Glacial Erratics at Wind Farm Project Area Bourne, Massachusetts: An Intensive Archaeological Survey

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I. GENERAL INFORMATION

A Proponent, proposed the construction of seven 100-meter tall 2.5 MW renewable energy wind turbines and associated infrastructure (access roads and electrical connections) on the north side of the Cape Cod Canal adjacent to routes 25 and 6 in Bourne, Massachusetts. The proposed project is already partially developed in the northeastern section as part of the on-going gravel operation, which encompasses approximately 140 of the 403.5 acres associated with the project. Additional disturbances to the project area include several NSTAR electric utility easements and dirt and paved roads, leaving approximately 260 acres as undeveloped woodland.

Activities associated with construction will include the delivery and erection of the turbines, which will involve the construction of new gravel access roads and gravel widening of existing access roads, as well as the construction of temporary gravel holding areas and gravel crane pads. Existing dirt and paved roads will be used for construction and future maintenance vehicle access when possible. Three of the seven turbines are proposed to be located within existing cleared land associated with the gravel operation area. The remaining four proposed turbine locations have been sited to minimize clearing and grading activities. The siting of all the turbines was done in order to minimize clearing and land disturbance. The foundations of the turbines, the turbines themselves, associated electrical systems, with a small fenced compound around each, and a gravel access road and parking areas for maintenance vehicles will remain upon the completion of the project. All other areas disturbed during construction will be loamed, stabilized, and restored with vegetation. The area of temporary disturbance to be restored will total 9.2 acres and the permanently developed area consists of 2.3 acres, representing approximately 1/2 of 1% of the total land area of the project.

No historic or archaeological sites are recorded as being located within the project area. Review by the Massachusetts Historical Commission (MHC) determined that wind turbines 2, 3, and 4, those proposed within the existing gravel pits, are unlikely to contain intact and potentially significant archaeological resources. The impact areas for turbines 1, 5, 6,and 7 were determined to be archaeologically sensitive. The determination of potential sensitivity was based on the environmental setting, the projects areas situation between several core areas of Native occupation, and the proximity to previously identified archaeological resources within two kilometers of the project area. Predicted evidence of occupation within the project area included trails, landmarks (such as culturally significant

glacial erratics), and occupation sites related to travel between settlement areas. MHC has recommended that an intensive (locational) archaeological survey (950 CMR 70) be conducted with the areas to be impacted by the proposed project.

The project proponent contracted with the Plymouth Archaeological Rediscovery Project (PARP) to conduct an intensive (locational) archaeological survey on their behalf. The survey was conducted in compliance with Massachusetts General Laws, Chapter 9, Sections 26-27C (950 CMR 70-71) and the Massachusetts Environmental Policy Act (MEPA) (301 CMR 11). Fieldwork was carried out at the project area in September 2010 under permit number 3212 issued by the State Archaeologist.

II. ENVIRONMENTAL CONTEXT

The town of Bourne is located on the Coastal Lowlands with drainage formerly being the Monosscusset and Manamet rivers (both destroyed by the digging of the Cape Cod Canal in 1914), the Herring River and Red Brook. The major drainage near the project area is the Cape Cod Canal (formerly the Monosscusset and Manamet rivers). The Cape Cod valley lies within a broad expanse of moraine soils that were deposited between the Cape Cod and Narragansett/ Buzzards Bay ice lobes during the last glaciation. Land surfaces in the remainder of Bourne consist of high hills that reach over 300' which taper down to valleys and hollows approaching sea level (MHC 1981:1). In terms of topography, the project area more closely resembles that of Wareham to the west as opposed to Bourne or Plymouth, both of which are very hilly. Numerous ponds and swamps are located in the northeast and along the river ways making this an ideal area for pasture and harvesting of meadow grasses and salt marsh hay by Plymouth Colony settlers.

The topography of the project area is gently undulating to some steeper sloping land forms derived from outwash and moraine glacial events. The majority of the project area is covered by pitch pine and oak woodland with the southeastern portion being an active sand quarry.

Soils in the western portion of the project area consist of Plymouth loamy coarse sand on 3 to 35% slopes. Plymouth coarse sands are very deep and excessively drained, having been formed on outwash plains, in glacial lake deposits, and on ground moraines at the end of the last glaciation. These soils are poorly suited to agriculture or hay and generally support woodlands. Two isolated wetlands are located in the western portion of the project area in this soil type.

Soils in the eastern portion of the project area are of the Plymouth-Barnstable and Barnstable -Plymouth complexes. Barnstable-Plymouth soils are very deep, excessively-drained soils on moraine derived side slopes (3-15%) and hills and have stones and boulders covering 1-3% of their surfaces. Due to their excessive stoniness, these soils are poorly suited to agriculture or hay production and most exist as woodland. Plymouth-Barnstable soils are extremely bouldery and excessively drained, existing on the side-slopes of moraine derived landforms. Stones and boulder cover 3-15% of the ground surface. They are also poorly suited for cropland or hay and exist as woodland. Field testing found that the soils often contained fist-sized cobbles of gray rhyolite, gray and pink quartzite, and quartz, all materials that could have been used by Native people as raw materials for the production of lithic tools.

III. PREHISTORIC POTENTIAL

Known Prehistoric Sites

A total of 23 prehistoric archaeological sites are recorded in the MHC site files within two kilometers of the two project areas (Table 1).

Table 1. Known prehistoric sites within 2 km of project areas.

Site	Water	Type	Date	Finds
19-BN-870	Unnamed Stream	Find Spot	Unknown	single quartz flake
19-BN-821	Swamp	Find Spot	Unknown	single quartz flake, charcoal
19-BN-690	Monument River	Base Camp?	Late Woodland	Levanna point, debitage, feature
19-BN-685	Herring River	Debitage Conc.	Unknown	Rhyolite debitage
19-BN-656	Monument River	Find Spot	Late Archaic	Possible Quartz Small Stemmed point fragment
19-BN-655	Monument River	Find Spot	Late Archaic	Possible Quartz Small Stemmed point fragment
19-BN-654	Monument River	Find Spot	Late Archaic	Possible Quartz Small Stemmed point fragment
19-BN-653	Monument River	Find Spot	Unknown	one piece quartz shatter
19-BN-650	Monument River	Find Spot	Late Archaic	Possible Quartz Small Stemmed point fragment
19-BN-620	Monument River	Findspot	Unknown	2 quartz flakes
19-PL-345	Swamp	Rockshelter/ Burial?	Unknown	Quartz, quartzite debitage, Burial (?)
19-BN-244	Nightingale Pond	Debitage Conc.	Unknown	Unknown
19-BN-224	Monument River	Base Camp?	Late Woodland	Unknown
19-BN-221	Monument River	Burial Ground	Late Woodland to Contact Period?	Unknown

Decima and Edens (1992) found that of the 32 sites located within five kilometers of the Bournedale Village/ Water Pipe Subdivision project area, a significant distribution of site types was apparent (Decima and Edens 1992: 7). Nine of the sites were located on the margins of large bodies of inland water, six were located on major streams, nine were coastal (four on the shores of Buttermilk Bay and five on the Atlantic Coast), while eight were located farther away from ponds, streams or shores. Cultural material recovered from these nine sites consisted single flakes, point fragments, and a few pieces of worked stone indicating a high rate of extremely thin sites with low visibility but high focus. These sites were often associated with kettle holes and extant or extinct small wetlands (Decima and Edens 1992: 7). The patterns identified by Decima and Edens for the Bourne area are broadly similar to what has been noticed elsewhere in southeastern Massachusetts: large multi-component camps near large bodies of water on lower ground and on higher ground along streams, and thin, usually single-component sites on lower ground near wetlands (Decima and Edens 1992: 8). Unlike other areas in southeastern Massachusetts, Bourne has a more varied topography with more uplands and less extensive wetlands, possibly resulting in a less intense occupation, or a more focused in a smaller number of locations, occupation pattern than elsewhere. The small, sometimes isolated wetlands, provided resources that were analogous to (if less abundant than) those available in neighboring areas with the topographically varied uplands providing resources (deer, and turkey for example) less

available elsewhere in the Bourne area. Added to this the varied resources of the coastal sites and a potential settlement pattern emerges where the average Inner Cape community territory may have been geographically larger than in other areas. Due to the water resource limitations of the uplands, community territory may have may have included a wider variety of geographic setting (stream-side, coastal, upland, pond-side) in order to provide all the community's needs (food, shelter, fresh water, firewood, lithic, floral and faunal raw materials) while in other areas a community would be able to exist within a smaller area due to its richer diversity. In a settlement system such as this, sites that would be found in upland setting would be limited to hunting and task specific extraction camps- sites that would be small, thin, and very focused due to short-term occupation by a small number of people.

Archaeological sites are found in a wide variety of environmental settings with new settings and locations of sites in areas not usually tested by cultural resource management surveys coming to light each year. The majority of sites though are to be found in particular environmental contexts (Funk 1972; Root 1978; Thorbahn et al 1980; McManamon 1984; Mulholland 1984; Thorbahn 1984; Nicholas 1990). Using the contexts of known sites allows archaeologists to predict the likelihood of additional sites in similar environments. These predictive models inform the location and testing interval of archaeological surveys.

In general sites in southern New England appear to be linked to three variables, topography, soil characteristics and proximity to water. These factors can be used to generate a predictive model showing a predominance of sites on flat to low slopes on well-drained soils near fresh or salt water (Robertson and Robertson 1978; Thorbahn et al 1980). These factors can be combined with the proximity to natural resources (clay, lithic raw materials, and seasonal foods) and the use of transportation routes via waterways or land trails.

Prehistoric Archaeological potential can be stratified as follows:

High Potential: 100-200 meters (m) from a fresh water source on a 0-5 degree slope with well drained to excessively well-drained soils and minimal site disturbance;

Moderate Potential: 200-300 m from a fresh water source 5-10 degree slope with well drained to moderately well-drained soils;

Low Potential: >300 m. from a water source, >15 degree slope on poorly drained soils and in a heavily disturbed context.

This predictive model relies on site characteristics identified by Dincauze and Meyer (1977) who compiled data on site location in Essex and Middlesex counties and found that 47% and 76% respectively, of the identified sites occupy land with less than an 8% slope on excessively well-drained soils; whereas 10-20% lie on well–drained soils on 8-15% slopes. In 1983 Kenyon and McDowell studied the distribution of sites along the Merrimack River drainage basin and found 30% of sites on alluvial deposits, 40% on river terraces, and 20% on glaciofluvial deltas, outwash, and lakebeds (Kenyon and McDowell 1983). Almost 90% of the sites were situated within 1000 m. of the river with 60% situated within 200 m. and 75% of these no more than 20 m. in elevation above the river. This study concluded that during both the Archaic and Woodland periods, sites were situated close to the river on alluvial or terrace settings.

In order to understand and help predict the distributions of sites in the project area, it is important to understand the settlement systems that were employed by the prehistoric inhabitants of southeastern Massachusetts Generally, populations who are known or who may have inhabited the area, changed from semi-nomadic hunters and gatherers to more sedentary horticultural populations over time. This change is evident in the distribution of known archaeological sites dating from the various periods. Environmental change since the last Ice Age, led to increased and diversity and stability over time, with the period of the fourth millennium (ca. 4000 BP) being the period of maximum stability (Dincauze and Mulholland 1977). Beginning in the Late Archaic and concurrent with stabilizing environmental conditions, was a shift from a simple foraging economy to a more complex collecting logistic strategy. Changes in economy throughout the prehistoric period have been explored through the use of two main models, one of which is territorial based and another which is logistical based.

Four behavioral aspects are associated with both models: 1) the geographic range of activities carried out by groups; 2) the specialization of resource procurement; 3) the function of specialization in the manufacture and maintenance of tools; 4) the bulk processing and storing of resources. The geographic range and minimum possible territory for a community was hypothesized by the Public Archaeology Laboratory Inc. during their I-495 survey (Thorbahn et al 1980), as 10 km for day trips, the minimum distance to another adjacent community would be 20 km, making the minimum local territory as being approximately 60 km (three times as large as the distance to next closest community) (Thorbahn et al 1980: 169). This means that archaeologically, the materials represented at a site came from five potential spatial intervals from the base camp: 1) on site; 2) off site local (10 km); 3) off site territorial (30 km); 4) non-local regional (100 km); 5) remote regional (300 km).

The first model, proposed by Dincauze (1980), is a **Territorial model**. This model hypothesizes that the response to increasingly stable, predictable and abundant resources in the fourth millennium BP, was a marked reduction in foraging territories. Territory sizes were large during the Paleo-Indian and Early Archaic periods, but they shrank from 8000 to 4000 BP due to local groups becoming increasingly specialized at exploiting resources. After 2500 BP, the environment became less stable and swidden horticulture was adopted as a way to maximize the return from these new smaller territories. A more generalist approach to exploiting the hinterland of the community came into fashion. Without the limits caused by reduced foraging and hunting territories after the fourth millennium, populations could have just expanded their subsistence area to cope with environmental instability. Now, because one community occupied one specific area, expansion without ensuing conflict (e.g. warfare) with neighboring communities, was more difficult. As a way of maintaining social cohesion and relationships, an intensification of the use of predictable, controlled resources was a better option to expansion. After 2500 BP, adoption of swidden horticulture led to relatively permanent, high density settlements in core areas of arable land with foraging continuing over large areas that then became the community hinterlands.

In Dincauze's model, a decrease in territory size of foraging correlates with an increasing specialization of resource use in a stable, diverse and high resource density environment. This should be visible archaeologically with a high function and diversity of tool assemblages across space and through time on both a seasonal and millennial scale and small territories will develop exchange networks for the procurement of essential and useful commodities unavailable locally. This exchange network will be

partially visible through the occurrence of non-local lithics used for tool production at sites as well as an increase in non-local high status items such as copper.

