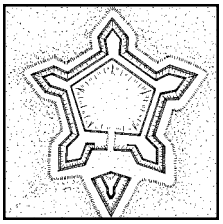
GPS MAPPING METHODOLOGY FOR EARTHWORKS MANAGEMENT AND EVALUATION



Technical Support Topic Three

Note: This section is provided by David Lowe of the Washington Area Service Center and is currently undergoing revision.

INTRODUCTION

Earthworks management begins with reliable maps of the resources. Until the introduction of Global Positioning Systems, there was no cost effective method for producing accurate maps of surviving earthworks. GPS allows a survey crew not only to map the locations of earthworks but to record various attributes associated with these resources, such as relief, ground cover, and condition. This information collected in the field can then be fed into a PC-based GIS program like ArcView or Atlas GIS. Once mapped and in the GIS, the earthworks can be measured, buffered, and analyzed in association with other digital coverages like ground cover, soil type, vegetation type, tax parcels, and so forth. Earthworks segments can be linked to existing maintenance databases and assigned a priority according to available funding. Restoration or stabilization efforts can be recorded and tracked, so that the park retains a record even if important personnel leave or are transferred. Although many parks currently lack access to a GIS, it is a safe bet that GIS will be in all parks within ten years if not much sooner.

The first hurdle is to get the earthworks data into the computer. This can be done by conducting a GPS survey of surviving resources.

A GPS survey of earthworks for the purpose of management would be conducted in two phases: (1) Inventory and (2) Evaluation. A basic inventory of the surviving earthworks should be conducted before beginning any condition or vegetation assessments. This ensures that the park's GIS contains consistent baseline data for all surviving features before additional layers are added. A complete inventory of resources provides a foundation for all subsequent management decisions.

During the inventory phase, the earthworks are located and described. To accomplish this task, the GPS survey team needs a basic understanding of the methods and techniques of earthworks construction, a general idea of the historic context of the defenses, and the ability to identify predominant

