5.0 METHODS

5.1 Archival Research

Archival research, conducted largely in association with the site evaluation study, consisted of a records search, review of historic maps, and regional and local historical background research. Information concerning the historical development of the site vicinity was obtained from land-use planning documents, and deed and tax records at the New Castle County Building, in Wilmington. Acts of the General Assembly, Clerk of the Peace Records, and books, historical maps, photographs, probate records were reviewed at the Public Archives in Dover. Information on the Blackbird Historic District was obtained from the NRHP Nomination form on file with the DESHPO.

5.2 Field Methods

The current archaeological investigations at the Black Diamond site (7NC-J-225) were conducted in two phases consistent with conventional Cultural Resource Management practices in the State of Delaware—site evaluation and data recovery, often referred to respectively as Phase II and Phase III studies. Each phase of the investigations had distinct goals, and field methods varied according to these goals.

5.2.1 Site Evaluation (Phase II)

The purpose of the site evaluation was to determine the significance of the cultural resources discovered at the Black Diamond site as a result of previously conducted archaeological site identification surveys (Bedell and Jacoby 1998; Custer and Bachman 1986). Significance was assessed on the basis of criteria required for nomination of the resource for inclusion in the NRHP, as well as the ability of the site to address specific research questions formulated in existing management plans for the State of Delaware (Custer 1986a, 1994; Custer and De Santis 1986).

Fieldwork was undertaken by the CR Division in June 1999. The initial round of work involved relocation of the site, the refinement of horizontal boundaries, and the identification of areas of artifact concentration within those boundaries.

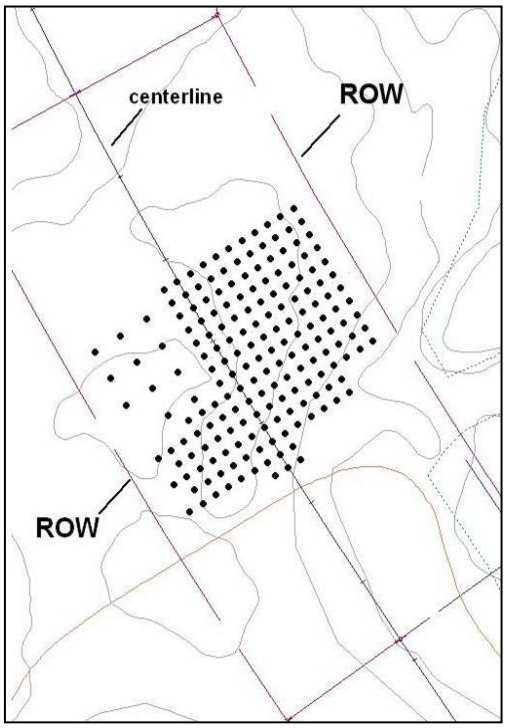

Figure 5-1. Site Evaluation Phase Shovel Test Grid in Relation to Proposed Right-of-Way.

Shovel tests averaging 50 cm in diameter, were excavated on a 5-m grid across the entire site area (Figure 5-1). A transit was used to establish the grid orientation relative to the centerline of the proposed SR1 right-of-way. The same grid was used to place test unit excavations used in the site evaluation as well as those in the subsequent data recovery block excavation. Additional shovel tests were excavated on a 10-m interval on the west side of

the landform on which the site occurred, down slope and within the adjacent bay/basin. In total, 185 shovel tests were excavated in the evaluation phase of the investigation.

All sediments from the shovel tests were screened through quarter-inch-mesh hardware cloth to ensure uniform recovery of cultural materials. To maintain provenience controls, sediments were separated and screened by observed stratigraphic layer. Layers were designated using an alphabetic sequence, beginning with the letter "A" at ground surface and continuing consecutively to the base of the excavation. Profile sections were recorded for each test on standard forms, listing soil consistency, color (using Munsell Soil Color Chart notation, 1990 Edition), and natural and cultural inclusions.

Following the completion of shovel testing, seventeen 1-m^2 test units were excavated on a systematic interval across the center of the site (Figure 5-2, 5-3). Sixteen of the test units were placed on a 4-x-4 grid (10-m interval). An additional test unit was placed along the southeast edge of the landform to investigate an apparent thermally altered stone concentration encountered in a shovel test. In the units, the plow zone soil was removed in a single level, after which excavation proceeded in 10-cm arbitrary levels within natural stratigraphy. As was the case with shovel tests, all excavated sediments were screened through quarter-inch-mesh hardware cloth to ensure uniform recovery of cultural materials. To maintain provenience controls, the sediments were separated and screened by stratum and level. Profile sections were recorded for each test unit on standard forms, listing soil consistency, color (using Munsell Soil Color Chart notation, 1990 Edition), and natural and cultural inclusions. Profile sections were drawn to scale and documented photographically.