The second model is a **Logistic** based one proposed by Binford (1980). This model is based on the hypothesis that hunter-gatherers have two distinct strategies available to them in time of environmental stress: move their base camp to key resources, or moving their resources to the base camp. The Logistical organization of the hunter and gatherer settlement system reflects the size of the group and the duration of the occupation. This model predicts that in the face of increasing spatial and temporal variation in resources, such as those faced by New England Natives after the fourth millennium, hunter-gatherers are most likely to chose the second option, moving resources to a base camp. Binford termed this foraging and collecting. Foraging is characterized by low spatio-temporal variation in resources with high mobility. Base camps are provisioned by individuals or groups moving between locations in the immediate vicinity (catchment area) of the base camp. Foraging is coupled with collecting, which is when the same base camp is maintained, but there are also field camps, stations and caches at a greater distance from the base camp. These collecting locales are maintained by smaller task groups who procure and process key resources in high bulk for use by all in the community. This model is more concerned with the behavior of hunters and gatherers over their entire range, regardless of the group size. In Binford's model, territory size is not as much of a factor as he did not see a constriction in foraging areas over time. Binford explained an increased number of artifact concentrations at certain sites as being the result of tracking- the tendency for a group to return to the same spot year after year due to specific characteristics of the sites that make it attractive for recurrent settlement. People chose to use the site because it was attractive, not because they had fewer options for occupation.

Three types of sites are predicted for this type of system: **Residential Base Camps (RBC), Foraging Locations (FL),** and **Field Stations (FS)**. At RBCs, large groups of people within the community congregate for weeks or months as the base to which resources foraged and collected in the local area are returned to for redistribution. Within a hunter-gatherer territory, several of these RBCs exist for use during the course of the year. RBCs should not be functionally specific but should be places where a full range of activities related to the manufacture, processing and maintenance took place. FLs were where people from the RBCs hunted and collected wild plants for use at the RBC. FLs were occupied for short periods of time, generally a day or less. FLs should be both functionally and seasonally specific with low archaeological visibility (i.e. low artifact density and little spatial cohesion of artifacts and features at one place). The third type of site, the FS, was where special task groups of individuals collected large quantities of resources (e.g., herring runs). These were occupied for longer periods of time, and were located more than one days walk from the RBC. The resources were stored or processed and transported back to the RBC. FSs and caches are functionally specific for the kinds of activities carried out there and the seasonality when they were carried out. Overall, because they were occupied for a longer period by a larger number of people, there should be evidence of a range of activities comparable to that found at RBCs. Both RBCs and FSs should be marked by indications of the high bulk procurement and processing of resources. After 3000 BP there appears to have been an increase in the FLs and FSs possibly due to the fact that if territories were expanding then the increase in special task group occupations indicates that there was a concomitant increase in the complexity of the logistical organization of the settlement systems (Thorbahn 1984: 219).

The Public Archaeology Laboratory's findings from the I-495 project found that territory sizes were found to have changed over time. They were large from 9000 BP to 4000 BP when they shrank, only to expand after 3000 BP. PAL also found that instead of becoming more specialized with decreasing territory area, as predicted by Dincauze's territorial model, groups underwent differentiation with a fully developed, highly complex, logistic system in place by 3000 BP (Thorbahn 1984: 236). Logistical organization for the Early to Middle Archaic is unclear but there appears to have been an increase in complexity for the Late Archaic to Early Woodland, and that overall, both Dincauze and Binford's models were supported. Approximately 10,000 BP the inhabitants of southern New England operated within large group territories with low logistic complexity and low population density. The resource economy was relatively specialized with a limited range of resources being exploited. This is reflected in a low diversity of tool inventories per deposit (Thorbahn 1984:255).

Environmental stress as a result of a lowered water table (hypsithermal period) led to a high resource heterogeneity both spatially and temporally and a highly specialized approach to resource exploitation within very localized habitats (Thorbahn 1984: 255). Territory sizes were still small at 4000 BP, logistical complexity had increased to a medium level, but population density was still low. A more diverse tool inventory that reflected tool complexity and a generalized approach to resource utilization is evident during this period. At ca. 4000 BP, the territory sizes were at a minimum with the minimum area for one group being approximately 1040 square kilometers with one RBC being located within 20 km of another. This would have created a situation where there were approximately 34 groups in southern New England with each group consisting of 20 to 50 people (Thorbahn 1984: 253).

By 1000 BP, territory size was at a minimum level. The populations maintained a high population density and a high level of logistic complexity. Beginning in the Transitional Archaic and continuing into the Early Woodland, there appears to be indirect evidence of the beginning of a core to hinterland logistic system (Thorbahn 1984: 255).

The project area had a high potential for containing potentially significant prehistoric archaeological resources. Sites predicted for the project area were expected to be small, thin, single-episode sites that were occupied for a short period of time by a small number of people. These sites were expected to represent Foraging Locations (FLs) in Binford's model of settlement systems (Binford 1980; Thorbahn 1984: 219). It was expected that these sites would date to the Late Archaic or later with a higher expectation for Late Archaic or Late Woodland versus other periods. Cowen's findings indicate that the Late Archaic people lived in small social groups that moved often to exploit a variety of resources with a mixed tool kit containing a broad range of tools and production methods. The resource being exploited and the tool that best suited the job determined the tools and methods used at various sites or times. Early Woodland populations were represented by extremely mobile groups that were exploiting resources and returning to a separate base camp. Their tool assemblages reflect this, being composed of bifaces and preforms without much core reduction. The Late Woodland seasonal base camps appear to have been occupied by small family groups tending crops near a main village while the logistical camps were used for the procurement and processing of game and other forest resources to be transported away from the sites (Cowen 1999:605). In southeastern Massachusetts, the number and diversity of Late Archaic sites, and their distribution in riverine and inter-riverine, upland settings suggest a broad-based collecting approach to resource use and considerable attention to small-scale

environmental features, including bogs and kettle-hole swamps (Binford 1980).

Anticipated prehistoric sites were small task camps expected to date from the Late or Transitional Archaic to Contact periods. Small sites were expected to relate to resource procurement activity such as the harvesting of floral and faunal resources from the adjacent wetlands and forest and might have included lithic production and sharpening loci and hearths. At sites such as these, there would have been evidence of lithic reduction, especially from the finishing of bifaces initially prepared elsewhere and the retouching/ resharpening of worn bifacial tools. Expedient tool production and use might have been evident in the form of quartz shatter and unifacial tools. Subsoil features would have been expected to take the form of shallow surface hearths (patches of fire-affected soil and scattered charcoal) or possibly more formal hearths used to heat stones for stone boiling in steatite bowls, as well as discarded fire-cracked rock resulting from stone boiling. Calcined bone may have been present in or near these hearths or scattered around the sites and carbonized botanical remains may have been present in hearth deposits. Material recovered from around potential culturally significant glacial erratics was expected to take the form of higher concentrations of stones in the upper soil horizons, possibly deeper humic deposits (resulting from the decomposition of the boughs and branches historically reported as being deposited around on and such stones) and possibly limited evidence of the use of such locations as camp locations (lithic reduction evidence and hearths).

IV. HISTORIC CONTEXT

Bourne was originally part of the Town of Sandwich until it was incorporated separately in 1883. The area that became Bourne, occupied an important position during the **Contact Period (1500-1620)**. Red Brook, to the west of the project area between Wareham and Bourne, likely formed the boundary between the Agawam community, whose principle area of residence may have been at Brandy Hill in East Wareham and the Manamet community, which had the present day Bournedale and Great Herring Pond as their main community location. Red Brook would have been a peripheral resource procurement and possible habitation locale during this period with families moving from the central winter community, likely centered around Great Herring Pond for the Manamet and the inland portions of the Agawam River for the Agawam, to the Red Brook valley where planting, fishing and shellfish occurred. The present-day Red Brook/ Head of the Bay Road was a Contact period Native trail leading from Agawam to Manamet. Other Native trails in Bourne included the Cape Cod Bay Trail, which followed Brody Road to Scusset River at Sagamore, the County Road which ran east, Bourne Road and a trail from Herring Pond to Monument/ Manamet River, both of which ran from Plymouth to Bourne. All the trails converged at the community of Manamet, where the today's Bournedale is situated. While much of the mainland Native population was devastated by European disease prior to the arrival of the settlers at Plymouth, the Agawam and Manamet areas appeared relatively unscathed.

The first reference during the **Plantation period (1620-1675)** to the area that later became Bourne was a voyage that the Plimoth colonists made to Manamet was near the end of July in 1621. At this time a young boy by the name of John Billington became lost in the woods outside of the plantation and eventually ended up at Manamet. Both Bradford and Winslow relate these events (Morrsion 1984: 87, Young 1974: 217). Canacum, the sachem of Manamet, sent the boy to Aspinet, the sachem of Nauset (present day Eastham). From this trip, Winslow described Manamet thus:

> "This town lieth from us south, well near twenty miles and stands upon a fresh river...It will bear a boat of eight or ten tons to this place. Hither the Dutch or French or both use to come. It is from hence to the bay of Cape Cod eight miles out of which bay it floweth into a creek some six miles almost direct to the town. The heads of the river and the creek are not far distant." (Young 1974:307).

This report fully supports the idea that the town lay between the two rivers at Bournedale. If the distances given by Winslow are compared to a modern map, then the present location is very near the present day Sagamore Bridge and Bournedale. The fresh river referred to by Winslow was the Manamet River and the creek that flowed to the town was the Monoscusset (Scusset).

Following this voyage, the sachem of Manamet, Caunacum, and several other Natives from the southeastern Massachusetts area, signed a document dated September 13, 1621, making themselves subjects to King James of England (Morton 1855: 29)

A second, more extended, trading visit to Cape Cod began in October of 1622. At this time Myles Standish and Tisquantum were to lead a party of men on a trading mission to Cape Cod, but Standish

fell sick and Bradford took his place. Unfortunately, Tisquantum fell sick and died and with no one else able to navigate the shoals, they decided to trade on the northern side of the Cape at Manamet. There he traded for corn and left it there in the charge of the leader, or sachem, of the community, Canacum, who had signed the subjugation treaty in 1621 (Young 1974:305).

Standish and some others went to fetch the corn from Canacum in March of 1623 after he was fully recovered. This party probably traveled as far up the Monoscusset river, at the northern entrance to the present day Cape Cod Canal, as they could and then walked overland to Manamet. It was here that Standish found out that the Natives of Cape Cod, including those of Agawam and Manamet, were in confederacy with those of Wessagusset (Weymouth, Massachusetts) where some other English colonists were abusing natives and provoking them. Later that March, Standish led a force against the natives at Wessagussett and slew several. Those Natives on Cape Cod, fearful due to the fact that the English knew that they were in a confederacy with Wessagussett:

> "… forsook their houses, running to and fro like men distracted, living in swamps and other desert places, and so brought manifold diseases amongst themselves, where of very many are dead; as Canacum, the sachim of Manamet, Aspinet, the sachim of Nauset, and Iyanough, sachim of Mattachiest...certainly it is strange how many of late have, and still daily die amongst them....because the fear they set little or no corn, which is the staff of life, and without which the cannot long preserve health and strength.... none of them dare to come amongst us." (Young 1974: 345)

The first European settlers in the area were servants set out from the Plymouth Plantation who were charged with manning a house established within the Native territory of Manamet. This trading house, also called the house at Aptucxet, was likely located near the mouth of the present day Cape Cod Canal (Chartier 1995). This initial settlement was likely short lived and no further settlement occurred until the 1638 settlement of Sandwich by families from Saugus. During the Plantation Period (1620-1675) settlement loci were located at Manamet and Pocasset with the first meetinghouse being in need of repairs in 1644 and the first gristmill in 1648 (Keene 1975 :29, 31). Two missionaries, Thomas Tupper and Richard Bourne, preached to the natives of Sandwich. Bourne's work focused on the Natives living at what was left of the Contact period community of Manamet around Great Herring Pond in present day Bournedale. Bourne established a meetinghouse here on the south side of Great Herring Pond in the early seventeenth century (MHC 1981: 4).

Red Brook and Buttermilk bay are identified in the 1666 laying out of the bounds of the Agawam purchase" and on the east side with a great salt water cove or river (Buttermilk Bay) and so bounded up along with the brook (Red Brook) unto the head thereof..." (Tritsch 2003: 3-5). Red Brook Road, also called County Road, was laid out in 1684 (MHC 1981: 5). It followed a traditional Native trail that was called comassakumkanet, which has been translated as “the trail going south” (Lovell 1984:21). Buttermilk Bay is believed to have been called wayquonset (Lovell 1984:371). By 1695 it is believed that there was a grist mill built by Elisha Bourne somewhere in the vicinity of Head of the Bay or Bournedale, possibly on the Manamet River (Lovell 1984: 259). In 1678, a deed from a Christian

Native named Nanumett from either the Herring Pond or Breakhart Hill, to his son Ralph (Aspuhchaumake/ Aspackanuck): "Beginning at the great rocke near unto the brooke and from this great rocke upon a strait line unto the Red Brooke and running northerly on this side Partriches Marsh" (Pulsifer 1861: 231).This rock has been identified as the "eyestone", a stone on the eastern shore of Red Brook, but it is probably a rock closer to Herring Pond such as Wampsett or Chamber Rock. Red Brook is also identified by William Bradford Jr. In 1688 as "red alias Gravely brooke" (Konig 1978: 132). The first known European settler in the Red Brook area is believed to have been Israel Fearing who died in 1754. In his will he stated that he left to his son John "my house at Red Brook also ½ of the fruit of the orchard the south half of my little barn" (MSA 1754: 297). Fearing's homesite likely was along Red Brook Road.

A plantation for the praying Indians at Herring Pond was established in 1655 being described as lying at a place called commquessakumkanet, a name translated as "at the rock that stands erect" (Shaw and Merrick 1982: 9). This plantation was described in 1674 as being "...a tract of land preserved for them and their forever...which is near ten miles in length and five in breadth." (Chase 1883: 92). This description would extend from Sagamore to the present location of Route 25 in Bourne.

