U.S. Department of Agriculture
Natural Resources Conservation Service

CONNECTICUT

Preservation of Buried Human Remains in Soil

This bone was located in a Hadley silt loam soil (map unit 105). Hadley soils are rated as having a high potential for preservation of buried remains.

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Introduction

The Soil Survey of the State of Connecticut is a modern soil survey, incorporating current soil taxonomy and standards, addressing land use changes and urbanization, and compiled onto planimetric orthophoto base. The soil survey provides information on the location and characteristics of various kinds of soils within the state, along with interpretations or ratings of the soils based on soil properties.

Soils are typically used by forensic science to link objects and persons with crime scenes. Many cadaver decomposition studies have since shown that processes in soil can also help to locate clandestine graves (Carter et al., 2007) and estimate time since death (Vass et al., 1992). If qualitative soil morphological information can help determine differential preservation, then it may become possible to make predictions prior to excavation using soil survey information.

Purpose

This interpretation is a guide for identifying the likelihood of a burial in soil, the breakdown of a cadaver in contact with soil, and preservation of bone within the state of Connecticut. Soils are the physical context within which both archaeological and buried forensic evidence is found. Thus, it is important that both the archaeologist and forensic specialist understand some of the potential implications of different settings for the preservation of buried human remains in soil.

The information presented here will be useful to groups or individuals involved with archaeological and forensic investigations. For archaeologists, the effects may be dating the site, interpretation of the site composition, and site selection for preservation *in situ* (Jans et al., 2002). For human biologists and forensic scientists, it includes the likelihood of a burial, condition and age of the bones, preserved bone suitable for DNA testing, and an assessment of the relative completeness of the skeleton. For law enforcement professionals, it could be used to understand a localized area for crime scene investigations. Among other things, this soil interpretation may help avoid costly exhumation activities in areas poorly suited to bone preservation, particularly if other methods of discovery are unavailable.

Use Constraints

In obtaining this data from NRCS, it is understood that you and/or your organization have the right to use them for any internal purpose. This data is not designed for use as a primary tool, but may be used as a reference source. This data is not suitable for site-specific studies or litigation. Inappropriate applications would include a decision requiring on-site verification or prejudicial judgment based on the soil potential ratings information alone.

Factors that Influence Preservation

Factors which determine bone preservation are both intrinsic and extrinsic to the individual and may act dependently upon or independently of each other. Intrinsic factors include the chemistry, size, shape, structure, and density of bone, along with pathological changes to bone structure. Extrinsic factors include ground water, soil type, temperature and air, along with the nature of local flora and fauna, method of burial, and human activity (Henderson, 1987; Galloway et al., 1997; Gill-King, 1997). Of all the intrinsic factors, bone mineral density is considered to be the most significant (Galloway et al., 1997). Soil chemistry is believed to be the most influential extrinsic factor in bone diagenesis, once all the soft tissue has been lost (Garland & Janaway, 1989).

There are also cultural factors, such as type of burial and treatment of the cadaver, that influence preservation. In the most recent past, coffins provide the first – and sometimes the only – line of defense against the elements for buried human remains, and different varieties of coffins convey different levels of protection. The intricate lead-lined metal coffins popular during the Civil War era can preserve bones and even soft tissues remarkably well. Above-ground vaults have the same effects on their occupants, primarily because they protect the remains from water. At the other extreme, cardboard coffins were frequently used in the past for pauper burials and offered little protection. A wide range of coffin types exists between these extremes, and variables such as basic design, type of wood, the use of paints, and the types of nails used can all alter a skeleton's chance for survival over time. A recent trend is to place the entire coffin in a sealed rectangular concrete case, which is then lowered into the ground by a backhoe (Nawrocki, 1991)

The preparation of the body itself is also important. Embalming, which became popular during the Civil War because it allowed dead soldiers to be transported long distances to their home towns, has been known to preserve buried soft tissues for as long as a hundred years. Embalming is still widely practiced in the United States. Many other factors, such as the use of burial shrouds and clothes and cremation are important in preservation as well (Nawrocki, 1991).

In the more distant past, Native American burial customs have varied widely, not only geographically, but also through time, having been shaped by differing environments, social structure, and spiritual beliefs. Prehistoric civilizations evolved methods of caring for the dead that reflected either the seasonal movements of nomadic societies or the lifeways of settled communities organized around fixed locations. As they evolved, burial practices included various forms of encasement, sub-surface interment, cremation, and exposure. Rites among Native Americans tended to focus on aiding the deceased in their afterlife, as some tribes left food and possessions of the person in or near the gravesite. Custom usually dictated some type of purification ritual at the time of burial. Certain ceremonies called for secondary interments following incineration or exposure of the body, and in such cases, the rites might extend over some time period. Where the distinctions in social status were marked, the rites were more elaborate (National Park Service, 2009).

Burial in Soil

A number of studies have been conducted to understand cadaver decomposition following burial in soil. It is generally accepted that burial of a cadaver decreases the rate of decomposition (Mann, et al., 1990; Rodriguez, 1997; Fiedler and Graw, 2003) and that the decomposition of a cadaver in soil follows a sigmoidal pattern as shown in *Figure 1.* This figure uses the six stages of cadaver decomposition proposed by Payne (1965): fresh, bloat, active decay, advanced decay, dry, remains.

Soils are likely most valuable to forensic taphonomy following the onset of advanced decay (Tibbett and Carter, 2008). It is at this time that such factors as soil reaction (pH), temperature, and moisture will have the greatest role in decomposition. During the remains stage, prediction of bone preservation in gravesoil is important to forensic scientists and archaeological research and in cultural resources management.

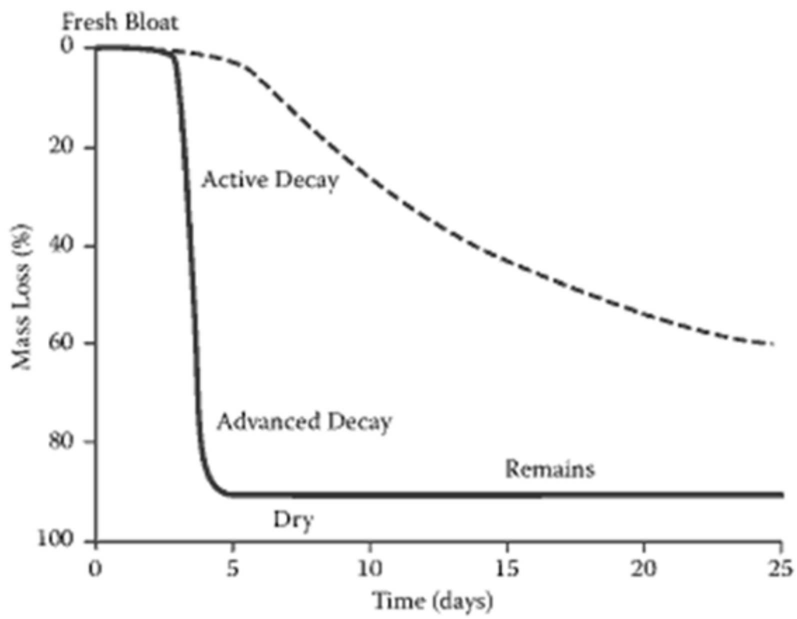

Figure 1. A sigmoidal pattern of cadaver decomposition on the soil surface (solid line) and following a burial in soil (dash line) (Tibbett and Carter, 2008).

Evaluation Criteria

This soil interpretation focuses on soil properties (depth of soil, soil reaction (pH), soil temperature, soil texture, rock fragment content, and soil moisture) that may influence the likelihood of a burial in soil, the breakdown of a cadaver in contact with soil, and preservation of bone.

Depth of Burial and Difficulty Digging

Generally, the burial of a cadaver in soil results in a decreased rate of decomposition as decomposition one week in the air is equivalent to two weeks in water and eight weeks in soils (CAP, 1986). Soils that are shallow to bedrock or restrictive materials make burials unlikely or else the burial is so shallow that decomposition is favored over preservation of bone. Typically, there is a greater level of biological activity at the surface and in the upper soil layers because of the greater availability of oxygen and food (Lawson et al. 2000). In contrast, burial at depth may result in the material being constantly or periodically below a water table which can restrict oxygen availability and decrease decomposition.

Deep burials of more than 1 meter will restrict insect and other invertebrate activity, are unlikely to attract the attention of carnivorous animals (Krogman and Iscan, 1986), and are protected from the temperature fluctuations usually experienced in an ambient environment (Galloway et al, 2001). Cadavers buried in soil usually require one to two years to completely skeletonize (CAP, 1986). Thus, the depth of burial will influence the decomposition of organic materials with greater depth impeding decay (Tibbett and Carter, 2008).

Rock fragments at the surface and in the soil can interfere with burials due to the difficulty of digging. As the number, size, and spacing of rock fragments increases on the surface of a soil – including those that lie on the surface and those that are partly within the soil but protrude from the ground – digging becomes more difficult and the likelihood of burials will decrease.

Soil Reaction (pH)

Correlations between osseous deterioration and soil acidity, as measured by soil reaction (pH), were found to be significant. The pH of soil has the largest influence on bone preservation (Gordon and Buikstra, 1981), with preservation generally advantageous in soils above pH 5.3 and adverse in soils pH 5.3 or less.

Soils containing a highly acidic pH will decompose bone rapidly due to the dissolution of the inorganic matrix of hydroxylapatite (Nafte, 2000). Seventy percent of bone is made up of the inorganic mineral hydroxylapatite (Wikipedia, 2008). Hydroxylapatite, the mineral in bone containing calcium and phosphates, is insoluble in water (Morse, et al., 1983). However, in the presence of an acid environment hydroxylapatite will break down into soluble salts of calcium and phosphorus. If the soil is neutral or basic, a buried skeleton may persist for centuries in good condition. In a corrosive soil environment it is clear that, irrespective of taphonomy, the outcome will be the same: catastrophic mineral dissolution, *see Figure 2* (Nielsen-Marsh et al., 2007).