5.2.2 Data Recovery (Phase III)

The results of test unit excavation in the site evaluation phase confirmed shovel test data that indicated the presence of an extensive but discrete concentration of quartzite debitage located on the ridge northeast of the bay/basin feature. The Black Diamond site was found to retain sufficient integrity and information potential to meet eligibility Criterion D for listing in the NRHP, and on that basis data recovery excavations were recommended. Field methods for the study were designed to address research topics developed for the site in a Data Recovery Plan submitted to DelDOT and the DESHPO.

In total, 165 meter-square excavation units were excavated during the data recovery investigation. The work was conducted in stages, punctuated by field consultation with representatives from DelDOT and the DESHPO to discuss current results and follow-on work. Placement of the initial set of 22 units was undertaken with a two-fold objective. First, eight units were placed on a 3-to-5-m interval along an east-west transect (N242) extending from the lower portions of the bay/basin slope, across the crest of the ridge, and down its eastern slope (Figure 5-4). A single unit was also placed at the far west end of the transect within the bay/basin proper. The purpose of this transect was to develop a more refined view of artifact distributions both within and outside of the main artifact concentration and to define the stratigraphic contexts across the full extent of the landform on which the site occurred. The remaining 13 units in the initial group were placed in selected locations along the site periphery to investigate artifact finds not tested during the evaluation phase.

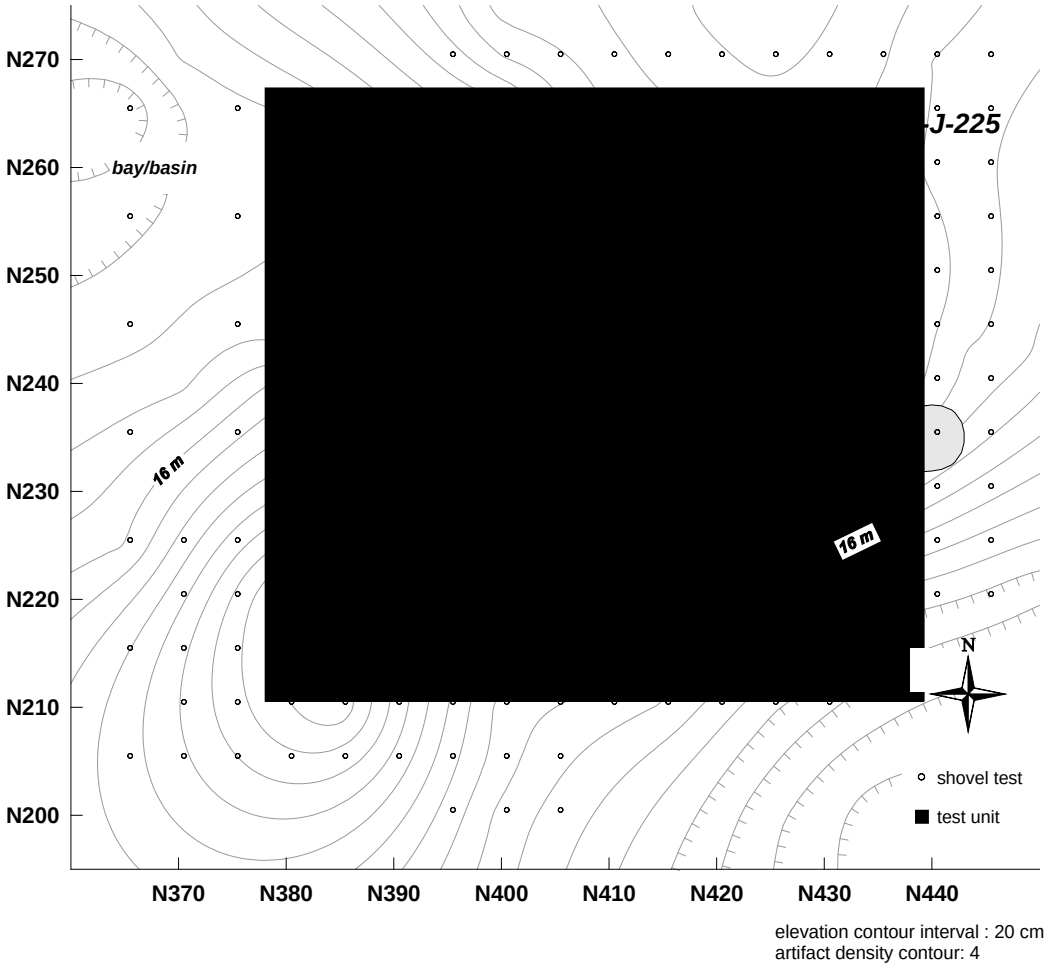

Figure 5-2. Site Evaluation Test Unit Locations in Relation to Artifact Distribution from Shovel Tests.

Figure 5-3. Test Unit Excavation.