The western portion of Sandwich was settled during the **Colonial Period (1675-1775**) and County Road, running along Buzzards Bay, was laid out in 1684 while other overland routes were also improved (MHC 1981: 5). Buzzards Bay harbors at Buttermilk Bay and Pocasset became important during this period while as early as 1676 the Monoscusset-Herring-Monument river drainage was explored as a possible location for a cross-isthmus canal linking Cape Cod bay to Buzzards Bay. The Native community at Herring Pond was said to number 226 people over the age of 10 years in 1693, and this population was recorded as close to the same in 1764 (Shaw and Merrick 1982: 11). Overall in Sandwich ,136 heads of households (exclusive of quakers) were recorded in 1730 and by 1765, 245 households and 1, 449 individuals were recorded (MHC 1981: 6). Grist mills were established in North Sandwich by 1695 (Elijah Bourne) and at Monument (Elijah Perry 1739) with corn being the main crop grown and ground (MHC 1981: 6). While herring were caught in the Herring River and sheep was increasingly becoming the most important livestock, the most significant industry for the town was wood exportation. Both Natives and non-Natives engaged in this trade which harvested wood for lumber as well as pine pitch for turpentine, tar and pitch (MHC 1981: 6). A meeting house for the Christian Natives at Bournedale was built in 1765, eventually being moved to Cataumet and used as a Methodist church.

The Herring Pond reservation was created by the Plymouth Colony government for the protection of the Native people who remained neutral during King Philip's War. It is recorded to have had a population of 120 individuals in 1685, all of whom lived in scattered small family units on the bands 3000 acres. Additional hamlets were located at Kitteaumet (aka Monimant [Manomet Ponds]) in Plymouth and at Mannamett in Sandwich (Mandell 1996: 51). John Cotton was their first preacher during the 1670s to 1680s but by 1685 he had been replaced by Captain Thomas Tupper, a man with no scholarly background but who preached to the Wampanoag in their own language (Mandell 1996: 52). Judge Samuel Sewall financed the construction of the congregation's first meeting house in 1688 at Mannamett. By 1693 a total of 226 above the age of 10 from four different communities, including Herring Pond, worshiped at this meeting house and by 1698 a total of 348 people were preached to by

Tupper and two Native preachers (Mandell 1996: 52). One of these preachers was possibly John Neesnumin who was a Sandwich Native minister who later went to preach in Natick by 1717 (Mandell 1996: 58).

Thomas Tupper's son Elisha followed in his father's footsteps and became the preacher to the Natives at Mannamett by 1751, reporting ten years later that the people to whom he ministered were exceedingly poor with 10 individuals between 75 to 90 years of age and unable to labor (Mandell 1996: 124). Tupper's congregation was the largest mainland Native congregation at the time, numbering over 100 families spread across Herring Pond's 300 acres, 12 families at Kitteaumet and 10 at Mannamett (Mandell 1996: 123). The reservation's population grew at a time when, due to epidemics and colonial wars, most other Native communities were shrinking. This was due in part to the community's isolation and their custom of accepting members from other dissolving communities. The economy of the population of the reservation at this time was focused on the harvesting of the seasonal runs of alewives from the Herring River, a right that they legally fought to defend in 1762 from poaching by non-Native neighbors (and which they received no recorded reply about from the courts) (Mandell 1996: 138). At Herring Pond, the population was scattered across the 300 acres, possibly as a result of the generally poor, sandy soils and possibly reflecting pre-Contact settlement patterns, while in the adjacent communities populations tended to cluster more (Mandell 1996: 178).

Herring Pond received a new meeting house in 1767 as this area had eventually become the core of the Christian Native population in southeastern Massachusetts (Mandell 1996: 178). The population of Herring pond in 1779 numbered 108 persons as a result of natural increase and continued in migration from dissolving communities.

The **Federal Period (1775-1830)**, saw an increase in the role of shipping with a route for what would one day become the Cape Cod Canal being surveyed in 1824 and wharves being constructed at Buttermilk Bay and Red Brook Harbor (MHC 1981: 7). The population, as well as the role of industry grew at this time as well. Salt making gained in importance and a woolen mill ans trip hammer were built on the Herring River (MHC 1981: 8). The population of Herring Pond had been halved by 1792 when it was reported that only 120 people lived there (Chase 1883: 93). In 1814 the non-Native overseers of the Herring Pond community petitioned the Massachusetts Legislature to sell 100 acres of the tribe's cleared land in order to repay expenses incurred by the tribe during an epidemic of contagious disease in 1813 (Shaw and Merrick 1982: 11). The legislature agreed to the sale. The population of the tribe numbered 40 persons by 1825. At the time, the Natives of Herring Pond's economic base was focused on the harvesting of wood from their reservation and the cleared land was aresult of the clearing of the area by the removal of the woods. Similar sales occurred from the late eighteenth century into the early nineteenth century, resulting in a loss of up to 2/3 of their reservation land (Shaw and Merrick 1982: 12).

The **Early Industrial Period (1830-1870)**, was one of rapid growth in the area. The population increased to 4496 people in Sandwich, the highway network was improved and in 1848 the Cape Cod Branch of the railroad arrived in Bourne and Sandwich (MHC 1914: 9). Industries in the Bourne area of Sandwich included a nail factory at Bournedale in the 1830s, a woolen mill at Sagamore in 1831, shoe making, which began in 1853, cranberry production in the middle part of the century, and the

export of wood. The wood industry was begun by the Perrys of Monument in the 18th century, and was expanded in the 19th century into the Head of the Bay area (Keene 1975: 64). From the heavily timbered Head of the Bay, large amounts of wood were shipped out along the Manamet River. Wood was piled at Skunk Hole, the northerly most cove of Buttermilk Bay and there was a wharf and landing at Gibbs narrows near Red Brook Harbor (Keene 1975: 65). The year 1850 saw the breaking up of the Herring Pond Reservation with each family and adult over 18 receiving 15 acres (Shaw and Merrick 1982: 12). The 1600 acres that remained by this point were divided in 1859 among 67 individuals and 19 families with 1200 acres held in common (Shaw and Merrick 1982: 12).

During the **Late Industrial Period (1870-1915)**, the town of Bourne became a separate entity. The town proper did not exist until 1883 and before that date, it was considered the western village of the town of Sandwich and it shared in the growth of the town. The economic base of Cape Cod as a whole and of Sandwich in particular blossomed in the early to mid nineteenth century. The growth of Sandwich began with the founding of the Sandwich Glass Company in 1825 (Lovell 1984:279). The economy in the next 25 years was further bolstered by the whaling industry, the arrival of the railroad in 1835, the flourishing of brick kilns and the establishment and growth of mills .

The peak of this economic growth was in the 1850s when the population reached 4479 persons with most of them working in the glass production, mills and maritime industries (Lovell 1984:319). The population began to decline in the 1860s foreshadowing the stagnation of the economy of the town. By 1870 the population had decreased to 3694 persons (Lovell 1984:319). Between 1860 and 1920 the Cape's population decreased by 26% (Brown 1995:204). While the population of the town as a whole was beginning to decline, that of the western village declined slightly from 1870-1883, but it appears that this portion of Sandwich was more isolated from the general population trend affecting Sandwich and Cape Cod in general. The western village maintained its own share of town industry and economic growth. The Keith Car Company which began in 1847 by making tools, axles and ironware expanded its operations throughout the century and eventually focused its production on Pullman cars for the expanding railroad (Lovell 1984:394). Coupled with the growth of the Keith Company was the expansion of the railroad on Cape Cod and specifically its expansion to Woods Hole. The line traveled through the western village and contributed to the tourist trade beginning in the late nineteenth century (Lovell 1984:370).

As a result of the growth in the western village, they sought to incorporate themselves into a separate town. The first attempt at separating from Sandwich was in 1873. This was a result of the rise in the value of the land in the western village where 51% of Sandwich's land valuation lay and the fact that there was a great deal of new construction in the western portion (Lovell 1984:371). While the first attempt at secession was not successful, the second attempt in 1883 was. The town of Bourne was incorporated in 1883 and at this time it included eight schools, six post offices, seven telephones, four churches, two foundries, one railroad car plant, fifteen grocery stores, five blacksmith shops, one lumber yard, one ax factory and eight cemeteries (Lovell 1984:375).

While 1883 represented a year of government freedom for the citizen's of Bourne, economically it was early in the slide of the economy. Although Bourne was its own town, it still was economically tied to its mother town Sandwich and Sandwich's financial future was in doubt.

Probably the main industry in Sandwich was glass making, but by the 1870s this business was becoming increasingly unprofitable. This was the trend on all of the east coast as the markets favored the glass producers in the Mid-west (Lovell 1984:381). The depression of 1874 with its financial panic and associated business depression as well as the power of the unions in creating strikes among workers marked the end of the Sandwich Glass Factory. The factory which at its height employed 520 workers, placed a for sale sign outside of its main factory on October 16, 1888 (Lovell 1984:385). Out of work glass makers tried to form their own company, the Cooperative Glass Co. which had limited success until it too went under in 1911. The failure of the Sandwich Glass Factory was also paralleled by the Cape Cod Glass Works of Sandwich, which closed its doors in 1892 (Lovell 1984:388-389).

The railroad business peaked in the 1890s when Eben Keith was expanding his car works, but at the turn of the century Bourne, as well as Cape Cod faced an uncertain future. The population of Sandwich as a whole continued to decline until 1930 when it stabilized and grew (Lovell 1984:515). Bourne's population, while never as large as Sandwich's grew throughout the century especially after 1920 (Lovell 1984:515).

The economic base of Bourne in the early years of the twentieth century was somewhat uncertain. Manufacturing, the marine industries and farming all experienced substantial losses. Industries continued to close down in town, many of which were reopened by new owners just to be closed down again. Industry always appeared to town planners to have the potential to save the town. The great boom times for Sandwich had been during the Sandwich Glass Company years, and it would appear that many saw the potential for a return to the glory years by encouraging new industry. The potential was never realized and industry never again played a major role in town economics.

The savior of Bourne was the increase in tourism and summer residency in the early twentieth century. As early as 1903 summer residents paid seventy five percent of the town's taxes (Lovell 1984:435). Along with this influx of tourists went the need to house all of them. Many towns along the west coast of Cape Cod were able to accommodate the tourists. Bourne participated in the building boom from the area around the presumed location of Aptucxet to the southern end of the Cape Cod Canal. Sandwich on the other hand was not as affected by the building boom because of the previous population decline. Many of the new residents merely moved into vacant houses in the town (Lovell 1984:499).

The economic gain to the town was accompanied by a cultural loss felt by the year round inhabitants. The small town atmosphere of the town was lost for several months out of the year as the summer residents returned. The local history of the town began to be researched, polished up and put on display for the summer residents. By 1930 two historical businesses formed the core of the historical tourism aspect of Bourne and Sandwich's tourist industry.

The **Early Modern Period (1915-1940**) saw the completion of the Cape Cod Canal in 1935, significantly shortening the route from Buzzards Bay to points north. This period also saw the construction and improvement of roadways leading to Cape Cod, encouraging tourist traffic to Cape Cod and away from the Town of Bourne (MHC 1981:14). This led to some population decline and economic difficulties. Bourne did remain the most industrial town on Cape Cod during this period. The

Keith manufacturing Company as well as foundries at Bournedale and Pocasset provided the majority of the economic base for Sandwich and Bourne. Unfortunately, the Keith Company closed in the 1930s and the economic base of the town quickly shifted to cranberry growing, dairying and the tourist trade (MHC 1981:15). The population of what was formerly the Herring Pond Reservation numbered 42 persons by 1928 with three families owning the land at or near the current project area, but not actually living on it (Shaw and Merrick 1982: 13).

Known Historic Sites

Four recorded historic period sites are located within one kilometer of the project area **(Table 2)**.

Table 2. Recorded historic archaeological sites within one kilometer of the project area

Site	Water	Type	Date	Finds
BOU HA-4	Cranberry Bog	Cranberry Bog	20th century	Bog, associated sand pits
BOU HA-3	Unnamed Wetland	Erratic Boulder	17th-20th century?	None
BOU HA-2	Unnamed Wetland	Erratic Boulder	17th-20th century?	None
BOU HA-1	Nightingale Pond	Homesite	Late 18th-19th century	Ceramics, coal, fieldstone foundation

These sites consist of two culturally significant glacial erratic locations (BOU HA.3 and BOU HA.2), one defunct cranberry bog and one historic homesite located well to the south and west of the project area. Bournedale Road, lying adjacent to the northeast and northwest edges of the project area, and Valley Road, which runs through the center of the proposed wind turbine location 7, are believed to be Contact to Early Historic Period trails that subsequently became roads. The Native community of Herring Pond is centered on Great Herring Pond to the north of the project area and these trails probably linked that community to the communities to the west such as Agawam in Wareham and the marine resources around Buttermilk Bay.

Sacred rocks, sacrifice rock, god's rock (mannittoo asseinah), memorials, wishing places and taverns are names that are synonymous with certain topographic features traditionally associated by Native people with spirits, spiritual powers or history. These places are or were probably once as rich in history and mythology as locations associated with the giant Maushop on Martha's Vinyard (Crosby 1991: 35).

Edward Winslow was the first European to record the Wampanoag's custom of commemorating worthy events by means of trailside markers. Winslow, in 1624, stated that

" Instead of Records and Chronicles, they take this course, where any remarkable act is done, in memory of it, either in the place, or by some path-way near adjoining, they make a round hole in the ground about a foot deep, and as much over, which when others passing by behold, they inquire the cause and occasion of the same, which being once known, they are careful to acquaint all men, as occasion serveth therewith. And least such holes should be filled, or grown up by any accident, as men

pass by they will oft renew the same: By which means many things of great Antiquity are fresh in memory. So that as a man travelleth, if he can understand his guide, his journey will be the less tedious, by reason of the many historical Discourses will be related unto him." (Winslow 1971: 365-367).

While many pre-Contact Native customs and mythology have been lost since 1624, the tradition of trailside markers is one that persisted throughout the centuries. Ezra Stiles recorded in 1762 that there were two memorial stones along the road from Sandwich to Plymouth (Simmons 1986: 251). The stones were located in places that were free of surface stones and the Natives had, since time before remembrance, casted sticks and stones onto the memorials for luck in hunting (Simmons 1986: 252). These stones were described in 1807 as being four and six feet high respectively and 10-12 feet in length, differing from the other glacial erratics encountered only by the rocks scattered on their surfaces (Simmons 1986: 253). The custom continued to be practiced in the nineteenth century when it was recorded in people Mashpee continued to cast sticks and stones onto the so called "sacrifice stones". The English recorder of this custom stated in 1802 that this was dome possibly as an acknowledgment of an invisible agent, as a token of gratitude for a safe journey by a traveler, or possibly as a gesture for good luck (Simmons 1986: 253).

