7.0 ANALYSIS AND INTERPRETATION

Research topics developed at the start of the project were used to organize and direct analysis of data recovered from the site. The research themes serve to place the Black Diamond site (7NC-J-225) in a wider, regional context. Chronology is considered first, since time is critical to ordering and understanding the remaining information. Other themes include intra-site patterns and site structure; lithic technology; paleoenvironmental studies; and inter-site and regional settlement patterns.

7.1 Chronology

In literal terms, chronology is the study of time. The purpose of chronological analysis in archaeological investigation is to provide a temporal dimension to the various data in a process that forms a backdrop for identifying and characterizing the nature of the site occupations. Typical of most prehistoric archaeological sites in eastern North America, temporal information was recovered from the Black Diamond site in both absolute and relative forms.

7.1.1 Chronological Data

Absolute Data

Absolute temporal data was derived from accelerator mass spectronomy (AMS) analysis of organic material recovered from a variety of proveniences. The results of the analyses are shown in Table 6-4.

The dates from archaeological contexts, as opposed to those from bulk sediments, were from contexts identified as features, all of which were in contact with the modern, plowed surface deposit. The calibrated ranges of two of the dates, 250±40 BP (cal 2 σ AD 1540 to 1951; Beta-149980) and (270±40 BP (cal 2 σ AD 1486 to 1951; Beta 149976), fall almost entirely within the historical period. The source for the charcoal used in the AMS assays for these two samples may have been related to early historical (colonial) land clearing. Both dates overlap at the two-sigma level with an AMS date obtained from a similar plow-truncated feature context at the adjacent Frederick Lodge Site Complex (Versar 2010a). The ranges of two of the remaining dates, 680±40 BP (cal 2 σ AD 1263 to 1394; Beta -149977) and 910±40 BP (cal 2 σ AD 1032 to 1210; Beta- 149975), fall entirely in the Late Woodland period. The range of the earliest date, 1870+/-40 BP (cal 2 σ AD 60 to 238; Beta-14979), is within the Middle Woodland period. No artifactual or other direct evidence for Middle or Late Woodland occupation of the site was recovered.

The AMS dating of bulk soil samples also yielded dates with ranges in the Late Woodland period. Two of the dates, 650+/-40 BP (cal 2 σ AD 1278 to 1398; Beta-150343) and 940+/-40 BP (cal 2 σ AD 1091 to 1185; Beta-150342), were from artifact-bearing strata within the excavation block. The date ranges were statistically identical to the ranges of samples from features that cut into the sediments, a finding that seemingly contradicted the notion of superposition, i.e., that younger deposits will overlie or intrude into older deposits:

sediment:	650+/-40 BP (cal 2 σ AD 1278 to 1398; Beta-150343)
Feature 24:	680±40 BP (cal 2 σ AD 1263 to 1394; Beta -149977)

sediment: 940+/-40 BP (cal 2 σ AD 1091 to 1185; Beta-150342)
Feature 29: 910±40 BP (cal 2 σ AD 1032 to 1210; Beta- 149975)

The final bulk soil sample was obtained from near the base of a backhoe trench excavated to a depth of three meters in the bay/basin bottom. The soil appeared to have been part of a buried surface covered by nearly three meters of coarse sandy deposits. The date range from the sample, 370+/-40 BP (cal 2 σ AD 1446 to 1635; Beta-150341), was among the latest returned on the AMS samples from the site.

Relative Data

Stratigraphic associations provided critical relative chronological data used in the analysis of the site. Contextual analyses of sedimentary and cultural stratigraphy detailed in Section 6.0 indicated that the surface of the site had been plowed repeatedly. However, sub-plow zone deposits were relatively undisturbed and suggested a direct relationship between the plowed and unplowed layers, indicating a single deposit, the top of which had been cut. The vertical distribution of artifacts, which corroborated this assessment, suggested that a single temporal component was present.

In terms of artifacts, the Black Diamond site findings were highlighted by the presence of a distinctive style of stemmed biface or projectile point. Although the artifacts did not neatly conform to a specific, conventional point style, their size, shape and general manufacturing characteristics along with the site orientation to quartzite utilization strongly suggested a connection to the greater Savannah River tradition at the end of the Late Archaic. The points were imprecisely dated, but provided an overall time frame within which to assess the depositional contexts at the site, as well as identifying the component assemblage that appeared to be represented. No evidence of steatite use or early ceramics, both characteristics of the latter end of the Late Archaic, was noted on the site. However, a single slate pendant was recovered. Use of slate for accouterments, while not fully temporally diagnostic, is strongly linked to the beginning of the Woodland period. McLearen (1991) observed that regionally, ground stone technologies carried over from the Late Archaic into the Early Woodland with the addition of better made implements, as well as ornaments. The slate pendant would thus be consistent with occupation of the site at the end of the Late Archaic.

Summary

The AMS results generally did not align well the associated artifact data. The artifacts and contextual analyses suggested that the site occupation was a single component dated to the latter part of the Late Archaic. The lack of correspondence in the data was probably related to the physical size of the materials that were submitted for AMS analysis. The samples consisted of either very small fragments of charcoal or bulk sediments. Very small items such as the carbonized wood samples from the Black Diamond site may easily be subjected to postdepositional movement within the soil column, especially in coarse-grained, or sandy sediments. Bulk sediments, moreover, may be exposed to soil development processes that can affect the chemistry that is the focus of the dating technique. Thus, while the dates that were returned on the samples were themselves valid, determining the ultimate sources of the materials that were dated and assessing the resulting implications for site formation and

occupational history were more complex tasks than could be undertaken with the data recovered from the site.

7.2 Intra-Site Patterning

Artifact distributions are assessed in this section of the report. The analyses are extensive and detailed but were undertaken to establish the contexts of the features and artifact assemblages, addressing issues of site formation and the integrity of the deposits. The results of the analyses are included in full so that the interested reader may follow the logic through the data.

7.2.1 Vertical

The characteristics of sediment stratigraphy revealed in the excavations at the Black Diamond site, including sediment texture, color, stratum thickness, and general appearance, suggested that the surface layer across the site, Stratum A, was a plow zone. This observation was corroborated by aerial photography from 1926 clearly showing the site situated in a field that has been cleared for agriculture (Figure 7-1).

The results of spatial analyses of artifact distributions in the deposit provided further evidence of what appeared to be a single depositional layer, the top of which had been cut by plowing (Figure 7-2). The artifacts in Stratum A were more evenly distributed than were the artifacts in the underlying Stratum B, exhibiting less distinct clustering yet similar patterning overall. That is, major artifact concentrations that occurred in the lower deposit were also visible in Stratum A, although they were less well-defined and in some instances were offset several meters from the underlying clusters. Such an interpretation is consistent with the results of numerous experimental and observational plow zone studies which have shown that artifact clusters tend to spread somewhat, or become dilated, but that if sufficiently concentrated in their original state, they will retain their overall patterning (Binford et al. 1970; Lewarch and O'Brien 1981; Odell and Cowan 1987; Tolstoy and Fish 1975; Trubowitz 1978).

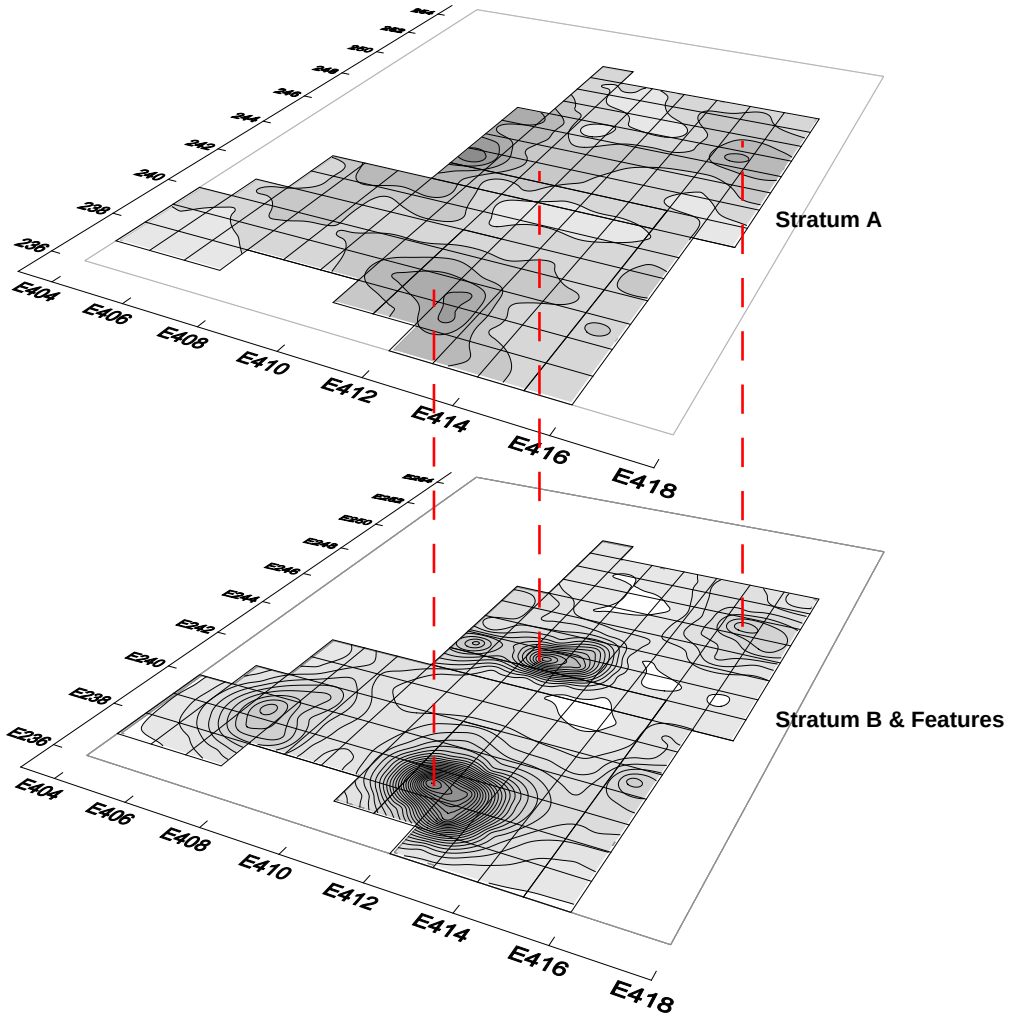


Figure 7-2. Comparison of the Horizontal Distributions of Artifacts, Stratum A and Stratum B.

(artifact clusters in Stratum B and feature contexts are diffused but clearly evident in Stratum A, as indicated by the dotted lines; artifact contour interval = 20)

Data related to refitted artifacts supported this interpretation. Although a formal lithic refit study was not conducted as part of the site analysis, a number of refits were encountered during normal cataloguing. Since the sample of refits was not systematically derived, the results were biased toward easily recognized large artifacts and refits within single proveniences or between adjacent proveniences. Nevertheless, the findings were useful in terms of stratigraphic interpretation. Sixteen refit groups were documented, fourteen consisting of two artifacts each and two groups consisting of three artifacts each (Figure 7-3). Ten of the refit groups were intra-provenience, occurring within an individual stratum or feature provenience within a single unit. These groups may have resulted from *in situ*, post-

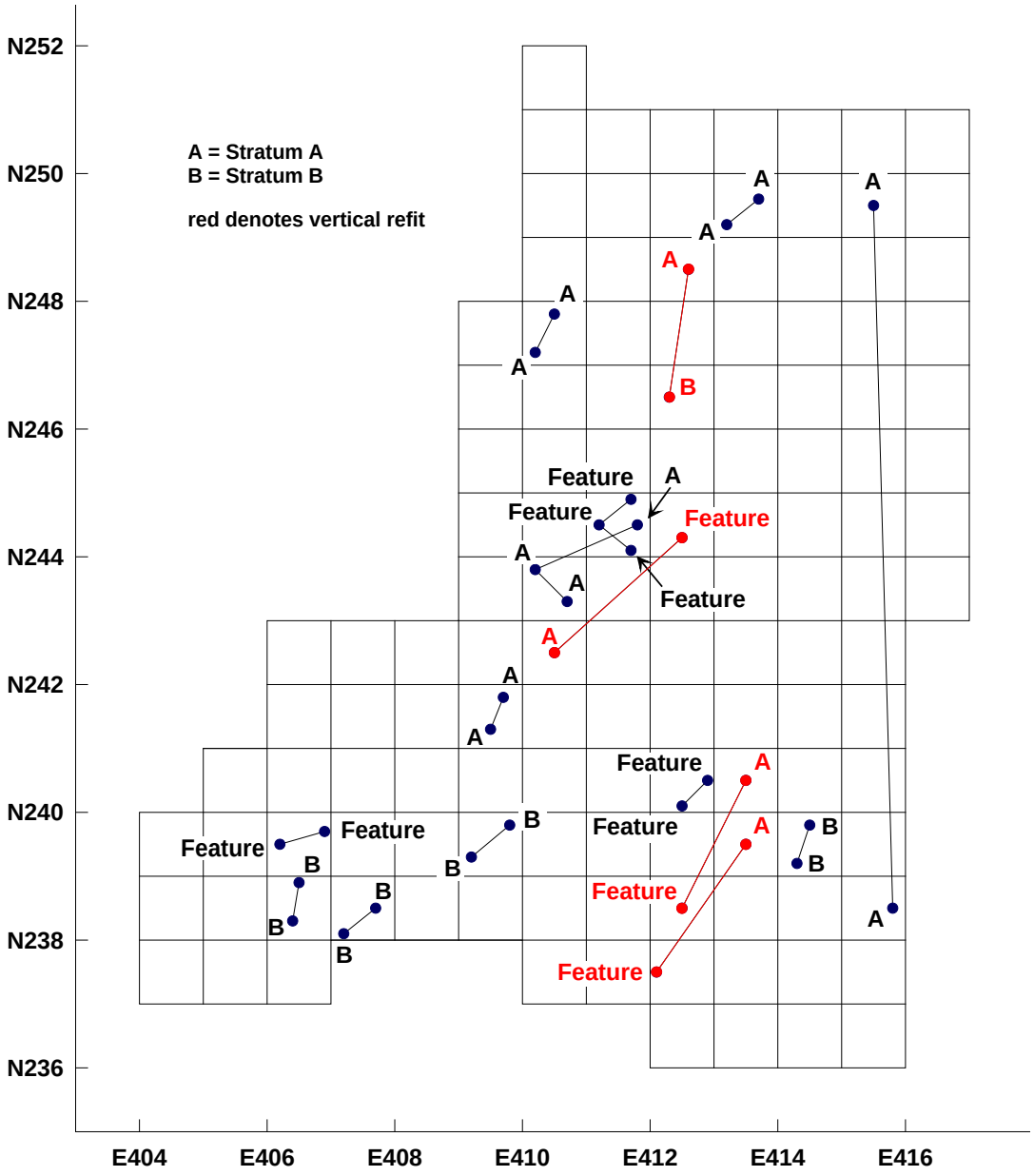


Figure 7-3. Lithic Artifact Refits, Black Diamond Site.

depositional breakage, a situation that would generally imply that stability had been maintained within the stratigraphic contexts. The remaining six groups, or nearly 40 percent of the refitted artifacts, crossed provenience lines either horizontally or vertically. These inter-provenience refits were either horizontal, located entirely within Stratum A, or occurred vertically between Stratum B and Stratum A, or between a feature provenience and Stratum A. The vertical refit data thus appeared to support the interpretation that the two archaeological strata represented a single cultural deposit. Some evidence of wide ranging dislocation was documented—three groups refit from feature proveniences to the plow zone across as much as three meters horizontally, and one group that occurred fully within the plow zone extended across as much as 12 meters. Yet, most of the information suggested that below the plow disturbance, artifact displacement had not been great.

As indicated by vertical artifact distribution analyses (Figure 6-11), the majority of the artifacts recovered at the site were located in the first 10-20 cm below the plow disturbance, referred to as Stratum B, Levels 1 and 2. These proveniences also encompassed most of the shallow feature contexts, including artifact concentrations such as Feature 24, Feature 48, and Feature 71. Stratum B contained distinct artifact concentrations, many of which were associated with these three features. Artifacts were also recorded deeper in Stratum B in several locations (up to five 10-cm levels in a few instances), as well as in Stratum C. Yet, analysis suggested that most of the items in these lower levels were intrusive postdepositionally, not associated with primary deposition. The greatest concentrations of artifacts in Level 3 of Stratum B, for example, were coincident with the locations of Feature 24, Feature 48, and Feature 78. Since these features were defined as artifact clusters, it was likely that the artifacts in the surrounding sediments were ultimately derived from them, either having been brought to Level 3 by settling or sediment drift, or documented there through imprecise definition of feature boundaries in the sandy sediments. Artifact analyses supported this interpretation. In the artifact concentration focused around Feature 48, for instance, artifact frequencies decreased with depth (Table 7-1, Figure 7-4; note that Level 4 was not represented in all unit proveniences). Artifact and raw material type frequencies were similar in each level of Stratum B and in Stratum C (the frequency of occurrence of Type I quartzite flakes in particular remained constant in each level), while flake sizes tended to diminish. The artifacts thus appeared to have been derived from a single deposit that included Feature 48, while some had migrated downward through the soil column becoming partially size-sorted in the process.

Similar distribution patterns were observed in the other main artifact concentrations. The depths at which artifacts were recovered were well within the zone of greatest surface-generated biological activity, suggesting that localized natural disturbances to the soil column may have been responsible for the presence of most of the more deeply occurring artifacts. The undulating transition to the sandy C horizon (Stratum C) appeared to determine whether artifacts occurred in the lower levels of Stratum B or the upper levels of Stratum C; that is, artifacts tended to be found in Stratum C where it occurred nearer ground surface, suggesting down-migration related to surface generated disturbances.

Table 7-1. Flake Size Distributions in Stratum B and Stratum C, Feature 48 Concentration.

	Levels 1&2 95% Type I quartzite flakes		Level 3 96% Type I quartzite flakes		Level 4 96% Type I quartzite flakes		Stratum C 93% Type I quartzite flakes	
size-grade	Type I quartzite	quartz	Type I quartzite	quartz	Type I quartzite	quartz	Type I quartzite	quartz
1	16%	27%	19%	18%	17%	n/a	21%	33%
2	65%	51%	66%	64%	69%	n/a	60%	33%
3	12%	13%	11%	9%	13%	n/a	16%	33%
4	5%	4%	3%	--	--	n/a	3%	--
5	1%	5%	1%	--	--	n/a	1%	--
6	1%	--	1%	--	--	n/a	--	--
n=	2,398	81	490	11	52	1	199	9
mean	2.2	2.1	2.0	2.1	1.9	n/a	2.0	2.0

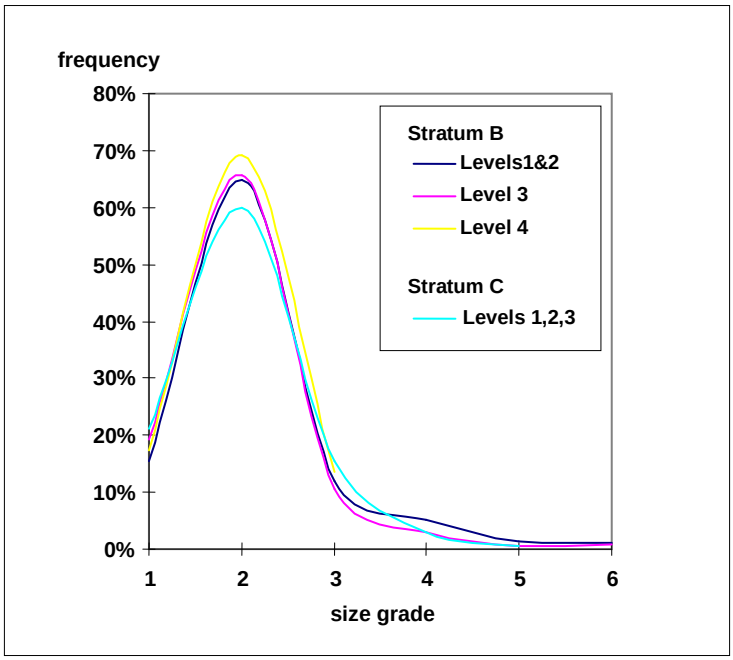


Figure 7-4. Frequency Distributions Associated with Feature 48 Showing Decrease in Artifact Size with Depth.

In conclusion, evidence suggested that artifacts occurred at the site in a single depositional layer that had spread upward and downward to some degree through natural processes of pedoturbation such as root growth or animal burrowing. The topmost portion of the cultural layer had been cut and partially redistributed by historical period plowing. Low artifact frequencies observed in the plow zone in relation to the underlying deposits suggested that there had been a period of sediment accretion following the last occupation of the land form. The site thus appeared to have contained a single occupation component, possibly representing only a few individual episodes during the overall period of site use. The main and least disturbed portion of the profile was represented by the upper levels of Stratum B, and that deposit was the focus of the majority of the horizontal spatial analyses, the results of which are detailed below.

7.2.2 Horizontal

Based on spatial analysis, six main artifact concentrations were identified at the Black Diamond site, five in the main excavation block and one in the small block to the northeast.

Small Excavation Block

The small excavation block was used to investigate an artifact concentration in the northeast part of the site (Figure 7-5). A large pit feature, Feature 29, was documented in the excavation along with a portion of a second pit feature, Feature 59, which occurred in the northern wall of the excavation (detailed in Figure 7-6). Both features were eventually interpreted as natural disturbances, probably related to the growth and decay of the root systems of trees. In total, 1,971 artifacts were recovered from the excavation in the small block. Artifact type distributions, summarized in Table 7-2, mirrored those in the larger block. Type I quartzite flakes dominated the distribution, accounting for 94 percent of the total. No diagnostic artifacts were present. Intermediate forms included 4 early stage bifaces and 2 middle stage bifaces, all of Type I quartzite.

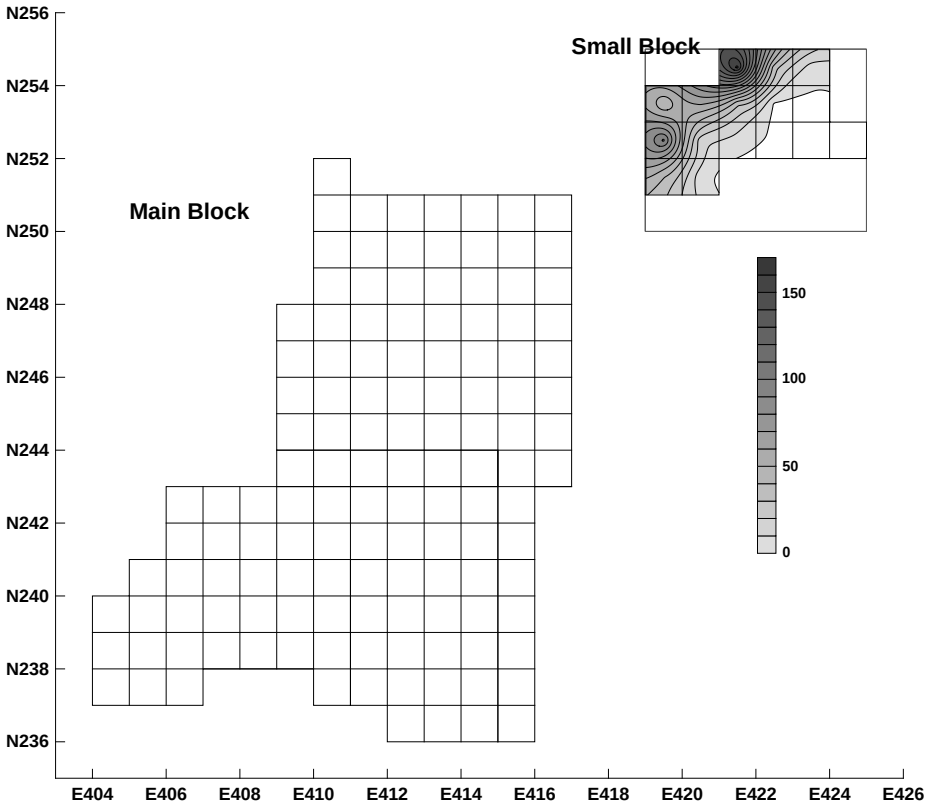


Figure 7-5. Location of Small Excavation Block.