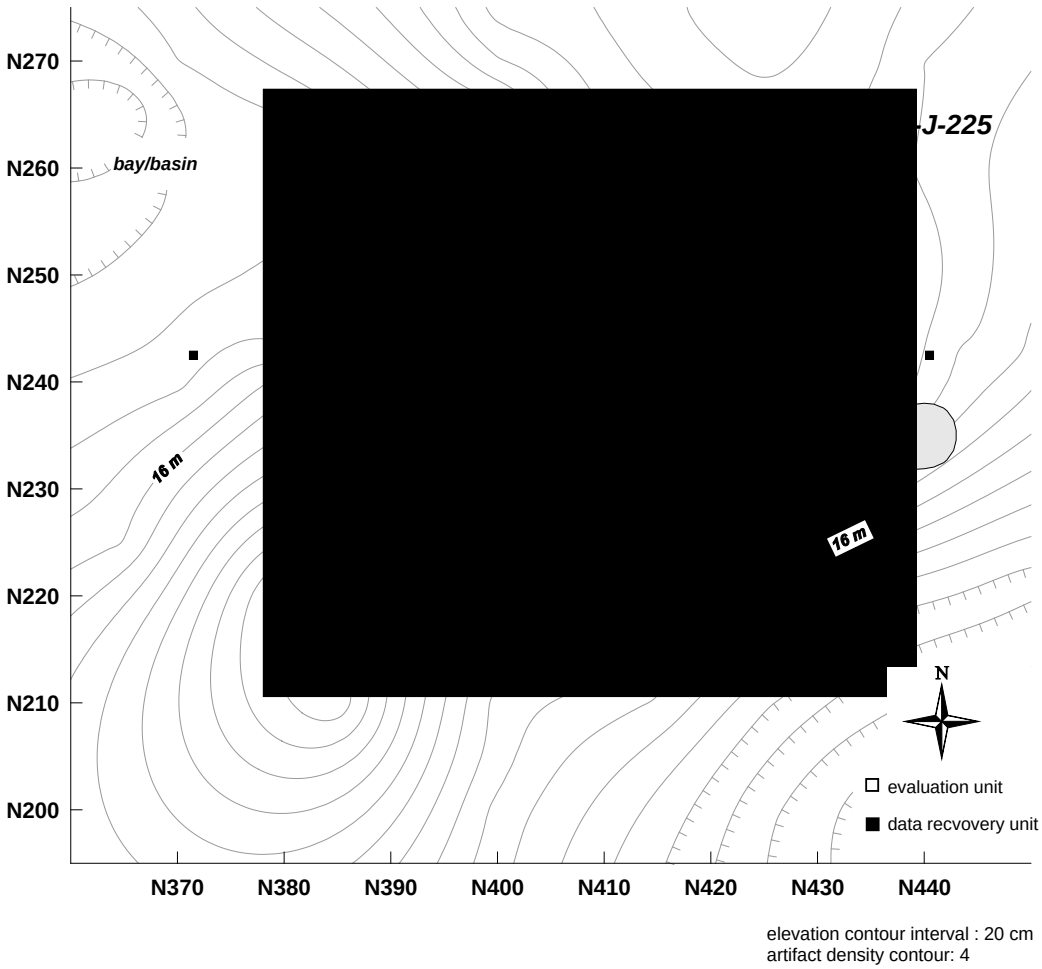

Figure 5-4. Additional Test Unit Locations, Data Recovery Investigation.

The remainder of the data recovery excavations focused on area exposure, with units arranged in two block excavations (Figure 5-5, 5-6). The largest block, containing 130 units (including two evaluation phase units), encompassed much of the core of the site. A second, smaller block of 16 units (including one evaluation phase unit) was excavated to the northwest to investigate a secondary artifact concentration. Features encountered in the excavations were fully exposed in plan, bi-sectioned, and drawn in profile. Recognizable stratigraphy within basin fills was generally absent, and thus excavation was conducted in arbitrary 10-cm levels. While large fragments of charcoal were also generally absent from the fill, small, weathered charcoal fragments were common. Standard 2-liter soil samples were retained from undisturbed basin feature contexts with the aim of recovering datable carbonized material through flotation. Soil samples were likewise retained from in and around select artifact concentrations. For a variety of reasons, pit features at the Black Diamond site were difficult to distinguish from the surrounding soils, and the features were often recognized only in profile.