Frank Speck reported that in Mashpee in the early twentieth century they marked locations where Native people had encountered spirits of decreased Natives, as often reportedly happened on journeys, and as these ghosts would not move until placated, the stones were there to act as shrines to place offerings to them (Simmons 1986: 254). The Mashpee Wampanoag would also construct great square, flat-topped lodges covered with brush at certain points along trials where people could stop and offer a piece of property, food, or a libation of whiskey to the spirits (Simmons 1986: 254). By this point these locations were called wishing places or taverns by the local Natives.

Certain attributes may indicate the presence of memorial locations. The first would be proximity to a known/ suspected trail, as these memorials are consistently recorded as being located near trails frequently used by Native people. The presence of a sizable stone in an area relatively free of such stones, or one or more depressions also should mark memorial locations. These depressions could be the result of either a single memorial hole or a holes from decayed posts associated with a square flat-topped memorial lodge. Subsurface testing in such locales could result in the recovery of a high concentration of small stones, a thick humic layer (a result of the disintegration of stick piles or boughs, and possibly offered artifacts including historic period bottles, plates, bowls or other food and liquid service vessels.

Historic Archaeological Potential

General historic settlement patterns have been developed for historical resources in New England and these can be used to help predict where historic archaeological sites may be found (Handsman 1981; Paynter 1982; Walbauer 1986; Wood 1978). Economic geographers have also formulated models on historic settlement that take into account variables such as proximity to water bodies, arable soils, granite outcrops, and gravel and clay beds (Haggett et al. 1977). Proximity to settlement concentrations, freshwater springs, streams and sources of falls for water power also affect where people will settle, especially during the Plantation Period.

Historic Archaeological potential can be stratified as follows:

High Potential: Within 100 m of a major transportation network, within 100 m of fresh water, within 1000 m of a settlement concentration and inclusion on historic maps;
Moderate: Within 100 m. of a major transportation network, within 100 m. of fresh water, within 1000 m. of a settlement concentration, but exclusion from historic maps;
Low Potential: >100 m of a major transportation network, >100 m of fresh water and >1000 m. of a settlement concentration

The project area is located adjacent to Bournedale Road and Valley Road appears to run close to the proposed wind turbine location 7. Valley Road likely became the path for the powerlines path located to the wets of turbine location 7. Nevertheless, both are believed to be Contact to Early Historic Period trails that subsequently became roads. The project area was given a moderate to high potential for containing historic archaeological resources related to occupation and use during the historic period. Due to the lack of permanent water resources in the project area, archaeological resources that may have been encountered were expected to be related to the short term use of the land for lumbering or possibly charcoal production and as a travel route.

V. FIELD METHODS AND RESULTS

A. Justification

The project area had a high potential for containing potentially significant prehistoric archaeological resources. Soils at the site are well-drained, isolated wetlands and depressions occur across it and historic period trails run adjacent to and through the project area. Sites predicted for the project area were expected to be small, thin, single-episode sites that were occupied for a short period of time by a small number of people. The project area was given a moderate to high potential for containing historic archaeological resources related to the short term use of the land for lumbering or possibly charcoal production, as a travel route, and possibly for limited occupation Based on the potential for both historic and prehistoric archaeological material, an intensive survey was justified for the project area.

B. Documentary Research

The Principal Investigator has conducted a preliminary examination of the prehistoric and historic site files, historic maps, reports of previous archaeological investigations within the immediate vicinity of the project area, and the Bourne town report (MHC 1981) at the Massachusetts Historical Commission. A review was also conducted at the Robbins Museum, headquarters of the Massachusetts Archaeological Society. This review facilitated our assessment of the archaeological potential of the project areas and their associated historical and cultural contexts. Research for the final report may also include examination of primary and secondary sources at local repositories, such as the Bourne Town Hall, the Bourne and Sandwich Public Libraries, the Bourne Historical Society, and the Bourne Historical Commission, to provide supplementary information. This information allowed our understanding of the project area's archaeological potential to be refined, and resulted in the creation of a micro-context for predicting and understanding cultural resources within the project area.

Knowledgeable local individuals from, but not limited, the following institutions were interviewed, Plimoth Plantation, Bourne Historical Society, and the Massachusetts Archaeological Society. Inquiries were made at all three of these institutes, but none of the individuals consulted had any additional knowledge beyond that found in the secondary sources, about the project area.

Cultural Resource Management Reports

Five previous archaeological survey have been conducted in close proximity to the project area (Cheney 1982; Cushman 1983; Davin et al 1994; Decima and Edens 1992; Fragola and Leveillee 1999; Graves and Herbster 2007; Herbster 1994; Mueller 1977; Shaw and Merrick 1982). These surveys tested locations along the present Cape Cod Canal, which would have formerly been along the Manomet/ Monument River (Davin et al 1994, Graves and Herbster 2007), along the Route 25 alignment in the uplands and adjacent to Nightingale Pond (Cheney 1982; Cushman 1983; Muller 1977; Shaw and Merrick 1982), along an Algonquin Gas Transmission Company alignment in the uplands (Herbster 1994), and in an area of a proposed subdivision, also in the uplands and associated with a known rock shelter (Decima and Edens 1992; Fragola and Leveillee 1999).

Davin et al's survey along the Cape Cod Canal, tested specific potentially undisturbed areas controlled by the Army Corp of Engineers. Testing to the immediate northeast of the project area identified one

site (19-BN-690) with a Late Woodland association (Davin et al 1994). This site may have been part of a larger base camp/ village site associated with the Contact Period community of Manomet or Commquessakumkanet (Herring Pond). Graves and Herbster's testing along Edgehill Road, immediately to the south of the Cape Cod Aggregate sand pit along the shoulder of Route 6 consisted of the excavation of twenty 50-cm-square test pits spaced 10-m apart along three transects. No cultural material was recovered from this survey. Testing along the Route 25 alignment, which crosses the project area in the western half between proposed turbine locations 1 and 6 on the eastern side and 7 on the western side of Route 25 (Cheney 1982; Cushman 1983; Mueller 1977; Shaw and Merrick 1982). Testing in this area identified six sites, which were designated P1-3 and S1-3, located to the north of the project area. These sites consisted of surface finds of Late Archaic Small Stemmed points, a small collection of quartz flakes from the Wampsett Rock rock shelter, a possible hearth with no associated artifacts, and a single piece of quartz chipping debris and charcoal flecks (Cheney 1982: 4). These sites were located in a slight valley that Valley Road runs through, between Horse Pond to the north and Goat Pasture Pond to the south. Testing by Muller 1977 identified one site (19-BN-244) as a debitage concentration and surface finds (Mueller 1977). Herbster's testing along the Algonquin Gas Transmission Company alignment to the north of the project area, identified one small site consisting of a total of six brown felsite flakes recovered from two test pits (Herbster 1994: 84). The site was located on the top of a ridge overlooking wetlands and cranberry bogs to the east. Testing in the Bournedale Village Farms/ Water Pipe Subdivision project area, located on the north side of Bournedale Road north of the project area, identified one culturally significant glacial erratic (Wishing Rock BOU HA.03) and one previously identified rock shelter (Chamber Rock/ BOU HA.02). Testing around these sites failed to yield any cultural material.

The testing strategy used by Herbster consisted of the excavation of 50-cm-square shovel test pits spaced 10 or 15 meters apart in areas of moderate or high sensitivity. Test pits were placed along single staggered transects within the 66' right-of-way associated with the gas line alignment (Herbster 1994: 18). Sensitivity was based on topographic and environmental variables as well as degree of disturbance. While testing was confined to only the right-of-way, a variety of topographic zones were tested including the edges of isolated wetland components, areas more distant from wetlands, and ridges overlooking larger wetlands. One prehistoric site was found on a ridge overlooking a larger wetland associated with the Herring River (19-BN-685).

The area tested by Fragola and Leveillee for the Water Pipe Subdivision (Fragola and Leveillee 1999), was previously the subject of a reconnaissance survey for the Bournedale Village Farms subdivision seven years previously (Decima and Edens 1992). The northeastern portion of the project area was given a high sensitivity ranking due to the presence of a small stream, wetlands and flatter surfaces. The area around Chamber Rock (BOU HA.02) was considered to have high archaeological sensitivity due to the presence of the possible rock shelter as well as a small pond-like depression. The central portion was given a low sensitivity due to the disturbance caused by power lines that run through this section, the steeper slopes present and the lack of surface water. The western section of the project area also did not have any surface water but was given a high sensitivity due to shallower slopes and its proximity to known archaeological sites identified during the Route 25 survey (Cheney 1982). Decima and Edens predicted that any sites encountered would be small extraction or satellite camps dating to the Late Archaic or later associated with a larger base camp at Herring Pond (Decima and Edens 1992:

11). Fragola and Leveillee's intensive survey of the same parcel ranked the area around Chamber Rock and Wishing rocks (BOU HA.02 and 03) with a high sensitivity based on oral tradition associated with them. The remainder of the project area was subdivided into high to moderate sensitivity and low sensitivity (Fragola and Leveillee 1999: 9). A broad terrace and swale east of Chamber Rock Road and the numerous knolls were given high to moderate sensitivity due to their proximity to Chamber and Wishing rocks and their topographic setting. Areas of steep slope and narrow swales in the central and northeast section were given low sensitivity rankings (Fragola and Leveillee 1999: 11). The areas of high to moderate sensitivity were tested with transects of 50-cm-square test pits spaced 10-meters apart. Testing around Chamber Rock consisted of array test pits placed fiver-meters away from the rock and oriented to the cardinal directions. Two supplemental test pits were placed 10-meters away from it as well. Transect testing in the remainder of the project are consisted of staggered judgmentally-placed transects with test pits spaced ten-meters apart. Testing was limited to areas proposed to be disturbed including house lots, and a proposed soccer field and school. No cultural material was recovered but due to the fact that testing was limited to areas of proposed disturbance, several high sensitivity areas adjacent to an unnamed stream and on top of prominent knolls were not subject to testing.

C. Research Design

a. Theory

The archaeological potential of the project area was developed by analyzing all the environmental and topographic characteristics of the area, the recorded archaeological sites, the distribution of identified prehistoric resources within 2 km of the project area, the documentary records relating to the town, and specifically to the project area. A predictive model for the probability of encountering prehistoric and historic period archaeological resources was developed, based upon proximity to water, soil characteristics and drainage, slope, and disturbance. Native sites have been identified on a wide variety of slope conditions and none of the slopes in the project area are severe enough to limit at least short term habitation.

b. Method

A testing strategy utilizing block and linear transect test pit testing was proposed within the project area. Prehistoric sites as well as historic activity areas are often fairly small and a 10-m sampling interval has been found to yield a nearly 1.0 probability for locating sites 12 m or more in diameter, using 30 x 30 cm shovel test pits (Lightfoot 1986: 493-494). Increasing the test pit size to 50 x 50 cm and decreasing the distance between test pits will increase the likelihood of identifying sites smaller than 12 m. Kintigh (1988:702-703) noted that small test pits were likely to yield artifacts on high-dense sites, whereas larger test pits proved more favorable for artifact recovery on lower density sites, similar to those commonly found in New England (Kintigh 1988: 702-703). The types of potential prehistoric sites predicted for the project area, small temporary single or dual activity resource procurement locales associated with the isolated wetlands, had a high probability for being encountered by using this testing strategy.

c. Intensive Survey Testing Strategy

Intensive survey testing consisted of the excavation of 50-cm square shovel test pits placed in block and linear transect test pit testing configurations. Block testing was proposed for each turbine impact area. Each impact area measures 60 x 60 meters and a block of 60 test pits spaced eight-meters apart was proposed for each of the four turbines located in potentially sensitive areas. Transects consisting of test pits spaced eight-meters apart were proposed for all of the proposed roadways into and throughout the project area. Spacing the test pits eight-meters apart instead the ten-meters that had been used for other intensive surveys in project areas located in close proximity to the this area, was felt to increase the likelihood of encountering the small types of sites expected in this upland setting. The final number of excavated test pits varied slightly due to field conditions and unexpected disturbance. Archaeologists would have also excavated bracket testing at a four-meter interval oriented to true north around test pits located at the edges of blocks or the ends of transects if prehistoric or early historic material had been recovered.

	Proposed testing	Actual Testing	
Block Testing			
Four 60 x 60 m blocks	240 test pits	240 test pits	Blocks 1-4
Transect Testing			
To turbine 1 to 6	45 test pits	55 test pits	Transect 1
To Turbine 1 and 6	24 test pits	15 test pits	Transect 5
To Turbine 7	15 test pits	13 test pits	Transect 4
To Turbine 5	24 test pits	18 test pits	Transect 3
Turbine 6 to road	12 test pits	8 test pits	Transect 2
Total Transect Testing	120 test pits	109 test pits	
Total	**360 test pits**	**349 test pits**	

The final number of excavated test pits varied slightly due to field conditions and unexpected disturbance. Transect 1 was found to be approximately 80 meters longer than was estimated prior to the start of fieldwork. Transect 2 encountered a significant area of disturbance as it approached Block while Transect 3 and 4 were found to be shorter than expected. A portion of Transect 5 was found to be located on a steep slope and testing was not conducted on this section.

All shovel test pits measured 50 x 50 cm. and were excavated through the B2 to the C subsoil horizon. Archaeologists screened all soils through quarter-inch mesh screens to ensure uniform recovery of cultural material. If any material had been recovered, it would have been bagged and recovery locations would have been documented for later processing and analysis. All test pit locations, stratigraphy, and contents were recorded on the appropriate forms and maps. All soil colors were recorded using the Munsell Soil Color Chart.