Figure 2 illustrates the significant increases in bone deterioration related to an increase in soil acidity; the difference in the proportion of completely deteriorated bones more than doubles between soils with pH 6.0 and soils with pH 5.5 (Nielsen-Marsh et al., 2007). Despite the overwhelming differences between sites, site environments, geography, and taphonomic history the bones examined fell into only four major diagenetic categories: basic vs. acidic soils; human vs. animal remains (Nielsen-Marsh et al., 2007).

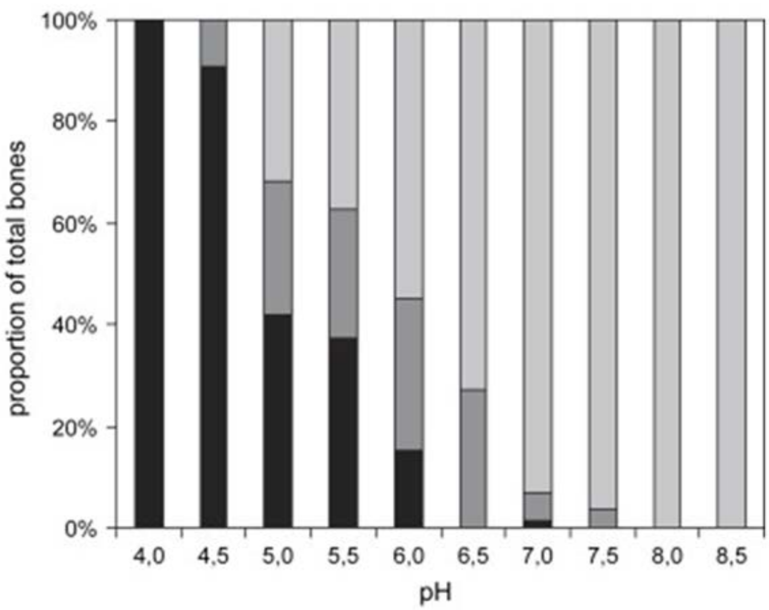

Figure 2. The influence of soil reaction (pH) on bone survival. Black shading, bones absent; medium grey shading, bones with >33% porosity; light grey shading, bones with <33% porosity (Nielsen-Marsh et al., 2007).

Soil pH can also affect adipocere formation. Adipocere is a product of a chemical reaction and can be stable for long periods of time due to its considerable resistance to bacterial action. This resistance allows for slower decomposition and is why it has been recorded on bodies that have been exhumed after 100 years. Mildly alkaline soil is the most favorable to adipocere formation. It can also form in mildly acidic environments, although highly acidic soils will inhibit its formation (Tibbett and Carter, 2008). Adipocere is usually not apparent for about three months after death and becomes more prominent with the passage of time (CAP, 1986). It has been shown that the odor of adipocere is detectable by cadaver dogs searching for clandestine burials (Rebmann et al, 2000).

During the decay process, ammonium concentrations and carbon dioxide liberated by decarboxylation reactions cause an increase of the pH of soils surrounding decomposing remains (Gill-King, 1997; Hopkins et al, 2000; Carter et al, 2008). However, the correlation between the pH of the soil and ammonium is only noticed in acidic soils. Research revealed that no significant increase in pH is observed during decomposition in alkaline soil types (Stokes et al, 2009).

In Figure 3, the influence of pH on the solubilization of bone mineral was researched. The solubility values increase substantially with a decrease in pH, and though are temperature dependent.

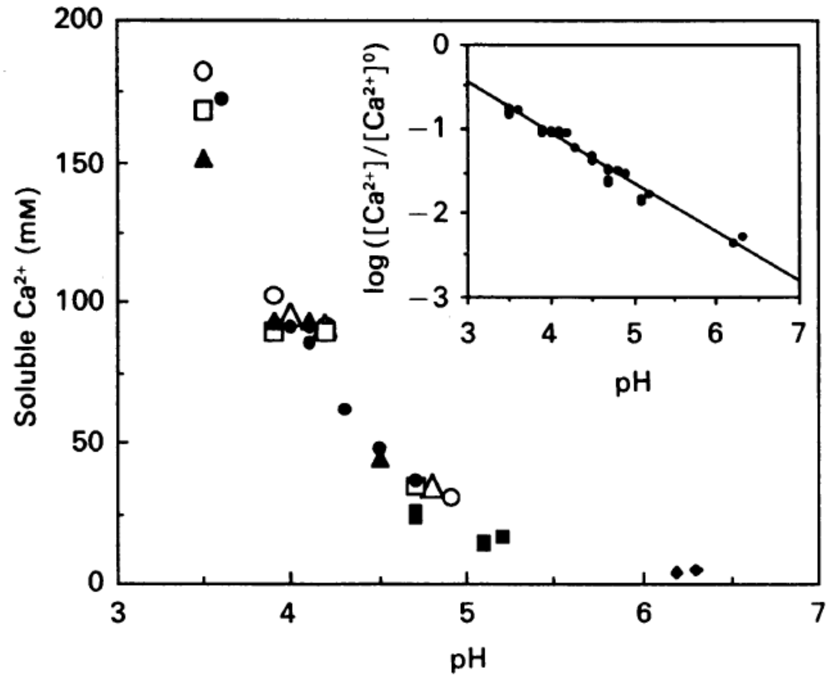

Figure 3. Influence of pH on the solubility of bone calcium (Eeckhout, 1990)

In clandestine burials, it is a common belief that lime can be used to enhance the speed of decay, to reduce the likelihood of detecting a body, to destroy evidence, and that ultimately lime will lead to the rapid and total destruction of human remains (Schotsmans et al, 2012). This belief couldn't be more wrong. Research into the effects of lime in a burial environment has shown that lime decreases the rate of decomposition and results in the formation of adipocere after a 12 month period (Forbes et al, 2005).

Lime can create pH levels greater than 12 and inhibit pathogens by controlling the environment required for bacterial growth. (National Lime Association, 2012). It can also destroy biological waste odors by providing free calcium ions that react and form complexes with odorous sulfur species such as hydrogen sulfide. (National Lime Association, 2012). Overall, the addition of lime can partially negated the effects of the soil environment; delaying the decaying process, restricting the release of cadaveric volatile organic compounds and therefore attracting fewer insects (Forbes et al, 2005).

Soil Temperature

Temperature is regarded as one of the most influential factors of decomposition (Gill-King, 1997; Mann, et al., 1990). It is currently known that the advanced decay and remains stages associated with a 150 pound human cadaver occur at 400 and 1285 accumulated degree days (sum of the average daily temperature), respectively (Vass et al. 1992). Thus an average summer daily temperature of 20 degrees Celsius would result in the onset of advanced decay after 20 days whereas an average daily winter temperature of 2 degrees Celsius would result in advanced decay after 200 days.

Soil temperature has an important influence on biological, chemical, and physical processes in the soil (Mount and Paetzold, 2002). Research shows that temperature can regulate cadaveric decomposition and associated gravesoil microbial activity (Tibbet and Carter, 2008). It has been repeatedly observed that an increase in soil temperature is associated with an increase in the rate of decomposition of buried cadavers (Vass et al. 1992). This is typically due to an increase in biological activity and chemical reaction rates. Putrefaction, the decomposition of organic matter by microorganisms, occurs optimally between temperatures of 21 and 38 degrees Celsius and is considerably retarded at temperatures below 10 degrees Celsius or above 40 degrees Celsius (Mant, 1987; Polson, Gee, and Knight, 1985). Generally, adipocere formation is promoted in warm environments as well, when the temperature is in the range of 22 to 38 degrees Celsius (Forbes et al., 2005a). Predictably, cold soil temperatures will slow the cadaver decomposition, as most soil microorganisms are inhibited by cold and freezing soil conditions.

In New England, bone splintering is often a by-product of the freeze-thaw cycle along with wet-dry cycles of the soil. In many cases, increasing depth will act as a counter balance effect to such effects of the freeze-thaw cycle.

Soil Moisture and Texture

Soil moisture can have a significant effect on decomposition (Swift et al., 1979). Generally, extremely dry environments promote desiccation (Galloway, 1997; Galloway, et al., 1989) whereas extremely wet environments promote waterlogging and adipocere formation. Both of these processes slow cadaver decomposition. This is due to the fact that soil moisture can affect the metabolism of decomposer micro-organisms.

Fluctuations in water activity in the soil is one of the most influential factors influencing microbial activity under field conditions (Lund and Goksoyr, 1980) and produce a wet-dry cycle consistent with the increased turnover of microbial biomass (Jenkinson and Ladd, 1981). *Figure 4* illustrates the significant increases in microbial activity after rewetting.

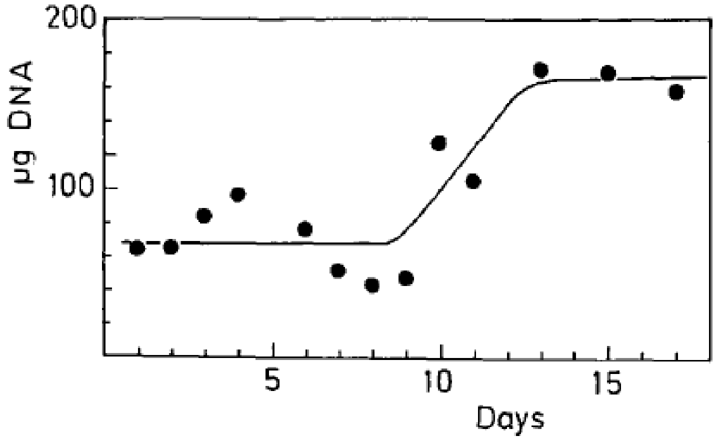

Figure 4. A rapid increase of bacteria DNA per g soil dry weight after rewetting (Lund and Goksoyr, 1980).

