5.0 PREDICTIVE SURFACE DESIGN AND DEVELOPMENT

The basis for the construction of predictive surfaces is that people preferentially choose habitation and use locations from the array of choices made available by the natural environment (e.g., Paleoindian site locations associated with locations of high quality cryptocrystalline lithic raw materials; historic period mill locations associated with stream locations that provide sufficient fall for water power). If these environmental variables are considered in concert with what is known about previously identified archaeological resources and historic period features within a particular geographic area, mapping representative of the potential for the geographic area to contain additional archaeological resources can be constructed.

The Western Parkway predictive surfaces were constructed using easily available or created digital layers within the GIS. This methodology has been applied by Skelly and Loy over the past 10 years to produce and test numerous archaeological predictive models and surfaces for varied geographic areas (Duncan 1997, 1998, 2002; Duncan and Schilling 1998, 1999; Duncan *et al.* 1995, 1998, 1999; Espenshade and Duncan 2000; Skelly and Loy 1996). The GIS is a computer-based set of tools developed to acquire, compile, manage, analyze, manipulate, retrieve, and present georeferenced spatial data sets traditionally represented on maps. Employing the GIS, these data sets can be compared, analyzed, and integrated, in order to produce new information. The coded and digitized GIS data sets were utilized to assess the potential for occurrence and preservation of pre-contact and historic period archaeological resources within the Western Parkway study area.

5.1 Pre-contact Period Archaeological Predictive Surface

As stated previously, the construction of a pre-contact period predictive surface is based on the presumption that pre-contact period settlement and land use patterns were determined by local environmental conditions, and that the environmental conditions that affected these choices can be related, either directly or indirectly, to modern environmental characteristics which are currently measurable across the study area. Given these assumptions, a predictive surface can be created which evaluates a given land parcel for potential attractiveness for pre-contact site location. This evaluation may be derived deductively from archaeological knowledge and theory or inductively from the known site record within the area (Kohler and Parker 1986). However, in reality, most predictive surface processes are a combination of both

approaches because of the inherent limitations and interactiveness of both theory and observation (Warren 1990). The Western Parkway predictive surface construction process utilizes both intuitive and empirical approaches within the selection and weighting of the environmental variables incorporated into the model. What follows is a summary of the predictive surface process and the key variables used in that process.

The defined study area for the Western Parkway project was gridded, within the GIS, into 30.0 x 30.0 m (98.4 x 98.4 ft) cells. The size of the cells was limited by the resolution of the digital elevational data available. Cells of this size are sufficiently small for a predictive surface of above-average resolution. The base mapping used for the surface was the 2002 aerial photographs supplied to Skelly and Loy by Whitman, Requardt & Associates, LLP (WRA); therefore, the buildings, roadways, and other features of the modern built environment shown on the predictive surfaces date to 2002.

The process used to construct the pre-contact period predictive archaeological surface includes multiple steps. The first step was the collection and digitization of primary data sets, including the environmental background data and archaeological site data for the study area. The environmental and archaeological site data were collected not only for the study area, but for a much larger data collection area comprised of approximately 24,181.2 ha (59,750.9 ac), in order to avoid creating an arbitrary edge effect in the study area during the predictive surface process.

The environmental background data were collected from multiple sources and included elevation, soil type, streams, confluences, and wetlands (Appendix C). Due to the geographically small size of the Western Parkway study area and its relative homogeneity with regard to environmental and topographic settings, very few environmental factors demonstrated effects to the predictive surface results. Those listed above were the defining variables used in the predictive surface process. Information about archaeological site distributions and settlement patterns in the region was collected from a number of sources. These included pertinent regional cultural resources reports, the Delaware State Historic Preservation Office Research Center's cultural resource survey database, and previously completed archaeological modeling for areas surrounding the Western Parkway study area.

The previously recorded archaeological site information was obtained in hardcopy format from the cultural resource survey files, converted into a database file and GIS layers, and analyzed in order to determine the general types and location patterns of pre-contact period archaeological sites discovered within the study area region. It should be noted that there are only 11 previously recorded pre-contact period archaeological sites within the bounds of the

Western Parkway study area, but within the area of data collection there are 130 previously recorded pre-contact period archaeological sites (Appendix D). All of the previously recorded site locations that were identified during the collection of primary site data contributed information to the predictive surface construction process. In addition to the site locations, the cultural affiliation and temporal components of the previously recorded sites were considered, but due to the small sample size, no predictive value was assigned based on cultural affiliation or temporal period. The primary data sets were used to derive a series of variables, each transformed into a gridded data layer in the GIS.

The second step in the construction of the pre-contact period predictive surface was the syntheses of and incorporation into the GIS of all of the relevant primary archaeological site data and environmental variables so that secondary data sets, comprised of more complex determinations, could be derived. Multiple secondary data sets were calculated using various combinations of variables; however, in the end, very few of these secondary data sets affected the predictive surface results. Therefore, most of the secondary data were excluded from the predictive surface process because it did not contribute information which strengthened the effectiveness of the predictive surface. Secondary data sets used in the predictive surface process included wetland cost distance and stream cost distance. The derivation of secondary data sets involved the complex iterations and interactions of the primary data sets within the GIS. In many cases, a single variable would be approached in different ways in order to define variables with greater discriminatory power. The derivation of more complex and potentially more relevant variables contributes to the power of a GIS-created predictive surface. The combination of the small cell size and the nature of the calculations required would make the creation of such a predictive surface impossible with manual operations.

