APPENDIX E:

LITHIC RAW MATERIAL STUDY

SANDOM BRANCH – BLACKBIRD CREEK RAW MATERIAL STUDY

As part of the data recovery investigations within the Smyrna to Pine Tree Corners segment of the State Route 1 (SR1) right-of-way, a study of locally available lithic resources was implemented. This study followed methodologies established by James T. Marine during the Hickory Bluff Raw Material Study conducted as part of data recovery investigations at the Hickory Bluff site (Petraglia et al. 2002). Similar to the Hickory Bluff Raw Material Study, sampling for this study was focused on the Pleistocene deposited pebbles and cobbles of the Columbia Formation. The previous study showed empirically that the Columbia Formation does contain materials of sufficient size and lithology for use in stone tool manufacture.

These studies were initiated to systematically analyze the lithologic and size characteristics of locally available raw materials. Thus, a descriptive framework is provided for the comparison of the recovered lithic artifact assemblages to the locally available raw materials allowing for interpretations of prehistoric lithic resource procurement.

Sample Methodology

Samples for this study were collected from exposed pre-Holocene Columbia Formation deposits within the Sandom Branch and Blackbird Creek watersheds, as well as from deposits exposed during data recovery excavations. Initially, a total of 22 standardized 18.9-liter (five-gallon) samples were collected for this study. However, due to time constraints and similarity of sample settings, the global sample was reduced to 13 samples, which were subjected to further analysis. They included six samples collected from within or near the stream channel of Sandom Branch and its tributary, two collected from within excavation blocks at 7NC-J-227 and 7NC-J-228, four samples collected from erosional gullies leading to Blackbird Creek on the northern edge of the Blackbird Creek site (7NC-J-195D), and one from the base of an excavated test unit. Figure E-1 shows the sample locations and Table E-1 lists sample provenience.

Table E-1. Sample Provenience for Sandom Branch (S) and Blackbird Creek (B)

Sample #	Easting*	Northing*	Elev. (amsl)	Geologic Setting
S2	445 (grid)	227 (grid)	9.4m	Erosional Terrace
S4	443489	4357509	7.3m	Stream Bed
S5	443467	4357529	6.7m	Stream Bed
S6	443463	4357519	6.7m	Stream Bed
S9	443467	4357602	6.0m	Stream Bed
S10	443491	4357481	7.6m	Stream Bed
S11	468 (grid)	67 (grid)	9.3m	Accretional Terrace
S14	443523	4357426	9.1m	Stream Bed
B1	443259	4358440	7.6m	Erosional Gully / Alluvial Fan
B2	443267	4358438	7.9m	Erosional Gully / Alluvial Fan
B4	443288	4358414	10.0m	Erosional Gully
B6	385 (grid)	240 (grid)	12.4m	Erosional Terrace
B7	443308	4358496	6.0m	Erosional Gully / Alluvial Fan

*UTM unless otherwise indicated

Figure E-1. Gravel Sample Locations, Clayton 7.5' USGS Quadrangle

Sample Attributes

Once collected, the percent by weight composition for each particle size within each sample was determined using the Wentworth scale. The Wentworth particle size scale classifies rock fragments based on the diameter of their long axis:

1/16 – 2 mm	sand
2 – 4 mm	granule
4 – 64 mm	pebble
64 – 256 mm	cobble
>256 mm	boulder

Since it was the goal of these studies to analyze raw materials suitable for the production of stone tools, sample particles less than 6 mm were combined into one category. A total weight was obtained for each sample, which was then screened through 6 mm (1/4 inch) mesh hardware cloth. The greater than 6 mm fraction of the sample was weighed and the difference recorded. The remainder of the sample was separated according to size category. Also, an arbitrary lower size limit of 30 mm was set for stones considered as candidates for lithic reduction (herein referred to as usable gravels). Gravels measuring less than 30 mm in

length were included in the percent by weight and discarded, whereas gravels 30 mm and greater were retained for further analysis. Table E-2 lists the percent by weight composition of each particle size by sample.

Table E-2. Percent Weight by Gravel Size, Sandom Branch (S) and Blackbird Creek (B)

Sample #	Total Weight (kg)	Percent Weight / Size (mm)			Percent Usable Gravels
		<6	6-64	64-256	>30mm
S2	33.3	80%	20%	--	2%
S4	38.9	36%	64%	--	7%
S5	37.6	36%	60%	4%	24%
S6	38.0	24%	60%	16%	49%
S9	35.3	40%	58%	2%	21%
S10	38.5	42%	58%	--	12%
S11	29.4	91%	7%	2%	2%
S14	38.5	34%	60%	6%	22%
B1	34.8	30%	47%	23%	47%
B2	35.7	51%	38%	11%	32%
B4	38.5	55%	32%	14%	31%
B6	33.0	80%	14%	5%	11%
B7	32.6	43%	33%	24%	41%

Overall, the collected samples trend toward the smaller size categories. Samples S2, S11, and B6, collected within excavation units on the upper stream terraces, consisted almost entirely of gravels less than 6 mm reflecting differing depositional processes between the active stream channel and terrace. In contrast, those samples from within the streambed consisted of between 58 and 64 percent pebbles (6-64 mm), although varying in the amount of usable gravels from 7 to 49 percent. The samples from the gullies above Blackbird Creek contained a higher frequency of cobbles (64-256 mm) and generally more usable gravels than either of the other two settings. There were no boulder sized (>256 mm) stones within any of the samples and cobbles were relatively scarce accounting for only 4 and 15 percent of the usable gravels from Sandom Branch and Blackbird Creek, respectively.