Oxygen dissolved in the groundwater is itself another source of gas for decomposition reactions (Dent et al., 2004). Thus, decay rates may exhibit seasonal fluctuations in some regions. This effect can be modified by soil texture because bioavailable moisture is determined, in part, by the suction with which water is held between soil particles, otherwise known as the matric potential (Tibbet and Carter, 2008). Thus, soil texture affects the water content of soils, as fine textured soils retain moisture better than sandy or silty soils (Krogman and Iscan, 1986).

Fine textured soils have been associated with an inhibition of cadaver breakdown due to low rates of gas diffusivity or wet conditions not sufficient enough to meet aerobic microbial demand (Carter, 2005). Where reducing conditions are established, anaerobic microorganisms dominate decomposition and are less efficient decomposers than aerobes (Swift et al, 1997).

In the context of grave soils, several of the products of anaerobic metabolism such as putrescine and cadevarine arise from proteolysis, the breakdown of the body's proteins by enzymes. These proteolysis products are usually present in burial environments and represent the characteristic odors of a decomposing body that are often detectable by cadaver dogs (Rebmann et al., 2000).

Reducing conditions can also promote adipocere (Fiedler and Graw, 2003; Forbes, et al., 2004; Forbes, et al., 2005b) which significantly reduces cadaver decomposition (Dent, et al., 2004; Fiedler, et al., 2004; Froentjes, 1965). Adipocere occurs best in the absence of oxygen in humid environments, such as in wet soil. Adipocere can form in a range of moist soil textures including sand, silty sand, loam, clay and sterilized soil. In a saturated or waterlogged soil environment adipocere will form rapidly; however, adipocere can also form in dry soils, which confirms that sufficient moisture and fat in human bodies may be present for the relevant chemical process to occur (Forbes, et al., 2005b).

Coarse texture soils with a low moisture content frequently promote desiccation (Fiedler and Graw, 2003; Santarsiero et al, 2000) which can inhibit decomposition and result in the natural preservation of a cadaver for thousands of years (Micozzi, 1991). This is due to the large pore content of the coarse texture soils that allow gases and moisture to move relatively rapid through the soil matrix. Coarse textured soils with low moisture contents also promote desiccation because hydrolytic enzymes associated with the cycling of carbon and nutrients are retarded (Skujins and McLaren, 1967). Generally the environmental conditions that will desiccate a substrate are hot-dry or cold-dry (Hansen et al, 1991).

Once dug, soils can never be put back into their original horizonation nor will they have some of the same soil properties. One may say soils never lie. Along with changes to soil color, another soil property that will change due to digging up the soil with a shovel and replacing the soil material is soil bulk density or compaction. Disturbed soils typically are less compact than that of the soils surrounding the grave so that effective porosity and permeability are both greater than equivalent undisturbed material and natural soils (Dent, et al., 2004). This change in compaction occurs in very recent burials and can be identified by pushing your finger into the soil surface.

Connecticut Case Study A

In the summer of 2006, Venture Smith's granddaughter Eliza Smith Roy (d. 1902) was excavated. With a soil pH of 4.9 at 30 centimeters from the soil surface, the acidic soils had decomposed virtually all of the skeletal remains. Coffin remains were identified by soil stains and the presence of hardware. Eliza Smith Roy's rectangular 20th century coffin had elaborate decorative hinges and cloth covering or lining. In addition to coffin remains, her grave yielded earrings, a wedding ring, and her vulcanized rubber false teeth (Perry, 2008).

Figure 5. NRCS Soil Scientist Debbie Surabian performs a pH soil test at the Eliza Smith Roy gravesite (photograph courtesy of John Spaulding).

Figure 6. Outline of Venture Smith's grave shaft. Note the coarse-grained, lighter colored soil from the 2C horizon shows up well against the fine-grained, darker soil of the backfilled material in the shaft (photograph courtesy of John Spaulding).

Figure 7. Elaborate decorative handles remain from Eliza Smith Roy's rectangular twentieth-century coffin. Ornate handles such as these were uncommon in 1902 (the year she was buried) and were usually only afforded by the well-to-do (photograph courtesy of John Spaulding).

The Venture Smith family plot is located in an area mapped as Canton and Charlton soils, 3 to 8 percent slopes. The very deep, well-drained soils formed in ablation till derived from schist, granite, and gneiss. The soil was described as a Canton soil formed in a loamy mantle underlain by sandy till. Average soil pH for Canton is very strongly acid (pH 4.8). Canton soils are considered to have a medium potential for bone preservation.

Connecticut Case Study B

Skeletal remains found at the Walton Family Cemetery site in Griswold, Connecticut date from 1757 to circa 1820. The burials were all in wooden coffins, mostly pine. Bone preservation varied, but, overall was very good in this dry, stratified sand and gravel, excessively drained soil. The remains of a six-month old child were recovered. On the other hand, there was no bone or wood preserved at an adult burial in the same cemetery. Only a burial feature stain and hardware nails still in the position of the coffin outline were identified.

Figure 8. Archaeologists examining a burial site. Notice the stratified sand and gravel layers of the soil (photo courtesy of Nick Bellantoni).

Connecticut Case Study C

Albert Afraid of Hawk was born in 1879 on the Pine Ridge Sioux Reservation in South Dakota. He was a member of the Oglala Sioux tribe. In 1898, Albert became a member of the Buffalo Bill Wild West Show. Traveling along the east coast with the show in 1900, Albert became ill from food poisoning contracted from canned corn. Suffering many hours, Albert passed away on Friday, June 29, 1900. He was buried at the Wooster Cemetery on July 2, 1900. The burial and expenses were arranged by the Buffalo Bill show. Albert's remains would lay in an unmarked grave until records were discovered in 2008. In 2009, members of Albert's family were contacted and wished for Albert to be reinterred with full Lakota honors on the Pine Ridge Reservation in October 2012 (Albert Afraid of Hawk, 2012).

The soil profile description completed at the site indicates this soil is an Agawam soil. These soils are formed in glacial outwash, more specifically, well sorted, loamy material over stratified sands and gravels derived mainly from granite, gneiss, and schist. Agawam soils are well drained having a water table depth of greater than 200 centimeters deep and therefore no fluctuating water table within the soil profile. Agawam soils are considered to have a high potential for preservation of bone in soil. This means they have the best combination of soil characteristics to allow for a deep burial, decreased rate of decomposition of buried cadavers in soil, and accentuate the relative preservation of bone in soil.

The soil profile description completed at the site reveals a disturbed soil profile of a grave shaft. The soil profile consists of a very thick A horizon at the surface and two well developed Bw and BC horizons due to weathering over time. The profile then becomes darker in color due to enrichment of organic material from the burial. The dark brown soil of the ^CA horizon contains bones and artifacts of the coffin such as wood, nails, and handles. Below the ^CA is the natural soil material of the C horizon. The soil reaction (pH) of the soil was moderately acid throughout the profile, ranging from 5.6 to 5.9.

The soil profile for this location is as follows:

0 to 40 centimeters; ^A horizon; very dark brown (10RY 2/2); fine sandy loam; pH 5.9
40 to 65 centimeters; ^Bw horizon; yellowish brown (10YR 5/6); fine sandy loam; pH 5.9
65 to 96 centimeters; ^BC horizon; dark yellowish brown (10RY 3/4); fine sandy loam; pH 5.6
96 to 180 centimeters; ^CA horizon; dark brown (10YR 3/3); fine sandy loam; pH 5.6
180 to 200 centimeters; C horizon; olive brown (2.5Y 4/4); fine sandy loam; pH 5.6

The presence of copper in the form of beads and a ring were also found in the grave. Copper has been shown to influence microorganisms found within soil, which results in much slower decomposition rates (eHow, 2012). Metal uptake by bone during burial is a complex process depending on numerous influencing factors such as geochemistry and concentration of the metal, hydrology of the site, uptake chemistry, and bone structure, porosity, and preservation (Millard and Hedges, 1996). Heavy metals can also accumulate in bone during the lifetime of an individual (e.g. Ambrose et al., 2000; Pyatt et al., 2004; Weisskopfet al., 2009; Wittmers et al., 1988). The copper pieces in this burial clearly influenced the preservation of the bones that were in close proximity to the copper.

The bone preservation at this site was extraordinary. The majority of the skeleton including hand and foot phalanges, some vertebrate, and rib fragments were recovered. All elements showed some damage associated with decomposition.

The preservation of bone at this site may have been aided by the depth of the burial. Deep burials may result in the soil material being constantly below a water table or moist enough to restrict oxygen availability and decrease decomposition. Deep burials of more than 1 meter will restrict insect and other invertebrate activity and are protected from the temperature fluctuations usually experienced in an ambient environment (Galloway et al, 2001). Overall, the depth of burial will influence the decomposition of organic materials with greater depth impeding decay (Tibbett and Carter, 2008).

Figure 9. Handles from Albert Afraid of Hawk's rectangular twentieth-century coffin. A moist towel can be seen draped over the skull. Notice the soil contains no rock fragments and the burial is extremely deep at 96 centimeters.

Connecticut Case Study D

The town cemetery in New Haven, located today on the New Haven Green, operated from 1630 to 1797. In 1797, many of the tombstones from this cemetery were relocated to the newly built Grove Street Cemetery. Some of the bodies did not make the move.

In 2012, a huge storm rolled into New Haven. This storm toppled over a large oak tree known as the Lincoln Oak which was planted in February 1909. The 103 year old oak tree ripped open a large area underneath the root ball and exposed 4 skeletons. The skeletons, 2 adults and 2 children, were located approximately 1 meter below the soil surface in a red, sandy outwash soil material. Due to hardware and brass tacks found at the site, the burials were most likely between 1770 and 1797.

