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ARCHAEOLOGICAL SITE STABILISATION AND RECONSTRUCTION IN THE UNITED STATES

WINSTON CHURCHILL MEMORIAL FELLOWSHIP REPORT 1993

by

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Program Coordinator of the Division of Continuing Education, University of Nevada, Reno, and Dr Tom Green, Director of the Arkansas Archaeological Survey.

I am not a botanist or plant ecologist, and all dominant-species lists noted in the text will be derived from the local specialists or managers with whom I visited the site.

It has been difficult to strike a balance between brief summary and demonstrating a grasp of the many issues bearing on site management. Of course, any deficiencies or errors in judgement remain mine.

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INTRODUCTION

This report covers travel to the United States on a Churchill Fellowship 1993 to discuss and to investigate methods and principles for managing archaeological sites to stabilise their condition. The scope of the work extended to the effects of reconstruction for interpretation. My background in these aspects of site preservation includes work on managing and controlling vegetation (Hamel and Jones, 1982) and restoration of earthwork fortifications (Jones, 1989), and with colleagues I am writing revised guidelines on these topics.

Throughout the world, the protection of archaeological sites has lagged behind several other fields of historic conservation (see Elia, 1993; Jones, 1989; Thorne, 1988). Historic buildings, paper archives, and museum artefact collections are today managed under a guiding set of principles which emphasise respect for the original fabric and the need to maintain and improve the state of documentation which shows the provenance and the meaning of the objects (Carpenter's Company of the City and County of Philadelphia, 1976). At a practical level, methods and conditions of preservation, while expensive, are also well established and widely practised. For example, artefacts or paper archives must be maintained in stable, optimum air conditioned circumstances. Buildings are protected as far as possible from weathering effect. These treatments take the historic objects *out* of the natural ecological processes that might otherwise affect them.

Archaeological sites, by contrast, cannot be removed from a natural ecology. Being in the soil, they are fundamentally affected by natural ecological processes -soil formation and erosion, siltation, tree root growth, burrowing and grazing animals, agricultural development, and so on. For a long time, then, the response to the discovery of an archaeological site has been simply to excavate it. Increasingly, however, concern has been expressed that the stock or "bank" of sites is finite. Sites may also have commemorative or spiritual meanings that stand apart from any interest in scientific investigation or data banks.

Attention has come now to be devoted to ecologically appropriate ways in which the condition of sites can be maintained *in situ*, in their natural setting (e.g. Getty Conservation Institute, 1987; Thorne, 1988; 1990). In that setting, there are two respects in which sites need protection and management:

- surface features, such as the profiles of mounds or ditches, which can be subject to soil erosion, or damaged by stock, and which can be a place of interest where the public can see the evidence of past human activity;

- sub-surface deposits which are subject to deleterious effects tree roots, animals, chemical changes, and changes in soil, water or physical pressure (e.g. Matthewson, 1989).

Definition of some key terms is required:

- *stabilisation* means the arrest of the processes of decay;
- *restoration* means returning a place as nearly as possible to a known earlier state by reassembly, reinstatement the removal of extraneous additions;
- *reconstruction* means to build again in the original form using old or new material (ICOMOS New Zealand, 1993).

Of these, stabilisation and reconstruction are of crucial importance to archaeological sites. Of course, with many sites or historic structures, there may be insufficient grounds to intervene at all. Decay is inevitable, and intervention is usually costly. The decision as to whether to intervene is therefore a primary question in conservation, and will depend on:

- the value or merit of the structure or site;
- whether proven techniques are available that do not affect the integrity of the original fabric materials;
- the cost of intervention, and value for money given the historic values at risk.

Throughout the world there is an increasing use of surviving archaeological sites or historic sites as part of programmes of heritage tourism. The legitimate interest in providing for tourists has to be balanced against the need to protect the actual surviving physical fabric of the site. The fundamental values for which visitors or archaeologists go to a site are basically three:

- commemorative function for the site;
- educative functions of the site;
- information potential of the site, e.g. information recovered from archaeological excavation.

These three factors are related. A visitor who goes to commemorate or to think about an event in the past is also being educated about that event. Information from the site itself is also a key ingredient in the educative potential of the site. However, in many cases, the commemorative (or spiritual) function may overwhelm the practical or scientific concerns of the archaeologist or professional conservator (Linenthal, 1991). Balancing these issues is a delicate, often politicised, professional function. The most controversial area in the last decade has been the practice of reconstructing on the archaeological sites themselves, transforming them into what are thought to be genuine replicas of the original structures that once stood there. This practice threatens the condition of the archaeological site acutely because the foundations and construction works extend directly on to or into the surviving archaeological evidence.

General itinerary

States or cities visited in the course of the Fellowship were North Dakota, Illinois, Georgia, Alabama, Mississippi, Philadelphia (Pennsylvania), Washington D.C., Virginia, Louisiana and Arkansas. The main reasons for choosing these sites and locations were:

- the existence of many earthwork fortifications and other earth-relief structures, not dissimilar to New Zealand sites;
- temperate and warm-temperate climates with abundant rainfall like most of New Zealand;
- a reasonable balance between centres with natural grassland experience and centres with experience of management of parkland and of commercial or exotic forests.

The travel was carried out in September and October 1993, at the end of a summer which had seen heavy rain in the mid-west, flooding on the Illinois, Missouri and middle Mississippi River; and in the east, drought and a heat wave.

Figure 1 Places visited.

In terms of the broad thematic interests of the fellowship, the visit to North Dakota was a useful opportunity to see the recent reconstruction of Fort Union Trading Post, a national historical landmark in the far northwest of North Dakota. In the vicinity of Bismarck, the capital of North Dakota, there are a number of very important late European and early 18th-century Indian villages on the Missouri River (Ahler and others, 1991). These villages are not dissimilar to New Zealand Maori settlements of these same periods.

In Illinois, I was able to visit a number of important mound sites, particularly Cahokia which is in the Mississippi River valley opposite St Louis, and Dickson Mounds which is about halfway up the Illinois valley from the Mississippi to Chicago. I also visited Albany Mounds, near Moline, again on the Mississippi River in the far north of the state. Atlanta, Georgia, is an important federal administrative centre for all the south-eastern United States, from Arkansas through to North Carolina. Here I called on the National Park Service archaeologists and also Dr Kent Schneider, the chief archaeologist for the south-eastern region of the United States Department of Agriculture Forest Service. The management of earthwork mounds, long known as a feature of these regions (e.g. Moore, 1905; Woodward and McDonald, 1986), was an important focus.

From Atlanta I travelled to Alabama, to Russell Cave and Moundville Archaeological Park near Tuscaloosa, Alabama. In Mississippi, I intended to meet with Forest Service archaeologists to discuss archaeological site management in the National Forests of the state. The University of Mississippi is the home institution of Dr Robert Thorne, a world-recognised authority on archaeological site stabilisation issues (Thorne, 1988, 1990). With him I was able to visit several sites in the vicinity of Tallahatchee River and had extensive discussions both at Oxford, Mississippi, the home town of the University of Mississippi, and later in Arkansas at a National Park course titled "Archaeology for Managers". In southern Mississippi I visited Vicksburg National Military Park and Natchez, the famous cultural centre of the Mississippi River, and also the U.S. Army Waterways Experiment Station, responsible for the scientific investigation underpinning the work of the Army's Corps of Engineers. On the Mississippi coast I visited a site which has come under threat in the vicinity of Mulatto Bayou, on the west side of the Pearl River not far from New Orleans. From Jackson, Mississippi, I travelled by car to Poverty Point in Louisiana. I also took a Cessna flight from Jackson to Vicksburg and Poverty Point to photograph the sites there.

In the east, in Philadelphia I met with Dr David Orr, Chief Archaeologist for the Atlantic region of the National Park Service, responsible for archaeology in most of the districts of Virginia, including the important battlefield parks of tidewater Virginia and Richmond/Petersburg vicinity. I was also able to visit Independence National Park, in Philadelphia itself, a park which celebrates the Declaration of American Independence in 1776 and the subsequent devising of the American Constitution. This park contains some interesting and innovative examples of display of urban archaeological places, in particular the original house site and tenements constructed by Benjamin Franklin in the late 18th century. Philadelphia is also the base for Andropogon Associates, an ecological consulting firm headed by Ms Leslie Sauer. I was able to have a useful discussion with her about the use of native vegetation in landscape design and in the protection of

archaeological sites (Andropogon Associates, 1988, 1989; see also transcript of conversation in Appendix 1).

In Washington D.C., I was able to spend a full day with the National Park Service Associate Director, Cultural Resources, Mr Jerry Rogers, the most senior permanent official in the cultural resources field. I travelled with him on Columbus Day in the course of a tour for National Park Service staff of significant sites and places associated with the War of 1812, a British invasion of the American mainland conducted from 1812 to 1814. In the course of one campaign, in Maryland and Washington D.C., the White House and the Capitol were burned. I was able to have an extremely useful discussion with Mr Rogers on the design of archaeological protection legislation and also the programmes of the United States National Park Service as they relate to protection of cultural resources such as archaeological sites and battlefields.

From Washington D.C., I travelled to the Richmond Battlefield Park and the Petersburg Battlefield Park, near the cities of the same name in Virginia. Both these parks are important technological markers of the change from a traditional 18th-century style of warfare to a characteristically modern trench warfare (see Catton, 1966; Conservation Fund, 1990). It is very important that the fortifications associated with these engagements at both Richmond and Petersburg are protected. At these places I was able to see innovative programmes of protection using native grasses, to see something of the implementation phases of this protection, and to be warned about some of the pitfalls.

In Virginia I was also the guest of Dr Marley Brown, director of archaeological research at Colonial Williamsburg and I was able to visit Carter's Grove, an important century plantation complex and site of early English settlement dating to the first part of the 17th century. I also visited Jamestown Island and Flowerdew Hundred, both important early 17th-century English settlements on the James River (Deetz, 1993).

From Virginia I travelled to Hot Springs, Arkansas, resort centre, where the National Park Service conducted a week-long course titled "Archaeology for Managers". This course is designed to introduce both archaeological research and the statutory protection programme for archaeological sites to field centre manager or park manager levels of a wide range of agencies including the National Park Service. My purpose in attending this course was firstly to shake down what I had learnt about statutory protection and protection techniques in the United States and secondly to see how the National Park Service trained a broad section of United States land managers about archaeological protection.

BACKGROUND TO THE STUDY

The detailed objectives were to study the following:

Monitoring

- methods for recording and assessing damage to earthworks;

Vegetation management on sites

- techniques for grassing, vegetating and animal stocking or mowing of archaeological sites in the most cost-effective manner;
- deliberate re-afforestation or tall grass approaches;
- protection of historic sites in production forestry and in natural revegetation or restoration of natural environments;

Physical techniques for protection

- physical restoration or protective techniques such as rebuilding of the damaged fabric of archaeological sites;
- physical protection such as root filters or other protective layers placed across the site;
- design of structures for visitor use and interpretation, e.g. track surfacing, drainage, access for the less physically able, use of off-site interpretative facilities.

The following sections cover the ecological setting, the types of archaeological sites encountered, and a discussion of the agencies visited and their governing statutes.

Ecological setting

In visiting sites I spoke to land managers on the following topics: the original and modem setting and the geomorphological agents/aspects that contribute to the setting; the nature of the ecological influences that have been at work, fire, seed sources, frosts, the influence of animals; recent management practices; the size of the reserve and the extent of the edges that it offers to the outside world. Another focus of interest was how plant succession would go if it was left alone. If intervention in the ecological process of revegetation was required, what maintenance and what follow-up was needed, e.g. weeding, or the cost of labour.

In the United States land that in New Zealand is termed "cutover" or "secondary growth" is "old fields", a term recognising the ancient uses of the land before dispersal of Indian cultivators (Kricher, 1988; Oliver, 1980/81).

Fire is an important factor in the maintenance of most nature reserves in the United States - in contrast to New Zealand where, by and large, our concept of what is "natural" precludes the deliberate use of fire as a management tool. This is not the case in the United States where fire has been a major ecological factor in forest coverage and type and in forest succession (Burrows, 1990: 320-322). Increasingly, however, we in New Zealand are coming to realise that diversity of and species, and the cultural significance of landscape, can be maintained by deliberate -although this has yet to be applied for various reasons. I wanted to find out how fire was allowed for in reserve planning and in the maintenance of the condition of the reserve.

It has long been recognised that grasses are the best cover for archaeological sites. The establishment and maintenance of grasslands has attracted a very large literature on both ethics and practice in recent years (e.g. Wedin, 1992; Andropogon Associates, 1989). However, grass is not necessarily a very stable cover in ecological terms. It is readily invaded by shrubs and eventually trees unless subject to grazing, mowing or fire. Park management has to address these practices in a cost-effective manner if grassland is to he maintained. Much of the United States, including most of the central northern and mid-western States, was once covered in tall or short prairie grass. The opportunity arises today to cover archaeological sites in native grasses which, in theory at least, will be self-maintaining, requiring little fertilisation and little maintenance apart from the occasional use of fire to keep out shrublands (Wedin 1992). However, to do that in the modern ecological setting is actually a difficult task.

In many parts of the United States, particularly in the south-east, forest or shrubland is the dominant vegetation cover. In southern Illinois, Mississippi, Georgia, Alabama, Florida, Virginia, and Pennsylvania, the forest cover was oak/hickory/chestnut in its natural state (Kricher 1988; Brockman, 1968). Chestnut has declined due to a disease, and only now occurs as suckers from long-established roots. The suckers do not grow to tree forms because of the disease (Burrows, 1990: 311-312).

A typical forest-establishment ecology is as follows. When burnt or reverting from fields, the first invasion is fire weeds followed by pine. After 50 or 60 years the pine rots out and hardwood species such as oak and hickory come through. This ecological process occurs on archaeological sites once they are abandoned by human beings. The problem for the modem land manager is to decide what to do with the forest succession on the site. This covers a large range of issues, including the question of root intrusion onto the sites, the mitigating effects of the forest canopy against soil erosion, damage to the canopy (e.g. from wind), whether or not to clear the understorey, and whether animals are affecting the plant and soil ecological processes.

The United States therefore has quite different plant species and ecological processes to those in New There is some direct applicability of techniques to the many exotic or imported species that we have in common, notably the grass species, fescue, which is in world-wide use in many varieties as a forage plant. In many New Zealand amenity parks, specimen trees are species from the United States - oaks, *Liquidambar* sp., and other ornamentals. Some ecological consultants in the United States have recommended specific plants to replace naturally adventive plants on earthworks and other

archaeological sites. Creepers are regarded as a nuisance, much as in New Zealand where we have a pervasive spread of several noxious creepers and climbers. Shrubs such as the lowbush blueberry have been recommended for American sites (Andropogon Associates, 1988; 1989). Clearly this last is not ecologically appropriate in New Zealand parklands, but my intention was to understand the character of plants sought and to bring back insights to assist in the selection of New Zealand plants and suitable management practices to deal with them.

Physical environment

Northern states such as North Dakota and Illinois have continental climates with severe winters and warm summers (Ahler and others, 1991). In both these states the natural vegetation cover is prairie grassland. Illinois is the northern-most extent of oak/hickory forest, which extends from there throughout the south-east (Kricher, 1988). The climate in the south-east is generally warm, temperate, and well watered. The soils are generally silty clays and often of very poor fertility except in alluvial settings. However, in the Mississippi Valley itself, the alluvial soils are highly fertile and very erodible. Adjacent to the flood plain of the Mississippi, varying in width from a few hundred metres to tens of kilometres back from the main river course, is the Mississippi bluff. The bluff consists of loess (glacial windblown silts). These loess soils are highly erodible. Where the bluffs come down to the river, as at Vicksburg and Natchez, many sites from the pre-European American Indian period, early European period and the Civil War of 1861-1865 are located.

Archaeological sites also are subject to many threats from their physical environment. The most important in many parts of the United States are from river erosion, or from lakes created by modem damming of rivers. As a river fills with sediment, its course changes by cutting away points and levees on which many valuable archaeological sites lie. When a dammed lake rises to its artificial level it creates a new shoreline, often cutting into archaeological sites. Similar processes occur on the sea coast.

Parkland management and urban encroachment

Another form of problem in the United States arises from land tenure practice and the extreme, politically charged emphasis on individual landowner's rights. The battlefield parks are often small in area because they have been produced by historical agreement between the federal government and local landowners (Conservation Fund, 1990). The original arrangements with the landowner allowed for access through narrow strips of parkland. Today, 50 years after the parks were established, urban encroachment and the selling-off of rural land for low-density urban development (a major shift in wealthier middle-class American habitation style) have had a major impact on the setting of archaeological sites. The new owners demand access into the park by roads and the consequences are intrusion into the setting and much non-park vehicle traffic. The design of reserves is now a highly specialised task with landscape architects and other specialists involved. I was interested to find out from landscape architects and these other specialists how they viewed the inherited problems with boundaries of the reserves.

Sites and reserves have further challenges for the land manager. I was particularly interested in the park manager's sense of the integration of nature with culture. By that is meant the way in which natural values are managed or are presented in the park so as to reveal cultural or archaeological evidence for public visiting and public education. Parks generally lie in an artificial setting, in the modern landscape, and the factors which led to the location of the archaeological sites are not always obvious. I was interested, therefore, to speak to the land managers about the reasons why historic sites occurred where they did in the modern landscape.

The United States is a large country with high population numbers. In the early there was a great increase in the mobility of the population, due to the ready availability of automobiles. Visitor pressures on parks have been very high since that period. In effect, we have the results of a potentially useful experiment for "New Zealand A.D. 2010". I was interested to learn the attitudes of land managers to "locking up" resources -were visitors encouraged to particular parts of the park and encouraged to leave other places alone? what social research was done by the park management into the needs of their visitors? were these needs tailored into the design of the programmes for public interpretation offered in the reserves? Unfortunately I was not able to deal with these issues in any great detail, and, consequently, I have not reported on them to any great extent.

Types of archaeological site

The types of archaeological sites encountered are as follows:

- Palaeo-Indian, i.e. sites as much as 10,000 years old, characterised by stone projectile points or stone blanks for projectile points;

- Late Archaic or incipient sedentary (i.e. the period when Native American peoples ceased to move great distances in search of migrating game and began to concentrate on plant food resources and local small game) sites, the most important of these being the large circular earthwork ridges of Poverty Point in Louisiana;

- Mississippian/Woodland period sites, sites associated with the incipient Native American civilisations of the river valleys such as the Mississippi and Ohio;

- 18th-century Native American sites associated with the earliest European visits to the inland country (Mississippi River and Missouri River basin) of the United States;

- 17th-century sites in Virginia, related to the earliest English settlement of the James River:

- 18th-century Revolutionary War and urban sites, particularly in Philadelphia and on the peninsula between the James and York Rivers, Virginia;

- 19th-century Civil War sites, particularly redoubts and trenches, in Georgia at Kennesaw Mountain and Chickamauga, in Mississippi at Vicksburg, and in Virginia at Petersburg and Richmond National Battlefield Parks.

Of great interest were the first Indian/European contacts in the United States. I visited sites on the James River in Virginia, at Natchez in Mississippi, and on the Illinois River. Perhaps the most famous of these are the sites at Jamestown, and the Grand Village of the Natchez near Natchez township, Mississippi.

The American Civil War, sometimes known as the "War between the States", took place over the years 1861-1865. It was the first major series of conflicts of the modern era, in the course of which modern ordnance was invented including breech-loading rifles and rifled cannon. The technological advances made by the North in the course of the war have had enduring influence on military tactics ever since. The issues over which the war was fought are not simply related to the North opposing slavery and the South being in favour of the practice. The fighting was between a system of industrial nationhood unified under the Constitution in the North and an aristocratic, "states-rights" labour-dependent rural economy in the South (Catton, 1966). Simply to describe the conflict in these terms is to predict the outcome, in which the North, the Unionists, won, creating the modern United States. The war has had enduring symbolism in United States political life (Linethal, 1991), particularly the emphasis on equality of all citizens before the law.

Fighting began in South Carolina in 1861, and the finishing phases were in Petersburg in Virginia in 1865. The main northern goals were to attack the southern capitals, particularly Richmond in Virginia and Atlanta in Georgia. This involved strategic movements down the east coast and a blockade of the eastern seaboard of the United States, to stop trade between international agents and the South. Other important strategic approaches were to control the Mississippi River in the centre of the country, with Vicksburg the most important centre, and to strike down to Atlanta and the Georgia coast from Tennessee, destroying the main industrial centres.

Agencies visited

The United States has an intricate network of federal, state, Indian, and private agencies that deal with historic conservation. Linkages between them depend on the federal and state statutes which are reviewed in the following section.

Federal agencies
The more important federal agencies visited include:

- National Park Service (Department of the Interior): a difficulty encountered in dealing with the service is the separation of its regional administrative centres from its archaeological research centres; I visited three regional centres (Denver, Atlanta, and Philadelphia) but no archaeological research centres;

- Bureau of Land Management (Department of the Interior): a very large agency responsible for leasing unallocated federal lands for rangelands, etc., and also for minerals where (as is common) these are not allocated to the landowner or lessee;
- United States Forest Service (Department of Agriculture);

- Bureau of Land Reclamation (Department of Agriculture): responsible for irrigation assistance;

- Corps of Engineers (Department of the Army): responsible for river control works and statutory permitting of river-related works; also administers the Waterways Experiment Station, Vicksburg, Mississippi.

The National Park Service administers all national battlefields and national historic sites, which are subject to the same administrative standards, guidelines and statutes as the national parks.

Historically, federal public administration of relief works in the Depression is also relevant to understanding the earliest reconstruction and stabilisation history of archaeological sites. Much work was done during this period. With one notable exception (Turuturumokai, near Hawea, south Taranaki), no New Zealand sites were reconstructed or restored using unemployed in this era. Agencies set up under the "New Deal" in this period were the W.P.A. (Workers' Progressive Administration) and the C.C.C. (Civilian Conservation Corps). The latter, in particular, had a quasi-military administrative structure and worked under the Department of Army on many battlefields, army lands, and in national parks. It ceased operation on entry of the United States to World War II.

State agencies
The state historic preservation officer (the SHPO, referred to as the "Shipp-oh") is a statutory officer appointed under a provision of the National Historic Preservation Act 1966, a political appointee of the state governor - usually an officer from the state historical society, state historic sites administration, or other agency. The parks and site museums functions may be carried out by the historic sites agency or society, or the general recreation and parks administration, or a combination of both – e.g. in Illinois, the Illinois Historic Preservation Agency incorporates the statutory office of state historic preservation officer (who will delegate archaeological matters to the state archaeologist) and also runs Cahokia Mounds State Park which incorporates a substantial museum. The Illinois Department of Conservation runs the state park system, which includes many places of historic and archaeological importance. To complicate matters further, the Illinois State Museum runs the Dickson Mounds Museum which is also a large park.

Indian reservations
Indian reservations are a feature of landholdings throughout the north-central, mid-west and western United States. Many legal powers, co-equal with and independent of the

state administration, lie with the reservation administration. As recipient of a range of federal funds, Indian reservation programmes of development are subject to the provisions of the National Historic Preservation Act (see below). At the National Park Service course "Archaeology for Managers", I made contact with senior resources managers for the Navajo Indian Nation. Otherwise, since I was mainly in the south and the east, there were few opportunities for contact with reservation administrations.

Statutory framework

Although this fellowship report is primarily about techniques for preserving or stabilising the condition of archaeological sites, a comment is needed on the statutory framework in the United States. Two statutes are primarily relevant: first the National Historic Preservation Act 1966, and second the Archaeological Resources Protection Act 1979. Neither applies to privately owned land, on which archaeological controls are minimal. However, private landowners who seek federal assistance or who need federal permits (e.g. for river control works) are subject to the strict federal controls. There is some debate about the status of advice from the federal agencies -does that require s.106 consideration?

The *National Historic Preservation Act* established a national register of historic places listing properties of national, state or local significance; an advisory council on historic preservation; and designated State Historic Preservation Officers (SHPO) who are required to be consulted when federal projects are proposed.

The consultation provision of the National Historic Preservation Act is one of the most important of measures in controlling archaeological stabilisation and protection matters in the United States (Hutt and others, 1992). Section 106 requires all federal agencies, or all bodies receiving federal funds, to determine whether their activities have an effect on archaeological sites or historic properties. If an effect is determined, the programme and the mitigation measures which the agency will follow must he referred to the SHPO for comment and discussion. The federal agency may or may not follow the advice of the SHPO. In most cases, however, they do so because the alternative is to have the matter referred back to the Advisory Council on Historic Preservation in Washington D.C., with subsequent delay. The Advisory Council on Historic Preservation also will have on it the chief executives of the principal federal agencies concerned in state-level activities, so that any agency, whose operational managers appeal, face their own chief executives on the council. Balancing federal and state opinion is especially difficult for the National Park Service, the lead executive agency dealing with cultural resources, which has great depth in its professional staffing in these topics.

I discussed this provision for consultation with Mr Jerry Rogers, Associate Director, Cultural Resources, National Park Service. He was interested in the blanket protection for archaeological sites that applies in New Zealand. However, he did stress to me that, in almost all cases, "the politics will out". By this he meant that a nominally strong system of absolute protection, with stiff provisions relating to authorities to destroy or modify, may not always be effective in practice. On the other hand, a statute which requires consultation between the various agencies concerned -the developing agencies, the federal agencies and the SHPO - will set in train detailed consultation which will ensure protection, as far as is economically feasible, of the historic resources.

Of less importance to the topic of archaeological site stabilisation is the *Archaeological Resources Protection Act 1979.* This establishes criminal and civil penalties for violations, and establishes procedures for issuing permits for archaeological excavation on federal lands (Hutt and others, 1992). A third act, which was being widely discussed in the United States at the time of my visit, is the *Native American Graves Repatriation Act.* The statute mandates the listing of all human skeletal material from burial areas and also all archaeological artefacts recovered from Native American graves, with the lists forwarded to Washington, D.C., for a decision on whether, and if so to which Native American tribe, the remains should be returned. The actual administration of this statute and the actions of Native American authorities on receiving the artefacts and skeletal material is not within the scope of this fellowship, but its implications for consultation with Native American peoples are clear.

These primary statutes are framed in very general terms. The legislation is made operational by regulations issued by the principal executive agencies concerning the implementation of the provisions of the parent act. In the case of heritage resources the most important regulation is 36 *Code of Federal Regulations,* in particular Part 7 on archaeological resources and Part 800 which deals with the protection of historic properties. These simplify regulatory burdens between the federal agency, the developing agency, and the state historic preservation officer and streamline the administrative process generally. They also make clear the liability of federal agencies where unanticipated archaeological discoveries occur in the course of development activities.

Finally, there is a series of non-statutory "standards" and "guidelines" on historic preservation and archaeology. These include the *Secretary of Interior's Standards and Guidelines* (National Park Service, 1983) and the *Section 110 Guidelines* (National Park Service, 1989). The former includes topics as such as: preservation planning, identification, evaluation, registration, historical documentation, architectural and engineering documentation, archaeological documentation, historic preservation projects, professional qualifications, and preservation terminology. These are often cited as de facto standards by state agencies and private contractors in specifying the scope and detail of documentation of contracts. The latter guidelines (s.110) detail the responsibilities of federal agencies under the application of the s.106 consultation provisions with state historic preservation officers.

PARTICULAR PLACES

This chapter is by state, in the order of visits: North Dakota, Illinois, Georgia, Alabama, Mississippi, Louisiana, Pennsylvania (Philadelphia), Virginia. Sites are treated under broad thematic and chronological headings. Some specific conclusions are drawn about management practices on a case by case basis, but more general conclusions are reserved for the final chapter headed "issues and concluding remarks".

North Dakota

In North Dakota an opportunity arose to see excavations of a Palaeo-Indian (late Age) archaeological site at Lake Ilo National Wildlife Refuge; to see late pre-European and European period Native American villages on the Missouri River, in particular the Knife River Indian Villages National Historic Site; and to see sites related to European incursion into the region, particularly the Fort Union fur trading post and fortifications relating to the "Indian Wars" of the period after the American Civil War period 1865 to about 1880. Sites visited were Fort Abraham Lincoln and Fort McKean, both near Bismarck, and Fort Buford in the far north-west of the state near Williston and the border with Montana. The sites were all on the Missouri River or its confluence with major tributaries, with the exception of the following. My main points of liaison were with Ms Signe Snortland, State Archaeologist, with whom I visited many sites in the vicinity of Bismarck city (the state capital), and the relevant National Park Service site superintendents. In Bismarck, I met briefly with Ms Pat Ness, President of the Fort Abraham Lincoln Foundation, a private foundation which supports the state park of the same name.

Lake Ilo National Wildlife Refuge: a Palaeo-Indian site

Lake Ilo lies in high plateau country near the township of in the central western part of North Dakota. A dam was constructed here by the Civilian Conservation Corps in the 1930s. The dam in recent years showed signs of beginning to fail and was cut down to reduce the stress on the dam, lowering the water level. The lake bed was exposed as a silty mass covering several square kilometres and many ancient artefacts, particularly projectile points, were found on the silty surfaces -and were actively collected by local looters.

The federal Fish and Wildlife needed to make decisions on the management of this large area:

- whether to maintain the lowered dam and lake level, mitigate archaeological and wildlife impacts, and restore the lakebed to a native grassland;
- whether the dam would be simply reconstructed to its original height;
- whether it would be reconstructed with different functions enabling, for instance, the draining of the entire area of the lake during winter to kill off coarse fish or the creation of several smaller wetlands areas.

The decision made was that there should be some capacity for raising and lowering the level of the lake and therefore the risk of artefacts being exposed periodically from the archaeological sites in the very extensive zones of silt was going to continue to be present (Fish and Wildlife Service, 1992). This was an effect on archaeological sites in a federal project, and therefore subject to the s.106 provisions of the National Historic Preservation Act. A substantial archaeological mitigation programme had to be undertaken as a result of these deliberations (Ahler and Karsmiski, n.d.). I discussed management of the site with Don Bozovski, the manager of the wildlife refuge. I also visited the sites which are towards the head of the very shallow lake, about 600 metres from the former shoreline and originally under about 1 m of water.

The site itself consists of a lakebed silt, 10 cm deep, over glacial gravels and silts. There were some signs of soils having formed in the glacial silts although the A horizon,
The mechanisms of resource destruction have been widely discussed in of Engineers reports in recent decades. Factors include the operating pattern of the lake, wind run or wave fetch across the lake surface (and orientation of prevailing winds), resistance of sediments, and resistance of the archaeological deposits (Ware, 1989). We discussed quite closely the mechanism and primary causes by which the artefacts were being exposed in this archaeological deposit by the actions of the lake. As mentioned, the water was about a metre deep and in winter in North Dakota this means that ice would form to the very bed of the lake. The mechanism of exposure of the archaeological deposits, then, is a combination of ice break-up in the spring, and ice expansion into the soils in the thick of winter, combined with summer conditions when the waves could be up to 50 or 60 cm high with a wind run or fetch of up to 3 km across the lake itself. These waves would disturb the bottom at a depth of 1 m or less, and the effect would be exacerbated by seasonal lowering of the level, i.e. in late summer drought.

Two obvious mitigation techniques were considered: deliberate burial under the lake water and the construction of protective dykes to keep water out of site areas.
Deliberate burial had to be not only impact-free in its emplacement but also, in the longer term, removable without damage so that the site could in future be excavated. However, the impact of machine-stripping of protective layers, as determined by work at the nearby Alkali Creek, would be destructive of the archaeological layers (Ahler and Karzmizki, n.d.: 556).

The cost of *protective dykes* to actually secure the areas out of the water of the lake was regarded as being very high. A dyke about 1.2 m high would have cost about US$250 per linear metre ($80 per linear foot). Of the 5 sites concerned, to protect the total area would have required about 800 to 1200 m (.5 to .75 miles) of dyke necessitating approximately US$200,000 of dyke construction. This, of course, would not have avoided the risk of fossicking in the site-areas themselves. Nor would it protect areas which are not known about in the course of current survey.

At the time of visit, the silts of the lakebed had been artificially seeded into a rough grass cover to protect sites both against fossicking (artefacts would not be visible under the grass cover) and wind erosion. The grass which this produced had not been grazed,

Figure 2 Lake Ilo National Wildlife Reserve. The treed hills in the distance are the original 1930s shoreline. Grass has been established on the silts of the drained lakebed, foreground.

although there was some pressure by local farmers to allow grazing on the extended area of the exposed by the drainage. This grazing had not been allowed because it could create an expectation that the lakebed would continue to be available for grazing and perhaps sold off as farmland. The well-formed grass bed will also stabilise sediments as the lake is refilled on completion of the dam reconstructions as recommended by Ware (1989: 21).

Research excavation as a mitigation measure was the preferred choice. The archaeological excavations were directed by a partnership between Alan Osborne of the Midwest Archaeological Center, a unit of the National Park Service, and Stan Ahler (an authority on North Dakota archaeology) of Washington State University. The total budget for the archaeology was US$2.5 million, from a total of 20 million dollars being spent on the restoration work for the wildlife reserve itself. Although a research excavation as a means of mitigation seems a reasonable approach in this case, there would seem to be some merit in experimenting with stabilisation of the site, perhaps by applying filter cloth and some form of rip-rap over large areas, maybe several hectares of the lakebed, to see whether this has the desired stabilising effect.

Missouri River Villages

The Missouri River runs north-south through the centre of most of North and South Dakota. The valley floor of the Missouri River was very important for Native American settlement from the period of about A.D. 500 to the late 18th -and early 19th- centuries (Ahler and others, 1991). The reasons for this were: easily-tilled soils compared with the

surrounding prairie on the uplands; the valley floors were forested with poplar and ash; and there was an abundance of smaller game on the valley-floor including deer and turkeys. The earliest significant and well investigated archaeological site is the Mound Group, just north of the Knife River junction with the Missouri. This site has now been acquired by the Knife River Indian Villages National Historic Site. It is in an area on the upland prairie that has been disturbed by farm rubbish dumping but survives in reasonable prairie cover. I did not have the time to look closely at the management of these particular sites.

