3.0 ENVIRONMENTAL SETTING

The 5-mile Smyrna-to-Pine Tree Corners corridor is located within the Low Coastal Plain of Delaware. This segment of SR 1 begins south of Smyrna Landing Road, in a broad area of Coastal Plains Uplands. Portions of these uplands are well drained and are currently in agricultural use, others are situated in wooded and wetland areas. Numerous bay/basins also are present across the landscape. Some of these features contain surface water; others are dry, broad depressions within actively plowed fields. The bay/basins, together with occasional low, ridge-like knolls, create a gently undulating terrain.

From south to north, the corridor crosses three intermediate-order streams. In contrast to the undulating terrain in the southern end of the corridor, broad, level upland terraces characterize the land north of the Blackbird Creek drainage. Bay/basins are absent in this portion of the corridor, and much of the land is in active agricultural use. Blackbird Creek is deeply entrenched within these uplands.

3.1 Present Environment

3.1.1 Site Location and Setting

The Blackbird Creek site was located in central New Castle County, approximately 3 kilometers (km) southeast of Townsend, Delaware. The site was situated in an open, relatively level, fallow agricultural field north of the village of Blackbird, east of U.S. Route 13, and flanked on the north by Blackbird Creek (Figure 3-1). At the time of investigation, landuse in the vicinity was primarily agricultural, while areas not suitable for cultivation (i.e. slopes and drainages) stood in hardwoods. The site area was covered in dense grasses and greenbriars, representing re-growth in a fallow field. A recently demolished historical farm complex (7NC-J-202) abutted the Blackbird Creek site to the southeast.

The site was situated on a bluff along the southern bank of Blackbird Creek. A springhead was located in the northwest portion of the site and wetland areas flanked the northern banks of Blackbird Creek, opposite the site location. The remnants of former drainages, visible on the USGS map of the area, traversed portions of the site area to meet Blackbird Creek (see Figure 1-1). The cultural components of the site were dispersed over a wide area of approximately 30,000 square meters.

3.1.2 Physiographic Setting

The project area is located within Delmarva’s High Coastal Plain (Custer 1989), which extends from the Smyrna and Chester Rivers, north to the fall line in northern New Castle County. The High Coastal Plain is typified by a rolling topography, with sufficient relief to influence seasonal differences in plant communities. A separate group of physiographic zones divides the peninsula lengthwise, from north to south. The Blackbird Creek site was located at the transition between two of these zones, the Mid-Drainage and Drainage Divide Physiographic Zones. Both regions are abundant in terms of natural resources, due to the combination of freshwater and brackish streams, freshwater swamps, and the range of soils found in them. The transition area between the regions, often referred to as an ecotone,
characteristically contains concentrations of resources typical of each zone, and thus would have represented an even richer locale.

Figure 3-1. Location of the Blackbird Creek Site on the Terrace above Blackbird Creek Prior to the Construction of SR 1.
(State of Delaware 1992)

Thomas et al. (1975) effectively categorized the Coastal Plain environment and the potential resource base it represented to prehistoric populations in terms of hydrological conditions. These zones were defined as follows: 1) saltwater bays/ocean; 2) tidal marsh and estuarine environments; 3) well-drained woodlands; 4) poorly drained woods and swamp; and 5) permanent freshwater (rivers/streams). Each zone would have offered a distinctive combination of aquatic and terrestrial animal life, plant foods, and lithic material resources. With the exception of the Delaware Bay shore, which occurs approximately nine kilometers distant, all of these zones occur within the immediate vicinity of the sites investigated along the SR 1 corridor.