Figure 10. The large Lincoln Oak at the New Haven Green toppled over and uncovered skeletal remains from the old town cemetery used from 1630 to 1797 (photograph courtesy of the Connecticut Archaeology Center).

The dominate soil in this area is called Penwood. Penwood soils are considered to have a medium potential for preservation of bone in soil. These soils have several soil characteristics that favor bone preservation and though properties such as soil reaction (pH) may create conditions which can interfere with bone preservation. Soil pH readings taken in 4 locations revealed pH values of 5.0, 5.1, 5.2, and 5.7. These pH values are rather low making conditions unsuitable for bone preservation. Other soil properties at his site must be affecting bone preservation enough to overcome the acidic conditions.

Penwood soils are formed in glacial outwash, more specifically, well sorted, loamy sands and sands derived mainly from red Triassic rocks with some basalt. These soils are excessively drained and therefore have no fluctuating water table within the soil profile. The coarse textured, sandy Penwood soils have a low moisture content which may inhibit decomposition and result in the natural preservation of a cadaver for many years. This is due to the large pore content of the coarse texture soils that allow gases and moisture to move relatively rapid through the soil matrix. The low moisture content affects the metabolism of decomposer micro-organisms and can slow the rate of decomposition. Coarse textured soils with low moisture contents also promote desiccation because hydrolytic enzymes associated with the cycling of carbon and nutrients are retarded (Skujins and McLaren, 1967).

Figure 11. A rib cage can be seen entangled in the roots of the Lincoln Oak tree on the New Haven Green (photograph courtesy of the Connecticut Archaeology Center).

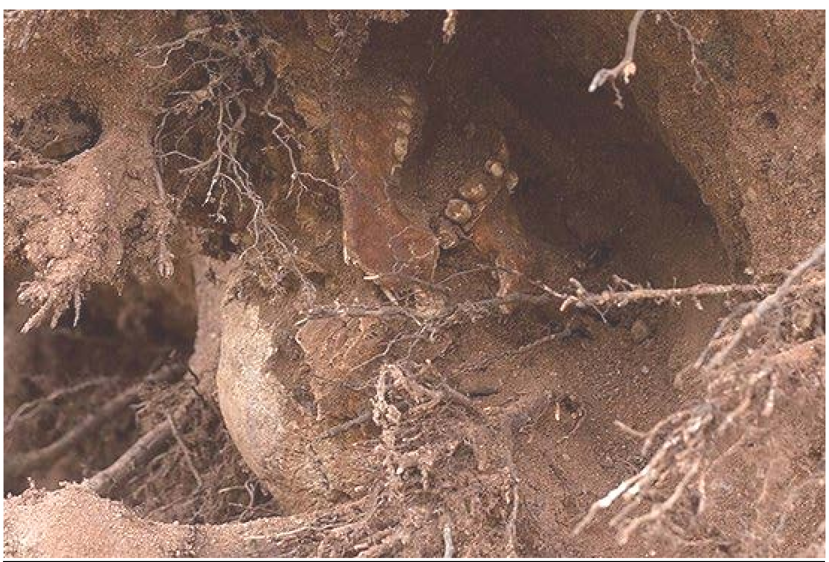

Figure 12. A skull can be seen tipped upside down underneath the toppled tree on the New Haven Green (photograph courtesy of the Connecticut Archaeology Center).

Ratings

Ratings are based on soil properties and qualities to the depth normally observed during soil mapping which is 200 cm (80 inches). The soil potential rating assigned is the maximum rating indices for one or more of the soil properties that may influence the likelihood of a burial in soil, the breakdown of a cadaver in contact with soil, and preservation of bone in the dominant soil(s) of the map unit. Each soil that is mapped in the state of Connecticut will fall into one of the soil potential ratings categories: high potential; medium potential; low potential; extremely low potential; and not rated.

Soil Potential Ratings

The soils information is provided by the USDA Natural Resources Conservation Service (NRCS). The National Soils Information System (NASIS) evaluations and rules were used to assess soil characteristics that may influence the preservation of buried human remains. This provided a standard against which various combinations of soil properties for the soils within Connecticut could be compared. Soils with the best combination of soil characteristics that increase the likelihood of a burial and preservation of bone in soil, and decrease the decomposition of a cadaver in contact with soil were rated the highest. Conversely, soils with several or more soil characteristics that decrease the likelihood of a burial and preservation of bone in soil, and increase the decomposition of a cadaver in contact with soil were rated the lowest. Soil characteristics that either favor or limit the likelihood of a burial, decomposition of a cadaver in contact with soil, and bone preservation in soil form the basis of the rating scheme. For more detailed information on each of these soil characteristics refer to the Evaluation Criteria section.

Rating Classes

The soil potential ratings are defined below.

High Potential – These soils have the best combination of soil characteristics to allow for a deep burial, decrease the rate of decomposition of buried cadavers in soil, and accentuate the relative preservation of bone in soil.

Medium Potential – These soils have several soil characteristics that favor bone preservation; however, properties such as soil reaction (pH) may create conditions that can interfere with bone preservation.

Low Potential - These soils have several soil characteristics that tend to increase the rate of soft tissue decomposition of buried cadavers and impede bone preservation.

Extremely Low Potential - These soils have one or more soil characteristics, such as shallow burials or acidic soil reaction (pH), that tend to rapidly increase the rate of soft tissue decomposition of buried cadavers and impede bone preservation.

Not Rated – Soils labeled *Not Rated* have soil characteristics that show extreme variability from one location to another. These soils may contain human altered or transported materials such as construction debris or dredge material prior to any burials.

Soil Potential Ratings by Map Unit

Connecticut's statewide soil survey identifies and displays the dominant soils in the state. The symbols on the maps identify map units, each map unit representing a unique combination of soils. Areas within the same symbol have similar composition. The name of a soil series is the common reference term, used to name soil map units. The soil series is the lowest category of the national soil classification system.

Table 1 assigns a potential rating to each map unit in the Soil Survey of the State of Connecticut. The list of map units is in order by soil map unit symbol. The potential rating is based on soil characteristics that may influence the likelihood of a burial in soil, the breakdown of a cadaver in contact with soil, and preservation of bone in the dominant soil(s) of the map unit. The majority of map units are composed of one dominant soil or of several soils with similar characteristics. A single potential rating is listed for the dominant soil(s) of the map unit. The limiting soil characteristic(s) for each soil are identified in Table 1 under the column labeled *Preservation of Human Remains in Soil*.

Appendix 1 is a large scale map of bone preservation in soil that identifies the soil potential rating based on the most dominant soil of the map unit for the Soil Survey of the State of Connecticut. Currently, the spatial data is available on the CT NRCS website http://www.ct.nrcs.usda.gov/soils.html. Soils data for Connecticut are available online at the USDA NRCS soil website http://soils.usda.gov. The Web Soil Survey has access to all current soil surveys online and provides maps, legends, reports, and interpretations. The Soil Data Mart has the ability to print a variety of reports and interpretations, and tabular and spatial data for use with GIS software.

In Connecticut, soils were mapped at a scale of 1:12000 with a minimum size delineation of approximately 3 acres. Maps enlarged from the soil survey report do not provide more detailed soils information. More detailed information can only be obtained through on-site investigations. The soil survey is not a replacement for an on-site investigation. The survey identifies the probability of finding a particular soil or combination of soils within a defined area.

Table 1. Preservation of Buried Human Remains in Soil by Map Unit, Soil Survey of the State of Connecticut

Map Symbol and Soil Name	Preservation in Soil
2:	
Ridgebury	Extremely low potential preservation Moderately deep burial Moderate pH Favorable soil moisture
3:	
Ridgebury	Extremely low potential preservation Moderately deep burial Stony surface - Burial unlikely Moderate pH
Leicester	Low potential preservation Stony surface – Burial unlikely Acidic pH
Whitman	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface – Burial unlikely Moderate pH
4:	
Leicester	Medium potential preservation Acidic pH Favorable soil moisture
5:	
Wilbraham	Extremely low potential preservation Moderately deep burial Acidic pH Favorable soil moisture
6:	
Wilbraham	Extremely low potential preservation Moderately deep burial Stony surface – Burial unlikely Acidic pH
Menlo	Low potential preservation Moderately deep burial Stony surface – Burial unlikely Favorable soil moisture
7:	
Mudgepond	High potential preservation
8:	
Mudgepond	Medium potential preservation Stony surface - Burial unlikely Favorable soil moisture
Alden	Medium potential preservation Stony surface - Burial unlikely Favorable soil moisture
9:	
Scitico	High potential preservation
Shaker	High potential preservation
Maybid	High potential preservation
10:	
Raynham	High potential preservation
12:	
Raypol	Medium potential preservation Acidic pH Favorable soil moisture

Map Symbol and Soil Name	Preservation in Soil
13: **Walpole**	High potential preservation
14: **Fredon**	High potential preservation
15: **Scarboro**	High potential preservation
16: **Halsey**	High potential preservation
17: **Timakwa**	Medium potential preservation Acidic pH Favorable soil moisture
Natchaug	Medium potential preservation Acidic pH Favorable soil moisture
18: **Catden**	Medium potential preservation Acidic pH Favorable soil moisture
Freetown	Medium potential preservation Acidic pH Stony surface – Burial possible
20A: **Ellington**	Medium potential preservation Acidic pH Unfavorable soil moisture
21A: **Ninigret**	Medium potential preservation Unfavorable soil moisture Moderate pH
Tisbury	Medium potential preservation Acidic pH Unfavorable soil moisture
22A: **Hero**	Medium potential preservation Unfavorable soil moisture Stony surface – Burial possible
22B: **Hero**	Medium potential preservation Unfavorable soil moisture Stony surface – Burial possible
23A: **Sudbury**	Medium potential preservation Unfavorable soil moisture Moderate pH
24A: **Deerfield**	Medium potential preservation Unfavorable soil moisture Moderate pH
25A: **Brancroft**	Medium potential preservation Unfavorable soil moisture Moderate pH
25B: **Brancroft**	Medium potential preservation Unfavorable soil moisture Moderate pH