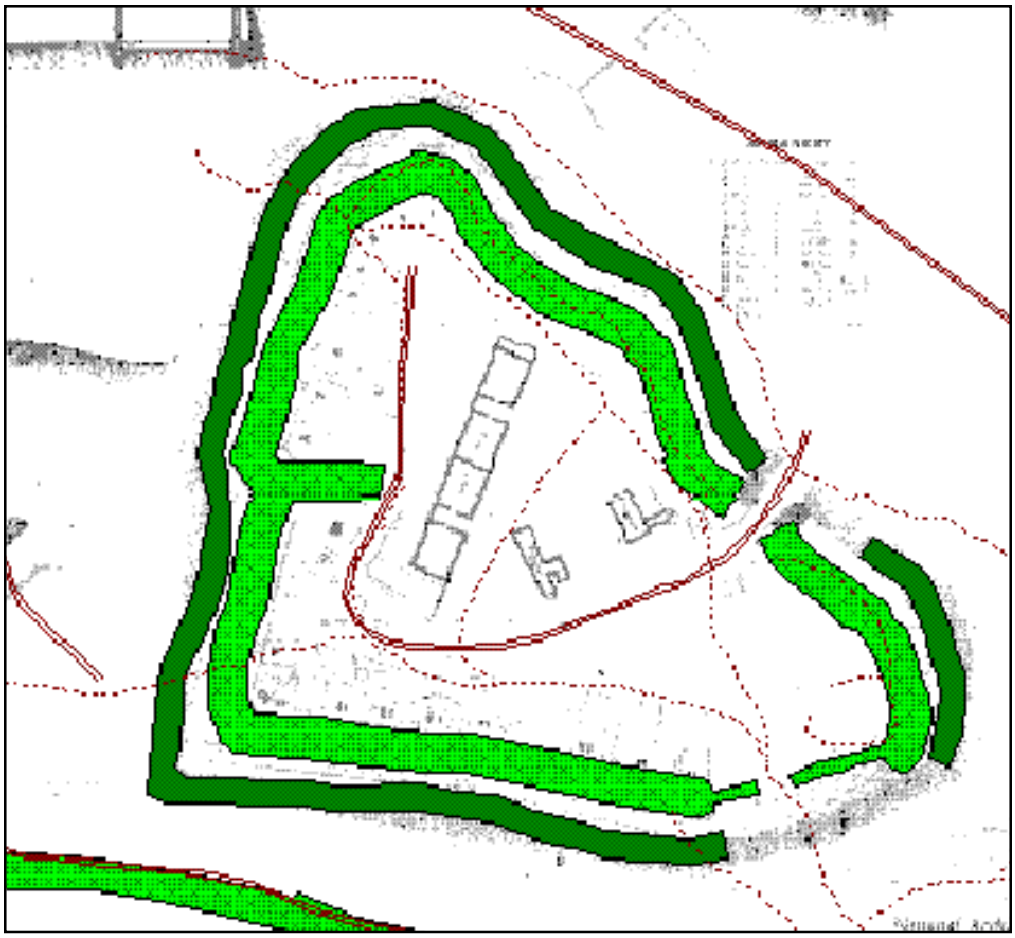


Figure 7.3.1. Fort Marcy, Arlington, Virginia. Lines for parapet and ditch were collected with GPS and buffered by width in ArchInfo. Modern data overlays a military site plan from 1865.

ground cover. In areas of heavy undergrowth, the inventory survey should be conducted (if possible) in fall-winter-early spring before vegetation has come out so that earthworks and related features are readily visible. The critical attribute collected is location, but the survey team should describe additional attributes that are important for interpreting and understanding the condition of the features. When designed for use with GPS, this list of descriptive attributes is called a *data dictionary*.

During the evaluation phase, vegetation is examined (sampled) at regular intervals along the linear earthwork and condition assessed. The survey team should have a more advanced understanding of vegetation and ecology or be accompanied by a biologist. The evaluation phase should be conducted in late spring-summer-early fall, when plants can be identified and counted.

FEATURES AND ATTRIBUTES COLLECTED DURING GPS INVENTORY SURVEY OF EARTHWORKS

Line Feature: Parapet

Earthworks (trenches, field fortifications) are linear features that reflect the deployment of military formations on the ground. Earthworks were sited according to principles of military science and therefore reveal much about the thinking and activities of the officers and soldiers who constructed them. Although many specific types of earthworks were built during the Revolution and the Civil War (redans, lunettes, redoubts, parallels, rifle trenches), all consisted of a parapet (a mound of earth) and a ditch (trench, moat) from which the dirt to form the parapet was excavated.

A GPS survey team approaches these features generically, mapping each as a parapet line that follows the course of the parapet. This generic approach allows the survey team to stick to observable features, thus minimizing interpretation in the field. The specific design of an earthworks feature can be determined later from the shape of the earthwork line on the map, its relationship to other earthworks, and from the various collected attributes, such as relief and type of construction.

1. Type of Construction

Military field fortifications consisted of a parapet, which is a mound of earth, and a ditch from which the earth was excavated. A field fortification typically faced in the direction of incoming enemy fire. A front line fortification "faced" in the direction that soldiers manning the trench pointed their rifles. Positions often received incoming fire from more than one direction, requiring other protective trenches with additional facings. "Feeder" or secondary trenches sometimes ran at odd angles to main, front lines. The parapets of such lines were piled on the side most likely to receive incoming "oblique" or "enfilading" fire. The facing of trenches might reverse from one side of a hill crest to the other as the source of incoming fire shifted from the right of the line to the left. The *front* of a line was toward the enemy; the *rear* was away from the enemy.

There were three techniques of earthworks construction: ditch in front, ditch in rear, and ditch on both sides. The simplest and most common method of construction was to line soldiers up along the intended course of a trench and set them to digging with shovels and picks. The soldiers threw the excavated earth to their front to provide a barrier of earth between themselves and the enemy. Often, the earth was thrown onto piles of logs or fence rails to increase the bulk of the parapet and its ability to absorb bullets. This

resulted in a ditch in the rear of the parapet or *ditch-in-rear* construction. The rifle or shelter trench shown here with four and a half feet relief could be constructed in about an hour and a half. If time permitted, the trench would be deepened, and the back side of the parapet could be revetted or reinforced with logs, braided branches, or sandbags. Often, soldiers added head logs — logs spaced lengthwise along the top of the parapet beneath which the soldiers could fire. This type of field fortification, commonly known as a rifle trench, or sometimes as a "rifle pit", provided basic shelter for infantrymen and averaged four to five feet in relief.