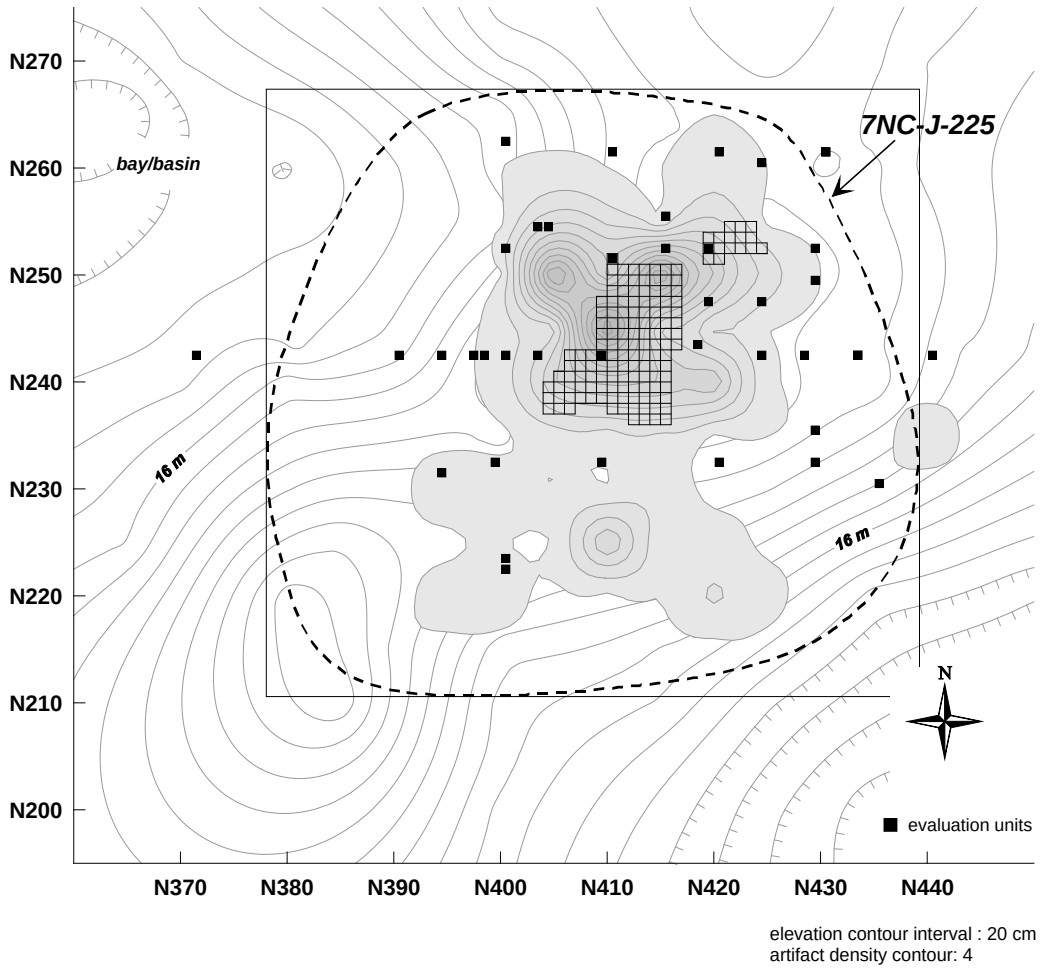

Figure 5-5. Data Recovery Block Excavation Locations.

Diagnostic and other selected artifacts were individually mapped or piece-plotted in three dimensions. As part of a study of the depositional relationships between feature and non-feature contexts, all artifacts within two 1-meter-wide transects were piece-plotted. Features 69 and 71 and Features 46 and 78 were investigated in this manner.

5.3 Laboratory Methods

5.3.1 Field Lab Procedures

Artifacts recovered during both phases of the archaeological investigation were inventoried at the CR Division Field Laboratory in Little Heaven, Delaware. Artifacts were classified by general category (prehistoric, historic) and specific type (biface, debitage, nails, brick), and were then counted by horizontal and vertical provenience. The inventories produced in the Field Laboratory were entered into a preliminary database that was used to generate a series of artifact distribution maps. The distribution maps provided feedback that aided in directing the placement of test units and block excavations throughout the evaluation and data recovery investigations.

Figure 5-6. Data Recovery Block Excavations.

5.3.2 Fairfax Lab Procedures

Comprehensive artifact processing, cataloging, and analysis were performed in the CR Division Laboratory, located in Fairfax, Virginia. Artifacts were processed to the standards of the *Delaware State Museums Sampling and Curation Policy* (DESHPO 1993). Artifacts were cleaned in plain water and bagged by material type in 4-mil polyethylene zip-lock bags. Catalog numbers and provenience information were written in indelible ink on the outside of the bags, and an acid-free tag with the same information was placed within the bags. All developed photographic images were curated in archival slide and print sleeves.

A full artifact inventory was compiled, and included artifacts recovered during the original survey investigations of the Black Diamond site by LBA. In addition to provenience information, coding for database entry included the information listed below:

- *group* – indicating prehistoric or historic period artifact
- *material* – for prehistoric artifacts, raw material type using general mineralogical terms
- *morphological type* – for prehistoric artifacts, generally using technologically derived terms, although some widely accepted functional terms are used
- *typology* – for prehistoric artifacts, conventional morphological types associated with known chronological periods; for historic period artifacts, a subdivision based on manufacturing technology
- *segmen*t – for prehistoric artifacts, indicating completeness or, if incomplete, the section of the artifact represented (proximal, medial, distal)
- *amount of cortex* – for flakes, expressed as a percentage of the dorsal surface
- *color* – recorded for lithic artifacts and relevant historic period artifacts
- *size grade* – measured on debitage as an indication of geometric dimension
- *weight* – for prehistoric artifacts, expressed in grams, reported as an additional indication of artifact size

Sample Curation

In total, 15 charcoal samples were collected at the Black Diamond Site, and it is recommended that they be curated with the artifact collection. The charcoal samples are listed in Table 5-1.