The sites for which the Knife River is most famous relate to the origins of the Plains Village Culture, approximately A.D. 1000-1200, to the Plains Village period itself, which ran A.D. 1200 to A.D. 1450, and to the period of Hidatsa consolidation A.D. 1600-1750. The sites of the last period, when populations appear to have been at their greatest, are most numerous in the region along the Missouri River throughout North Dakota. Apart from Knife River, proceeding south, sites which I was able to visit were Double Ditch, Ward Earth Lodge or Looking Village, On-a-Slant Village, and Huff Indian Villages. These are administered by the North Dakota State Parks, Bismarck City, or the North Dakota State Historical Society.

At the same time as the Hidatsa were consolidating their settlement north of the general area of what is today Bismarck City, in the south the Mandan tribal group from South Dakota were extending their influence up towards North Dakota. By the mid-1400s they had established a number of settlements south of the vicinity of present-day Bismarck. These sites appear to have had a characteristic fortification style with a perimeter ditch with bastions. The houses, unlike the Hidatsa houses, were square or rectangular in plan. I visited a village of this period called Huff, an early fortified Mandan settlement, which today lies on the northern reaches of Lake Oahe, a dam created by the United States Army Corps of Engineers. There has been severe slumping of the shores of this very long lake in its southern parts (the lake extends over some 280 km). In the southern reaches slumping of the loose bluffs has apparently been quite catastrophic in places (Ebert and others, 1989; U.S. Army Waterways Experiment Station, 1990).

Huff Indian Village archaeological site consists of a rectangular perimeter ditch about 150 m on its longest edge, enclosing the riverbank. Within the perimeter are many sunken housefloors. It lies on a gravelly terrace with a loess cap which has been eroded by wind and wave action from the lake. The Corps of Engineers has installed a length of rip-rap to protect the main part of village site. The rip-rap is benched at the top just above the flood level with a scarp or "cut-back" leading up to the site itself. Since its installation, the rip-rap has so far been successful in stabilising the condition of the site. The site area is maintained in a mown grass of medium length. The general appearance of the site is of a relatively rounded profile to the features, including both the many rectangular house floors and their perimeter ditch and bastions. Overall, this was a site whose surface aspect posed relatively small stabilisation problems due to the very rounded contour. Another problem with stabilisation on the site was burrowing by ground squirrels or gophers. Control of the ground animals is the main issue requiring

attention, and this will require liaison between the Historical Society and the county authorities.

The site was the subject of extensive excavations, conducted during the 1960s, over the part of the site which was estimated to be liable to erosion in the coming 150 year period. This excavation extended 30 metres back from the cut bank of that time. Generally, however, the instability of the site caused by wave erosion seems to have been stopped by the application of rip-rap which showed no sign of weakness or failure at the time I visited.

The *Knife River Indian Villages National Historic Site* is a complex of sites extending for some 3000 m along the Knife River just above its confluence with the Missouri River. There are four major site complexes in the park. Mentioned earlier were the Stanton Mounds on the upland prairie in a newly acquired area on the north of the park. Sites relating to the later pre-European period are Big Hidatsa Village, Sakakawea Village (named after an Indian maiden of the period of Lewis and Clark's first visit), Lower Hidatsa Village, and Amahami Village. The park management has had an aggressive programme of buying farmland from local farmers. One of the specifications for the contract of purchase was that the land should be sown into exotic grasses. This practice is now recognised to be counter-productive to the overall goal of establishing the environs of the villages and the park itself in a replicated or restored prairie grassland.

The only surviving area of prairie grassland in the park is in its northern reaches, on the Kreiger parcel (approximately 300 acres). I was able to visit this prairie with Charles Cartwright, park superintendent, and Kelly Privratsky, a natural resource technician. The prairie here was short prairie, no more than 15 cm (6 inches) tall, with fine views from the bluff edge northwards towards Garrison Dam. I was unable to document species composition, but there were few improved pasture grasses, and a great range of forbs and wildflower species in the sward (see figure). There was some problem with invasion of smothering exotic clover species. In the valley floor and on the scarp leading up to the high terrace country was an interesting assemblage of cottonwood (poplar, *Populus* sp.), ash (*Fraxinus* sp.) and many other shrubs.

A new visitor centre has recently been constructed in the southern part of the park near the principal road end by township. The park building has been partially hidden, as a landscape architectural feature, by a mound which is meant to replicate the general form of an earth lodge. This mound has been grassed in prairie species. Although the prairie species have been planted for some two years, the spread of the grasses has been quite thin, and much bare ground still shows. Forbs and other grass, low-lying herbs have yet to establish strongly. One of the major problems in establishing the short prairie grass here has been the invasion of clover from the adjacent farm grasslands, which has to be hand-weeded.

The *Big Hidatsa Village* had been adjacent to the previous visitor centre, now a work depot. This appears to have put some pressure of visitor-numbers on the site in the past, but the pressure bas now eased and an opportunity has been taken to stabilise and

Figure 3 Short prairie grass on the Krieger Block, a newly-acquired upland area at the Knife River Indian Villages National Historic Site. The land has not been grazed for 18 months; many herbs (non-grass species) are prominent in the sward. The figure is Kelly Privratsky, natural resources tech-nician at the park.

restore site condition. The site consists of a perimeter ditch enclosing many circular earthlodge depressions about 8-10 m in diameter. To the west are low linear mounds or raised ridges. To the north on the escarpment edges are a number of deep cuts created by the dragging of travois (load-bearing frames drawn by harnessed dogs). These are all landscape and earthwork features of considerable importance (Ahler and others, 1991: 85-86). At the time of my visit the site lay in a low-growing mallow (family Malvaceae), kochia (*Kochia scoparia*, a chenopod or "glass wort" fleshy-leaved genera), and the grasses, broome (*Bromus* sp.) and western wheatgrass (*Agropyron smithii*), each species occupying different points in the relief of the sites. The kochia and mallow, kochia in particular, was regarded as undesirable on the site, and the overall goal sought was a cover of prairie grasses. Kochia and mallow covered the high points of the rims between the depression of the former earth lodges. Their distribution on the ground suggested that there was an environmental cause for the failure of grasses. First, the grasses appear to have been established as a simple species or mix of two species, neither of which competes successfully in the seasonally arid conditions of the river. In winter, there may also be a cold problem for some grass species.

Secondly, kochia, being a chenopod, is probably well adapted to somewhat saline soils (West, 1993, pers. comm.), suggesting that the soils upon which the earth lodges are situated have high salinity, particularly on the dry rims.

The kochia is also understood to require a high nitrogen level in the soil. On advice from Dr E. Redente of the Colorado State University, the park has begun a programme of applying granular sugar, conventional sucrose, to the area to raise soil carbon and thereby to lower the level of nitrogen. The exact mechanism by which available nitrogen levels in the soil would be diminished by this process is not clear. Some 25% of the area of the site (approximately 2.5 hectares) was divided into 40 plots each plot being 10 metre square. The sugar was applied six occasions per year in three concentrations, totalling 1600 kilograms per hectare per annum, 1200 kilograms per hectare per annum, and 800 kilograms per hectare per annum. At the same time some native prairie seed grasses were being sown at the rate of 14 kg/ha (12 lbs/acre). The work had been begun in August 1993. It was not possible to report any diminution in the kochia in the short period in which sugar has been applied.

Another alternative suggested by Redente (n.d.: 4) was to spray with 2,4-D amine, but the park management, following national policy, is reluctant to further increase the use of herbicides. It has been suggested (West, 1993, pers. comm.) that Tordon (picloram) may be a more suitable spray. Seeding of a prairie grasses mixture at 28 kg/ha (25 lb/acre) following clearance is suggested by Redente.

Figure 4 Big Hidatsa Village, Knife River Indian Villages. The depression formed by the collapsed earth lodge is covered in grasses, while the rim of the lodge (prominent in foreground) has a cover of mallow (*Malva* sp.) and kochia.

Among other points of concern, there was also some evidence of ground squirrels digging in the village itself.

At *Sakakawea Village* the ground cover was a grass (unidentified). The site appears to have been undefended and consists of upwards of 40 circular earthlodge depressions (Ahler *et al.*, 1991: 92-94). The relief of the features on the surface of the ground was quite rounded. Mowing to moderate height had maintained a very clean and continuous cover of grass sward on the site. The site was very stable. The main point of interest about Sakakawea Village is the cutting-in of the Knife River on the north-eastern margin of the site. Here rip-rap had been installed down at river level up to the highest flood level with a small terrace approximately 3 m wide running along the length of the river leading up to the original eroded cut-bank. The cut-bank had been interpreted as an interesting example of archaeology for visitors. The view of the section was increasingly becoming obscured by a low shrub, probably sage-brush or wormwood (*Artemisia* sp.). When I visited the site there were obvious layers of darkened soil and much midden exposed in the cut bank above the path. Visitors had not had access to it (there is a fence at the base of the scarp by the path) and apart from the natural erosion of the face, it was fairly stable. The grassland at the top had been mown up to within a metre of the edge. The unmown grass strip had grown quite tall and was drooping over the bank providing some protection. A substantial set of wooden steps led from the high terrace level of the site down to the path above the rip-rap slope. These steps stabilised the access-way from the site down to the path very satisfactorily. Another feature of this site was a well-formed and level track which has been made down from the new visitors centre and allows for wheelchair visiting up to the steps previously mentioned. Several very good interpretative signs stood beside this track.

Although the areas of the major sites were mown, mainly for interpretative purposes, the extensive areas not mown in the park had an interesting and potentially useful conservative cover of shrubs. These shrubs as I observed them included snowberry (*Gaultheria* sp.), native *Prunus* (American plum), other forms of *Prunus* including chokecherry (*P. virginiana*), several species of the family Rosaceae, green ash (*Fraxinus pennsylvanica*) and elm (*Alnus* sp.) (the last two are tree seedlings). This cover had evidently been cut by ground-hog (rotary scythe) at some point in the previous 5-10 years. I did not ascertain from the park service staff how far they were prepared to allow this shrubland to advance towards a forested landscape. The interpretative value of the shrubland seemed to be considerable because it contains many economic plants of importance in pre-European subsistence gathering.

The park will soon commence re-construction of an earth lodge. In light of the controversy over Fort Union Trading Post (see below), the philosophical and ethical issues were paramount in design. The planned building site is not far from the Knife River Villages interpretation centre, on the trail to the archaeological sites, where it will lie in a small concrete-rimmed amphitheatre benched into a slope. The earth lodge to be reconstructed is not on an archaeological site. I was able to speak to Richard Cronenberger, of the Denver Center of the National Park Service, the architect responsible for the mid-west region of the National Park Service. He was responsible for the design of the earth lodge (National Park Service, 1992). His design is based on

Figure 5 Awatixa X'ie, Knife River Indian Villages. The site is on the "cutbank" at right. Rip-rap stabilises the bank at left by the Knife River, and a path has been established to view the "cutbank archaeology".

a 1910 plan of an Indian earth lodge, and not on archaeological records. He was critical of the fact that the earth lodges at On-a-Slant Village (see below) were not maintained. The park had not established the hard plaster surfaces which originally existed over the exterior of the lodges, rather the lodges were maintained in a grass cover. *As* a result, the wood used in the reconstructions had been open to moisture and had rotted, while the black plastic membrane placed underneath the soil surfaces had not proved satisfactory. Richard Cronenberger will insist that the Knife River reconstruction has a plaster coating to weatherproof the structure. The structural details of the building, which is quite a difficult engineering task in its own right, are available in the report cited previously.

Double Ditch Village lies on the eastern bank of the Missouri about 8 km north of Bismarck City. *As* the name implies, this site had a double defensive perimeter. Again the site features were quite rounded and had a conservative cover of grass. Unfortunately, the very extensive middens of the site which are interspersed with and spread around the perimeter of the earth lodges had no grass cover whatsoever. The reason for this is not clear. On the surface of the middens was a scatter of cracked bison bone, sparse pottery and stone flakes, resulting from the digging of gophers or ground squirrels.

As at Big Hidatsa on the Knife River (discussed above), the grass species present on the balance of Double Ditch village showed little variety. I was unable to confirm this view, but the appearance was as if pre-existing vegetation had been sprayed, and the ground

surface planted in a single grass species. In this situation, there is potentially little ground-spreading adaptive value in the composition of the grass sward. If the dominant grass fails to adapt to the soil conditions on the midden mound, there are no competing alternative species of a desirable adaptive character to take its place. The principal grass species has done very well on the rest of the site, and has been conservatively mown, but it has failed on one key component of the site.

At the time of my visit many gopher or ground squirrel holes were visible in the midden area. Subsequently in New Zealand, I was able to discuss the control of ground-dwelling animals in small areas such as historic reserves with Mark Tohin of the U.S.D.A. Denver Wildlife Research Center. He stressed that there were many standard agricultural approaches to removing these pests, and that shorter term control measures were regularly applied by local contractors throughout the west and north-west in agricultural and forestry areas. The options are poisoning, fumigation (of burrows) and trapping. Ground application of poisons is practical in spring and autumn, the active period for ground squirrels. Gophers, being active only underground, require baits or fumigation devices placed in the burrows. Fumigation should be carried out in wet ground conditions, to avoid seepage of the gas into the soil. In the autumn conditions of my visit to North Dakota, it is probable that ground squirrels were seasonally active on the surface, and would be readily controlled. Numbers were generally low in all the sites visited, with the exception of the Double Ditch middens.

Ward Earth Lodge or *Looking Village* lies on the northwest outskirts of Bismarck city on a river bluff on the east side of the Missouri River. The site consists of a defensive ditch and bank perimeter on the end of a broad ridge. The southeastern perimeter of the site has a number of distinctive and rather spectacular bastions. Again the profiles of the ditches are well rounded and infilled, and a short grass is maintained by the city parks and recreation department. The site is in stable condition but appears to be maintained partly as a scenic outlook up and down the Missouri River. A path of gravel lying between 100 by 100 mm wooden slabs has been constructed across the defensive perimeter and into the interior. The path then traverses around the full inner extent of the defensive perimeter with a large cross-shaped extension into the interior as well. This path has been constructed to allow wheelchair access as required by the Federal Disabilities Act. The overall impression of this track, given the relatively low relief of the earthwork features, is dominant and detracts from the site presentation. It is one of the few compromises of presentation in favour of access that I saw.

On-a-Slant Village is part of the Fort Abraham Lincoln Park, administered by North Dakota State Parks and Recreation and lies about 10 km south of Mandan township, on the west bank of the Missouri River. The village is reached by a short track from the interpretation center of the Fort Abraham Lincoln Park, and lies on the south bank on a point created by the entry of the Heart River into the Missouri. It has a simple defensive perimeter of a ditch and bank enclosing the point created at the confluence of the Heart River and a shallow, steep-sided gully closer to the Missouri River. Within the ditch and bank are approximately 50 earth lodges of which some five have been reconstructed, by the Civilian Conservation Corps in the 1930s. The largest of the reconstructed lodges, recognised to be a ceremonial lodge, has begun to collapse in recent years. The

Figure 6 Denuded midden mound at Double Ditch village, with pottery sherds, stone chips, and cracked buffalo bones exposed.

entrance-way to it has been barricaded off with a steel mesh screen.

The grass cover of the site is mainly crested wheat. One of the mounds had recently been resurfaced with a fine turf grass. The park managers spray regularly for hackberry (*Celtis occidentalis*) a tree which sends out extensive suckers. No controlled burns were conducted in the park, partly because the site managers believe that the thatch, the dead grass which lies on the ground, burns too hot. The turf grasses were failing due to lack of water on the crest of the mounds, and here some more drought-tolerant weed species were unsightly, having long gone to seed.

One of the lodges in the village which had been constructed in the 1930s was experimentally burned in recent years. The burn was carried out in mid-winter when the site was under snow cover and there was little risk of the fire escaping. The fire was used partly as an experiment in archaeology, to see the effects of burning such a lodge, and partly to stabilise a site which had become dangerous. Both site managers and the state archaeologist, Signe Snortland, regarded the decision to burn the lodge and

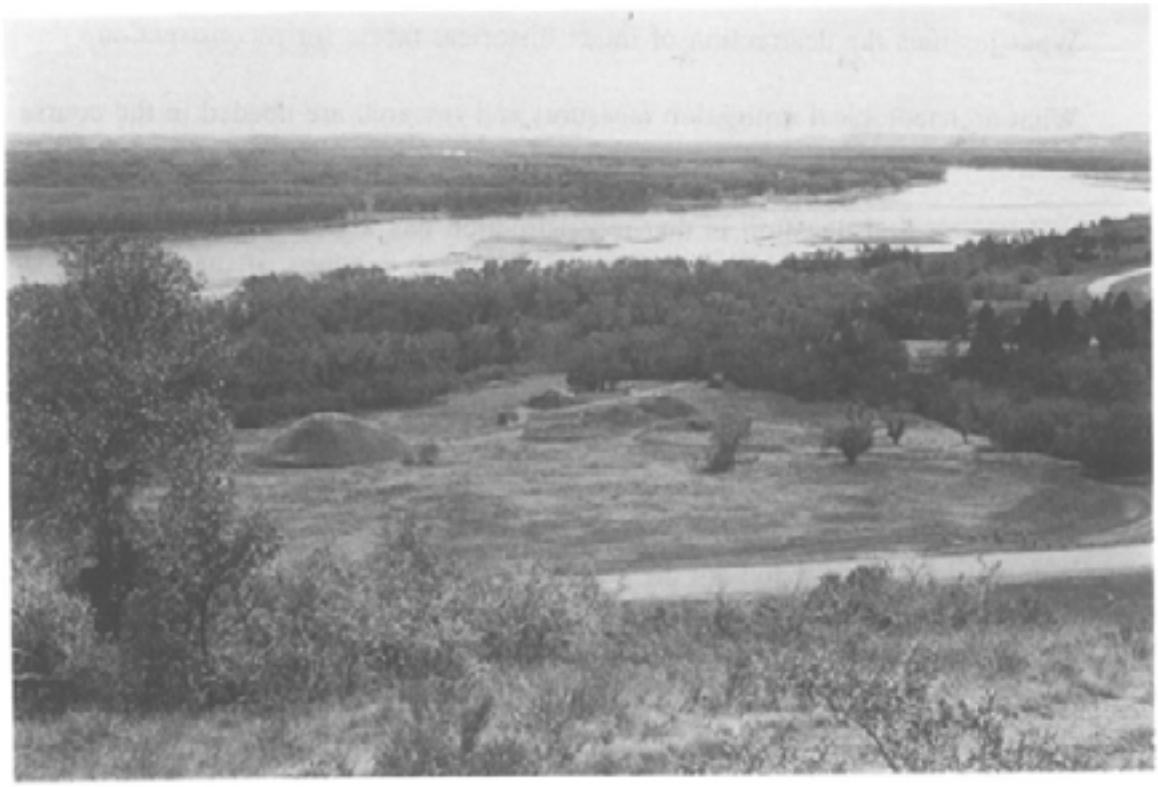

Figure 7 On-a-Slant village, Missouri River in background; the view is to the east. Reconstructed earth lodges are prominent by the pathway, centre. The defensive ditch is just above the road, foreground.

the results of the burning as undesirable. The fire burned far too hot and was quite destructive of the archaeological evidence on which the lodge was based.

By the late 18th century most of the Missouri villages had been visited by epidemics of European diseases such as influenza and smallpox. In 1804 Lewis and Clark visited locality of the Knife River Indian Villages, amongst others, in the course of their historic expedition to the headwaters of the Missouri. In the 1830s and 1840s smallpox epidemics amongst the villages reduced populations by between 50-90% and, as a result, many villages were abandoned.

Fort Union Trading Post, National Historic Site
Fort Union was established at the confluence of the Yellowstone and Missouri Rivers in 1829 by the Astors, an English family. It was a key centre to provide protection for trade goods and fur traders in the north-central territories of the United States at that time. The governmental structures of the western states had not then been set up. In the 1830s the company and the property was sold to Pierre Chouteau, a St Louis-based fur trader. These companies all operated under a form of home government charter, which gave them significant rights and interests as European outposts.

As noted in a later section, Fort Union was a key place to visit to consider the politics, ethics and principles which inform current decision-making on reconstruction. The later-cited open letter from Robert Utley pointedly concludes the debate about the reconstruction. Initially, the issues may be restated as:

- What justifies the destruction of intact historical fabric for reconstruction?

- What archaeological mitigation measures and research are needed in the course of reconstruction?

The answer to the first question is that reconstruction has arguably greater educative power or potential, an important park function. Current versions of the *Secretary of Interior's Standards for Historic Preservation Projects* (see updates of National Park Service, 1983: III - 113-117) indicate that reconstruction is "appropriate" where "essential" for understanding an historic district, where no similar example exists, and where the documentation of the structure is adequate. The Fort Union case is probably justified under these criteria. The second question, the archaeological response, is detailed below.

Unfortunately, I was not able to visit the Mid-West Archaeological Center, the principal National Park Service unit which was responsible for the archaeology at Fort Union. However, I was able to speak to Ms Signe Snortland, the state archaeologist. She discussed with me the role which the State Historic Preservation Office had in commenting on the National Park Service plans for Fort Union. At Fort Union I was able to discuss the reconstruction and the result as it lies in the field today with Paul Hedren, the superintendent. Paul Hedren is a principal advocate for the success of the reconstruction. His specialty is historic interpretation, specialising in the Indian Army of the 1860s and 1870s (units rather like the New Zealand Armed Constabulary). Paul Hedren outlined to me the long and chequered history of thinking about reconstruction, and in particular the history of the plans for reconstruction at Fort Union.

Fort Union was a large wooden stockade with stone bastions (comer towers) and many internal buildings (described below in their current reconstructed form). In later years as the fur trade died out, the fortification was "cannibalised" into other local structures, and it met its final indignity in 1869 with the timbers being incorporated into Fort Buford by the troops of the Indian Army. This centre of the fur trade flourished until the late 1850s.

By the turn of the 20th century, Fort Union was very substantially an archaeological site, with a few indentations in the ground where the building cellars had been and a faint outline trench indicating the foundations of the stockade. Thinking about the potential for reconstruction began with the Civilian Conservation Corps in the 1930s. It is fortunate that nothing was done at that time; it is likely that no recognition would have been given to the value of the archaeology of the site, and today a major maintenance problem would probably exist. Following the Second World War, the gravel terrace on which the site lies was extensively quarried, extending across and into the southwest bastion of the site. Local citizens argued for protection of the site in the face of this activity. The gravel extraction was stopped.

In the 1950s the North Dakota Historical Society gained ownership of the property. They sold the property (presumably because it was a cost liability) to the National Park Service. In 1962 a report assessed the historical values of the Yellowstone/Missouri

confluence and the importance of Fort Union was then well recognised. In 1966 a subsequent report analysed the values of this site and fitted them into a frame of national themes, which indicated the significance of the site as a unique representative of the fur trade. The themes identified are: "The original inhabitants"/Indian meets European sub-theme/changes in social and political organisation subdivision; and "Western expansion 1763-189"/ fur trade subdivision (National Park Service, 1989b). The decision was made then that the site should be reconstructed. Also in 1966 came statutory authorisation to establish the unit as part of Theodore Roosevelt National Park. A master plan for the park was prepared and available within two months of the passing of the law. The actual reconstruction stayed at the bottom of the priority list for 20 years. The reasons for not raising it in priority were the remoteness and the demands elsewhere in the country.

Figure 8 Fort Union Trading Post National Historic Site from the tower of the north-east bastion, the Bourgeois's House centre right. To the right of the Bourgeois's House is a protective roof for the exposed kitchen foundations. The stockade and internal wooden bracing run out to the left. The outlines of the "barracks" within the walls are marked by horizontal wooden beams. By the entrance, centre left, is the earth-roofed trade house.

By 1978 debate had started to emerge as to the ethics of reconstruction. Fort Union reconstruction continued to be a low priority partly because of that ethical debate but it was still recommended that partial reconstruction be carried out. This ethical debate arose from some significant failures of reconstruction efforts elsewhere in the United States, notably Fort Stanwyx, near New York, a bicentennial project of 1976, and Bent's Old Fort National Historic Site in Colorado. The former was reconstructed with treated wood which proved to be toxic to visitors. Bent's Old Fort was constructed in adobe

and green cottonwood logs, which "twisted and melted away". The cost of reconstructing Bent's Old Fort was very high and fuelled the debate about the value of reconstruction.

In 1984, when Paul Hedren took up the appointment as superintendent, visible on the surface of the ground were a few cellars and the archaeologists' steel stakes which outlined the perimeter of the fortification. He arranged for the ground to be mowed and a gravel track to be laid inside the compound. The actual line of the stockade was indicated by a strip of unmown grass. At this time Fort Union was an outpost of the Theodore Roosevelt National Park, a "badlands" park which lies about 40 miles to the south on the border of Montana and North Dakota. Paul Hedren's previous interpretative experience had been at Fort Laramie, Big Hole National Battlefield (Montana), an earthwork of 1877, and the Golden Spike National Historic Site (Utah), the point where the railroads from the west and east first met.

In 1979 a reconstruction analysis was prepared for Fort Union, and money was appropriated by Congress in 1980. This money was stopped at the administrative level in the National Park Service. The local citizens in the area, adjacent to the Park, had waited for the development of the site for some 20 years. They wanted development and programmes as an economic benefit for citizens of the local area. Very strong protests were made to their Congressional representatives. As a result, in the mid-1980's, some US$10 million was appropriated to be spent on the reconstruction at Fort Union.

About US$1.5 million was spent on archaeology to establish the exact perimeters of the fortification, to recover information about structural details of the stockade perimeter and the Bourgeois's House, and to recover material that would he useful for displays in the museum and administration quarters to he established in the Bourgeois's House.

Archaeology at Fort Union occurred in two main phases. Earlier mentioned was the 1966 report on the values of the vicinity. As part of this review of the values, archaeological investigations were conducted on the fortification, which showed the outline of the stockade and some of the internal structures. However the archaeology was not a comprehensive exercise in determining the plan of the fortifications or the structures within such as the trade house or the Bourgeois's House. The strategic goals of the excavations conducted in 1987, prior to reconstruction, related to architectural detailing of the palisade, other structures selected for reconstruction, and the construction-impact zones including the levelling to historic grade of areas outside the stockade (Peterson and Hunt, 1990: 2). The last impact extended outwards for 6-14 m from the stockade line. The archaeologists concerned explicitly recognised that many questions relating to the "socio-cultural" aspects of the fur trade could be addressed, but would not be, unless there was close examination and reporting of the artefactual remains. Nevertheless, in my view, the sole report (Peterson and Hunt, 1990) on architectural matters but not broader archaeological topics is of great value. It contains extensive discussions of the earliest (historically rather poorly depicted) fortification features of 1829-1833, as well as detailing of the palisade/stockade of 1833 which lasted through the period 1851, which is the period to which the fort is reconstructed.

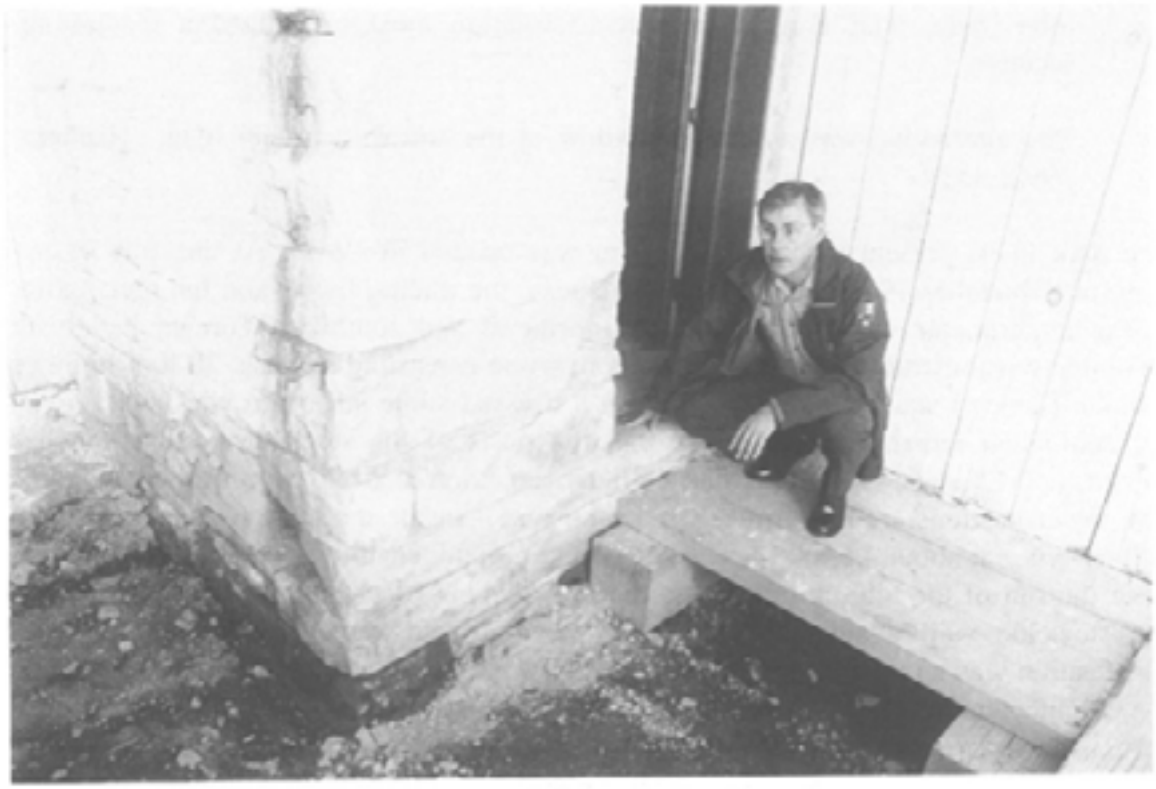

Figure 9 Fort Union, the exposed original foundations of the south-west bastion. The courses of stone at and below the level of his hand are original; note whitewash on the corner stones at this original level, the only evidence for the finish on the fortification's surfaces. The foundations have been left exposed. The figure is Paul Hedren, site superintendent.

These decisions on reconstruction and archaeology were accompanied by a quite vigorous and surprisingly open debate between the National Park Service professionals involved, including archaeologists, architects, and the specialists in site interpretation. An example is the open letter from Robert M. Utley about Fort Abraham Lincoln (quoted below), which followed his earlier opposition to the Fort Union reconstruction. Here is a response to the general debate from Paul Hedren:

> Doubtless some, perhaps many, in the National Park Service remain convinced that even well-executed reconstructions are nothing more than crass manipulations of historic environments. Yet, the National Park Service has long had bent. National parks routinely manipulate natural environments through wildland fire programs, the reintroduction of native species and the elimination of exotic species, vista clearings, screen plantings, and other natural resources mitigations. The parallels are patently relevant in historical context ....
>
> Indeed, the answer must ultimately come from the American people. If the public is better able to conceptualize a three dimensional place where before there was none; if a sense of the original environment its space, use, color -is again palpable; if the recovered archaeological

> record provokes an under-standing and renewed study of the business and of the Indian robe trade, then Fort Union's reconstruction must be judged a resounding success.
>
> The alternative was a grassy meadow at the end of a gravel road. (Hedren, 1992: 353)

The park in its present reconstructed form was opened in 1987. At the time of my visit, in September 1993, the Bourgeois's House, the trading house and the rectangular stockade perimeter with bastions at the northeast and southwest corners had been completely reconstructed. The stockade is in wood consisting of posts 20 foot high, of 10-inch (25 cm) square section resting on a dressed stone sill at ground level. (The archaeological remains demonstrated that the posts of the stockade were 10 inches square, not 12 inches square as had earlier been inferred from paintings of the fort.) The tower bastions are made of dressed limestone. Inside the stockade perimeter is a gallery lying at about 4.5 m (14-feet) above the ground, enabling potential defenders to have the run of the high points of the massive diagonals across the gallery also brace the stockade wall against the pressures of wind and snow. The centre of the fortification was an open square, surrounded by living quarters for the men. Just inside the entrance on the south side of the stockade was a trade house. Opposite the entrance across the square was an imposing building, the Bourgeois's House. (The Bourgeois appears to be the title of the manager of the company at Fort Union, a title rather like the Scottish "factor".)

Considerable money was saved in the reconstruction by not excavating some areas, and leaving some excavated archaeological areas open without reconstruction. Living quarters in houses inside the perimeter had been left as deep cellars surrounded by a wooden beam which indicated the approximate outline of the houses. At the rear of the compound, that is on the northern side, a dairy and kitchen flagstones had been exposed. The kitchen had been "ghosted" with a protective roof over it and the dairy, which was adjacent to the stockade line, had been left exposed but under a roof. The archaeological evidence of the foundations of the southwest bastion had also been left exposed. Here one can see the original base courses of the limestone tower, showing clearly that the tower itself was at some stage whitewashed. This archaeological evidence of the surface treatment of the site was the only evidence for the surface finish of the place.

The site is reached by a road which angles into the site along the edge of the Missouri River terrace, dropping into the original gravel pit of the 1950s. This gravel pit is used as a disabled persons carpark. The principal carpark, containing about 100 spaces, is further west, about 200 m walk from the site. From the environs of the fortification and from the crest of the stockade itself one has the impression of a site in a fairly original setting.

Archaeologically there are probably two criticisms that could be made of the exercise at Fort Union. The first is the nature of the archaeological excavations that took place.