Two rock shelters were identified previously to the northwest (19-BN-345) and northeast (BOU HA.02) of the present project area. One large erratic with an oral history associated with the Herring Pond Native population (BOU HA.03) has been identified to the northeast of the project area. All of these sites occur in similar topographic settings to the project area. As a result, there is the potential that rock shelters or other potential culturally significant erratics may exist within the project area. The portions of the project area that will be impacted by direct project impacts (turbine locations and roadways) were subjected to a pedestrian reconnaissance survey in order to attempt to identify any possible rock shelters or potential culturally significant erratics. Any possible rock shelters or potential culturally significant glacial erratics that are identified within the impact areas were recorded and subjected to judgmental testing using 50-cm-square test pits if they do not fall within the proposed block or transect testing strategy. Recording took the form of photographic and measured hand drawings as well as complete measurements of the dimensions and descriptions of the area surrounding each potential site. Site forms for any potential rock shelters or potential culturally significant glacial erratics would have been completed and submitted with the draft report. Previously unrecorded historic period or potential pre-contact roads and trails were also sought during the walkover and were recorded in a similar fashion to that described for the potential rock shelters or potential culturally significant erratics.

E. Results of the intensive survey

Block 1 test pit 1 (B1-1) was located at the southwest corner of the proposed impact area associated with Turbine 6 **(Figures 1 and 2).** The block extended to the north and east from B1-1. The area is covered by pine and oak forest with blueberry and small white pine underbrush. The topography was generally flat with some undulation. A dry kettlehole was located approximately 10 meters to the north of Block 1. The area just to the south of Block 1 was found to have been disturbed by heavy equipment earthmoving, probably associated with the dirt road to the south, at some time in the past. The earthmoving left the area with numerous hillocks and trenches and impacted the soils to a depth of at least 50 cm. An exposure of partially buried glacial erratics was encountered between test pits 29 and 56. The erratics averaged one meter in length and 50 to 75 cm in height above the forest floor. A large glacial erratic measuring four meters 30 centimeters long on its long axis (130°), two meters 40 centimeters wide, and one meter thirty centimeters tall was also encountered **(Figure 3)**. Test pit B1-54 was moved so that it lay three meters from the erratic. Test pit B1-44 was located 4 meters west of the same erratic while test pit B1-45 was located two meters from it. Excavation of this test pit yielded a normal profile with no indications that this erratic represents anything other than a random glacial drop (as opposed to showing any signs of cultural significance). No historic or prehistoric cultural material was recovered from this testing segment.

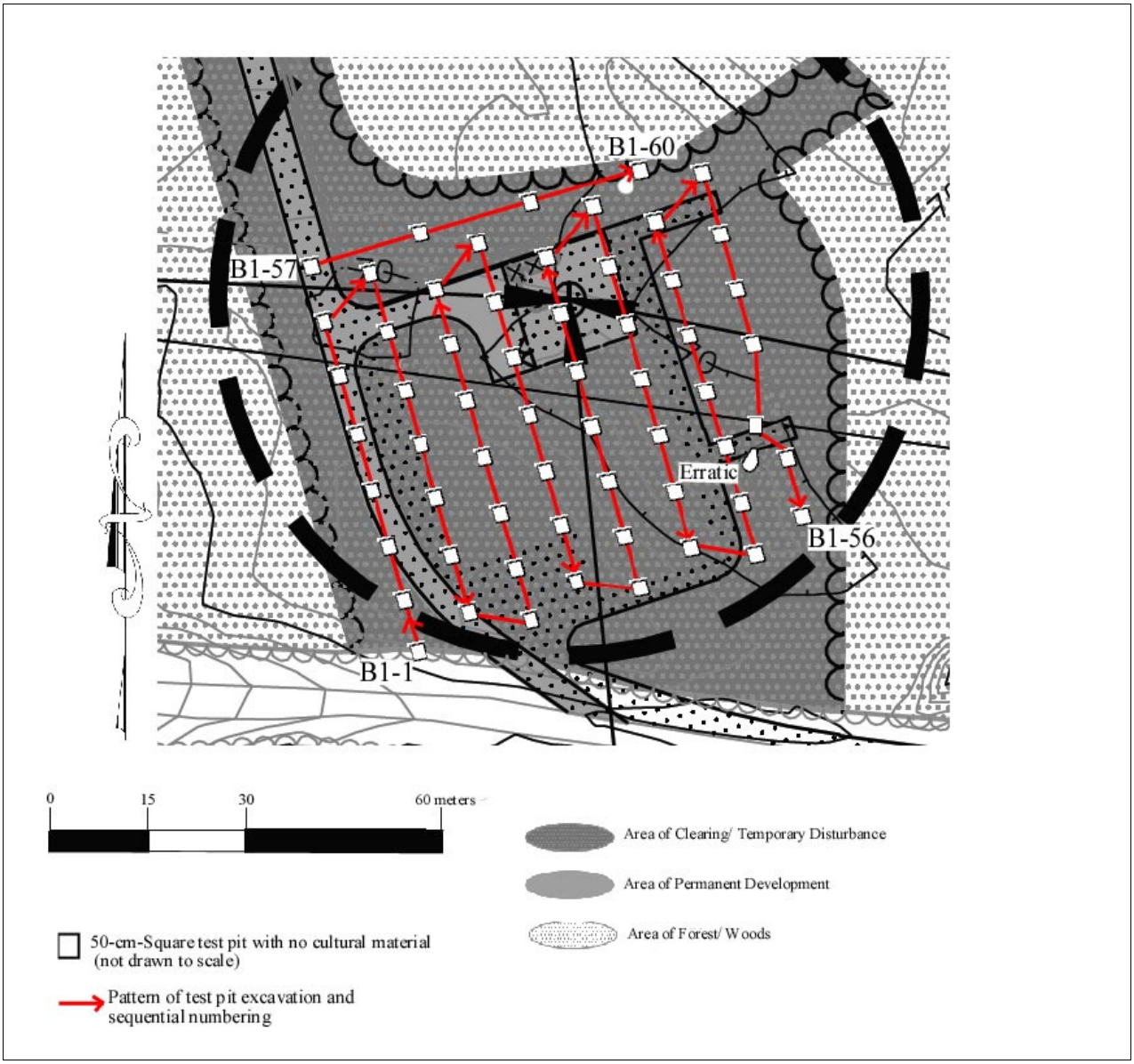

Figure 1. Block 1 testing

Figure 2. Block 1 field conditions, looking northeast from Block 1 test pit 1.

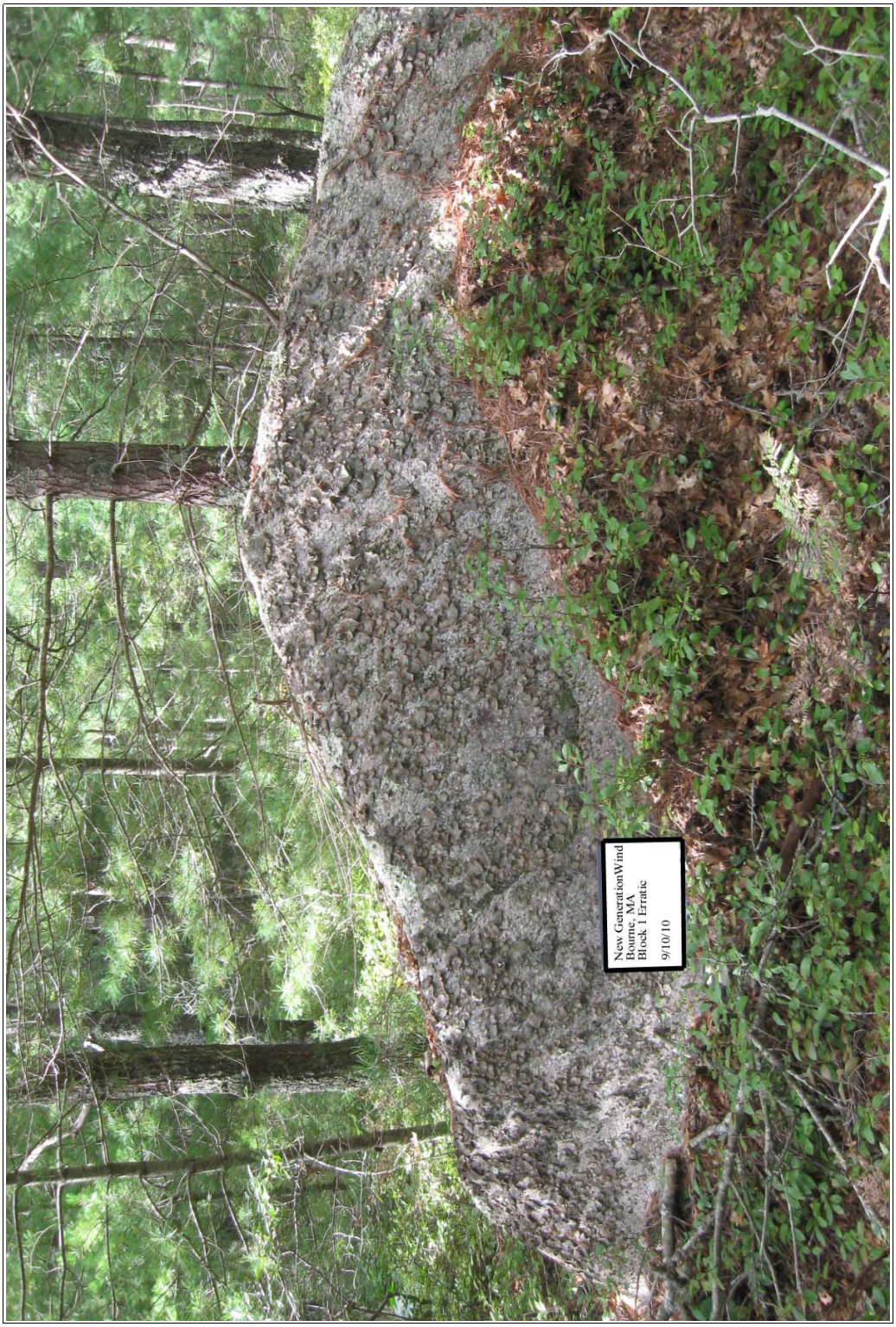

Figure 3. Block 1 erratic looking east. Photo board 50 cm x 40 cm

Block 2 test pit 1 (B2-1) was located at the southeast corner of the proposed impact area associated with Turbine 1 **(Figure 4)**. The block extended to the north and west from B2-1. The area is covered by pine and oak forest with blueberry and small white pine underbrush. The topography was generally flat with some undulation. Several test pits (B2-3, 13, 16, 27, 30, 41, and 43) were located within and adjacent to a historic roadway (a presumed logging road) that ran roughly east to west across the southern half of the turbine location. The roadway was one meter 50 centimeters wide and ran at 252°. Test pits B2-6 and 7 were located at the edge of the rise of the turbine location and overlooked an approximately 10 meter deep dry kettlehole to the east. No historic or prehistoric cultural material was recovered from this testing segment.

Block 3 test pit 1 (B3-1) was located at the southwest corner of the proposed impact area associated with Turbine 6 **(Figure 5)**. B3-1 was located eight meters off the existing powerlines road. The block extended to the north and east from B3-1. The area is covered by pine and oak forest with blueberry and small white pine underbrush. The topography generally flat with some undulation. Several test pits (B33, 11, 12, 17, 18, 25, 26, 31, 32, 39, 40, 46, 53, and 54) were located within and adjacent to a historic roadway (a presumed logging road) that ran roughly east to west across the center of the turbine location. The roadway was two meters wide and ran at 100°. A set of 10 cm deep ruts were located at either edge of the roadway. Several soil dump piles and an area of hummocky disturbed earth were encountered at test pits B3-13, 39 and 42. No historic or prehistoric cultural material was recovered from this testing segment.

Block 4 test pit 1 (B4-1) was located at the southwest corner of the proposed impact area associated with Turbine 5 **(Figure 6)**. The block extended to the north and west from B4-1. The area is covered by pine and oak forest with blueberry and small white pine underbrush. The topography generally flat with some undulation. Large buried cobbles and possible erratcis were encountered in several test pits (B4-7, 9, 10, 15-18, 22, 26-28, 31, 35-37, 39, 40, 48, 50, and 51). No historic or prehistoric cultural material was recovered from this testing segment.

Transect 1 was was located along the centerline of the proposed roadway connecting the Turbine 1 and 6 locations **(Figure 7)**. Transect 1 test pit 1 (T1-1) was located eight meters from test pit B1-8. The area is covered by pine and oak forest with blueberry and small white pine underbrush. The topography generally flat with some undulation. A total of 55 test pits were excavated along this transect. Several test pits (T1-1 to T1-9) were located within a historic roadway (a presumed logging road) that ran roughly north to south along the path of the proposed roadway **(Figure 8)**. The old roadway was one meter 50 centimeters wide and ran at 106°. While the first nine test pits were located in the center of the historic roadway, the remaining test pits transversed the woods between the two turbine locations. This transect ended four meters from Block 2. No historic or prehistoric cultural material was recovered from this testing segment.