Approximately 90 percent of the artifacts occurred in non-feature contexts. Almost 70 percent of those artifacts occurred in Stratum A, the plow zone, in contrast to proveniences in the main excavation block where the majority of the artifacts occurred below the plow zone. The finding suggested that the original sediment stratigraphy in this part of the site was compressed, with the cultural deposits occurring at a slightly higher elevation where they were subject to disturbance by historical period agricultural activity.

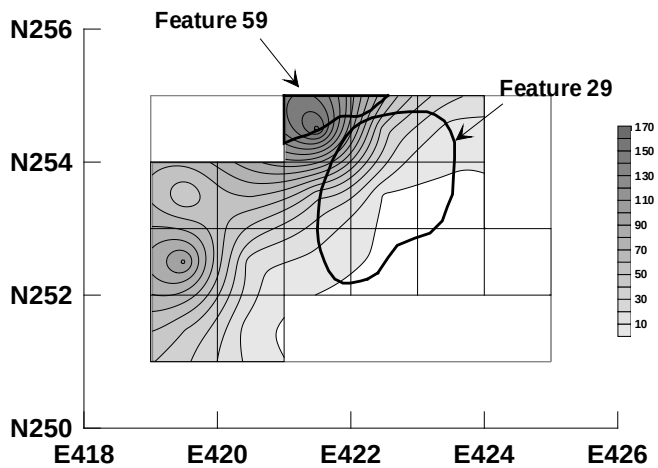


Figure 7-6. Detailed Results of Artifact Distribution Analysis in the First Two Levels Below the Plow Zone, Small Excavation Block.

Table 7-2. Artifact Type Distribution, Small Excavation Block.

		general		Feature 29		Feature 59[1]	
artifacts		*count*	*freq*	*count*	*freq*	*count*	*freq*
flakes	Type I quartzite	1,663	94%	133	100%	69	100%
	quartzite	34	2%	0	--	0	--
	quartz	4	<1%	0	--	0	--
	cryptocrystalline	39	2%	0	--	0	--
chips		16	1%	0	--	0	--
bifaces		6	<1%	0	--	0	--
tas		7	<1%	0	--	0	--
	totals	1,769		133		69	

[1]incompletely excavated

Main Excavation Block

In the main excavation block (Figure 7-7) distinct artifact concentrations were associated with Features 24 and 78 (central), Feature 48 (southwest), and Feature 71 (south central). Clusters not associated with features occurred along the southeast edge of the block (E414-416) and in northeast quadrant (north of N246 and east of E414). Feature 24, Feature 71, and Feature 78 were each defined as distinct artifact concentrations occurring within shallow, vaguely defined pits. The features were similar in content, containing extensive amounts of flaking debris, most of which consisted of Type I quartzite flakes (Table 7-3). Feature 48, a small cluster of bifaces and large flakes, differed somewhat from the larger features.

The areas surrounding each of these four features contained additional extensive artifact distributions outside the mapped boundaries of the feature concentrations. The characteristics of the artifacts in each area were analyzed in detail (Table 7-4). The artifacts were examined by type as well as by lithic material. Sample sizes in the concentrations ranged from 1,674 to 6,633 artifacts. In each case, flaking debris (flakes and chips) comprised 98 to 99 percent of the total. The remaining artifacts in each area consisted of small numbers of cores, bifaces, points, unifaces, hammerstones, and several fire-cracked rock fragments. Remarkably little variation was noted between the concentrations. Of some note was a higher frequency of cryptocrystalline flakes and rhyolite flakes in the area

containing Feature 71, while the frequency of quartz flakes was higher in association with Feature 48. Among non-flaking debris, cores and, in particular, bifaces, were more frequent in the area containing Features 24 and 78 and in association with Feature 71.

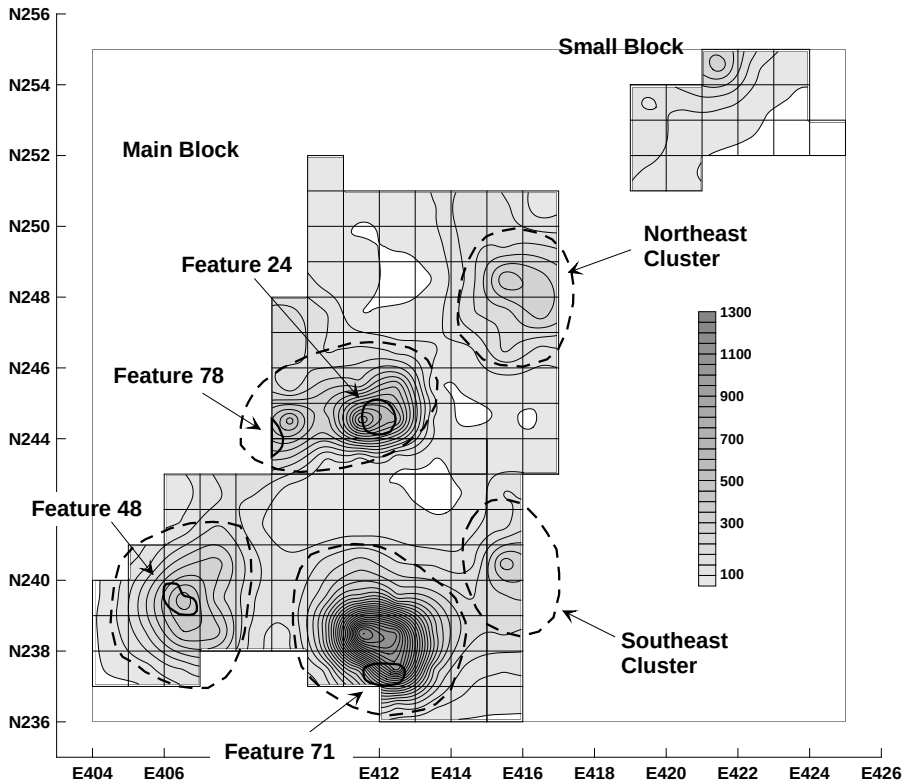


Figure 7-7. Results of Spatial Analysis of Artifact Distribution in the First Two Levels Below the Plow Zone, Including Feature Proveniences.

Table 7-3. Artifact Type Distributions in Selected Features.

		Feature 24		Feature 78		Feature 71		Feature 48	
artifacts		*count*	*freq*	*count*	*freq*	*count*	*freq*	*count*	*freq*
flakes	Type I quartzite	906	91%	317	95%	379	84%	25	74%
	quartzite	47	5%	12	4%	35	8%	--	--
	quartz	20	2%	1	<1%	1	<1%	--	--
	cryptocrystalline	10	1%	2	1%	10	2%	--	--
	other	--	--	--	--	4	1%	--	--
chips		11	1%	1	<1%	5	1%	1	3%
cores		3	<1%	1	<1%	8	2%	1	3%
bifaces		2	<1%	--	--	7	2%	6	18%
points		--	--	--	--	--	--	--	--
unifaces		--	--	--	--	--	--	--	--
hamm		--	--	1	<1%	1	<1%	1	3%
tas		2	<1%	--	--	2	<1%	--	--
	totals	1,001		335		452		34	

Table 7-4. Artifact Type Distributions in the Five Main Artifact Concentrations, Stratum B Levels 1&2.

		Feature 24/78 Area		Feature 48 Area		Feature 71 Area	
artifacts		*count*	*freq*	*count*	*freq*	*count*	*freq*
flakes	Type I quartzite	3,265	90%	2,398	93%	5,628	85%
	quartzite	218	6%	4	<1%	476	7%
	quartz	82	2%	81	3%	36	1%
	cryptocrystalline	38	1%	27	1%	304	5%
	other	1	<1%	3	<1%	99	1%
chips		19	1%	35	1%	23	<1%
cores		4	<1%	5	<1%	19	<1%
bifaces		8	<1%	16	1%	22	<1%
points		0	--	1	<1%	1	<1%
unifaces		0	--	0	--	1	<1%
hamm		1	<1%	2	<1%	4	<1%
tas		6	<1%	1	<1%	20	<1%
	totals	3,642		2,573		6,633	
		SE Area		**NE Area**			
artifacts		*count*	*freq*	*count*	*freq*		
flakes	Type I quartzite	1,327	5,628	85%	79%		
	quartzite	180	476	7%	11%		
	quartz	58	36	1%	3%		
	cryptocrystalline	68	304	5%	4%		
	other	6	99	1%	<1%		
chips		14	23	<1%	1%		
cores		2	19	<1%	<1%		
bifaces		8	22	<1%	<1%		
points		2	1	<1%	<1%		
unifaces		1	1	<1%	<1%		
hamm		--	4	<1%	--		
tas		8	20	<1%	<1%		
	totals	1,674	6,633				

Flake size distributions were also calculated in each area for lithic material types with sample sizes sufficiently large to support analysis (Table 7-5). As with artifact type distributions, variation in flake size distributions was limited. In general, less than 10 percent of the Type I quartzite flakes in each area occurred in the lowest interval size-grade 1 (<1 cm), while 60 to 65 percent occurred in the second interval, size-grade 2 (>1 cm and <2 cm). As noted earlier in the descriptive analysis of flaking debris, frequency distributions such as these are typical of manufacturing sequences in which there is relatively little emphasis on primary reduction. Flakes were somewhat smaller in the Feature 48 concentration, with more occurring in both size-grades 1 and 2, suggesting a slight variation in manufacturing technology in that location. Overall, quartz and cryptocrystalline flakes were often smaller than Type I quartzite flakes, which may have been related to differences in the sizes of the original clasts. Rhyolite flakes were also consistently smaller, emphasizing the exotic nature of the stone and the fact that little if any rhyolite reduction other than tool refurbishing was conducted at the site. The frequency of occurrence of cortical flakes was also similar in each area. Few Type I quartzite flakes bore remnant cortex—typically 2 percent or less in each size grade. The frequency of cortex on other quartzite flakes was also very low. Cortical flakes occurred more frequently among quartz and cryptocrystalline materials, and the frequencies were

similar among concentrations with relatively large samples: quartz and jasper in association with Feature 24, quartz in association with Feature 48, and chert in association with Feature 71. That the frequency of cortex among these materials was higher than among quartzites supported the interpretation of different source materials: pebbles in the case of quartz and cryptocrystalline materials; larger, cobble-size pieces in the case of quartzites.

An additional finding of the size distribution study indicated that flakes in Level 3 of Stratum B were consistently smaller on average than in the overlying sediments (Table 7-6). These results suggested that a substantial amount of postdepositional size sorting may have been in evidence, implying that most of the debris in Level 3 had settled there from the overlying strata. These findings provided additional evidence implying that a single level of deposition was present. The sizes of artifact samples below Level 3 would not support statistical analysis, but by further implication, these artifacts also appeared to have migrated downward from their original levels of deposition.

Further investigation was conducted into the nature of the three main artifact features: Feature 24, Feature 48, and Feature 71. A starting point for the examination was the assumption that variations in artifact content between the features and the surrounding sediments would imply that the feature designations and boundary definitions were valid, and that the features were not just more visible parts of larger artifact concentrations. But as detailed in Table 7-7, comparison of the contents of each feature with surrounding artifact distributions showed few differences among the proveniences. Feature 24 and 78, for example, both contained between 90 and 95 percent Type I quartzite flakes, a small proportion of flakes from other materials, and several cores and bifaces. The artifact concentration associated with the features differed only in that it contained a slightly higher proportion of regular (non-Type I) quartzite flakes. Likewise at the south end of the block, approximately 85 percent of the artifacts in Feature 71 were Type I quartzite flakes.

Table 7-5. Flake Size Distributions, Main Artifact Concentrations, Stratum B Levels 1&2.

	Feature 24/78 Area								Feature 48 Area			
size-grade	Type I quartzite		quartzite		quartz		Jasper		Type I quartzite		quartz	
	frequency by grade	cortical flakes	frequency by grade	cortical flakes	frequency by grade	cortical flakes	frequency by grade	cortical flakes	frequency by grade	cortical flakes	frequency by grade	cortical flakes
1	8%	<1%	12%	<1%	11%	1%	16%	14%	16%	<1%	27%	1%
2	62%	3%	62%	6%	57%	10%	54%	14%	65%	2%	51%	9%
3	18%	2%	16%	4%	22%	12%	19%	14%	12%	1%	13%	2%
4	7%	1%	8%	4%	5%	4%	8%	5%	5%	1%	4%	2%
5	3%	1%	2%	<1%	2%	2%	3%	3%	1%	<1%	5%	2%
6	2%	<1%	--	--	2%	2%	--	--	1%	<1%	--	--
n=	3,265		218		82		37		2,398		81	

	Feature 71 Area									
	Type I quartzite		quartzite		quartz		jasper		rhyolite	
	frequency by grade	cortical flakes	frequency by grade	cortical flakes	frequency by grade	cortical flakes	frequency by grade	cortical flakes	frequency by grade	cortical flakes
1	15%	<1%	15%	--	19%	--	8%	1%	19%	--
2	61%	2%	57%	1%	53%	--	70%	11%	66%	--
3	17%	2%	19%	1%	17%	--	19%	7%	14%	2%
4	5%	1%	5%	<1%	8%	--	2%	1%	1%	--
5	2%	<1%	2%	<1%	--	--	1%	1%	--	--
6	<1%	<1%	1%	1%	3%	3%	--	--	--	--
n=	5,628		477		36		193		96	

	NE Area								SE Area	
	Type I quartzite		quartzite		quartz		chert		Type I quartzite	
	frequency by grade	cortical flakes	frequency by grade	cortical flakes	frequency by grade	cortical flakes	frequency by grade	cortical flakes	frequency by grade	cortical flakes
1	11%	<1%	8%	--	17%	--	26%	--	14%	<1%
2	65%	2%	55%	4%	66%	5%	52%	--	63%	4%
3	16%	2%	22%	1%	10%	2%	10%	--	15%	2%
4	6%	1%	11%	1%	--	--	--	--	6%	1%
5	2%	<1%	2%	1%	3%	--	10%	3%	1%	<1%
6	1%	1%	2%	1%	3%	2%	3%	3%	1%	<1%
n=	1,327		180		58		31		2,036	

Table 7-6. Flake Size Distributions, Main Artifact Concentrations, Stratum B Level 3.

	Feature 24/78 Area				Feature 48 Area		Feature 71 Area			
size-grade	Type I quartzite	quartzite	quartz	jasper	Type I quartzite	quartz	Type I quartzite	quartzite	jasper	rhyolite
1	8%	15%	7%	11%	19%	18%	17%	14%	15%	25%
2	62%	61%	79%	78%	66%	64%	65%	63%	61%	63%
3	23%	21%	14%	11%	11%	9%	14%	23%	23%	12%
4	4%	3%	--	--	3%	--	3%	--	--	--
5	2%	--	--	--	1%	--	1%	--	--	--
6	<1%	--	--	--	1%	--	--	--	--	--
n=	579	39	14	9	490	11	474	44	13	8

	SE Area	NE Area
size-grade	Type I quartzite	Type I quartzite
1	13%	16%
2	70%	65%
3	13%	15%
4	4%	2%
5	--	2%
6	--	--
n=	23	113

Table 7-7. Comparison of Feature Contents with Surrounding Artifact Concentrations.

		Feature 24		Feature 78		Area w/o features	
artifacts		*count*	*freq*	*count*	*freq*	*count*	*freq*
flakes	Type I	906	91%	317	95%	2,042	89%
	qtzt	47	5%	12	4%	159	7%
	qu	20	2%	1	<1%	61	3%
	crypt	10	1%	2	1%	26	1%
	other	--	--	--	--	1	<1%
chips		11	1%	1	<1%	7	<1%
cores		3	<1%	1	<1%	--	--
bifaces		2	<1%	--	--	6	<1%
points		--	--	--	--	--	--
unifaces		--	--	--	--	--	
hamm		--	--	1	<1%	--	--
fcr		2	<1%	--	--	4	<1%
	totals	1,001		335		2,306	

		Feature 71		Area w/o feature	
artifacts		*count*	*freq*	*count*	*freq*
flakes	Type I	381	83%	5,247	85%
	qtzt	35	8%	441	7%
	qu	1	<1%	35	1%
	crypt	10	2%	294	5%
	other	4	1%	95	2%
chips		6	1%	17	<1%
cores		9	2%	10	<1%
bifaces		8	2%	14	<1%
points		0	<1%	1	<1%
unifaces		0	<1%	1	<1%
hamm		2	<1%	2	<1%
tas		2	<1%	18	<1%
	totals	458		6,175	

		Feature 48		Area w/o feature	
artifacts		*count*	*freq*	*count*	*freq*
flakes	Type I	25	74%	2,373	93%
	qtzt	--	--	4	<1%
	qu	--	--	81	3%
	crypt	--	--	27	1%
	other	--	--	3	<1%
chips		1	3%	34	1%
cores		1	3%	4	<1%
bifaces		6	18%	10	<1%
points		--	--	1	<1%
unifaces		--	--	--	--
hamm		1	3%	1	<1%
tas		--	--	1	<1%
	totals	34		2,539	

In addition, a proportion of cryptocrystalline and rhyolite flakes not seen in other parts of the site was also present, along with a slightly higher proportion of cores and bifaces. The contents of Feature 71 mirrored artifact types in the surrounding area. And finally, Feature

48 differed somewhat in that it contained few artifacts overall, having been defined in the field as being limited to large items. Nonetheless, the relative proportions of main artifact types and materials were similar to those in Features 24, 78, and 71, except for a larger proportion of bifaces, which affected the relative frequency of quartzite flakes. Fewer bifaces occurred in the surrounding area, and flake frequencies were similar to those in other concentrations, with the exception of a greater proportion of quartz flakes.

Overall, then, the analysis implied that there was little difference between the features and that artifact concentrations in which they occurred. The features were artifact clusters, some of which may have been located in small shallow basins for disposal, but they remained clusters within more general distributions of flaking debris. The main differences seen in the artifact distributions were: 1) more cryptocrystalline and rhyolite debris in the southern part of the site, in association with Feature 71; and 2) more quartz debris to the west, in association with Feature 48. Otherwise, the features were parts of wider artifact distributions that were generally were uniform in composition, implying extensive lithic reduction of similar form occurring across much of the site area.

Patterns noted in these features were reflected in the overall distribution of lithic raw materials in the excavation block. Due to the overwhelming dominance in frequency of occurrence of Type I quartzite flakes, their distribution formed the underlying pattern in the general artifact distribution in the block (Figure 7-8). Type I quartzite flakes accounted for the majority of artifacts in each of the main clusters. The greatest concentration occurred in association with Feature 71, where 2,100 flakes were recovered from two adjacent units (N238/E411 and N238/E412). In the area containing Feature 24 and Feature 78, two distinct clusters were indicated by the analysis within the overall concentration, associated with the location of each of the features—almost 1,600 flakes in three contiguous units associated with Feature 24 (N244/E411-412 and N245/E412); and almost 700 flakes in adjacent units associated with Feature 78 (N243-244/E409).

The distributions of other material types mirrored portions of the Type I quartzite distribution in that there were no areas with concentrations of other stone types in which Type I quartzite was not also heavily represented. Quartzites other than Type I quartzite, for example, clustered in two areas within the main block—in association with Features 24 and 78; and to the south, in association with Feature 71 (Figure 7-9). Overall, counts were substantially lower than for Type I quartzite: one group of 339 flakes in six units adjacent to Feature 71; and two clusters, one associated with Feature 24 (139 flakes), the second in the northwest part of the concentration, north of Feature 78 (124 flakes). Quartzite flakes also occurred in low frequency (15-20 artifacts per m^2) in the southeast concentration, but were virtually absent from Feature 48 and the northeast quadrant of the block.

Cryptocrystalline materials (including jasper, chert, and chalcedony) occurred in each of the main concentrations, but in low frequencies—typically 1-to-4 flakes per m^2 (Figure 7-10). The main occurrence of cryptocrystalline debris lay in association with Feature 71, where more than 250 flakes were recovered in nine units centered north of the feature (N238/E411).

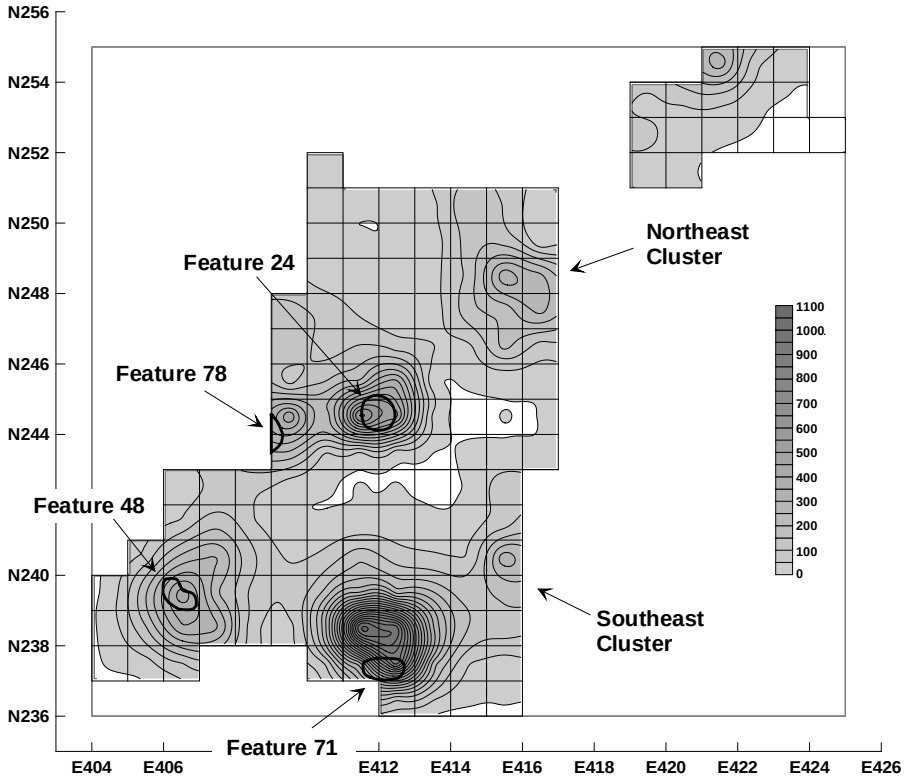


Figure 7-8. Distribution of Type I Quartzite Flakes, Levels 1&2.