Strategically, these were for architectural investigation but they were essentially salvage excavations for Bourgeois's House and the line of the stockade and bastions. The line of the stockade had long been established before the reconstructions. An understanding of the stockade line could readily be achieved by sampling the parts of the length of it, and would not need excavation of the full approximately 300 m (1000 foot) perimeter of the site. As a result of this excavation of the stockade line, and the apron of earth which surrounds it, many tens of thousands of artefacts have been recovered, which have been stabilised in condition and placed in storage. Some of these artefacts are on display.

The second criticism is that, apart from the reports which went through to the architectural designers of the place in the course of reconstruction, comprehensive reporting of the excavations has been limited. Along with reconstruction, this lack of full documentation will remain controversial until the reports are prepared. It is arguable of course that the archaeology was an exercise in support of reconstruction and that the archaeological services offered were adequate to that task. Nevertheless, many in the archaeology profession would argue that in fact the National Park Service has a responsibility to report more widely the results of its work.

In conclusion, while in transit through Denver airport, I was able to speak by telephone to Richard Cronenberger, the architect responsible for Fort Union, who is based at the Denver Service Center of the National Park Service. He argued to me that the archaeologists were in a service role in the reconstruction programme. He found that the utility of archaeological remains in defining details of building fittings was not so important. The archaeologist's work was of key importance in defining features of the defensive perimeter, but the utility was not so great for the house itself. He made a point to me that the archaeologists commenced some of their programme by indicating how they thought the palisades should he constructed. This was presumably based on their understanding of the foundations from the archaeology. However, it was pointed out to them that this was not the job for the archaeologists, this was a job for architects. The role of the archaeologists was simply to present the evidence relating to the foundations as they had been able to recover them. Trash pits which contributed little to the understanding of the architectural detailing of the plan or particular features of the property were not excavated in great detail. In the case of the house itself it was possible to recover, as we have seen, the plan of the stone flagging of the kitchen and dairy floors, but also the hearths of the original house were recovered. These were incorporated into the building of the reconstruction. Hence the hearthstones of the house as is reconstructed are one of the few original items to be seen there today. Richard Cronenberger argued to me that today the Fort Union should be regarded as a "stage set". When asked directly how he would rate the archaeological services that he received overall in the course of the reconstruction work for Fort Union, he regarded the services that he received (from the Midwest Archaeological Center) as very good. The work could not have been done without the archaeologists' contributions.

Indian Wars Period fortifications

The next historical phase which has left significant archaeological remains is the period of the Indian Wars. In North Dakota this period runs from about 1865 through to 1880,

i.e., the decade following the Civil War, when renewed attention was paid to the west. The principal personality on the European side was Lieutenant-Colonel George Custer, whose base was at Fort Abraham Lincoln, about five miles south of the railhead at Bismarck Township. On the Indian side the main personality was the great chief, Sitting Bull, who surrendered at Fort Buford in the far northwest of North Dakota in 1881. Sitting Bull was killed at Wounded Knee in South Dakota in 1890 following what some say was a misunderstanding with the Indian Army of that period. Fort Abraham Lincoln and Fort Buford probably held as many as four or five hundred troops. At both sites there are no earthwork fortifications as such. The bases were large, presumably the Indian threat was perceived as relatively slight, and the rectangular outline of the major barracks blocks around a barracks square was sufficient security for the establishment. At Fort McKean, an earlier fortification maintained as part of Fort Abraham Lincoln State Park, there was a stockade and flanking towers to the stockade. At Fort McKean the line of the stockade is evident as a shallow ditch. All the flanking towers there have been reconstructed in modem times.

Figure 10 Fort Abraham Lincoln; original barracks location outlined by Civilian Conservation Corps stone markers, foreground. In the right distance is the reconstructed "Custer House" which contains an exposed cellar. The figure is Signe Snortland, North Dakota State Historical Society archaeologist.

At Fort *Abraham Lincoln* itself, the original commander's house, Custer's House, has been reconstructed, with the archaeological evidence of the cellar still exposed within. (I did not visit this.) The commissariat and one of the major barracks blocks have been reconstructed in recent years. At the insistence of the State Historic Preservation Officer, the sites were excavated and revealed the plan of the buildings. To protect the exposed archaeological remains a pad of earth was placed over the full area of the site.

The buildings were constructed on steel caissons driven down through the archaeological site but disturbing only a very small part of the site. On top of the caisson was erected a steel framework. The reconstructed buildings were built on top of the steel framework. Base boards of the buildings were taken down to the level of the earth pad, so that the overall appearance of the two buildings is very similar to that of the original buildings on the site. The total cost of the caissons plus the steel framework probably added $20-$30,000 to the cost of the reconstructed buildings (information Historical Society officers). These buildings are each 30-35 m long and approximately 10 m across. I would estimate the cost of these buildings to be in the order of US$200,000 each, so the cost of the archaeological mitigation work on the foundations was a small proportion.

Figure 11 Reconstructed commissary and Civilian Conservation Corps outline of barracks (foreground). The reconstructed building is placed on a steel framework on caissons (large steel pipes), while the excavated archaeological site beneath is protected by an earth pad about one metre thick. Note sign on concrete footing, not dug into ground.

The recent work of reconstruction at Fort Abraham Lincoln has probably occurred in part because of the competitive stimulus of the federal project at Fort Union Trading Post. The state project has not been without its critics, especially Robert M. Utley, a former National Park Service Chief Historian and also a critic of the Fort Union reconstruction:

> Through legerdemain not unknown in the history of the U.S. Congress, you have embedded a Christmas tree bauble in the appropriations bill for the National Park Service ....

> Apart from the devious tactics that prevented the relevant congressional committees from examining this measure on its merits, I resent your action .... I resent it as a citizen concerned over the squandering of two million tax dollars to which I contributed for a project that claims no other merit than the political.
>
> Several evils will flow from your reconstruction -as from every other reconstruction I have known of. First, in order to recreate the buildings that vanished long ago, you will destroy what little of them remains. At Fort Lincoln, these are mainly archaeological evidences on and beneath the ground surface. But unlike your new buildings, they are original fabric, the only thing left, together with the landscape, actually associated with General Custer. Second, on top of the original materials you have destroyed, you will create a fake representation of what once stood there. It will have no connection with the original builders or users. It will not accurately replicate the original buildings, for your architects will have to speculate and infer the myriad architectural details that have been lost to posterity ....
>
> And once you have completed it, you must maintain it by the same painstaking and expensive measures that genuine historic fabric requires. If North Dakota cannot afford the bill, which seems likely, you must either watch it deteriorate or drop a Christmas tree bauble into the National Park Service appropriations each year unto eternity.
>
> That the National Park Service itself is completing a reconstruction at Fort Union Trading Post National Historic Site, in your own state, does not argue for Fort Lincoln. That project suffers all the disabilities cited above; it was funded through the same kind of political manipulation as your Fort Lincoln authorization; and it was undertaken in defiance of the National Park Service's own policies as well as a review process mandated by federal law.
>
> Almost never can a historical reconstruction be justified. Americans have repeatedly demonstrated their preference for the original materials and workmanship of history.... The few dollars that can be spared for the nation's historic places should be spent on preserving what has survived rather than spuriously recreating what has vanished. (Open letter to Hon. Kent Conrad, Senator, North Dakota, 1988.)

Fort Buford is located on the Missouri River not far from Fort Union in the far northwest of North Dakota. This military town was built by the Indian Army and maintained for the period approximately 1866-1895. Its ground plan is not dissimilar to Fort Abraham Lincoln, with a square surrounded by barracks, officers' quarters, a munitions store, and a Commandant's house. There are few above-ground remains. There is no earthwork defensive perimeter; however, the plan of the ruins of the hulk of the buildings, shows in a vertical aerial photograph which I viewed in the site museum (figure). In its forward planning, the State Historical Society recognises the limitations in visitor appeal of the place: "the site could be used to tell a much broader and more exciting story if more land were obtained *and the site were to a closer approximation*

of its original size and condition" (State Historical Society of North Dakota, 1992: 4, emphasis added). Amongst the research recommended is more work on the archaeology of the place and a plan to "ghost" some buildings -phrased as to "install frameworks showing the size and location of several of the buildings" (State Historical Society of North Dakota, 1992: 4).

An overall comment on the issue of reconstruction in parks in North Dakota is provided in the final chapter of this report.

Figure 12 Vertical aerial photograph of Fort Buford; north is to the right. Top right is the magazine (still extant). The rectangular outline of the barracks perimeter runs from below centre, left, up to above centre, right. The cellar of the officers' quarters lies on the perimeter above and to the right of centre.

Illinois

Illinois is the setting for three major mound groups – Albany Mounds near Moline, in northern Illinois, Cahokia and Dickson Mounds on the Illinois River. The sites visited are of interest because of their grasslands management, practices in allowing reversion, responses to problems of stability, and the condition of long-exposed *in situ* excavated sites.

Cahokia Mounds State Park
Cahokia lies on the alluvial flats of the American Bottom. This is a 60 mile long strip of lowland between the bluffs and the east bank of the Mississippi River, running from the

Figure 13 Cellar of the officers' quarters, Fort Buford. The foundations of the building, at left, are being mowed over and damage is accumulating.

confluence of the Missouri and Mississippi south to the confluence with the Ohio River. The area was first recorded in European annals in 1673, with a major voyage of exploration by La Salle, in 1682, when the French claimed possession. Major French settlements of this period were Cahokia township 1699 and Kaskaskia, in the south of the American Bottom, established in the early 18th century. The English occupied the area from 1765-1778, until the end of the Revolutionary War.

The site known as Cahokia Mounds State Park is separate from the township of Cahokia, the latter being the original French township of the American Bottom. The Cahokia mounds vicinity was occupied from about A.D. 500, with the flourishing of a remarkable "civilisation" about A.D. 1000 to A.D. 1300 (Fowler, 1973). The features of the site include very large mounds ranged around an open plaza area. On the north of the plaza is Monk's Mound, North America's largest and tallest mound. The plaza is only part of the settlement complex (not all of which is in the park) which included some 120 recorded mounds, palisade lines, a "woodhenge", and domestic settlement areas (Fowler, 1973).

Cahokia Mounds State Park is a unit of the Illinois Historic Preservation Agency and a World Heritage Site. The manager is Ms Margaret Brown, formerly the state archaeologist.

The total area of the park is 2200 acres, of which 800 is maintained intensively in mowed grass. The area in prairie grass is 100 acres. Some areas in grass are mown for hay, others are simply mown. In the areas of grass, mowing is necessary at least once a year to keep down shrubs. To the south of the mounds and plaza complex, the ground surfaces are maintained in reverting pasture grasses, or old field forest. In other areas active regeneration of shrubland and forest is allowed, particularly in some southern parts. In several areas the grasses are rapidly reverting through successional species to forest. Around the plaza and to the north of the reserve, grasslands are maintained. The grass is cut at about 15 cm (6 inches) tall. To the north of the reserve there are also extensive fields of *Andropogon* sp., tall prairie grass. These *Andropogon* fields are maintained as a ground cover, and periodically burnt, mainly to protect subsurface archaeological deposits which have survived below the previous plough-zone of these areas.

In general, no trees are allowed to grow on the mounds, there being only one example with trees in the extreme northern part of the reserve which has only been recently acquired. This particular mound has a tree cover of locust (*Robinia pseudoacacia*). According to Ms Brown, trees would have grown over the site following abandonment by the Mississippian peoples. However, roots of trees disrupted the constructed drains in the mound by entering the drainage layers and destroying them. Trees, therefore, are not an appropriate vegetative cover. Another reason for removing trees was that when the mounds were in use, they did not have trees on them. They probably had a cover of plastered clay.

Nine years ago Monk's Mound began to enter a phase of instability, with major slumps from the western, eastern, and northern faces. These caused great concern at the time (Emerson and Woods, 1990). The mound itself is approximately 30 m (100 feet) high, and had a distinct engineered structure. The mound did not simply accumulate as people added different layers to it over the years. It is constructed in distinct layers, some of which were designed to drain water percolating down through it, and there also appear to have been caps and buttresses of stiffer clay material within the structure itself (Emerson and Woods, 1990). The mounds are constructed of a very fine silt fill, highly erodible.

In the course of studies into the reasons why the mound has remained stable for so long, and then suddenly entered a phase of instability, a number of cores were obtained. These showed the mound to be composed of clays and silt fill with a high shrink-swell capacity and low permeability. The clays crack upon drying, and open up fissures which new rainfall or raised groundwater levels penetrate. In Emerson and Woods' (1990) view, the basic cause of the recent instability was a lowering of groundwater levels in the 1940s to 1960s, followed by a raising of groundwater levels from the 1960s:

> In response to the initial dropping of the water table, the lower core of the mound dried out for the first time, where previously it had been wetted by capillary action to a height of up to 10 m. Consequently, this portion of the core contracted and probably developed cracks at

Figure 14 The western slopes of Monks Mound, Cahokia Mounds Historic Site, Illinois. Note tall cover of exotic grasses on areas too steep to mow. Slumping in this area was bad some years ago but has now stabilised.

> numerous locations. This shrinking of the core would also have disrupted the integrity of higher parts of the construction, including the drains and massive fill units. The expansion of the core due to rewetting exacerbated this problem. With the internal drains no longer functioning efficiently and cracks in the clay core, massive fill units, and clay caps, intrusion and retention of atmospheric water increased dramatically. As a result of this instability, failure and slumping occurred. The prehistoric planning that had been successful for centuries had not taken into consideration modem changes in the water table. (Emerson and Woods, 1990)

Proposed solutions to the perceived stabilisation problem included combinations of:

- reducing internal seepage pressure by incorporating more satisfactory drainage media such as crushed rock passages or even a system of wells;
- modifying the mound geometry by adding a toe or retaining wall at the base of the slope;
- restraining the slope of the sides by pinning the surface into the core (Emerson and Woods, 1990).

All these solutions had potentially high impacts on the integrity of the archaeological structures of the mound. An evaluation of the priorities placed the following factors foremost in deciding on a solution:

- no negative impact on the archaeological integrity of the mound or the plaza areas;
- minimal visual impacts;
- a sound geotechnical/engineering base, and a high probability of success;
- both current and future causes of instability must be addressed;
- economically justifiable and cost-effective.

The only geotechnical solution that met most criteria was a system of wicks to draw up moisture and frequent small pin-piles on the slopes. Estimated costs were U.S. $1.7 million. Emerson and Woods (1990) concluded that "no action" was the preferred course of management. No further slumping has occurred since this rather alarming phase of the mid-1980s. Other aspects of surface treatment are simple and appear to be effective. During the period since the slumping alarm, established on the northern and eastern slopes of the mound. Any continuing erosion on the surface of the mound and on its slopes, were corrected by placing straw hales into the gullies. As the straw rotted topsoil was added and this had the effect of stabilising the gullies.

Access to the Monks Mound is via a wooden constructed stairway, which follows the line of the original stairway to the top of the mound. The stairway, although it has an underlay of geosynthetic cloth, is in fact concentrating water drainage from the mound. The water collects on the platform on the top of the mound and runs down to the top point of the stairs, and then creates a gully in the earth slope beneath the steps. However the steps are essential to maintain a suitable access-way to the top of the mound. In the past people would go up to the mound using informal tracks up the sides. These also caused erosion.

Ms Brown, the site manager, is satisfied with the state of archaeological research on the reserve area. Only 1% of the site has actually been excavated. Currently there is some re-excavation of the trenches dug by Mr Moorehead some 50 years ago. The object of these excavations is to reinterpret the sections that he recorded. Ms Brown would not accept proposals for research unless they were clearly funded right through from excavation to publication. She was satisfied that there was enough archaeological evidence to be able to interpret the site satisfactorily.

The mounds originally supported structures and there is a proposal for "ghosting" of the structures on one or more of the mounds. A building would be if it were erected in its full form. The visitor centre itself is located on a valuable part of the archaeological complex, and was comprehensively excavated prior to construction. It has an interesting plaza on its eastern side. On this broad expanse of concrete slab is

Figure 15 The plaza of the Cahokia Mounds Museum. The plan of archaeological structures as revealed by excavations before the museum was built have been painted on to the concrete. The structures at left are different periods of a house floor, with the wall bases outlined in a rectangle.

painted the outline of archaeologically excavated structures. The building itself lies on a slab 1.4 m (5 feet) thick of fill, which has the effect of protecting the excavated archaeological remains underneath.

Other points of site conservation noted at Cahokia include the following. A dance circle, in which Native Americans reinterpret their dances, has actually been constructed on the site of a former drive-in movie, now demolished. The roads which formerly entered small areas of domestic buildings in the reserve area have been left, with the surface asphalt ripped to allow some regeneration of grass. There has been no attempt to remove the road down to its base course which would place at risk any archaeological remains underneath.

Albany Mounds

I visited Albany Mounds with Beth Carvey-Stewart, Assistant Manager of the Black Hawk State Historic Site, Moline, Illinois. Albany is about 40 km north of Moline on the Mississippi River. It is of particular interest because of the decision some 15 years ago to allow reversion and assist with restoring prairie cover in the belief that this would be a low-cost, effective conservative cover (Brown, 1983; U.S. Army Waterways Experiment Station, 1989a). The site is owned and managed by the Illinois Historic Preservation Agency, of which the Black Hawk State Historic Site is a part.

At the site we were met by officers of the Illinois Department of Conservation, Randy Nyboer and Ed Anderson, who are responsible for organising volunteers who assist in the management of the natural cover of the historic sites. The area is 85 ha (208 acres) of which 25 ha (60 acres) are leased out for farming, 20 ha (50 acres) are in prairie, and the balance is in woodland of composition. The sites lie on the edge of the Mississippi bluff, in land primarily up until recent years. On the very crest of the bluff are intact mounds about 3-5 m tall, while in the area of farmland are many ploughed-out mounds. At the foot of the bluff are further mounds and village areas, some of which are included in the park. The complex is adjacent to the Meredosia slough, which was a very large oxbow lake, part of the old bed of the Mississippi River, and now filled with glacial debris. The slough was on the flyway for geese from the south to the north, and is an important zone of interaction between upland forest and prairie of the great Illinois Plains. This ecotonal setting is particularly favourable for both animal life and human settlement because of the variety of resources which are easily accessible.

Figure 16 Interpretation studies on tall prairie grass for grade-school children, Black Hawk State Historic Site, Moline, Illinois. The teacher is Beth Carvey-Stewart, the assistant director at the site.

The establishment and maintenance of grasslands has attracted a very large literature on both ethics and practice in recent years (e.g. Wedin, 1992; Andropogon Associates, 1989). However, grass is not necessarily a very stable cover in ecological terms. It is readily invaded by shrubs and eventually trees unless subject to grazing, mowing or lire. Park management has to address these practices in a cost-effective manner if grassland is to be maintained.

Tree growth has been removed from almost all standing mounds in the park, and prairie grass established on the formerly ploughed fields adjacent to the top edge of the bluff. Much of the work at Albany has been done by local conservation volunteers, who have sought to have some interpretation of the place as a natural prairie. This means that strips of fire break have been maintained as trails, and there is now a small visitor station at the entrance to the park.

Figure 17 At Albany Mounds, Illinois, tall prairie grass has been established and is maintained by fire on formerly ploughed fields. The view is from the edge of the bluff which is covered in oak/hickory forest.

There are four reasons why the ground has been put into prairie:

- prairie does not need ploughing or turning over of the soil;
- prairie cover is historically correct, an important interpretative measure that fulfils a widespread goal of conservationists in Illinois and elsewhere in the mid-West and Plains regions;
- prairie grass cover stops people digging in the sites because the sites are obscured;
- prairie grass is important for wildlife.

Albany Mounds is a balance between the habitat types of prairie on the one hand, and forest on the other; in effect it provides a savannah cover, i.e. a mixed prairie grass and

forest cover (U.S. Army Engineers Waterways Experiment Station, 1989a). However, much of the ground plan in the landscape design that I saw was based on the need to conserve existing patches of forest on the bluff itself, and by the establishment of fire breaks and the establishment of prairie grass paddocks in the original paddocks, to maintain the original farming field pattern. The Illinois Historic Preservation Agency and the Department of Conservation, appear to have less operational restrictions on fire management than has the National Park Service. Both at Cahokia and Albany, fire is used frequently as a management tool. In Randy Nyboer's view, the parameters by which fire was managed were as follows:

- use topography to control fire, particularly using the crest of hills;
- use back slopes of hills;
- set the burn units biologically, so that one does not remove a total community;
- ensure the correct timing - burning here was done in spring after the winter snows had flattened the prairie grass;
- use the best wind and then back-burn to start the fire, the sequence then being back-fires, flank fires, and then finally head fires which burn the area desired.

Another reason for burning in spring was that the low grass of the mown fire breaks was in good, green condition, and unable to burn. A considerable amount of public relations was needed to sell the concept of fire as a management tool because of health problems and the need for fire notification (both these factors need pre-fire planning). Positive points in favour of fire are:

- people in the local area must have an understanding of the reasons for fire - it does not simply burn up animals, but in fact creates habitat for animals;
- fire follows ancient peoples' practice, and has use as an interpretative model;
- fire gives increased soil fertility, particularly through the increase in potassium;
- fire enables grass regeneration from the roots, and also improves the setting of seed;
- there is an increased biomass, particularly of the root mass under the ground as a result of burning.

The net effect of the burning process is to increase productivity at ground level and the biodiversity of both the animal and grass and other ground-level productive systems.

Fire is sometimes thought to create an opportunity for noxious weeds to invade. Randy Nyboer's view is that soil surface disturbance was a much more important factor in allowing noxious weeds to invade. The seed bank in the soil is released, and noxious

weeds invade. When prairie grass is established, even when it is periodically burnt, the perennial prairie grasses dominate the ecological succession, so that exotic weeds do not get a chance to establish.

The general method for establishing prairie grass is to have a bare soil cover on the ground. The former cropping areas are allowed to go to natural seed. The farmer takes off a crop of hay. The new growth is allowed to green up and is then killed with Roundup. There is no cultivation of the browned-off grassland that results. The prairie seed mix is entered into the ground by drill. The approximate cost of the big bluestem (*Andropogon gerardii*) and forbs mix which is planted is U.S.$2,000-5000 per acre. There is a risk of failure due to drought. The ecological process after seeding is also of interest. Goldenrod (*Solidago* sp.) was dominant in areas which had been planted in 1988, four years earlier. These areas were due for a burn. Fire break widths are maintained at two to three times the height of the fuel, i.e. the width of the fire breaks is 6-8m. The areas with a fully established Andropogon grass cover had been planted as early as 1984/85. Once the *Andropogon* is established, burning takes place every three years. Legumes and other forms seem to be slower to establish than the grasses, but in the 1984/85 *Andropogon* there was a good mixed cover of legumes and forbs including tick trefoil (see figure). Appendix 1 contains notes on "tallgrass prairie savannah restoration" (from Packard, 1988).

The well-preserved mounds at the edge of the bluff have had the trees cleared off them. These are currently in a cover of foxtail grass, which will stay there until a perennial grass cover establishes, probably smooth broome, accompanied by blackberry and mulberry bushes. On some mounds this process was beginning to occur and locust was beginning to regenerate as well. In five to ten years time someone will have to cut out the locust (*Robinia* sp.). In Randy Nyboer's view this process of cutting out the locust should occur as soon as possible to avoid the risk of setting seed. Normally oak would regenerate through the locust, but obviously this is not desired practice here on these sites. There is a little *Andropogon* on some of the mounds but it was naturally established and it is questionable whether it would become dominant on the mounds, particularly with the degree of shading from the surrounding trees.

In summary, at Albany we were presented with an interesting model of a mixture of forest and prairie grassland, with mounds maintained in grasses but not in this case prairie grass. However, the overall effect is quite artificial in terms of its landscape design. There seems to me to be some case for landscape design to be imposed on this area, which would more closely replicate an original savannah-type forest. The urgency of such management is not dictated solely by the archaeological needs. Much contemporary savannah management, or rather reconstruction, is achieved by the inappropriate destruction of existing woodland reserves (Mendelson and others, 1992: 128). At Albany, where the reserve land was largely agricultural land, this critique does not apply and it is possible to engineer a form of savannah.

Albany Mounds reserve had been put into prairie grass, originally as a kind of benign neglect, designed essentially to and lower maintenance costs. As time has gone on, some ten years now since the original programme, what has been created is a park

Figure 18 A legume, tick trefoil, growing amongst the stems of *Andropogon* in the tall prairie grass sward at Albany Mounds.

of considerable natural interpretive vale – moreover, a park which protects the archaeological values of the standing mounds and the ploughed-out mounds. It is now possible for visitors to walk through the fire break trails, and to see what a large extent of prairie was once like. It should be possible for the mounds to be more fully interpreted than they are now.

Dickson Mounds

The Dickson Mounds were an important example if *in situ* display of archaeology, in particular human skeletal remains. In recent years, the museum has decided to cover over the skeletal remains, out of respect for the native American dead. Nevertheless, the process of entombment and the management of the original display hold some interest.

The Dickson Mounds lie on low bluffs just north of the flood plain of the Illinois River, about 30 miles south of Peoria. In the 1920s Dr Don Dickson, then the owner of the property, set up a private museum to display skeletal material which he had excavated from one of the principal mounds. The skeletons were displayed as excavated, and are believed not to have been removed from the ground. In the 1930s, the University of Chicago took an interest in the site, and it became an important venue for establishing an archaeological sequence of the mid-West Native American cultures, and an important training ground for archaeologists in classical (southern European) archaeology from the University of Chicago.

Figure 19 Cleared mound in oak-hickory forest at the edge of the Mississippi bluff, Albany Mounds. Mound is in a creeper (foreground) with foxtail and other grasses at crest. A perennial grass will probably establish on the mound, if locust is kept back. Otherwise the succession will be from locust to oak/hickory forest.

The Dickson family sold the site to the Illinois State in 1944, and it came into the hands of the Illinois State Museum in 1965. The burials have been on display for some 66 years since the 1920s, but about 20 years ago, pressure came to be brought on the Museum authorities to remove the skeletal material from display. Removal of the skeletal material from display is strongly opposed by the local people in the area. As a result of their opposition, the Illinois State Governor has put an emphasis on and provided money for new displays in the museum, to make up for the loss of the display of the skeletons.

The main area of skeletal display had been progressively enclosed in museum buildings from the time of Dr Dickson. In 1972 the enclosed space had been air-conditioned, but not totally controlled. Humidity was about and temperature 65-70 over the period since 1972. These factors fluctuated. Nevertheless the skeletal material little of which had been stabilised remained in remarkably good condition over that 66 year period. One of the skeletons had apparently been stabilised, probably with PVA (polyvinyl acetate solution) placed on the surface of the soil but not on the bones. The annual maintenance for the site had to the dust off the remains and to pick up objects which had inadvertently been dropped into the display space by visitors, who saw the site from a surrounding and slightly elevated gallery.

The reason for the skeletal material surviving in such good condition despite the vagaries of the air-conditioning system is that the loess of which the mound was composed is of slightly alkaline composition. The physical and chemical properties of the loess are such that they acted as a buffer for variations in the air-conditioning. The loess matrix in the immediate area of the skeletal material would he relatively unaffected by changes in the air-conditioning because the loess had the capacity to moderate frequent changes in humidity and temperature, such as one would expect in the Illinois region. (In Illinois air temperatures could vary from 35 C (95 F) in summer down to -23 C (-10 F) in winter.)

As part of the "interment project" (i.e. removing skeletal material from public view) the original area of the burials is to be simply enclosed under a new raised floor. The area is approximately 15x35 m in plan. A concrete ring foundation has been placed around this area, and 76 cm-deep (30-inch) steel RSJs installed as joists. Over these has been placed a floor. From an upper entrance-way will descend a walkway which will follow down through the display space. The display space will be used for an exhibition on the belief systems of the Mississippian peoples.

The material beneath the floor should remain in good condition. The floor and beams beneath do not positively seal the skeletal material. Although no provision has been made for access to the burials, cavities or spaces have been left so that the soil surface and the skeletal material is part of the air-conditioned space of the display area. The effect of the slowly descending gallery on which people will walk through a system of banners which illustrates cosmology will avoid the possibility of people actually walking over on the floor surface – i.e. over the graves of the Native Americans beneath. Intact burials also survive in the unexcavated section of the mound which lies immediately outside the display space.

Another group of sites at Dickson Mounds is a Mississippian village dating to approximately A.D. 1000. Here, several buildings, including some very rare types, have been excavated and left *in situ* exposed to view. Two of these, the "rectangular building" and a ceremonial lodge, are enclosed in concrete block shelters with eaves designed to look like original Native American houses. Visitors enter one side of the building and view the site through a glass window. The exposed sites themselves consist of trenches defining the wall foundations, collapsed charred beams from the roof and other debris in the floor of the house. The earth into which they have been constructed is fine loess. Consolidation of some kind was done on the soil surfaces, probably with PVA, although this cannot be confirmed. The effect of this has been quite disastrous where moisture has entered the perimeter of the actual site from the exteriors of the walls. The shelters are poorly ventilated, the eaves are not guttered properly, humidity is high, and the buildings have no capacity to be heated. As a result, environmental conditions are very humid, and temperature fluctuates wildly.

These are conditions under which no archaeological site or other museum artefacts should he stored. The soil is scaling off in large lumps. Some mould is growing in places on the site, and has been controlled to some extent by reduction in light levels and the spraying with a mould-killing reagent. Long term, the solution for this site is probably to

retain the existing concrete block structures even though, because they enclose the site with very little room to spare, they do pose a problem with a perimeter effect around the sites. Moisture also percolates from the immediate environs of the building into the archaeologically sensitive areas immediately inside the walls.

A further building encloses the archaeological plan of a cross-shaped building, a rare type of building. This particular building is chipboard-walled with an exterior tile drain. When one looks into the display space, moisture is actually condensing on a glass screen which forms a protective barrier. White mould is visible on the charcoal of the burnt and collapsed beams. The building's roof is supported more or less like a farmshed, with posts set rigidly in the ground rising to the cross beams of the ceiling. The chipboard walls are infilled around the beams. Again, the walls are too close to the archaeological features, the building is too small for the site it encloses. In one corner, water has actually flowed across the floor of the archaeological site and deposited silt in low points. There is no ventilation for the display space other than holes or cavities at the base of the walls. This site needs an entirely new building erected over it.

A solution is needed to the problem of drainage in the generally low-lying, level ground on which the sites occur. In the particular case of the cross-shaped building, work needs to be done to re-excavate the areas that have been covered with silt and to destroy mould. Overall, these "protective" shelters and buildings probably doing more damage to the sites than the sites would have suffered had they been reburied. However there is merit in having the sites available for display. Technical solutions to the problem of stabilisation of the sites are relatively straightforward: firstly, to avoid any leaks into the protected space, perhaps by installing more effective guttering to the buildings; secondly to drain the perimeter with a drainage trench or other kind of buried drainage coil; and thirdly by installing some form of air-conditioning in the buildings. The solution to the problem of the unfortunate stabilisation compound applied to the soil surfaces is not something which I can address. However, the key to stabilisation of these sites is a decision on the amount of money which is available to be spent to house them properly. If that money is not available, then removal of the present superstructures, the laying down of some kind of geotextile filter, the deposition of a fine sand and loess, and eventually grassing and leaving alone, is probably the only solution.

Georgia

Main contact points in Atlanta, Georgia, were with Dr Kent Schneider of the southeast region of the USDA Forest Service, Dr John Ehrenhard of the Inter-Agency Archaeological Services Division of the National Park Service and B. Sotir Associates, Marietta. Sotir is a consultant and project manager in vegetative stabilisation of engineered surfaces such as canal banks or road berms (Sotir and Grey, 1992), and was associated with the writing of the "Earthworks Landscape Management Manual" (Andropogon Associates, 1989).

Sites visited were in the Chattahoochee National Forest, north-east Georgia, and Civil War battlefields.

National Forests
Activities in the national forests are subject to section 106 of the National Historic Preservation Act. In the southeast region, there are 12 state historic preservation officers (SHPOs) with a consultative role on 15 national forests. The actual power of the SHPO relies on the failure of a federal agency to follow the consultative process required under Section 106. Once sought and given, the advice of the SHPO can be ignored. However, it must be sought, otherwise projects will be delayed. In the southeast region the Advisory Council on Historic Preservation and the Forest Service have an agreement relating to the functions of the SHPO on Forest Service land. A programmatic agreement is in force on how to conduct business in the forests. The process is as follows:

- each forest has a programme of work which is taken to the SHPO before the year begins.

- each forest conducts surveys using previously agreed upon methods.

- a single annual synthesis of work performed is presented to the SHPO.

The main effect on archaeological sites subject to section 106 is the impact of logging. I was able to discuss forest practice and make site visits both with Kent Schneider in the Chattahoochee National Forest, north-east Georgia, and with Meeks Etchison, archaeologist at Ouachita National Forest, Arkansas. The forests are selectively logged only, and a mix of different-aged trees and different tree species is maintained. Sites are identified in the course of surveys, the pine trees are left on the site and no logging is allowed. The protection process is known as "find and avoid". There are no resources available to evaluate the significance of sites left in the pine trees. The result is that logged-over country generally is left with a scatter of pieces of land with trees which can act as red flags to pot hunters or fossickers. It was estimated that in some sites up to U.S. $4000 of timber is left standing for want of the cost of a U.S. $200 for investigation to establish the significance of the site. However, much timber in the United States in the National Forests is sold to logging contractors well below true market value. Federal programmes emphasise the value of timber in creating local economic activity and employment. As a result, the value of the land that is left in trees with archaeological sites on it is relatively insignificant. This has the compounding effect that not only is there little income from the trees logged, but the amount of resources available from current income to do archaeological surveys is correspondingly limited.