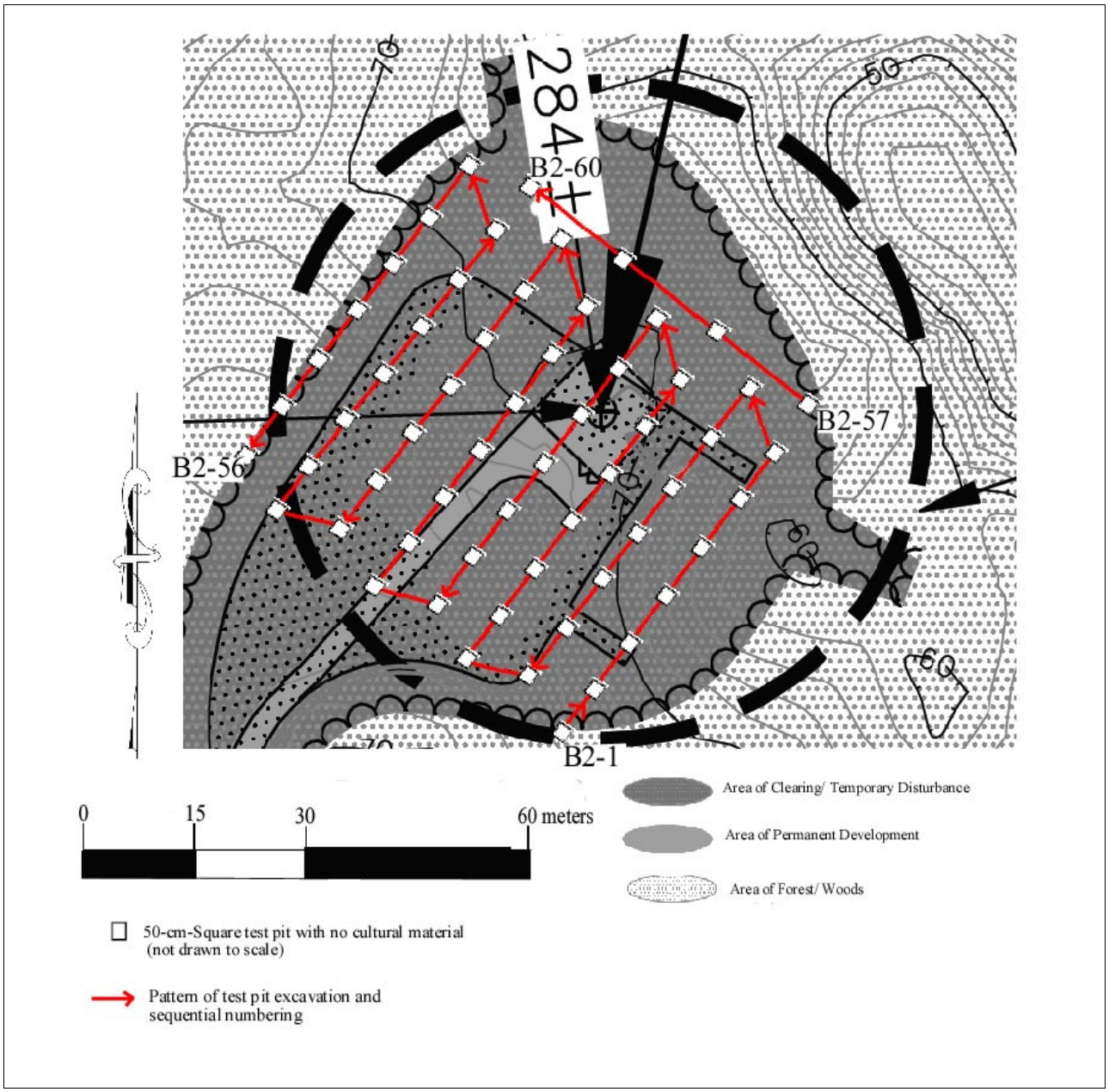

Figure 4. Block 2 testing

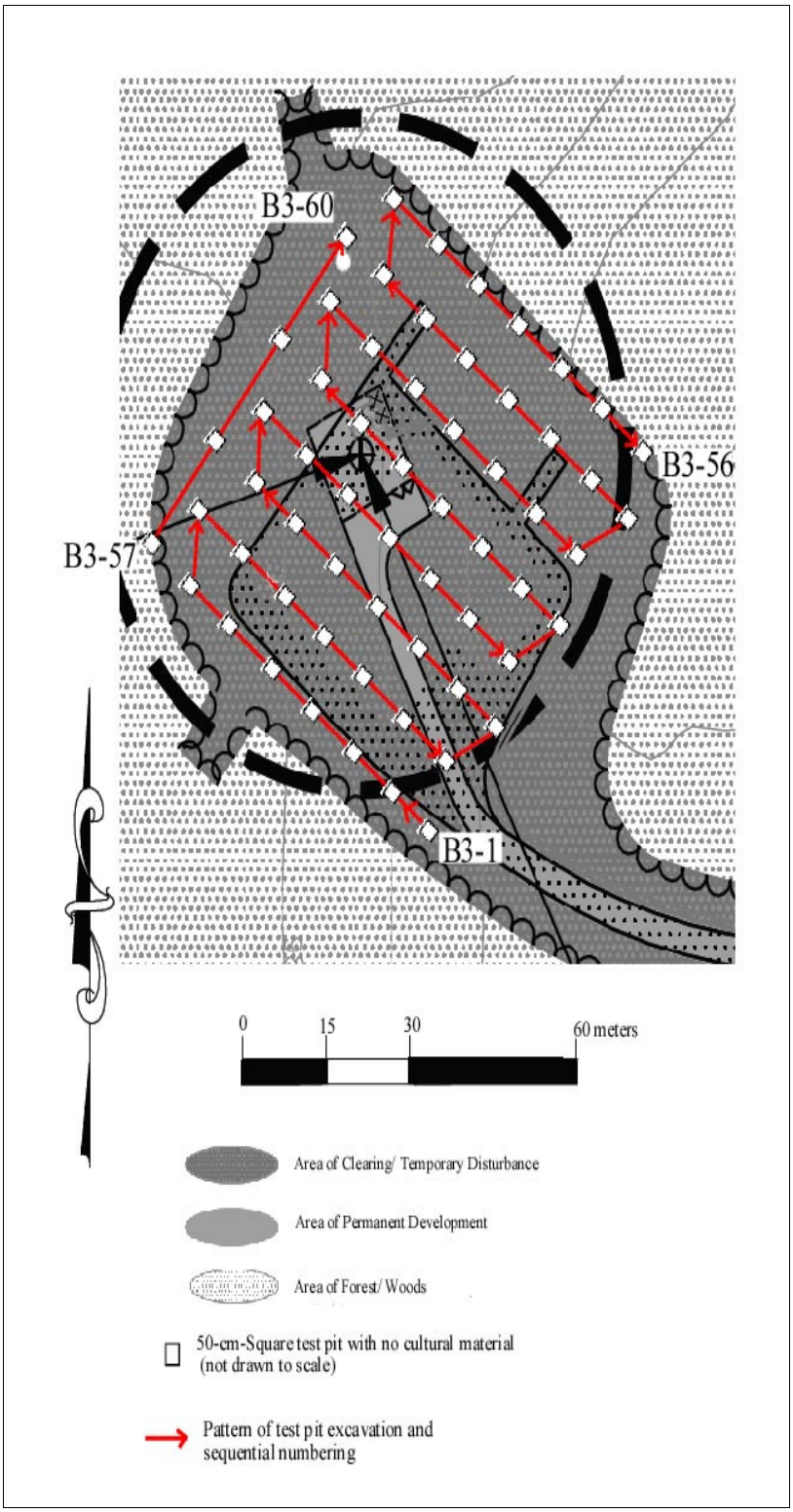

Figure 5. Block 3 testing

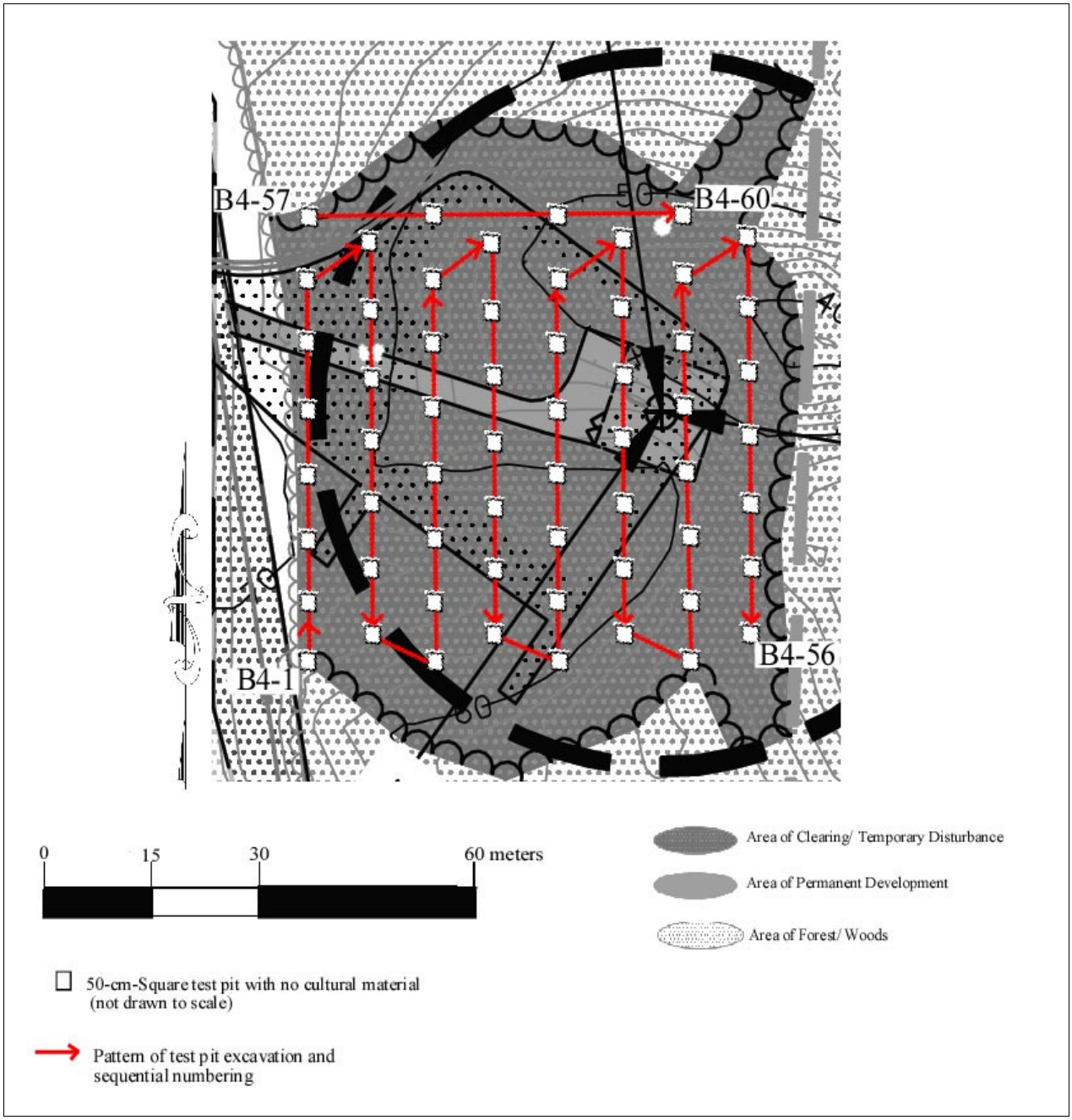

Figure 6. Block 4 testing.

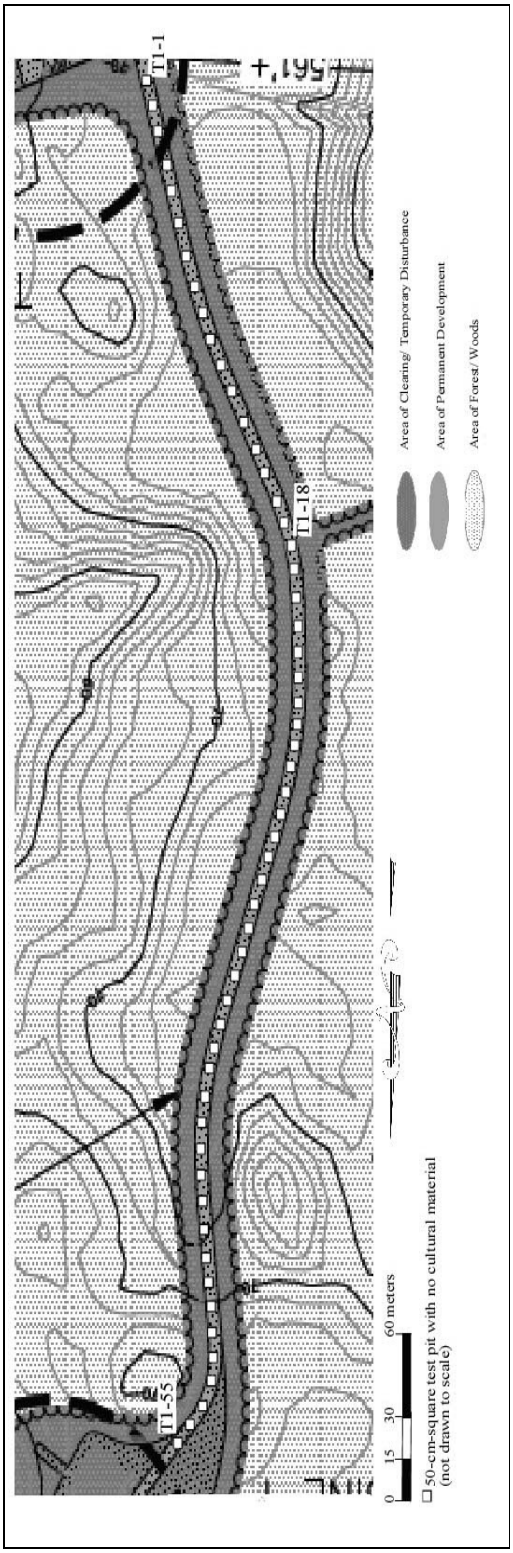

Figure 7. Transect 1 testing

Figure 8. Historic roadway, Transect 1 looking west.

Transect 2 was located along the proposed route through the woods for a roadway from Heather Hill Road to Turbine location 6 **(Figure 9)**. The area is covered by pine and oak forest with blueberry and small white pine underbrush. The topography generally flat with some undulation. Transect 2 test pit 1 (T2-1) was located four meters at 290° off the dirt road into the project area and a total of eight test pits were excavated along this transect. The area at test pit T2-6 was found to be heavily disturbed by earthmoving activities or perculation testing with the result being the presence of a four meter wide by one meter deep depression at this location **(Figure 10)**. This tets pit was moved four meters to the east of its original location and a normal soil profile was encountered. A total of twelve test pits were proposed for this transect but at the proosed test pit locations 9 to 12 a three meter high by four meter long pile of earth was encountered followed by an area o heavy earthmoving disturbance **(Figure 11)**. This was the same area of disturbance noted during the Block 1 testing. Test pits 9 to 12 were not excavated as a result of the disturbance. No historic or prehistoric cultural material was recovered from this testing segment.