Map Symbol and Soil Name	Preservation in Soil
25C: **Brancroft**	Medium potential preservation Unfavorable soil moisture Moderate pH
26A: **Berlin**	Medium potential preservation Unfavorable soil moisture Moderate pH
26B: **Berlin**	Medium potential preservation Unfavorable soil moisture Moderate pH
27A: **Belgrade**	High potential preservation
28A: **Elmridge**	Medium potential preservation Unfavorable soil moisture Moderate pH
28B: **Elmridge**	Medium potential preservation Unfavorable soil moisture Moderate pH
29A: **Agawam**	High potential preservation
29B: **Agawam**	High potential preservation
29C: **Agawam**	High potential preservation
30A: **Branford**	Medium potential preservation Acidic pH Stony surface – Burial possible
30B: **Branford**	Medium potential preservation Acidic pH Stony surface - Burial possible
30C: **Branford**	Medium potential preservation Acidic pH Stony surface – Burial possible
31A: **Copake**	High potential preservation
31B: **Copake**	High potential preservation
31C: **Copake**	High potential preservation
32A: **Haven**	Medium potential preservation Acidic pH Stony surface – Burial possible
Enfield	High potential preservation

Map Symbol and Soil Name	Preservation in Soil
32B: **Haven** .... **Enfield**	Medium potential preservation Acidic pH Stony surface – Burial possible High potential preservation
32C: **Haven** .... **Enfield**	Medium potential preservation Acidic pH Stony surface - Burial possible High potential preservation
33A: **Hartford**	Medium potential preservation Acidic pH Stony surface - Burial possible
33B: **Hartford**	Medium potential preservation Acidic pH Stony surface - Burial possible
34A: **Merrimac**	High potential preservation
34B: **Merrimac**	High potential preservation
34C: **Merrimac**	High potential preservation
35A: **Penwood**	Medium potential preservation Acidic pH Stony surface – Burial possible
35B: **Penwood**	Medium potential preservation Acidic pH Stony surface - Burial possible
36A: **Windsor**	High potential preservation
36B: **Windsor**	High potential preservation
36C: **Windsor**	High potential preservation
37A: **Manchester**	Medium potential preservation Acidic pH Stony surface - Burial possible
37C: **Manchester**	Medium potential preservation Acidic pH Stony surface – Burial possible
37E: **Manchester**	Medium potential preservation Acidic pH Stony surface – Burial possible
38A: **Hinckley**	Medium potential preservation Acidic pH Stony surface - Burial possible
38C: **Hinckley**	Medium potential preservation Acidic pH Stony surface – Burial possible

Map Symbol and Soil Name	Preservation in Soil
38E: **Hinckley**	Medium potential preservation Acidic pH Stony surface – Burial possible
39A: **Groton**	High potential preservation
39C: **Groton**	High potential preservation
39E: **Groton**	High potential preservation
40A: **Ludlow**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
40B: **Ludlow**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
41B: **Ludlow**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
42C: **Ludlow**	Low potential preservation Stony surface – Burial unlikely Acidic pH Moderately deep burial
43A: **Rainbow**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
43B: **Rainbow**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
44B: **Rainbow**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
45A: **Woodbridge**	Medium potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
45B: **Woodbridge**	Medium potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
45C: **Woodbridge**	Medium potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture

Map Symbol and Soil Name	Preservation in Soil
46B:	
Woodbridge	Low potential preservation Acidic pH Unfavorable soil moisture Moderately deep burial
46C:	
Woodbridge	Low potential preservation Acidic pH Unfavorable soil moisture Moderately deep burial
47C:	
Woodbridge	Low potential preservation Stony surface - Burial unlikely Acidic pH Moderately deep burial
48B:	
Georgia	Medium potential preservation Unfavorable soil moisture Moderate pH
Amenia	Medium potential preservation Unfavorable soil moisture Stony surface – Burial possible
48C:	
Georgia	Medium potential preservation Unfavorable soil moisture Moderate pH
Amenia	Medium potential preservation Unfavorable soil moisture Stony surface - Burial possible
49B:	
Georgia	Medium potential preservation Unfavorable soil moisture Stony surface - Burial possible
Amenia	Medium potential preservation Unfavorable soil moisture Stony surface - Burial possible
49C:	
Georgia	Medium potential preservation Unfavorable soil moisture Stony surface - Burial possible
Amenia	Medium potential preservation Unfavorable soil moisture Stony surface - Burial possible
50A:	
Sutton	Medium potential preservation Acidic pH Unfavorable soil moisture
50B:	
Sutton	Medium potential preservation Acidic pH Unfavorable soil moisture
51B:	
Sutton	Low potential preservation Acidic pH Unfavorable soil moisture
52C:	
Sutton	Low potential preservation Stony surface – Burial unlikely Acidic pH

Map Symbol and Soil Name	Preservation in Soil
53A: **Wapping**	Medium potential preservation Unfavorable soil moisture Moderate pH
53B: **Wapping**	Medium potential preservation Unfavorable soil moisture Moderate pH
54B: **Wapping**	Medium potential preservation Unfavorable soil moisture Stony surface – Burial possible
55A: **Watchaug**	Medium potential preservation Unfavorable soil moisture Moderate pH
55B: **Watchaug**	Medium potential preservation Unfavorable soil moisture Moderate pH
56B: **Watchaug**	Medium potential preservation Unfavorable soil moisture Moderate pH
57B: **Gloucester**	High potential preservation
57C: **Gloucester**	High potential preservation
57D: **Gloucester**	High potential preservation
58B: **Gloucester**	Medium potential preservation Stony surface - Burial possible Moderate pH
58C: **Gloucester**	Medium potential preservation Stony surface – Burial possible Moderate pH
59C: **Gloucester**	Medium potential preservation Stony surface – Burial unlikely Moderate pH
59D: **Gloucester**	Medium potential preservation Stony surface – Burial unlikely Moderate pH
60B: **Canton**	Medium potential preservation Acidic pH Stony surface – Burial possible
Charlton	High potential preservation
60C: **Canton**	Medium potential preservation Acidic pH Stony surface - Burial possible
Charlton	High potential preservation

Map Symbol and Soil Name	Preservation in Soil
60D:	
Canton	Medium potential preservation Acidic pH Stony surface - Burial possible
Charlton	High potential preservation
61B:	
Canton	Medium potential preservation Acidic pH Stony surface – Burial possible
Charlton	Medium potential preservation Stony surface – Burial possible Moderate pH
61C:	
Canton	Medium potential preservation Acidic pH Stony surface – Burial possible
Charlton	Medium potential preservation Stony surface – Burial possible Moderate pH
62C:	
Canton	Low potential preservation Stony surface – Burial unlikely Acidic pH
Charlton	Medium potential preservation Stony surface – Burial unlikely Moderate pH
62D:	
Canton	Low potential preservation Stony surface - Burial unlikely Acidic pH
Charlton	Medium potential preservation Stony surface – Burial unlikely Moderate pH
63B:	
Cheshire	Medium potential preservation Acidic pH Stony surface – Burial possible
63C:	
Cheshire	Medium potential preservation Acidic pH Stony surface – Burial possible
63D:	
Cheshire	Medium potential preservation Acidic pH Stony surface – Burial possible
64B:	
Cheshire	Medium potential preservation Acidic pH Stony surface – Burial possible
64C:	
Cheshire	Medium potential preservation Acidic pH Stony surface – Burial possible
65C:	
Cheshire	Medium potential preservation Stony surface – Burial unlikely Acidic pH

Map Symbol and Soil Name	Preservation in Soil
65D:	
Cheshire	Medium potential preservation Stony surface – Burial unlikely Acidic pH
66B:	
Narragansett	Medium potential preservation Acidic pH Stony surface - Burial possible
66C:	
Narragansett	Medium potential preservation Acidic pH Stony surface – Burial possible
67B:	
Narragansett	Medium potential preservation Acidic pH Stony surface – Burial possible
67C:	
Narragansett	Medium potential preservation Acidic pH Stony surface – Burial possible
68C:	
Narragansett	Low potential preservation Stony surface - Burial unlikely Acidic pH
68D:	
Narragansett	Low potential preservation Stony surface – Burial unlikely Acidic pH
69B:	
Yalesville	Medium potential preservation Acidic pH Stony surface - Burial possible Moderately deep burial
69C:	
Yalesville	Medium potential preservation Acidic pH Stony surface – Burial possible Moderately deep burial
70C:	
Branford	Medium potential preservation Acidic pH Stony surface - Burial possible
Holyoke	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface – Burial possible Moderate pH
71C:	
Nipmuck	Medium potential preservation Acidic pH Stony surface - Burial possible
Brimfield	Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface - Burial possible
Rock Outcrop	Not rated

Map Symbol and Soil Name	Preservation in Soil
71E:	
Nipmuck	Medium potential preservation Acidic pH Stony surface - Burial possible
Brimfield	Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface - Burial possible
Rock Outcrop	Not rated
73C:	
Charlton	Medium potential preservation Stony surface – Burial possible Moderate pH
Chatfield	Low potential preservation Moderately deep burial Stony surface - Burial possible Moderate pH
73E:	
Charlton	Medium potential preservation Stony surface - Burial possible Moderate pH
Chatfield	Low potential preservation Moderately deep burial Stony surface - Burial possible Moderate pH
74C:	
Narragansett	Medium potential preservation Acidic pH Stony surface – Burial possible
Hollis	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface - Burial possible Moderate pH
75C:	
Hollis	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface – Burial unlikely Moderate pH
Chatfield	Low potential preservation Moderately deep burial Stony surface – Burial possible Moderate pH
Rock Outcrop	Not rated
75E:	
Hollis	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface – Burial unlikely Moderate pH
Chatfield	Low potential preservation Moderately deep burial Stony surface - Burial possible Moderate pH
Rock Outcrop	Not rated