In the United States, what in New Zealand would be known as plantation forests, are termed synthetic forests. These are forests in which clear felling occurs and in which an even-aged stand of highly desirable seedlings is planted. In New Zealand the cost of establishment and the ongoing costs mean that accumulated capital costs up front and 30 years before income is received, e.g. for archaeological survey, are resisted by the

forest managers. In the southeast region, where I visited, synthetic forests are very few. On balance, then, the "identify and avoid" practice is probably cost-effective under federal programmes of wood supply as they stand today.

In the patches of land that are set aside as a result of archaeological survey, the trees are left to gradually age. There is no intervention to manage succession. At about 60 years of age the pine trees start to lose their health, and are subject to insect attack. The trees eventually fall and are succeeded by the hard woods such as oak/hickory which eventually take over as site cover. The New Zealand equivalent for this ecological process is the early stages of manuka or kanuka succession. In effect, in the United States pine trees are playing the role of a pioneer species on archaeological sites, and the result after about 100 years is a reasonably well established oak/hickory forest on the archaeological site. Surprisingly, I saw an example of a reserve that was treated in a manner that would be readily applicable to archaeological site conservation -a low cover with pine trees systematically kept down -but it was a wildlife refuge, created to allow for quail, browsing deer, and other indigenous or game species. In the Chattahoochee National Forest the Blue Ridge Wildlife Management Area had a cover of 2 m-tall oak, pine, very low *Acer* sp., grasses, legumes, *Solidago* (goldenrod), and much rotting slash and sawn boles of the pine at ground level. The canopy forest is not allowed to grow following logging. The area had been subject to some tornado damage in the past as well.

Practice for felling and skidding, i.e. clearing the trees from the forest, is not dissimilar to practice in easy hill country in New Zealand. I was able to speak to one contractor about the question of clearing trees using explosives. This is sometimes mentioned as a quick way of removing trees from archaeological sites without the tree actually falling on the site. He had done this practice for clearing helicopter platforms while in the Army. Plastic explosives were laid into a notch opposite to the side the tree was intended to fall. All trees to be removed were treated with plastic explosives and the plastic explosives were detonated at one time. The effect was to clear the crest of the hill in one clean blow. The applicability of such techniques to clearance of archaeological sites is doubtful. The main point of using plastic explosives was not to demolish the trees so they had no impact on the ground when they landed, but to clear the hilltop rapidly for military purposes.

Interagency Archaeological Services Division, National Park Service
This division of the National Park has a coordinating and encouraging role between federal agencies and state agencies to assist in archaeological site protection and education of the public. The prime interest from the point of view of site stabilisation is the work done from this office on shoreline stabilisation on the Georgia coast with the Gulf. Two programmes are of some interest in the vicinity of the Cumberland Island National Seashore. In one project, a 2.4 m (eight foot) diameter sand sausage has been installed over almost 1.6 km (1 mile) of seashore. This sausage is made of a geotextile and is filled by dredge tailings (Sprague, 1993). The success of such a method for shoreline stabilisation requires that there be a drainage work or channel enlargement work being done in the vicinity, and that this work is close to the shoreline needing to be stabilised. If the silt filling the sausage has to be pumped from an intermediate

station then the costs increase dramatically. The cost for 1.6 km of seashore is approximately U.S. $90,000 (based on a quoted cost of U.S. $17/foot). This compares with a cost for mitigation by excavation estimated to be some US$480,000. This figure does not allow for of artefacts or analysis of materials for publication.

The basic technique consists of laying the filter fabric sausage, empty, on a shaped bed, and then the sausage is filled with dredgings.

Another exercise concerned a cut bank at the seashore. The Cumberland seashore is characterised by a chain of offshore islands with very extensive inland channels and lagoons through which the intracostal waterway runs. The offshore islands are a major geomorphological feature of most of the coast of the Gulf. Here, the intracoastal (not the oceanic shore) seashore is characterised by very extensive shell rakes. (A rake is a small beach ridge consisting entirely of shells which is quite resistant to erosion.) It should be stressed that the marine setting that has been considered is a low-energy (i.e. little wave action) marine environment. The archaeological sites concerned are on the inland side of the intercostal waterway and are slowly eroding. Shell was taken from very large shell banks elsewhere in the waterway, under permit from the relevant authority, and placed in jute bags along the area to be protected. The jute hags eventually rotted out and with the small amount of wave action a distinct artificial rake was formed. The initial exercise was unsuccessful because of insufficient volume of shell being put into the artificial rake. However, when further shell was added in jute bags, the success of the rake was satisfactory. In future, the rake will be inspected on a regular basis to ensure that it has not failed. Behind the rake were placed graduated stakes to measure the amount of silt which accumulates.

Civil War battlefields

Kennesaw Mountain National Battlefield Park lies on the mountain of the same name, a linear range of hills lying about 20 km to the northwest of Atlanta. In 1864, it was occupied by the Confederate forces to protect the railway line route to Atlanta. The Union forces advanced from the north from the vicinity of Chattanooga, Tennessee. The park contains some 19 km (11 miles) of linear earthworks, mainly on the northwestern face of the mountain. The park covers 2880 acres, of which 240 acres are kept as fields. The fields are kept open as parts of the historic landscape, since they were places over which Union forces charged the Confederate positions -unsuccessfully and at considerable cost (Catton, 1960: 214). The forest cover is mainly white pine (*Pinus strobus*) and white oak (*Quercus alba*). Some areas of clearance of the forest have occurred, apart from the fields, to maintain historic viewpoints. My impression was that these historic views replicated known photographic views taken in the 1860s. The open areas had a thick tangle of Japanese honeysuckle (*Lonicera japonica*), sumac (*Rhus* sp.) and other shrubs including peach trees.

The main areas of the park which I was able to visit were Cheatham Hill and Pigeon Hill. Both have well preserved Confederate earthworks. On Cheatham Hill, beside Cheatham Hill Road, is a very extensive sweep of linear earthworks culminating in a redoubt

nearer the Illinois monument. The forest cover here is oak/hickory which has been extensively cleared of undergrowth shrubs. On the ground, the fortification defended by Vaughan's Brigade consists of a forward breastwork with many parallel breastworks at right angles behind it. The light levels are relatively low and the main ground cover is periwinkle, *Vinca minor*. The fortifications are carefully signposted, asking people to stay off them. In areas more open to the light, the periwinkle is interspersed with seedlings of oaks. The shrubland succession which is occurring in the better-lit areas has been subject to, and will require, considerable maintenance over the years.

On Pigeon Hill, north-east of Cheatham's Hill and more or less in the centre of the battlefield line, are further Confederate breastworks in two main lines. Unfortunately, these are on the same line as the major walking track along the principal ridgeline of the park. In several places the track intersects with the trenches, and efforts have been made to reduce the infilling of the trenches with erosion. The basic technique has been to lay a causeway across the breastworks and to put a stone berm on the edge of the track. The result tended to obscure the pattern of the earthworks. Given the volume of erosion along the track, a satisfactory solution to the problem short of wooden boardwalks on this relatively steep country probably could not be achieved. The crest of Pigeon Hill itself is maintained in an open cover to give the historic view to the west, and in this vicinity an unsatisfactory vegetation has built up, as noted elsewhere. The shrubland is growing on granite bouldery slopes on which no earthworks can be detected.

Grant Park is a major inner-city park of Atlanta, and the site of the Atlanta Cyclorama, a large circular painting of the battle of Atlanta which is selectively lit to show a narrative about the attack on Atlanta. (I was not able to attend a showing.) In the northern part of the park are fortifications relating to the Confederate defence of the city. Today these are maintained mainly in grass. Trenches lie to the east of a gully up which attacking forces would have to run. In the northern corner of the park is what appears to be a redoubt. Although the existence of earthworks in the park is frequently mentioned in the brochures, I could find nobody on the staff of the Cyclorama who could tell me where the earthworks actually were. However, by examining the grass surfaces of the northern part of the park, I was able to detect several lines of trenches which followed the contour on the slopes to the gully just mentioned. These trenches were recognisable only because of their general form and layout on the slopes. They appear to have been infilled at some stage and a kind of sloped mowing-path created along their length (see further comment in appendix 2). The redoubt at the crest of the hill was in even poorer condition. Tennis courts have been created in the interior. Drainage for the tennis courts was allowed to exit through a breach in one comer of the redoubt. Grant Park to me seemed to be an extreme case of an area which had great historic significance, with a significant assemblage of earthwork fortifications, but in which recreational activities had been allowed to become dominant to the detriment of the fortifications.

Alabama

Russell Cave National Monument
Russell Cave National Monument was established by the National Park It covers an area of (310 acres) in a valley which has a catchment area of 35 km^2 (13.6 square miles). In prehistoric times the valley would have been heavily forested with oak hickory. The valley has a closed stream system, in which an intermittent stream enters a cave in the karst formation adjacent to Russell Cave itself. In modem times, with extensive strip mining for coal in the vicinity of the valley, and also the dumping of rubbish into the stream, the entrance to the modern outlet has become filled with trees, gravel and other debris.

A typical cave deposit consists not only of an archaeological site in the cave itself, but also, of more significance, a deposit consisting of rubbish thrown out by the occupants of the cave down the slope in front. These deposits are known as "talus deposits". Floods in the Russell Cave catchment can be quite severe with as much as 100 mm (4 inches) of rain in 12 hours. When this occurred in recent times, the partially blocked outlet forced the water to rise up to the level of Russell Cave itself, threatening to erode deposits which lie immediately outside the cave. If the erosion had been allowed to proceed, the deposits within the main cave itself would also have been at risk.

Figure 20 Russell Cave National Historic Monument, near Bridgeport, northern Alabama. The cave site is at the end of the walkway middle right, and the rip-rapped protective slope is at centre bottom. The rip-rap has alluvial gravels placed on top, to allow revegetation and a natural appearance. The stream exit is the large cavity to right of figure.

The method chosen to the talus deposits at the toe of the slope below the cave was as follows: the mouth of the outlet cave was cleared and extensive bulldozing undertaken to clean the bed of the stream and to establish a gentle grade into the outlet cave itself. Following the cleaning up of the bed of the stream, and the deposition of a reasonably coarse grade of rubble in the bed of the stream, rip-rap was installed against the archaeological talus slope. The rip-rap was brought in down the stream bed and placed against the talus slope over a geotextile. On top of the rip-rap was placed a light gravel similar to that of the stream bed itself. The overall effect, as it comes to be gradually grassed and go back into a shrubland, is quite pleasing to the eye. The work was carried out by the Alabama National Guard. 100 tonnes of rip-rap from a local quarry were installed in the form of large boulders, often 200-1000 kg weight.

Figure 21 Flat-topped mound and the wider area of Moundville Archaeological Park, showing pattern of grassing and shrubland vegetation on slopes of mound.

Moundville Archaeological Park

This park enjoys a reputation as the best-preserved archaeological site complex east of the pueblo-dwelling parks of the American South-west. The overall form of the park is a series of mounds arranged around a broad rectangle about 500 m square. This rectangle fronts onto the Black Warrior River, and the complex is not far from the fall line. (The fall line is the point where the rivers cease to be navigable as the ground rises to the tail end of the Appalachian chain.) The overall impression of the grounds is one of a very well kept parkland with open grass spaces and the mounds lying in grass, or grass with shrublands on the sides of the mounds. I met with Dr Douglas Jones, Director of the Alabama Museum of Natural History, who is the son of the original founder of the park, Walter B. Jones. The park covers a total area of 317 acres, and has been progressively

purchased since the 1930s. The park was dedicated in 1939 as a public facility. It was initially titled Mound State Monument, subsequently Mound State Park, but was never part of the Alabama state parks system. In recent years the name has been Moundville Archaeological Park.

Originally the area of the park was cotton fields cultivated up until the 1930s and the mounds had trees growing on them, in amongst the cotton fields.

Figure 22 Detail of the vegetation cover on Mound B at Moundville. Locust and goldenrod (*Solidago* sp.) are prominent in the cover, which has not been cut for about 3 years. Dr Douglas Jones, Director of the Alabama Museum of Natural History is at right.

In the 1930s Civilian Conservation Corps and Workers Progressive Administration labour was used to stabilise and shape the mounds. The Civilian Conservation Corps appears to have reshaped and stabilised the form of the mounds. In the view of Dr Jones, they carefully examined the configuration of the mounds to determine their original shape, and appear to have raised dirt from the base of the slopes and placed it at the top of the slopes forming the edges of the mounds. This had the effect of refining the shape of the mound into its original rectangular plan with relatively steep sides. In the 1930s, a drainage problem was recognised in the area of the park. The Civilian Conservation Corps installed approximately 300,000 m (1 million feet) of tile drains. Some of the drop-drain structures from parking areas are still visible from this period. There tends to be some forest encroachment on the perimeter of the park, but this is not allowed to affect the mounds. From time to time the forest encroachment is cleared back, using prison labour.

The largest of the mounds, Mound B, has a reconstructed Mississippian period house on the top. This is the only mound with an artificial drainage structure on the surface. A natural depression in the surface of the mound leads to a drop structure, which takes the water down a drainage pipe to the base of the slope where it is taken away in a concrete channel. Mound B also has the fullest cover of shrubland on the sides, consisting of sumac *(Rhus), Solidago* and many other shrubs.

On the bank of the Black Warrior River there is an interpretation and function center. Just adjacent to the function center is an area where the river has been cutting quite hard into the area of the site. The area affected rises some 20 m from the low water level of the river to the level of the park itself. Some 150 m of the bank here has rip-rapped. The work was done by the United States Army Corps of Engineers. All rip-rap was carried in by barge on the Black Warrior River, avoiding the necessity to transport heavy materials across the site itself. Originally the Corps of Engineers was reluctant to do any investigation of the archaeological features adjacent to the rip-rap work. At the insistence of the state historic preservation office and the park management excavations were carried out. Many archaeological structures were recorded in an area where few had been suspected.

Figure 23 Rip-rapped slope, Moundville Archaeological Park, near Tuscaloosa, Alabama. The Black Warrior River cut into the alluvial soils threatening the convention centre, centre top, and the site beyond. All rip-rap and machinery was brought in by barge on the river, avoiding damage to the wider archaeological site.

Mississippi

In Jackson, the Mississippi state capital, I had discussions with Ms Judy Pace, of the Bureau of Land Management, Dr Sam McGahey, archaeologist for the Mississippi Department of Archives and History (the state historic preservation office), Sam Brookes, archaeologist for the USDA Forest Service in Mississippi, and Dr Paul Nickens, U.S. Army Waterways Experiment Station. Dr is the editor and compiler of the *Archaeological Sites Protection and Preservation Notebook* (contents listed in appendix 3). These contacts provided useful orientation to site stahilisation problems in the state and guided my itinerary. Discussions with geologists at the experiment station are collected under Vicksburg National Military Park and Poverty Point in the following sections.

In Mississippi the air temperatures cooled dramatically and the atmosphere became very clear. I took this opportunity to fly from Jackson to Vicksburg, and Poverty Point, Louisiana, both to be discussed below. I also travelled to Oxford in the far north to attend a meeting of the Mississippi Association of Professional Archaeologists and to have discussions with Dr Robert Thorne of the Center for Archaeological Research at the University of Mississippi. Dr Thorne has for some ten years been involved with site stabilisation initiatives (see appendix 2) and is an advisor to the National Park Service on the preservation of archaeological sites throughout much of the southeast region and elsewhere in the United States. I visited several sites in the vicinity of the Tallahatchee River with Dr Thorne. We were able to view Hurricane Mound, a mound submerged in Lake Sardis, a lake created by the United States Army Corps of Engineers (Thorne, 1988).

Mississippi landforms are dominated by one major division, between the upland bluffs and the lowland alluvial plains. The distinction between bluff and alluvial plains is clear as one drives down from the uplands to the alluvial plains. The height of the fall is about 50 or 60 m. The uplands have comparatively few archaeological sites, although many of the Civil War land routes are along the edge of the bluff, and there are several Civil War encampments by the major rivers which cut through the bluff into the main alluvial plains. I was able to visit an example of such a Civil War encampment on the banks of the Tallahatchee River in the north of the state. This site was mainly in ploughed cotton fields, with some surrounding trenches and fortifications in an oak/hickory forest. The general condition of the earthworks under the oak/hickory forest was good. In discussion with Dr Thorne, his view was that oak and hickory was a relatively shallow-rooting species and the damage done to subsurface strata was minimal.

The major area through which I travelled while in Mississippi was "The Delta", a large area which runs from Memphis, Tennessee, to Vicksburg, Mississippi, bounded on the east by the Mississippi River and on the west by the Yazoo River and the bluff. This area is about 320 km by 100 km across (east to west) and consists of a complex set of meanderbelts and flood plains of the Mississippi and Yazoo Rivers. The area is characterised by many large oxbow lakes such as Lake Washington. Indian mounds are very common throughout much of the Delta region but, unless specifically reserved

within national forests or in other reserve areas, these mounds have suffered terribly from agricultural levelling.

Big and Little Spanish Forts
I was referred to these two remarkable archaeological sites by Sam Brookes of the USDA Forest Service. Both archaeological sites are large ridges, circular in plan, enclosing the bank of the Sunflower River. The Big Spanish Fort lies in a curve off the riverbank approximately 120 m long as seen from the road, entirely on private land. This curved area is in a 100-200 year old oak/hickory forest and the site itself is in very good condition. The site is about 2.5 m high and 8 m across at the base. The total diameter of the original feature would be about 600 m.

Only a part of the Little Spanish Fort lies in the Delta National Forest. Little Spanish Fort also encloses the Sunflower River bank. It lies partly in agricultural land and partly in old field forest. The profile of the part of this mound which lies in the old field forest is very rounded due to cultivation in the last 100 years. A part of this site is in better condition and here the mound itself is 3 m high and up to 10 m across at the base with a ditch outside it, about 10 m across and 1 m deep.

Yazoo National Wildlife Refuge
This wildlife refuge lies near Lake Washington in the Delta, about 15 miles south of Greenville and 60 miles north of Vicksburg. I had been referred to the refuge by Dr Thorne from Oxford. The refuge consists of an area of land about 11.5 km^2 in area consisting of most of a large semi-circular slough, a former oxbow bend of the Mississippi River. The refuge consists of some areas of oak/hickory forest, many open extensive areas of grassland maintained for their wildlife supporting capacity, and the area of the slough and bayou themselves. On some of the high ground are a series of mounds. The main point of interest here was that the mounds had recently been prepared for burning. The grasslands need to be maintained on the mounds to avoid the regrowth of shrubland and eventually forest land. The work was done on the advice of the federal archaeologists of the National Wildlife Service. The immediate vicinity of the mounds had been ploughed in a circle, about 15 m across, leaving only hare ploughed ground between the mound and the surrounding grassland. The mounds themselves had a cover of *Rhus* (sumac), some other shrubs and *Solidago* sp. Closer to the autumn period the mounds were scheduled to be fired. This firing would maintain them in a grassland and kill the developing shrubland.

Winterville Mounds
These mounds are an 18 ha (43 acre) complex about 5 miles north of Greenville. Run by the Mississippi Department of Parks and Recreation, the park contains 13 mounds, and there were seven more to the south taken down by agriculture during the 1960s. This is one of the largest extant complexes of mounds in the whole of the southeastern region of the United States. A citation has been written to declare the place a National Historic Landmark, but has not been fully processed through the National Park Service. The mounds are fairly worn down in places in the park, but several mounds exist to the full height. The largest of the mounds has a 1.2 m (4 foot) cap of earth on top, and a rectangular house/ceremonial structure has been reconstructed on top of that. This

structure was burnt not long after it was built, and only the plastered concrete-block walls remain. The interior of the structure is a thicket of very tall grass, although the surface of the mound outside is mowed.

The top of the mound is reached by a set of wooden steps. The sides of the full-height mounds of the park are covered in a mix of grass and shrublands and are maintained by burning. The mounds are isolated as single units, so burning is readily done. The burning is done when there is no wind and for preference they are burnt from a point or front downwind from the prevailing winds. This gives greater time for the fire to bum and to have a more satisfactory effect. The park manager would like to be able to spray for weed control; there is no objection to burning from local people because it is widespread local farm practice to bum off stubble at the appropriate season.

There is a Ciba Geigy experimental plant station adjacent to the park which appears to cause some problem with weeds from the trialling of experimental crops entering the park -weeds include Johnson grass, wild roses, honeysuckle, barnyard grass (a stoloniferous species) but no kudzu. The last species does not grow because the ground is said to be too rich.

The local garden club which has a hand in maintaining the property is very reluctant to see weeds thriving on the mounds. The club is also a major influence in attempting to keep the park maintained as an open classical parkland, rather than as a place interest. While walking around the mounds I heard several animals, probably rabbits and rats, moving in the mounds. When the mounds are burnt a lot of rats come out. Other ground-dwelling animals are also tending to migrate back into the area of the park - ground squirrels, snakes (common in the shrublands on the sides of the mounds) and red foxes. The last may have dens in the mounds but they are exceedingly furtive animals that are seldom seen or trapped. Over time, these animals must cause a problem in maintaining site condition.

Vicksburg National Military Park

Vicksburg was a key controlling point on the Mississippi River, since it was an area in the middle of the deep south, in which the tactical advantages of bluffs overlooking the river was important. For the Union, control of Vicksburg was one of the general key strategic objectives in winning the war. Vicksburg was heavily fortified by the Confederate forces by 1862 and their forces were able to blockade the river. The Union tactical approach to Vicksburg was very complex, and early attempts involved trying to take gunboats across through canals to the Yazoo on the west, and east to the Red River on the Louisiana Delta. For various reasons these attempts to bypass Vicksburg failed. Eventually Vicksburg was eventually outflanked to the south, by breaking through the blockade and making a landing 25 miles downstream. The Union forces successfully attacked Jackson, just west from Vicksburg, and from there a siege was mounted against Vicksburg itself. The Confederate lines occupied a perimeter about 10 miles long west of the city, taking advantage of the ridges which surround it. The Union lines were established about 300 m west again on another ridgeline. Almost all of this very extensive system of fortifications has been preserved in the Vicksburg National Military Park. The main campaigns at Vicksburg occurred in the year 1863.

The Vicksburg defensive fortifications have a long military and administrative history following the actual actions of 1863. The Union forces occupying the city were ordered to fill in their attacking positions, i.e. the outer siege lines, and occupied the Confederate lines. They subsequently pulled back to a newly constructed inner line and were ordered in turn to fill in the Confederate lines. In fact the original Confederate lines were not particularly well filled in since photos of the 1890s show that they were still standing. About the turn of the century, following congressional legislation, the War Department was ordered to restore the fortifications at Vicksburg and to clear them of vegetation. By 1910 photographs show clearly restored fortifications in good order.

Figure 24 Stockade Redan, Vicksburg National Military Park, in badly eroded state in the late 19th century. The view is from the east, from the Union attacking positions.

In 1933, the Civilian Conservation Corps set up many camps in the Vicksburg Military Park vicinity, with up to 500 people stationed there. Their role was to reconstruct the fortifications, to clear vegetation and to eliminate erosion scars. It is important to remember that erosion is a very difficult problem on the Mississippi bluffs. To eliminate erosion properly any erosion gullies have to be back-filled. A complex, temporary system of trenches and fortifications leads to many opportunities for gullying, and the means of clearing and establishing a stable landscape is very difficult indeed. The Civilian Conservation Corps appears to have wrought major changes on the shape of earthworks in this period. Subsequently in 1960s, under the guidance of "Mission 66", the National Park Service also conducted a major renovation of the earthworks at Vicksburg. There have therefore been three major renovations of the earthworks at Vicksburg.

Figure 25 Stockade Redan in September 1993, from a similar vantage point to Fig. 24. The redan is as restored by stabilisation programmes in the early part of this century.

An interpretative road covers the full length of the park in one single loop with some connecting roads across. The loop road is 15-20 miles long, more or less continuous along the line of the principal Union and Confederate defences. The military park has visitor numbers of the order of 850,000 to 1 million per year. There is an entrance charge per vehicle to enter the park of U.S. $4.00.

Where I first entered the park, I could not see the Confederate lines from the Union lines and could gain no sense of the strategic or tactical positioning involved. Eventually I came across three major planned vistas in which views of opposing lines were evident. These views are at the Third Louisiana Redan, the Stockade Redan on Old Cemetery Road, and Thayer's Approach on the northern flank of the park. The extent of some of the work stabilising the structures is evident at Fort Hill on the extreme northwestern flank of the park overlooking the confluence of the Yazoo and Mississippi Rivers. The fortification at Fort Hill originally dates to before the Civil War, back to the period of Spanish occupation of the area. The fortifications are now carefully moulded with even, contoured, and grassed slopes, with brick steps entering the fortifications. To the west below the slope leading down the main bluff is a perimeter drain built into the slope. This drain has the effect of preventing rainfall running down the slope and creating erosion and instability. It is clearly not an original feature and to install it must have meant considerable restructuring and re-contouring of the profile of the fortification. From Fort Hill looking north along connecting avenue is a long series of Confederate trenches following the line of the interpretative road.

Figure 26 Fort Hill, in the north loop of the Vicksburg National Military Park, September 1993; the view is to the northeast. A concrete surface drain has been installed along the steep slope (at left, in shade) about 10 m down from the crest, to stabilise the edge of the bluff. Note house in the immediate park vicinity, lower right.

A typical section across one of the defensive or offensive lines at Vicksburg consists of the following elements: on the slope rising to the crest of the ridge are trees, oak and hickory, with a relatively dense shrub layer and a ground cover of leaves; on the very crest of the ridge are the long linear trenches and breastworks of the soldiers' lines; on a grassed slope below the trenches are a great variety of monuments to the fallen of the battlefield; below this again is the line of the driveway through the park; and beneath the driveway of the park is an elaborate drainage and drop-drain structure which carries the water away from the principal slopes of the crest of the ridge; below this again is a further oak/hickory forest regenerated since the time of the action in 1863-1864. As already discussed, most of the defensive features have been long reconstructed from as early as the turn of the century. There were several places, for instance by the 8th Battery of the Michigan Light Artillery, where steps and paths lead up to the breastworks in front of the guns and there was tracking, not particularly severe, along the top of the breastworks. There were also "erosion hot spots" where people walked down into the emplacements of the guns.

Where vistas had been opened up between the Union and Confederate lines, for instance, along Old Cemetery Road, there was a very dense presentation of signs on posts explaining the Union advance against the Confederate lines. Signage was so dense in places as to threaten the sense of being on a battlefield at all. Nevertheless it does assist in understanding the intricacies of the tactical approach across quite extensive

Figure 27 The Stockade Redan, lower right, and Old Cemetery Road, a view to the east, September 1993. The confederate line including the redan (a forward-projecting defence) is across the foreground. The Union attack including artillery positions progressed along the ridge line of Old Cemetery Road; several lines of Union trenches can be seen in the cleared grass slopes of the approach, centre and top right.

areas of ground and gullies towards the Confederate lines. An interesting feature of the signs is colour-coding, the Union signs being in the blue of the Union uniform, and the Confederate signs in a brown-orange colour.

In the 1930s, it was decided to let much of the vegetation around the earthworks and the ridges surrounding the fortified lines to revert to forest; only selected vistas of earthworks would be maintained. Allowing forest to re-grow had the effect of reducing erosion. The tree growth of today is quite extensive over most of the park. My impression had been initially that the forest has been allowed to grow up the sides of the ridges in the park to enable protection of the erosion-prone edges of the ridges. However, in discussion with the U.S. Army Waterways Experiment Station staff, also based in Vicksburg, I was led to understand the trees are a mixed virtue in protecting against erosion:

- trees are very heavy and increased the weight at the head of the slopes with a consequent risk of failure;

- when the trees die they leave cavities which can conduct water down into the sediments beneath;

Figure 28 U.S.S. Cairo, a Union iron-clad river gunboat, sunk in the Yazoo River, Mississippi, in 1862. The boat was taken from the river in the early 1960s, and neglected for many years. It is now housed by the Vicksburg National Military Park under a roof, with destroyed parts of the structure "ghosted" with laminated wooden beams. The boat continues to have several conservation problems, partly because of its exposure to climatic fluctuations. Although periodically reimpregnated with sprayed polyethlyne glycol (a water-soluble waxy alcohol which is designed to maintain the cell-structure of the original wood), its conservation status is not good.

- there is a risk of tree throw, particularly under severe windstorm conditions;
- trees do not protect as much as believed from the splash of raindrops falling on the ground;
- trees do not make organic colloids (a chemical which binds the soil, giving it the consistency of a stiff clay);
- there is always a time when the trees have to be felled, either because of old age or failure to thrive or for harvest, and this process is particularly catastrophic from the point of view of erosion protection.

The trees generally at Vicksburg are little more than 80 years old, in my judgement, and the park is yet to face significant problems from the senescing of trees.

I was able to sight the: historian's collections including interesting examples of the published reports of the Civilian Conservation Corps activities at the park. Something of the flavour of these reports can be gained from the very extensive photographs of quite

heavy earth-moving equipment in use at the battlefield. The battlefield is described as "one of the most beautiful and unique siege battlefields in the annals of history". Soil erosion is described as "active erosion gullies actually encroaching upon roadways and threatening destruction of many of the existing monuments and memorials. Historic trenches, fortifications, etc., erected by the opposing "blue" and "grey" armies were rapidly disintegrating under the effects of erosion and other natural elements". (This particular report was from the *Civilian Conservation Corps, District E, 4 Corps Area, Official Annual* 1937.)

Not long before my visit, in October 1992, the park had held a management objectives workshop. Amongst the objectives which were derived from this workshop are the following:

Interpretation

- to use the siege and fencelines and the Mississippi River as the primary interpretative resources in order to interpret the Vicksburg campaign;

- to manage all public use and activities to foster an atmosphere in which to contemplate the acts and deeds of the struggle for Vicksburg;

- to restore and preserve a landscape which is reflective of the 1920 commemorative appearance of the park landforms and vegetation;

- to maintain buffering landscapes to screen off site developments and to enhance the commemorative atmosphere.

Monuments/historic structures

- to restore, preserve, maintain and interpret all commemorative monumentation related to the campaign, and to provide public access.

Among the issues discussed in this management document are the following (a selection only):

- extremely erodible soils

- inappropriate development next to the park

- lack of artefact storage space and related staff training

- illegal dumping in the park

- vista and viewshed clearing

- inholdings [i.e. freehold land within the general park boundaries] not purchased

- lack of interpretation of the national cemetery

- safety hazards on the Cemetery Road
- landscape plan for the national cemetery not followed because of lack of staffing
- lack of a park landscape plan
- difficult for visitors to understand the battle
- lack of a fire management plan
- lack of baseline data [for monitoring condition?]
- lack of alternative community recreational sites creating demand for recreational rather than commemorative use of the park
- use of recreational vehicles and buses which intrude on the visitor experience.

These issues are mentioned not as a criticism of the park management but to show the complexity of the management environment of this park. Not dissimilar difficulties occurred at all the other larger parks which I visited.

Jackson's Landing circular earthwork
This site is on the west side of the Pearl River in southern Mississippi on the coast. The site lies on the Mulatto Bayou which feeds into the coastal marshes. I visited this site with Mr Jim Barnett, who is the manager of the Grand Village of the Natchez, and also manager of historic properties for the Mississippi Department of Archives and History.

The site consists of a large circular linear earthwork, enclosing the edge of the Mulatto Bayou. The diameter of the circle is approximately 350 m (estimated) and the length of the surviving earthworks is 480 m (approximately). From the outer edge of the borrow pit to the inner edge of the raised linear mound is approximately 25 m and from the base of the borrow pit to crest is approximately 9 m at its maximum height. This is a very large earthwork indeed, and is probably similar in its form to one of the ridges at Poverty Point before that area was ploughed. The mound is covered in forest estimated to be some 80 years old, with some locust in areas exposed to light. Generally the ground level is clear of low shrubs, with the leaf litter revealing the shape of the mound through the boles of the oak and hickory forest.

Our purpose in visiting this site was to encourage a local company to donate one small piece of the earthwork to complete the purchase of the whole of the earthwork by the Mississippi Department of Archives and History. However, the site had an interesting history of management which illustrates certain points about the value of forest cover on such earthworks. A part of the earthwork had been sold by the local company just mentioned to the port authority. The port authority had promptly bulldozed a road line through the earthwork to give access for a waste discharge overflow pipe. At the time of our visit the cut was still open and had been cleaned down by a local archaeologist who was making a study of the section for a research thesis. At the point of the cut the

Figure 29 The large linear earthwork largely owned by the Mississippi Department of Archives and History at Jacksons Landing on Mulatto Bayou, lower Pearl River, Mississippi. This illegal cut is through a small section owned by the port authority, and is here being examined by archaeologists and the environmental manager for a General Electric plastics-feedstock company which owns another small portion of the earthwork. Note the limited penetration of the earthwork surface by the roots of oak/hickory trees, and the extent of soil erosion indicated by the exposed roots.

roots of the oak and hickory trees penetrated some 20-40 cm into the topsoil horizon on the mound. The roots spread quite widely from the point of entry to the soil. This is a relatively minor intrusion on the values of the site, which consists of a very high column of undifferentiated fill to the original topsoil about 4 m below the crest of the mound. It was noticeable that, although this site has been under relatively little visitor or other pressure in recent decades, the roots of the trees were distinctly buttressed at ground level. This suggests that there has been in the lifetime of the tree (80 years) some 15-20 cm of erosion of the crest of the mound. The mound was presumably grazed during this 80 years, if only by deer, and this degree of erosion is acceptable given the size of the earthwork.

Grand Village of *the Natchez*

This site lies on the valley-floor of the St Catherine creek on the outskirts of Natchez. The site itself is of relatively modest size with three mounds lying between the St Catherine Creek and a historic ceremonial plaza. The Grand Village lies on the levee of St Catherine Creek which means that the mounds are on the elevated part of the levee closest to the river, and the plaza slopes down to the foot of the Natchez bluff to the southeast.