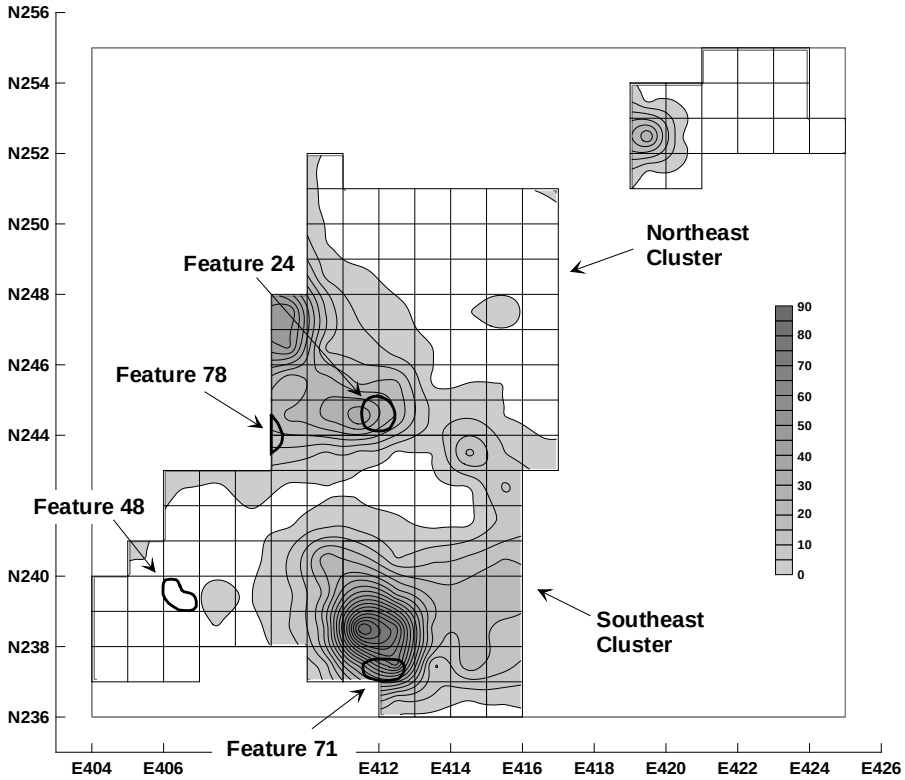


Figure 7-9. Distribution of Quartzite Flakes, Levels 1&2.

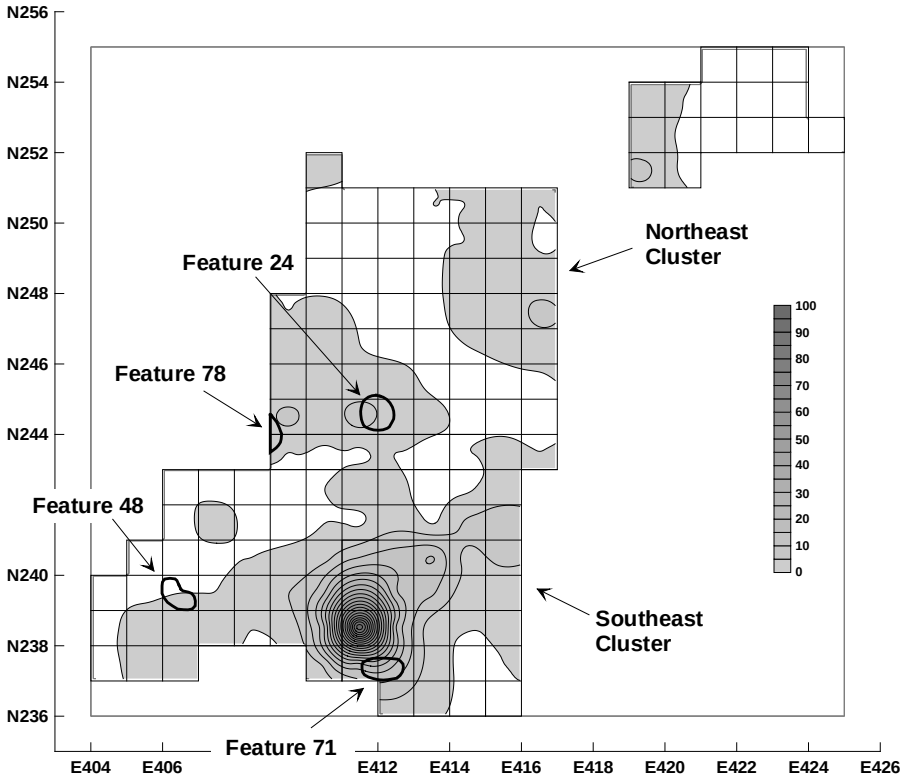


Figure 7-10. Distribution of Cryptocrystalline Flakes, Levels 1&2.

Rhyolite also occurred in the south part of the block, concentrated near Feature 71, but unlike other material types, it was found only in that location: no rhyolite occurred north of the N241 line (Figure 7-11). Moreover, rhyolite counts were low in comparison to other material types, with the largest cluster consisting of 47 flakes recorded in two adjacent units (N237-238/E412). The distribution of rhyolite was also markedly uneven: units without the material occurred among units with relatively high counts, suggesting the evidence of distinct activity areas.

The distribution of quartz also differed from that of most other materials. Very little quartz debris occurred in association with two of the major feature concentrations, Feature 78 and Feature 71 (Figure 7-12). The highest quartz counts occurred north of Feature 48, where slightly more than 100 artifacts were recovered from six units (N240-242/E407-408). Another, smaller cluster occurred in association with Feature 24. Notably though, counts of Type I quartzite debris exceeded those of quartz in each area. A final, less prominent cluster of quartz occurred in the extreme southeast corner of the block, where several units exhibited counts between 5 and 15 artifacts per m^2.

Large, non-flaking debris items, such as cores, bifaces, points, and hammerstones, occurred in all areas within the excavation block, following the general distribution of flaking debris. The distributions are summarized graphically in Figure 7-13. The detail shown in the figure is less important than the general indication of clustering that is illustrated. Note that most of the artifacts were not piece-plotted: artifacts recovered from features have been plotted

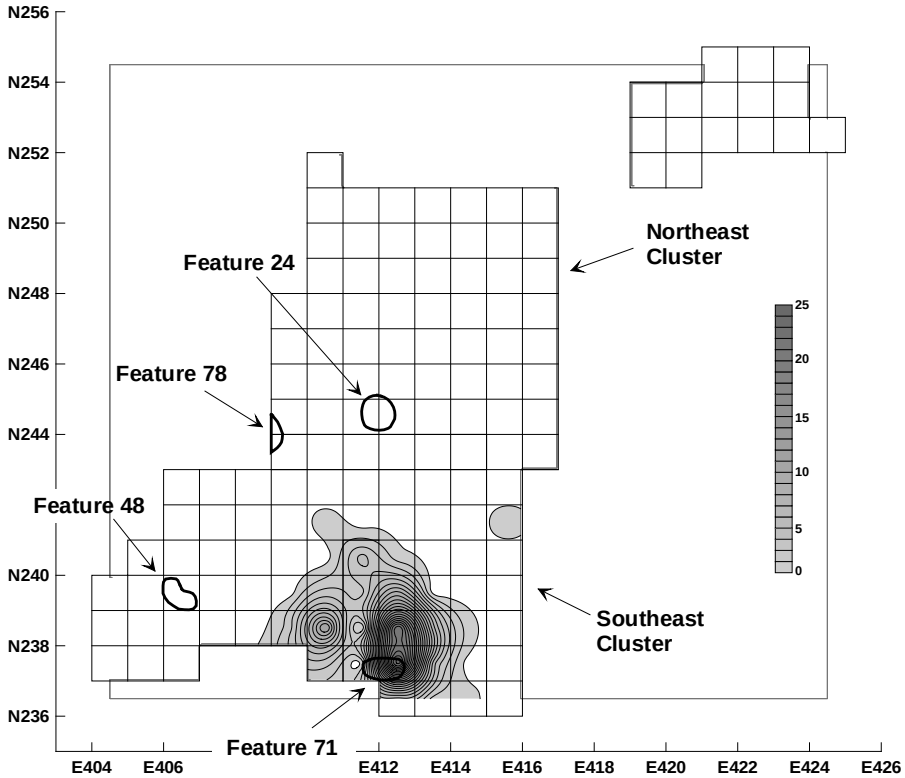


Figure 7-11. Distribution of Rhyolite Flakes, Levels 1&2.

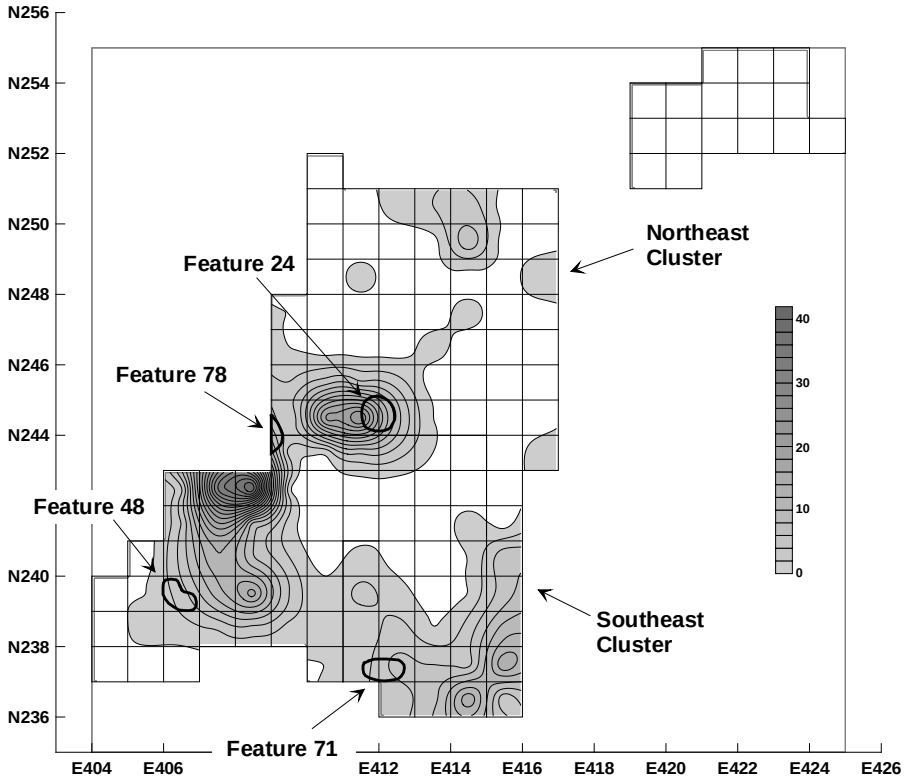


Figure 7-12. Distribution of Quartz Flakes, Levels 1&2.

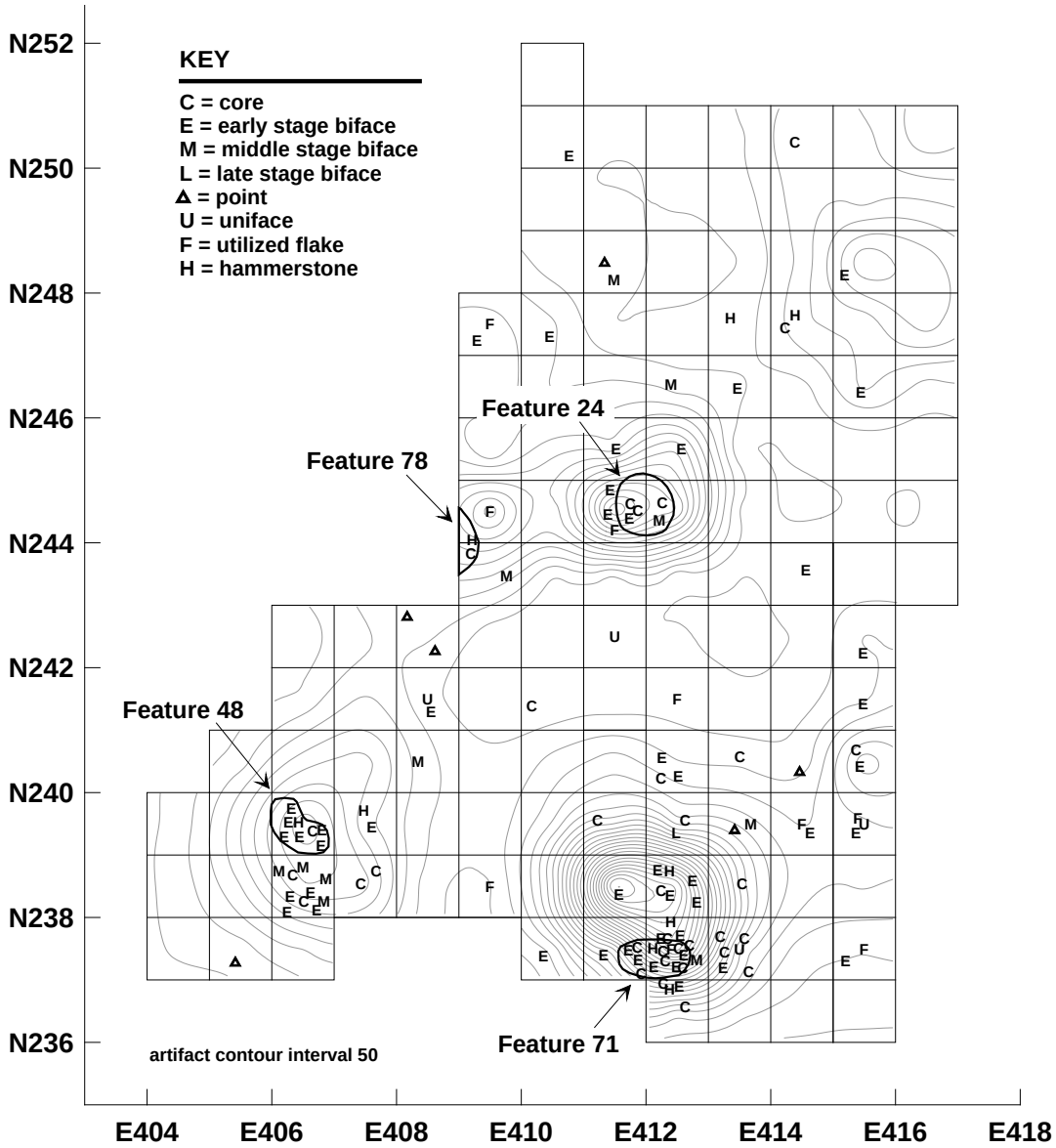
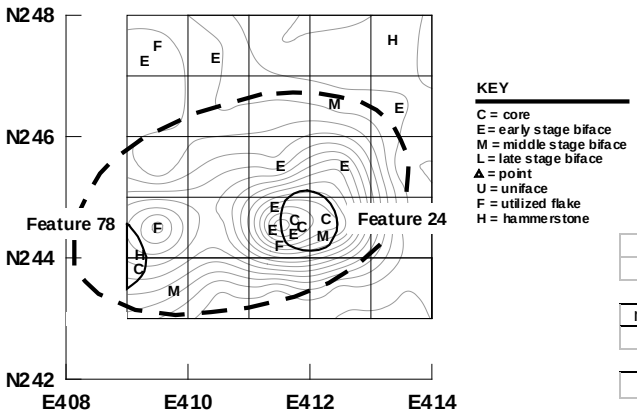


Figure 7-13. Distribution of Non-Flaking Debris, Levels 1&2, with Contours Representing Cluster Analysis of Flaking Debris and Feature Locations Indicated.

within feature boundaries while the rest were randomly mapped within the appropriate unit. As is clear from the graphic, most of the large artifacts were found in association with the three main artifact concentrations, generally clustered near the features that formed the focal point of each artifact group. In comparison, only a few cores and early stage bifaces occurred in the NE and SE clusters, and fewer still were scattered in other parts of the block.

More detailed examination of the individual clusters showed that although there was a degree of internal variation within the three feature concentrations, little substantial difference was evident between the groups. For example, the area including Features 24 and 78 (N243-246/E409-414) contained 5 early stage bifaces, 3 middle stage bifaces, 4 cores, and a hammerstone (Figure 7-14). Most of these large artifacts were identified within the boundaries of Feature 24, although several early stage bifaces were scattered in the general

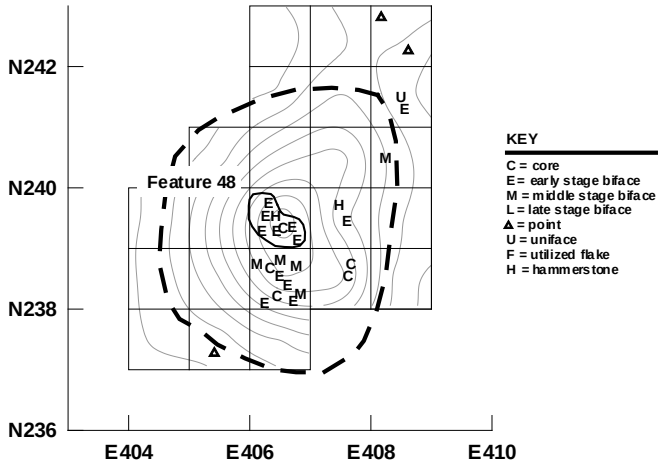
artifact concentration surrounding the feature. Feature 78 and the sediments surrounding it, in contrast, contained few large artifacts—a core and hammerstone mapped within the feature boundaries, and a middle stage biface to the south of the feature.



early stage biface	Type I quartzite	2
	quartzite	2
	quartz	1
middle stage biface	Type I quartzite	3
core	Type I quartzite	3
	jasper	1
hammerstone	quartz	1

Figure 7-14. Feature 24/78 Concentration.

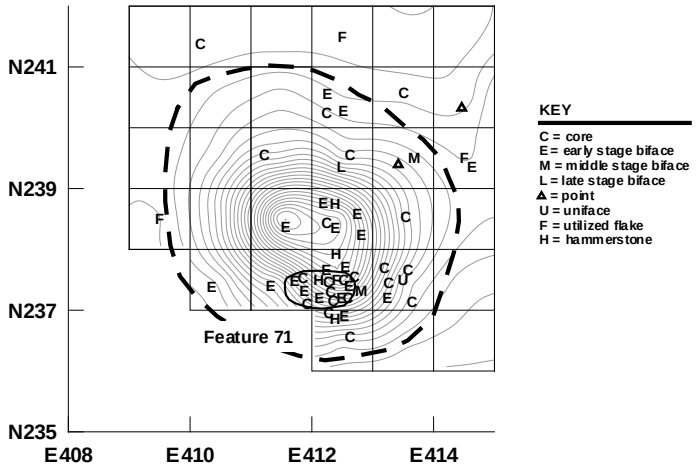
The concentration including Feature 48 contained 11 early stage bifaces, 5 middle stage bifaces, a point, 5 cores, a uniface, and 2 hammerstones (Figure 7-15). Note that the feature was defined as an artifact cluster with no evidence of an associated pit. Only early stage bifaces, a core, and a hammerstone were located in the area identified as the feature. The remaining large artifacts, including all of the middle stage bifaces, were clustered to the south and east of the feature. One point was included in the group on the basis of the spatial analysis, while two additional points occurred beyond the northeast limits of the concentration.



early stage biface	Type I quartzite	11
middle stage biface	Type I quartzite	5
point	Type I quartzite	1
core	Type I quartzite	5
hammerstone	quartzite	1
	quartz	1

Figure 7-15. Feature 48 Concentration.

The concentration focused around Feature 71 contained the largest number of artifacts, both in terms of flaking debris and larger chipped stone items (Figure 7-16). Among the large artifacts were 21 bifaces, including 2 middle stage and 1 late stage, and 18 cores. While the majority of the flaking debris was concentrated north and west of Feature 71, many of the large artifacts occurred within the boundaries of the feature or scattered to the east and north.



early stage biface	Type I quartzite	15
	quartzite	2
	quartz	1
middle stage biface	Type I quartzite	2
late stage biface	Type I quartzite	1
core	Type I quartzite	16
	quartzite	1
	jasper	1
point	Type I quartzite	1
uniface	Type I quartzite	1
hammerstone	quartzite	4

Figure 7-16. Feature 71 Concentration.

7.2.3 Summary

Concentrated and apparently discrete lithic reduction activity areas were evidenced by recurrent patterning in artifact distributions that contained similar types of artifacts, thus implying similar activity. The evidence appeared to indicate repeated visits to the site during which people worked in slightly different locations within the landscape. The activity represented by the lithic debris was heavily focused on biface reduction, specifically to produce the stemmed points that were found in other areas of the excavation block. The reduction of Type I quartzite was not spatially exclusive, however. Tools appeared to have been manufactured in the same parts of the site no matter the material type, particularly in the southern part of the excavation block in the most concentrated activity area around Feature 71. Even in the case of quartz, which appeared to be clustered north of Feature 48 in an area with relatively little quartzite debris, flakes of Type I quartzite outnumbered those of quartz in raw counts in each of the excavation proveniences. Further evidence of concentrated activity was seen in the distribution of rhyolite. Although a very minor part of the assemblage, the distribution of the material was markedly uneven, with relatively high counts occurring in units adjacent to others with none, again suggesting the maintenance of distinct activity areas across the block.

Evidence of activity not directly related to lithic reduction was also observed. No tools and relatively few flakes were noted in the southwest corner of the excavation block, for example, where several pit features that may have represented storage or processing activity were located. Other locales without flake deposits included an area northwest of Feature 48 and between the concentrations associated with Features 71 and 24. This finding indicated distributional relief at the site, suggesting either specific non-manufacturing activity areas or portions of living areas that had been maintained clear of manufacturing debris. Other evidence of non-reduction activity consisted of points and other items, such as unifaces and utilized flakes, that were found away from the reduction clusters, suggesting that they were not directly associated with the manufacturing activity. All of the points recovered from the site appeared to have been broken or resharpened, several of them numerous times, and thus they did not appear to have been production rejects but were finished tools that had been used for other activities.

7.3 Lithic Technology

The high volume of lithic debris at the Black Diamond site attributable to the manufacture of a particular form of artifact made the detailed examination of lithic technology one of the primary points of interest in the investigation. Technology refers to the body of knowledge related to the manufacture and use of material items. Derived from the Greek for the study of skills or arts, technology encompasses virtually all aspects of human manipulation of the material world. The technology of use deals with artifact function, about which relatively little attention is concentrated here. Manufacturing technology, in contrast, is concerned with the production of artifacts, the study of which, it may be argued, can provide insights into cultural differentiation as well as agency and the role of the individual in society. Models of sequence, such as the *chaîne opératoire*, are useful in examining lithic tool manufacture, considering the structured aspect inherent in the reduction process (Bleed 2001). This particular model both describes the structure of the process but also accounts for diversity and situational variability within that structure. As one recent commentator noted, cultural traditions shape the sequential operations of lithic reduction technology and limit the ways in which individuals participate in the processual strategies; however, people consciously choose particular strategies either from within the tradition or separate from it, and in so doing reinforce or restructure the process (Mounier 2006).