Map Symbol and Soil Name	Preservation in Soil
76E:	
Rock Outcrop	Not rated
Hollis	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface – Burial unlikely Moderate pH
76F:	
Rock Outcrop	Not rated
Hollis	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface - Burial unlikely Moderate pH
77C:	
Cheshire	Medium potential preservation Acidic pH Stony surface – Burial possible
Holyoke	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface - Burial possible Moderate pH
77D:	
Cheshire	Medium potential preservation Acidic pH Stony surface – Burial possible
Holyoke	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface - Burial possible Moderate pH
78C:	
Holyoke	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface – Burial possible Moderate pH
Rock Outcrop	Not rated
78E:	
Holyoke	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface – Burial possible Moderate pH
Rock Outcrop	Not rated
79E:	
Rock Outcrop	Not rated
Holyoke	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface - Burial possible Moderate pH
80B:	
Bernardston	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture

Map Symbol and Soil Name	Preservation in Soil
80C: **Bernardston**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
81C: **Bernardston**	Low potential preservation Stony surface – Burial unlikely Acidic pH Moderately deep burial
81D: **Bernardston**	Low potential preservation Stony surface – Burial unlikely Acidic pH Moderately deep burial
82B: **Broadbrook**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
82C: **Broadbrook**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
82D: **Broadbrook**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
83B: **Broadbrook**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
83C: **Broadbrook**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
84B: **Paxton**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Montauk	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
84C: **Paxton**	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Montauk	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture

Map Symbol and Soil Name	Preservation in Soil
84D:	
Paxton	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Montauk	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
85B:	
Paxton	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Montauk	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
85C:	
Paxton	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Montauk	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
86C:	
Paxton	Low potential preservation Stony surface - Burial unlikely Acidic pH Moderately deep burial
Montauk	Low potential preservation Moderately deep burial Stony surface - Burial unlikely Acidic pH
86D:	
Paxton	Low potential preservation Stony surface – Burial unlikely Acidic pH Moderately deep burial
Montauk	Low potential preservation Moderately deep burial Stony surface - Buria unlikely Acidic pH
87B:	
Wethersfield	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
87C:	
Wethersfield	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
87D:	
Wethersfield	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH

Map Symbol and Soil Name	Preservation in Soil
88B: **Wethersfield ……………………………………**	Low potential preservation Moderately deep burial Unfavorable soil moisture Stony surface - Burial possible
88C: **Wethersfield ……………………………………**	Low potential preservation Moderately deep burial Unfavorable soil moisture Stony surface – Burial possible
89C: **Wethersfield ……………………………………**	Low potential preservation Moderately deep burial Stony surface - Burial unlikely Unfavorable soil moisture
89D: **Wethersfield ……………………………………**	Low potential preservation Moderately deep burial Stony surface – Burial unlikely Unfavorable soil moisture
90B: **Stockbridge ………………………………………**	High potential preservation
90C: **Stockbridge ………………………………………**	High potential preservation
90D: **Stockbridge ………………………………………**	High potential preservation
91B: **Stockbridge ………………………………………**	High potential preservation
91C: **Stockbridge ………………………………………**	High potential preservation
91D: **Stockbridge ………………………………………**	High potential preservation
92B: **Nellis ……………………………………………**	High potential preservation
92C: **Nellis ……………………………………………**	High potential preservation
92D: **Nellis ……………………………………………**	High potential preservation
93C: **Nellis ……………………………………………**	High potential preservation
94C: **Farmington ………………………………………** **Nellis ……………………………………………**	Extremely low potential preservation Shallow soil - Burial unlikely High potential preservation Stony surface - Burial possible Moderate pH
94E: **Farmington ………………………………………** **Nellis ……………………………………………**	Extremely low potential preservation Shallow soil - Burial unlikely High potential preservation

Map Symbol and Soil Name	Preservation in Soil
95C:	
Farmington	Extremely low potential preservation Shallow soil - Burial unlikely
Rock Outcrop	Not rated
95E:	
Farmington	Extremely low potential preservation Shallow soil - Burial unlikely
Rock Outcrop	Not rated
96:	
Ipswich	Extremely low potential preservation Moderately deep burial Favorable soil moisture Moderate pH
97:	
Pawcatuck	High potential preservation
98:	
Westbrook	High potential preservation
99:	
Westbrook, low salt	High potential preservation
100:	
Suncook	High potential preservation
101:	
Occum	High potential preservation
102:	
Pootatuck	Medium potential preservation Unfavorable soil moisture Moderate pH
103:	
Rippowam	High potential preservation
104:	
Bash	Medium potential preservation Unfavorable soil moisture Acidic pH
105:	
Hadley	High potential preservation
106:	
Winooski	Medium potential preservation Unfavorable soil moisture Moderate pH
107:	
Limerick	High potential preservation
Lim	High potential preservation
108:	
Saco	High potential preservation
109:	
Fluvaquents, Frequently Flooded	High potential preservation
Udifluvents, Frequently Flooded	High potential preservation

Map Symbol and Soil Name	Preservation in Soil
221A:	
Ninigret	Medium potential preservation Unfavorable soil moisture Moderate pH
Urban Land	Not rated
224A:	
Deerfield	Medium potential preservation Unfavorable soil moisture Moderate pH
Urban Land	Not rated
225B:	
Brancroft	Medium potential preservation Unfavorable soil moisture Moderate pH
Urban Land	Not rated
226B:	
Berlin	Medium potential preservation Unfavorable soil moisture Moderate pH
Urban Land	Not rated
228B:	
Elmridge	Medium potential preservation Unfavorable soil moisture Moderate pH
Urban Land	Not rated
229B:	
Agawam	High potential preservation
Urban Land	Not rated
229C:	
Agawam	High potential preservation
Urban Land	Not rated
230B:	
Branford	Medium potential preservation Acidic pH Stony surface - Burial possible
Urban Land	Not rated
230C:	
Branford	Medium potential preservation Acidic pH Stony surface – Burial possible
Urban Land	Not rated
232B:	
Haven	Medium potential preservation Acidic pH Stony surface - Burial possible
Urban Land	Not rated

Map Symbol and Soil Name	Preservation in Soil
234B:	
Merrimac	High potential preservation
Urban Land	Not rated
235B:	
Penwood	Medium potential preservation Acidic pH Stony surface - Burial possible
Urban Land	Not rated
236B:	
Windsor	High potential preservation
Urban Land	Not rated
237A:	
Manchester	Medium potential preservation Acidic pH Stony surface – Burial possible
Urban Land	Not rated
237C:	
Manchester	Medium potential preservation Acidic pH Stony surface – Burial possible
Urban Land	Not rated
238A:	
Hinckley	Medium potential preservation Acidic pH Stony surface – Burial possible
Urban Land	Not rated
238C:	
Hinckley	Medium potential preservation Acidic pH Stony surface – Burial possible
Urban Land	Not rated
240B:	
Ludlow	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Urban Land	Not rated
243B:	
Rainbow	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Urban Land	Not rated
245B:	
Woodbridge	Medium potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Urban Land	Not rated

Map Symbol and Soil Name	Preservation in Soil
245C:	
Woodbridge	Medium potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Urban Land	Not rated
248B:	
Georgia	Medium potential preservation Unfavorable soil moisture Stony surface – Burial possible
Urban Land	Not rated
250B:	
Sutton	Medium potential preservation Acidic pH Unfavorable soil moisture
Urban Land	Not rated
253B:	
Wapping	Medium potential preservation Unfavorable soil moisture Moderate pH
Urban Land	Not rated
255B:	
Watchaug	Medium potential preservation Unfavorable soil moisture Moderate pH
Urban Land	Not rated
260B:	
Charlton	High potential preservation
Urban Land	Not rated
260C:	
Charlton	High potential preservation
Urban Land	Not rated
260D:	
Charlton	High potential preservation
Urban Land	Not rated
263B:	
Cheshire	Medium potential preservation Acidic pH Stony surface - Burial possible
Urban Land	Not rated
263C:	
Cheshire	Medium potential preservation Acidic pH Stony surface - Burial possible
Urban Land	Not rated

Map Symbol and Soil Name	Preservation in Soil
266B:	
Narragansett	Medium potential preservation Acidic pH Stony surface - Burial possible
Urban Land	Not rated
269B:	
Yalesville	Medium potential preservation Acidic pH Stony surface – Burial possible Moderately deep burial
Urban Land	Not rated
269C:	
Yalesville	Medium potential preservation Acidic pH Stony surface – Burial possible Moderately deep burial
Urban Land	Not rated
273C:	
Urban Land	Not rated
Charlton	High potential preservation
Chatfield	Low potential preservation Moderately deep burial Stony surface – Burial possible Moderate pH
273E:	
Urban Land	Not rated
Charlton	High potential preservation
Chatfield	Low potential preservation Moderately deep burial Stony surface – Burial possible Moderate pH
275C:	
Urban Land	Not rated
Chatfield	Low potential preservation Moderately deep burial Stony surface – Burial possible Moderate pH
275E:	
Urban Land	Not rated
Chatfield	Low potential preservation Moderately deep burial Stony surface - Burial possible Moderate pH
Rock Outcrop	Not rated

Map Symbol and Soil Name	Preservation in Soil
282B:	
Broadbrook	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Urban Land	Not rated
284B:	
Paxton	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Urban Land	Not rated
284C:	
Paxton	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Urban Land	Not rated
284D:	
Paxton	Low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
Urban Land	Not rated
287B:	
Wethersfield	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
Urban Land	Not rated
287C:	
Wethersfield	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
Urban Land	Not rated
287D:	
Wethersfield	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
Urban Land	Not rated
290B:	
Stockbridge	High potential preservation
Urban Land	Not rated
290C:	
Stockbridge	High potential preservation
Urban Land	Not rated

