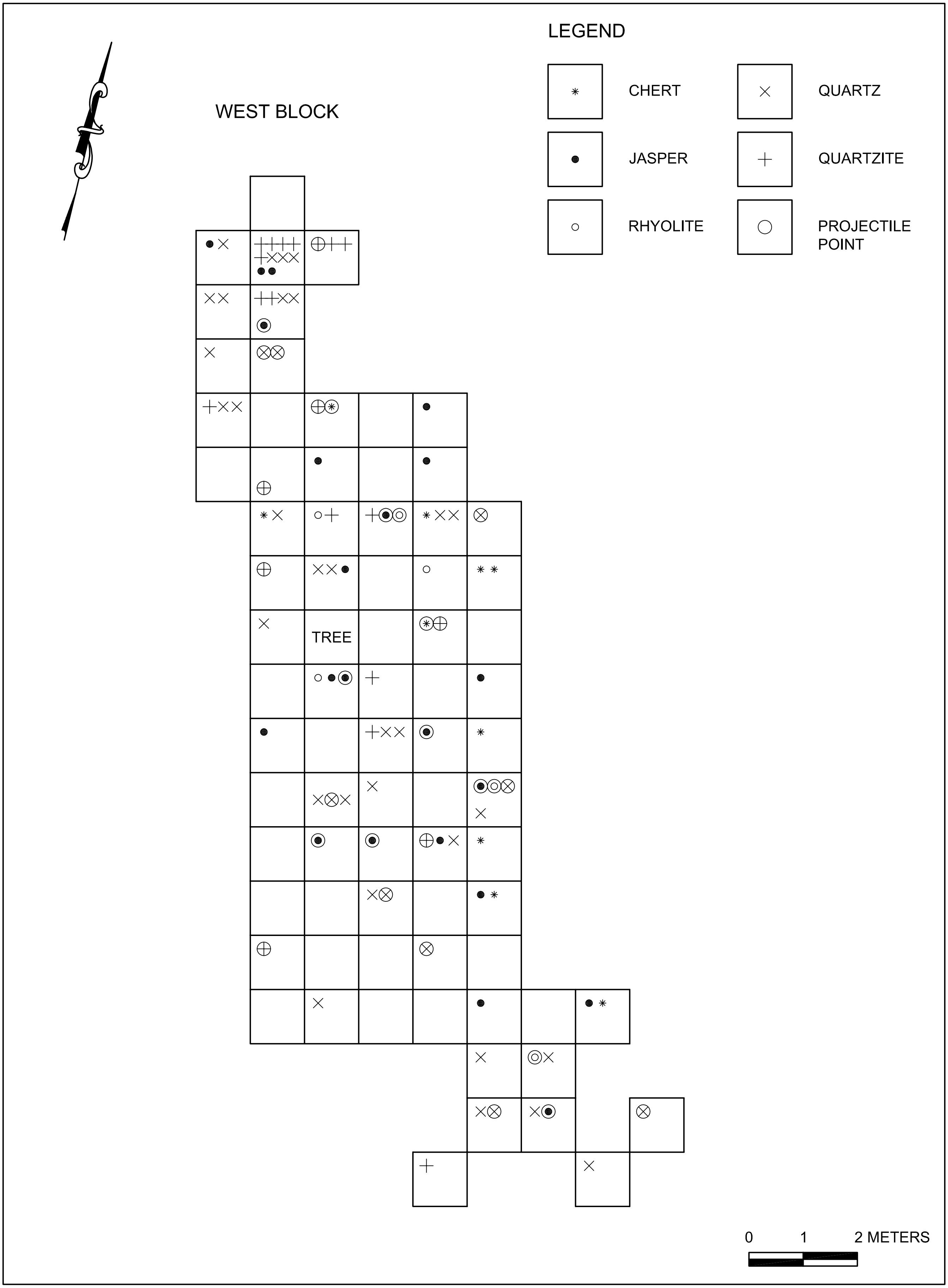

FIGURE 23a: Bifacial Tool Distribution, Site 7NC-G-151

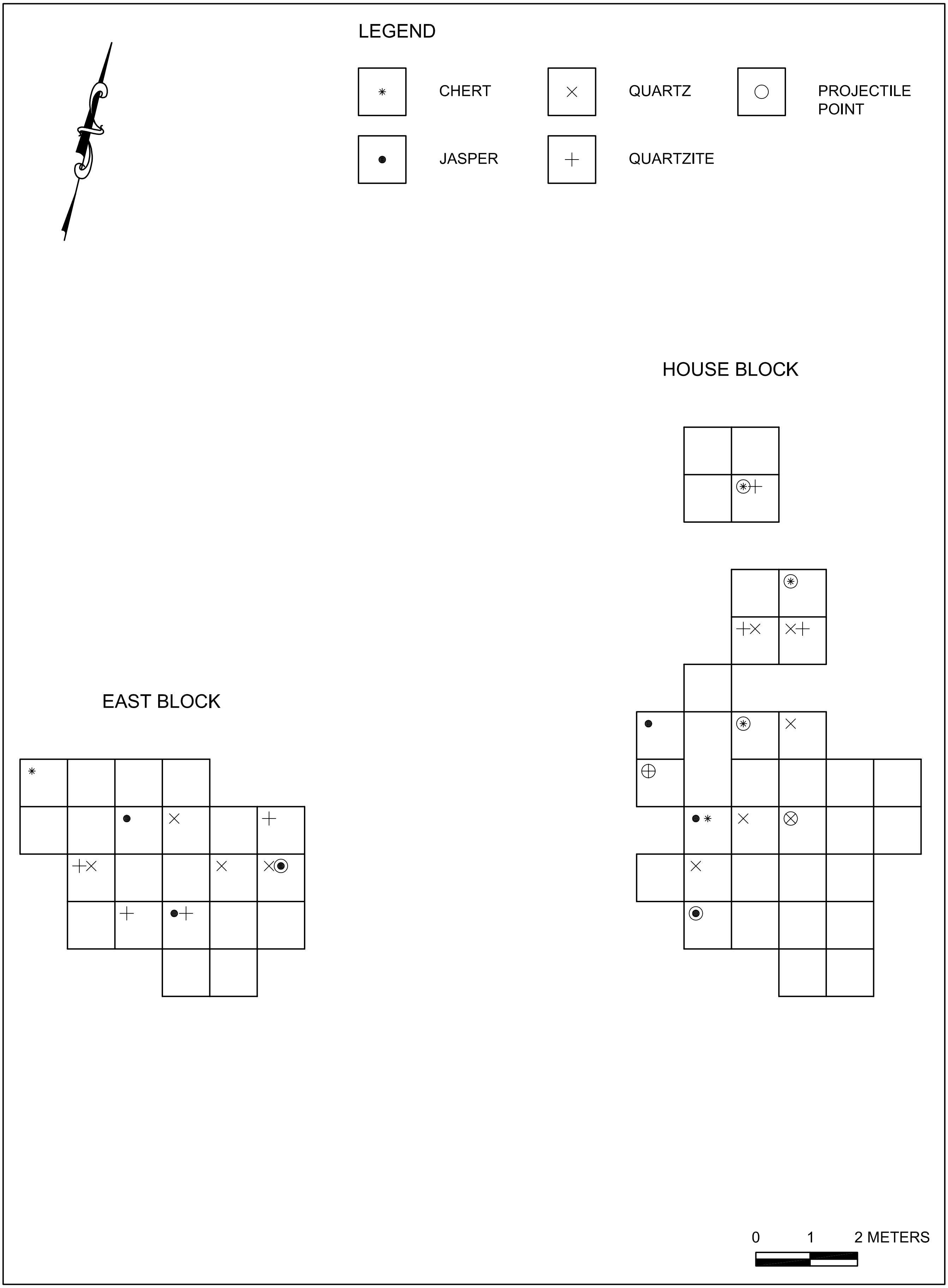

FIGURE 23b: Bifacial Tool Distribution, Site 7NC-G-151

site. However, the high proportion of jasper cores (12 of 15; 80%) and jasper staged bifaces (13 of 15; 87%) found in the West Block Excavation strongly suggests that the Jack's Reef points were made and used there.