The frequency of lithic material type was determined, for each sample. The majority of the global sample (63 percent) was composed of quartz followed by quartzite at 20 percent. Also present were jasper (9 percent), sandstone (4 percent), chert (3 percent), and less than 1 percent of conglomerate, diabase, siltstone, limestone, and ironstone (Figure E-2). Tables E-3 and E-4 show the variation in the lithic materials within each individual sample. The atypical lithic frequencies of Samples S2 and S11, collected from within excavation blocks, is a likely result of small sample sizes rather than a difference in lithology between depositional settings.

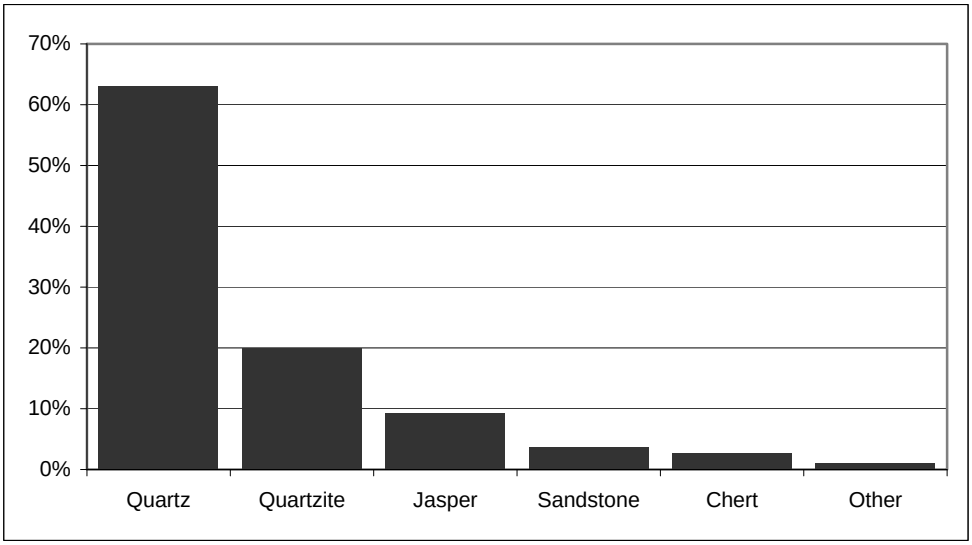

Figure E-2. Raw Material Frequency within the Global Sample

Table E-3. Lithic Material Frequency by Sample, Sandom Branch

Material	S2 (n=15)	S4 (n=87)	S5 (n=241)	S6 (n=404)	S9 (n=172)	S10 (n=142)	S11 (n=7)	S14 (n=159)
chert	--	2%	5%	2%	1%	6%	--	3%
conglomerate	7%	1%	--	--	--	--	--	2%
diabase	--	--	--	--	--	--	--	1%
ironstone	--	--	--	--	1%	--	--	--
jasper	13%	13%	10%	8%	10%	10%	--	13%
limestone	--	--	--	--	--	--	--	--
quartz	47%	59%	57%	72%	66%	64%	43%	68%
quartzite	27%	23%	24%	16%	20%	17%	29%	13%
sandstone	--	1%	2%	1%	2%	2%	29%	1%
siltstone	--	--	--	--	--	1%	--	--
unidentified	7%	1%	--	--	--	--	--	--

Table E-4. Lithic Material Frequency by Sample, Blackbird Creek

Material	B1 (n=177)	B2 (n=155)	B4 (n=173)	B6 (n=53)	B7 (n=134)
chert	2%	5%	2%	2%	1%
ironstone	--	--	2%	--	--
jasper	4%	12%	6%	11%	10%
limestone	--	--	1%	--	--
quartz	56%	52%	60%	68%	66%
quartzite	30%	21%	24%	13%	16%
sandstone	7%	10%	6%	6%	7%

The range of usable pebbles and cobbles within the global sample was between 30 and 160 mm. With the aid of the database it was possible to further break down the gravel sizes in successive 5 mm intervals (Tables E-5 and E-6). The tables show that gravels between 35 and 40 mm were the most frequent within both the Sandom Branch and Blackbird Creek samples. This figure also indicates that pebbles (<64 mm) were the most frequently

occurring size category within the global sample. Over 95 percent of the usable sample was composed of pebbles between 30 and 64 mm. The Blackbird Creek samples had higher mean length and mean weight indicating the higher frequency of cobble-sized stones (Table E-7).