Map Symbol and Soil Name	Preservation in Soil
290D: **Stockbridge** .... **Urban Land**	 High potential preservation Not rated
301: **Beaches** .... **Udipsamments**	 Not rated High potential preservation
302: **Dumps**	 Not rated
303: **Pits, Quarries**	 Not rated
304: **Udorthents**	 High potential preservation
305: **Udorthents** .... **Pits**	 High potential preservation High potential preservation
306: **Udorthents** .... **Urban Land**	 High potential preservation Not rated
307: **Urban Land**	 Not rated
308: **Udorthents**	 High potential preservation
309: **Udorthents**	 High potential preservation
310: **Udorthents, Periodically, Flooded**	 High potential preservation
401C: **Macomber** .... **Taconic**	 Medium potential preservation Moderately deep burial Acidic pH Stony surface – Burial possible Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface – Burial possible
402D: **Macomber** .... **Taconic** .... **Rock Outcrop**	 Medium potential preservation Moderately deep burial Acidic pH Stony surface - Burial possible Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface - Burial possible Not rated

Map Symbol and Soil Name	Preservation in Soil
403C:	
Taconic	Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface – Burial possible
Rock Outcrop	Not rated
403E:	
Taconic	Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface – Burial possible
Rock Outcrop	Not rated
403F:	
Taconic	Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface – Burial possible
Rock Outcrop	Not rated
405C:	
Dummerston	Medium potential preservation Acidic pH Stony surface - Burial possible
405E:	
Dummerston	Medium potential preservation Acidic pH Stony surface - Burial possible
407C:	
Lanesboro	Low potential preservation Acidic pH Unfavorable soil moisture Moderately deep burial
407E:	
Lanesboro	Low potential preservation Acidic pH Unfavorable soil moisture Moderately deep burial
408C:	
Fullam	Extremely low potential preservation Moderately deep burial Acidic pH Unfavorable soil moisture
409B:	
Brayton	Extremely low potential preservation Shallow soil - Burial unlikely Stony surface - Burial possible Favorable soil moisture
412B:	
Bice	High potential preservation
412C:	
Bice	High potential preservation
412D:	
Bice	High potential preservation

Map Symbol and Soil Name	Preservation in Soil
413C:	
Bice	High potential preservation
Millsite	Medium potential preservation Moderately deep burial Acidic pH Burial possible
413E:	
Bice	High potential preservation
Millsite	Medium potential preservation Moderately deep burial Acidic pH Burial possible
414:	
Fredon, cold	High potential preservation
415C:	
Millsite	Medium potential preservation Moderately deep burial Acidic pH Burial possible
Westminster	Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface – Burial possible
Rock Outcrop	Not rated
415E:	
Millsite	Medium potential preservation Moderately deep burial Acidic pH Burial possible
Westminster	Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface - Burial possible
Rock Outcrop	Not rated
416E:	
Rock Outcrop	Not rated
Westminster	Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface – Burial possible
416F:	
Rock Outcrop	Not rated
Westminster	Extremely low potential preservation Shallow soil - Burial unlikely Acidic pH Stony surface - Burial possible
417B:	
Bice	Medium potential preservation Stony surface – Burial possible Moderate pH
417C:	
Bice	Medium potential preservation Stony surface – Burial possible Moderate pH

Map Symbol and Soil Name	Preservation in Soil
417D: **Bice ………………………………………………**	Medium potential preservation Stony surface – Burial possible Moderate pH
418C: **Schroon …………………………………………**	Medium potential preservation Unfavorable soil moisture Stony surface - Burial possible
420A: **Schroon …………………………………………**	Medium potential preservation Unfavorable soil moisture Moderate pH
420B: **Schroon …………………………………………**	Medium potential preservation Unfavorable soil moisture Moderate pH
421A: **Ninigret, cold ……………………………………**	Medium potential preservation Unfavorable soil moisture Moderate pH
423A: **Sudbury, cold ……………………………………**	Medium potential preservation Unfavorable soil moisture Moderate pH
424B: **Shelburne ………………………………………**	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
424C: **Shelburne ………………………………………**	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
424D: **Shelburne ………………………………………**	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
425B: **Shelburne ………………………………………**	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
425C: **Shelburne ………………………………………**	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
426D: **Shelburne ………………………………………**	Low potential preservation Moderately deep burial Stony surface - Burial unlikely Unfavorable soil moisture
427B: **Ashfield …………………………………………**	Low potential preservation Moderately deep burial Unfavorable soil moisture Stony surface - Burial possible
427C: **Ashfield …………………………………………**	Low potential preservation Moderately deep burial Unfavorable soil moisture Stony surface - Burial possible

Map Symbol and Soil Name	Preservation in Soil
428A: **Ashfield** ……………………………………………	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
428B: **Ashfield** ……………………………………………	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
428C: **Ashfield** ……………………………………………	Low potential preservation Moderately deep burial Unfavorable soil moisture Moderate pH
429A: **Agawam, cold** …………………………………..	High potential preservation
429B: **Agawam, cold** ……………………………………	High potential preservation
429C: **Agawam, cold** ……………………………………	High potential preservation
433: **Moosilauke** ………………………………………	High potential preservation
434A: **Merrimac, cold** ……………………………………	High potential preservation
434B: **Merrimac, cold** ……………………………………	High potential preservation
434C: **Merrimac, cold** ……………………………………	High potential preservation
435: **Scarboro** ……………………………………………	High potential preservation
436: **Halsey, cold** ………………………………………	High potential preservation
437: **Wonsqueak** ………………………………………	High potential preservation
438: **Bucksport** …………………………………………	Medium potential preservation Acidic pH Favorable soil moisture
440A: **Boscawen** …………………………………………	High potential preservation
440C: **Boscawen** …………………………………………	High potential preservation
440E: **Boscawen** …………………………………………	High potential preservation
442: **Brayton** ……………………………………………	Low potential preservation Moderately deep burial Favorable soil moisture Moderate pH

Map Symbol and Soil Name	Preservation in Soil
443:	
Brayton	Low potential preservation Moderately deep burial Stony surface – Burial unlikely Favorable soil moisture
Loonmeadow	Medium potential preservation Stony surface - Burial unlikely Favorable soil moisture
448B:	
Hogansburg	Medium potential preservation Unfavorable soil moisture Moderate pH
449B:	
Hogansburg	Medium potential preservation Unfavorable soil moisture Stony surface – Burial possible
449C:	
Hogansburg	Medium potential preservation Unfavorable soil moisture Stony surface - Burial possible
450B:	
Pyrities	High potential preservation
450C:	
Pyrities	High potential preservation
450D:	
Pyrities	High potential preservation
451B:	
Pyrities	High potential preservation
451C:	
Pyrities	High potential preservation
451D:	
Pyrities	High potential preservation
457:	
Mudgepond	High potential preservation
458:	
Mudgepond	Medium potential preservation Stony surface – Burial unlikely Favorable soil moisture
Alden	Medium potential preservation Stony surface – Burial unlikely Favorable soil moisture
501:	
Ondawa	Medium potential preservation Acidic pH Stony surface – Burial possible
503:	
Rumney	High potential preservation
508:	
Medomak	High potential preservation
W:	
Water	Not rated

Handling Freshly Excavated Bone and Artifacts in High Potential Soils

Actions should be in accordance with **Connecticut General Statutes Title 10, Chapter 184a, Sec. 10-388 on Human Remains**.

Sec. 10-388. Human burials (a) Any person who knows or reasonably believes that any human burials or human skeletal remains are being or about to be disturbed, destroyed, defaced, removed or exposed shall immediately notify the Chief Medical Examiner and State Archaeologist of such fact. If human burials or human skeletal remains are encountered during construction or agricultural, archaeological or other activity that might alter, destroy or otherwise impair the integrity of such burials or remains, the activity shall cease and not resume unless authorized by the Chief Medical Examiner and the State Archaeologist provided such authorization shall be made within five days of completion of the investigation of the Chief Medical Examiner pursuant to subsection (b) of this section.

(b) After notification under subsection (a) of this section, the Chief Medical Examiner shall determine if the remains represent a human death required to be investigated under section 19a-406. After completion of his investigation, if the Chief Medical Examiner determines that the remains may be the remains of a Native American or were found in the subsurface and buried for more than fifty years, the Chief Medical Examiner shall notify the State Archaeologist of such fact. The State Archaeologist, upon such notification, shall in consultation with the Connecticut Commission on Culture and Tourism, the Native American Heritage Advisory Council, established under section 10-382, the Commissioner of Environmental Protection, and the landowner determine, within seventy-two hours, if the site where such remains were discovered can be preserved in situ and protected by a preservation restriction as defined in section 47-42a.

(c) If in situ preservation is not prudent and feasible or not agreed to by the landowner, the State Archaeologist, upon consultation with the landowner and, if appropriate, the Native American Heritage Advisory Council, the Connecticut Commission on Culture and Tourism, and the Commissioner of Environmental Protection shall, if feasible, provide for removal and reburial of the remains at another location or for additional archaeological investigations and scientific analysis prior to reburial. Any excavation and recovery of remains by the State Archaeologist shall be completed not more than five business days after notification by the Chief Medical Examiner under this section unless the landowner consents to additional days.

(d) Human skeletal remains discovered during archaeological investigation shall be excavated under the supervision of the State Archaeologist, pursuant to a written agreement between the State Archaeologist and the holder of the permit specifying the excavation, methods to be used and data to be collected. Due care shall be exercised during excavation, subsequent transport and storage of skeletal remains to insure that the sacred meanings of the remains for Native Americans are respected and protected.

(e) The provisions of this section shall not be construed to require the owner of private lands on which human skeletal remains are found to pay the costs of excavation, removal analysis or reburial of such remains.