Ten soil samples (nine 2-liter and one 200-gram) were analyzed for ethnobotanical remains and it is recommended that the heavy and light fractions of these floated samples be curated to allow for future study. In addition, 56 soil samples were analyzed as part of a geoarchaeological study. Of the remaining soil samples, it is recommended that a limited number of pint-sized soil samples be retained from the deeper basin features that contained cultural material. These include Features 60 (Bag 5030), 65 (Bag 5026), and 74 (Bag 5043). One non-feature sample (Bag 5005) may also be retained for a control. This would be a total of four curated pint-sized soil samples. The samples have been thoroughly air-dried and are stored in 4-mil polyethylene bags.

Table 5-1. Black Diamond Site Charcoal Samples

North	East	Stratum	Level	Feature	Portion	Bag No.
238	405	I	2	58		5000
239	405	I	1	58		5001
247	414	B	1	0		5008
247	414	B	2	0		5009
247	414	I	1	10		5010
247	415	I	1	10		5012
247	415		0	10		5013
247	415	I	4	10		5014
247	416	I	1	10		5015
247	416	I	3	10		5016
241	415	I	1	63		5032
236	413	I	1	75		5044
238	407	I	1	60	W	5049
246	416	I	1	17		5067
232	399	B	5&6			5069

5.3.3 Analytical Methods

Analytical Methods: Lithic Technology

Given the frequency of occurrence of lithic debris at the site, the artifact analyses were oriented toward describing the technology associated with the production and use of stone tools. Lithic tool manufacture is generally recognized as a process of reduction, in which fragments of stone are systematically reduced in size to produce a desired tool form. The reduction process was first recognized in the archaeological literature in this country by William Henry Holmes, in his pioneering study of quartzite quarries in Washington, D.C. (Holmes 1897). Since then, research has focused on the types and variety of tools produced and, in recent decades, on the debris resulting from the manufacturing process itself. Lithic reduction is often viewed for analytical purposes as a sequenced or staged process, with the end-product being the bifacial tool form. Other tools, such as unifaces and both formal and expedient flake tools, were also produced and are found regularly on prehistoric archaeological sites of all ages. The focus of most analyses, though, is bifacial tools, since they comprise the most complex tool form represented. Recent studies have shifted emphasis from the artifacts to the artisans, focusing on the cognitive processes involved in tool manufacture—the decisions made rather than the artifacts made (Bleed 2001; Mounier 2006; Young and Bonnichsen 1984). One such form of analysis, for example, the *chaîne opératoire*, is said to allow rediscovery of the both “the techniques of production and, beyond that, the conceptual patterns from which they sprang” (Julien and Julien 1994:15).

The model of biface reduction followed here is drawn from a number of analytical studies including Callahan's (1979) widely cited experimental work with fluted point manufacture, and theoretical and site-specific models developed by Muto (1971), Collins (1975), and McElrath (1986). In these studies, lithic tool manufacture is seen as a series of stages. While it has been noted that the stages in fact represent points on a continuum (*v*. Sheets 1975), the concept of staging represents a useful heuristic or analytical device that allows the

organization of data into standardized categories. Granted, subjective interpretation may be, and often is, incorporated into the recognition of stages within a given sequence. Thus, for instance, the number of stages that are distinguished can vary greatly (e.g., Collins employed a sequence with four main stages, while Frison and Bradley [1980] identified eleven). Yet, the judicious use of inclusive and generally accepted stage definitions as reference points can provide a basis for meaningful intersite comparative studies.

In the current analysis, a simplified model with four very general reduction stages was used. From the perspective of the *chaîne opératoire*, these stages would be seen as major decision points or branches at which options may be weighed and selected depending on situational variability (Bleed 2001; Mounier 2006). The characteristics of each stage, their end products, and the debris expected to be associated with them are noted as follows:

early stage: initial edging—preliminary edge creation, characterized by wide, deep flake scars produced by percussion flaking; artifacts exhibit sinuous bifacial edges; flaking may not cross the centerline of the artifact, and thus patches of cortex are often left on one or both faces; little evidence of platform preparation; the end-product is referred to as an **early stage biface,** a roughed-out artifact with a bifacial edge that is ready for thinning and shaping