In an examination of lithic manufacturing technology based on the replicative work of modern-day craftsmen, Young and Bonnichsen (1984) noted that there may be a potentially significant analytical difference between the shape of an artifact and the manufacturing technology employed in producing that shape, suggesting that technology may be indicative of socio-cultural processes. Artifact morphology, they argue, may cross cultural and individual lines, in that a particular artifact style may be borrowed or copied from one cultural group to another. Such dispersal of forms is readily apparent from the recurrence point styles across widespread regions through time. Conversely, the techniques of flaking may be more idiosyncratic, more particular to individual artisans, an observation made also by Callahan (1979). Individually distinctive manufacturing technology, the researchers contend, may thus provide more diagnostic potential than simple artifact morphology. Some aspects of manufacturing technology may be constrained by tradition or social custom, reflecting Bourdieu's concept of *habitus*, or simply by raw material characteristics—bipolar percussion is one of the only ways to create flaking surfaces on small, rounded pebbles, for example. Yet the goal of technological analysis is to not only assess uniformity or the norms by which culture operates, but also to identify areas wherein individuals as active agents may be present and recognizable.

7.3.1 Raw Material

The examination of lithic industry at the Black Diamond site begins with description of the lithic raw material, a distinctive form of orthoquartzite referred to in this study by the expedient term, Type I quartzite. The material was of a variety referred to as "silicified sandstone" or immature quartzite (Ebright 1987:30). It was distinguished by the presence of separate quartz grains cemented in an opal or chalcedony-like matrix, rather than by the tight, interlocking grains of more typical and fully metamorphosed varieties of quartzite. The material was similar to descriptions of cuesta quartzite, a term coined by Jack Cresson to describe a specific quartzite occurring in a geological formation that separates the Inner and

Outer Coastal Plains in New Jersey (Mounier 2003). Several of the recorded attributes of cuesta quartzite, including its Physiographic distribution, flaking quality, and the prevalence of heat treatment in artifacts manufactured from it, suggested that the Type I quartzite from Black Diamond was not the same material. Mounier (2008), however, notes that the material has cognates of similar lithology in other regions. An equivalent material derived from Calvert Formation deposits along the Choptank River on the Maryland side of the Delmarva Peninsula was reported from the Hickory Bluff site, on the St Jones River near Dover (LaPorta in Petraglia et al. 2002).

A large degree of variability was noted in the overall form of the Type I quartzite found at the site, and the variation would have influenced the potential of the stone for controlled flaking, or flint-knapping. The best quality material was smooth, with small grains that were well-separated within a uniform, gray-to-light-brown cement. From the general character of the debitage and the flake scars on bifaces and points, the artisans were able to work the stone with some degree of skill, finished points and late stage bifaces were well-made. Poorer quality varieties of the material were more coarsely textured, with larger and more densely packed grains as well as large or small inclusions. Cobble cortex was noted on many pieces of flaking debris that presumably resulted from both chemical and physical weathering of the original clasts that the knappers had selected for reduction. While the cortex itself was smooth, the outer surfaces of the cobbles appeared to have been irregular in places, with lumps and pits noted on some fragments. This, in addition to fractures along wave-like incipient fracture planes that were observed on some of the debitage, reflected unevenness in the material.

The color of the material was variable. While gray was the most common color among the artifacts, light brown-to-beige was frequently noted, as were light reddish-brown, reddish-brown, and red, the latter consisting of hues occurring in the 2.5YR and 10R ranges in Munsell Soil Color Chart notation. Since no pattern of color variation was detectable among particular artifact types—flaking debris, bifaces, or points—it did not appear that color alone was an important factor in the selection of the material and that any symbolism attached with the color range of the artifacts might be elusive. Indeed, it has been noted that color symbolism can be difficult to establish in the absence of direct evidence such as oral or textual histories (Cooney 2002). Archaeological examples of symbolic connections between artifacts and color have generally been characterized as “not compelling,” typically occurring in the literature as “stray cases in which the archaeologist, confronted by some instance of patterned coloration, concludes that ‘cosmic symbolism could be indicated,’ followed by a telling ethnographic citation” but with no necessary connection to the observed pattern (DeBoer 2005:84). Cooney (2002) traced color variation in Irish Neolithic stone axes, for example, noting that raw material sources could be distinguished by color and that polishing highlighted the relationship by bringing out the color of the stone. And yet, while not arguing an ambiguous cosmic symbolism, he was unable to show evidence of particular symbolic connections.

Difficulties in establishing direct symbolic relationships notwithstanding, the Type I quartzite utilized at the Black Diamond site was probably selected in part for non-utilitarian reasons almost certainly related to its appearance. The flintknappers appeared to have been working

within a widespread tradition in the Late Archaic in which coarse-grained stone such as quartzite was selected for tool making purposes. Within this tradition, the Type I quartzite stood out due to the combination of color and texture that was atypical or at least unusual among stone in the region—different from the pebble chert, jasper, or quartz available locally, or from other forms of quartzite that may have been more regularly selected at this time. Individual quartz particles were present in a smooth, gray or occasionally reddish gray silica cement. These sparkling fragments could have conformed to what Jones and MacGregor (2002) note as the light-giving, spiritual qualities of brilliant things. In terms of color, most of the lithic materials available regionally were brown or yellowish brown, dark gray or, occasionally, black or white. Cooney (2002) relates most of these colors to the earth and sees the act of manufacturing tools from stones of these colors as possibly symbolic of harnessing the power inherent in the earth. Thus, the sparkling, gray and red-stained stone may indeed have had symbolic connotations of spirituality and power, including the obvious association of red with the power of blood and its consequent implications for hunting success. An open question is whether or not the material had been heated, which may have been done to make the material easier to flake or to release the color and thus the power of the stone.

7.3.2 Procurement

Several lines of evidence implied that as distinctive as the stone was, it did not occur as a single source, such as an outcrop or a large boulder. An outcrop source would imply that the stone had been imported from at least as far as the Piedmont. There was, though, no evidence to support such an interpretation. The range of variation in the texture of the material argued against it being derived from a single boulder. Further, the rate of curvature of remnant cortical surfaces and the positions of opposing patches of cortex on various artifacts indicated that the initial sizes of the clasts were in the cobble range, and that some cobbles were tabular in shape. Several exaggeratedly plano-convex or turtle-backed bifaces were noted, often with cortex on the high-backed face, in addition to numerous rounded cores or early stage bifaces such as result from incomplete thinning of cobble-shaped pieces rather than of thinner, flake blanks struck from a boulder. The material thus appeared to have originated locally, probably in a deposit of cobble-sized clasts that included a relatively high proportion of this particular quartzite form. That the stone did not occur only in small, pebble form was evident from both the relatively large sizes of the biface fragments made from the material and by the general lack of evidence of bipolar reduction in association with it. Bipolar percussion is commonly seen at sites on the Coastal Plain with pebble-based industries (e.g., Leipsic [Custer et al. 1996] or Snapp [Custer and Silber 1995]; Puncheon Run [LeeDecker et al. 2005]; Sandom Branch [Versar 2011b]), and its general absence in association with Type I quartzite implied that the clasts were large enough that consistent or systematic use of the technique was unnecessary.

Analysis of flaking debris provided further evidence that the quartzite was obtained from a gravel exposure in the area. Specifically, the evidence implied that the material was partially reduced off site before being transported to the Black Diamond locale. Few large cortical flakes were noted in the Type I quartzite assemblage, and the frequency of cortical flakes in general was low in comparison to other material types occurring at the site, implying that initial decortication had been conducted elsewhere. In addition, few tested cobbles were

present in the assemblage, and almost two-thirds of the multi-directional cores bore no remnant cortex.

Studies of lithic procurement practices generally subdivide the process into two main forms—focused procurement and incidental collection. Hantman (1987) characterized procurement in four levels or behaviors that are in a sense variations on the two main forms. In Hantman's model, special trips to quarries represent focused procurement. At the opposite end of the scale, selective collecting involved obtaining raw material from available stone as it occurred, with no particular mobilization or concentration of effort. Between the extremes, Hantman noted a practice he refers to as embedded procurement, borrowing a term from Binford (1979), which involved quarrying or collecting during the course of other activities across a wide-ranging territory. Embedded collecting thus represented a combination of focused and non-focused procurement. A final level, exchange, comprised specific procurement on a different level, separate from actual visits to source areas. Ultimately, the focused procurement *versus* incidental collection dichotomy may in fact be matter of our own modern analytical perspective. Some ethnographic research has suggested that the acquisition of lithic raw material may not have been regarded as one or the other, i.e., as the result of special-purpose trips or trips structured within more generalized subsistence rounds, but as either, depending on needs or opportunities (Gould and Saggers 1985).

In the case of Type I quartzite at the Black Diamond site, the procurement process was likely to have been expedient in nature. It probably involved the selection of cobbles from secondary deposits that were discovered locally, rather than the end result of organized, formal quarrying through the excavation of pits or the extraction of stone from exposed bedrock. Locating the actual source of the material during the current investigation was unsuccessful. The landscape has changed considerably in historical times, particularly with regard to the topography of stream drainages. Erosion and infilling resulting from historical period clearing and cultivation have tended to reshape the land on a localized basis, filling small, seasonal drainages and burying gravel bars once exposed along stream sides. Thus, locating potential sources of cobbles proved a difficult task. Backhoe testing was conducted around the site in likely locations in all four cardinal directions, but failed to discover gravel deposits of the type that might have been the source of the Type I quartzite. In addition, a comprehensive, if non-systematic, pedestrian survey of the entire SR1 right-of-way was conducted after the corridor had been cleared and grubbed, at a time when ground surface was visible throughout. No evidence of gravel exposures was noted. Surface deposits of cobbles were documented along Herring Run, a tributary that meets the main stem of Blackbird Creek three kilometers northeast of the Black Diamond site (Bupp et al. 2003). While Type I quartzite was not observed in the deposit, the cobbles were of a size range similar to those presumed to have been used at the Black Diamond site (Figure 7-17). The Herring Run cobble exposures implied the potential for surface deposits containing Type I quartzite to be located in one of the local stream drainages. Archaeological evidence from surrounding sites further implied that the source of the quartzite was located nearby. That is, artifacts manufactured from the material were recorded at sites in the Blackbird Creek watershed—at the Sandom Branch Site Complex and at the Blackbird Creek site—as well as at the Hickory Bluff site, on the St. Jones River in Dover. In no instance, however, was the material seen in the quantity or concentration observed in the Black Diamond assemblage.

7.3.3 Reduction Sequence – Analysis of Flaking Debris

Investigation of the reduction sequence associated with the manufacture of tools from Type I quartzite at the site was conducted using two sets of data: flaking debris; and tools, both complete and partially completed. To better understand the implications of the attributes documented in the archaeological flake assemblage, the artifacts were systematically compared with material from experimental replications.

Figure 7-17. Cobble Exposure near Herring Run.

Experimental Data Set

Type I quartzite flaking debris from the Black Diamond site was analyzed in relation to data from a biface reduction experiment conducted by a modern craftsman, Errett Callahan. The experiment entailed the replication of a large biface from a tabular quartzite cobble, during work conducted by Callahan as a demonstration at the Virginia Commonwealth University Archaeological Research Center in 1992. The data, including the biface and resulting waste flakes, were obtained for study from VDHR collections with the assistance of then Assistant Curator, Keith Egloff. In the replication, a single cobble weighing 792 grams was reduced in two stages: 1) decortication and initial edging; and 2) primary thinning and shaping. All of the flaking debris generated during each stage was recovered. While the sample was small, comprising the results of only a single replication, the acknowledged skill of the flintknapper implied that the data were not biased by inexperience or lack of accomplishment.

The replicated artifact consisted of a middle stage biface, corresponding with the primary thinning stage as defined and used in the current analysis. The biface measured 12.75 cm long and 5.5 cm wide. Reduction was carried out for the most part with a large antler billet (Keith Egloff, personal communication 2003). As the cobble was reduced, the proximal and distal ends of the biface were selected and their shapes roughed out, producing a general lanceolate form. Blade edges were relatively straight in plan, although still sinuous in profile. The replication stopped when the biface failed along a slightly bending, perverse snap break initiated approximately midway along one edge. The break, which is common in quartzite bifaces at this stage of production, appeared to have been associated with a failed attempt to remove a hump on one face. Quartzite is a tough yet brittle material, and the number of hard blows the artifact had sustained resulted in internal cracks along which it eventually separated into two halves.

Analysis of flake attributes in the replication data was conducted on a size-interval basis to allow comparison with the Black Diamond site database. Observations concerning platforms, bulbs of percussions, and other specific attributes were also recorded. As is obvious from the shapes of the charted size distributions (Figure 7-18), most of the debris from the replication—70 percent of the early stage debris and 76 percent of the middle stage debris—occurred in the smallest fraction, size-grade 1 (<1 mm). Yet, variations in the graph also indicated that more large debris was associated with the early stage of the reduction experiment, as a higher proportion of flakes from the early stage occurred in grades 3 and 6. As statistical corroboration, comparison of the early and middle stage distributions implied a significant difference (*chi-sq*=14.863, *df*=4, *p*=0.011).

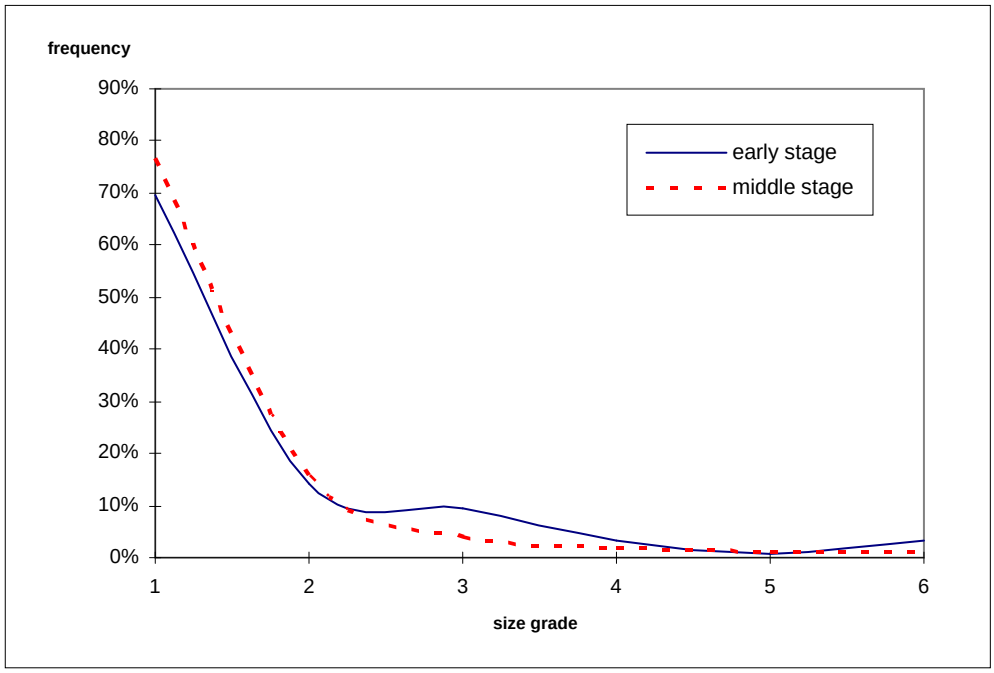


Figure 7-18 Frequency Distribution of Flakes Sizes Produced During Early and Middle Stage Reduction, Callahan Experimental Data Set.

The frequency distribution by weight confirmed that the middle stage debris consisted of smaller sized flakes (Figure 7-19). A total of 29 percent of the cumulative early stage mass (measured by weight) occurred in the five smallest grades, in contrast to 65 percent of the middle stage mass that occurred in the same grades. Corroborating this finding were the mean weights of flakes in each grade (Table 7-8), indicating that in the smaller grades, flakes from both reduction stages were similar in terms of weight, and thus of relative thickness. In contrast, flakes resulting from early stage reduction were on average heavier in the two largest grades, indicating that thicker debris had been generated early in the reduction sequence.

The frequency of cortex on flakes also corresponded with the known sequence of flake removals (Table 7-9) in which early stages of flaking were designed not only to start a bifacial edge but also to initiate thinning and remove the outer portions of the cobble (Callahan 1979). Flakes from early stage reduction in all of the size grades retained cortex—

up to 100 percent in the three largest grades (size-grades 4-6), and at least 25 percent in the smallest grade (size-grade 1). In contrast, only one-half of the largest flakes from the second stage of reduction (size-grade 1) retained cortex, while cortex was negligible or not present at all on most flakes from the smaller grade intervals (size-grades 1-4).

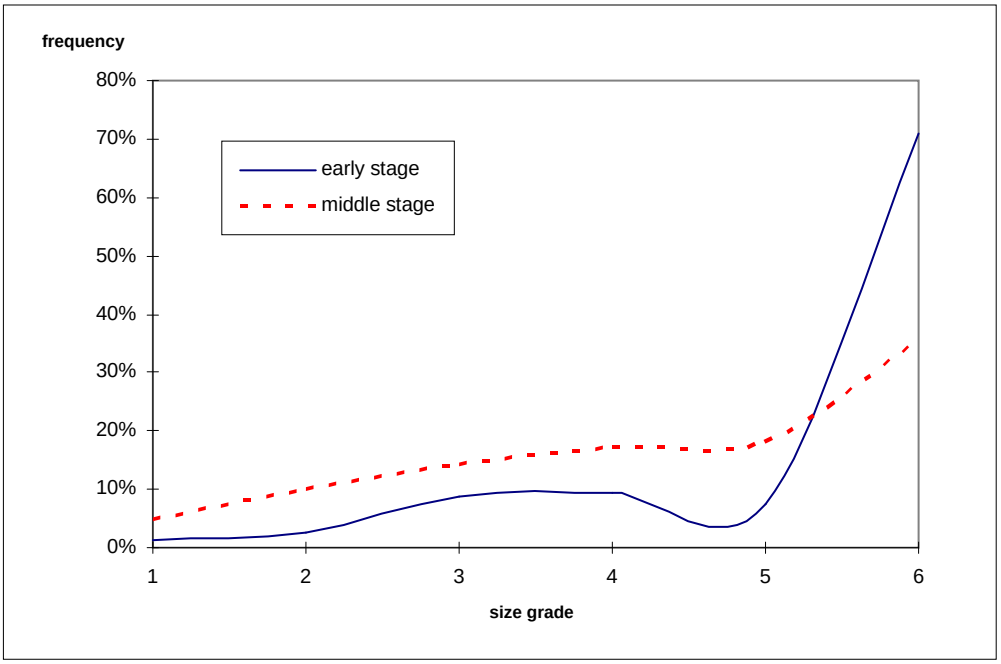


Figure 7-19. Frequency Distribution of Flakes by Weight within Grades, Callahan Experimental Data Set.

Table 7-8. Mean Flake Weights by Reduction Stage, Callahan Experimental Data Set.

	mean weight (gm)	
s-g	early stage	middle stage
1	0.03	0.03
2	0.31	0.28
3	1.47	1.51
4	4.80	4.02
5	15.05	7.62
6	36.19	18.63

Table 7-9. Cortical Frequency by Reduction Stage, Callahan Experimental Data Set.

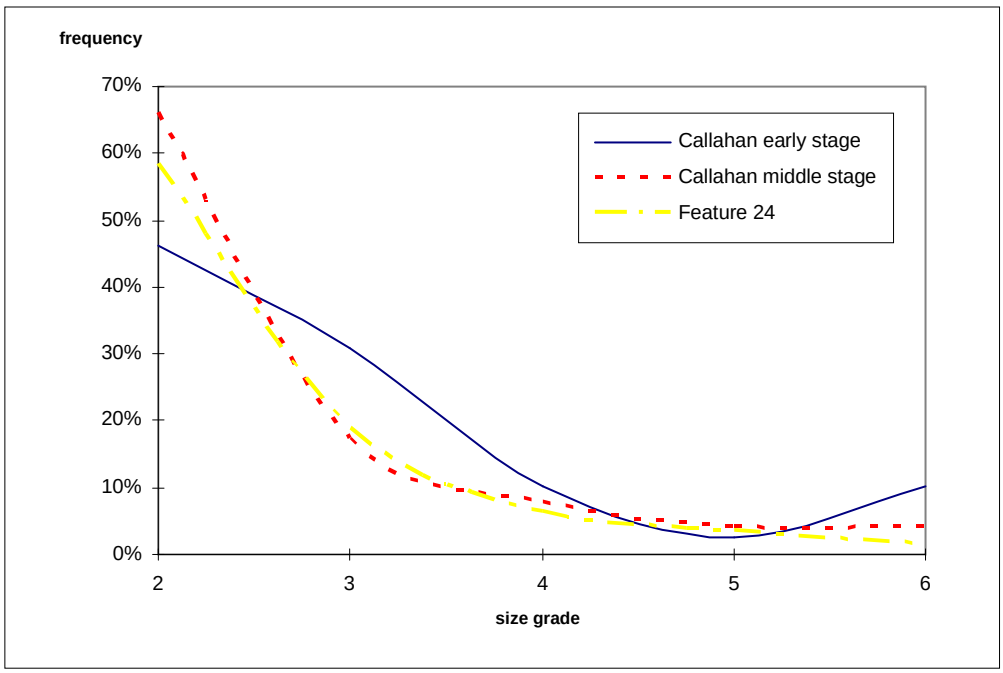
	cortex frequency	
s-g	early stage	middle stage
1	26%	4%
2	56%	5%
3	63%	0%
4	100%	0%
5	100%	20%
6	100%	50%

Several striking-platform characteristics were recorded, although the data were not quantified. Cortical and converging platforms (platforms with 2 or 3 facets) were common, particularly on large flakes generated during early stage reduction. Additionally, small flakes were propagated incidentally from the dorsal surfaces of large flakes, indicating that a great deal of force had been applied to release the flakes and ensure that they did not terminate in hinge or step fractures. Bulbs of percussion were wide but not prominent, and ventral lipping was occasionally present—both attributes have been cited as characteristic of the knapping of tough materials such as quartzite (Ebright 1987), as well as of soft hammer or billet flaking in general (Crabtree 1970; Newcomer 1971; but see also Johnson 1981).