Geologically, the High Coastal Plain of Delaware is underlain by continental deposits rather than marine sediments. These Middle Pleistocene sand, gravel, and cobble deposits, known as the Columbia Formation, are the result of glacial outwash from melting continental ice sheets (Groot and Jordan 1999). In addition to sorted sands and boulders, the Columbia Formation contains quartz, quartzite, and chert pebbles and cobbles, which were a source of raw material used by prehistoric populations for in stone tool manufacture. Outcrops of Columbia Formation deposits are visible locally in exposures along Blackbird Creek and its tributaries, in eroded gullies, and, occasionally, in large tree-throw depressions. The High Coastal Plain contains a high percentage of coarse material that has resisted weathering and contributes to a major geomorphological characteristic of the region, moderate relief.
Differences in elevation of up to 16 m are found, mostly along entrenched tributary streams and creeks. The range of elevation measured in the vicinity of the Blackbird Creek site was from 5-to-15 m above mean sea level.

The site area itself contained some distinct topographic features (Figure 3-2). The most pronounced was the deep valley cut by the Blackbird Creek channel as it traverses the High Coastal Plain-Low Coastal Plain interface. Down cutting by the stream resulted in a steep bluff directly in front of the site. A second topographic feature was a broad, sink-like depression centered approximately 50 m from the bluff edge. This depression, the core of which measured approximately 40 m across, resembled in part Carolina bay features common in and around the upper portions of the Blackbird Creek watershed. Rather than a true closed drainage feature, the depression opened on the northwest side. This opening led to narrow swale that became more pronounced approaching the terrace edge, beyond which point transitioned to a gut-like ravine cut into the bluff face. This landform would likely have held a stream head or spring that may have provided a water source for people utilizing the adjacent terrace.

The nearly level terrace segment extended between the sink-like depression and the Blackbird Creek bluff. The aforementioned ravine defined the western (upstream) limits of this terrace. The opposite (downstream) end was bounded by a minor knoll. This summit was the terminus of a low ridge that extended south from and perpendicular to Blackbird Creek. Together the bluff-side terrace and north-south trending ridge formed an inverted “L”. The short leg of this feature is herein referred to as the bluff-side terrace. The inside of the inverted “L” contained the broad, sink-like depression. The long leg of the “L” is best referred to as the north-south ridge. In Figure 3-2, the boundary of the data recovery investigations roughly follows the “L” shape formed by the bluff-side terrace and north-south ridge.

A minor spur the extended from the bluff edge, overlooking the Blackbird Creek bottom. This spur was bounded on the east side by the ravine and on the north side by a near vertical section of Blackbird Creek bluff face. The bluff-side terrace segment was not fully level. Elevation fell slightly from the minor knoll, westward towards the ravine head. This drop in elevation ran in an opposite direction as the Blackbird Creek flow. Terrain also fell slightly northwards Blackbird Creek as well as southwards to the sink-like depression, forming a low spine that traversed the terrace mid-section parallel to the adjacent bluff edge.

3.1.3 Soils

The USDA Soil Survey for New Castle County (Mathews and Lavoie 1970) indicates the Blackbird Creek site vicinity occurred within the Sassafras-Fallsington soil association, which is characterized as nearly level, smooth soils with slopes generally less than 5 percent. Soils classified for the Blackbird Creek site belong to two soil series, Sassafras and Woodstown. These soils consist of generally well-drained sandy loams. The specific soil phases mapped for the Blackbird Creek site consist of Sassafrass sandy loam and Woodstown sandy loam.
on the Blackbird Creek site were somewhat unusual for the Delaware Coastal Plain. In particular, subsoil along the bluff-side terrace was extremely dense and clayey. Initially, no major variations in surface soil texture or surface drainage characteristics were observed during shovel testing. Surface soils appeared to consist of fine sandy loam. Sand content appeared to be greatest along the north-south trending ridge and this minor topographic feature was thought to have an aeolian formational component. Shovel testing along the bluff-side terrace first indicated the presence of the dense subsoil. Mechanical stripping of plow zone in this area subsequently revealed the full nature of these soils. Texture became
progressively more dense moving east to west along the bluff-side terrace. A sandy loam to loam subsoil was present near the north-south ridge crest. Further west (upstream) along the bluff-side terrace, subsoil transitioned to a clay loam. Exposed subsoil near the head of the ravine appeared to be pure clay.