First European contact with the Grand Village of the Natchez was probably by de Soto, the Spanish explorer, in 1542, although no clear records survive of this contact. The first well recorded contact is with the Frenchman, La in 1682. A French colony was established here and from a Dutchman, Page du Pratz, made some very important records of the life ways of the Natchez. In 1730 the French dispersed the Natchez and survivors of these events are to be found amongst the Chickasaw descendants now domiciled in Oklahoma. Du Pratz's record is a key document in understanding the life ways of Indians in the Mississippi valley at the initial period of European contact.

Two mounds, Temple Mound and the Great Sun's Mound, have been completely excavated and reconstructed to something approaching their original form (Neitzel, 1965). A third mound on the southwestern side of the site has been left unexcavated, but is under some threat from riverbank erosion. Amongst other archaeological features discovered on the site are house locations and the line of a siege trench constructed by the French in the 1730s. No surface evidence of this siege trench remains.

Three stabilisation problems exist with the site. The first is the St Catherine Creek eroding into the western side of the site, a problem which has been solved by the construction of rip-rap at this point. A point of note about the rip-rapping was an arrangement with the neighbour on the western side of St Catherine Creek to allow access and also to allow for more intense erosion of that side of the river once the installation of the rip-rap had been done. Second, more severe problems arose from stormwater drainage from subdivisions of Natchez township itself. Stormwater from a subdivision was directed on to the site, some years ago. This was taken in a ditch along the boundary of the park to the west into the St Catherine Creek. As a result, a gully eroded quite severely back into the site along the line of the drainage ditch. Third, compounding this problem from the flow of stormwater onto the site was excavation of the wider area of the plaza. Colluvial deposits (i.e. silt washed down the slopes from the hill behind the park) had filled much of the area of the historic and prehistoric ceremonial plazas on the site. This was stripped off in considerable volume in the course of a second phase of excavations of the site two decades ago (Neitzel, 1983). Tree-clearance material was thrown onto the stream scarp on the northeast of the site by the two excavated mounds. Fill removed from the site was then dumped on to this unstable, rotting vegetable matter. Excavation of the silt left a concave surface and led to a distinct drainage problem for the central part of the site. The edges of the site to the northeast on the line of the 1730 course of St Catherine Creek began to suffer from severe gullying erosion.

A solution to these problems has been three-fold:

- the stormwater from the subdivision was taken in a single buried drain across the site in the northerly direction direct into the 1730 course of the creek;

- drop structures and drains were installed elsewhere on the site taking water from the wider areas of the plaza into the St Catherine Creek;

- a berm was constructed on the margins of the 1730 course of St Catherine Creek to avoid the risk of water running directly over the scarp and creating gully erosion.

An opportunity was taken to examine a section and to excavate along the line of the buried stormwater drain at the time. This three-pronged approach to the stabilisation problem of the site has been successful, with the exception that the scarp of the northern side (on the 1730 course) has remained unstable because of the trees buried underneath in the course of filling of the site. This problem is probably more cosmetic than real (in terms of archaeological deterioration) because the material that is eroding is basically a modern fill.

The only unexcavated mound on the site has been maintained in a low shrubland and merges with a cottonwood (poplar)/oak/hickory forest on the floodplain of the St Catherine Creek. On the mound which has not been excavated the cover is black locust (*Robinia* sp.) dominant, *Vitis* sp. (native grapevine), *Panicum* sp. (a grass), elm saplings, (Goldenrod), giant ragweed, blackberry and passionfruit vine (*Passifloa* sp.). There was also evidence of armadillo burrows in the mound. Although there was some erosion on the northwestern side of this mound from the former course of the creek, this erosion does not seem to be severe at the present day. Continued maintenance of the shrubland on the mound is warranted. Elsewhere the two mounds that have been excavated and reconstructed, Great Suns Mound and Temple Mound, are maintained in a mown grassland with the mower being brought over the scarps which are of quite low relief.

At Natchez I was able to meet with Mr Bryan Stringer of the local USDA Soil Conservation Service. Mr Stringer is a very experienced advisor on soil conservation in the region. In his view, one of the main reasons why engineering structures designed to assist in soil conservation fail, for instance drop structures or facings for culverts, is the growth of trees. The Soil Conservation Service does not favour the growth of trees in conjunction with engineering structures. The preferred grasses used in Mississippi are "Pensacola" bahia grass (a tenacious and very competitive variety of *Paspalum nototum*), Bermuda grass, St Augustine (a grass grown from sod or cuttings) and centipede. Centipede can be grown only in full sun, whereas St Augustine competes well in sun and will out-compete others in the shade. "Pensacola" bahia grass has to be planted with other temporary seasonal grasses. The grass is a perennial, slow to establish and is not very palatable, but it is very deep-rooted and survives drought.

With Mr Stringer, I was able to discuss the merits and demerits of the infamous vine kudzu, a vine imported from Japan to prevent erosion in the American south during the 1930s. Trees cannot establish in a ground sward of kudzu, and the kudzu itself grows very rapidly up any available tree trunk eventually penetrating through to the canopy and killing the tree for want of light. Kudzu is a characteristic plant on roadsides in Mississippi, and can be seen growing up lamp posts, electricity pylons and wires supporting such pylons. However, the leaves of the kudzu are palatable to cattle and cattle grazing is a good control measure, hence the typical presence of kudzu on ungrazed roadsides rather than in open fields. Kudzu develops a large tap root and does

not have a fibrous rooting system beneath the soil surface. This is the main reason why it is spoken of as being very poor for soil conservation in Mississippi conditions. There is little fibrous root matter in the roots immediately below ground level, in contrast with a mown grass sward. However Mr Stringer was of the view that kudzu, as we saw growing above the rip-rap at the Grand Village of the Natchez, was better than nothing and would establish where other species could not.

Emerald Mound, Natchez Trace Parkway
Emerald is the second biggest mound in North America, being 230x140x12 m high (770x435x35 feet high). The surface of the mound gives the impression of a very large football field, with a 9 m (30 foot) high mound at the western end, and a slightly smaller mound at the opposite end. The mound was created by levelling an existing hill and building up scarps with the fill derived from the levelling. There appears to be a slight slope down to the south on the broad area of the "football field". This is a 30 cm high and 100 cm wide berm. However there are no drop structures around for drainage through this berm. The berm is apparently designed to stop direct passage of water across the head of the scarp, but the volume of water and its concentration is apparently not sufficient to warrant drop structures.

I drove elsewhere on the Natchez Trace Parkway (a National Park Service roadway) between Natchez and Jackson. The parkway extends from Tennessee south to the remote outskirts of Natchez, but not into the city itself. At the time of my visit to Natchez, there was intense and much publicised lobbying of Congress about extension of the parkway into the city and the need to create a Natchez National Historic Park.

Louisiana

Poverty Point
Poverty Point is a large ceremonial complex occupying a reserve area of 160 ha (406 acres). This site lies on the Bayou Macon (pronounced "Mason") on the western side of the floodplain of the Mississippi River on a slight rise or ridge known as the Macon Ridge. This ridge is about 8 to 15 m above the level of the Mississippi floodplain. The site itself consists of six concentric, earthen, semi-circular banks or ridges focused on a point on the edge of the bayou. The rings were once long, linear mounds originally about 5 m high with a corresponding swale about 5 m deep; from one edge of the ridge to the outer ridge of the swale was about 40 or 50 m. The diameter of the semicircles described by these rings varied from 250 m on the inner rings to 500 m on the outer. The date of settlement is Late Archaic (1000 B.C.) (Ford and Webb, 1959; Gibson, 1988).

On the extreme western edge of the rings was an effigy mound, in the shape of a bird with a head and wings. This mound led by way of a ceremonial avenue to the ceremonial centre on the edge of the bayou. Domestic houses stood on the crests of the ridges. The overall effect of the village in its original form was to focus the attention of the villagers on the ceremonial centre of the village, thereby unifying the social organisation of the town.

Poverty Point was only discovered in the early 1950s by reconnaissance of vertical aerial photographs (Ford and Webb, 1959). Most of the site had been either under forest with fields along the strips of the ridges, or openly ploughed more so towards the bayou edge. This cultivation had reduced the profile of the mounds quite considerably by the 1950s. It was only when the pattern was recognised in aerial photos that its true significance was realised.

Figure 30 Earthwork model of Poverty Point, a novel interpretative device. Bayou Macon is represented by the concrete channel bottom left; the bird effigy mound is prominent top centre.

The site is owned by the Office of State Parks, Louisiana Department of Culture, Recreation and Tourism. The site is said to have the largest area of mown grass in the whole of the state of Louisiana, and needs to be kept in this form for public interpretation. The relief of the circular mounds is clearest inside the forest areas, where the age of the forest in the swale is about 150 years, and the age of forest on the crests of the ridges is noticeably younger, about 40 years. In the open grass areas the profile of the ridges is very slight indeed, with a rise of little more than 1-1.5 m over 15 m horizontal distance. This means that the overall pattern of the circular structures is not evident from a ground view. To assist visibility, the ridges are maintained in slightly longer grass (15 cm tall) than the rest of the grassland. There is also a red clover planted in amongst the grass. Elsewhere the grass is mown to about 6 cm in height.

Near the ceremonial centre where the museum complex is now built is a viewing tower. This viewing tower was not designed to enable a view of the whole of the site complex, but was meant for viewing of the bird effigy mound in the west of the complex.

Figure 31 Poverty Point, oblique aerial view September 1993. The view is to the south-west, and the concentric ridges are indicated by taller-grass (unmown) strips. On the ground, the moulding of the ridges is clearer in a ground view in the forested areas where understorey has been removed. The interpretation complex is at centre left. Active erosion of the site into Bayou Macon at left is controlled by a low berm and several "drop" drains on the left (eastern) margins. Note protective forest cover retained at bayou margins.

However, at the insistence of the state historic preservation office, it was not allowed to be built on the mound and was re-located closer to the museum building itself. Today the function of the tower is principally to view a unique and quite remarkable model of the ridges which has been constructed just below the tower. This model is probably at about 1:100 scale, i.e. the concentric mounds range from 4 m to 7 m across and they front on to a shallow concreted ditch which represents the Bayou Macon.

Poverty Point has a number of features of interest from the point of view of the site management (see also Louisiana Office of State Parks, n.d.): first, the management of the grassland and in the understorey of the tree-covered areas; second, the treatment of drainage on the western side of the park area; and third the treatment of the highly erodible edge of the Macon Ridge as it enters the Bayou Macon. Soils on the site are fine silt loams and are highly erodible. In the forested areas, the understorey is completely cleared, leaving a sparse grass cover underneath. This has been subject to some erosion, which is evident at the top of the bird effigy mound. Here the buttresses of the trees on the ridge lie at about 40 cm above the soil surface. This suggests that the ridges of the mound have eroded about that amount (40 cm) in the time that the trees have been growing. I estimate that rate to be a 40 cm loss over some 50 years growing time of the oak tree forest on the crest of this mound. The park manager's view of the future of the

trees, is that they should be allowed to grow, but they will not be replaced as they senesce and eventually die. No effort has been made to maintain ground cover other than the sparse grass under the trees. The combined area of the steep mounds (which includes the bird effigy) is 3.2 ha. From April 1 (spring) the mounds are weed-eaten three times in the season, the last trim being scheduled for July 30. The work requires 130 person-days for each phase, i.e., the mounds require one and a half full-time persons per annum (Louisiana Office of State Parks, n.d.: 10).

Figure 32 Crest of the bird-effigy mound, Poverty Point, showing unsatisfactory cemented path on left, and foot-erosion of summit. The extent of erosion is indicated by the exposure of the roots of the tree centre.

The paths, the feature with most steep relief in the park, on the effigy mound are of some interest. They were in a coarse gravel, hut this was found to be too difficult to maintain and not cost-effective. Currently the cover consists of a kind of asphalt, composed of from bitumen roofing tiles, a roofing material which is manufactured locally. The bitumen chips create a firm surface which moulds itself to usage in the course of the Louisiana summer heat quite well. An earlier effort to use cemented soil on particularly vulnerable areas of the crest of the bird effigy mound was unsuccessful. The cemented soil cracked and opened up in a most unsatisfactory fashion, leading to closure of the path in these areas. The only functioning path on the bird effigy mound currently is in the asphalt created the bitumen chips.

Drainage problems on the west of the site complex are compounded two factors. This area appears to have been drained in the early agricultural history of the site

the creation of what is called "the slave drain", a large ditch which drains several of the swales back into an adjacent small bayou to the west of the site. This drain is periodically blocked up by heavers, which have migrated into this region in the last couple of years. The beavers both kill the forest to get logs for their dam, and the dammed-up lakes kill the forest which is not adapted to having wet feet. A very large area to the west of the site has been killed in this fashion. The beaver dams are therefore periodically broken down to avoid the compounding of drainage problems on the site.

The banks of the Bayou Macon and the eastern edge of the site have been subject to quite severe gullying erosion in the past. Rainfall at Poverty Point is approximately 1600 mm (60 inches) per annum, with frequent cloudbursts which provide the peak flows to which drainage design must be tailored. The streams running from the surface of the site down into the bayou cut down and their heads advance very rapidly back into the site. The solution to this problem has been twofold. First, the gullies are filled with a firm and well-packed silt. Second, a defined perimeter averaging about 5 m from the Bayou Macon, a distinct herm, a low ridge approximately 50 cm high and 2 m across, has been created. These gather the surface water and prevent it flowing directly across the edge where it would otherwise initiate gullying. At a low point, of which there are about six on a 600 m perimeter, drop structures have been created. These consist of grill drains which drop down to a concrete settling sump; the stormwater is taken off in pipes and taken down to the bayou. This protective measure has worked very effectively. In one case the drop drain has not been satisfactory because of the compounding effects of road drainage and a small drainage tunnel under the interpretative path which lies along the edge of the Bayou Macon. Here the drainage from the road and the drainage from uphill of the interpretative path is channelled through a single culvert. The water in flood comes through here at a great velocity and over-runs the berm. Efforts to solve this problem involved creating a very much larger drop structure, and a more elaborate system for getting the water from the drain into the bayou without compounding the gullying problem. The work was on-going at the time I visited.

This problem had similar solutions elsewhere on archaeological sites in the Mississippi valley. To avoid repetition, I add the following notes. At the Corps of Engineers Waterways Experiment Station, Vicksburg, a geomorphologist on the staff had been called in to advise on similar gullying problems next to a stream at the station itself. His advice was to fill the empty place between the eroding gully and the new fill with a particular class of stiff clayey silt from the surrounding area. In fact his advice was not followed and a distinct tunnel erosion had occurred underneath the fill and at the interface of the fill with the original gully. This led to radical instability of the filled area. At another location, the Grand Village of the Natchez, the instability of the slope to the stream had also been solved using a berm. Drop structures here were also in use. The problem at the Grand Village of the Natchez was made even worse by inadequate filling and compacting practice in the initial stages of the programme. Here fill had been deposited which incorporated debris and other vegetable matter cleared from the site itself. As these rotted, they opened cavities into which the water ran in quite an unpredictable fashion, creating a difficult situation to try and stabilise.

Figure 33 Berm on the eastern margins of Poverty Point. Bayou Macon is at left.

The profile of the just described is slight so that, although they do train the water into the drop structures, they are also easy to mow using a tractor-drawn reel or other rotary slasher-type mower. Where the berm does fail it is a relatively simple matter to re-route the line and to try and stablise the gully between the berm and the bayou itself. These gullies tend to be filled vegetable rubbish such as tree branches, are not filled over with silt which would induce an instability in the long-term. The intent of placing the tree branches in the gully is to stop direct rainfall impacting on the gully surfaces. These gullies do not take a flow of water from the surface of the site itself, because this water is diverted by the berms which feed into the drop structures.

Near the museum rip-rap has been installed. Here the bayou struck directly at an outward curving bend, cutting away the bank itself. This was beginning to threaten the museum; the top of the cut bank is currently only some 10 m the structure. The point of interest about this rip-rapping exercise is the use of barges in the bayou itself. The bayou is not as wide as the Black Warrior River, mentioned earlier for the Moundville Archaeological Park, Alabama. The barge was placed in the Bayou Macon and a bridge built from the opposite eastern bank on the Mississippi flood plain. Rip- rap was trucked into this barge/bridge and placed directly on to the bank to be stabilised. The rip-rap surface is currently filling with silt in places, and a cover of grasses and sweet gum *(Liquidambar* sp.*)* is growing. The sweet gum which grows to a large tree has to be killed periodically to avoid interference with the stability of the rip-rap. The rip-rapping at Poverty Point was carried out in 1985 and has been successful to date.

Philadelphia/Washington D.C.

Visits in Philadelphia and Washington D.C. were mainly to make contact with archaeologists in management positions for the mid-Atlantic states and at a national level. In Philadelphia I met with Dr David Orr, and in Washington D.C. with Jerry Rogers, Drs Frank and Dick Wildbauer. Mr Rogers is the Associate Director, Cultural Resources for the National Park Service, the principal permanent staff position covering archaeology, historic architectural and museums in national parks. In Philadelphia I also met with Leslie Sauer, of Andropogon Associates, an ecological consultancy, and in Washington D.C. I met Dr Diane Gelburd of the USDA Soil Conservation Service, and Dr Stephen Potter, of the D.C. administration of the National Park Service.

In Philadelphia I was able to have extensive discussions with Dr David Orr, the principal archaeologist for the Mid-Atlantic Region of the National Park Service. The Mid-Atlantic Region includes Virginia and Pennsylvania, and covers many very important Civil War and Revolutionary War earthwork fortifications, and early century historic sites. Dr Orr is therefore responsible for the archaeological protection of some of the key historical sites of the eastern United States. In his view, the conflict in reconstruction is between a "memorial landscape" and a "true historical reconstruction". The latter, being a direct contradiction in terms, is not possible. The outcome in park management has been to institutionalise the landscape of 1890, which is pretty close to the battle landscape, but one which has been re-designed to suit the memorial purposes of that period, 25-40 years after the actual battlefield events of the Civil War. David Orr has excavated on some of the memorial landscapes recreated in the early parts of this century. At Hancock Avenue, Gettysburg, the memorial landscape had been layered over the eroded breastwork and trench system of 1863. In other words, the historical landscape, even in its eroded and degraded form, had been protected under the earthworks of the memorial landscape. Much of this work was done under the guidance of the veterans themselves, relaying an oral-historical view of the history of the actual gun emplacements and actions on the field.

Leslie Sauer, a principal of the ecological consultancy, Andropogon Associates, is one of the main authors of the Earthworks Landscape Management Plan. This plan was one of the main reasons why I wished to visit Civil War earthworks, and to observe their management, in tidewater Virginia. An interview with Leslie Sauer, emphasising her involvement and ethical views on the use of native plants in restoration, is attached as appendix 3.

My main purpose in Washington D.C. was to talk to senior National Park Service administrators about how the law is applied to the issue of site stabilisation, and to see something of the programmes and direction of the archaeological assistance division. The results of these talks are presented in the introductory material to this report, and do not need to be summarised again here. However, I also learned of one or two other new developments in spheres of interest to the Department of Conservation. The first is the National Park national biological survey, a division of the National Park Service which will be responsible for surveying the condition of the conservation lands in the

United States. Second was the setting up under Congressional legislation of a Center for Preservation Technology at the Northwestern State University, Natchitoches, Louisiana. The centre's teaching and research programme will cover the full range of preservation technologies, including the preservation of standing buildings, and it is likely that archaeological site protection will be amongst its priorities. Staffing has yet to be given a Congressional vote but once appointed the programme of the centre will become clearer. Although northwest Louisiana may seem a remote location, in fact it is in close proximity to the University of Oxford and the Center for Archaeology run by Robert Thorne. The centre will generally be well placed to ensure there is a meeting of thinking between east and west in the United States.

Civil War Sites Advisory Commission
This statutory commission was charged with identifying historically significant Civil War sites to establish their relative importance, to condition, assess threats to integrity, and provide alternatives for preservation and interpretation. The commission ranked some 149 sites as either A or B, i.e. having a decisive or major influence in the course of the war. These sites were regarded as requiring action by the National Park Service. Lower-ranked sites totalling 235 were regarded as requiring action by states. Almost half the Class A battlefields have less than 20% of the core area of the battle under protection. Class A and B battlefields which I was able to visit in the course of my time in the United States included Cold Harbour, VA, Petersburg, VA, Chattanooga, TN, Chickamauga, GA, Vicksburg, MS; and of Class B, Kennesaw Mountain, GA, and Chaffin's Farm, VA.

Amongst other findings of the commission were that 18% of battlefields are already lost, i.e., the battlefield landscape has changed beyond recognition. Some 235 battlefields are in good or fair condition which means that topography, land use, road networks and massive scale of the buildings have remained essentially unchanged. About half of this class of battlefields are under high or moderate threat, meaning that within 10 years most of the sites will be lost or seriously damaged. Few National Park Service battlefield units have an adequate acreage and many are threatened by encroaching incompatible land use changes, such as highway construction and development. Furthermore historical views from and across the battlefields are being obstructed by adjacent developments. Class A and Class B battlefields average approximately 7000 acres each, while the core areas are about 2500 acres.

Administrative measures recommended were a Civil War Heritage Preservation law (generic title) which would enable the National Park Service to enter into a stewardship agreements with private landowners, and to enable the appropriation of money to protect additional units. Another group of measures recommended tax incentives for private owners of battlefields (Civil War Sites Advisory Commission, 1993).

Old Fort Mifflin
Fort Mifflin is a conventional "star-shaped" fort built by the British in 1772 to defend Philadelphia. The fortification was built on the lower course of the Delaware River, and was eventually occupied by the Americans in their defence of Philadelphia against the British in 1777. The American defenders were driven from the fortification after a

massive bombardment. Subsequent history includes further fortification during the Civil War in 1860-1865, and use as a prisoner-of-war camp during the same period. The site is managed by a private corporation, Fort Mifflin on the Delaware.

The perimeter of the fortification consists of a high wall with stone facings. The core of the wall is earth and the top is grass. Because of the very waterlogged condition of the ground, the fortification was built on three lines of piles, with squared wooden plates on top. The stonework is built on top of the wooden base foundation. To judge from the level along longitudinal sections of the walls, the piles are in excellent condition and very little settling has occurred. Trees have in the last decade been taken from both the interior of the fortification and from the grassed areas along the top of the perimeter. These were tending to lift the capstone of the stone wall, but the main reason for removing was that the original cover here was grass. On the interior of the perimeter are a number of hell-vaulted chambers, and on top of some of these have been placed gun emplacements. The bell-vaulted chambers are sealed by a lead sheet. The weight of the gun emplacements is tending to rupture this lead sheet introducing a drainage problem to the chambers.

The fortification is surrounded by a moat, the water level being controlled by tide gates to the estuary of the Delaware. In the vicinity of the fort the water table is very high, and the ground level is actually beneath the high water mark. As a result there is a problem with rising damp in the buildings, but this high water table is maintaining the condition of the piles on which the fortification itself is based.

Independence National Historical Park
This park is situated in the historical center of Philadelphia, and celebrates the Second Continental Congress (i.e., the second meeting of what is now Congress) and the Declaration of Independence in 1776, and the subsequent devising and writing of the American Constitution. As such it is amongst the pre-eminent American historical parks, although other historic sites which I visited in Virginia are also associated with the Revolutionary War (Yorktown) and the First Continental Congress (Williamsburg).

Franklin Court lies off Market Street in central Philadelphia. The street facades here are generally of 18th-century, 3-storey terraced houses, with modern retail accretions at street-level. At Franklin Court a reconstruction of the original form of the early century houses has been made, and an archway enters the courtyard of the site of Benjamin Franklin's original house. His house has not been reconstructed, for want of adequate historical detail as to its nature. However the site of the house was excavated and the general plan of the building is known. Neither the archaeologist involved at Franklin's house, John Carter, nor the architect, Robert Venturi, wanted to see a reconstruction of the house. They devised a scheme whereby the approximate proportions of the house could be represented on its original plan using a steel framework or outline. A steel framework or outline indicated the approximate bulk and positioning of the house. The date of this work is in the lead-up to the Bicentennial of the American Revolution in 1976. The ghosting of the structure was completed in 1975.

Figure 34 A model designed for the blind to give a sense of the grounds layout and structures of Independence Hall, part of Independence National Park, Philadelphia.

The concept of ghosting is understood, from a discussion with Dr David Orr projected to derive from an idea of James Deetz. Deetz had a slide of a whaling village, on which he penned the approximate elevation of the whalers' structures. This led fairly directly to the concept of establishing a framework on and over an archaeological site. It was also in use in the late 1960s at Wolstoneholme Town, on the James River.

Other details of the reconstruction of Franklin's house are wells which actually look down into the level of the original foundations of the house. These are approximately 2-3 m below the ground level on which one walks today. They show details such as the kitchen and the privy. Today some 18 years after the excavation and the stabilisation of these sites, the contents of the wells are dirty, as if it is not possible to get down to them to clean them. I was unable to ascertain whether this was the case or not.

On the ground level, are a series of annotations of Franklin's correspondence with his wife about the house. The flooring within the ghosted structure is granite or slate slabs, and on them are inscribed Franklin and his wife's actual words about details of the house. These three elements, the wells into the archaeological excavations, the inscriptions on the granite slabs comprising the floor of the ghosted house, and the ghosted steel framework itself, comprise a satisfying visitor experience. Visits to Franklin Court are an important part of the planned visitor programme at Independence National Park, and in the short period I was there several large visitor groups came through, making clamorous use of the small spaces available.

Figure 35 Benjamin Franklin's "good house", the outline of which is ghosted in the steel framing. The actual footprint is known from the archaeology, and the hood-like concrete structures give well-like views of details of the floor such as the "necessary house" (privy) and the kitchen. The house dates to the mid-18th century, and the "Market Street houses", containing his printery, were adjacent on the Market Street frontage.

Underground and adjacent to the vicinity of the ghosted house is a museum devoted to Benjamin Franklin. Of more interest from the point of view of this fellowship, are the reconstructed 18th-century houses on the Market Street facade. The tenement rooms on Market Street are also sometimes known as the Moyety rooms. They were opened to the public in 1976, the Bicentennial Year. The left-hand unit as one faces Market Street, has been built as a pure facade with a steel framework inside. (Another unit is a reconstruction of the post office which Franklin owned, and this is still staffed for postal service.) The steel framework underpins a 3-storey stairwell which goes from the attic level down to the basement some 3 m below the ground level of Market Street. The extreme left hand wall, as one faces Market Street, is the wall of the building against which Franklin constructed his tenement. On this wall, which covers the full 3 storeys, are remnants of the original plaster, traces of the chimneys constructed against the wall, and detailing of the joists. Within the complex of steel framed floors are several small museum displays showing cases of artefacts excavated from the vicinity of this particular building.

Figure 36 Exposed wall in the late 18th century "Market Street" or "Moyety" houses. This wall is exposed in one skeletal unit of three units reconstructed on the site. Exposed on this wall is the original plaster finish, the demolished chimney, and the joists of a floor (at top). At left are modern steel joists supporting a stairwell to allow a view of the full 3-storeys of the original wall.

This is a fascinating visitor experience, which did not seem to be getting great numbers of visitors on the two occasions that I was there. The archaeological remains which have enough complexity to excite interest, particularly when taken in conjunction with the interpretative signage and the small cased displays, are in very good condition. Drainage from the street seems to be satisfactory, and the ceiling and roofing of the reconstructed area is well sealed. There is no impression of dampness or mould or fungus growing on any of the archaeological displays including the very bottom displays below ground level. The space is air-conditioned.

I was able to discuss the problems with the archaeological wells at Franklin's house and other places with Mr Bob Giannini, a curator at the National Park, and his view was that the problem lay with condensation and algae growing in the wells. In the Franklin tenements on Market Street, some of the areas of the exposed wall are protected behind large acrylic screens, particularly as a protective measure where the public is able to get close enough to touch the wall area. My impression was that some cleaning was needed behind these acrylic screens.

Virginia

A major focus of the time spent in Virginia was the battlefield parks at Richmond and Petersburg. I also called on the director of archaeology at Colonial Williamsburg, and senior rangers at Colonial National Historical Park, Yorktown. Jamestown, the site of the earliest English settlements from about 1608 in Virginia, is administered as part of Colonial National Historical Park. Very early English settlements are also a feature of Carter's Grove, a unit of Colonial Williamsburg, and Flowerdew Hundred, near Hopewell and Petersburg further up the James River. The last is a private corporation, with a trust set up to administer the archaeological aspects of a large, privately-owned cropping estate.

Richmond and Petersburg were the two principal Confederate cities on the limits of navigation of the James River and the Appomattox River (a tributary of the James) respectively. Although only some 80 miles from Washington D.C., the Union capital, these cities were many times invested by Union forces in the course of the Civil War. Richmond was the subject of campaigns against the Confederate forces under in 1862 and again under Grant in 1864. Petersburg was besieged in 1864 and 1865, after Grant that he could not take Richmond directly. The battlefields of both cities are characterised by very extensive lines of trenches, on a perimeter some 8-20 km from the city centres. The perimeter of Richmond covered by the Battlefield Park units involves a 130 km vehicle tour. The fighting at Petersburg was much closer into the city, and the vehicle tour is approximately 50 km to cover the key installations. This report concentrates on the earthworks at Cold Harbor to the northwest of Richmond, and Fort Harrison and Fort Hoke, siege lines close by the James River to the south of Richmond. At Petersburg, the concentration is on the principal park unit to the east of the modem city, and the fortifications on the flank roads to the southwest and west of the city. All the units have very extensive breastworks and field fortifications associated with the campaign.

The two battlefield parks are the principal centres of expertise on practical earthworks management and were a key focus of my visit to the United States.

In the mid-1980s concern had grown in the National Park Service at the conservative capacity of the existing ground and forest covers on these sites. The National Park Service Mid-Atlantic Region engaged the services of Andropogon Associates to consider the ecological management of the sites and the most cost-effective way in which ground cover could be managed to protect the values. The main conclusions of these reports were that there should be a much less use of widespread closely mown grasslands in the park areas; that there should be greater use of tall or medium height native grass swards on earthworks sufficient to protect and at the same time expose the earthworks for view; and that an attempt should be made to establish a more natural forest ecology on sites where forest was allowed. A more natural forest ecology entailed allowing for both the visibility of the site, without severe removal of the ground-level shrubs, while allowing some understorey trees and saplings and to grow so that they would eventually replace the canopy species in the forest. The main focus of my interest was on the attempt to establish native grassland, a tall prairie-style grassland, on the earthworks.

This was being attempted on a relatively small scale at both Richmond and Petersburg National Battlefields, following the recommendations of Andropogon Associates (1988, 1989).

Richmond National Battlefield Park
The headquarters of this park is in part of Chimborazo City Park, the site of a former Confederate Hospital. The Park Superintendent is Ms Cynthia McLeod with whom I was able to have a brief conversation, but my main contact was with the park's natural resource specialist, Ranger Mike Brennan. Richmond was successfully defended by the Confederate States Army from Their defensive lines lay on two perimeters encircling the city to the north of the James River, covering overland attacks from the north and from Chesapeake Bay and the Yorktown vicinity to the south-east. The outer line covered a length of 100 km about 16 km distant from the city, while the inner line was about 10 km distant. From an interpretative viewpoint, the park is organised on a battlefield driveway, mostly county but with some park-administered roads, from which visits can be made to the many small, discrete land units of the park. The principal units that I visited were Cold Harbor and the complex centred on the Fort Harrison Visitor Center, also known as Chaffin's Farm.

Cold Harbor was the scene of fighting in 1862 and 1864 over an 11 km-long front with only 150 acres today reserved in the park. Much of the park unit is in regenerating oak hickory forest, with an open field retained to provide a vista between the lines at the entrance to the park. The field is maintained as a grassland by being mown for hay. The lines of the and Union armies in 1864 consist of more or less parallel lines of trench and breastwork taking advantage of low ridgelines. The opposing lines stand three and four ranks deep, the Union lines generally spaced over a greater distance. Towards the northern part of the unit, where the opposing lines are close together, the forward Union lines, dug under fire, are noticeably less well dug in than the Confederate lines. This particular part of the field was the site of a catastrophic Union charge when many thousands were killed or injured. The trenches have had all shrubs removed to reveal their form. Soils are clayey and are of poor fertility. The ground cover is particularly thin, consisting of a few strands of grass and mosses, suggesting both a lack of light and high soil acidity.

A new (almost complete) foot track has been constructed between the lines in the southern part of the unit. This has been excavated into the soil about 6 cm deep and 70 cm wide, filter fabric laid, and then filled with a gravel. A bridge has been constructed over the Union trenches and breastworks, which allows a slightly higher vantage point to gain views along the lines and protects the features beneath.