Black Diamond Archaeological Data Set

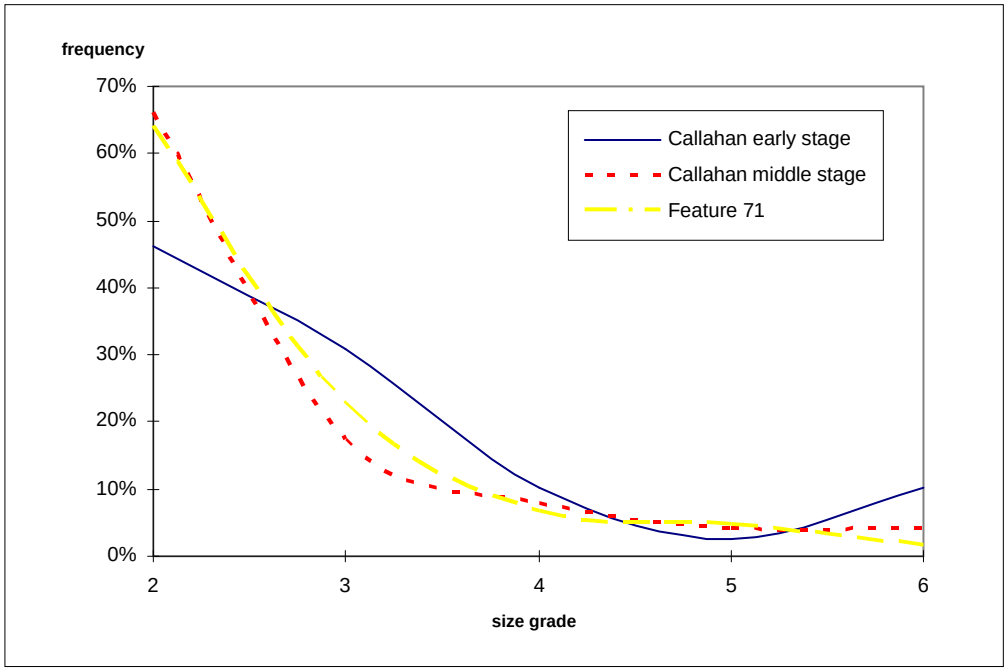
In the initial comparison, the archaeological distributions from the Black Diamond site looked very different from the replication distribution since there were no data from the archaeological samples in the smallest interval, size-grade 1. One reason for the difference lay in the recovery techniques employed in retrieving the archaeological samples. That is, the replication experiment was conducted on a tarpaulin, and the entire small fraction of the debitage assemblage was collected. In contrast, the archaeological sample was captured in quarter-inch mesh screening, as is typical in field recovery. A large proportion of the smallest grade material would be expected to fall through the screen mesh, resulting in recovery of an incomplete sample of that grade. One published estimate based on replication data suggested that as much as 95 percent of the smallest debris may be lost in quarter-inch mesh (Kalin 1981), while other experiments have indicated a figure around 85 percent (Petraglia et al. 1993). Frequency calculations from the Callahan replication indicated that a 70-to-75 percent loss would be expected (the lower percentage may reflect the fact that the Callahan replication was confined to the early stages of reduction, which would result in the presence of less small debris overall). This loss of data is one of the accepted consequences of field sampling, since the use of fine screening, using a mesh smaller than one-quarter inch, can be time-consuming and labor-intensive, taking resources from other aspects of a data recovery investigation conducted on a necessarily limited schedule. The constraints in the data set can in part be compensated for in analysis through concentration on the larger end of the size-grade continuum, as was done in the current analysis.

The analyses of the experimental data were re-run, with data from the smallest size grade disregarded. The results of these calculations were compared with the results of similar analyses of Type I quartzite flakes from three large sub-assemblages that appeared to be typical of flaking debris at the site: Feature 24, Feature 71, and Feature 78 (Figure 7-20). The archaeological distributions showed some similarity with the middle stage experimental debris, but not a close fit, implying that either different reduction techniques were represented or that an assortment of debris from more than one reduction stage was present within the archaeological sample. A mix of reduction stages was, of course, expected in the flaking debris from the archaeological site.



a) Feature 24

Figure 7-20. Comparison of Flake Size Distributions, Experimental Data and Archaeological Sub-Assemblages.



b) Feature 71

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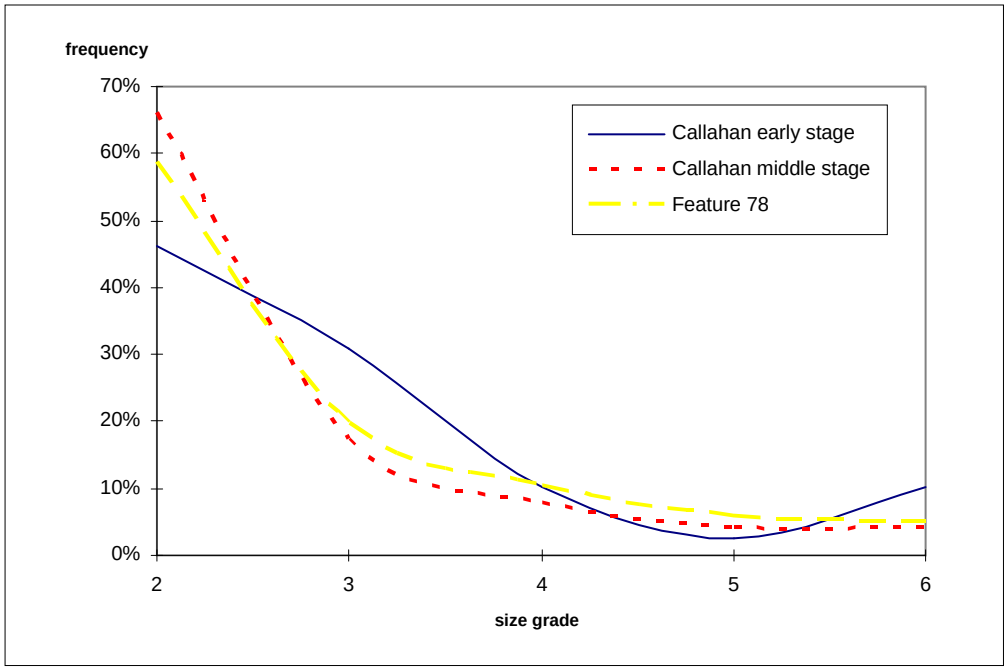

c) Feature 78

Figure 7-20 (cont). Comparison of Flake Size Distributions, Experimental Data and Archaeological Sub-Assemblages.

An important question, though, was how much if any primary reduction could be inferred from the flake size distributions. Mixed assemblages will tend to produce averaged statistics (Ahler 1989), a finding corroborated by the construction of simulated assemblages based on experimental data from a replicative study conducted by the authors using quartz pebbles and cobbles (Petraglia et al. 1993). The graph of a mixed assemblage will be influenced by the proportion of material that is present from each stage, although the degree of influence from any one stage does not appear to be precisely visible in the data. Moreover, no reduction stage contains unique flake types that can be used as exclusive identifiers. Rather, each stage may be expected to contain different proportions of large and small, or cortical and non-cortical debris. Since considerably more small and non-cortical debris is generated in later reduction stages, almost any deviation in the graph of a mixed assemblage toward larger debris may be potentially significant. In the Black Diamond site data, the charts suggested that some primary reduction debris was present, although relatively little. The archaeological distributions followed the middle stage experimental distribution, but enough large flakes were present in the samples to draw the graphs toward the early stage plot slightly, particularly in the smallest grade (size-grade 2). The variations were not dramatic, but appeared sufficient to imply the presence of early stage debris.

Analysis of cortex frequency statistics produced similar inferences. Cortical flakes would be expected to be common in the larger size grades for primary cobble reduction debris, as was indeed the case in the experimental data (Table 7-10). In the archaeological samples, frequencies were low, even in comparison with middle stage debris (which typically includes cortical flakes related to thinning—flakes driven across the centerline of the biface that may remove remaining patches of cortex). Nonetheless, cortical flakes were present in sufficient

amounts in each of the archaeological proveniences sampled to imply that at least some primary reduction debris was present.

Table 7-10. Frequency of Cortical Flakes by Size Grade, Experimental Data and Archaeological Sub-Assemblages.

	experimental		Archaeological		
size-grade	early stage	middle stage	Feature 24	Feature 71	Feature 78
2	56%	5%	5%	3%	4%
3	63%	0%	8%	11%	7%
4	100%	0%	14%	15%	25%
5	100%	20%	26%	22%	28%
6	100%	50%	18%	33%	33%
total	68%	17%	7%	7%	9%
n=	78	129	1,089	375	302

In the end, the comparative analysis indicated that primary reduction had been undertaken at the Black Diamond site but that it was relatively limited in scope. The presence of cobble cortex indicated the original form of the Type I quartzite: i.e., cobbles, as opposed to a larger form such as boulders or flake blanks from an outcrop source. But the relatively low frequency of occurrence of cortical flakes in the assemblage overall, and particularly among the larger size-grades, implied that most of the initial stages of reduction were undertaken off site, and that the majority of the quartzite had been brought to the site partially reduced.

7.3.4 Reduction Sequence – Analysis of Bifaces

Additional information regarding the reduction of Type I quartzite at the site was obtained from examination of complete or partially completed tool forms, including points and unfinished or rejected bifaces. Width:thickness ratios were calculated for each specimen. The fragmentary nature of most of the bifaces made it difficult to determine how characteristic of the whole artifact a given measurement may have been. Therefore, a second measurement was calculated—the thinning index (following Johnson [1981]). A measure of relative thinness, the index was determined by dividing the weight of each artifact by its surface area and multiplying by 100. In the resulting statistic, larger values are equivalent to thinner artifacts. Two minor caveats should be considered regarding the present application of this statistic. First, as a calculation of mass, the figure assumed that the density of each artifact and of all of the material types represented was the same—such variation as may have been present was presumed to have been negligible in terms of the overall comparative value of the calculation. A second caution, also related to the precision of the thinning index, concerned the computation of area. Several rather elaborate procedures for calculating the area of a biface have been reported, involving processes that vary from the use of polar coordinate systems to custom-designed computer programs and emerging three-dimensional scanning technology (Gunn and Prewitt 1975; Johnson 1981; Nextengine n.d.; Shott and Trail 2010). But for present purposes, squaring off each artifact and merely calculating the rectangular area (length-x-width) was considered sufficiently precise to provide a relative measure for intra-assemblage comparison. The thinning index as applied here was thus an estimated value of the relative mass of each biface. The ratio calculation that it represented served to standardize the statistic, in effect neutralizing the influence of overall size (large

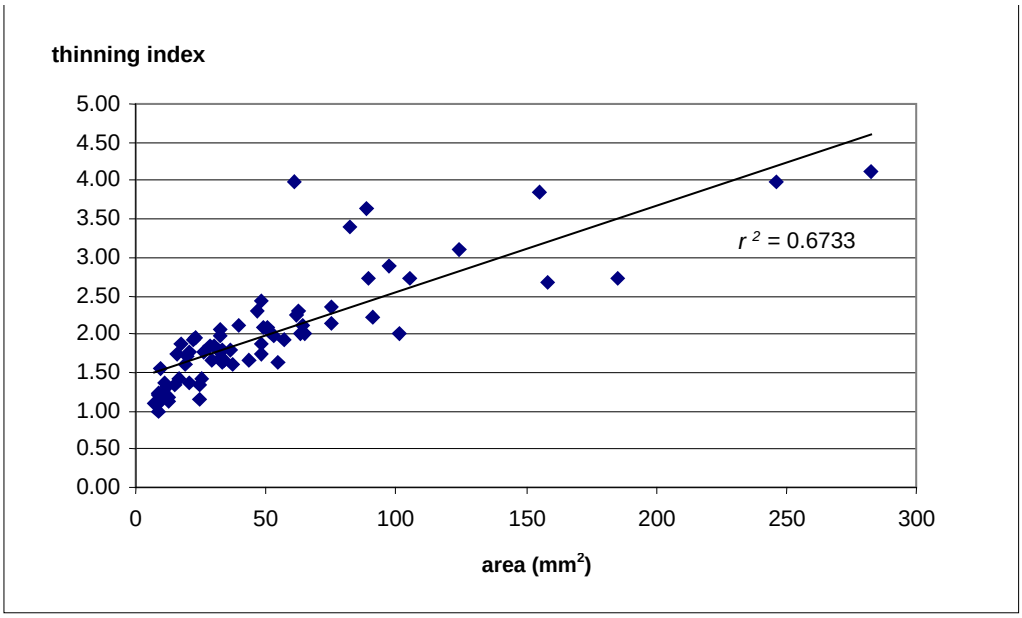

Figure 7-21. Comparison of Area and Thinning Index Among Early Stage Bifaces, Showing the Positive Relationship Between the Attributes.

versus small) on the measure. Nevertheless, a positive correlation was observed between artifact size and the thinning index, as illustrated in Figure 7-21, in which artifacts with smaller areas tended to have lower thinning indexes. The influence appeared to be unavoidable given the cross-sectional shape of a biface and the fact that many of the artifacts were fragments: that is, small fragments tend to be edge pieces, whether proximal, distal, or lateral, and the edge of a biface is the point at which it is thinnest.

Over 75 percent of the early stage bifaces were bi-convex in cross section, implying that the majority had been reduced from cobbles rather than from large flake blanks or bipolar core fragments, both of which can retain a relatively flat ventral surface well into the reduction sequence. While several clear examples were present of bifaces with either a distinct curve in profile, a flat face with little invasive flaking, or high-backed or turtle-back profile, the tabulation of cross-section shapes indicated that these pieces were not common. The proportion of bi-convex cross sections fell to 55 percent for middle stage bifaces, indicating that cross-sectional symmetry was not maintained systematically at this stage of reduction. However, all of the late stage bifaces and points were bi-convex, indicating that symmetry was an important design characteristic and that the artisans were generally successful in achieving it.

The most common fractures across all reduction stages were perverse breaks (Table 7-11), exemplifying the tough yet brittle nature of the raw material. Hard percussion impact (whether hard or soft hammer) was required to release flakes, and misdirected blows tended to snap the artifacts. Perverse fractures occurred less frequently in each successive reduction stage, while in contrast, lateral breaks increased in frequency. Sample sizes were smaller in the middle and late stages, making the results more difficult to interpret, but the trend was apparent—fractures occurred more often due to direct blows (either misdirected or at unseen flaws) early in the sequence, while fractures due to tension failure in areas weakened by

repeated blows were more frequent later. Hinge fractures were equally common in the early and middle stages of reduction, but did not occur on late stage bifaces. The knappers appeared to have removed artifacts with stacked hinge and step fractures from the sequence at these earlier stages, either by breaking them in attempts at clearing the stacks or by rejecting them outright if the pieces were perceived as too difficult to thin further. The low frequency of unbroken, rejected artifacts demonstrated the persistence of the artisans, in that few bifaces were abandoned without considerable efforts to recover from hinge stacks. Incipient fracture plane breaks were also missing from the later reduction stages, indicating that percussion blows in earlier stages had revealed flaw planes or emergent cracks, leaving only the more uniform pieces for further reduction.

Table 7-11. Fracture Types among Early, Middle, and Late Stage Bifaces.

	early stage		*middle stage*		*late stage*	
fracture	count	freq	count	freq	count	freq
perverse	42	60%	11	50%	2	40%
hinge	15	21%	4	18%	--	--
incipient fracture plane	8	11%	--	--	--	--
lateral	5	7%	7	32%	3	60%
totals[1]	70		22		5	

[1] totals include refitted fragments as single artifacts

Presumably due in large part to the fragmentary nature of the biface assemblage, the thinning index was not as characteristic of reduction as expected. Nevertheless, the index was in general negatively correlated with reduction stage, with the mean values decreasing—indicating relatively thinner artifacts—with each successive phase in the sequence (Table 7-12). That the variation was not more pronounced may also have been a factor of calculating the statistic from bifaces rejected from the production sequence ultimately because their thickness. The mean thinning index for points was within the progression for bifaces. The amount of variation, as indicated by the coefficient of variation, was substantially lower for points than for any of the biface groups, reflecting the fact that the points were finished artifacts that conformed to accepted design criteria, while the bifaces had been rejected because they did not fit similar, if intermediate criteria.

Table 7-12. Thinning Index Values among Bifaces and Points.

	mean	*standard deviation*	*coefficient of variation*	*sample*
early stage	2.01	0.72	0.36	70
middle stage	1.72	0.34	0.20	22
late stage	1.33	0.31	0.23	5
point	0.85	0.08	0.09	6

Fracture patterns among bifaces, when examined in relation to relative thinness, showed trends generally attributable to artifact size. The range of thinning indexes for early and middle stage bifaces was divided into four intervals (Table 7-13), each representing an equal number of artifacts, with thinner values lying to the right in the table. The frequency of

fracture types was then tabulated for each interval. At both reduction stages, the number of perverse fractures increased in inverse proportion to the thinning index, reflecting the tendency of the artisans to break bifaces more frequently as the artifacts became thinner. Likewise, hinge fractures were more common on early stage bifaces with higher thinning indexes, reflecting difficulties experienced in clearing errors in flaking control as they accumulated. Late stage bifaces were not included in the analysis due to the small sample size, although the general incidence of fractures noted in Table 7-11 indicated that lateral breaks were the most common at this stage.

Based on the type of fracture recorded on each artifact, along with attributes including artifact size and material quality, the bifaces in the Black Diamond assemblage were further categorized in Table 7-14 in terms of the basis for their rejection, or removal from the reduction sequence. Some reasons were obvious—certain bifaces, for example, had become too small for producing artifacts the size of the Type I stemmed points that were the apparent focus of manufacture. In other cases, combinations of fracture characteristics and size appeared to have influenced the decision to reject an artifact. Several of the categories listed in the table pertained to whole, or non-fragmented artifacts: *size*, for example, referred to artifacts that, while unbroken, had become too small to be thinned or shaped further; *size/thickness* indicated that while large enough in length or width, the artifact was too thick in relation to its remaining width—usually high-backed or with stacked hinge fractures—for practical thinning; and *material quality* indicated that flaws or imperfections had been recognized in the raw material that would hinder flaking control and further successful reduction. Two additional categories referred to broken artifacts: *fracture* indicated that a fragmented artifact was large enough to be thinned further, but exhibited an awkward shape, presenting difficulties in restarting a bifacial edge; and *size/fracture* indicated that an artifact was both small and broken, and that further attempts at thinning would have been impractical. In the end, the final two categories, fracture and size/fracture, although seemingly different from a *post hoc* perspective, were little different in terms of practical application.

Table 7-13. Cross-Tabulation of Fracture Types and Thinning Index Values Among Early and Middle Stage Bifaces.

ESB	*Interval 1 (4.11-2.21)*	*Interval 2 (2.20-1.85)*	*Interval 3 (1.84-1.62)*	*Interval 4 (1.61-0.98)*
perverse	9	9	11	13
hinge	5	4	4	2
incipient fracture plane	3	3	2	0
lateral	1	1	1	2
total artifacts per interval	18	17	18	17
MSB	*Interval 1 (2.26-2.01)*	*Interval 2 (2.01-1.63)*	*Interval 3 (1.63-1.58)*	*Interval 4 (1.58-1.12)*
perverse	2	3	2	4
hinge	1	1	2	-
incipient fracture plane	-	-	-	-
lateral	2	2	1	2
total artifacts per interval	5	6	5	6

Table 7-14. Rejection Categories for Bifaces.

	early stage		*middle stage*		*late stage*	
rejection basis	count	freq.	count	freq.	count	freq.
size/fracture	27	39%	7	32%	1	20%
fracture	25	36%	14	64%	4	80%
size	7	10%	--	--	--	--
material quality	6	9%	1	5%	--	--
size/ thickness	5	7%	--	--	--	--
	70		22		5	

Categorizing the artifacts in terms of the apparent cause for rejection was a subjective process, yet the results were seen as potentially useful for analytical purposes in describing the failures and failure rates in the reduction process. Fracture and size/fracture together were the most common basis for rejection. The high frequency of these rejection categories, particularly in the middle and late stages of reduction, reflected both the skill and seemingly the single-mindedness exhibited by the artisans working at the site. That is, relatively little experimentation was apparent in the artifact assemblage, or in the terms of agency theory, little innovation or divergence from the customary technological tradition—stemmed points of a specific form were the design focus of the activity and few small or odd-shaped bifaces were produced. Most errors came from breakage during the thinning process, rather than an inability to produce artifacts of a specific size and shape. The low frequency of items rejected due to material quality at any stage in part reflected the ability of the knappers to perceive the flaking characteristics of the stone and avoid selecting pieces of non-uniform or otherwise inappropriate quality. The finding also lent support to the contention that cobbles were selected, tested, and partially reduced at the source locale, decreasing the likelihood that poor quality stone would be carried to the site only to be rejected there.

7.3.5 Manufacturing Trajectory – Summary

The size distribution of the flaking debris in the assemblage, along with the sizes and forms of unfinished and rejected bifaces, suggested that reduction of Type I quartzite at the Black Diamond site was aimed at the manufacture of finished points of a single form—the wide-bladed, contracting stemmed point. The staged reduction sequence that is typically articulated in experimental and theoretical literature was adequate to describe the production technology at the site (Figure 7-22). The reduction sequence represented in the assemblage consisted of all major stages with the exception of primary decortication, as depicted schematically in Figure 7-23. Evidence suggested that the quartzite was procured in cobble form, and that the cobbles were tested for material type and flaking quality off site, presumably at the locale in which they were discovered. Once the appropriate material was identified, preliminary reduction was undertaken producing artifacts with rough bifacial edges. Most if not all of the Type I quartzite brought to the site thus arrived in blank form, generally as early stage bifaces, entering the sequence in the middle of the first stage, initial edging.

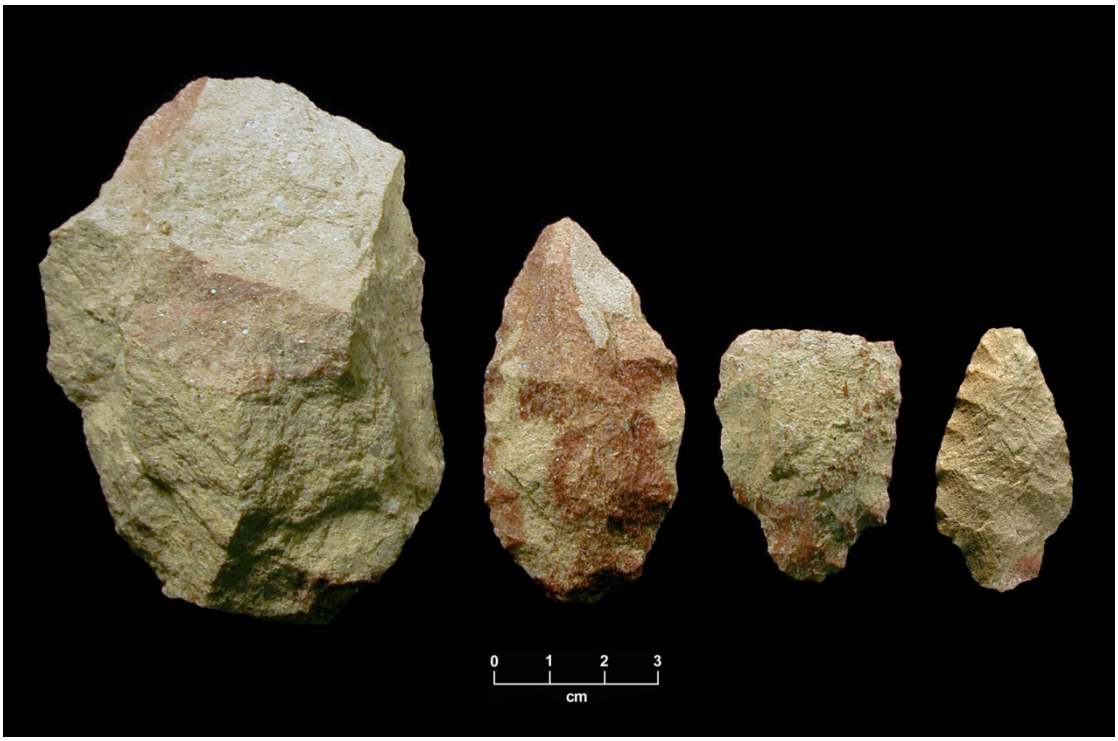

Figure 7-22. Sample of Artifacts from Biface Reduction.
(left to right: early, middle, late stage bifaces; point)

The overall frequency of bifaces in the assemblage decreased with each successive stage, corroborating the interpretation of sequential reduction and reflecting the degree of expertise demonstrated by the flint knappers. That is, rejection of an artifact would typically result from the perception that continued attempts at thinning and shaping it were no longer practical, whether due to the quality of the material, to the poor exercise of flaking control that had led to thickness that could not be overcome, or due to breakage. Poor quality material or unthinnable pieces would tend to be culled out of the production stream through a combination of observation and breakage during each successive stage, so that subsequent thinning would more often be successful in producing later stage artifacts—the success rate for producing points from late stage bifaces would be higher than for producing late stage bifaces from middle stage bifaces, and so on down the line, resulting in fewer rejects at each stage. Not coincidentally, the proportion of broken bifaces in the assemblage increased later in the reduction sequence, from 77 percent for early stage bifaces, to 90 percent for middlestage bifaces, to 100 percent for late stage bifaces. These frequencies reflected the fact that fewer artifacts were rejected at later stages due to material quality or inability to continue thinning, but were more likely to be rejected due to breakage.