Soils within the sink-like depression were also dense. Although no surface water was noted, soils within the depression were hydric and remained wet throughout the summer months. The swale opening/ravine clearly represents an outflow channel. It is strongly suspected that prior to historical land clearing, plowing and resultant colluvial infilling, the depression would have held an active spring. Even though the site investigations did not map out the full horizontal extent of the clayey subsoil, it is thought that ground water perched on this dense substrate would likely account for the hydric soils and a spring within the sink-like depression.

3.1.4 Hydrology

Rivers divide Delaware into two main watersheds – the Lower Delaware and the Upper Chesapeake. The Delaware is the largest river in the state. The Delaware River estuary forms the border of the state, and the lower portion of the estuary widens to become Delaware Bay. Tributaries of the Delaware River in the state’s northern region include the Christina and its feeder, Brandywine Creek, which merge to form the Wilmington harbor. The Appoquinimink, Smyrna, and St. Jones rivers feed the Delaware River in the central part of the state. In the southern portion of the state, the Mispillion River feeds the Delaware River. In southwestern Delaware, the Nanticoke River and its tributary, Broad Creek, flow westward through Maryland’s Eastern Shore and empty into the Chesapeake Bay. Many additional short rivers and streams are located in Delaware as well. Although there are no large lakes in Delaware, the state does contain many small lakes and ponds. Small closed depressions, called bay/basins, occur in the north central portion of Delaware, and provide seasonal sources of water.

The Blackbird Creek site was located on the south side of Blackbird Creek, a third order stream with headwaters near the Delmarva drainage divide. The stream flows northeast across the Delaware Coastal Plain to meet the Delaware Bay just below the mouth of the Appoquinimink River, 3 km north of Taylors Bridge. Total length is 27 km. The archaeological site straddled the interface between High Coastal Plain terraces and the Low Coastal Plain on a minor scarp that forces the stream to cut down, creating a deep, narrow valley. Several low order tributaries join Blackbird Creek upstream of this topographic break. These include Sandom Branch, Herring Run, and Barlow Branch. The site was situated just above the head of tide for Blackbird Creek. Upstream of the site Blackbird Creek is a gravelly, free flowing stream. Below the site, the channel widens into a meandering tidal reach of the Delaware Bay.

The upper reaches of Blackbird Creek drain the Blackbird State Forest area. This portion of the Delaware Coastal Plain contains numerous “bay basin” Carolina bays and interior wetlands. The lower, tidal portions of Blackbird Creek are also characterized by ecologically rich settings including extensive freshwater and brackish tidal marsh complexes. These marshes comprise a unit of the Delaware National Estuarine Research Reserve.
3.1.5 Climate
Climate data can be used to suggest potential restrictions on settlement and land use (e.g., drought conditions, frequent catastrophic storm events), as well as to aid in interpretation of other sources of data such as tree ring growth rates, rates of sedimentation in lakes and land surfaces, and apparent erosional gaps in a depositional sequence. Hot, humid summers and mild winters characterize Delaware’s modern climate. Average winter temperatures range from –7 to 5 degrees Celsius (°C) with averages approximately 2°C higher in the southern part of the state. Summer highs can exceed 32°C with humidity between 45 and 85 percent. Precipitation averages between 9-to-140 centimeters (cm) and is heavier in the late spring and summer. Although the freeze-free periods are as long as 280 days, snowfall in the central and northern portions of the state averages 37 cm per year. Generally, the freeze-free periods increase from inland areas toward coastal and bay areas (USDA 1981).

3.1.6 Historical Landscape Impact
The Blackbird Creek site contained evidence of a variety of historical land use impacts. Agricultural plowing was the most widespread of these disturbances. As stated earlier, the plow zone was in some areas over 40 cm (15 inches) thick. Distributions of historical and prehistoric artifacts within the plow zone provided evidence of several site occupations, but other than features, no intact sub-plow zone cultural deposits were identified. Among the features identified were 48 historical features, which had likely disturbed evidence of prehistoric occupations. These features were generally small and localized, such as post holes/molds, a shallow ditch, and other indeterminate stains, but others such as two pipe trenches were larger. Site 7NC-J-202, a late-19th-century farmhouse, was located adjacent to the Blackbird Creek site, but archival research did not identify any structures within the boundaries of the Blackbird Creek site. Some disturbances were noted in the upper horizons in the areas adjacent to Site 7NC-J-202 that were likely related to the demolition of the structures in the 1990s. Despite extensive plowing and historical use of the site, intact sub-plow zone contexts were identified in the form of the bases of prehistoric pit features.