In one large area of the no-man's land between the lines, there has probably been an attempt earlier this century to open up the battlefield and to grass it with the object of presenting an historical vista. Today the forest cover here is almost entirely 50-60 year old pine, with occasional sparse seedlings of oak, hickory and sassafras. This pattern, of an open area in pine surrounded by oak/hickory forest with an understorey (e.g. surrounding the new track), is very distinct. What has happened is that the natural forest succession through pine to oak/hickory has been arrested when the grassland

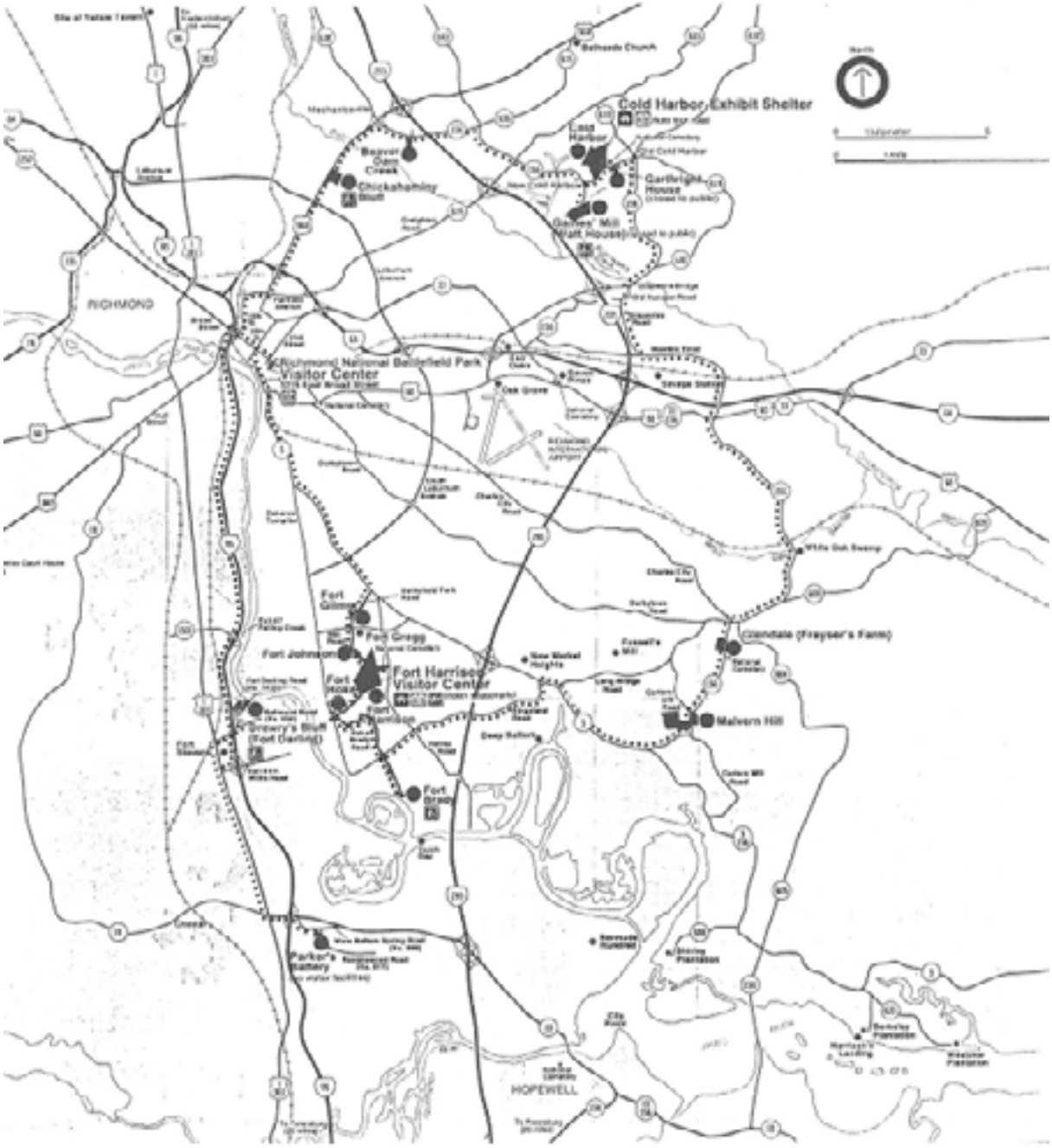

Figure 37 Map of the Richmond National Battlefield Park reproduced from the park's interpretative leaflet.

Figure 38 Track details at Cold Harbor, Richmond National Battlefield Park, Virginia. The track is gravelled over a slight excavation covered by a geotextile. The geotextile prevents mixing of the gravel and subsoil, while allowing free drainage. Where the track crosses the Union lines, a footbridge has been erected.

failed, and the pines were allowed to grow to full size by an earlier park management. The understorey has continued to be removed up to the present day with the result that there is no provision for eventual replacement of the pines which will become senescent in the next few decades. Their removal will be costly but could not have been avoided in any event unless a decision were made to allow a natural forest succession.

In the present setting, the open view between the holes of the pine trees create a "gallery effect" and make it possible to gain a moving sense of the closeness of the lines. Happily, visitors generally respect the signage asking them to stay off the earthworks. The vehicle road passes close by the rear of both lines here (crossing over and forward of the lines closer to the entrance); several turnouts for parking occur close by the lines. These are the only positions where there is erosion caused by people walking forward across the lines (creating foot tracks) to get into the area of the no-man's land between.

Cold Harbor therefore is a useful illustration problems of maintaining a conservative vegetation cover, as diagnosed by Andropogon Associates. However, although at risk from visitor erosion, the very detailed and its placement, and the existence of the vehicle road itself (attracting both foot and vehicle traffic), have reduced the erosion risk. Although recognising the difficult ecological parameters in which the park management has placed itself, I found the effect of the battlefield presentation to be

Figure 39 A view looking along the Confederate trenches, Cold Harbor. The trenches cover a front of some 11 km anchored on the Chickahominy River some 4 km from this point. Union forces unsuccessfully attacked across the field to the right (out of view). The forest here has been cleared of shrubs and should be compared with the more or less natural cover on this battlefield in Figure 38. The soil is acid and infertile and only mosses and thin grass grow. Signage asking people to keep off the earthworks is reasonably well respected.

effective as a "visitor-experience", with a far clearer sense of the murderous proximity of the opposing lines, and an effective treatment (for interpretation) of the trenches with their drifts of autumn leaves (from the surrounding oak/hickory forest) piled against the banks.

Fort Harrison is at the centre of a long (approximately 8 km) linear easement which protects Union and Confederate lines running north from Fort Brady on the James River. They comprise the southern flank of the siege lines on Richmond and access up the James River. Again, the road serves as one of the keys to the interpretation experience, and a high proportion of the flanking earthworks are exposed to view by use of a tractor-driven rotary mower (known in the United States as a "bush-hog"). Apart from an extensive line of low-lying trenches which are permanently filled with water and eroding where wind runs gather large waves, these earthworks were in good conservation status.

There is a generally perceived problem with these earthworks which arises from urban encroachment, a problem which is also acute at Petersburg. The original enabling Congressional acts which set up the battlefield parks operated on the assumption

that simple easements were needed over quite large parcels of land, and that the existing owners should have fairly free access into the easements (through which the park road runs). With the increasingly smaller parcels of land of these rural areas, the pressure for service and driveway access into them has increased, directly destroying earthworks and ruining the sense of the historic field setting. This is a particular matter of concern to the Civil War Sites Advisory Commission (1993) discussed in an earlier section of this report.

Parts of Fort Harrison and some of the adjacent linear earthworks have been grassed in *Andropogon* sp. (probably *A. scoparius*), a shorter species endemic to the eastern seaboard. The standing forest in the surrounding country and in the unit is pines with oak/hickory forest succession fairly well advanced. About 200 m of the earthworks near the picnic site, one kilometre from Fort Harrison, were planted with Andropogon plugs (nursery grown planter-pots of the species) about 3 years ago. The technique was to kill pre-existing vegetation with a herbicide, to clear any shading forest within approximately 10 m of the earthwork, and to plant in the plugs in autumn at a density of greater than 1 at 1-foot centres (i.e. a density of about 6 plugs/m^2). The grass growth has been hand-weeded, but not in the last year. The weeds requiring special attention were honeysuckle, blackberry and broadleaf weeds generally. The use of fire appears to be impracticable at this site because of the forest adjacent to long sections of the earthwork. The work done here has been summarised in a park memorandum of February 3 1992 (H30 (RICH)) to Chief, Park Historic Preservation Division.

Fort Harrison itself has been treated in a similar fashion in some parts, with the most recent plantings having occurred in the past summer. The earlier treatments cover larger traverse earthworks in the centre of the fortification. (The fort has an enclosed perimeter, but is in fact a salient, a forward projection, in the Confederate lines, taken by the Union, with the salient then reversed in direction and with the perimeter then closed. The Union fortification is known as Fort Burnham). The traverses have not been weeded since establishment, because they are isolated in the grassed centre of the fort and it is anticipated that they can be fired as a unit to clear the shrubland which is rapidly establishing. This shrubland now consists of 1-2 m-high saplings of pine, oak, hickory and sweet gum; among the short-lived weeds are goldenrod (*Solidago* sp.), pokeweed (*Phytolacca* sp.), and daisy fleabane (*Erigeron* sp.); and the vines include the native grapevine (*Vitis* sp.), blackberry and raspberry (*Rubus* sp.). *Andropogon* is present in low densities throughout, and appears to have done especially well on southern (warmer, drier) aspects. In some places, the traverses appear to have originally been in exotic grasses which were not cleared, and here the *Andropogon* was not present.

A recent attempt has been made to cover further areas of the perimeter earthworks of Fort Harrison. Here Roundup was applied to an existing shrub cover, and the cover cleared from the ground surface. To protect the exposed soil, straw mulch was applied. Plugs about 5 cm square were planted at 30 cm intervals over some 50 m length of the earthworks (estimated to be 12 m wide, an area of about 600 m^2). The total cost of the 5,000 plugs used was US$2,500, and planting took 150 hours. Unfortunately, the exercise was undertaken in the notoriously dry, hot summer of 1993, due to the

Figure 40 Successful establishment of *Andropogon scoparius* (the short native prairie grass dominant) at the "picnic area" on the Confederate lines at Chaffin's Farm (Fort Harrison unit), Richmond National Battlefield Park. The small numbers of invasive shrubs may be removed by burning or hand-weeding. The age of their establishment is approximately 3 years and they now offer good protection. The figure is Mike Brennan.

availability of student conservation corps labour. At the time of my visit (late October 1993), most of the plugs had failed, except for a few still alive at the base of breastworks. A contributing factor to the apparent failure of this particular plot may have been the retention of some shade trees in the vicinity of the earthworks. The park also has no capacity to irrigate the newly-established grass.

One failing of the approach using plugs of a single species is that it does not re-create a natural grassland which would have not only a variety of grasses, but also many non-grass species such as forbs and legumes. These last serve to maintain fertility by fixing nitrogen amongst other benefits. A common nitrogen fixer encouraged in production pasture is clover, but this does not occur naturally in the tall-grass sward and indeed would out-compete the native grasses in the establishment phase, eventually smothering them in the absence of grazing. I discussed this issue with Mike Brennan.

Petersburg National Battlefield Park

At Petersburg, I met with Superintendent, Mike Hill, Chief Interpreter, John Davis, and the resource specialist, Dave Shockley. The park was the scene of the final siege of the southern capital in 1864-5, the siege lasting just over nine months. The Union forces under Grant came here after the stalemate on the lines at Richmond, crossing the James

at Flowerdew Hundred near Hopewell, and intending to strike north across the Appomattox River to Richmond and the interior of Virginia. By this stage in the war both Vicksburg and Atlanta had fallen to the Union, and the political capital of the Confederacy was the final objective. Petersburg and Richmond together are the precursors of the style of trench warfare that became the norm in the First World War.

The park lies in six main units, but the units of most interest here are the large compact area south of the Appomattox and north-east of the city and Interstate 95 (containing other Union and Confederate lines), and the long linear easements along Flank Road on the south-west of the city (comprising mainly Union lines). Also visited on the south-west of the city was Confederate Fort Gregg, scene of desperate fighting by the Confederate forces as they withdrew from the city not long before the final surrender at Appomattox Courthouse. The park also has an area of full-size reconstructed earthworks, not on an original site, showing the construction of bombproof shelters, with gabions and fascines facing the surfaces of breastworks.

Battery 5, a simple breastwork enclosure with embrasures (earthwork enclosures for gun emplacements), is close by the park visitor center and maintenance complex. It has been cleared many times of tree cover in the past, with the result that it has stood in a

Figure 41 Almost complete failure of *A. scoparius* establishment in part of Fort Harrison, Richmond National Battlefield Park. The ground has been cleared with a herbicide, but the grass plugs were planted in the course of the droughty summer of 1993, when they should have been planted in the Fall (autumn). The bare ground surface of the earthworks has been left prone to erosion and invasion of undesirable weeds.

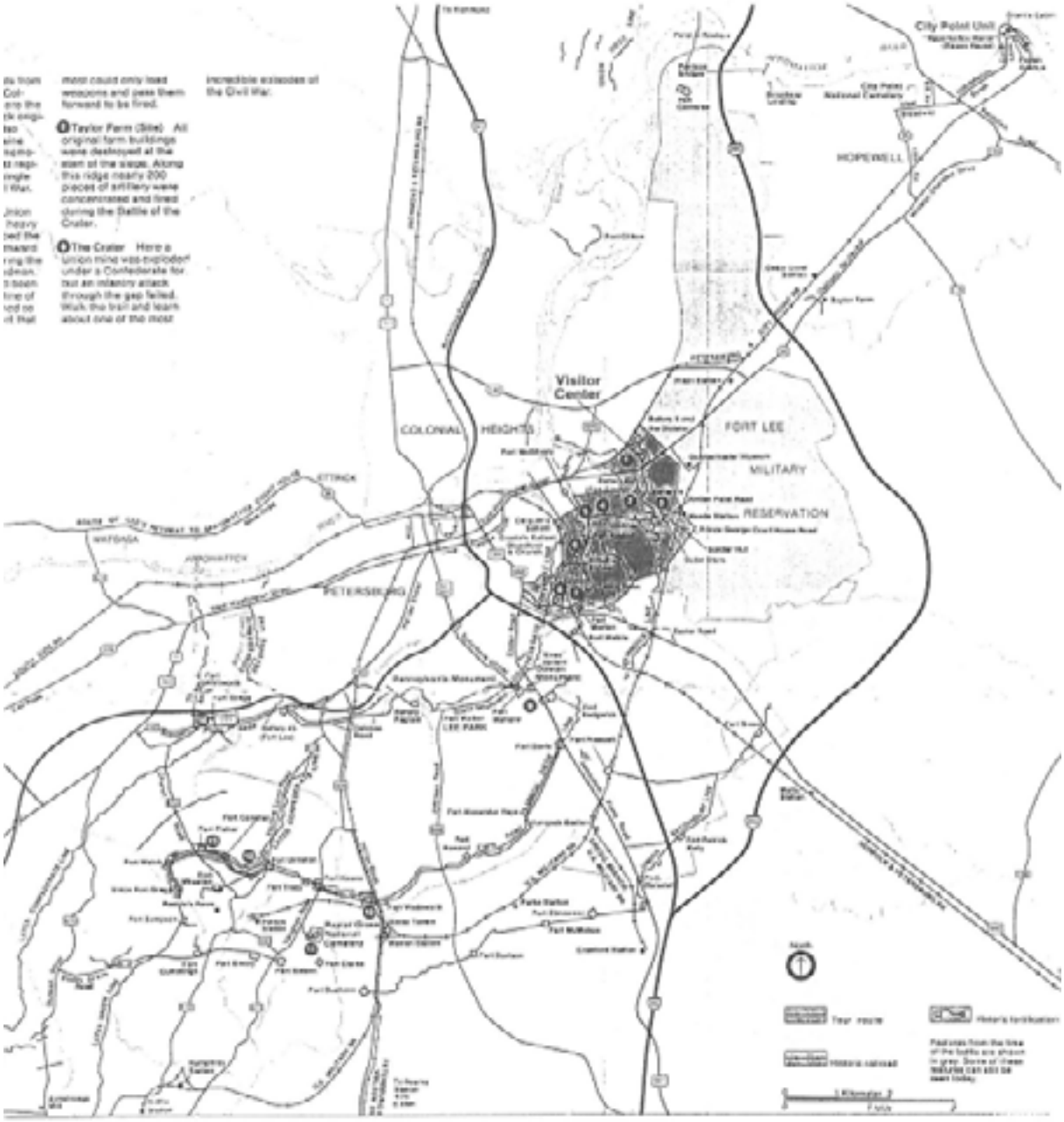

Figure 42 The Petersburg National Battlefield Park from the park's interpretative leaflet.

pine (probably loblolly, *P. taeda*) successional stage for much of the time. There had also been repeated attempts to lime the acid (typical pH upper 4 to lower 5) soils under the pine trees and to establish fescue K31. This had failed due to drought, acidity and shade; the effect here was probably not dissimilar to that described previously for the open parts of Cold Harbor in the Richmond National Battlefield. The main grass which established here was crab grass (*Digitaria sanguinalis*). There was extensive wear from visitor usage.

The recommended prescription from Andropogon Associates (1988: guideline sheet) was for repair of eroded areas (by applying topsoil), mulching and oversowing with fescue K31, a clover, and *A. scoparius*. I was advised that fescue K31 only had been sown, and not the native grasses, the latter being a quick adventive in all old fields in Virginia. However, I believe that the Andropogon must have been sown or plugged to achieve the density that I saw. Detailed data from the park staff on the management of selected sites is in appendix 5. Appendix 6 is an Andropogon Associates data sheet on the management of *Andropogon scoparius.*

Figure 43 Petersburg National Battlefield Park, Confederate Battery 5 in a cover of *Andropogon scoparius*, established after the failure of repeated attempts to gain a cover of fescue. The figure, John Davis, Chief Interpreter, is holding some of the mulch placed on the earthwork after the clearance of the trees. Grass is mown on the flat interior of the fortification at right, and by the access way across the breastwork top right. Competing with the *Andropogon* is sweetgum (*Liquidambar* sp.) prominent in left foreground, oak seedlings, honeysuckle and blackberry vines, wild cherry and sedges. These will be checked by cutting or hand-weeding.

Although attempts have been made to correct fertility and acidity problems, *A. scoparius* (?) has invaded naturally on the failure of the fescue and has competed successfully with the annuals. Vines (principally honeysuckle and blackberry), tree saplings (pine, probably *P. taeda*, oak, sweet gum (*Liquidambar styraciflua*), wild cherry) and sedges are establishing on the slopes of the earthworks. The crab grass is still dominant in the central, flat, closely-mown part of the fortification. The woody plants will be discouraged by mowing with a high-set bush hog or hand-pushed rotary mowers (the last adapted by re-fitting the wheels on 20 cm-high steel struts attached to the aluminium protective casing of the mower) or both. Because of its setting in an urban area, the park does not anticipate a successful application to the county for a permit to hum, and hand-lopping and weeding of species that cannot be coped with by mowing will be carried out.

Fort Stedman is on the interpretative road about 2 km south-west of the park visitor center. The fort consists of a tall breastwork on commanding ground in the Union lines; it was the scene of a major Confederate attack in March 1865, calculated to divert attention from their western lines. The site had been badly damaged by recreational usage. Currently, it has 100,000 visitors p.a. In 1978 (i.e. long prior to the recommendations of Andropogon Associates) the site was fenced off, erosion was repaired with fresh topsoil, and protective seed mats were placed on it, and left to grow for 12 months. Today, the interior of the site is in tall specimen trees of oak and pine (probably loblolly, *P. taeda*) with regularly-mown turf, giving the place a park-like character. An interpretative path runs inside the perimeter of the earthworks and cannon in the embrasures. The earthworks perimeter had received its annual mow just prior to my visit. The cover here is fescue, *Andropogon* sp., cedar and oak saplings, and blackberry. In its unmown state, this cover probably deters walking on the features in the normal course of the year. The earthworks were in excellent conservation condition at the time of my visit.

The pattern of *Andropogon* sp. establishing naturally on an earthwork was evident at *The Crater*, one of the most famous sites of the Civil War. Here the original Taylor farm land of 1865, and vistas from the Union lines towards The Crater are kept open and maintained in a tall-grass (i.e. not mown) fescue. (For comment on the establishment of this tall grass cover see the interview with Leslie Sauer in appendix 4.) An interpreted walkway follows the line of the collapsed Union sap which was dug towards a key artillery position in the Confederate line. The Crater itself was created by the explosion of a large mine under the Confederate artillery. The notoriety of the site arises from the failed Union advance following the explosion, when many Union troops were helplessly trapped in the hole and killed. Today the site has something of the atmosphere of a shrine to the Union dead.

The general vicinity, before being taken into the park, had been purchased by a conservation group who had been compelled by economic necessity to lease it as a golf course. To maintain grass cover here, the cavity (about 30 x 15 x 3 m deep) had been irrigated and put into fescue. Subsequently, under park management, the area has been fenced and an interpretative walkway created around it. Fescue continues to thrive on the cool, north-facing interior slopes and at the bottom, even although the irrigation has

Figure 44 Fort Stedman, Petersburg National Battlefield Park, where the interior is mown, and the breastwork (at right) has recently been hand-clipped or mown. The breastwork's natural regenerating cover (not obvious here) is blackberry, fescue, *A. scoparius* (sparse), and cedar and oak seedlings. Note visitor trail by cannon, but no tracking up on to the breastwork.

long been discontinued. *Andropogon scoparius* forms a fairly even sward composed of small clumps on the south-facing slopes, and on low ridges on the north face of The Crater. Here, it is naturally established. This seems to represent a natural climatic and edaphic (soil) preference of the plant, while it has difficulty competing with the fescue under well-watered and cooler conditions.

On the south-west side of the lines, on Flank Road, sites visited included Fort Wadsworth, Fort Conahey, Fort Fisher (all in the Union lines) and Confederate Fort Gregg. A large (more than 4 km in length) sector of the lines here had been in the park but tenure had been handed to the city by earlier park management because they wished to simplify difficulties caused by the interpretative road. It had come increasingly to be used for commuting, and had several housing accessways across it. The park had been responsible for traffic management and to rid itself of this task had proceeded to have the land vested in the Petersburg City. The current park managers disagree with that decision. However, apart from some rubbish, the general condition of these works seemed adequate from the view from a moving vehicle.

The Union fortifications managed by the park all illustrate various forms and states of manipulation of the forest cover. *Fort Wadsworth* was in tall (50 m plus), open-

canopied loblolly pine (*P. taeda*), with many senescent specimens. The interior was mown while the banks were in sassafras, some privet and honeysuckle. The main point of interest was treatment of the pines, one of which was dead having been struck by lightning; this tree was infested with southern pine beetle and was scheduled to be cut down piecemeal, by a process of de-limbing and lowering the limbs to the ground. I was cited a typical cost of approximately US$3,000 for the removal of one tree in this fashion.

At *Fort Conahey,* trees greater than about 5 cm d.b.h. (diameter at breast height) had been removed some 8 years previously, but a few large specimen trees had been left. There were some erosion hot spots on tracks into the site. The stumps of black oak (*Quercus velutina*) had begun to sprout and there were many loblolly pine seedlings in a generally overgrown interior. This was the first opportunity I had to see blueberry (*Vaccinium* sp.), a Virginia native of the heath family, the low bush species of which had been recommended as an earthwork cover by Andropogon Associates. It has a bushy growth habit (less than 4 m) and the specimen that I pulled to inspect had a dense, tough root and rhizomatous mass just under the soil surface. The park managers were of the opinion that this was a site on which the park had over-reached its maintenance capacity, and there was a dilemma as to how it should be handled in future.

Fort Fisher is one of the largest (120 x 200 m in plan) single fortifications constructed in the Civil War but did not see action. It is in an oak/hickory/holly (*Ilex* sp.) forest cover, with some blueberry, cedar (*Juniper* sp.) and alder (*Alnus* sp.) in the understory, and fairly open at ground level with good visibility of a very stable, leaf-covered ground surface. The site had been cleared of forest on its south-western corner, and its current management and condition criticised by Andropogon Associates (1989: G 19) for attracting visitors to walk on the walls, increased erosion, and the filling of trenches with water from the newly sealed road surfaces to the south and west. Generally, I felt that this criticism was not warranted, and it seems that the consultants may have seen only the south-western corner and generalised from that. The main damage to the perimeter seems to be from the long standing transverse cut into the bank on the south-west corner where there was some active erosion. The forest cover on this corner was not dissimilar to that at Conahey but has a greater proportion of early succession pine. Elsewhere on the site is a stable cover of 60-80 year old oak/hickory. The main threat to the site will be increased visitation and casual recreational use from the new, adjacent residential development taking place some 30 m to the north of the site where the buffer zone is exceedingly narrow - a characteristic problem of all the battlefield parks.

Confederate Fort Gregg has been the subject of major conversion from an isolated stand of oak/hickory/pine to grassland in the last year and half. The site is of great thematic interest to the park, and a painting of the action here features on the main interpretative leaflet. The site consists of a semi-circle of breastwork about 120 m in length and standing about 2 m above the surrounding ground. Forward of the breastwork is a broad trench. The trees which covered most of the earthworks area except for the very crest of the breastwork were removed and the hardwood stumps poisoned. The crest was in a pine duff only. Some 90 m^3 of topsoil was applied to the skeletal soils of the breastwork, taking care not to obscure surface features of low relief such as the trench

of the rear stockade (the breastwork is forward-facing towards the Union direction of attack). Winter rye (a cool season annual) was planted in the fall of 1992 and in spring 1993 the site was limed and planted in three varieties of fescue (including using jute matting on severely eroded places and straw mulch elsewhere. The site has been heavily irrigated throughout the summer. The site in October 1993 was largely in seeding crab grass, which will die back in winter, allowing the perennial fescue to come through. On the north-eastern side of the lunette is some honeysuckle while sweet gum seedlings are thriving on the counter scarp.

At the end of my visit, I was able systematically review and discuss these highly varied models of site maintenance with senior staff park, with the following points emerging:

- the decision as to which sites to convert to tall grass and which to maintain in a managed forest cover is not simple;
- the easiest part to do is the removal of the woodland -it is the follow-up that is not properly costed or anticipated properly;
- never clear ground that cannot be maintained in the long term;
- no matter how concerted the effort to establish fescue, where it fails the natural grassland ecological succession in the Petersburg area is to native tall grasses such as *Andropogon* sp.;
- tall grass covers such as *Andropogon* sp. can be established, as the park staff have demonstrated, but are these the most cost-effective covers for sites?

Colonial National Historical Park
At park I met with Mr Jim Haskett, the chief interpreter, and Ms Jane Sunderberg, cultural resources specialist. The park contains three major units: the Yorktown battlefield, site of the English defeat by the Americans and the French in 1781, the deciding battle of the Revolutionary War; significant built properties in the town of Yorktown nearby; and Jamestown Island, site in 1607 of the first English settlement of Virginia under Captain John Smith. Both Jamestown Island and the Yorktown battlefield also have significant Civil War earthworks. The two principal places are linked by the Colonial Parkway, a restricted access, low-speed road with carefully maintained forest environs.

Jamestown Island is currently undergoing a major review of its archaeological resources conducted by Brown and his research associates under contract to the National Park Service. The Jamestown settlement was extensively excavated in the 1950s and 1960s, and brick foundation markers built on the recovered house foundations. These markers stand about five or six brick courses above the ground level. Taken with an extensive series of trench boundary markers or original individual properties, they reveal a fairly complete sense of the plan of the late 17th-century (not the earliest) village. (The earliest settlements of the early 17th century have been eroded

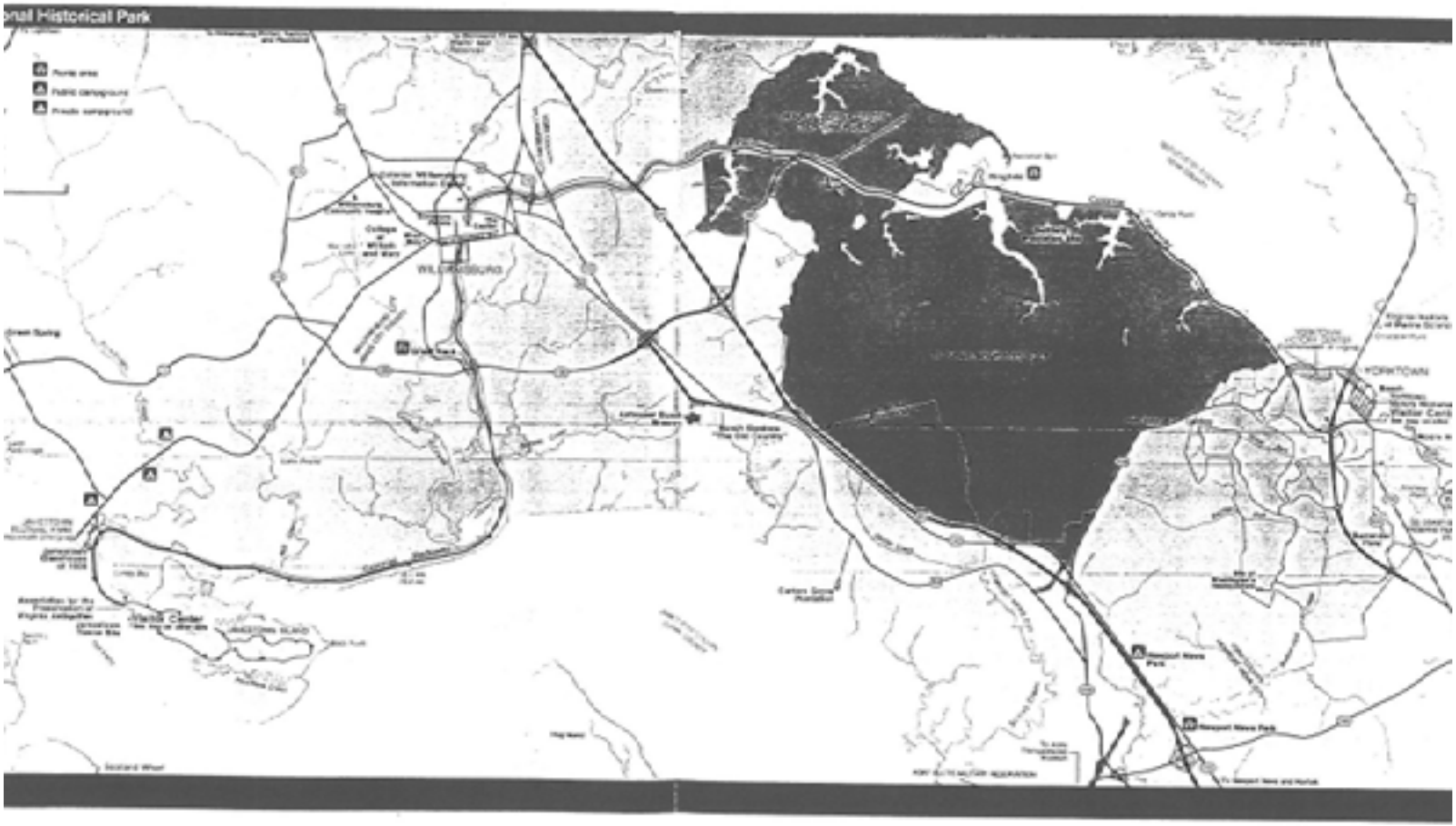

Figure 45 Map of Colonial National Park from the park's interpretative leaflet.

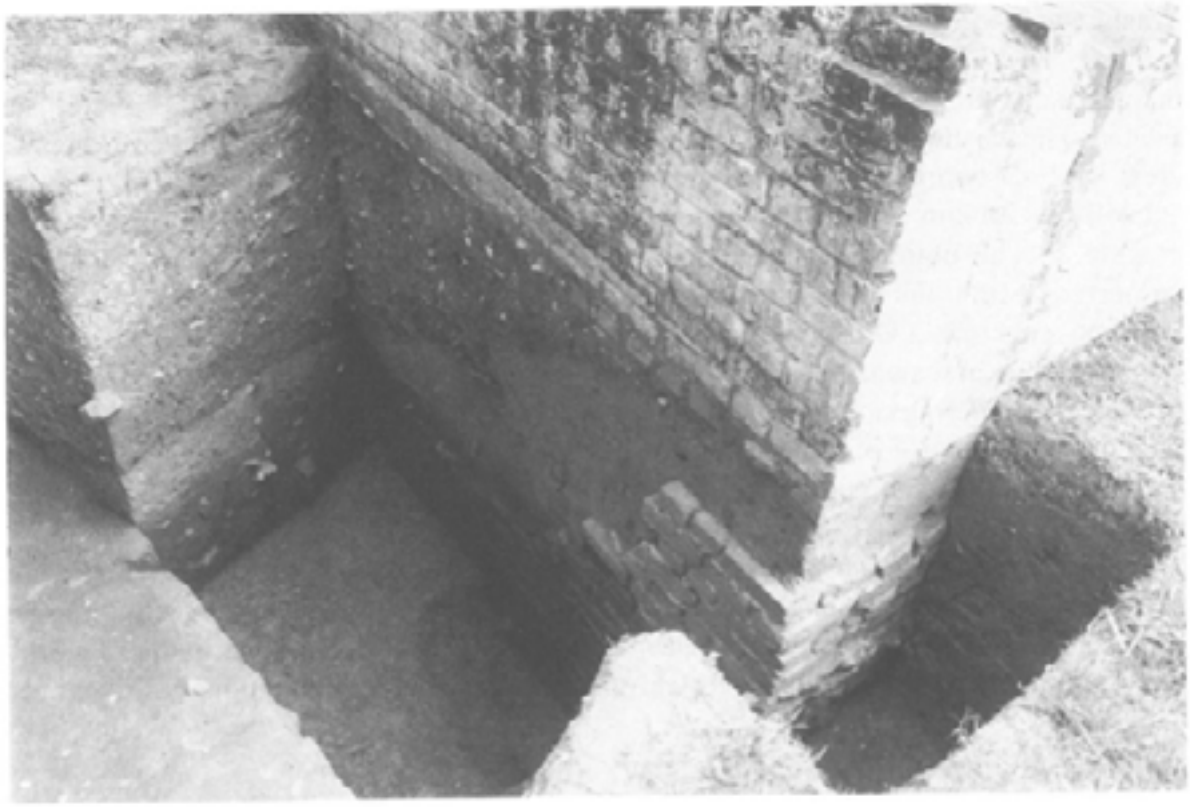

Figure 46 Cellar walls of the 18th-century Jamestown settlement, Colonial National Park. The foundations and cellars of the buildings were excavated in the 1950s, backfilled, and the outlines of the house foundations constructed in brick on the ground surface. The only original features seen here are the brick cellar walls below ground level, and the subsoil showing at bottom left. The layers of fill at centre left are from the archaeologists' backfilling of the 1950s.

away by the James River estuary.) Some excavations conducted as part of the current review were open at the time of my visit. Points of note were the relative lack of intrusion of roots from the open "park-like" oak hickory forest of the archaeological area; the existence of a "park-zone" layer, consisting of reworked plough-zone material (itself dating back to before the turn of the century) that has been modified by landscaping and the remixing or archaeologically excavated fill; and finally, the relative paucity of intact original archaeological remains in the main interpreted part of the site.