Transect 3 was located along the centerline of the proposed roadway to Turbine 5. Transect 3 test pit 1 (T3-1) was located 12 meters at 300° from the edge of Ernest Valleri road **(Figure 12)**. The area is covered by pine and oak forest with blueberry and small white pine underbrush. The topography generally flat with some undulation. Large buried cobbles and possible erratcis were encountered in several test pits (T3-5 to 7 and 14 to 18). Test pit 8 (T3-8) was moved five meters to the southwest from the center line of the road to place it within three meters of a large erratic located just off the proposed road location **(Figure 13)**. This erratic measured five and one half meter long along its 220° longest axis and was three meters wide. The erratic varied in height between one meter 75 centimeters and two meters 50 centimeters. Quartz veins were located on the upper and west faces **(Figure 14)**. None of the quartz veins appear to have been quarried. Excavation of test pit T3-8 yielded a normal profile with no indications that this erratic represents anything other than a random glacial drop (as opposed to showing any signs of cultural significance). Transect 3 ended eight meters from B4-1. No historic or prehistoric cultural material was recovered from this testing segment.

Transect 4 was located along the centerline of the proposed roadway to Turbine 7. Transect 4 test pit 1 (T4-1) was located eight meters east of Bournedale Road **(Figure 15)**. The area is covered by pine and oak forest with blueberry and small white pine underbrush. The topography generally flat with some undulation. Transect 4 ended three meters from the powerlines road. No historic or prehistoric cultural material was recovered from this testing segment.

Transect 5 was located along the proposed connector between the tunnel running beneath Route 25 and the roadway linking Turbine 1 and 6 locations **(Figure 16)**. Transect 5 test pit 1 (T5-1) was located eight meters at 290° from test pit T1-28. The area is covered by pine and oak forest with blueberry and small white pine underbrush. The topography between test pits T5-1 and 9 was generally flat with some undulation. The land exhibits a steep drop at a 50° angle between test pits 9 and 10 for a distance of 24 meters. As a result of this steep drop, test pits 9 and 10 were spaced 24 meters apart. The land from test pits T5-10 to T5-15 was again fairly flat with some slight undulation before dropping off to the gas line paralleling Route 25. No historic or prehistoric cultural material was recovered from this testing segment.

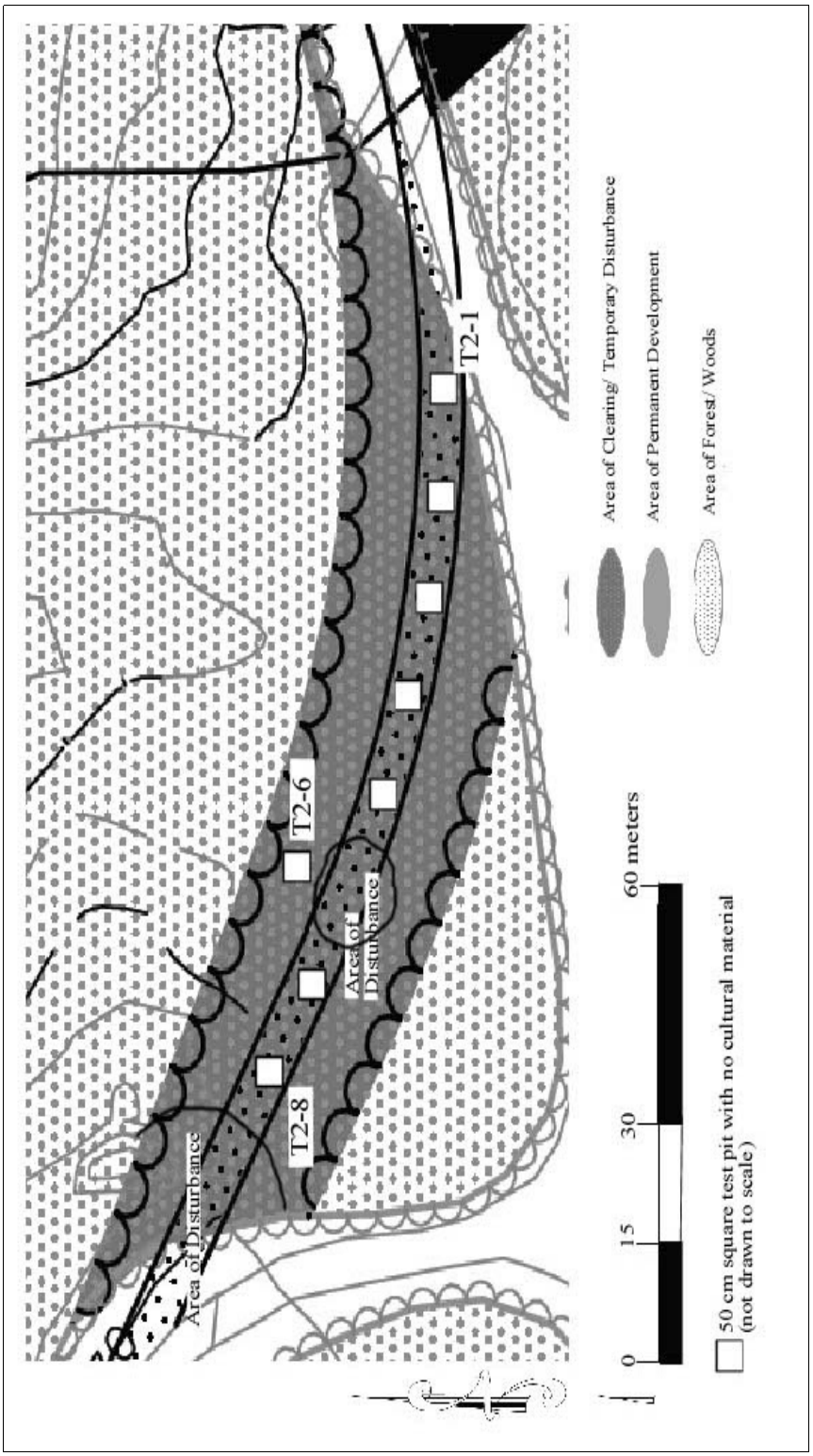

Figure 9. Transect 2 testing.

Figure 10. Transect 2 test pit 6 disturbance looking west..

Figure 11. Transect 2 large earth mound disturbance at test pits 9-12 locations looking northwest.

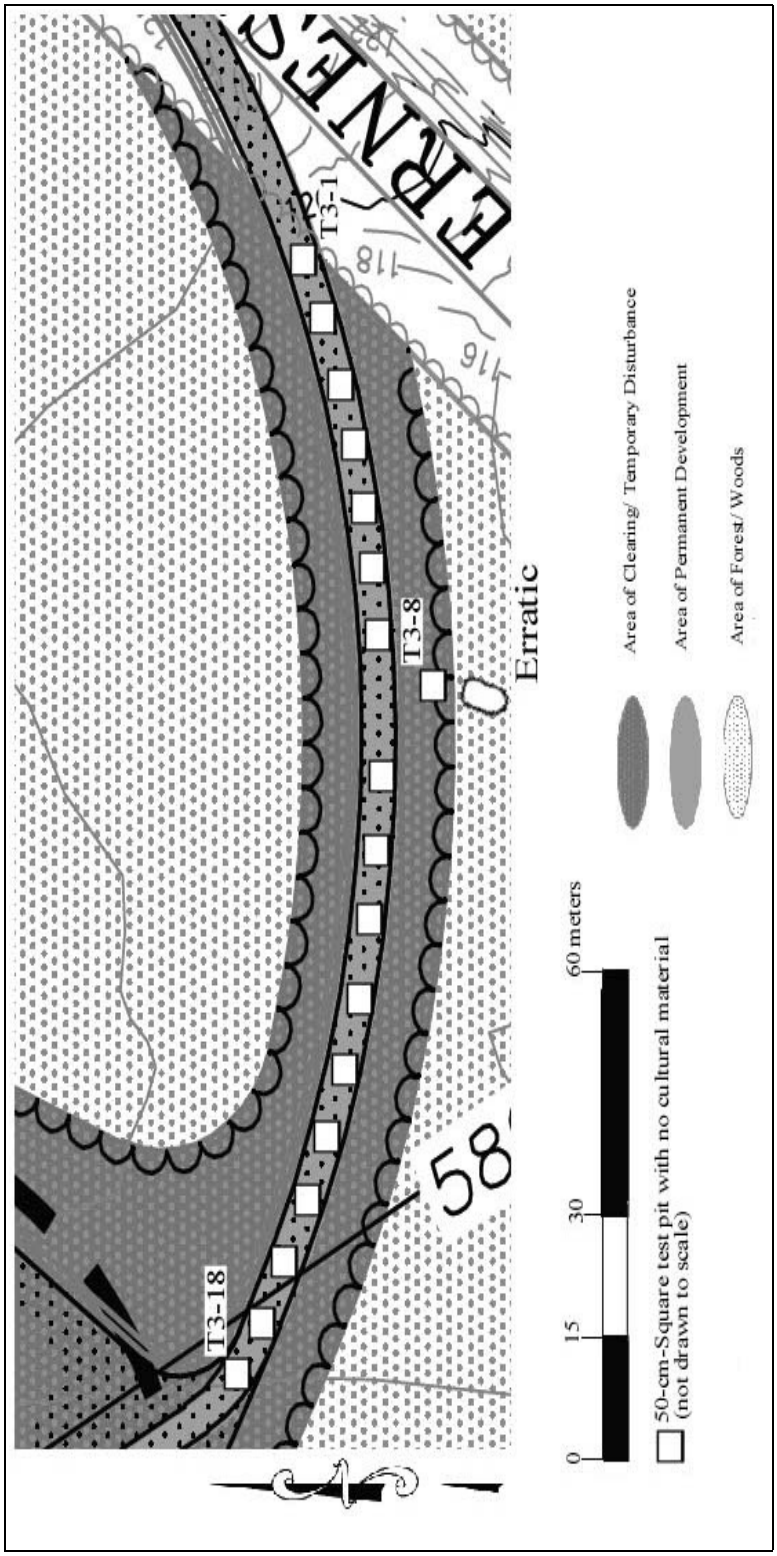

Figure 12. Transect 3 testing.

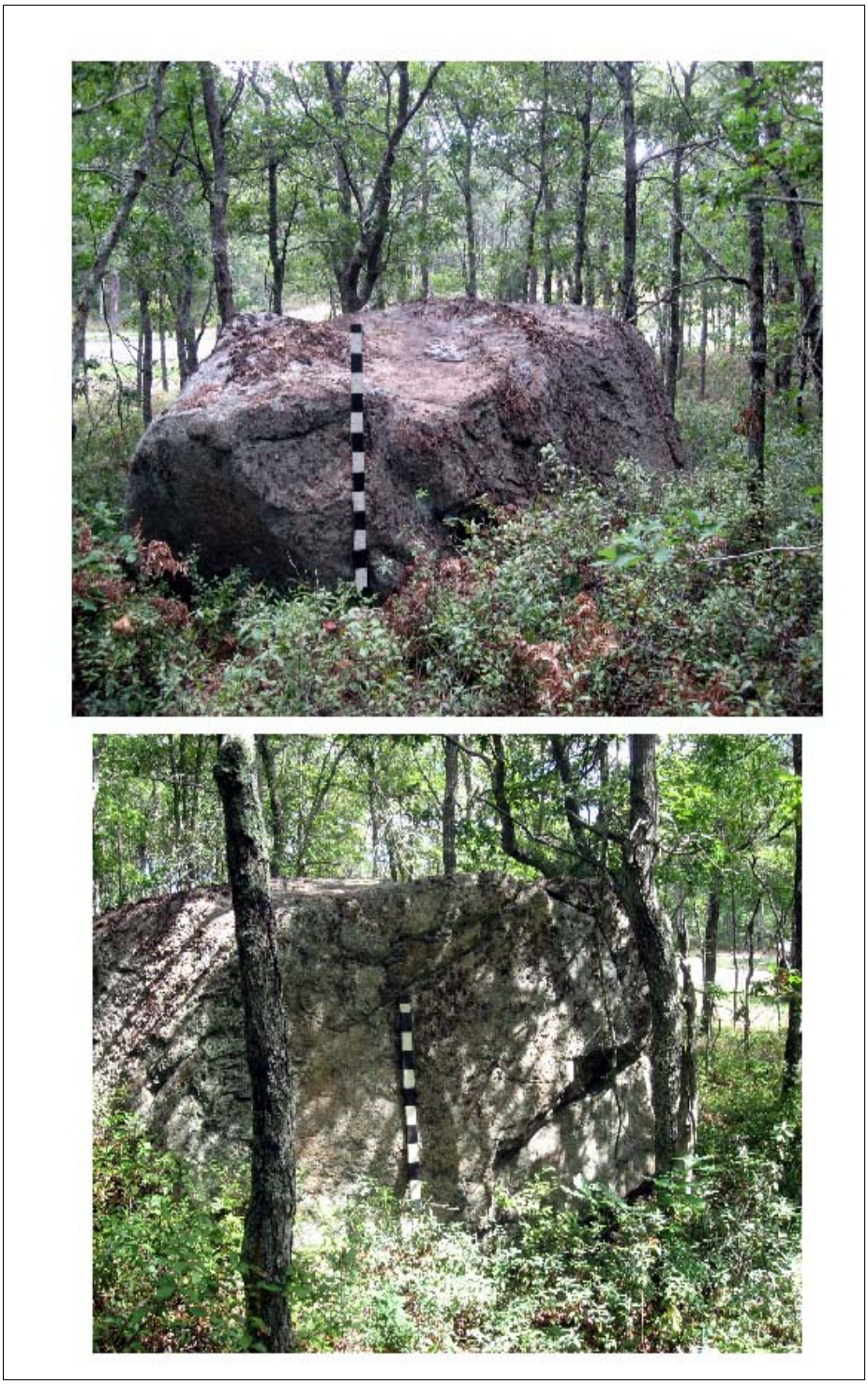

Figure 13. Transect 3 glacial erratic. Top: Looking southwest, Bottom: Looking southeast

Figure 14. Quartz veins on the top of the Transect 3 erratic looking southwest.