3.2 Paleoenvironment
To assess the character and distribution of prehistoric occupations within the project area through time, it is helpful to consider the changing characteristics of the environment during the approximately 12,000 years of human occupation of the region. In general, the environment of the Middle Atlantic region has remained relatively stable for the past 5,000 years. Prior to that time, two broad trends are noted, both related to the retreat of the last continental glaciers during a period that coincides with the arrival of American Indian populations in the Northeast. These trends are characterized as gradual warming, and the replacement of an open boreal forest, typified by conifers, with temperate, mixed deciduous communities (Gaudreau 1988).

At the end of the last glaciation, much of northeastern North America was considerably colder and wetter than at present, covered by open tundra and boreal forest environments. Milliman and Emery (1968) estimated sea level at that time to have been as much as 130 m below current levels, with estuary systems such as the Chesapeake and Delaware Bays still
consisting of rivers and outwash channels. Accompanying the retreat of the ice sheets was a gradual warming trend, a rise in sea level, the flooding of coastal zones, and the development of new estuary environments extending far up the channels of coastal river systems. In addition, northern forests and their associated faunal communities were gradually replaced with varieties more typical of southern temperate zones. An essentially modern climate and environment had become established by approximately 5000 BC.

### 3.2.1 Climatic Episodes

Climatic changes did not occur at a smooth, unvarying rate, but rather consisted of a series of short-term variations within a general trend. The following outline of the various climatic episodes in the Northeast and Middle Atlantic regions is based on the work of Carbone (1976) in the Shenandoah Valley; Rippeteau (1977) in the Upper Susquehanna Valley of New York; Vento and Rollins (1990) in the Susquehanna and Delaware Valleys; Dent's (1979) research from the Upper Delaware Valley; Delcourt and Delcourt's (1981) regional synthesis; and several site-specific studies, such as Buckles Bog, in Garrett County, western Maryland (Maxwell and Davis 1972); Hartstown Bog, in Mercer County, northwestern Pennsylvania (Walker and Hartman 1960); the New Paris Sinkhole, in Somerset County, southwestern Pennsylvania (Guilday et al. 1964); the Indian Creek V site, in Prince Georges County, Maryland (LeeDecker et al. 1991); and several locations in central Delaware, including Walter’s Puddle, in southern New Castle County (Newby et al. 1994; Webb et al. 1994); and the floodplain of St. Jones River at Blueberry Hill, in central Kent County (Brush 1995). The dates used in the presentation approximate those of Dent, who provides a full and detailed sequence based on data closest to the current project area. The initial episode, the Late Glacial, pre-dates the traditionally accepted date of human presence in the Northeast by at least 1,500 years.

**Late Glacial ca. 13,000-11,000 BC**

The Late Glacial was a cold and wet period, with tundra-like vegetation present, particularly near the ice front. Further south were abundant open parklands, with sedge and grass interspersed with stands of spruce and fir (Maxwell and Davis 1972; Wright 1981). Pollen records at Marsh Creek, in Chester County, Pennsylvania, indicate a changing mixture of grasses, sedges, and boreal species by approximately 11,500 BC (Martin 1958), which suggest the transitional nature of climate and vegetation during the period. Whitehead (1973) has suggested a general zone of displacement approximately 1,000 km in width between the glacial front and boreal forests to the south. Northern faunal species and megafauna ranged freely. Guilday (1982) has noted a distinctly greater variety of faunal species, and in particular large animal species, in Pleistocene and Late Glacial times, as compared with the later Holocene Period. This variety suggests more open forest and grassland capable of supporting greater numbers of grazing animals. In contrast, Custer (1990) has argued that a relatively undifferentiated boreal forest environment was in place in the Middle Atlantic region, and that herds of large game were probably not present by the time of the first documented human occupations.