A feature of both Jamestown and Yorktown is the presence of large reception and interpretation centres right in the midst of the archaeological features, adding some visitor pressure in the form of tracking and erosion to the physical site features - particularly severe at Yorktown, the worst erosion of any battlefield earthworks that I saw in a national park. (These were on the British lines, which had been reworked by the Confederate Army in the Civil War.) Both centres were the product of "Mission a major revamp of park facilities throughout the United States motivated by concern about the growing taste for long-distance motoring and park visiting, and resultant pressure on park facilities. The trend then was to establish facilities in this way, but it is not regarded as good practice today.

At *Yorktown,* the siege lines were ordered by the United States commander, George Washington, to be destroyed so that they could not become a threat to the American forces. The very extensive first and second siege lines today are in the form as reconstructed from the period of the Civilian Conservation Corps in the 1920s and 1930s. The earthworks are very steep with slopes up to 3 m high from base of ditch to crest of breastwork. These are generally maintained in a tall grass and cut once annually in autumn. There is some damage from people walking on the banks causing erosion. The pointed wooden logs forming the chevaux de frise (lines of spikes pointing out from the defensive bank) on the reconstructed redoubts are cast in a surfaced concrete. On the French siege lines south-west of the road was a established natural sward of *Andropogon* sp. especially dominant on the warm dry crest of the earthwork. Because the earthworks are reconstructed it was suggested to me that ongoing maintenance of their integrity did not arise as an issue; they could be simply reconstructed or made good from time to time.

The early English settlements (1): Colonial Williamsburg and Carter's Grove
In Williamsburg I met with Drs Marley Brown and Ed Chappell, respectively directors of archaeological and architectural research. Colonial Williamsburg has gained a world-wide reputation as a place of historical preservation and interpretation, and has been

Figure 47 The stockade line, right, indicated by truncated posts and gravel walkway, of Wolstenholme Towne fort of c. A.D. 1620, part of the Carter's Grove outlier of Colonial Williamsburg. This interpretative device has been installed because of the failure and ongoing maintenance costs of the previous fully re-constructed stockade. Note "talking barrel" centre foreground.

visited and discussed by a previous Churchill Fellow, Ms Jo Breese. Historically, Jamestown was the 18th-century capital of Virginia (subsequently shifted to Richmond), and an important centre of American governance in the Revolutionary War. My interest was in the role of an archaeologist or an historical architect with the Foundation. Brown's view was that the two professions existed to authenticate the programmes of the Foundation. Ed Chappell argued for the value of archaeology in establishing the footprint or plan of the buildings. Reconstruction of buildings often takes place on the original foundations where sound, with some indication of and protection remaining for the archaeological fabric.

Williamsburg has in the past offered an unsustainable image of an immaculately kept, socially ordered, upper middle class 18th century society. However, in the last decade that has changed. Both the archaeologists and the architects have recovered a wide range of lifestyles and trades within the foundation's landholdings. A notable example is the Public Hospital (including an asylum) which forms the frontage of the De Witt

Figure 48 A wooden-beam "ghosted" house of the "domestic unit" and grave locations in the open part of Wolstenholme Towne. The ghosting has been reduced in its extent and repaired in recent times. The long wedged wooden panels indicate the position of burials. The figure is Dr Marley Brown, Director of Archaeology, Colonial Williamsburg.

Wallace Decorative Arts Gallery. Elsewhere in the town, the trades activity and related structures have been based on archaeological research. Almost all 18th-century trades are practised (I saw blacksmithing, carpentry, cabinetmaking, and brickmaking), and their products are included in the restoration programme. All this work is authentically done, based on the archaeological, architectural and documentary record.

Carter's Grove is a separate unit of the foundation about 12 km south of Williamsburg on the hanks of the James River. The historical attractions include a mid plantation mansion, a reconstructed slave quarters (based in part on archaeological data), an archaeology museum concentrating on the 17th Century, and Wolstenholme Towne site. The last was the administrative seat for Martin's Hundred, an English settlement complex dating from 1619. In the 1960s and 70s it was completely excavated

Colonial Williamsburg's first director of archaeology, an Englishman, Ivor Noel Hume. Almost the complete plan of the early settlement lying over an area some 200 m square was recovered, including a stockaded fort, a "company compound" (which includes appears to be a store or warehouse), a small domestic unit with a house and graves, and a barn. The complexity of the detail and the modern treatment of this settlement are remarkable. The stockade had been fully reconstructed and other structures ghosted under Noel Hume's direction after the excavation. The stockade was evidently quite elaborate with external, full-height solid wooden members backed by an interior line, and the space between filled with gravel or earth. (I am not clear whether the gravel was on a slightly elevated interior walkway or gallery, or whether it went to full height as in a 19th-century New Zealand blockhouse. The width of the walkway (about 60 cm) suggests the former.) In recent times the ghosted structures (approaching 25 years in age) had deteriorated to the point where they gave a poor impression. The ghosted structures had been simplified in their framing and some members replaced.

Grave markers which replicated above ground the wedge-sectioned lid of the original coffins were still in good condition. In the recent restoration, the plans of the houses and other closed structures were indicated by true-to-scale rectangular gravel beds retained by wooden 100mm-square sectioned timber, with or without ghosting of the frame. The stockade had been replaced with half-height interior and exterior timbers linking the two opposed flanking bastion towers, of which much of the 1970s timber remained. The line of the stockade further away from the bastions was indicated by an alignment of widely-spaced posts, with a kind of gravel path at ground level indicating the full extent of the original gravelled and posted interior sections. Further afield, the flat was drained with drop structures and there is some erosion of the strand line to the James River which is maintained in a rough cover dominated by low-growing locust *(Robinia* sp.), providing some erosion-protection but obscuring views to the wide expanse of the tidewater.

In a subsequent discussion with Marley Brown and Ed Chappell I discussed what made the impression of this ghosted (not reconstructed) town so effective, and the wider question as to the conditions under which it was warranted to keep excavations open. At Wolstenholme Towne, Marley Brown and I had thought that it was the complexity and depth of detail revealed by the very large area of the excavation that provided the fascination. The ghosting and physical ground-marking had in effect offered a readily

perceived sense of the archaeologist's plan of the place, besides being honest to the fact that there was no record of above ground elevations and detail. A somewhat simpler plan layout, such as the nearby slave quarters would not have sustained such treatment and required fuller reconstruction of the buildings. (Here indeed, because of the trueness of the reconstruction, with poor foundations, earth floors, thatch and untreated log and mud walls, the costs of ongoing maintenance had yet to be faced.) Ed Chappell was of the view that the following pitfalls and criteria for retention of public viewing applied:

- in most cases of exposed sites the conservation technology has not been thought through and the sites are mouldy, dirty and depressing;

- remains to be exposed must have visual "drama" of some form which captures public imagination and attention (the quintessential example being Roman mosaics);

Figure 49 Stone foundations of the house site "64", Flowerdew Hundred, near Hopewell, on the James River. The hard silt or sandstone foundations have been protected by a geotextile and a layer of river sand/gravel.

- remains will generally need to be enclosed in a complete building shell which has some facilities to focus attention on the plan feature;

- there must be a capacity to elevate the viewer to see the full plan of the feature(s) exposed.

To these criteria I would add factors relating to drainage and stability of the building substrate, the two extremes of which I saw at Dickson Mounds, Illinois, with the fine loess of the museum building contributing greatly to the stability of the site, and the miserable exposure of the lower village house sites.

Like the treatment of the Franklin complex in Philadelphia, both the Martin's Hundred and Flowerdew Hundred sites illustrate relatively cheap, relatively robust alternatives to full reconstruction. The term relative is stressed here because although operating and capital costs are low, the capital up-front cost of archaeology, to recover the plan of the structures, is not. However, the archaeology cost is a factor which will be borne anyway, a sunk cost, since the site was either discovered by the archaeology or a precondition (often statutory) of architectural reconstruction. The lack of durability of timber members in ghosting is also an added maintenance cost.

The early English settlements (2): Flowerdew Hundred
Like Martin's Hundred, Flowerdew Hundred was an early English settlement (1617-?) on the James River which has been the subject of close archaeological investigation. This 17th-century settlement is on the tidal banks of the James River and later, century sites cluster on a terrace edge set some 3-400 m back from the river. The wider Flowerdew Hundred estate today is maintained in crops. Its owner, David Harrison III has established the private Flowerdew Hundred Foundation to maintain a small museum and the site complex, in close collaboration with the estate's farming managers. The overall vision is for the estate to be a corner stone of historic tourism in the region south of the James River and Richmond. The estate is near Hopewell on the south bank of the river, and some 50 km upriver from Jamestown. However, the capacity of the Foundation to supply the necessary capital is limited, with currently only about 13,700 visitors p.a. (entry fee US$4). The archaeology has recently been summarised by the pre-eminent historical archaeologist of the United States, James Deetz (1993). I met with the director of the foundation, Robert Wharton.

The archaeological structures of particular interest were an "earthfast house" with stone wall foundations, and an enclosure of apparently defensive function. (An earthfast house is one in which the uprights consist of squared posts placed into holes in the ground to give the structure rigidity - not unlike pre-European houses in New Zealand.) The uprights were filled between with wattle and daub. The unusual feature of the house (site "64") is the sandstone sills between the posts which reveal its rectangular plan (15x6 m). This is temporarily preserved by a filter cloth laid over the stone sills with gravel placed to secure the cloth. Outside the house is a perimeter of solid posts spaced at 1.5 m intervals and covering an area enclosing the river bank of some 40x40 m. This is probably a fortification or massive post and rail fence.

Figure 50 The "enclosed compound" site "65", at Flowerdew Hundred, outlined by natural growth of grasses and wild flowers on the actual excavated perimeter. The defensive perimeter appears to have been a relatively narrow (by New Zealand standard) ditch, some 60 cm across at the subsoil level at which it was exposed, backed by a palisade constructed on relatively light posts. Inside the compound, were two post-in-hole framed structures, one a house, the other probably a warehouse for tobacco. At top left is a recently-constructed levee to hold erosion from the James River. It acts in a sacrificial fashion to delay encroachment on the site, but because it covers only the length of the site, it does not protect from floods. The figure is Robert Wharton.

Mr Harrison is understood to be interested to see reconstruction on the site. Robert Wharton thought it would be possible to float a structure over the stone sill, with some form of window or port so that the stone sill could be seen. If re-construction is decided against, the presently exposed structure would be backfilled over filter cloth with the corners of the rectangle and the internal partitions and fire place marked by posts.

The enclosure (site “65”) is rectangular and about 55x20 m in plan with one long side enclosing the bank of the James River. The enclosure consists of an exterior rather narrow-based ditch with a solid fence or palisade within; major posts occur at 3.5 m intervals. Inside is a long rectangular structure thought to be an "export store" for tobacco (the local cash crop in the 17th century), a water well and another rectangular structure. These structures, including the enclosure line, have all been laid and left unmown through the spring summer season, so that a 80-cm tall growth has developed. This effectively and cheaply gives a sense of the scale of the place and its structure, although less precisely as to detail when compared with Wolstenholme Towne. The composition includes milkwort, Asters, several grasses, Queen Anne's Lace (*Daucus carota*), Asiatic dayflower (*Commelyna* sp.?) and goldenrod (*Solidago* sp.).

Figure 51 Detail of the tall grass and wild flowers of the perimeter; species include milkwort, asters, Queen Anne's Lace, Asiatic dayflower, and *Solidago*.

ISSUES AND CONCLUDING REMARKS

Review of itinerary

- The course of travel was dictated by the objective of visiting sites in warm, moderate rainfall areas with many earthwork sites. This meant that I did not visit some of the most renowned archaeological parks in which the sites have remained more or less stable for many hundreds of years because of *arid* conditions - examples are in the south-west such as Bandelier National Monument, Chaco Culture National Historic Park, or Mesa Verde National Park. However, these areas do receive catastrophic downpours of rain from time to time, which depart leaving a clear, stable imprint of the erosion. Park efforts to minimise erosive effects are also easy to see.

- Another region that might have been visited is the coast of northern California and Washington state, where there has been recent effort on shoreline stabilisation for eroding middens and other archaeological deposits. Forestry practice is also more akin to New Zealand than the limited practices that I was able to see in Mississippi.

- With the exception of plantation forestry practice and coastal management, then, the stated goals of examination of reconstruction ethics, site stabilisation using grasses, and the management of the condition of earthwork sites were well served by the itinerary.

Grasslands and site stabilisation

- In the United States, the value of maintaining a grassland cover is well recognised and the difficulties that this cover presents for site conservation are fairly well understood. In very few cases was a tree cover accepted as the appropriate method of protecting earthwork sites from erosion. However, field observations suggest that root intrusion from oak/hickory forest is minimal, especially on large, deeply filled or built-up sites.

- Like New Zealand, the United States has problems of national extent in maintaining cost-effective, plant covers on archaeological sites. It appears to be not widely recognised that cost-effective management requires a sound understanding of the grassland and adventive weed and forest establishment.

- Many park practices are still driven by a conception of recreational park attractiveness (open field fringed by specimen trees) that is inappropriate and expensive to maintain, although it can open and focus vistas of historic interpretative importance.

- In some places, unwarranted management practices involving ground clearance over historic earthwork fabric and single or few species replacement programmes were failing because of mal-adaptation of those species to annual seasonal variation in conditions. These ground covers surely fail completely in the longer term.

- The problems discussed in the points above arise because of the lack of recognition by some park managers that naturally established, sometimes "weed" species (both natural and introduced), can usually provide a good conservative ground cover. Such natural ground covers (based on locally occurring natural ecological processes) need to be manipulated but cannot be prevented from occurring without great cost and, worse, great threat to historic fabric.

- Nevertheless, demonstrated successes have taken place, notably on the eastern Civil War battlefield parks, to convert unsatisfactory brush- and/or vine-weed covers to indigenous grasses. These projects have been relatively small in scale, compared with overall park management requirements, and have required detailed prioritisation, forest clearance, close management and manipulation of soil acidity and fertility, herbicides application, rehabilitation of profiles at topsoil level, and irrigation of newly established grasses. The cost-effectiveness of this procedure, compared with simply allowing conventional grass covers to grow longer with less fertiliser application, is still under review. The higher cost of initial establishment of native grass covers (neglecting potential damage to earthwork fabric) is established. However, it will be some years before the on-going costs of native grassland cover can be compared with conventional management.

- Visitor acceptance of the somewhat unkempt appearance of sites under a native tall-grass cover is reasonable, but the reasons for the practice have to be explained.

- Fire is accepted as a management tool, especially in the south and mid-western states, where it is part of local agricultural practice. Fire will probably prove not to be accepted in the eastern states where there are large urban areas adjacent to or surrounding parks. In these cases, the alternative is costly hand-weeding and various forms of mowing adapted to suit the height of grass needed and the demands of the immediate terrain.

- In the course of many site visits, only a few informal examples of recording and monitoring of site condition were encountered.

- In some parks, where conversion to native grasslands was being carried out, large areas were still maintained in long or reverting swards of exotic bred grasses, notably fescue. Where maintained on sites such as the mounds at Cahokia or Moundville, the conservative value was good.

Forests and site stabilisation

- There is no consensus in the United States on the desirability of forest cover on archaeological sites; on much-visited sites, tree clearance is carried out and grass established, but in many more cases understorey only is removed, or the forest and its understorey is left.

- In parks in the east and south-east, a pine and later oak/hickory succession is accepted on areas of very extensive sites, except on parts where close management is sought. In some parks, trees will not be replaced as they senesce (age).

- No solution has been found to the control of adventive vine weed-species, some of which had been introduced as a ground cover in previous attempts at establishing a conservative ground cover. In some parks, less noxious vine ground covers such as periwinkle are still encouraged where clearance of understorey species has been carried out.

- Removal of understorey species over quite large areas is practised in most parks. Although this is the simple solution to visibility of site features, its effects on regeneration prospects for forest (where desired) are not being recognised.

- In the mid-West, successful examples such as Albany Mounds show that a form of slightly mechanical savannah (mixed grassland and groves of regenerating forest, originally maintained by fire and buffalo grazing) can offer site protection and the visitor attraction of reconstructed prairie fields.

- In National Forests (i.e. native forests) in the south-eastem region, there is no active management of pine and oak/hickory succession to protect archaeological sites. Instead, historically sensitive areas are dealt with on an "identify and avoid" basis, a blanket measure that is operationally effective only because of the low value per unit of area of trees in these naturally regenerating forests. Overall, because of the great age of the Native American sites which have been subject to several forest successions from old fields, the impact of the most recent phase of tree growth is not great. Civil War sites, which are not uncommon in some south-eastern forests, would he affected by such tree growth, however.

- Wildlife reserves in forests (and elsewhere on Corps of Engineers land) with a low cover maintained to provide protection and forage to wildlife species (often game species) offer a model that could be applied to archaeological sites. These areas are sometimes with leguminous and other food-bearing plants to make them more attractive to game and protected wildlife. The low cover would also suit the conservation of archaeological sites.

Engineered solutions to site erosion

- Engineered solutions to radical instability of major sites such as large mounds or mound complexes have generally been rejected on the grounds of cost, impact on historic integrity of fabric, and sometimes the lack of a sound geotechnical base to the potential engineering solution. However, simple repairs to slumping by the addition of topsoil or straw bales, sometimes with the assistance of geotextiles, have proven successful.

- Geotextiles are preferable in almost all situations requiring clean separation of different fill or archaeological protective layers, and should replace the use of the traditional builder's black polythene sheet for all but temporary use on wet sites.

- Simple engineered solutions to the protection of flatland or very extensive mound surfaces from erosion were widely adopted. These consist of low, berms at the erosion scarp coupled with drop drains and outflow pipes to carry out the water contained by the berms. Visual impacts are low. Failure of sites on flatland or on broad ridges from erosion of terrace edges is not uncommon in New Zealand and this solution might be applied in some cases.

- Broader, ancillary drainage works, often affecting sites in urban or development settings, pose acute problems and require re-direction of drainage channels or underground piping that needs careful archaeological consideration of impact before installation. At the Grand Village of the Natchez, Mississippi, archaeological excavation removed large more or less convex deposits of alluvial silt from the post-occupation period, leaving the site vulnerable to local sourced storm water and river flood damage.

- Rip-rap and other forms of river bank protection are frequently installed where site value has been unambiguously demonstrated. These are generally professionally engineered solutions, which require close judgement of cost-effectiveness. Considerable costs are incurred by the inability to take fill or to move over areas adjacent to the eroding bank; solutions included temporary barge-bridging of narrow rivers and barging of fill in larger rivers.

- Apart from rip-rapping, shoreline erosion control methods for low wave-energy situations include the creation of artificial bunds or shell rakes, and the encouragement of saline-or submergence-tolerant shrubs (such as small willows) or glassworts that will allow initial sedimentation and a protective layer to build up. Sediment-filled geotextile tubes are an engineering solution that would have limited application in New Zealand.

Site stabilisation *in situ* versus mitigation by excavation

- Currently, understanding is poor of the balance of cost-effectiveness between site stabilisation on the one hand, and excavation on the other, to mitigate destruction.

- As sites exist in a wide range of environmental circumstances and, under development, are subject to extreme threat from accidental damage, it is difficult to generalise about the cost-effectiveness of stabilisation *in situ.* However, it is clear that the true costs of excavation mitigation of impacts is often not borne at the time of excavation, if at all. Excavation may be done but inadequate attention paid to conservation and of artefacts or to full reporting of the work.

- Excavation is probably justified where there is doubt about the effectiveness of *in situ* stabilisation and where there are clear, fully-funded archaeological objectives to be achieved.

- For these reasons, simple cost comparisons of the two broad options in face of development is not warranted at this time.

In situ stabilisation of exposed archaeological excavations

- Almost all instances of exposed excavations visited were poor advertisements for the craft of archaeology. Notable exceptions were the Moyety or Franklin Market St. house museum in Philadelphia and the (no longer to be seen) Dickson Mound excavation. In both cases, the natural or pre-existing built environments with good drainage, air circulation and non-acidic soils (at Dickson Mounds), assisted in preserving the site. All other cases were poor visitor attractions, offering views and conditions worse than any modern domestic house would be kept in.

- Excavations should only be left open where there is sufficient complexity of plan and detail to provide visitor interest and where maintenance in the face of drainage ventilation or other problems is feasible. Provision needs also to be made for elevated gallery viewing by the public. Earthwork surface plans or half-height timbering or grassing of plans of archaeological sites can have sufficient complexity to maintain visitor interest, but again elevated viewing if not galleries are of value.

- Excavation should not be left open without review of physical and other soil-chemical processes that may affect the condition and viewing-acceptance of the site. Drainage and soil salts are key factors. Air-conditioned space and access for regular cleaning should also be provided.

Reconstruction issues

- The United States park system stresses interpretation of a wide range of historical themes, some in great depth, with an elaborately developed system of thematic definition including political and Constitutional, historical personalities, Native American and Afro-American history, industrial development, and historical everyday life. The large body of professional interpretative staff in parks are the principal supporters of reconstruction as one of "the tools of trade".

- Reconstruction is also favoured by local groups who see an opportunity to tap federal funds for local economic and community development. Lobbying of congressman and senators on these topics is keenly followed by the local press, and sometimes professional opinion is lost sight of in the higher political decision-making. Nevertheless, compromises to protect some archaeological values (and to save money) are possible in the expenditure of moneys voted by Congress.

- However, National guidelines and regulations on reconstruction are generally opposed to reconstruction on original sites or in other situations where the reconstruction threatens intact historical fabric, unless it is essential to an appreciation of the significance of the place or landscape and the reconstruction can be achieved without conjecture. This ethical principle is in line with ICOMOS and ICAHM charters on this topic. In recent years, following this principle very little reconstruction has occurred on the original sites, although reconstruction on original sites occurred in the past. The debate over reconstruction is sharp and widely published within park service journals.

- Interpretation is a strong professional discipline in the National Park Service, and interpretation is the main reason for reconstruction on otherwise valuable archaeological sites. An effort should be made to incorporate an understanding of archaeological site values and stabilisation in professional or on-job training for interpreters.

- The Fort Union Trading Post in North Dakota is probably one of the last of the models of reconstruction that has destroyed large parts of a significant archaeological site. Reasonable levels of archaeology to guide restoration architecture and for salvage was carried out. Some important archaeological site features have been retained. Publication of archaeological results is still needed.

- In North Dakota, in a few years professionals and the public will be able to judge the effectiveness of three if not four models of stabilisation and reconstruction:

  reconstruction off-site of an earth lodge (Knife River)
  on-site (Fort Union, On-a-Slant Village)
  reconstruction on caissons and a steel framework *protecting underlying archaeological deposits* (Fort Abraham Lincoln)
  ghosting of *structures* outlining an Indian Army base (Fort Buford).

- Other forms of reconstruction that do less or no damage to sites include laying out ground plans with half-height timber or other markers, and laying out with unmown grass strips. It is important in these cases to provide or maintain elevated or gallery views of the site.

- Many reconstructions seen were aging badly, and account must be taken the start of the cost of maintenance, where partial or ghosted reconstructions must have a considerable cost advantage over full reconstruction, the maintenance costs of which approach those for authentic structures.

- As long-recognised in professional principle, the decision on which period of a long-lasting site to represent is very important. At Fort Union, the correct decision was made to go for the apparently most elaborate (and hence expensive) and historically well documented period, some 25 years later than the fort's founding. This decision, more generally, is not always clear-cut and may involve unfortunate loss of earlier (or indeed later) historic fabric of great value.

- The problem of period is important in commemorative function, e.g. for Civil War earthworks. It is impossible to take these earthworks back to their unstable state as abandoned. As we receive them today, they are a stabilised reconstruction, still ecologically significant, of a memorial era when the aging veterans of 1860-1865 came back to the battlefields in the first decades of this century. Then, many memorials were installed and the oral narratives and memories of revered men were recorded.

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APPENDIX 1

Tallgrass savannah restoration basics

Savanna Grasses and Forbs

The complex discussed here under the name tallgrass savanna—midwestern oak grasslands on good soil—varies from mostly shady to mostly open and from wet to dry. A wet-open savanna has very different grasses and forbs from either a dry-open or a wet-closed savanna. The species of the most open areas are largely prairie species. Those of the least open areas are largely forest species. The short list assembled below was designed to give the flavor of one of the least well-known components of that continuum in northern Illinois—mesic savanna with a canopy of about 50 percent. This component is particularly important because it appears to contain many plants and animal species and genetic strains that may not survive elsewhere in our preserve systems. As a result we may be attempting to maintain such species and communities in an incomplete and unresilient form (see discussions in Pickett, 1985). These representative species are on lists made by early observers, are present in remnants, and are also successful in restoration plantings.

Asclepias purpurascens—purple milkweed
Bromus kalmii and B. purgans—brome grasses
Cacalia atriplicifolia—pale Indian plantain
Elymus canadensis, virginicus and villosus—rye grasses
Gentiana flavida—cream gentian
Hystrix patula—bottlebrush grass
Lathyrus venosus—veiny pea
Lespedeza violacea—violet bush clover
Panicum latifolium—wide-leaved panic grass
Seymeria macrophylla—mullein foxglove
Silene stellata—starry campion
Solidago ulmifolia—elm-leaved goldenrod
Swertia carolineana—American colombo
Triosteum perfoliatum—wild coffee

The only presently known extensive list of savanna species compiled by a person who saw the real thing was made by Mead (1846). Mead's list has been republished and the nomenclature updated (Packard, in press). Brief lists of "prairie grove" species were published by Bebb (1860) and Gleason (1909). An extensive list of the flora of oak openings in Michigan was published by Daniels (1904); although the more open portions of the ecosystem had clearly been lost by the time Daniels worked, the closed savanna species are well represented. Curtis (1959) and Bray (1955) published lists drawn from Bray's work in the 1950s; these cover savannas of up to 50% canopy under the heading "oak opening." Closed savanna or savanna woodland (50–90%) is treated, and species lists are presented by Curtis under "dry and dry-mesic southern forest."

Tallgrass Savanna Restoration Basics

These "working hypotheses," developed over ten years of work, may be of interest to others who are involved in similar or parallel experiments.

Site Selection

Almost any land with oaks and good soil is acceptable. (The related sand savanna and barrens communities are on poor soil.) Big old oaks with spreading limbs are visually splendid, but a great many sites described by early travelers had smaller trees—"about the size of pear trees," for example. Bur oak (*Quercus macrocarpa*) is the characteristic tree of mesic open savanna. White and then red oak (*Q. alba* and *rubra*) dominate the increasingly closed, shady portions. Hill's and black oak (*Q. ellipsoidalis* and *velutina*) occur on drier sites. Swamp white oak (*Q. bicolor*) is the tree of wet savanna.

In the understory, the best sites would have at least some surviving native herbs—prairie species in the most open (10–30% canopy) portions, distinctive savanna species in intermediate light (30–70% canopy), and prairie grove species in the closed savanna (70–90% canopy).

Few such sites exist, however. Another desirable situation would be to carry out a restoration adjacent to a railroad or cemetery edge where some original savanna survives and where remnant populations of savanna invertebrates, fungi, bacteria, and so forth may still exist. In such cases, the best areas should not be seeded, but should be burned, left alone, and studied.

Fire

Fire is essential. No fire, no savanna. Fire must be frequent: burning annually, or two years out of three, is probably best in the early years of restoration. For control techniques, follow the guidelines given for prairie burns by Pauley (1982). There are, however, major differences between prairie and savanna burns. Compared to prairie, the savanna may require drier, hotter or windier burning weather. This is especially true for degraded savannas with relatively little fuel. As an additional consideration, matted oak leaves may take three or four days to dry out after a rain; waving prairie grasses might be ready to burn in an hour. Brush copses and standing dead trees present a variety of hazards unfamiliar in many prairie situations. The copses, for example, may fail to burn when the backfire is put in and then burn explosively when a headfire provides a "critical mass" of heat. Such a fire may then carry across a firebreak through an apparently secure "unburnable" area.

Brush Control

The records of early surveyors should reveal what tree species were present and which were lacking from the savannas of any area (Noss, 1985). Invading unwanted species are in most cases readily controlled by fire. Brush too large for moderate fire to kill (as small as 3" DBH for many species) can be cut or girdled.

In areas that have too little fuel to burn, it is possible to cut all brush and herbicide the stumps, if quick results are necessary. Such areas will have to be seeded with herbs that will develop an adequate fuel matrix, or new brush and weeds will replace what was cut.

Weed Control

Prairie weed control strategies described by Virginia Kline and others (R&MN, all issues) are generally appropriate for savannas as well. A few special problems and opportunities in savannas are described below.

In closed savanna, an annual carpet of oak leaves makes weed control by fire particularly easy, even in the first year of restoration. For example, garlic mustard (*Alliaria officinalis*), a major weed of our degraded prairie groves, is easily controlled by spring fires.

Some native species that probably were components of the original savannas are overly aggressive in restoration situations. These and some alien species that are not sensitive to cool-season fires can become so dense by midsummer that we think they may kill the seedling savanna natives that we hope will reclaim the understory. Scything or mowing in mid-summer (or when a species is in flower) is often an effective control. Such species include tall goldenrod (*Solidago altissima*), briars (*Rubus sp.*) and creeping thistle (*Cirsium arvense*).

Seeding

The best remnant savannas will have a rich variety of grasses and forbs. These are easy to deal with: just burn and leave everything else alone. But, because savannas detiorate so rapidly in the absence of fire and because typical savanna remnants have been heavily grazed, most potential restoration sites have lost most herb species. The first burn in such a savanna creates a massive opportunity for new plants—both savanna species and weeds. In order to restore a diverse, vigorous community, reseeding is crucial if the makings of an herb matrix are not nearby. Restorations with seeds gathered from spontaneous local populations are most valuable, since they help preserve local ecotypes.

On the North Branch, our savanna seed mixes have contained over two hundred species. These are divided among at least twelve mixes according to degree of openness (prairie, open savanna, closed savanna, and grove) and moisture (wet to dry). The year's harvest of seeds of any given species is typically divided among the two or three most appropriate mix bags. These seeds are then hand broadcast either before the leaves have fallen (for early ripening species) or after a burn, preferably in fall, so the seeds can over-winter in the ground.

Broadcasting is tricky. Spreading the seed too densely or putting it in the wrong spot wastes a precious resource. Subtle topographic features often separate mesic from either wet-mesic or dry-mesic ground. Recognizing patterns of canopy cover requires mentally computing sun angles at different times of the day and year. Research by Bray (1955) and our experiences suggest that, under trees, many herbs thrive in drier situations than those same species occupy in full sun. To some extent it is possible to compensate for misreading the landscape by spreading the seed in overlapping patterns. Over the years, of course, many plants will end up in their right spots, even though seeded into slightly wrong ones, if they have a few seasons to disperse seed before being outcompeted in the places we have erroneously selected for them. In other words, given half a chance, the community will largely take care of itself.

Planning

Don't expect quick perfection. Be ready to be embarrassed for many years by charred brush, bare ground and weeds. Prepare the public, your boss, etc., for this transitional period. A very visible area will require extensive public education, since most Americans have learned their fire ecology from the lumber interests (Smokey) and Walt Disney (Bambi). Modest sampling of plant and animal populations will help you respond to critics and, more important, understand how the restoration is progressing.

APPENDIX 2

Thinking about Site Stabilisation: Interview with Dr Robert Thorne, University of Mississippi, September 1993

Robert Thorne has been responsible for synthesizing principles and practice for archaeological site stabilisation over a number of years. He has published extensively on this topic and worked cooperatively with National Park Service Archaeologists on the stabilisation of many sites throughout the United States.

KEVIN JONES: Why do you think theory and practice in site stabilisation has been so long coming in archaeology? If you compare it with stabilisation say of museum artefacts, the development of principle in archaeology seems very backward indeed. If anything, we are still in cowboy country.

ROBERT THORNE: That's a good example - the Wild West's about where we are. There is a lag because of the theoretical development in American archaeology in the late 60s - the era of the "new archaeology". What we were supposed to do, then, was to be more systematic. At that same period, the United States Congress passed several laws that required that if a site which met the criteria for admission to the National Register, and was going to be damaged or destroyed as a result of federal development expenditure, either by the federal agency or the private contractor, then the adverse impact on the site had to be mitigated. I think as much as anything else, that was a function of the time. The number of archaeologists who were trained in the United States was no more than about 3,000 from my recollection, not many more in the entire country. The emphasis by constructing agencies, which had huge projects, was to excavate sites rather than try to protect them. That is not entirely true because some sites were subject to what they call avoidance. That just meant that you sealed them off from trucks going over them, and there was no thought given to what would happen to the sites in the long term.

KEVIN: So that becomes neglect.

ROBERT THORNE: Yes, it becomes neglect over a period of time. In a way we were beginning to catch up with theoretical views of site preservation and protection the actual practice of archaeology. There was still a fair amount of distance I guess is the word on the part of academic archaeologists to doing site conservation. In the areas we have a good number of consulting archaeologists who make their money doing excavation.

KEVIN: The shovel-bums and all that.