resulting debris: thick, often blocky waste flakes, many of which are primary or secondary cortical flakes (with cortex covering all or part of the dorsal surface, respectively); simple flake platforms including cortical, single-faceted, 2- or 3- faceted; prominent bulbs of percussion, characteristic of hard hammer percussion; relatively few remnant flake scars on dorsal flake surfaces; large debris may include cores or bifaces with minimal flaking that were rejected due to manufacturing failure or poor material quality

middle stage: primary thinning—progressive thinning and shaping of the implement to produce a relatively straight bifacial edge and the early outline of the tool in plan; thinning is characterized by invasive flaking that crosses the centerline of the artifact, typically carried out with either hard or soft hammer percussion; platform preparation may be apparent; the end-product is referred to as a **middle stage biface,** an artifact with a thinned, regularized shape ready for final shaping and sharpening

resulting debris: thinner flakes than the previous stage; more complex platforms that are frequently bifacial *(i.e.*, retaining a portion of the edge of the biface), and may often be lipped; flaking debris is usually non-cortical, or tertiary (though secondary cortical flakes—with small patches of cortex—are not unlikely, particularly when small cobble or pebble raw material is used); multiple flake scars on dorsal flake surfaces from previous flake removals; larger debris may include broken or rejected bifaces resulting from manufacturing errors or raw material flaws

late stage: secondary thinning and shaping—final thinning and shaping, characterized by less invasive flaking, typically either percussion or

pressure; flaking is designed to complete the thinning process, straighten edges, and shape the hafting element; the end-product is referred to as a **late stage biface,** which requires only minor additional work to produce a finished tool

resulting debris: small, thin tertiary (non-cortical) flakes; bifacial platforms, often crushed in the case of pressure flakes; multiple dorsal flake scars; large debris should include relatively few incomplete or broken bifaces, since most artifacts of poor quality material or with material flaws will have been eliminated at earlier stages

finishing—final shaping, characterized by pressure flaking to complete straightening and sharpening of blade edges, and to complete the hafting element, which may be thinned and ground as needed; the end-product is a finished **point**

resulting debris: small tertiary (non-cortical) flakes that are typically pressure flakes, with small, often crushed platforms; broken or rejected bifaces should be rare, since most manufacturing errors or material flaws will have been eliminated at earlier stages

While not recognized as a formal reduction stage in the present model, an additional level of reduction is sometimes identified as retooling, consisting of either the resharpening of blade edges worn through use, or the reworking of portions of a damaged tool. Cognitive models, such as the *chaîne opératoire*, typically include rejuvenation or recycling as part of the entire historical and social process that describes an artifact, from its manufacture and use-life to curation and discard or abandonment (Mounier 2006). Debris resulting from this form of reduction would include rejuvenation flakes, recognized by extensive usewear on platform edges, or late stage reduction debris from the refurbishing of broken tools. Other evidence of the process would be expected in the form of the tools themselves, which may often be small in size or asymmetrical in shape.

A functional distinction is made in the analysis between rejected and discarded tools, the difference generally concerning the point in the manufacture and use-life cycle at which the artifact was abandoned and entered the archaeological record. Rejects are distinguished by serious manufacturing errors or raw material flaws leading to abandonment prior to completion. Discarded tools were, by implication, used and exhausted, and are identified by size (they are often small) and by evidence of usewear. The distinction between rejects and discards is of course, complicated by the fact that the so-called end-products of the reduction stages are only end-products in an analytical sense. Artifacts might be withdrawn from the reduction sequence at any stage and used as tools, and thus seemingly unfinished bifaces may in some cases have been considered finished tools.

Points

Chronological definition of site components was based diagnostic point typology. Projectile point types and ascribed date ranges utilized in the component analysis are drawn from regional archaeological literature and research databases. Points are chipped stone artifacts, usually bifacial in manufacturing technology and bi-laterally symmetrical in shape, and have

a thinned, proximal end that functioned as a hafting element, and a distal end with blade edges that converge to an apex or point. Labels ranging from "projectile point" to "hafted biface" have been used to designate these artifacts. The simpler term *point* is generally used here, chosen since it does not imply an undemonstrated function, as in the former case, but is not as deliberately non-functional as the latter.

For artifacts that were sufficiently complete, a standardized series of attribute data were recorded. These data included dimensional measurements, such as length, width, thickness, and several angle measurements, along with a suite of nominal variables related to shape, raw material, knapping characteristics, and edge wear. Statistics presented in the text include the range of each measurement and, where appropriate, indices of central tendency, including the mean, standard deviation, and coefficient of variation. The metrical data, as presented, should be considered with some caution, since damage, reuse, and rejuvenation can alter the shape of a tool from its original form, as a number or researchers have noted (Dibble 1995; Flenniken and Raymond 1986; Frison 1968; Towner and Warburton 1990). Thus, the archaeological form of a tool as recorded in its dimensional measurements usually represents the form of the artifact following its last use, or as often, the last attempt at retooling, and does not necessarily reflect its original design.