**Pre-Boreal ca. 11,000-8700 BC**

The Pre-Boreal was primarily a cold and wet period, though with the retreat of the continental ice sheet, regional temperatures increased, creating a gradual warming trend from
the preceding Late Glacial episode. The existing mosaic of tundra, open grasslands, and boreal forest may have continued in some areas, with spruce and pine forest becoming dominant. Swamps and remnant peri-glacial lakes were common (Custer 1984). Less varied plant food availability has been suggested (Raber 1985), and a decline in both large and small animal species has been reported (Guilday 1982). Both circumstances bear implications for human subsistence practices. Carbone (1976:185), in contrast, suggests a fairly compressed mix of "boreal and austral species side by side," including deer, elk, moose, possibly remnant mastodon, horse, bison, and smaller game.

**Boreal ca. 8700-7200 BC**
Initially, this period was marked by an increase in warm air masses, which induced a gradual warming trend. Open grasslands diminished in extent pine forest and northern hardwoods, especially oak, replaced spruce woodlands (Walker and Hartman 1960; Sirkin 1977). Watson and Custer (1989) report the replacement of spruce by hemlock in the Middle Atlantic Coastal Plain. Less varied habitats may have resulted in lower carrying capacity (LeeDecker et al. 1991). Guilday (1982) has indicated that modern faunal species were in place in western Pennsylvania in a mixed, oak/chestnut-dominated forest by at least 7000 BC. He notes an overall decrease in species diversity among browsing and grazing herbivores, from 75 species during the Late Pleistocene to 51 in the Holocene. The proportion of large grazers decreased from 35 percent of the total fauna to 12 percent, suggesting development of a closed, deciduous forest. Webb et al. (1994) note an extended period of desiccation in central Delmarva beginning around 9000 BC and continuing through the Boreal into the following Atlantic period. Evidence for this is derived from pond sediments suggesting depressed water levels throughout the period.

**Atlantic ca. 7200-4600 BC**
The early portion of the Atlantic period was characterized by warm and increasingly wet conditions, signaling the onset of a fully modern climatic regime with associated floral and faunal communities. Oak-hemlock forests expanded, and "mesic forests mantled the landscape from the floodplain to the ridges" (Carbone 1976:189). An oak-hemlock complex was well established at the Mitchell Farm Site (7NC-A-2), in northern New Castle County by about 5900 BC (Custer and De Santis 1985). Oak dominance over hemlock is noted in Delmarva by 5000 BC (Bernabo and Webb 1977). Wetter conditions may have fostered wetland expansion, but a drying trend is noted near the end of the period (Carbone 1976). Generalized deciduous forests, producing large quantities of mast foods, were in place by 4000 BC, turkey, deer, and other small mammal populations increased (Custer 1989).

**Sub-Boreal ca. 4600 BC-AD 0**
The Sub-Boreal consisted of a warm and dry period, with consequent re-expansion of grasslands and dominance of oak-hickory forests and xerophytic species. Pollen analysis at Walter’s Puddle, approximately one kilometer north of the present project area, suggests the presence of a regional forest dominated by oak by 3870 BC (Newby et al. 1994). Environmental stabilization near the end of the period is evidenced by a lack of change in forest components, as suggested by pollen cores taken near St. Mary's City, in southern Maryland (Kraft and Brush 1981). These cores indicate the general dominance of oak, hickory, and pine by around 3400 BC. Additional pollen profiles from Delmarva suggest
that hickory was the dominant species in the northern part of the peninsula, and pine in the southern part (Bernabo and Webb 1977). The decrease in hemlock during the Sub-Boreal was widespread in eastern North America during the middle Holocene, but in Delmarva, it may have been as much a result of edaphic conditions—specifically the predominance of dry, sandy soils—as of climate change (Custer 1989). The burial of landscapes through aeolian deposition has also been observed throughout the peninsula, and is presumably associated with a combination of xeric soils and drying climatic conditions (Curry 1980, 1992; Ward and Bachman 1987; Curry and Ebright 1989; Daniels 1993). Increasingly cool and moist conditions prevailed near the end of the Sub-Boreal period.