ROBERT THORNE: Yes, the shovel-bums and all that, and the companies they work for. They don't like the notion of conservation. But it's eminently more practical to conserve a site in the long term than it is to excavate the site and do the analysis and to cumulate the material. Under current federal law mitigation procedures are very strict.

KEVIN: When you set out -it must be ten years ago - to think systematically about stabilisation, what were the issues that were uppermost in your mind when you set out to write those papers? There was one paper with a flow chart showing when to intervene in site stabilisation procedures.

ROBERT THORNE: I'm not really sure. That's a difficult question without going into the history of my involvement with the topic. I became involved with site conservation stabilisation in a purely serendipitous manner. The Tennessee Valley Authority were losing a lot of sites due to shoreline erosion and I asked their archaeologists, simply "What are you doing about it"? Their response was -"Nothing".

KEVIN: I asked the Forest Service people what they were doing about pine trees growing on sites and they said -

ROBERT THORNE: Nothing. When I raised the original question about what was happening to conserve sites with the TVA archaeologists it was in April and the federal financial year ended in September. Some time towards the end of August I got a call saying, "You've got to get your budget in". I didn't know what they were referring to! Apparently it was the stabilisation paper and I'd forgotten all about that conversation! All of a sudden I got into the stabilisation business. One of the initial charges of that contract was to identify stabilisation conservation projects that were in progress at that time -the large projects on the National Park Service mounds where they cut grass, at Mesa Verde and places like that. But the emphasis was on less monumental sites. I found that where people had carried out such projects they had not been written up. At least they weren't in the professional literature. This stimulated thought about those things that we needed to do to take systematic steps to conserve a site. The steps ranged from the resource being eligible for the National Register, through the entire series of steps that ideally you could go through. The chart that I worked out, a flow chart, was developed in stages: you go in one direction, conservation falls out, go in another -up to a point to where the project that you put in place has actually been written up. So we don't have to continue to re-invent the wheel.

KEVIN: And you also report on the design of monitoring procedures for the site and the report on the monitoring.

ROBERT THORNE: Yes, I'm old fashioned I'd just about gotten to the point where I don't like the notion of monitoring any more. Because I discovered that when people monitor sites that means they go out and ignore them but if you have to go out and evaluate them then the implication is if there's something wrong you've got to fix it. If you monitor it then there's no implication that you have to do anything other than you went out and looked at it.

KEVIN: So it's a phase of evaluation .... Now, a question about routine management. In Grant Park in Atlanta there are a large number of Civil War earthworks around the hill on which Grant Park is built. When I went there I found that the city management had been mowing along the inside of the ditches but all you saw was a little slope into the hill along which the mower had gone. The overall plan of the trenches was clear

enough but any casual visitor had no real sense that they were looking at something which was in fact a trench. The routine damage had accumulated to the point where I could see what was originally there -and even I had trouble - but no visitor could. It seems to me that if you take the scalping of a site because the mower is set too low; if you take routine ploughing over natural levees where the rim of the levee gets worn down -that a lot of routine management accumulates problems and losses that we simply aren't recognising in day-to-day management.

ROBERT THORNE: How do we recognise that damage and what sort of things are we doing wrong -and do we need to improve to get that to make that situation better? Mostly we're cutting the grass too short. That does lead to continuing damage of the site by cutting the grass too short. You are damaging the grass and you lose the protective qualities of the sward -for example, if you have Bermuda grass in your lawn and you cut it down to an inch and the recommended maximum is 2 inches. Then you destroy the quality of the grass. Somehow we have yet to get that message to those who cut grass in our national parks. As a consequence we do have a problem.

KEVIN. But in Illinois, I did not see any archaeological sites that had short grass on them. At Cahokia it's pretty much all in long grass.

ROBERT THORNE: My recollection of the big mound at Cahokia is that most of that grass is Johnson grass. It's not a native grass -it's an oriental grass that was brought in for erosion control. It's become an extremely noxious weed through much of the southern country, but it's an advantageous weed because it has a very strong root system. You can mow Johnson grass down close and then mow it again when it comes up later it won't stand that kind of mowing.

KEVIN: This is one of the paradoxes that we come across, isn't it. That when you manage a site you manage it as part of the surface ecology of the land and sometimes it seems to me that noxious plants are often the best plants to maintain archaeological site condition. Noxious legumes and grasses have terrible root systems and seeding capacity that causes them to spread everywhere, and yet they're the ones that do the best job of site stabilisation.

ROBERT THORNE: If you were in United Kingdom, you would not want those in your enclosed lawn. In the United States where we have open yards, at different terms a different function in the household, we can stand those grasses. In the United States park service management of the resources to a certain extent are secondary in nature, I mean the earthworks of sites. The management of visual space is really what the park managers are on about. They like to keep the grass cut short, and they like to have nice visual aspects.

KEVIN: So it's an eighteenth-century Capability Brown type of approach to land management. I saw that at Kaskaskia, a state park in southern Illinois, where the trees had been carefully mown underneath, maintaining vistas so that trees were carefully clumped to frame the views of the Mississippi River. All the while underneath them was this marvellous eighteenth-century French earthwork fortification.

ROBERT THORNE: In Illinois, Margaret Brown [the site manager of Cahokia State Park] has a good grasp of site conservation techniques. The great mound at Cahokia in itself is a major problem. Over the last 150 years it has slumped in various places, it seems to be a natural phenomena from what I've read about it. But the maintenance of the longer grasses is keeping the water level down in the mound itself and increasing transvaporisation.

KEVIN: Are the grasses doing as good a job as tree cover, setting aside this question of whether the trees are doing damage to the fine structures in the mound itself?

ROBERT THORNE: It depends on what the species of trees are and what the characteristics of the root system are. In the background of this scene where we are standing now [at Lake Sardis on the Tallahatchee River] there are a number of cypress trees. That thing has a simple tap root which is probably 45 feet deep -and that certainly would not be recommended for archaeological sites. Trees with a broad surface system of roots, without tap roots, by and large don't disrupt the subsurface much more than 3 feet. Those are not really the larger roots, that's just the smaller roots [at that depth]. They don't really have the size capability to damage artefacts beneath the ground. The roots are rounded on the ends and sensitive to food sources and they come up to an artefact and they determine that this is not a source of food and they go around it -pretty neat, eh?

KEVIN: They also dig into post holes as well. Just on this question of tree cover, in Illinois they were pretty thoroughly cutting trees off mounds. A colleague of mine said to me in New that the Americans have a good sense of the integration of nature and culture. I thought I was going to see this in the United States.

ROBERT THORNE: Not likely.

KEVIN: What I found was this Capability Brown approach to landscape. Much of the nature that we saw was like the brass bed posts that we saw in the museum back there. The nature had been dobbed on top as an ornament. For example, the deer at Chickamauga in Tennessee, they were put there as a decoration to the battlefield landscape. At Chickamauga, of course, this is not a problem as far as the archaeology is concerned, because there are no earthworks on that particular battlefield -it was an engagement of infantry on open ground.

If we just go back to this model of Albany Mounds, in Northern Illinois. The Albany Mounds site was retired, and you'll be familiar with the literature on it which was written by Margaret Brown. I wanted to go and see it. What I found there was vast paddocks, formerly in corn where the mounds had been ploughed down over the years. They had been planted in praire grass, *Andropogon* sp., the most beautiful tall grass. But they were arranged in English kinds of fields. Because of that original agricultural field pattern they were able to put in quite a satisfactory system of firebreaks so that they could continue to fire the fields and maintain the prairie grass without shrublands or weeds encroaching. You came to the edge of the Mississippi bluff, and there were these bunches of mounds in a forest. The mounds themselves had been cleared of trees so

they were left like little alien creatures from out of space, and then you went down through the forest to the actual flood plain. It seemed to me that here and also in National Park Service properties in North Dakota, that a golden opportunity to integrate nature and culture had been missed. The model that was put to me at Albany Mounds was that of a savannah -long prairie-grass strips fingering into the mounds and an oak hickory forest fingering back out into other areas of the prairie. What would your comment be on that?

ROBERT THORNE: The National Park Service model is one in which the tourists can go out and stand in one place and see the greatest amount of whatever it is they are looking at. To do that you have to have cut trees. By and large cutting trees is not a good idea. Thinning is one thing; to take them out completely is not really good -not for site conservation. In addition to not being good for site conservation, it is not good for visitors coming in to see what the original landscape was like. To do that you have to go back to traditional archaeology and to get the palaeoenvironment results, to see what the original environment was like. The vast majority of the areas has been denuded of its original ground cover. In areas that now have trees on them would not have had trees in say the fifteenth century, and areas that are grassland did have trees. You get a really jaded view if you see a battlefield with miles and miles of trenches and you look out and all you see is something that looks like a soccer field. That's not really what it's about. So from an interpretative perspective what you need is to try and go back and make a union of the various environments that were originally there, something like the natural environment that the original inhabitants lived in.

KEVIN: I think you would find many shouts of agreement from New Zealand archaeologists -because what human beings do is to burn around their settlements. So you would have fairly extensive grass and which is an ideal cover for the protection of earthworks. I don't want to put words in your mouth but what's your thoughts on that?

ROBERT THORNE: I would advocate a careful selection of woody vegetation that you go out and plant.

KEVIN: We talked about the concept of benign neglect, I wondered what were your thoughts on that concept.

ROBERT THORNE: That's absolutely evil. Another way to phrase it is to let nature take its course. Nature is a destructive phenomenon; the built environment will deteriorate if measures aren't taken to preserve it. The cultural environment that is archaeological sites below the surface of the ground -if some effort is not made to preserve the surfaces of the ground those things will deteriorate as well. For a good number of years I used the term “stabilise”, "protect", and "preserve". Those kinds of terms deal with the conservation of archaeological sites but I've just about quit using the term "preserve" because we can't preserve archaeological sites. We can't stop the deterioration of all kinds of archaeological resources from nature. To make bad matters worse we've put acid in our rain and that makes the situation a whole lot worse.

To neglect an archaeological resource of any kind and not try to proactively manage it is simply the hastening the loss of that resource. I have believed for a long time that, not just in the U.S. but it is a worldwide phenomenon -when archaeological resources are treated it was a reaction to a particular incident -someone said, "Oh my God, it's washing away -let's fix it". In the U.S. now we are moving slowly, dragging ourselves, kicking and screaming to become proactive about the management of archaeological resources. We need to treat resources so that if an archaeologist has a question of a specific site in twenty or fifty years time from now, the site will be there to do that. As a conservationist, I don't have any problem with someone wishing to excavate a site which I have preserved. If I don't conserve it won't be there for the person to excavate.

APPENDIX 3

Contents listing, Archaeological Sites Protection and Preservation Notebook

Archeological Sites Protection and Preservation Notebook

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No.		Title	Date
ASPPN	I-14	Problems Identified by the General Accounting Office in the Protection and Preservation of Federal Archeological Resources	September 1989
	I-15	Impacts of Domestic Livestock Grazing on Archeological Resources	June 1990
	I-16	Documenting and Predicting Erosion of Cultural Resources along Reservoir Shorelines by Sequential Historical Aerial Photographs	June 1990
	I-17	Erosion at the Shell Bluff Landing Site (8SJ32)	June 1990
	I-18	Off-Road Vehicle Impacts to Archeological Sites	May 1992
		Section II – Site Burial	
ASPPN	II-1	Site Burial and Results of Soil Tests at the Magrum Site, Craighead County, Northeastern Arkansas	June 1988
	II-2	Preservation at Bear Creek Rock Shelter, Lake Whitney, Texas	June 1988
	II-3	Experiments on the Effects of Site Burial on Archeological Materials	June 1988
	II-4	Site Burial as a Means of Preserving Archeological Sites	September 1989
	II-5	Laboratory Experiments to Study the Effects of Compaction and Pressure on Artifacts in Archeological Sites	September 1989
	II-6	Preservation of Site 23HE260 Through Burial, Harry S. Truman Lake, Missouri	May 1992
		Section III – Structural Stabilisation	
ASPPN	III-1	Seawall Protection of Ministers Island, New Brunswick, Canada	June 1988
	III-2	The McCutchan-McLaughlin Mound Stabilization Project, Oklahoma	June 1988
	III-3	Site Preservation at Roods Creek Mounds, Georgia	June 1988
	III-4	Streambank Protection of the Chapel of Santa Rosa de lima de Abequiu, New Mexico	June 1988

No.		Title	Date
ASPPN	III-5	Use of a Log Revetment to Stabilize the Lone Pine Bar Site, Idaho	June 1988
	III-6	Whistling Elk Archeological Site Bank Stabilization	January 1989
	III-7	Estimating Costs of Archeological Site Protection	January 1989
	III-8	Control of Coastal Erosion to Protect Archeological Resources	January 1989
	III-9	Preservation of Hurricane Landing Mound	September 1989
	III-10	Stabilization of the Hocking Valey Barge, Athens County, Ohio	September 1989
	III-11	Stabilization of Mound State Park, Moundville, Alabama	September 1989
	III-12	Stabilization Using Retaining Walls at the Packers Creek and Sierra Sites, Idaho	May 1992
	III-13	Stabilization of Coastal Archeological Sites, Victoria, Australia	May 1992
		Section IV – Soil and Rock Stabilisation	
ASPPN	IV-1	Preservation of Davis Gulch Pictographs, Glen Canyon Reservoir, Utah	June 1988
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ASPPN	V-1	Mothballing Albany Mounds	January 1989
	V-2	Control of Shoreline Erosion by Means of Revegetation	January 1989
	V-3	Shoreline Erosion Control Using Revegetation and Floating Breakwater, Sailboat Harbor, Carlyle Lake, Illinois	May 1992
		Section VI - Camouflage and Diversionary Tactics	
ASPPN	VI-1	Site Protection Strategies Employed at Fort Hood, Texas	June 1988

No.		Title	Date
		Section VII -Site Surveillance	
ASPPN	VII-1	Electronic Surveillance Systems Potentially Useful in the Protection of Archeological Sites	September 1989
	VII-2	Photointerpretive Evaluation of Vandalism and Erosion at Mud Springs Pueblo, Cortez, Colorado	June 1990
		Section VIII -Stabilization of Existing Structures	
ASPPN	VIII-1	Experiments in the Structural Preservation of Submerged Anasazi Units	June 1988
	VIII-2	Monitoring of Ruins Stabilization at Glen Canyon National Recreation Area	June 1990
	VIII-3	Scale Modeling of Impacts and Protective Structures for Historic and Archeological Sites	May 1992
		Section IX - Faunal and Floral Control	
ASPPN	IX-1	Conservation of Pictographs, Fern Cave, Lava Beds National Monument, California	June 1988
	IX-2	Vegetation Management of Archeological Sites	January 1989
	IX-3	Reevaluation of Conservation Experiment on Mass Removal from Pictographs, Fern Cave, Lava Beds National Monument, California	May 1992
		Section X -Signs	
ASPPN	X-1	Sign Placement as a Means of Protecting Archeological Resources	June 1990
		Section XI -Inundation	
ASPPN	XI-1	Protection of the C.S.S. Georgia, Savannah Harbor	January 1989
	XI-2	Archeological Inundation Studies	June 1990
		Section XII - Miscellaneous	
ASPPN	XII-I	Bibliography of Corps of Engineers Research Related to Cultural Site Protection and Preservation	September 1992

APPENDIX 4

The Nativist Ethic and Park Management: Interview with Leslie Sauer, Philadelphia, October 1993

Leslie Sauer is *a principal of Andropogon Associates, an ecological and landscape consulting group. Amongst her recent work* is *advice on the rehabilitation and restoration of Central Park, New York city. She is the principal author of the "Earthworks Landscape Management Manual" (Andropogon Associates, 1989), covering particularly the civil war sites around Richmond, Virginia.*

KEVIN: It is some four years since the manual was written, what second thoughts do you have about how it's been received and actioned?

LESLIE: Even at the time of the manual we had second thoughts about the ability of these people to change the way they perform management. We incorporated a sequence of workshops, etc. into the programme. I think it was the right idea, hut it fell vastly short of what I think is actually necessary to effect a real change in the management that people do. In the same period, we have been working with the City of New York and with the Central Park Conservancy, a group of people that includes managers, people in charge of operations, security, foresters, historians. We meet monthly in order to review the management. We meet with the crew in the field on a very regular basis. We hammer out all the really difficult aspects of actually following through on new policies. There's a general tendency to think that you get an outside consultant for a period of time; they provide the and then they go away. And we really don't do that much any more. We tried from the very beginning to make it clear that this is not a one-shot deal. Changing behaviour is very difficult to actually effect, and even people who seem to be very gung ho and into the idea at the outset are relatively helpless when they hit a snag. And they inevitably hit a snag.

We have a site out near the Philadelphia Airport. It is a relatively small area, a very nice old field landscape along the right of way coming in from the airport. We have a little woodland legume there; a little Aphis that is going honkers on the site. Its not a plant that you ever find in any quantity anywhere. Whether this is the plant that is going to give us long-term difficulty managing this site, I'm not really sure. All I can say is that its a condition I have never witnessed before. And every site I've come to and spend any length of time in, there's something like this. There's something that you're not really prepared for.

Peoples attitudes towards the landscape are so simple, so simplistic. The people who are managing and caring for this landscape do not know the vegetation they are looking at. They have no idea whether something's exotic or native. They can't diagnose the landscape if it has woody things on it, they think its a forest. So that forest may be declining, it could be losing species-diversity, declining. We have relegated the care of the landscape to people with the lowest training. We give them no education, we expect them to have no on-the-job training, except to fix a truck, or work a winch or clean a chainsaw, all very gadget-oriented. It never occurs to anybody that they might

have to actually know something about the landscape. And I think this is such a fundamental law in this regard. The supervisors I find know no more than anybody else.

KEVIN: We've talked about some of the strongly stated recommendations of that manual, for instance the observation tbat the only earthworks that are in good condition are in trees or in trees with an understorey. Also there is an assumption that native vegetation is the best cover. Is this a working assumption of your associates?

LESLIE: We are very interested in working with natural systems, we are interested in what it takes to restore natural systems so that they can begin to show signs of real recovery, like recruitment. A lot of our broad-scale landscape management effort will have to be native plant focused or we will not have the ability to sustain native communities elsewhere.

The roadside is a vital arterial connection corridor. It may be a lousy place for wildlife but in fact the same places are all linear environments that are crucial to our maintaining connectivity between natural systems. These are exactly the environments where we should have vital ecological connections happening and I think to not include that in terms of what is required of that landscape in terms of being stable is inappropriate. You cannot have fractured, fragmented systems that work.

KEVIN: What I would say, just turning this to archaeology in New Zealand we have a nativist assumption. The question in my view is not "How do we establish natives on this site?", but "What is the best cover for this site to protect it".

LESLIE: And the issue of how to achieve real stability. There's always the theoretical possibility that there is some non-native cover that is going to be better. I don't discount the theoretical possibilities, but the actuality is that once you go around and work out what cover is stable and what cover is not stable, particularly when you look at a long haul, we find over and over again is the exotic cover is simply not stable, and part of the reason is its typically a species, or two species in a system that was previously stabilised by upwards of 300 plants on any given acre. So to think that such a simplistic system is going to perform over as broad a range of conditions as a very complex system, may be part of the problem here. A lot of these exotics will perform great for a period time. They will be in a period of vigorous colonisation where they're sending out a lot of tuberiferous material, rooted every two inches, and they're not going to dislodge any surface - I'm thinking of vines, grasses. But it doesn't mean that cover is going to persist and be that effective over time. Many of these areas that were stable with exotic plants at one period of time are now re-stabilised with the kind of mish-mash of exotic and native ruderal species and the cover may be more complex, but its not necessarily very good cover.

KEVIN: One of the things that New Zealand audience would not grasp, as I have because I have seen it, that you have literally areas 30 miles square that have no natural features in them at all -I can appreciate your concern for natural area dislocation.

LESLIE: Oh we're looking at areas larger than that. They are absolutely solidly asphalt, and we are losing our neotropical migratory birds. 70-90% of our forest birds are neotropical migrants. Their numbers are plummeting. Central Park at New York City has more bird species now than it had at the turn of the century. This is not because it's better habitat, it's because its the only game in town.

KEVIN: I think the forest ecosystem is still "alive" in New Zealand in the sense of its capacity for regeneration, and it does in fact work through exotics like gorse *(Ulex* sp.). It is commonly regarded as benign because the native species come through as it rots out at about 30 years.

LESLIE: The issue though, is how much longer they can come do this. There are a lot of areas where 30 years ago, succession was proceeding relatively normally, exotic species, some of the grasses and things that were being used would be there and the native vegetation would come right through it and I tended to perceive it as largely harmless. But as the system gets more and more fragmented, and the assaults begin to accumulate, we begin to realise that happened once hut its not going to happen two or three times. I think that this is the problem that we are dealing with; we can always find an example where the other thing worked in one place or at one point in time. Or maybe a lot of different places in time, but if you were really out there looking at what is happening to the native systems, what kind of recruitment, what kind of reproduction of native plants is really happening. I would have difficulty in believing that you were not having very severe impacts that I could pick up. I think there are risks you know, I can go into federal forests with federal foresters and look at the landscape and they'll tell me its just fine. And I'll ask them "Where did you find hickories reproducing?" and they can't find these things.

It's this under-perception of the damage that is being done, the extent to which a native community might have only been arrested for a period of time, but that period of time may be now long enough that it can't come back. Just because it came back once. If you start looking at the sum total of what systems are recovering, there is just this sort of irrevocable march of ruderal systems displacing the more complicated systems. Part of the problem with the idea of exotic stabilisation is that I feel that the definition of stable should include the potential to support natural systems. I'm not sure I would consider a site stable -I don't consider a site stable until it will support natural systems. If it is so bad off that I could get only a ruderal or an exotic to grow, then I consider this site basically to be compromised.

KEVIN: If you had to sum up in a few sentences your message to actual landscape management practitioners, the landscape architects and the guys with the shovels and the weedsprayers, what advice would you give?

LESLIE: That if they spent a little time with me and do the job better, and spend less time and have more native vegetation. The vast bulk of what we do in terms of land management activity is simply destructive. I've been watching them on this highway for example; they have been coming in with the rotary blades and clearing all the understorey vegetation along this very steep slopes with things like locust on them. It

looks marvellous right now, you have a little fuzzy green growth under what looks like this beautiful copses of locust. They will not come hack for four or five years and during that time all the young trees have been set back enormously. The vines have all been invigorated, the has been invigorated. Their habit of bushwacking every few years, is just enough to set back any native forest development that might have been happening. It's blown right out of the water. And they are irrevocably and slowly turning this to a vine and not wetland-scape and I see this everywhere. They mow to a point where all vegetation is damaged rather than mowing infrequently enough so that medium-sized, smaller, dwarf herbaceous plants can get established, can make a cover. They could have had beautiful herbaceous landscapes under these trees. They could have savannahs.

KEVIN: What we've found in New Zealand is that some natural landscapes, of native grasses and herbs are progressively being invaded by shrublands -perhaps because we now control natural fires. When you mow earthworks, and hand cut, you create a new landscape patch in which those lower native species can continue to survive -rare species that once would have been displaced.

LESLIE: I mentioned a Louisville project where we tried to work with these people to get them to go back to green sward in the Victorian sense where they have historic Victorian landscapes. They read the historical literature. The lawn for example is described as astonishingly fine and very green and very close cropped. The modern reader envisages the golf course. But to a Victorian, a fine close-cropped monospecific lawn had probably 12 broadleaf herbs in it from Veronicas on over, was 5 inches tall, never got anything but organic fertiliser to it. There was no such thing as inorganic fertiliser, or whatever they were using in that context. It did not get herbicides, it did not get pesticides. It was what we would call low-impact turf today.

KEVIN: Is that going to be cost-effective and robust enough?

LESLIE: Of course it's going to be cost-effective. In fact their single biggest problem then was to remember to roll it enough. What I'm getting at is that we have to really go and examine the fact that most of what we do degrades the landscape over time. Take roadsides, the Atlantic City expressway was cut through the pinelands. It was one of the most beautiful growths imaginable when it was first opened up. They were slicing through this rolling landscape, the blade basically helped to view the tiniest things. But now because the blade has been used so thoughtlessly mow, mow, the pH is about 4. So that the other turf grass that they seeded has failed to persist. The exquisite little bearberries which created a magical pixie moss, all this rare stuff that was showing up in their initial mowing, all the competition was taken away from these small plants. But of course they never looked at that and said -"Well we could really make use of low growing cover, we could mow it all a little less frequently. We could set the cover a little higher, so that we don't damage these plants." Now its dirt and ruderal vegetation. It has taken 20 years to reduce a biologically rich soil to nothing, absolutely nothing.

KEVIN: I made the mistake of saying to a mid-west biologist that he must have a problem deciding between a high-producing exotic sward, demanding and a low-productivity native sward which might not protect. He rounded on me and said that the prairie grass that we were discussing maintained its own fertility and stability -by the coexistence of many herbs, leguminous species, and so on.

LESLIE: If you read the old Soil Conservation literature from even 25-30 years ago, when I first started harassing them about native plants, you get all this crazy literature from them about how native plants were to be eradicated or limed to death and replaced with fescue K31 and things like that. You read the most current material you find that K31 is toxic to cattle, has actually caused loss of life in livestock, is a major loss of calves, has rendered some fields very, very poor, and it turns out that native grasses were higher quality forage, produced less disease. Native plants have been out of vogue for a very long period of time and now there is a relatively small contingent of people who say we are about to lose all of our native communities globally, there's no biome that is untouched.

KEVIN: It is quite clear that you and your associates have a strong ethical premise to your advice. Some National Park Service staff say that they have a mandate to establish or re-establish native species. But what you see is under-shrubbed trees used as specimens to frame a view -a kind of 18th-century, Capability Brown approach to landscape design in which the earthworks are simply follies, curiosities - if the designers had the wit to see them that way. Certainly the large memorials act as follies. I did not see any sophistication in designing native plants such as grasses into the park landscape. Why is that?

LESLIE: I think that it's just what is accepted maintenance-wise, if you mow the grass, this is somehow all that is expected, there is a kind of country club mentality about this. The park at Petersburg thought they had to be turfed; they thought that the public would not perceive them to be a national park -if they weren't turfed. And we were very careful to leave turf in the national parks. The roadsides were bordered in turf edges that made them very crisp and green. The pathways were bordered in turf. If we were going into a big meadow, or something like that, it might have had a snake fencing. The turf would go up to the snake fencing, which was a historic artefact, and then we would move on to total grass beyond it. I mean its got to be done with some eye to how the visitor is going to see it. We used it a lot in terms of visitor control, working very closely with the rangers. At Petersburg, there was a problem perceived by the sight of sunbathers appearing in historical vistas, towards key points of the line such as the Crater. We put that vista into long grass and the hill on the opposite side was put into turf. The sunbathers moved there without the necessity of a whole lot of signs saying "No Sunbathing Here, Please Go Over There". So a lot of what was accomplished in terms of the visitors perception was oriented around using turf as a base that people are supposed to walk on.

KEVIN: What message do you have for that other interest group, the archaeologists themselves?

LESLIE: The biggest message to the archaeologists is that you can't treat the landscape as if it's dead. It's not dead too, it's not an artefact, it's a living thing. And living things cannot necessarily fulfil such a tight prescription. You can't necessarily say to it, "I want you to grow to a height of only six inches and I will only come here every three years and whack it down. Don't erode and don't do anything like that". People will issue these pronunciamentos about what should be done with the landscape and what's going to happen. The landscape doesn't do that. It's alive, and I think the archaeologists do not acknowledge that.

APPENDIX 5

On-ground management prescription and costs, Petersburg National Battlefield Park

EARTHWORKS MANAGEMENT

MAINTENANCE SCHEDULE

1993

BATTERY # FIVE

1. REMOVE ALL WOODY GROWTH BY HAND (PULLING OR CLIPPERS). CUT GROWTH.
FLUSH TO GROUND TWICE/YEAR.

TIME: SPRING & FALL

2. MOW ANNUALLY DURING DORMANT SEASON (NOV/DEC/JAN) TO A HEIGHT OF 8 – 12".

3. ADD TOPSOIL, SEED, STRAW AND JUTE BARE AREAS. WATER WHEN WEEKLY RAINFALL IS LESS THAN 1 INCH.

4. MOW INTERIOR OF BATTERY TO CLASS "A" STANDARDS TO A HEIGHT OF 3".

TIME: WEEKLY DURING GROWING SEASON.

FORT STEDMAN:

1. REMOVE WOODY GROWTH BY HAND OR CLIPPERS TWICE YEARLY.

TIME: SPRING & FALL

2. MOW EARTHWORKS ANNUALLY DURING DORMANT SEASON TO A HEIGHT OF 8 – 12".

3. MOW INTERIOR OF FORT TO CLASS "A" STANDARDS TO A HEIGHT OF 3".

TIME: WEEKLY DURING GROWING SEASON.

CONFEDERATE FORT GREGG:

1. ADD TOPSOIL, SEED, STRAW AND JUTE BARE AREAS. WATER WHEN WEEKLY RAINFALL IS LESS THAN 1 INCH.

2. REMOVE ALL WOODY GROWTH BY (PULLING OR CLIPPERS). CUT GROWTH FLUSH TO GROUND TWICE/YEAR.

TIME: SPRING & FALL

3. OVERSEED & RE-HAB BARE AREAS AS NECESSARY
(SEE RM STAFF FOR DETAILS).

TIME: SEPT & OCTOBER.

4. MOW INTERIOR OF FORT TO CLASS "A" STANDARDS TO A HEIGHT OF 3".

TIME: WEEKLY DURING GROWING SEASON.

5. MOW EARTHWORKS ANNUALLY DURING DORMANT SEASON (NOV/DEC/JAN) TO A HEIGHT OF 8 -12".

EARTHWORKS MAINTENANCE (FT. GREGG)

DATE	MATERIALS	PRICE
June 2,93	150 lbs of fertilizer 50 lbs of grass seed 5 rolls of jute	
May 25,93	100 lbs of fertilizer 30 lbs of grass seed 10 rolls of jute netting	
May 11,93	150 lbs of fertilizer 35 lbs of grass seed 20 bale of straw	
May 10,93	220 lbs of fertilizer 75 lbs fescue 40 lbs of grass seed	
April 30,93	lyme (4400 lbs) applied	
April 28,93	fertilizer (5-10-5) (2250 lbs)	215.55
April 19,93	14 tarps	279.44
April 12,93	topsoil (100 cu.yards)	2165.00
April 09,93	2210 lbs of lime applied	
March 25,93	2 Maruyama headtrimmer tools	1731.00
March 22,93	grass seed	342.50
March 22,93	1 soil test	6.00
March 24,93	earthwork photo documentation	20.00
March 16,93	earthwork hand tools	219.00
March 15,93	safety equipment	299.75
	seed sower	22.95
Nov 17,92	280 lbs of winter rye	161.00
Aug 24,92	herbicide application, "Roundup"	900.00
June 4,92	herbicide application, "Roundup"	350.00

WATERING AT FT. GREGG

DATES	HOURS LABOR	LOADS (1000 GALLONS)
June 18,93	15	6
June 24,93	8	3
June 25,93	16	7
June 29,93	10	4
June 30,93	6	2
July 03,93		1" rain
July 07,93	8	3
July 10,93	7	4.5
July 14,93	13	5
July 16,93	7	4
July 20,93	10	10 (+ .1" rain)
July 21,93	6	4
Aug 03,93	7	4 (+ .3" rain)
Aug 05,93		.3" rain

TOTAL HOURS LABOR = 113

LABOR

DATE	HOURS	RATE	COST
April 9,93	4	10	40
April 19,93	5.5	10	55
April 20,93	14.5	9	130.5
	56	9	504
May 5,93	272	(volunteer)	5510
	272	(paid)	3498.64
May 10,93	20.5	10	205
	40	9	360
May 11,93	10	10	100
	40	9	360
May 25,93	8	10	80
	48(Maint.)	9	432
June 2,93	8	10	80
	5	8	40
	64(Maint.)	9	576
Summer 93	113	9	1017

TOTAL COST= 12,993.14

APPENDIX 6

Description and management of Little Bluestem, *Andropogon scoparius*

PLANTS FOR CONSERVATION IN THE NORTHEAST
USDA - SOIL CONSERVATION SERVICE
TSC - UPPER DARBY, PA.

CONSERVATION PLANT SHEET

LITTLE BLUESTEM
(Andropogon scoparius, Michx.)

Use: This is a true native grass species that occurs in old fields, mountain pastures, and roadbanks throughout the Northeast. It has value as a persistent low maintenance cover plant and as a summer forage plant.

Description: It is a medium tall, warm season, bunch type grass with coarse stems and basal leaves. As a perennial it begins growth in late spring and continues thru the hot summer period until the first killing frost. It is easily mistaken for common broomsedge. Little bluestem has flat bluish basal shoots, which are somewhat bulbous. Plants are green, but often purplish at base of stem and entire plant has a reddish cast after frost. Leaves are smooth, but frequently are covered with hair at the base next to the sheath. Leaves tend to fold with maturity. Seed heads are in the form of racemes about three inches long. The raceme stems are hairy. Plant height varies from 18 inches on droughty sites to three feet on deep, fertile soils. It develops full stands where moisture is sufficient, but gets clumpy on drier sites.

LITTLE BLUESTEM

Varieties: These are few in number. 'Pastura' is a release from SCS, Los Lunas, New Mexico Plant Materials Center; 'Aldous' is a release from Kansas Experiment Station; 'Morton' from the SCS, Manhattan, Kansas Plant Materials Center; and 'Blaze' from Nebraska Experiment Stations. Other varieties are being developed in SCS Plant Materials Centers of the Northeast.

Sources: Varieties of little bluestem are readily available from seedhouses in the Central Great Plains States of Nebraska, Kansas, and Oklahoma.