In contrast to the Jack's Reef points, the sample of contracting-stemmed points is not restricted to one portion of the site, and drawing conclusions about their production or use areas would be speculative.

The north end of the West Block Excavation has been termed the Supercluster because it contains an extremely dense concentration of lithic reduction debris that has no known correlates from recorded prehistoric sites in the Delmarva Peninsula. Excavation Units 92, 109, 126, 131, and 132 combine for 4,685 pieces of debitage, an astonishing 36.6 percent of the site total, while accounting for only 3.5 percent of the total excavated area (see Figure 4 and Figures 17a, 18a, and 19a). Excavation Unit 109 alone accounts for 16.8 percent of the site total, yielding 2,155 flakes and shatter, a figure exceeding the *total* artifact counts from such base camps as the Mitchell Farm Site (7NC-C-A2), the Brennan Site (7NC-F-61A), the Webb complex and Woodland II components of the Snapp Site (7NC-G-101) and the Leipsic Site (7K-C-194A), Site 7NC-D-19 of the Delaware Chalcedony complex, and Sites 7NC-D-54 and 7NC-D-62 of the Green Valley complex, among others. Debitage frequencies from Level 2 and Level 3 of Excavation Unit 109 were 959 and 901, respectively, indicating an extraordinarily intensive reduction endeavor within a very limited activity zone.

The very high debitage densities found in the northern Supercluster elicit the question of origin: is this clustering the product of reduction activities at the point of deposition, or does it reflect dumping(s) of debris from elsewhere, for example from hearth perimeters? Binford (1978) and Bodu (1996), among others, have posited that a variety of subsistence practices, such as lithic tool production and maintenance, were centered around hearths, creating debris patterns within nearby "drop zones" and "toss zones." Debris accumulation around a working individual will continue until either the person moves to a new work station or the debris is collected and discarded. The margins of residential and activity zones were probably used as dumps where work debris was discarded, creating dense lithic middens.

The restricted bounds of the Supercluster and its location at the periphery of the site landform would appear to provide a good fit for this kind of discard activity, and may explain the extremely high artifact densities. An examination of different artifact class distributions in the Supercluster presents conflicting information about the origin of this cluster.

Debitage smaller than 6 millimeters, or "microdebitage," obtained from 2-liter flotation samples from Excavation Unit 92 displays irregular frequency distributions. The sample is overwhelmingly composed of quartz block shatter, with hundreds of specimens identified in the size range of less than 1 millimeter. Quartz is extremely prone to fracture upon impact, and the large quantity of small debris may reflect the mechanical properties of the material. Alternatively, however, the shatter may have been created by trampling of debris deposits (Nielsen 1991; Schiffer 1983) or sand grains, which are composed largely of quartz silica, and which are plentiful in the sandy loam soil matrix.

The near-absence of quartzite, chert, and jasper from the microdebitage sample suggests that this latter proposition has some validity.

In contrast to the microdebitage assemblage smaller than 1 mm, the 1 mm-6 mm size range is significantly less abundant, with only six specimens and 11 specimens unambiguously identified in the Level 2 and Level 3 samples, respectively. Some studies of refuse disposal have demonstrated an associated size-sorting effect, in which smaller debris is more likely to be overlooked and left in its area of use (primary deposit), while larger debris is more often removed to an area of discard, becoming a secondary deposit (Binford 1978; Metcalfe and Heath 1990:782). These processes can be the result of deliberate cleaning, or can be incidental, caused by repeated movement or traffic across a site. Shott (1994:102), meanwhile, explicitly warns against assuming that the presence of microdebitage is an indicator of primary depositional context. The correlation of microdebitage frequencies to larger debris frequencies has yet to be adequately established in field situations, although experimental reduction has shown that microdebitage is a ubiquitous element of a created assemblage (Fladmark 1982).