Other Chipped Stone Tools

The remaining chipped stone tools were categorized during the cataloging process based on form and manufacturing characteristics.

Bifaces. Bifacial artifacts were defined by the presence of patterned flake removals from opposing surfaces along at least one edge. Most bifaces were further distinguished by a regularized shape. Bifaces were subdivided into categories based on their level of completion as described above in the discussion of reduction sequences. All of the complete bifaces from the sites were measured for length, width, thickness, and weight.

Unifaces. Unifacial artifacts were defined by the presence of flake removals from one face of the artifact that had shaped at least one edge of the piece. Complete unifaces were measured for length, width, thickness, and weight. The edge angle of the bit, or working edge, was measured at the approximate center of the bit using a goniometer.

Retouched Flakes. Retouched flake tools were characterized in the analysis by marginal flake scars at least 3 mm in length oriented perpendicular to the flake edge that had resulted in minimal shaping along the flake perimeter. The focus of the flaking on retouched flake tools was edge modification rather than formal shaping.

Utilized Flakes. Utilized flake tools were identified by the presence of usewear along the edges of the artifact, without evidence of intentional edge modification. Usewear was indicated by various types of edge degradation or modification, such as microflaking, rounding, or blunting.

Cores. Cores represent one of the basic residues of lithic reduction. They can range in size and complexity from pebbles or cobbles with only a single flake

removal, to an exhausted cobble core that has been rounded and is no longer workable. In most cases, cores that occur archaeologically are artifacts that were rejected because additional flake removal was impractical, either because of poor material quality (in the case of a tested cobble or a fractured core), or because the size or shape of the core made further flaking difficult. By general implication, cores are usually assumed to have been used for flake production. While it is recognized that some cores were worked into bifacial tools, it can be difficult to discern intent in the early stages of reduction when only one or two flakes have been removed. And so, all cores have been described together in this analysis regardless of the final goal of the reduction process.

In the analysis, cores were separated into two categories based on flake removal patterning: multidirectional and bipolar. Multidirectional cores were defined as cores with flake removal occurring in a random pattern from multiple platforms. Bipolar cores were identified by a distinctive arrangement of opposing striking platforms. In bipolar reduction, the core was placed on a hard surface, usually a dense stone serving as an anvil, and was struck from above. The blow typically produced crushed platforms on opposite sides of the artifact and flakes that were either flat and sheared, or were distinctly convex in shape.

Flaking Debris

Flaking debris was separated into two basic categories: flakes and chips. Flakes were defined by the presence of identifiable attributes such as bulbs of percussion, striking platforms, dorsal flake scars, and feather, snap, or hinge terminations. Chips, sometimes referred to as shatter, represented small-to-medium sized, angular pieces of lithic material with no identifiable flake attributes.

Flaking debris usually represents the majority of the artifactual material recovered from a prehistoric archaeological site, and the Black Diamond site was no exception. Efficient analysis of such a large number of artifacts can be challenging. A useful approach to this task involves the analysis of flake size based on interval data (Henry et al. 1976; Shott 1994; Stahle and Dunn 1984). The process used in the current study is ultimately based on techniques of so-called flake aggregate or mass analysis, as documented by Ahler (1989). The procedure consists of grading the artifacts according to standardized size intervals and retrieving various quantitative data from each size-grade. These data are then subjected to a variety of statistical manipulations that can be used to aid in characterizing the type or types of reduction technology represented in the assemblage. Size grading for the Black Diamond assemblage was conducted using the following interval scale:

- *size-grade 1*: < 1 cm
- *size-grade 2*: ≥ 1 cm and < 2 cm
- *size-grade 3*: ≥ 2 cm and < 3 cm
- *size-grade 4*: ≥ 3 cm and < 4 cm
- *size-grade 5*: ≥ 4 cm and < 5 cm
- *size-grade 6*: ≥ 5 cm

Usewear and Edge Angles

Usewear patterns and tool edge angles are considered measurable attributes that can be basic indicators of tool use (Crabtree 1974; Carmichael 1985; Hayden 1979; Wilmsen 1974). In general terms, experimental studies have indicated that unifacial microflaking [serial flake removals measuring less than 3 millimeters (mm) in length] can be characteristic of activities involving a scraping motion, while bifacial microflaking typically suggests a cutting motion. When these patterns are accompanied by edge rounding or blunting, the scraping or cutting of soft materials, such as hides, fibers, or other vegetal material, may be implied. Experimental data have also suggested that the angle of a unifacial bit may correspond with the type of material the tool was intended to process: 26-35 degrees, light cutting or scraping work; 46-55 degrees, medium work; 66-75 degrees, heavy work.