**Sub-Atlantic ca. AD 0-present**

A general, progressive cooling trend is noted throughout the Sub-Atlantic period. A rise in the incidence of organic debris in sediments along the St. Jones River, in central Delaware, suggests increased precipitation (Daniels 1993). Stratigraphic unconformities associated with both aeolian and alluvial depositional events suggest abrupt shifts in precipitation (Custer 1978, 1989). By approximately AD 500, the pattern had stabilized. Modern oak-chestnut forests were well established in the Piedmont and Fall Line Zones, while chestnut-pine communities were common in the High Coastal Plain, particularly in sloping locales (Braun 1950).

### 3.3 Prehistoric Resource Base

Understanding the natural environment and its role in American Indian life has long been an integral part of descriptive studies in Delmarva, as witnessed by the regionally influential work of researchers such as Thomas (et al. 1975) and Custer (1984). Environmental and ecological research has long played an important role in analysis of Delaware prehistory. In general, the Coastal Plain of Delaware presented a productive environment that easily supported prehistoric hunting and foraging populations. A relatively mild coastal climate provided short winters. Soils were fertile, as evidenced in historical times by the state’s rich agricultural tradition. A variety of environmental zones occur within a relatively small geographic area in the region. Thomas (et al. 1975) effectively summarized the various zones and the potential resource base offered by each: 1) saltwater bays/ocean; 2) tidal marsh and estuarine environments; 3) well-drained woodlands; 4) poorly drained woods and swamp; and 5) permanent freshwater (rivers/streams). With the exception of saltwater bays and the ocean along the Delaware Bay shore, all of these zones occur within the immediate vicinity of the Blackbird Creek site.

At present, the northern half of the Delaware Coastal Plain falls within the oak-hickory climax forest type (Braun 1950), and the key species in this forest have been an important component of the local forest cover for the last 6,000 years (Kellogg and Custer 1994). The Holocene pollen sequence recorded at the Walter’s Puddle bay/basin, located just west of the project area, records an oak-dominated forest, along with vegetation characteristic of bog habitats (Newby et al. 1994). The oak-hickory forest, with its characteristic mast or nut production, represented a productive environment, with nutmeats constituting a plentiful and storable human food source that also served as primary seasonal forage for important game species, such as deer, turkey and squirrel.
As potential resource bases, wetlands along the stream margins and bay/basin features, large natural depressions (ponds) that at various times have held water and supported wetland environments, would typically support a variety of vegetation and aquatic and amphibious animals. A number of mammalian species, notably beaver, muskrat, mink, otter, and weasel, live or feed along ponds and wetland fringes. The stream margins and ponds also would have attracted waterfowl in various seasons. Cattail species and other emergent wetland vegetation would have offered both food resources and useful raw materials. Stream banks and slopes adjacent to open pond margins would have supported forest fringe species, most importantly black cherry (*Prunus serotina*), wild plum (*Prunus americana*), and persimmon (*Diospyros virginiana*), which flourish in border areas (Taber 1995), as well as bayberry (*Myrica* sp.). The latter thrive in infertile soil along coastal areas and around the sandy, open rims of brackish-to-freshwater ponds and wetlands (Fernald and Kinsey 1958; Angier 1974). Mast species would have included sweetmeat hickories, such as the pignut (*Carya glabra*) andmockernut (*Carya alba*) species (Taber 1995). Also, a number of edible plant species known would have been available to the site inhabitants, including paw paw (*Asimina triloba*), hackberry (*Celtis occidentalis*) (Taber 1995), shadbush (*Amelanchier aborea*) (Sutton and Sutton 1985), and Jack in the Pulpit (*Arisaema sp.*) (Fernald and Kinsey 1958).