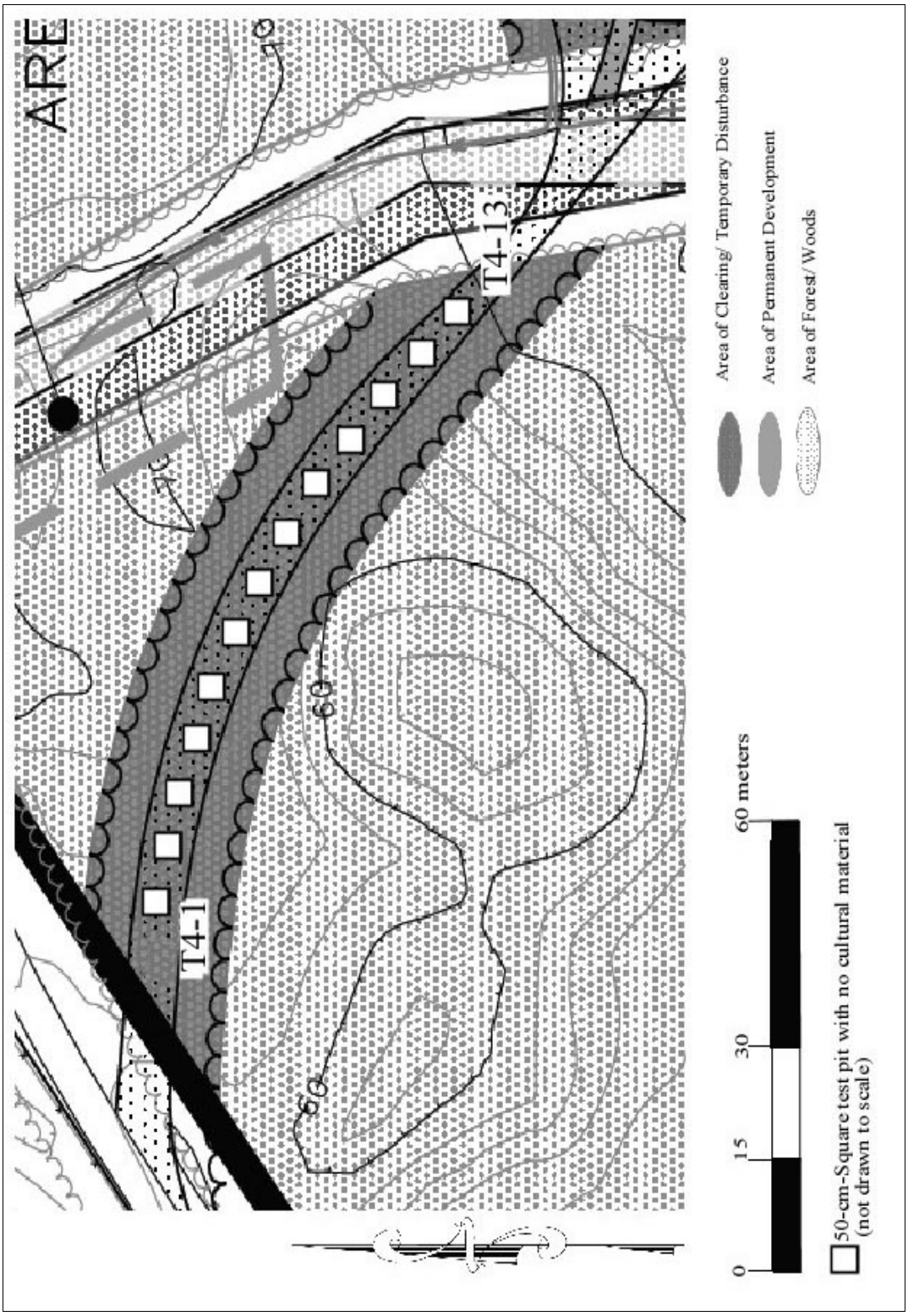

Figure 15. Transect 4 testing..

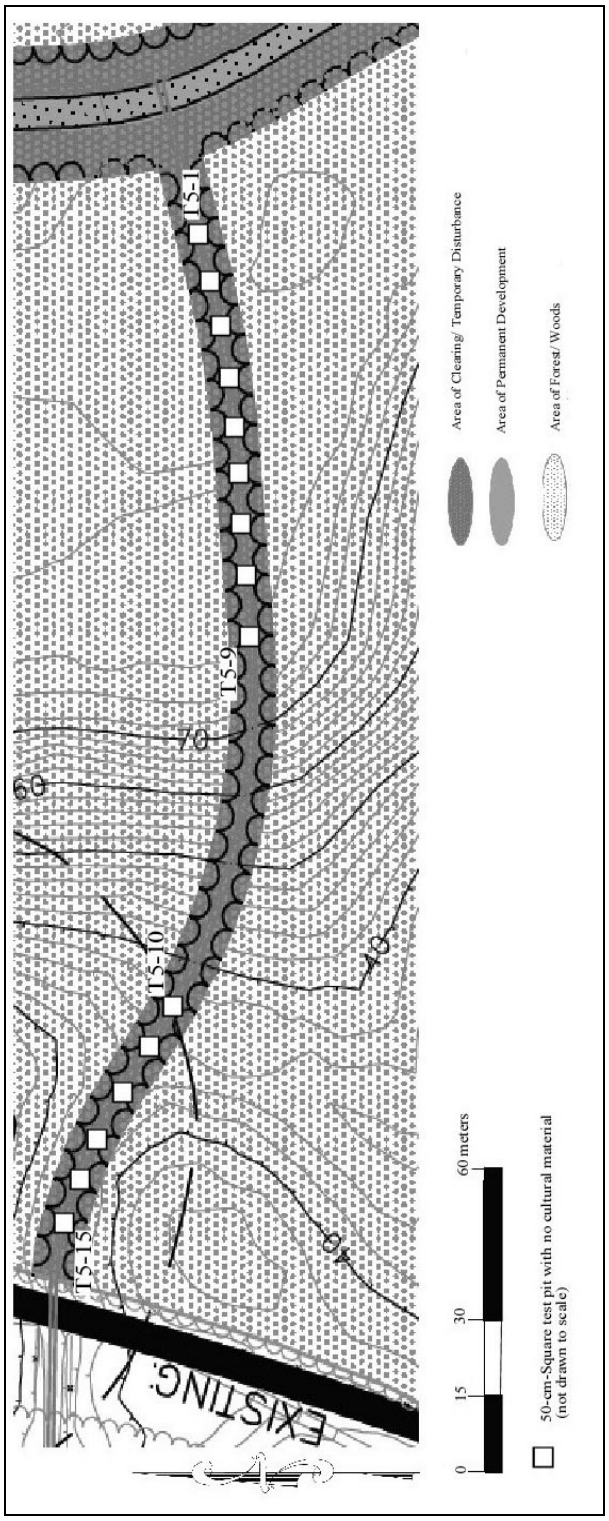

Figure 16. Transect 5 testing.

Test pit excavation across the project area revealed consistent soil profiles **(Figures 17 and 18).** Two distinct profiles were encountered with the type of profile dependent on whether the test pit was located off of the former logging roads crossing the property or whether they were located on it. Soil profiles off of the logging roads consisted of a three centimeter deep A0 horizon followed by a three centimeter deep Ae horizon that was light gray (10YR7/2) in color and consisted of loamy sand. The A1 horizon was below the A0 and extended to an average depth of 10 cmbgs. It was dark grayish brown (10YR4/2) in color and was loamy sand with moderate amounts of gravel. The B1 was encountered below the A1 to an average depth of 40 cmbgs. The B1 horizon was yellowish brown (10YR5/8) in color and was a loamy sand with medium to heavy gravel content. The B2 horizon extended below the B1 to an average depth of 50 cmbgs. It was brownish yellow (10YR6/6) in color and of a loamy sand consistency with moderate to heavy gravel. A layer or rock was often encountered at the B1 to B2 transition. The C1 horizon was excavated to an average depth of 60 cmbgs and was very pale brown (10YR7/4)gravelly coarse sand in texture.

The second type of soil profile was encountered in the areas identified as former logging roadways that crossed the project area in several locations **(Figures 17 and 18)**. The soil profile consisted of an A0 horizon to a depth of 4 cmbgs followed by a layer of loamy sand road fill that was light olive brown (2.5Y5/4) in color and had moderate to heavy gravel content. This road fill was encountered to an average depth of 20 cmbgs. A buried A0/A1 horizon that was was dark grayish brown (10YR4/2) in color and was loamy sand with moderate amounts of gravel was encountered to a depth of 25 cmbgs. The buried A0/A1 rested on top of the B1 horizon. This horizon was yellowish brown (10YR5/8) in color and was a loamy sand with medium to heavy gravel content and extended to an average depth of 60 cmbgs. The B2 horizon, brownish yellow (10YR6/6) in color and of a loamy sand consistency with moderate to heavy gravel, extended to an average depth of 70 cmbgs. The B2 rested upon the C1 horizon. This horizon was very pale brown (10YR7/4) and gravelly coarse sand in texture. It was excavated to an average depth of 90 cmbgs in the test pits that were located on the road.

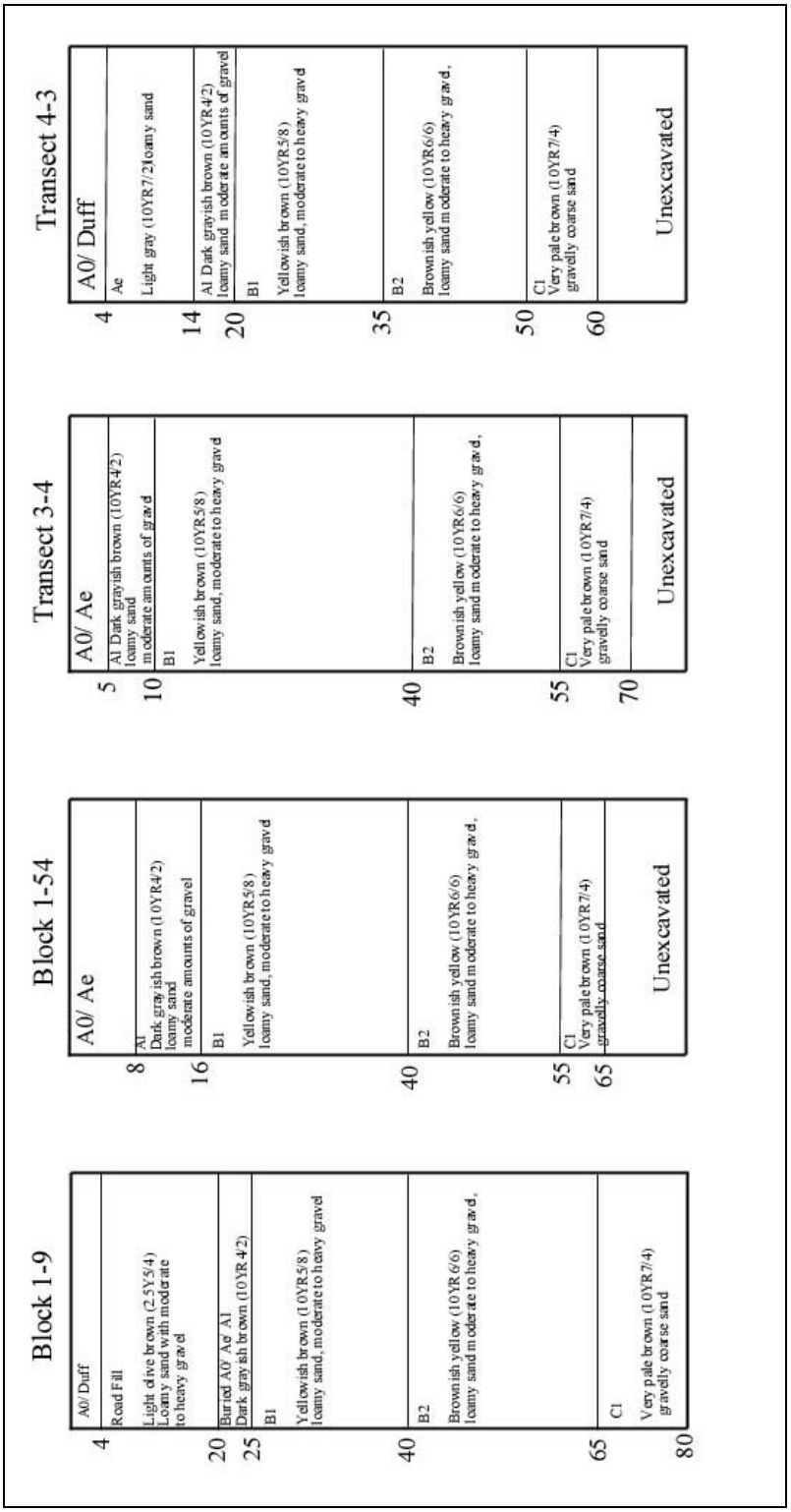

Figure 17. Representative soil profiles.

Figure 18. Representative soil profile pictures.

VI. CONCLUSIONS AND RECOMMENDATIONS

The Proponent, was proposing the construction of seven 100-meter tall 2.5 MW renewable energy wind turbines and associated infrastructure (access roads and electrical connections) on the north side of the Cape Cod Canal adjacent to routes 25 and 6 in Bourne, Massachusetts. The proposed project is already partially developed in the northeastern section as part of the on-going gravel operation, which encompasses approximately 140 of the 403.5 acres associated with the project. Additional disturbances to the project area include several NSTAR electric utility easements and dirt and paved roads, leaving approximately 260 acres as undeveloped woodland. The project area was given a high potential for containing potentially significant prehistoric archaeological resources. Soils at the site are well-drained, isolated wetlands and depressions occur across it and historic period trails run adjacent to and through the project area. Sites predicted for the project area were expected to be small, thin, single-episode sites occupied for a short period of time by a small number of people. The project area was given a moderate to high potential for containing historic archaeological resources related to the short term use of the land for lumbering or possibly charcoal production, as a travel route, and possibly for limited occupation

Fieldwork was carried out at the project area in September 2010 under permit number 3212 issued by the State Archaeologist. A total of 349 50-cm-square test pits were excavated in the areas proposed for testing, Turbine locations 1,5, 6, and 7, and the areas to be impacted by the construction of access roads into and between the project impact areas. Test pits were excavated to an average depth of 60 cm below ground surface encountering loamy and coarse-gravelly sands from the A to C1 horizons.

No cultural material was recovered. The roadways encountered are not considered to be historically significant. No further work is recommended for this project area.

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