Cores and staged bifaces are abundant but unevenly distributed across the site, with density peaks for each class occurring in the Supercluster (see Figure 23a, b; Figure 24a, b; Figure 25a, b). The concentrations in the Supercluster make up 17 percent and 19 percent, respectively, of the core and staged biface site totals, far less than the value obtained for the debitage sample (36.6%). This finding implies that behavior responsible for biface and core discard may be somehow different from that of debitage (Table 23). At issue is not simply whether these differences are the product of primary versus secondary deposition, but whether the patterns in the frequencies between raw material types and artifact classes are co-relational to either primary or secondary discard behavior. If so, these patterned variations may prove to be operational signatures of specific behaviors.

An expected product of a lithic work station would be the presence of hammerstones, used as percussion tools in decortication and early-stage reduction, and as tools to prepare flake platforms on cores and bifaces. No hammerstones were recovered within 3.5 meters of the Supercluster.

Table 23. Frequencies and Site Proportions of Staged Bifaces, Cores, and Debitage from the Supercluster, Site 7NC-G-151

RAW MATERIAL	STAGED BIFACES	CORES	DEBITAGE
Chert	.	2 (9%)	94 (7%)
Jasper	3 (19%)	2 (13%)	146 (9%)
Quartz	6 (15%)	7 (13%)	2,993 (52%)
Quartzite	9 (39%)	14 (29%)	1,444 (37%)
TOTAL	18 (19%)	25 (17%)	4,685 (37%)