Table E-5. Frequency Distribution by Size Interval and Lithic Material, Sandom Branch

Interval in mm	Total Count	Total Frequency	Chert	Jasper	Quartz	Quartzite	Sandstone	Other
<30	--	--	--	--	--	--	--	--
30-35	170	14%	8	21	119	20	1	1
35-40	394	32%	15	46	273	53	4	3
40-45	260	21%	7	24	179	39	6	5
45-50	152	12%	2	19	88	36	2	5
50-55	98	8%	5	8	63	21	1	--
55-60	54	4%	--	3	29	20	2	--
60-65	43	4%	1	--	21	19	1	1
65-70	15	1%	--	1	9	4	1	---
70-75	16	1%	--	--	9	7	--	--
75-80	6	>1%	--	--	5	1	--	--
80-85	6	>1%	--	--	2	4	--	--
85-90	5	>1%	--	--	3	2	--	--
90-95	3	>1%	--	--	3	0	--	--
95-100	1	>1%	--	--	--	1	--	--
100-105	1	>1%	--	--	--	1	--	--
105-110	--	--	--	--	--	--	--	--
110-115	2	>1%	--	--	--	1	1	--
115-120	--	--	--	--	--	--	--	--
120-125	1	>1%	--	1	--	--	--	--
Total	1,227		38	123	803	229	19	15
Material Frequency			3%	10%	65%	19%	2%	1%

Tables E-5 and E-6 also list material frequency by size interval. Most of the material frequencies peak within the 35-40 mm with quartzite and sandstone peaking slightly higher or nearly even at 40-45 mm. Quartz, quartzite, and sandstone account for the majority of cobble-sized stones with the bulk of the cryptocrystalline materials (chert and jasper) occurring within the pebble range with the occasional cobble-sized outlier.

Summary

The purpose of this study was to provide a framework for comparison of lithic artifact assemblages recovered from 7NC-J-227 and 7NC-J-228 with locally available lithic raw materials. Analysis of gravels (30 mm or greater in length) systematically collected from various depositional settings within the Sandom Branch and Blackbird Creek watersheds found that the most abundant lithic material was pebble-sized clasts of quartz comprising 60 percent of the global sample. Of the 10 lithic materials identified, only four (quartz, quartzite, jasper, and chert) were present in all 13 samples. The vast majority of the collected gravels were pebble-sized or smaller with a low frequency (>10 percent) of cobble-sized stones.

Table E-6. Frequency Distribution by Size Interval and Lithic Material, Blackbird Creek

Interval in mm	Total Count	Total Frequency	Chert	Jasper	Quartz	Quartzite	Sandstone	Other
30-35	36	5%	--	1	29	4	2	--
35-40	190	27%	2	17	137	24	10	--
40-45	158	23%	5	17	97	26	10	3
45-50	72	10%	1	8	47	11	5	--
50-55	52	8%	2	4	25	15	5	1
55-60	43	6%	2	3	21	12	5	--
60-65	37	5%	--	3	18	14	2	--
65-70	24	3%	--	1	9	12	1	1
70-75	20	3%	1	--	9	8	1	1
75-80	17	2%	2	--	4	10	1	--
80-85	7	1%	--	--	3	2	2	--
85-90	6	1%	--	1	1	3	1	--
90-95	5	1%	--	--	1	4	--	--
95-100	7	1%	--	--	1	5	1	--
100-105	2	>1%	--	--	--	--	2	--
105-110	2	>1%	--	--	--	1	1	--
110-115	3	>1%	1	--	--	1	1	--
115-120	3	>1%	--	--	2	1	--	--
120-125	--	--	--	--	--	--	--	--
125-130	1	>1%	--	--	1	--	--	--
130-135	3	>1%	--	--	--	3	--	--
135-140	--	--	--	--	--	--	--	--
140-145	--	--	--	--	--	--	--	--
145-150	1	>1%	--	--	--	--	1	--
150-155	1	>1%	--	--	1	--	--	--
155-160	1	>1%	--	--	--	--	1	--
160-165	1	>1%	--	--	1	--	--	--
Total	692		16	55	407	156	52	6
Material Frequency			2%	8%	59%	23%	8%	1%

Table E-7. Statistics for Sandom Branch and Blackbird Creek Sample Groups

		Sandom Branch	Blackbird Creek
length (mm)	*mean*	43.4	49.8
	median	40.0	43.0
	standard deviation	10.9	18.4
	range	30-123	31-160
weight (g)	*mean*	41.8	78.4
	median	28.1	36.4
	standard deviation	46.5	136.2
	range	4-506	6-1521
	Total	1,227	692

REFERENCES CITED

Petraglia, M.D., S. Bupp, S.P. Fitzell, and K.W. Cunningham (compilers)
2002 *Hickory Bluff: Changing Perceptions of Delmarva Archaeology*. Draft. Delaware Department of Transportation Archaeology Series, No. 156.