Sec. 10-390. Penalty. (a) No person shall excavate, damage or otherwise alter or deface any archaeological or sacred site on state lands or within a state archaeological preserve unless such activity is in accordance with the terms and conditions of a permit issued under section 10-386 or in the case of an emergency.

(b) No person shall sell, exchange, transport, receive or offer to sell, any archaeological artifact or human remains collected, excavated or otherwise removed from state lands or a state archaeological preserve in violation of subsection (a) of this section.

(c) No person shall engage in any activity that will desecrate, disturb or alter any Native American burial, sacred site or cemetery, including any associated objects, unless the activity is engaged in pursuant to a permit issued under section 10-386 or under the direction of the State Archaeologist.

(d) Any person who violates any provision of this section shall be fined not more than five thousand dollars or twice the value of the site or artifact that was the subject of the violation, whichever is greater, and imprisoned not more than five years or both.

(e) Any person who violates any provision of this section shall be liable to the state for the reasonable costs and expenses of the state in restoring the site and any associated sacred objects or archaeological artifacts.

Treatment of Cultural Resources

Upon excavation, the environment is once again disrupted and the object will again undergo changes as it reaches equilibrium with the new conditions. Some of these changes can be particularly damaging. The agents of decay found in the new environment may include, but are not limited to, visible light, ultraviolet (UV) radiation, temperature, relative humidity, pollutants, insects, and handling for processing, conservation, study and exhibit (Society for Historical Archaeology, 2009).

The first step in stabilizing freshly excavated artifacts is to provide storage that minimizes the degradative effects of the artifact's environment. Providing proper handling, storage and packaging after excavation is the responsibility of every member of an archaeological team. For many objects, these actions may be sufficient to stabilize the artifact and allow it to reach equilibrium gently with its new environment. If proper storage alone does not stabilize an artifact, active conservation treatment will also be necessary. As damage can occur if treatments are carried out improperly, conservation treatment is typically the responsibility of the conservator or, depending on the degree of difficulty of the treatment, a member of the excavation team who has been trained in materials science and conservation (Society for Historical Archaeology, 2009).

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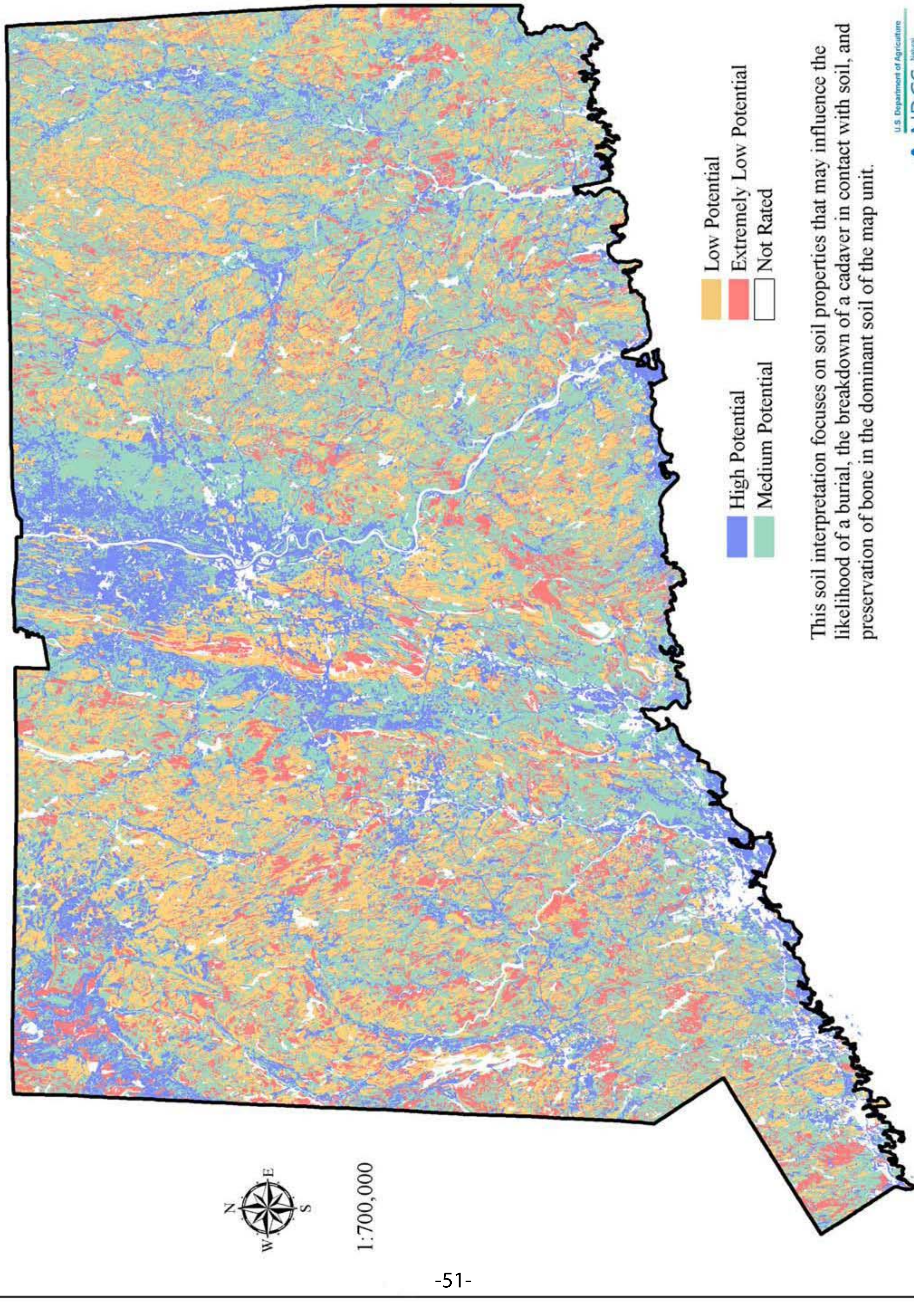
Appendix 1. Preservation of Buried Human Remains in Soil, Soil Survey of the State of Connecticut



This soil interpretation focuses on soil properties that may influence the likelihood of a burial, the breakdown of a cadaver in contact with soil, and preservation of bone in the dominant soil of the map unit.

Appendix 2. Documentation of NASIS rules, evaluations, and properties

Depth of Burial and Difficulty Digging
Soil layers with rock fragments greater than 75 mm in size and ranging from 30 percent or more in the fine earth fraction.

Property: *Fragments >75mm 0-100cm or ABOVE RESTR, WTD AVE (NSSC PANGAEA)*
Restrictive Limits:
Limiting: > 0.5 percent
Not Limiting: < 0.5 percent
Null depth is assigned to the not limiting class.

Soils with a restrictive layer within 100 centimeters from the soil surface. A restrictive layer is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly reduce the movement of water and air through the soil or that otherwise provide an unfavorable root environment. Cemented layers, frozen layers, abrupt or stratified layers, dense layers, strongly contrasting textures, and dispersed layers are examples of soil layers that are restrictions (USDA NRCS, 2007).

Property: *CT-Depth to First Restrictive Layer (MLRA12_Office)*
Restrictive Limits:
Limiting: < 100 cm
Not Limiting: > 100 cm
Null depth is assigned to the not limiting class.

The percentage of rock fragments at the surface of a soil is greater than 3 percent. Stones of the smallest size are as little as 0.5 meters apart; boulders of the smallest size are as little as 1 meter apart (USDA SSDS, 1993).

Property: *CT-Surface Fragments (MLRA12_Office)*
Restrictive Limits:
Limiting: > 0 % surface fragments
Not Limiting: <= 0% surface fragments

Soil Reaction (pH)
The average soil reaction (pH) of each horizon between 20 and 150 centimeters below the soil surface is analyzed. This depth takes into account the mixing of the soil upon removal and redepositing over the buried cadaver.

Property: *pH in depth 20 – 120 cm, WTD AVE (NSSC DATA)*
Restrictive limits:
Limiting: > 5.3
Not Limiting: < =5.3

Soil Temperature:
In theory, every soil pedon has a mean annual temperature that is essentially the same in all horizons at all depths in the soil. The measured mean annual soil temperature is seldom the same in successive depths at a given location, but the differences are so small that it seems valid and useful to take a single value as the mean annual temperature of the soil. The mean annual soil temperature is related most closely to the mean annual air temperature (Mount and Paetzold, 2002). Soil temperatures throughout New England favor bone preservation over decomposition.

Property: There are two classes of soil temperature regimes in Connecticut, mesic and frigid.

Mesic - the mean annual soil temperature is 8 degrees Celsius or higher but lower than 15 degrees Celsius, and the difference between mean summer and mean winter soil temperatures is more than 6 degrees Celsius either at a depth of 50 cm from the soil surface or at a densic, lithic, or paralithic contact, whichever is shallower.

Frigid – the mean annual soil temperature is lower than 8 degrees Celsius and the difference between mean summer and mean winter is more than 6 degrees Celsius either at a depth of 50 cm from the soil surface or at a densic, lithic, or paralithic contact, whichever is shallower.

Soil Moisture and Texture
Soil moisture patterns in soils are represented by soil moisture status by month and depth. The moisture status is estimated based on long-term weather patterns of precipitation, temperature, and wind but must be tempered by topography, landscape position, slope, aspect, surface condition, infiltration, soil structure, available water capacity, internal water movement restrictions, vegetation, and land use (USDA NRCS, 2001).

Property: *CT-Depth to High Water Table Minimum (MLRA12_Office)*
Restrictive limits:
Limiting: between 0 to 100 cm
Not Limiting: < = 0 cm or >= 100 cm

Soil Potential Rating
Soils are placed into soil potential rating classes per their rating indices. These are high potential (rating index >=0.85), medium potential (rating index between 0.50 and 0.85), low potential (rating index between 0.25 and 0.50), or extremely low potential (rating index <=0.25). Each soil that is mapped in the state of Connecticut will fall into one of the classes.