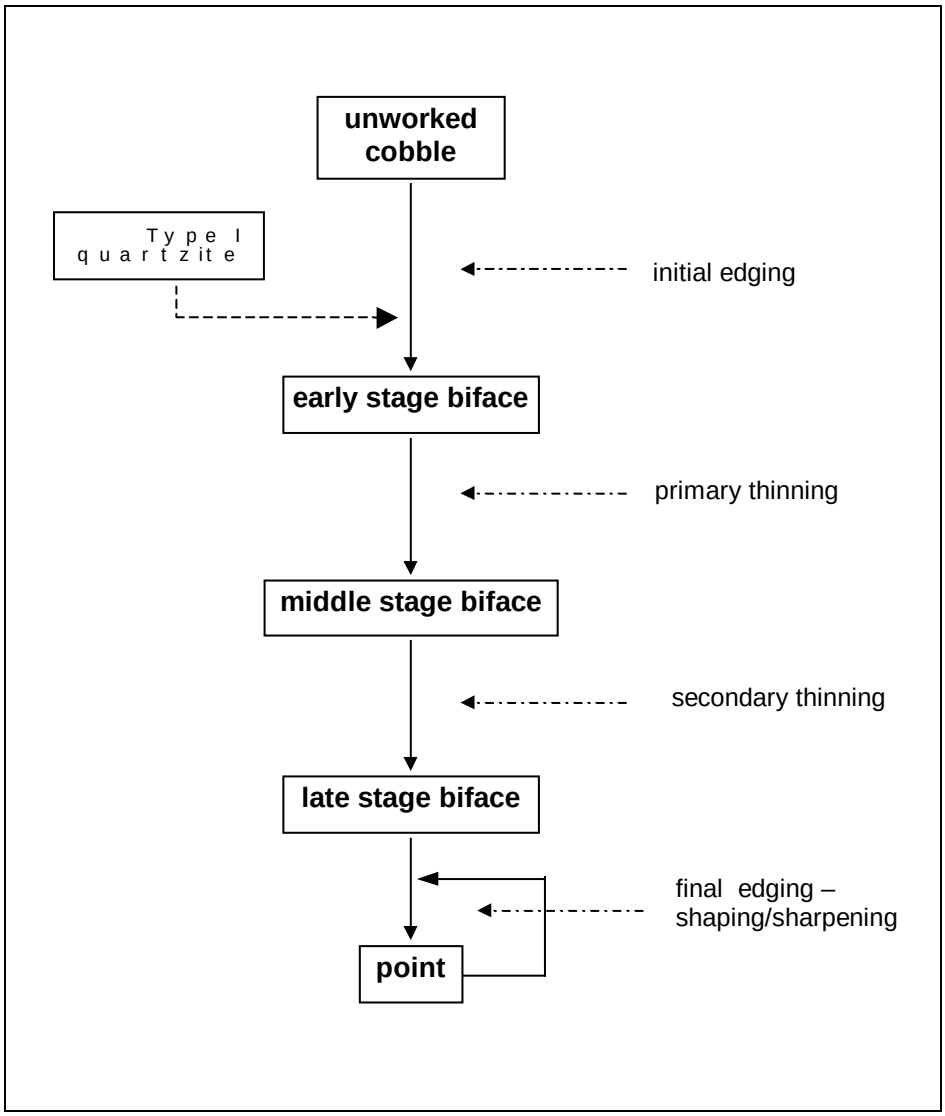

Figure 7-23. Schematic Representation of the Reduction of Type I Quartzite at the Black Diamond Site.

The reduction of Type I quartzite at the site was carried out by percussion flaking, using combinations of hard-hammer, soft-hammer, and on occasion bipolar percussion. While some of the artifacts exhibited signs of exposure to heat, no evidence could be demonstrated of systematic heat treatment of the lithic material for the purpose of enhancing flaking characteristics. Little evidence was noted of pressure flaking on artifacts other than points, suggesting that the technique was only used at the end of the manufacturing process to finalize and sharpen edges or to resharpen utilized tools. Because the hafting element was simple in form, it could be generated largely by percussion flaking. More complex haft designs, such as basal flutes, corner notches, or side notches, require prepared (thinned) bases and specialized flaking techniques, such as indirect percussion or pressure flaking (Titmus 1985). In contrast, wide, stemmed hafting elements may tend to appear earlier in the reduction sequence, as was observed in the Black Diamond site assemblage in the case of at least two middle stage bifaces. A similar phenomenon was also noted by Custer (1992) in an

examination of quartzite assemblages from several broadspear-related sites in southeastern Pennsylvania and northern Delaware.

Although strict design criteria seemed to have been followed in the manufacturing process at the Black Diamond site such that points with little apparent variation in form were produced repeatedly, tightly controlled, formally executed tasks were not necessarily evident. The degree of variation apparent in the process suggested that the work was conducted by more than one person. An individual will typically repeat a series of mechanical operations in a particular manner or a specific sequence (Young and Bonnichsen 1984), yet there was little evidence in the Black Diamond assemblage of systematic activity or progressions. For example, complete removal of cortex was not a specific step that was executed early in the reduction process. In fact, the relative absence of cortex on artifacts in the assemblage was probably as much an indication of the form in which the material was introduced to the site—partially reduced bifaces—than evidence of a particular step in the reduction sequence. Based on analysis of cortical frequencies on flaking debris, artifacts were transported to the site bearing varying amounts of cortex, while cortex remained on some middle stage bifaces following the first stages of thinning. Similarly, cross-sectional symmetry was not achieved systematically until the latest stages of reduction. While a bi-convex shape appeared to be an integral part of the design of the finished artifacts (points and late stage bifaces were bi-convex), a higher proportion of middle stage bifaces were plano-convex (45 percent) than early stage (24 percent). Shaping the outline of the artifact also seemed to occur at various points during the edging process—stems were not formed as a specific step, but as previously observed were noted on several middle stage bifaces. These variations suggested that more than one individual was involved in the manufacturing effort.

7.3.6 Production Estimate

A large proportion of the finished artifacts manufactured from Type I quartzite appeared to have been removed from the site, as evidenced by the disparity between the amount of flaking debris and rejected bifaces that were recovered in relation to finished points. Almost 33,000 Type I quartzite flakes, characteristic of all stages of biface reduction and weighing a total of more than 60 kg, were included in the assemblage, along with 97 bifaces or biface fragments, most of which could be identified as rejects from point manufacture. In contrast, six points made from Type I quartzite were recovered, far fewer than implied by the waste debris.

Based on these figures and the average amount of flaking debris that is typically produced at each reduction stage, an estimate was made of the number of points originally manufactured at the site. Comparative data regarding the amount of debris generated during biface reduction were taken from three sources. First was a series of replication experiments conducted in association with research at the Puncheon Run site (7K-C-51), on the St. Jones River, south of Dover (LeeDecker et al. 2005). The experiments were aimed at reproducing small, stemmed points from cryptocrystalline pebbles. The data recorded in the replications indicated that the artifacts produced accounted for between approximately 20 and 30 percent of the weight of the original material. Mean proportions for each stage are listed in Table 7-15.

Table 7-15. Biface Replication Data, Puncheon Run Site and 44PW554.

	mean proportion of cobble/pebble weight	
artifact type	Puncheon Run	44PW554
point	17.4%	2.6%
late stage biface	19.2%	5.6%
middle stage biface	27.4%	--
early stage biface	14.0%	37.1%
core	--	43.6%

A second data set was derived from experiments conducted during the mitigation of 44PW554, a Late Archaic-to-Early Woodland occupation site in the Piedmont of northern Virginia (Petraglia et al. 1993). In this study, bifaces and stemmed points were replicated from quartz cobbles. The proportions of debitage generated during the replications were considerably different from those reported at the Delaware site. For example, points represented an average of 3 percent of the original cobble weight, and late-stage bifaces an average of 6 percent (Table 7-15). Among several possible reasons for the differences in results from the two studies were the relative skills of the flintknappers (the Puncheon Run knapper may have been more efficient, producing less waste), or the quality of the raw material (cryptocrystalline stone is often easier to flake efficiently in comparison to quartz). But perhaps as likely, the amount of debris produced may have been related to the sizes of the initial raw material clasts. The Delaware replications were conducted on small nodules—pebble in size—while the Virginia replications were conducted on cobbles. Holding the flintknappers' skill constant, the lower initial mass of pebbles in comparison with cobbles would be expected to produce less waste material—and in fact, in several instances three or even four artifacts were produced from one quartz cobble in the Virginia experiments in comparison to one from each pebble in the Delaware study.

The third source of comparison was the data set from the Callahan replication experiment cited earlier, in which a middle stage biface was produced from a cobble. In this instance, the biface represented 22 percent of the initial weight of the cobble, effectively falling near the center of the range noted for early and late stage bifaces in the Virginia quartz replications.

As preceding analyses have suggested, cobble-sized material appeared to have been employed in the manufacture of the quartzite points at the Black Diamond site. Thus, the frequencies from the Virginia experiments and the Callahan replication were more likely to be applicable to the Black Diamond data set than the pebbled-based data. Accordingly, Table 7-16 contains estimates of the amount of flaking debris represented by the Black Diamond artifacts using a formula of *total weight/mean proportion*100*, where total weight is the total weight of the artifacts in each type in the assemblage; and mean proportion is the mean proportion of the original cobble weight, using the values from Table 7-15 (2.6 percent for points; 5.6 percent for late stage bifaces; 22.0 percent for middle stage bifaces; 37.1 percent for early stage bifaces; and 43.6 percent for cores).

Table 7-16. Estimates of Flaking Debris Associated with Bifaces and Cores from Type I Quartzite.

artifact	count	total weight	debitage represented
point	9	61.0 gm	2,310.6 gm
late stage biface	5	119.2 gm	2,124.8 gm
middle stage biface	25	769.7 gm	3,498.6 gm
early stage biface	77	3,816.7 gm	10,279.3 gm
core	43	6,495.4 gm	14,904.5 gm
total			33,117.9 gm

The total figure, 33.2 kg, is the amount of flaking debris that would have been generated in producing the flaked artifacts (bifaces, points, and cores) recovered from the site. However, a total of 60.1 kg of flaking debris was actually recovered. The difference, 26.9 kg, represents extra debris, in that there were no bifaces, points, or cores to account for it, assuming the various artifact types to be proportionally representative samples. The implication would be that artifacts manufactured in the generation of this additional debris had been removed from the site. Since individual points in the Black Diamond assemblage weighed an average 10 gm, each artifact represented approximately 260 gm of debitage (based on a figure of 2.6 percent, the proportion of the cobble represented by the finished artifact). Assuming that all of the extra 26.9 kg of flaking debris resulted from successful point manufacture, the total number of points represented would have been approximately 103. Added to the six recovered in the archaeological excavations, the total number of points manufactured would have been approximately 109.

Not all of the additional artifacts would necessarily have been finished points. Yet the presence of used and resharpened tools in the artifact assemblage suggested that the site was not primarily a quarry workshop, at which the main artifact type created would have been mid-to-late stage bifacial blanks suitable for transport off site. It is reasonable to assume, then, that finished points would indeed have been the most likely artifacts taken away from the site.

Nonetheless, some of the transported artifacts may well have been late stage bifaces, in which case the total number of points produced would have been lower than the estimate of 109. Given that there were 97 unfinished bifaces or biface fragments recorded in the inventory (most of which appeared to have been rejects from point manufacturing), a total of 109 points implies a failure rate of almost 50 percent—nearly one of every two bifaces were rejected prior to completion. In contrast, the finished points recovered from the site were well-made, and the form of the flaking debris in general, consisting of many large, thin flakes, suggested that the artisans working at the site were skilled and efficient. Thus, errors related to knapping skill were probably minimal, particularly at the latter end of the production trajectory, implying that an estimate in the neighborhood of 110 points may in fact be somewhat low.

It should be noted that the preceding analysis assumes a complete reduction trajectory, beginning with an unworked cobble. But in fact, analysis of debitage from the Black Diamond site clearly implied that on-site lithic manufacture did not include the primary

reduction of cobbles. Rather, quartzite was brought to the site in partially reduced form, probably as early stage bifaces or occasionally as large flake blanks or bipolar core fragments. The frequency data from experimental replications that were used in estimating production rates were based on initial weights of complete cobbles. Little data were available on the weights of intermediate bifaces or the weight of debitage resulting from the intervening reduction stages. Thus the production estimate presented above may again be low. The greatest amount of mass tends to be removed during the initial or primary stage of reduction, when large and thick primary decortication flakes are produced along with a variety of smaller debris. As reduction continues, flaking is directed more specifically at thinning the artifact, and consequently, smaller and thinner flakes result. In general, therefore, less mass is produced in the later reduction stages. Thus, the debris in the Black Diamond assemblage, which may not have included all of the material from cobble reduction, would represent the manufacture more artifacts than the estimate based on the full reduction sequence.

7.3.7 Chaîne Opératoire

Applying the *chaîne opératoire* modeling techniques helps describe the structured production sequence apparent in the Type I quartzite assemblage while accounting for the entire lifecycle of the artifact, ranging from procurement, through use, to discard activities. Figure 7-24 illustrates the sequential model for the Black Diamond site, showing the main segments of the process in circles, along with feedback loops indicating points at which strict linearity is broken. Across the top of the graphic are some of the major types of information potentially available in the data from each segment; along the bottom are the types of information gathered from the Black Diamond site analysis.

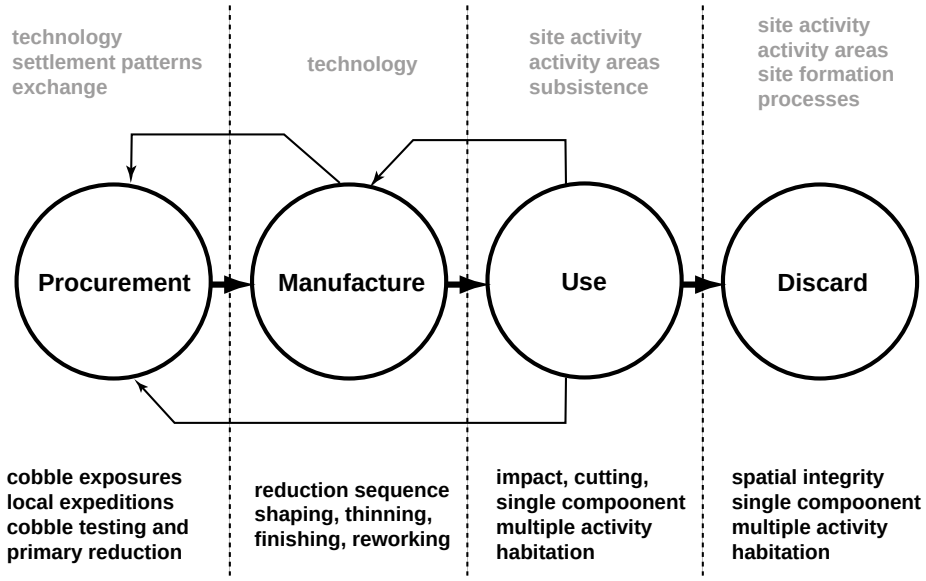

Figure 7-24. Schematic Representation of the *Chaîne Opératoire.*
(adapted from Grace 1996; the types of information potentially available at each segment are listed are above and the types of information from the Black Diamond analysis below)

At the Black Diamond site, flintknappers worked within a defined tradition to generate a specific style of artifacts, displaying an evident ability to follow design criteria. The

characteristics of cortical debitage from the assemblage indicated that the acquisition of Type I quartzite entailed visits to local cobble sources, rather than long-distance procurement from sources external to the region. Because the source was presumably not at the site but was some short distance away, the lithic production that was so prominent in the archaeological record may not have been the primary reason for the site occupation. Had the quartzite been the main focus of activity, the site would presumably have been at or very near the source of the material. Even so, the process of obtaining stone and making tools would have been planned. That is, the site appeared to have been occupied more than once, indicating that the cobble source was remembered and thus had become part of, if not the prime reason for the occupation, demonstrating that the rationale for site location was more complex than the exploitation of a single resource. The raw material was tested and some primary reduction was undertaken at the source, based on analysis of flaking debris from the site that indicated that the material entered the reduction sequence there in partially reduced form. An apparently low incidence of bifaces rejected due to material quality indicated the knappers' skill at perceiving the flaking characteristics of the stone and avoiding non-uniform or low quality material. Details of manufacture were summarized earlier in Figure 7-22 and the accompanying text. Evidence of use was noted in the form of impact fractures and edge rejuvenation. Evidence was clear that the site was a single component habitation site at which multiple activities were carried out, although little information regarding subsistence was available. Within the discard segment of the *chaîne* sequence were data that similarly suggested complex site structure and multiple activity areas. Information related to discard also provided evidence of discrete artifact distributions and well-preserved spatial data that helped to justify the more in-depth artifact analyses that were undertaken. Estimates of production combined with a relative absence of used or discarded artifacts provided information on the organization of production, which may have been fairly systematic, particularly if all of the items were made in a short period of time.

7.4 Paleoenvironmental Studies

The Black Diamond site was located in the Blackbird Creek area of central New Castle County. This portion of the Delaware Coastal Plain contains a number of large upland depressions referred to as bay/basin features. The depressions were ponded at various times during prehistory, and some retain water to the present day. As wetland areas interspersed between well-drained uplands, bay/basins would have provided local environmental diversity within limited areas and would likely have represented a significant attraction to Native American populations living in the region. Bay/basins have been recognized as geomorphological entities since the nineteenth century. However, only recently have researchers begun to view these phenomena as having had a significant role in shaping prehistoric Native American settlement in the Coastal Plain uplands (Custer and Bachman 1986b; Sassaman 1996).

7.4.1 Bay/Basin Research

Bay/Basin Formation

Bay/basins are broad, circular-to-oval depressions that occur across much of the Atlantic Coastal Plain. They vary greatly in size from as little as 30 m in diameter to over two kilometers in greatest dimension. Though numerous, bay/basins are found in an uneven distribution along the Atlantic coast from northern Florida to Delaware (Grant et al. 1998).

One of the greatest concentrations occurs in the inner Coastal Plain of North Carolina (Kaczorowski 1977), where they are known as Carolina bays. While many of the large depressions remain ponded, use of the term "bay" likely refers to the distinctive vegetative communities characteristic of the landscape features rather than to the presence of surface water. In historical times, many of the depressions have been drained or otherwise altered to claim the land for agricultural use (Krajick 1997).

Some researchers maintain that bay/basin features in Delaware differ from those occurring further south, and therefore have used the term "closed drainage depressions" instead of bay/basins or Carolina bays (Bonfiglio and Cresson 1981). This terminology is based in part on the observation that the Delaware features are often circular, while by contrast, those along the southern Coastal Plain are generally oval or elliptical in form. Similar landscape features are known on the New Jersey Coastal Plain, where it has been proposed that their occurrence was linked to perigalcial conditions (Bonfiglio and Cresson 1981, Cresson, personal communication, 2000). Others, notably Custer (1986b), have questioned the periglacial origins of the New Jersey features, assuming instead that all were part of the same bay/basin phenomenon seen from Delaware southward.

Despite their widespread distribution, there seems to be no clear consensus as to the origin of bay/basin features. Many early formation theories centered on meteorite strikes. Yet, a wide range of radiocarbon dates, together with evidence for ongoing morphological changes, argue against a single, catastrophic event such as an impact strike as the source of bay/basin formation. In addition, other studies have indicated that soils below the organic deposits within the bay/basin remain essentially unaltered (Gamble et al. 1977, Grant et al. 1998) making the impact strike model an even more unlikely explanation.

Wind action has long been suspected of playing a role in promoting and modifying the bay/basin form. Bruce Thom (1970) expanded on earlier theories of aeolian effects by suggesting that the basins were formed as collections of surface water in sand dune deflations and that these ponded depressions expanded with time under the influence of dominant southwesterly winds. Raymond Kaczorowski (1977) presented a convincing model in which he linked bay/basin development to persistent aeolian and littoral processes, the latter associated with wave action in open, ponded areas. This model, which presents the morphological development of bay/basins as the result of strong unidirectional winds blowing across ponded water in upland locations, has gained considerable measure of acceptance (Brooks et al. 1996). In his work, Kaczorowski presents a wide range of dates for the onset of organic deposition in the bay/basins, from 40,000 to 6,600 years BP (Kaczorowski 1977).

Extensive research was recently undertaken on bay/basins at the Savannah River site, on the upper Coastal Plain of South Carolina (Brooks et al. 1996; Grant et al. 1998). These studies employed ground penetrating radar to map subsurface bay/basin stratigraphy at Flamingo Bay and six other bay/basins on Department of Energy property. Findings were synthesized with geological, ecological and archaeological data, and suggested that the ponds in these bay/basins were significantly larger and more permanent in the early Holocene than at present, with significant infilling having occurred during the latter half of the Holocene.

Bay/basin evolution was summarized as the result of "fluctuating but generally open water conditions [in which] breaking waves along bay shore lines eroded and transported sediment which was subsequently exposed for deflation during periods of low water. Deflation and transport of sand into standing vegetation along the margin of the bay created a rim in the form of a parabolic dune lacking obvious internal stratification. Simultaneously, in-filling occurred by shoreline erosion and transport from adjacent elevated surfaces" (Grant et al. 1998:325).

While these findings strongly suggest extensive Holocene modification of bay/basins, a large body of radiometric data suggests that the original form was inherited from the Pleistocene (Thom 1970, Kaczorowski 1977). In Delaware, radiocarbon dates suggest that deposition within bay/basins may have begun well before 18,000 years BP (Newby et al. 1994). The ultimate genesis of the landscape features that evolved into bay/basins is uncertain but could include spring activity, deflation, or drainage channel abandonment (Grant et al. 1998). Dramatic changes in surface hydrology associated with proximity to the glacial margins could have been a factor in the original formation of the basins in Delaware. Frost heaving or other dynamics associated with periglaical conditions may also have played a role.