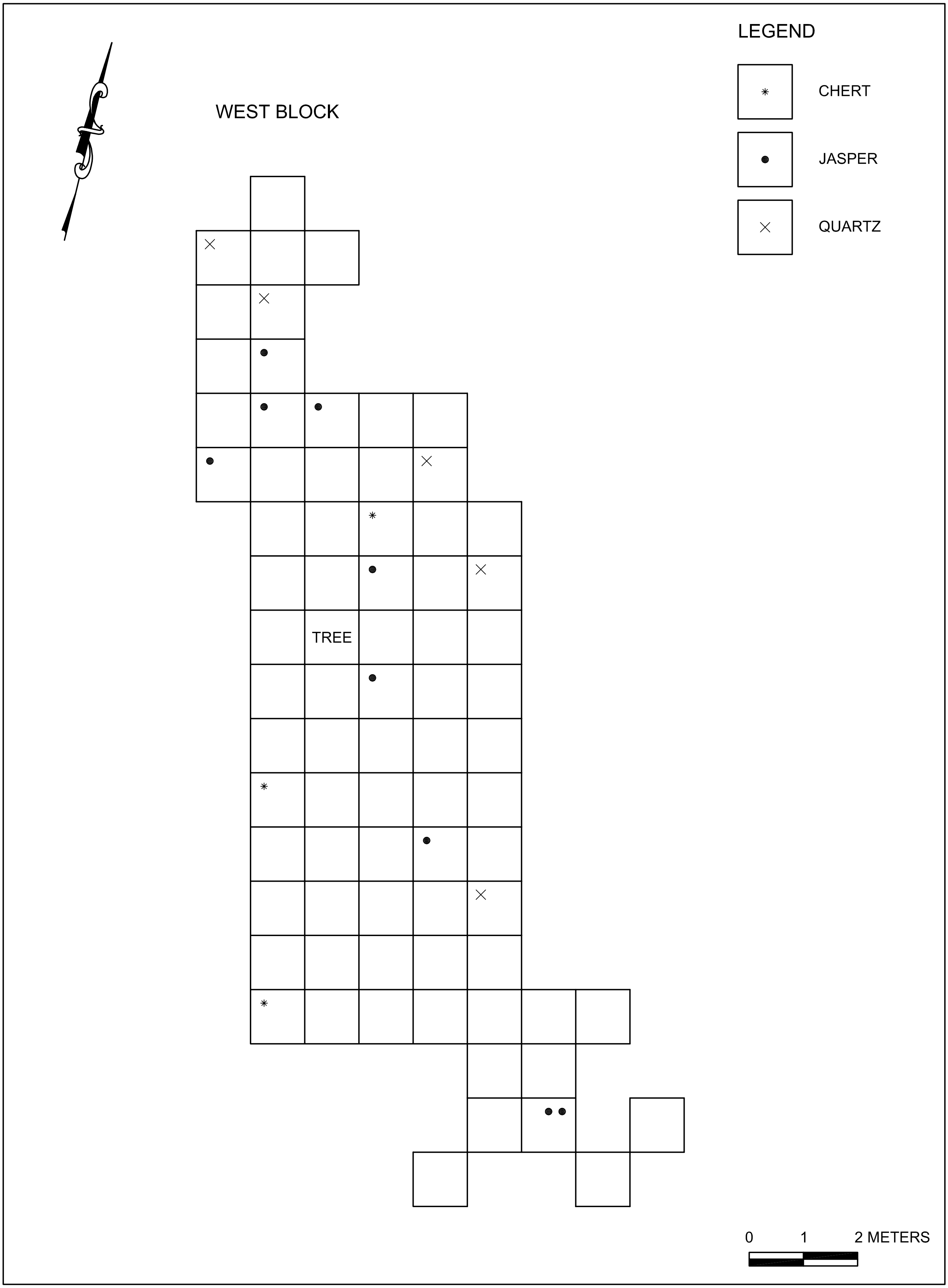

FIGURE 24a: Unifacial Tool Distribution, Site 7NC-G-151

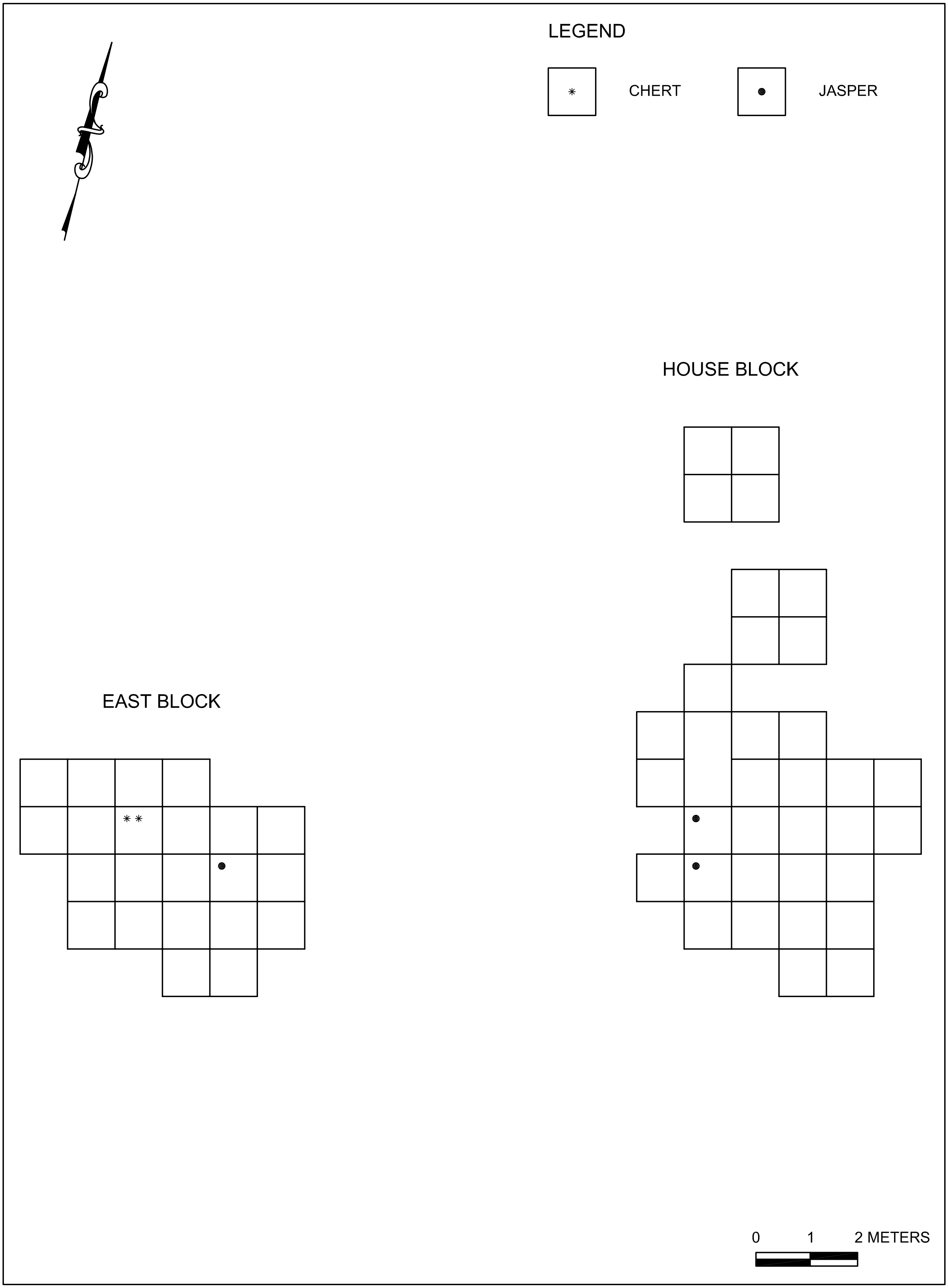

FIGURE 24b: Unifacial Tool Distribution, Site 7NC-G-151

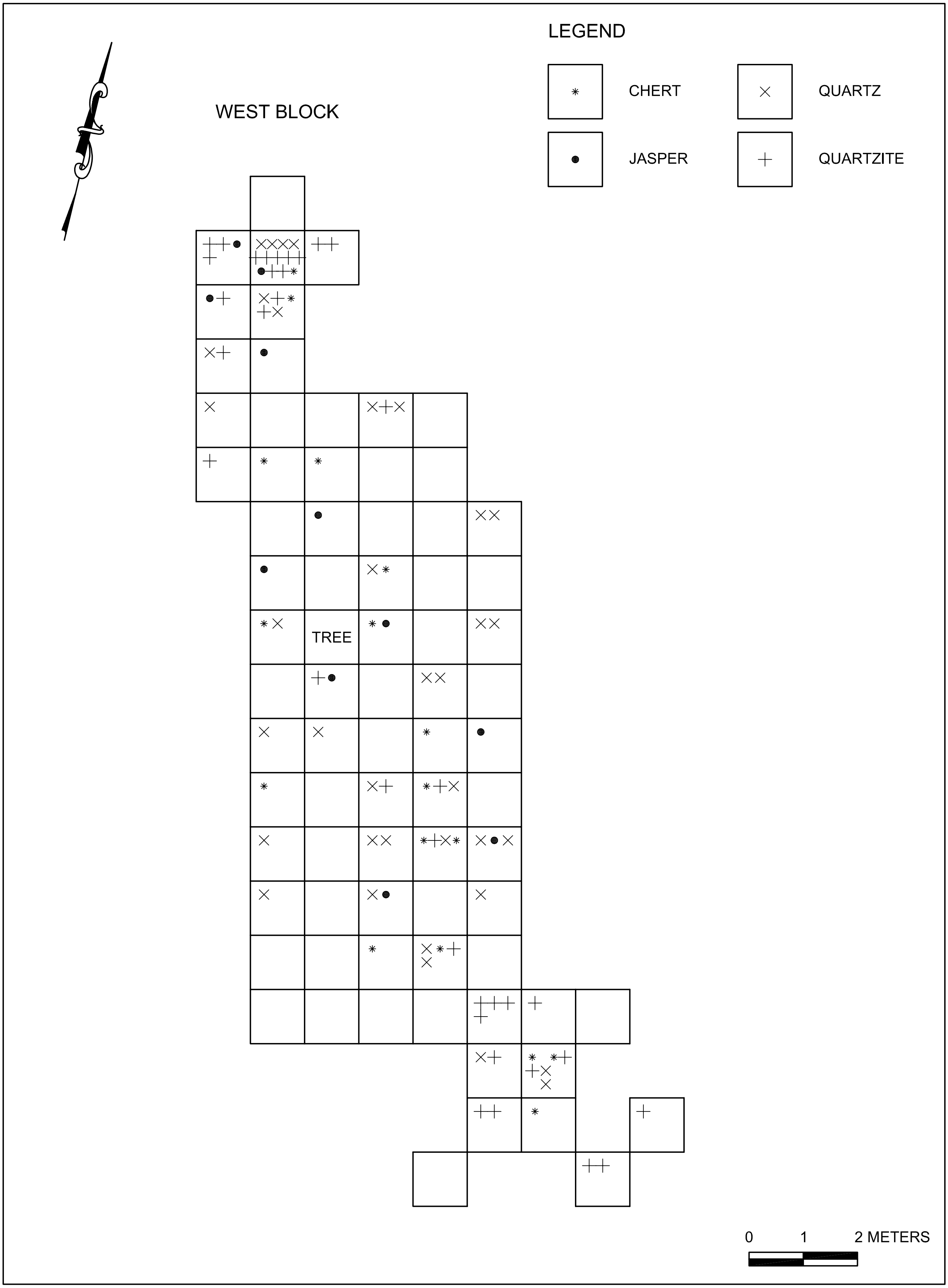

FIGURE 25a: Core Distribution, Site 7NC-G-151

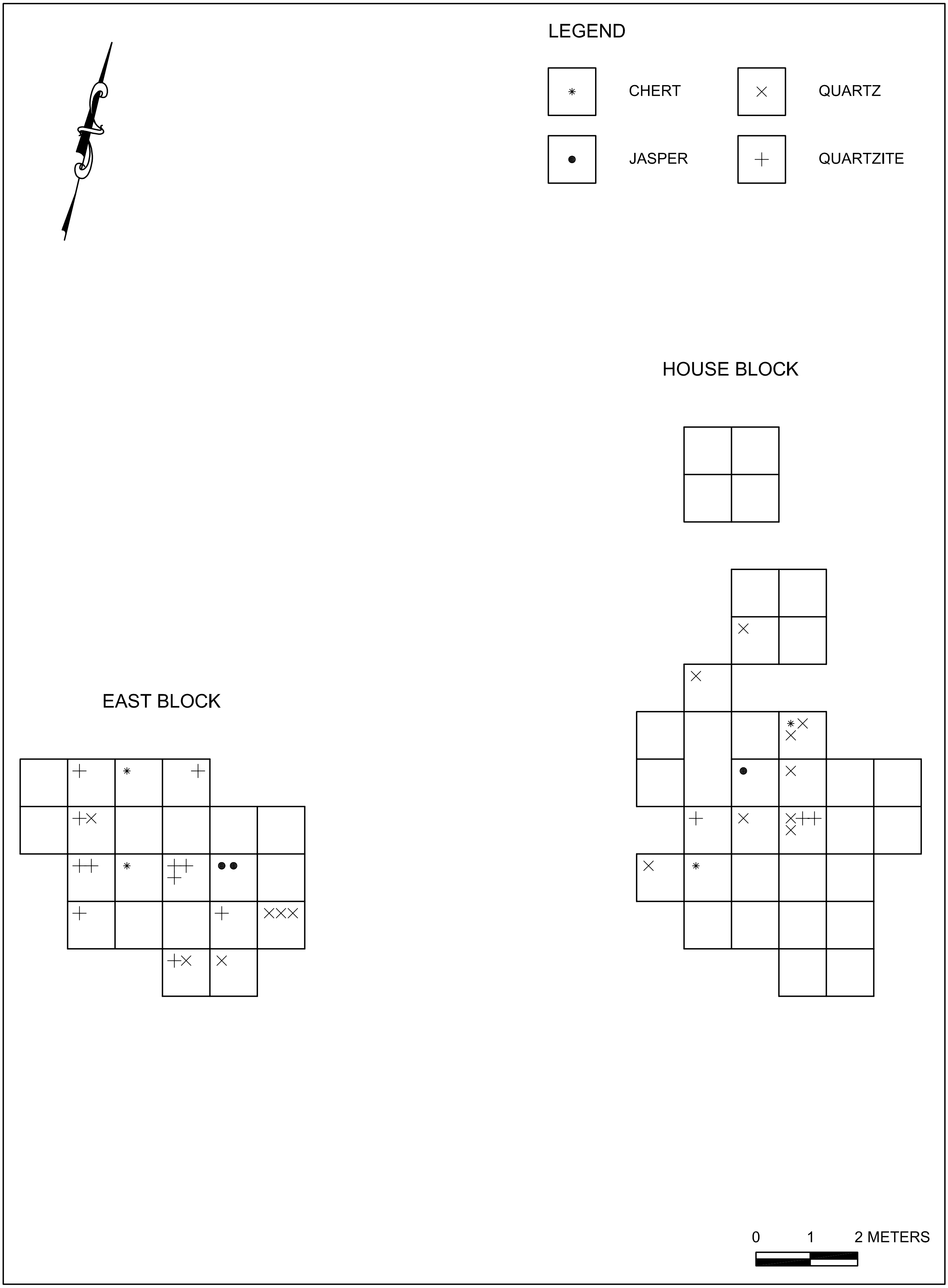

FIGURE 25b: Core Distribution, Site 7NC-G-151

Unlike flaked debris or bifaces, hammerstones are not likely to have been culled from a discard pile for further reduction or use. The absence of this tool class from the vicinity of the Supercluster is a possible indicator that the cluster is the product of secondary deposition.