The site data were explored for possible site/environmental correlations and trends in order to determine the general types and location patterns of pre-contact period sites discovered within the study area region. Key variables were then identified. The combination of these variables, as well as general archaeological knowledge, the pattern of site distribution indicated by the previously recorded pre-contact archaeological site locations within the region, the results of other pertinent regional site distribution studies, and information gained from informant interviews, was used to identify probable locations of pre-contact archaeological resources.

Also included in the assessment of resource potential within the project area were disturbance factors, such as single and multiple family dwellings, mobile home parks, retail/commercial buildings, institutional/government buildings, junk or salvage yards/landfills

and waste sites, roads, parking lots, utilities, water, railroads, cemeteries, and wetlands. These factors relate more to the potential for preservation of archaeological deposits within a given location, rather than to the original attractiveness of the locale for pre-contact occupation or use. The lack of preservation is an important consideration for assessing the resource potential, as areas where the deposits have been substantially disturbed have much less promise of containing archaeological remains.

The potential for the presence of pre-contact period archaeological site locations is represented in the GIS predictive surface by a cumulative score, produced from the weighted sum of all attractiveness factors and modified by the relative potential for preservation of the deposits (i.e., disturbances) (Figures 2, 3, 4, 5, and 6). In this way, each 30.0 x 30.0 m (98.4 x 98.4 ft) cell within the study area was assigned a resource potential score. This range of scores was then divided into five ranks of archaeological site potential, including very low (purple/blue), low (green), moderate (yellow), high (orange), and very high (red). The resulting mapping of ranked cells constitutes the GIS pre-contact period predictive archaeological surface (Figure 7).

5.2 Historic Period Archaeological Predictive Surface

In order to assess the potential for encountering historic period archaeological resources within the study area, a historic period archaeological predictive surface was produced *via* a GIS. This predictive surface incorporates the results of background research, including available local histories, historic records and mapping, previously recorded historic sites (Cultural Resource Survey [CRS] files), and the results of a historic structures survey. The historic archaeological sensitivities were related to historically mapped or documented features and assessed within the historic context of the area. Features incorporated into the GIS historic period archaeological predictive surface included extant historic structures (greater than 50 years old) identified by historic resource surveys, historically mapped structures and properties, historic districts, cemeteries, roads, railroads, canals and waterways, and the intersections or crossings of the linear features.

The construction of the historic period archaeological predictive surface incorporated the results of Skelly and Loy's Western Parkway historic structures survey and evaluation of the above-ground historic period resources (Kuncio *et al.* 2006). In order to identify extant historic structures (greater than 50 years old), previously surveyed historic period resources, and historic districts, the historic structures survey commenced with a review of the National Register of Historic Places (NRHP) files, the CRS files at the Delaware State Historic

Preservation Office, and the results of a DelDOT survey previously completed by John Milner Associates, Inc. (Harris *et al.* 2005). Following this background research, a windshield survey was conducted. This level of study was implemented as part of the preparatory data gathering in order to expediently identify notable above-ground historic resources within the study area. The identified historic period resource locations were then used within the GIS as sets of variables for the development of the historic period predictive surface.

Cemetery locations were identified through the review of historic and current mapping, the windshield survey, and informant interviews. The routes of roads, railroads, canals, and waterways and the intersections of these linear features were determined by the review of a series of historic maps (Beers 1868; USGS 1918b; U.S. War Department 1941, 1943).

Subsequent to the identification of the historic feature locations but prior to their inclusion in the predictive surface, each identified feature was assigned a resource sensitivity rank (ranging from 1 [very low] to 5 [very high]) and a buffer distance (around each of the individual historic features) based on the type and age of the feature. The resource sensitivity ranks assigned to the identified features reflect the probable occurrence and research potential of the anticipated historic period resources. In this way, a historic period roadway appearing repeatedly on historic mapping beginning in the early nineteenth century would have a greater potential for significant historic remains than a later roadway appearing in the early twentieth century. Conversely, both features would generally have less potential than the immediate surface area surrounding a historically mapped or extant historic structure.

The distances assigned to the buffers around various historic features were derived from visual analysis of the historic period mapping and the apparent relevant distances based on the type of resource to various mapped roadways, railroads, or water. Buffering was also applied judgmentally, given general archaeological knowledge of the typical distribution patterns for archaeological remains found in association with various types of historic period features. For example, a majority of below-ground cultural resources (e.g., privies, wells, on-site sheet middens) are generally found within 61.0 m (200.0 ft) of extant structures/foundations and associated outbuildings. Dispersed trash scatters and off-site concentrations (i.e., dumps), however, are highly varied in their distribution and not generally predictable within the landscape, unless noted on historic period mapping or by an informant. Appendix E presents the historic features with their ranking and buffer distances used in the compilation of the Western Parkway Historic Period Archaeological Predictive Surface.

The overlay of the ranked and buffered layers of historic features within the GIS resulted in a cumulative potential for encountering historic archaeological resources within the project

area; it is shown in the historic archaeological resource sensitivity map (Figure 8). This mapping will be generally utilized within the Western Parkway project planning and feasibility study for the purpose of aiding in preferred alternative selection. Once a preferred alternative is selected, it is anticipated that a complete Phase I archaeological survey for pre-contact and historic period resources will be required within the preferred alternative Area of Potential Effects (APE), in order to identify any archaeological sites that may be potentially eligible for listing in the NRHP. The historic context (Kuncio *et al.* 2006) developed for the preparation of the historic period archaeological predictive surface, chronicles the local/regional histories and includes the contexts for the evaluation of historic agricultural, lumber, transportation, refractory brick, and bituminous coal related features. The context will also help in the evaluation of identified historic period resources, once they are identified during the Phase I archaeological survey.