7.4.2 Paleohydrology and Palynology of Bay/Basins in New Castle County, Delaware

A paleoenvironmental study of the SR1 corridor conducted through the Center for Archaeological Research at the University of Delaware (Kellogg and Custer 1994) included detailed investigations of four bay/basin locations in New Castle County. One of these studies analyzed sediment cores and pollen profiles from the Walter's Puddle bay/basin (Newby et al. 1994), located about three kilometers northwest of the Black Diamond site. A second, more intensive coring study was repeated at Walters Puddle and at three additional nearby bay/basins: Nowakowski Pond, Longhauser Pond, and Prison Pond (Webb et al. 1994). The data obtained in these studies aid in the reconstruction of the local paleoenvironmental conditions during the time that the Black Diamond site was occupied.

Initial work at Walter's Puddle indicated a drop in water levels over a period from approximately 11,880 BP to 5830 BP (Newby et al. 1994). Additional work confirmed a similar reduction in water tables in all four bay/basins lasting from ca. 11,000 to 6000 years BP, a period during which the features may have been dry (Webb et al.1994). Following 6000 years BP, water tables rose, and evidence of organic-rich sediments that accumulated in the features implies that the depressions were again ponded (Webb et al. 1994).

Pollen cores suitable for analysis were recovered from the Walters Puddle location. Data from the deepest contexts (WP-3, 122-300 cm) were difficult to interpret due to poor preservation and low pollen counts. However, the presence of oak pollen, which was absent from the next context WP-2 (61–122 cm), suggested that the lowest deposits may have dated to the Wisconsin interstadial period of about 23,000–36,000 years BP (Newby et al. 1994). Coring material from the WP-2 context yielded a late glacial age (14,400–11,880 years BP). The presence of spruce, hemlock, pine, and birch pollen, together with sedges suggested that boreal vegetation covered the area (Newby et al. 1994). A distinct hiatus in the depositional sequence was noted at a depth of 61-63 cm, marking the break between the WP-2 and the WP-1 contexts (Newby et al. 1994). The basal level of the WP-1 context (52-61 cm) yielded

a radiocarbon date of 5800 BP. Pollen at this level was dominated by oak, with hickory present in moderate amounts. Secondary species included pine, birch, maple, beech, and poplar (Newby et al. 1994). This latter pollen assemblage closely mirrored modern tree communities in the area and suggested that essentially modern forest conditions had developed by 5820 BP.

While the Walters Puddle data may not be directly applicable to the Black Diamond bay/basin, which appeared to have been dry for much of the Holocene, it nonetheless provides information on the larger bay/basin setting in central New Castle County. During the Late Archaic period, numerous bay/basins across the area were likely ponded. This mosaic of upland wetlands and attendant well-drained rim areas likely constituted an attractive and productive landscape for Native American groups in the region. The pollen data from Walters Puddle also indicated that the forest communities at the time the Black Diamond site was occupied were likely very similar to what one would see in a local climax forest in Delaware today.

7.4.3 The Black Diamond Bay/Basin Setting

Although bay/basins are widely distributed along the Delaware Coastal Plain, a marked concentration of these features is present in New Castle County between the towns of Smyrna and Townsend. The landscape features are particularly prevalent just west of the SR1 corridor in the upper Blackbird Creek area. These particular bay/basins measure as little as 50 m in diameter to over 500 m in greatest dimension. At present, many of the depressions are ponded. Some of the large bay/basins in the region have been drained in historic times to claim the land for agricultural use, as at the nearby Frederick Lodge Site Complex (Versar 2011a). By contrast, no evidence was encountered soil profiles from the Black Diamond bay/basin that the feature had been modified in such way.

A uniform attribute among most of the bay/basin features in the region is a crest landform on the east or northeast side. These dune-like landforms suggest that sediments were conveyed out of the bay/basins by southwest winds. Examination of the USGS 7.5-min series quad sheet for Clayton DE suggested that similar landforms are situated on the east sides of many bay/basins, indicating a pattern of aeolian transport of bay/basin by westerly winds occurred across a broader area. Aeolian transport appears to have persisted from the late Pleistocene though the Holocene. At the Frederick Lodge locale, as much as a meter of culturally-sterile aeolian soils capped the Columbia Formation subsoil on the crests overlooking the bay/basins. The crests continued to receive minor additions of aeolian soil following both the Middle Archaic and the Early/Middle Woodland occupations (Versar 2011a). Soil profiles capping the Columbia Formation on the Black Diamond crest were substantially thinner.

7.4.4 Black Diamond Geoarchaeological Findings

Geoarchaeological analysis at the Black Diamond site corroborated the presence of a crest landform or dune running northeast/southwest along the rim of the bay/basin, referring to the feature as a ridge or aeolian/hummock terrain. Dune buildup characterized the higher ground along the ridge. Slopes evolved through limited backwearing, colluviation, and the reworking of sands and silts in the evolving basin depression. The landscape contours were

established in the Late Holocene, while the upper margins of the basin reflected cultural landscaping in the form of land clearing and cultivation during the historical period.

The geoarchaeological study also confirmed that aeolian sedimentation was the dominant geomorphological process affecting the Black Diamond site over the course of the Holocene prior to, during, and subsequent to the time that people lived at the site. Significantly, however, the deposition was episodic, punctuated by intervals of soil formation and surface stabilization. It is probable that site occupations occurred on stable surfaces, while progressive buildup of the surfaces through slow and infrequent dune activity resulted in burial of the occupation horizons. Soil profiles featured classic A-E-Bw horizons typical of the spodosol order, suggesting that the immediate landscape was covered by needle leaf forest communities (conifers). The duration of pedogenic process was such that soil horizon boundaries were indistinct, and thus composite EB horizons were identified in most profiles. Soil formation "overprinted" the organic residues of the primary occupation such that more diffuse artifact distributions were entrained in the cohesive soil fabric of the weathering B-horizons. Discrete activity areas marked by dense artifact concentrations were also recognizable in the sediment matrix.

In summary, geoarchaeological analysis suggested that periodic aeolian sedimentation, semi-continuous weathering, and limited erosion accounted for the preservation context of the archaeological assemblages at the Black Diamond site. The sequence of events and site formation processes can be visualized in a six-stage model as presented in Figure 7-25 and describes as follows.

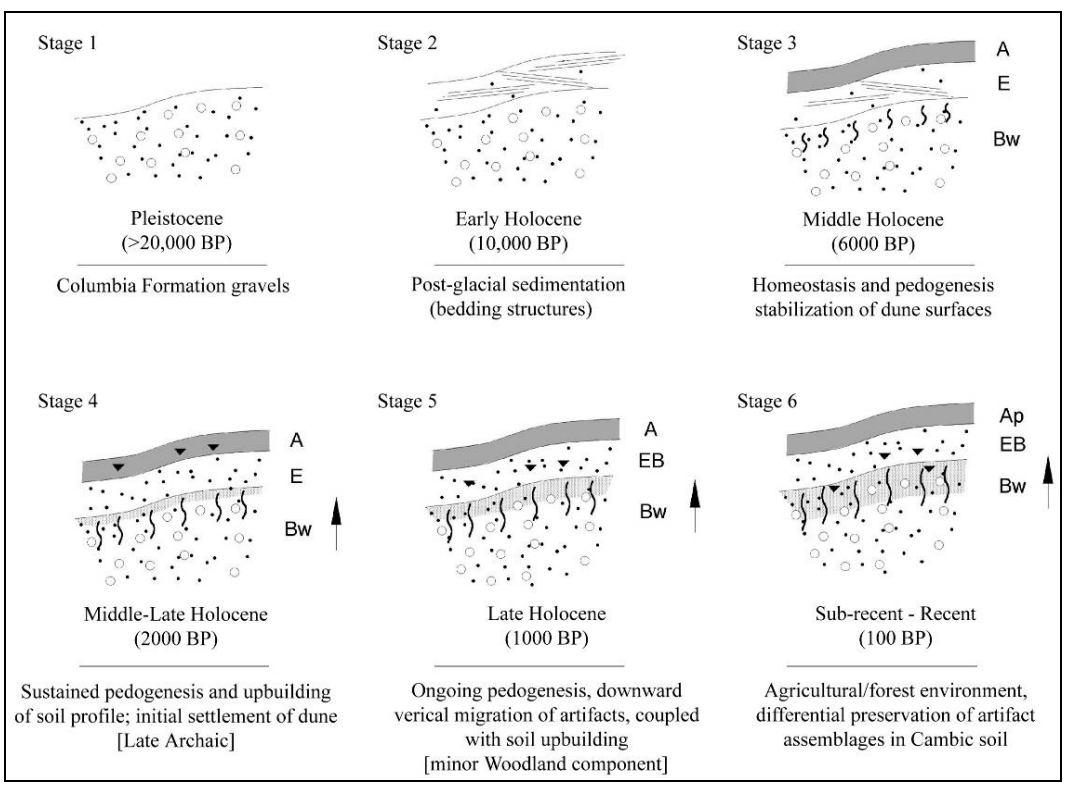

Figure 7-25. Diachronic Site Formation Model, Black Diamond Site.

The end of the Pleistocene is marked by the erosional surface of the weathered Columbia Gravels (Stage 1). Sometime during the Early Holocene (<10,000 BP), bedded aeolian sands accumulated atop the higher elevations of the stripped terrace landscapes of Delaware's interior Coastal Plain and Piedmont (Stage 2). Rates of sedimentation slowed over the course of the Holocene period, giving rise to weathering and promoting a homeostatic balance between aeolian deposition and the emergence of the podsols (Stage 3). The forest cover stabilized the surfaces promoting A-E-Bw horizonation; given that regional climates turned moister after 6000 BP, it is probable that the spodosols also stabilized around this time. By the Middle Holocene, incremental aeolian accretion balanced by soil formation resulted in the increased mineralization and deepening of the solum (EB-Bw); weathering also overrode and obscured the bedding planes within the former (now buried) cover sands (Stage 4). At the same time, these stable settings became increasingly attractive to Late Archaic populations that were starting to disperse locally. Ongoing soil formation and periodic additions to the aeolian cover caused the weathering front to rise in the profile while the thickness of the solum increased ("upbuilding"). As site topography rose, artifacts of the preceding occupation were buried by sands (Stage 5) and were incorporated into the solum (E, EB, and Bw horizons). Features were typically found in the latter two contexts (Stage 6).

Archaeological deposits that were preserved within the Holocene soil generally reflect their initial discard locations. In some cases, historical landscaping may have displaced portions of the artifact assemblage laterally and vertically. However, it is generally possible to isolate pristine archaeological contexts and to reconstruct the key formation processes at the Black Diamond site by understanding this diachronic model of site formation.

7.4.5 Black Diamond Archaeobotanical Findings

Soil samples from ten features were subjected to flotation processing. The findings are summarized here (Table 7-17), while a full description of the archaeobotanical remains and recovery methods is included in Appendix F. Standard two-liter samples from nine pit features and a suspected post feature were processed. Preservation of carbonized botanical material in the feature fills was extremely limited. Ten fragments of wood charcoal were recovered from the samples; the fragments were very small and detailed taxonomic classifications were not possible. Seven fragments, recovered from Features 9 and 24, were identified as deciduous *taxa*. Single fragments from Features 11, 19 and 29 could only be identified as wood charcoal.

Table 7-17. Inventory of Wood Charcoal Remains.

Provenience	**N245 E412-413**	**N248 E414-415**	**N248 E414**	**N294 E412**	**N253 E421**
	Feature 9	*Feature 11*	*Feature 19*	*Feature 24*	*Feature 29*
Sample Volume	2 liters	2 liters	200 gm	2 liters	2 liters
Total Charcoal Weight	0.02 gm	<0.01 gm	0.01 gm	0.02 gm	0.01 gm
WOOD CHARCOAL					
total weight	0.02 gm	<0.01 gm	0.01 gm	0.02 gm	0.01 gm
deciduous taxa	4			3	
unidentifiable		1	1		1
total fragments identified	4	1	1	3	1

That a limited amount of archaeobotanical remains were recovered from the Black Diamond site was presumably related to the poor preservation characteristics of the local soils and the age of archaeological deposits. While interpretations based on such limited data are difficult to support, it is interesting to note that the identifiable wood charcoal recovered from the site were deciduous *taxa*. In contrast, both *pine sp.* and deciduous *taxa* charcoal fragments were represented in Woodland period feature contexts at the adjacent Frederick Lodge site (Versar 2011a). These findings may imply that during the Black Diamond occupations, at the latter end of the Archaic period, local forests were in a climax state, while the Woodland period forest consisted of mixed growth due to a natural and/or cultural disruption of climax conditions.

7.5 Regional and Inter-Site Settlement Patterns

The people living at the Black Diamond site resided both on and within their landscape, acting within natural and socio-cultural environments. Their lives were influenced by the characteristics of the physical setting which they occupied and by changes occurring in that environment. Their lives were similarly shaped by cultural systems—their own and, occasionally, those from outside or external sources. Pronounced and observable changes were occurring in Native American lifeways on the Delmarva Peninsula during the time the site was occupied, beginning in the Late Archaic period. Regional archaeological evidence suggests that life was generally becoming more settled, characterized by less portable storage technologies and larger population aggregates.

Shifts in material culture and settlement patterns have long been recognized in the archaeological record of this period. For example, a clear orientation to riverine settings, in contrast to earlier, wider-ranging settlement patterns, has been documented across the much of the Middle Atlantic Coastal Plain in the first part of the Late Archaic (Witthoft 1953; Kinsey 1972). Dent (1995), in summarizing a broad body of data from the region, characterized the latter part of the Late Archaic period as an era of intensification in terms of resource exploitation with settlement beginning to center around newly developed estuary environments. These gradual changes laid the foundations for the development of the more sedentary lifeways and increased socio-political complexity that eventually became hallmarks of the ensuing Woodland period.

The paragraphs that follow place the Black Diamond site in a regional context of settlement and socio-political change occurring at the end of the Late Archaic. Rather than listing similar temporal components across the state or region, the analysis will examine broad issues pertaining to Late Archaic material culture, settlement and social organization that would have affected the people living at the site. Specifically, Late Archaic settlement at the Black Diamond site will be examined in the context of the cultural dynamism that to a large degree defined the Late Archaic period. In discussing broader patterns of social organization, cultural forces such as population growth, cultural landscapes, socio-cultural regionalization, and group competition will be discussed along with the more traditional themes regarding the local food resource base or the availability of stone for tool making. The discussion begins by examining patterns across the wider Middle Atlantic region, and then considers data from the Delmarva area.

7.5.1 The Regional Context of the Late Archaic

The Black Diamond site occupation is ascribed to the latter part of the Late Archaic period. Lacking unambiguous radiocarbon dates, the exact temporal parameters of the occupation are unclear. And so, the site will be discussed as Late Archaic, with the understanding that the latter part of that period and the earliest part of the Woodland represent a cultural continuum.

The archaeological record from the Late Archaic period clearly indicates a time of change in the Middle Atlantic. The replacement of boreal with temperate forests and the expansion of the Chesapeake Bay and Delaware Bay estuaries as a result of ongoing sea level rise stand as the great ecological changes during the period. Along with these environmental variations came new ways in which people used and altered the landscape: shifts in settlement patterns; changes in the ways in which various resources were obtained and used; and developments in material culture that left behind an archaeological record significantly different from that of the preceding millennia.

Conventional and in some cases long-held interpretations of the archaeological record suggest that a pattern of settled occupation developed in the Late Archaic out of a more generalized foraging pattern that was characteristic of the preceding Middle Archaic period. Riverine locales were the focus of settlement during the initial part of the Late Archaic, as people took advantage of increasingly predictable anadromous fish runs (Custer 1978; Gardner 1978). As stable estuaries developed with the eventual slowing of sea level rise, new and highly productive environments opened up that are traditionally viewed as having played a major role in shaping the subsistence and settlement practices of the period (Custer 1994; Mouer 1990, 1991). In the Chesapeake Bay area, for example, shell midden sites begin appear toward the end of the Late Archaic, indicating that shallow estuaries that allowed the growth of shellfish beds were gaining importance in local subsistence systems (Potter 1993).

An increase in site frequency and, occasionally, in site size during the early part of the Late Archaic have traditionally been seen as evidence of overall population increase, movement into new environmental zones, and a trend toward sedentism and organized resource procurement strategies (Custer 1994; Johnson 1986; Turner 1978). Gardner (1982) maintained that in upland areas, particularly near the fall line, anadromous fish were harvested at large, spring-and-summer base camps, while smaller, fall-and-winter base camps were situated along inland streams, and multi-seasonal, transient camps were located in a variety of environments, offering additional support to the base camp occupations.

While many of these traditional observations are valid, different approaches to understanding the lives and experiences of the people who inhabited the region have been taken in recent years. Dent (1995) provided a view of the interplay between the ecological and socio-cultural changes of the period that separated the early and latter parts of the Late Archaic, describing a pattern of hunting and foraging (10,000 to 3,500 years ago) followed by a pattern described as intensification (4,200 to 3,000 years ago). While his research focused primarily on the Chesapeake Bay area, Dent's observations are clearly relevant to the Delaware Bay region, on the opposite side of the Delmarva Peninsula and within which the Black Diamond site is situated. He notes an increase in the carrying capacity of the

landscape during the Late Archaic that accompanied the growth of temperate forest communities and their more varied, abundant, and predictable understories, along with faunal species that were less diverse but more abundant than those associated with earlier boreal forests. During the early, hunting and foraging segment of the period, sites tended to be small, but because resources were predictable, the sites were frequently re-occupied, sometimes making them appear large in the archaeological record. More areas were settled on the inner Coastal Plain and Piedmont than on the outer Coastal Plain, presumably because ongoing marine transgression resulted in less stability and less predictable resources on the outer plain.

The latter part of the Late Archaic saw a fundamental change in resource production, which Dent characterized as intensification. Rather than merely adapting to nature people began to use or appropriate it; they no longer merely reacted to what the environment provided but began to take steps to enhance or even to promote available resources. Archaeological evidence from this era includes a suite of new artifacts that included broad-bladed projectile points, durable containers made from steatite, and certain non-portable items—fish weirs and large cooking features, for example, which are viewed specifically as evidence of intensified fishing directly related to the maturing of estuaries. A Delmarva example of this type of site is Naamans Creek (7NC-C-2) (Custer 1989). Dent suggested that much of the immediate impetus for the changes in both artifacts and subsistence practices was the migration of people, perhaps limited in numbers, from the south. He reasoned that the appearance of the same broad-bladed points up and down the East Coast logically argues for population movement of some form, however unclear the magnitude. This new era of intensification was "less an economic phenomenon driven by ecological change and more a new way of life based on changing social imperatives" (Dent 1995:214).

The Late Archaic Point Traditions

Central to the recognition of the changes taking place in the Late Archaic is the appearance of material culture traits that were different from those of the preceding Middle Archaic period. Noted previously, these new traits included the appearance of hafted biface forms often referred to collectively as broadspears or broad-bladed points, and stone vessels carved of steatite. Several broad-bladed forms are generally recognized—Savannah River, Susquehanna, Perkiomen, and Koens-Crispin among them. While many researchers, including Dent, view these as regionalized variations, they all appear to be derived from the original Savannah River tradition in the southeast. Recognition of this derivation is not new. Coe (1964) noted the morphological parallels between the Savannah River point and the Koens-Crispin type (in New Jersey), as well as similar forms such as Appalachian or Benton (in Tennessee). Morphological similarities and intergrades between the forms of Koens-Crispin, Lehigh, Snook Kill and other varieties in the northeast are also clearly evident (Kinsey 1972). In New York, Ritchie proposed what he termed a genetic connection between the Poplar Island type and the Savannah River tradition to the south (Ritchie 1971). In essence, the archaeological record of the eastern U.S., from Georgia to New York, and west to the Appalachians and beyond, reflects the manufacture and use of large, broad-bladed and stemmed bifaces of very similar form, spreading from south to north with distinctive and apparently localized forms developing. A range of early radiocarbon dates compiled by Dent (1995) supports this contention, with early dates from locales in the southeast and later dates

through the Middle Atlantic and into the northeast. Mouer (1990) suggested a form of adaptive radiation as the model by which this cultural change spread in the Late Archaic. Stated simply, this model presents Savannah River material culture and settlement proliferating by way of a focused orientation toward newly developing estuarine/riverine environments. In fact, the expansion appears to have been less an adaptation to altered environmental conditions (as an evolutionary model such as adaptive radiation supposes), and more a spread of socio-cultural processes into new geographic areas; less a reaction to environmental change and more an active appropriation, to borrow Dent's term, of new resource opportunities.

The uniformity seen in material culture in the Late Archaic led Dent to argue that population movement was the basic force behind the change. Questions about migration versus diffusion aside, the archaeological record does suggest that a general set of cultural traits was introduced consistently over a wide-ranging area. As noted, some regional differences are observed with broad-bladed points such as Perkiomen, Susquehanna, Koens-Crispin being well-documented in parts of the Middle Atlantic. Further, variation has been recorded in terms of the raw materials used in point manufacture: quartzite is often associated with Savannah River; jasper with Perkiomen and Lehigh; argillite with Koens-Crispin; rhyolite with Susquehanna (Whitthoft 1953; Kinsey 1959; Ritchie 1971). Yet the point types are considered ordinary or expected variations on the original broad-bladed design, and material variation as having been related to resource availability, with the general suggestion being that people made use of what was commonly available. The underlying theme across the region is seen as uniformity, not variation.

Given the regional variations observed in the broad-blade point styles of the period, the points recovered from the Black Diamond site have not been forced into a particular type. Rather, the points have been characterized by general morphological style and apparent raw material preference, both attributes being viewed as temporally diagnostic to some extent. The points do not, in fact, neatly fall into established point types, yet their relatively large size in comparison with points made from local jasper or chert pebbles, the orientation to quartzite, and general manufacturing characteristics link them to the greater Savannah River-related traditions. In blade and stem outline the point form is seen as related to, or an outgrowth of, the Savannah River tradition, and thus the points are considered a regional expression of a broadly occurring derivative form.

Late Archaic Quartzite Utilization

An apparent preference for quartzite or other hard or coarse-grained stone during the Late Archaic period has long been documented across a broad region of the eastern U.S. including the Middle Atlantic (Kinsey 1972; McLearen 1991; Dent 1995; Wall 1996). Lithic use and preference varied by region, apparently on the basis of availability rather than selection of a particular material type regardless of quality (Kent 1970; Kinsey 1977; Witthoft 1953).

While quartzite was used in biface tool manufacture for much of Middle Atlantic prehistory, deliberate selection and focused use of the material is a characteristic of many Late Archaic traditions. Regionally, an orientation to quartzite is clearly demonstrated for the Late Archaic broad-bladed point tradition in general and for Savannah River points in particular

(Custer 1996; Dent 1995). This focus on quartzite is seen not only in the occurrence of points, but also in the incidence of quartzite quarry-related sites dated to the period. In the Middle Atlantic, such quarry sites are known in diverse settings including the Piedmont sections of the Potomac Valley (Daugherty et al. 1989); the Welsh Mountains of the southeastern Pennsylvania Piedmont (Custer 1992); the James River Coastal Plain (Mouer and McLearen 1989); and the Blue Ridge of Southwest Virginia (Barber 1984, 1986).