On balance, the question of the genesis of the Supercluster appears to tip in favor of secondary deposition. This conclusion is based on a combination of factors, including its location at the periphery of the known site; its sharply defined boundaries; the under-representation of microdebitage (particularly quartzite); and the apparent disparities between the tool and debitage proportions for quartz and jasper. Additionally, it appears more reasonable to conclude that the observed quartz microdebitage is the product of silica sand shatter caused by repeated trampling instead of *in situ* reduction activities, particularly given the absence of chert, jasper, and quartzite microdebitage.

The distribution of cultural features is another useful measure of intrasite patterning, and provides a clear indication of discrete activity areas within the site (see Figure 7). Of 14 FCR clusters found across the site, 11 were identified in the West Block Excavation, between the North 100 and North 114 grid lines. These features are interpreted as hearths or processing areas, and the preponderance of them in the West Block Excavation suggests that activities associated with fire were largely restricted to this area. Interestingly, the single residential structure identified at the Whitby Branch Site, Feature 19, is located at the opposite end of the site from the main hearth cluster. Radiocarbon and oxidizable carbon dating techniques indicate a slight overlap in the age of the possible pit house (790-400 BC) and that of Feature 6 (430-300 BC), an FCR cluster found in the West Block Excavation. The near-contemporaneity of the two features suggests that the spatial separation of the feature types may be the product of behavior demarcated by discrete activity zones.

High concentrations of jasper and chert debitage indicate an activity area along the western perimeter of the possible pit house (see Figures 20a and 21a). Within this circumscribed area the small sample of Wolfe Neck ceramics was found, lending support to the notion that household subsistence activities were associated with a residential structure between 700 and 400 BC.