Accordingly, usewear and edge angle analyses were conducted for selected artifacts from the Black Diamond site. Usewear analysis was carried out with a 10x hand lens in bright light. Evidence of both usewear and retouch were recorded along each working tool edge. Retouch, as defined above, may result from trimming during initial manufacture, intentional edge modification (i.e., flake tools), tool shaping, or resharpening episodes. Usewear was indicated by various types of edge degradation or modification, such as microflake removal, polish, rounding, or blunting. As noted, edge angles were measured at the approximate center of each tool edge or bit using a goniometer.

Fractures

Since many of the bifaces recovered from an archaeological site are production failures, archaeologists studying stone tool manufacturing technology have identified a series of characteristic fractures on the tool forms through comparison with experimental tool assemblages. In many cases, recognizing the type of fracture can help determine the manufacturing techniques involved in the specific production episode. The following list is not definitive, but includes those fracture patterns recognized in the Black Diamond site artifact assemblage. The categories are based on standard fracture types recognized in archaeological literature (Purdy 1975; Johnson 1981):

> *perverse* – an irregular, twisting break traveling across the face of the tool often at an oblique angle to the long axis: "Natural flaws, excessive force and mass to be removed add to the possibility of perverse fracture" (Crabtree 1972:82).
>
> *lateral* – also referred to as a transverse snap break, lateral fractures extend directly across the artifact at right angles to the long axis and may be the result of either a direct or indirect blow (Johnson 1981:47); the latter is referred to as end shock, resulting from tension failure in areas weakened by repeated blows (Crabtree 1972:60)
>
> *hinge* – lateral fracture with a rounded cross section typically occurring while attempting to remove a stack of incompletely terminated flakes (Johnson 1981:44)
>
> *incipient flaw plane* – an often irregular break along one or more existing fracture planes with in the raw material; such planes are often a source of weathering from ground water intrusion, occurring as thin beds of oxidized or mineralized inclusions and may be unseen, but can be sufficient to redirect the force of

> percussion, allowing the stone to separate in a uncontrolled manner. (Johnson 1982:48)

Cobble Tools/Groundstone

Cobble tools were used for a variety of tasks including battering, abrading, grinding, and pecking. These tools typically consisted of unmodified, rounded cobbles procured locally from stream beds or other exposed gravel deposits. In the current analysis, two functional categories were recognized: hammerstones and anvils. Some cobble tools contained multiple usewear patterns and were categorized based on most frequent use type in evidence.

Analytical Methods: Viewshed

A viewshed analysis was conducted to examine aspects of human interaction with the landscape that might not be readily evident with more conventional archaeological approaches. This form of analysis, typically computer based, compares relative elevation and aspect (the compass orientation of a slope) between a specific point and surrounding areas to provide an indication of the terrain visible from that point (Lake et al. 1998; Wheatley 1995; Tripcevich 2002). The results of viewshed analyses can assist in interpreting past landscape use, providing a means of visualizing the world as it was experienced by the people living within it.

Viewshed analyses have been used to aid an understanding certain features of past cognition—how people saw and understood the world around them. In an early study of barrow sites in England, for example, Lock and Harris (1996) used viewshed analysis to demonstrate that long barrows in the Danebury region of England were not mutually visible, supporting a theory that the barrows had been used as territorial markers. Wheatly (1995), in contrast, demonstrated that long barrows of the Stonehenge group (Avebury and Salisbury Plain) tend to occur in locations from which high numbers of other barrows were visible. In North America, Maschner (1996) analyzed village locations on the Northwest Coast around A.D. 500, demonstrating that when villages relocated, they moved to landscapes with views encompassing approximately three times the visibility of the previous locations. The finding was interpreted as reflecting a perceived need for increased defense. In a more recent study, Jones (2006) came to a similar conclusion regarding Onondaga Iroquois settlement: site location was interpreted as a measure of defensibility and was “a major factor governing settlement location during the Late Woodland and early Historic periods…because of the high frequency of warfare” (Jones 2006:537).

Kvamme (1990) proposed some ground rules for conducting and interpreting a viewshed analysis. The viewshed operation should be based on several premises: that the digital elevation model (DEM) used as the base data represents the terrain accurately; that the paleoenvironment can be modeled with relative confidence; that the object of observation stands out sufficiently to be visible; and, finally, that the measured landscape attributes were relevant and significant to the prehistoric inhabitants. The latter is the conceptual leap that must be bridged by the archaeologist’s interpretations. Some have argued that the analytical process over-represents ecological data and simplifies complex socio-cultural variables that may also be involved in landscape use (Kvamme 1997; Tilley 1994; Wheatley and Gillings 2000). Others observe that viewshed analysis describes a middle-ground that draws on

geographically measurable attributes to reflect the experiences of individuals and the ways they made their settlement choices (Wheatley 1995).

Other Analyses

Special analyses and procedures, including geoarchaeological investigations, archaeobotanical studies, and AMS dating, were performed by outside laboratories. Summaries of results of these studies are presented in the appropriate sections in the main body of the report, while complete texts of the reports submitted, including methods, results, and interpretations, are presented in a series of appendixes.