Custer (1992) documented a Late Archaic quartzite industry at the Long site (36LE4), in Lancaster County, southeastern Pennsylvania, which he described as a quartzite reduction station situated adjacent to a raw material source. He further documented a series of quarry-related sites associated with Hardyston Formation quartzite outcrops in the same region, suggesting that the first widespread use of the material occurred in the Late Archaic. Farther west, the close relationship between quartzite—usually occurring in the form of river-borne cobbles—and the Savannah River tradition has been noted on both the Coastal Plain and across the Piedmont of the western Chesapeake Bay watershed (McLearen 1991). On Chesapeake Bay tributaries from the upper the Potomac near Washington, D.C., southward to the James River, quartzite cobbles are common in stream beds and bank cuts, and specialized quarry sites have been documented. One of the first archaeological sites systematically excavated in the U.S. was the Piney Branch quarry (51NW004), in the Rock Creek Park section of Washington, D.C. Investigated by William Henry Holmes at the end of the nineteenth century (Holmes 1890, 1897; Munford 1982), quartzite cobbles are exposed in several areas along ancient fluvial terraces. Nearby sites in Washington with substantial concentrations of quartzite knapping debris from the Late Archaic period related to the Rock Creek quarries include 51SE25, at Barney Circle, along the Anacostia River (Artemel et al. 1989; Bromberg et al. 1900); and 51NW103, at the Whitehurst Freeway (Knepper et al. 2006). North and westward, in the Piedmont section of the Potomac Valley, regional quartzite extraction and distribution activity in the Late Archaic period has been documented at a variety of sites (Rust 1983, 1986; Daugherty et al. 1989; Petraglia 1994).

7.5.2 The Black Diamond Site in Archaeological Context

Two themes are central to discussion of the archaeological context of the Black Diamond site findings: 1) how people used the Delmarva uplands during Late Archaic—where they lived and how they used and shaped the landscape; and 2) more specifically, how people selected and used stone for tool making during the period.

Late Archaic Upland Settlement and the Use of Bay/Basins in the Delmarva Region

The number of upland Late Archaic archaeological site locations excavated in Delmarva is relatively limited. This situation may be due at least in part to upland settings having received little research attention on the past. The majority of the major archaeological investigations in Delaware have been at sites located in fluvial/estuarine settings, including SR1-related excavations such as the Snapp site (Custer and Silber 1995); Liepsic (Custer et al. 1996); Pollack (Custer et al. 1995a); and Carey Farm and Island Field (Custer et al. 1995b); as well as investigations at Hickory Bluff (Petraglia et al. 2002); and Puncheon Run (LeeDecker et al. 2005). In contrast, intensive settlement of interior streams and freshwater water wetlands located near the Fall Line is well documented in the northern part of New

Castle County (Thomas 1981; Custer 1989, 1994; Petraglia et al. 1998; Jacoby et al. 2001; Wall et al. 2001).

However, use of bay/basins and interior streams is increasingly being viewed as an important part of the overall prehistoric settlement of the region. During the early planning and survey efforts related to the SR1 project, Custer and Bachman (1986a, 1986b) recognized bay/basins as having played a significant role in prehistoric settlement in parts of Delmarva, with settlement beginning about 8500 years BP and intensifying between 4500 and 2000 years BP. The initial SR1 corridor surveys in New Castle County identified 86 sites associated with bay/basin settings. While the study relied on Phase I survey-level information alone, the large dataset that was generated indicated that settlement and use of bay/basins in the area was extensive (Custer and Bachman 1986b).

Prehistoric use of bay/basins has also been documented in southern New Jersey, by Bonfiglio and Cresson (1981). Extensive archaeological work has been conducted in the region around bay/basin-like landscape features, referred to locally as closed circular wetlands. Cresson (personal communication 2001) notes that in Burlington County, there is a strong pattern of Late Archaic/Early Woodland use of these landscape features. Early and Middle Archaic remains often occur in lower levels buried under aeolian deposition, while use of the settings falls off dramatically following the Early Woodland.

In the Southeast Atlantic Coastal Plain, use of bay/basin settings is increasingly being recognized as having played an important role in the American Indian settlement of upland areas (Sassaman 1996; Brooks et al. 1996). Some of the most detailed information on the prehistoric use of bay/basins comes from studies the upper Coastal Plain of South Carolina, where the features are also known as Carolina bays. Studies have indicated that the greatest use of the locations ranged from the Early Archaic to the Late Archaic (9500-4000 years BP) and declining thereafter (Brooks et al. 1996). Research suggested that among other factors, the emergence of modern floodplain conditions on nearby rivers and tributaries in the Late Archaic may have shifted occupation emphasis away from upland locations. Recent archaeological investigations at the Frederick Lodge site provided evidence of a similar pattern. Early Archaic site use was clearly evident, but Late Archaic use was limited a short-term encampment characterized by a small hearth and lithic debris from associated activity areas (Versar 2011a).

Additional information on prehistoric settlement around Delaware bay/basins comes from the extensive collections of Joe Hughes, in Kent County. The collections, inspected by the authors, contain large numbers of Early Archaic points as well as numerous broad-bladed varieties that, while more limited in number, do imply Late Archaic occupation of the areas. These finds were made mostly along bay/basins on Hughes' property located inland, along the Mid-Peninsula Drainage divide near the headwaters of the Murderkill and Choptank rivers. Further south on the peninsula, interior bay/basin settings in Somerset County, Maryland, are known to have seen extensive use throughout much of prehistory, including the Late Archaic period (Darrin Lowery, personal communication 2001). On the southern end of the Delmarva Peninsula, a marked concentration of large bay/basin features is present

along the Virginia Eastern Shore, although few, if any of these locations have been archaeologically investigated, even at a cursory survey level.

Late Archaic Lithic Material Use in Delmarva

The record of lithic material use during the Late Archaic in Delmarva is less clear than in other parts of the Middle Atlantic, possibly due to the peninsula's geographic location on the Coastal Plain where sources of lithic material are inconsistently distributed. Quartzite use was frequent, yet with a few exceptions, examples of focused use of the material are not common in the Delmarva archaeological record. The Whitby Branch site (7NC-G-151), on an upland tributary of the Appoqunimink River approximately 8.5 km north of Black Diamond, was classed as a cobble quarry associated with Pleistocene cobble beds exposed in an adjacent scarp (Jacoby et al. 2001). Commonly occurring stone from the beds, such as quartz, jasper and chert, was used for tool manufacture, with quartzite important in Late Archaic contexts. At Mitchell Farm (7NC-A-2), a Late Archaic quartzite industry was recorded in a series of broad-bladed forms (Savannah River-related) and narrow-bladed forms (Bare Island/Lackawaxen). The raw material was reportedly brought to the site from outcrops in the Pennsylvania Piedmont as much as 30 km to the north (Custer 1989, 1992).

At other locales, different types of coarse-grained stone were the focus of tool manufacture and use. At the Herring Island site (18CE146) to the northwest in Cecil County, Maryland, a dense, quartzite-like ferruginous sandstone referred to locally as ironstone was quarried from outcrops and fashioned into broad-bladed points (Ward 1984, 1985). Approximately 20 km to the northeast, the Wrangle Hill site (7NC-G-105), near Dragon Run north of the Chesapeake and Delaware Canal, reportedly contained a Late Archaic ironstone workshop, although broad-bladed points were not recovered in the assemblage (Custer et al. 1995c). Argillite was also commonly used in Delmarva during the period. The material does not occur widely on the Delmarva Peninsula, particularly in fragments large enough for bifacial blanks, but has been reported in caches at sites such as Crane Hook (7NC-E-18) and Naaman's Creek (7NC-C-2) (Weslager 1968), and other unspecified sites in central Kent County and central Delaware (Custer 1989). Argillite artifacts have been proposed as part of socio-cultural composites such as Custer's Barker's Landing or Clyde Farm complexes that included the use of steatite and ceramics in rigid container technology, other non-local stone such as rhyolite, and large site aggregates (Custer 1989, 1994). Caching suggests a type of planned activity very different from the opportunistic use of easily available stone that appears to have characterized the Late Archaic. Evidence of the practice implies, of course, that the situation was more complex than a mere switch in focus from specific to expedient procurement.

In summary, a number of researchers, including Custer (1992) and Dent (1995), follow earlier research (Kent 1970; Kinsey 1977; Witthoft 1953) to describe the use of quartzite and other coarse-grained stone types as a change from a concern with knapping quality to one of availability—the use of the most commonly available material. The impulse behind this activity may actually have been that stone represented a secondary need. That is, while collecting stone for tool making may have been an important element in subsistence systems, it may not have been a principal factor (see Gould and Saggers [1985] for a discussion of several views on the place of lithic procurement in the organization of subsistence activities).

As researchers, we have a tendency to see lithics as a central component of prehistoric technology in part because of the archaeological visibility of stone artifacts. Lithic debris makes up a large proportion of the archaeological record, and it can be difficult to not assume its importance to the people who left that record. Yet, the durability of the material is in large part why so much is recovered from an archaeological site. It is likely that stone tools may not have been as critical a focus as we tend to suppose. While generally not as long-lasting, other materials can do most of the tasks required of stone tools and generally take less time and effort to acquire or make. Although difficult to estimate from archaeological contexts, the proportion of the tool kit represented by stone implements has been estimated range from less than 5 percent to 15 percent (Adovasio et al. 2001; Andrews and Adovasio 1996; Clarke 1968; Collins 1993; Drooker n.d.). In Swanton's (1946) survey of ethnohistorical accounts of Native Americans in the southeast following the period of European Contact, over 300 pages are devoted to descriptions of material culture, while only eight pages deal specifically with the stone tools that were observed. Descriptions of projectiles, for example, typically note the use of organic material for points: "They made the heads for them [spears] of deer horn…or harpoons of palm or other wood that they have" (Garcilaso 1723, in Swanton 1946:584); or "Their arrowes are made, some of straight young sprigs, which they head with bone some 2 or 3 inches long" (Smith 1907, in Swanton 1946:572).

Given this apparent emphasis on a wide range of materials for tool making, finding and obtaining stone may not have been a particularly important concern in many societies. As the type and availability of food resources changed in the early portions of the Late Archaic—as resources became more predictable, consistent, and abundant—people traveled less across the landscape to fulfill their needs. Consequently they appear to have simply used the most appropriate stone found in their region rather than obtaining specific types of material during far-reaching resource rounds. As part of the new subsistence technologies introduced in the Late Archaic, people made and used broad-bladed tools, and they needed large pieces of stone to manufacture these items. In the middle Delaware Valley in New Jersey, and portions southeastern Pennsylvania, argillite appears to have been the most readily available and appropriate material (Kinsey 1975; Lothrop and Koldehof 1994; Wall et al. 1996). Elsewhere, quartzite cobbles provided a readily accessible source of material. That a less clear preference is evident on the Coastal Plain of areas like Delmarva may reflect a more sporadic distribution of stone in large clasts within the region. Whether the impetus was solely technological or whether there was a socio-cultural or religious aspect to the selection of locally available, coarse-grained stone is unclear. If Gould and Saggers (1985) are given credence, any non-technological impetus will remain unclear, since they argue that detecting such motivations archaeologically is difficult (see also Anschuetz et al. 2001).

7.5.3 Black Diamond Site in a Regional Cultural Context

Over the past few decades, archaeological research in the Middle Atlantic has followed general research trends oriented toward studies of process and systematics, developing theories about the way in which the environment conditions or determines socio-cultural structures. Accordingly, the role of environmental adaptation was stressed as an important theme in settlement models in Delaware. Griffith (1974), Thomas et al. (1975), and Custer (1989, 1994) proposed various settlement models that emphasized the movement of people

between the different environmental zones that occur close together on the Delaware Coastal Plain. These zones roughly correspond to: 1) bayshore/tidal marshlands; 2) the mid-drainage zones of larger streams and rivers; 3) interior swamps and poorly drained woodlands; and 4) well-drained woodlands. Thomas et al. (1975) proposed five alternate settlement scenarios in which base camps and smaller camps were occupied in various permutations of setting and season. The delineation of these ecological zones was intended to provide a physiographic context for the reconstruction of local and regional prehistoric settlement/subsistence systems. Being based on essentially modern conditions, the interpretation was applicable only to environmental settings similar to those today. Custer (1989) reiterated a three-tiered settlement system composed of macro-band base camps, micro-band base camps, and procurement sites, with sites predicted to occur in different combinations within various regions of the state. This model was predicated on a group fission/fusion cycle and as such, differed only slightly from those proposed for the Chesapeake basin by Gardner (1982), Mouer (1990), and others. Custer (1994) eventually questioned the validity of the macro-band camp concept. As an alternative, he proposed that the larger sites represented the remains of extended-period camps occupied by limited numbers of individuals—perhaps as small as a single family unit—and that these sites may have been the primary type of settlement. In this model, sites that had been construed as base camps, primarily due to their size and the amount of archaeological material they contained, were interpreted as intensively reoccupied sites.

More recent research has suggested that models other than environmental adaptation may be more appropriate ways to describe how people lived in places like the Black Diamond site. The preceding approaches generally assumed that prehistoric settlement occurred in a cultural vacuum, with the driving mechanism being the optimum utilization of seasonal resources offered by the various physical locations. The models fail to take into account the full range of cultural variables that may have been active, from economics to ritual, politics, migration, territoriality, group competition, and individual choice. Other interpretive concepts, such as models of landscape archaeology, heterarchy, or materiality, may be more suited to portraying the lives of people living at the site. Such a theoretical perspective could, for example, imply replacing strict adherence to a hierarchical base-camp/support-camp or micro-band/macro-band model with a heterarchically oriented model that embraces settlements that were simultaneously independent and interdependent in a relationship that varied with the specific conditions present during the occupations, whether environmental, seasonal, social, political, ceremonial, or some combination of factors

And indeed, certain aspects of the occupations at the Black Diamond site do not readily conform to models of settlement in Delmarva during the Late Archaic period. People appeared to have lived at this small upland site over an extended span of time, while accepted models of upland settlement in the region suggest that such locations were typically procurement locales populated on a short-term basis and focused on extraction of a specific resource. Evidence of prolonged occupation at the Black Diamond site was seen in the presence of features that appeared to have been storage pits and scatters of apparent domestic debris that included a variety of artifact types beyond tool manufacturing waste.

The idea of persistent places, locations repeatedly visited over a span of time, may also be relevant to describing the occupations at the Black Diamond site. Often referring to recurrent use during long-term occupation of a region (following Schlanger 1992), persistence in this context can be similarly viewed as a short-term description of people returning to a specific landform (Dooley 2008). A particular site may have been associated with favorable habitation factors such as high ground, good soil drainage, or prevailing wind direction, or there may have been social or ceremonial factors involved in the selection of the locations (Tooker 1979; Carmichael et al. 1994; Waldren et al. 1995). But in returning repeatedly, the people inhabiting the site would have remade the landscape, not only by leaving visible, reusable material or features (Camilli and Ebert 1992; Wandsnider 1992), but by changing their own perception of it in an almost symbolic manner. Thus, repeated use of the ridge at the Black Diamond site may have created a locale that was different than when it was originally encountered. The wooded ridge became the ridge inhabited by the individuals who lived and worked there repeatedly; the landscape would have been transformed by human action and thereby "imbued" with cultural meaning (Yesner 2008:49).

Landscape Analysis: Viewshed

One definition of a cultural landscape holds that it is "the world…as understood, experienced, and engaged with through human consciousness and active involvement" (Bender 2006:303). In the present investigation, a GIS-based viewshed analysis helped to provide some insight into that experience by examining the visual perspective the Native Americans inhabiting the site—their view of the landscape, whether in the form of wide vistas, lines of sight to particular geographic features, or obstructed views for defensive purposes, any of which may have been factors in choosing the location.

The Black Diamond site was located on the northeast side of the bay/basin feature. The viewshed analysis indicated that the southern half of the potential field of view was for the most part blocked beyond a distance of 150-200 meters, while the view was generally unobstructed by landforms to the north, west, and east (Figure 7-26). In seeming contrast, a separate GIS analysis depicted the site's aspect (the slope orientation or direction) as south. Similarly, a detailed contour map showed the site to lie just below the crest of a knoll above the bay/basin, the ground generally sloping to the west (Figure 7-27).

Whether any of the areas indicated by the analyses would actually have been visible when the sites were occupied would have depended largely on whether blocking tree cover or understory vegetation may have been present. Paleoenvironmental studies have suggested that parts of the area may have had limited vegetation for periods of time (Curry 1992; Custer 1999; Webb et al. 1994). However, the precise timing of these events in relation to the occupation at the Black Diamond site is unclear, and so the degree to which the surrounding landscape would have been clear or treeless is not certain.

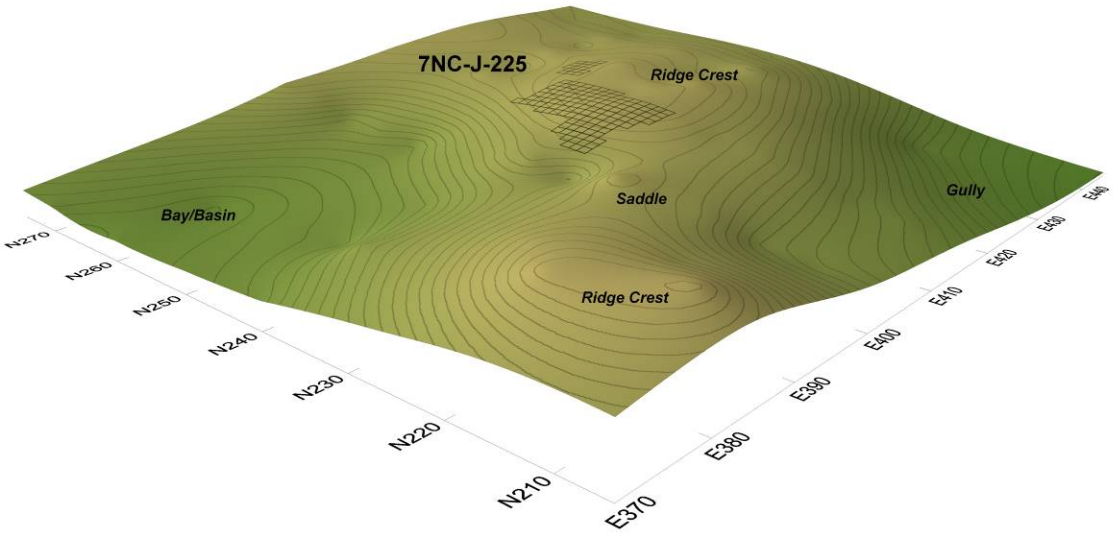

Figure 7-27. The Black Diamond Site and High Resolution Elevation Contours.
(showing the occupation just off the crest on the side slope of the bay/basin rim)

A further implication of the viewshed study was that the site would not necessarily have been sheltered from northerly weather. The viewshed analysis compares elevations between points, assessing visibility in terms of slope and relative elevation. Broad areas of visibility to the north would imply open ground and, consequently, lack of effective shelter from winds in that quarter. Yet, the map of local topography (Figure 7-27) suggested that the viewshed analysis may not have captured sufficient detail to make this distinction, since the site does appear to be on the west side of the ridge and thus may have been somewhat sheltered.

In the end, the direct view from or toward the site did not appear to have been a major factor in the choices made by the people who occupied the ridge at Black Diamond. Although there may have been non-utilitarian reasons for targeting this specific location, the naturally occurring resource base occurring at the margins of the wetlands was clearly a major factor motivating the people to settle on the ridge. The desire for views of the surrounding landscape or shelter from view did not appear to have been important criteria influencing the selection of the location.

An Alternate View of the Late Archaic Cultural Landscape

At the Black Diamond site, a different, culturally-based settlement scenario has been proposed as alternative interpretation of settlement. This interpretation portrays the Black Diamond site in terms of an intrusive site component. In such a reading of the data, the people occupying the site would have been a group that was culturally distinct from the people of the surrounding area. The group would have, either by necessity or by choice, maintained themselves in this interior location, physically removed from the settlements of a locally dominant cultural group. The occupation is deemed intrusive because it represented the physical arrival of different people into the area. The presumed impetus for the migration would have been population pressure, resource competition and/or group conflict within the immigrant group's original range.

The Late Archaic clearly represented a time of change over the preceding millennia, with key trends recognized during the period including increased sedentism, population growth, and an orientation to the new and ecologically productive but geographically limited estuarine/floodplain environments. These trends are clearly interrelated and likely operated in a positive feedback cycle. An eventual outcome of such a cycle may have been population pressure and competition for prime resources, causing tension throughout the region. Group movement and migration would be natural and ongoing responses to these stresses.

Movement of Native American groups as a response to cultural or environmental stress is hardly without precedent. Nowhere in North America was this more prevalent than in the Plains area, where population movement spurred in large part by European encroachment from the east was ongoing long before the Spanish introduction of the horse. A significant research domain in the archaeological study of the Plains regions is the reconstruction these migrations (Schlesier 1994). Group migrations also played a role in shaping the archaeological record of the Late Woodland in the Middle Atlantic region. The most studied and well-known archaeological manifestation is the Potomac Creek site (44ST2). This site has been the focus of numerous researchers over the years including Dale Stewart (1939, 1940, 1992), Karl Schmitt (1965), and most recently the William and Mary Center for Archaeological Research (Blanton et al. 1999). The settlement of the site, and the wider occurrence of Potomac Creek wares without a local antecedent in the Coastal Plain of Maryland and Virginia, is widely assumed to represent the migration of people from outside the area. The culturally intrusive nature of the main Potomac Creek site settlement was underscored by the defensive posture of the site location, and the extensive fortifications constructed to protect it (Blanton et al. 1999).

The concept of a Late Archaic cultural landscape characterized by group movement, competition, and possibly conflict, has been articulated by other researchers. Notably, Dent (1995) proposed that people we recognize archaeologically by their broad-bladed point technology expanded into the ranges of contemporary groups using narrow-blade technologies, perhaps with the new arrivals forcing the other groups to occupy less productive locations. He further asserted that co-existence and even interdependence may have eventually arisen between the two groups and that analogous trends are documented in a broad range of archaeological and ethnographic literature. In this perspective, for instance, a yellow jasper Perkiomen point and a Susquehanna point manufactured on purple rhyolite, reported by Egghart (1991) on a minor, interior streamside site near Cumberland Gap, Tennessee, could be interpreted as evidence for the long distance migration of people from core population areas. The geographically isolated Perkiomen components reported by Painter (1988) along the western margins of the Great Dismal Swamp could be similarly viewed. It has further been conjectured that ongoing cultural stresses may have lead to increased socio-cultural regionalization, expressed by the development of point forms such as Perkiomen, Susquehanna, and Poplar Island/Lackawaxen, as morphological traditions that exhibit both particular geographic centers and specific lithic material orientations. Dent (1995) views these forms as regional developments out of the original Savannah River broad-bladed form, yet the broader archaeological occurrence of the forms may represent the out-migration of specific groups from core areas.