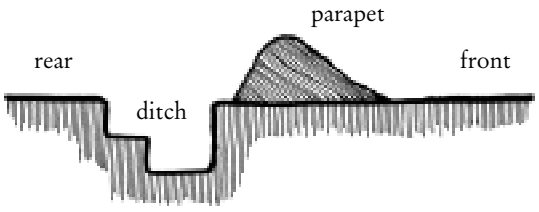


Figure 7.3.2. Profile of a rifle trench, showing ditch-in-rear construction.

The second technique used to construct field fortifications was to excavate a ditch in front of the parapet. The soldiers first constructed a retaining wall of logs or other materials, called a revetment. The soldiers then lined up in front, excavated earth, and threw it back against the revetment. The *ditch-in-front* method allowed the ditch to be deeper than a soldier could stand, often six to ten feet or more. The extra earth made the parapet correspondingly thicker and stronger. This type of construction placed the parapet and the ditch between the contending parties with the ditch serving as an additional barrier to attacking troops. Such works typically were used in semi-permanent fortifications, to shelter artillery batteries, or to provide extra protection for infantry from incoming enemy artillery fire. Detached works, such as redans, lunettes, and redoubts, were built this way, often under the direct supervision of a military engineer. Long, straight segments of ditch-in-front entrenchments for infantry connecting artillery strong points were called "parallels".

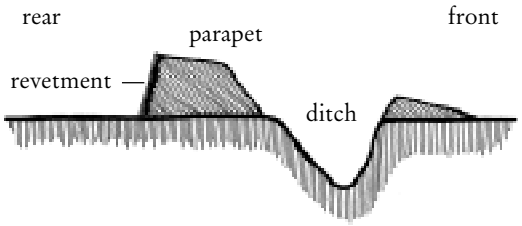


Figure 7.3.3. Profile of a field fortification, showing ditch-in-front construction.

The third type of entrenchment was built with a ditch on both sides of the parapet. *Ditch-on both-sides* construction often was employed as an ad hoc measure to strengthen a section of parapet, to adapt it to shallow topsoil, or to respond to uneven terrain. This technique was sometimes used to deepen a wagon road or protect a "covered way" that ran behind the parapet. It is also seen where trench segments were captured and refaced or "turned" to face the opposite direction.

2. Relief

The relief of an eathwork is the vertical distance between the top of the parapet and the bottom of the ditch.

3. Width of Parapet

The width of the parapet is measured from the angle of the parapet where it joins the original ground surface to the angle at the bottom of the ditch. Deep relief, narrower parapet, and sharper, "cleaner" angles imply good surviving integrity. For rifle trenches, a wider parapet, shallower relief, and blurred angles at ground level, show that the parapet has eroded, "melted" and spread out to fill the ditch. "Melted" parapets are often observed in areas that were clear-cut and exposed to the elements. In extreme cases, a parapet may have eroded almost flat, leaving only the shallow trough of the trench visible.

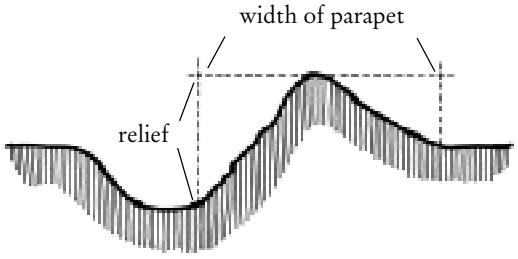


Figure 7.3.4. Profile of a fieldwork, showing dimensions of relief and width of parapet.

4. Predominant Ground Cover

It is important to collect the predominant ground cover associated with an earthwork in order to identify applicable management techniques. Collecting this information on the ground also provides a check for land cover information derived from other sources, such as aerial photographs. Past surveys have revealed that earthworks in mature forests, particularly deciduous forests, tend to retain the best integrity. In most areas, pine dominated forests indicate that the area has been recently timbered, typically

causing some erosional damage. It is rarer for earthworks to survive in open areas without the protection of tree cover, but it does occur, and parks have intentionally cleared and planted areas to exhibit earthworks.

The following vegetation categories are suggested as generic enough to be used by non-specialists in a range of climatic zones: evergreen forest, mixed forest (evergreen and deciduous); deciduous forest; meadow/pasture/grassland; marsh/wetland; scrub regrowth; maintained cover; and other (which can be used for unclassified cover). The park's biologist may wish to use already established vegetation categories in the data dictionary, so long as the surveyors are able to distinguish the differences among vegetation types.

Point Feature: Earthworks Point

Civil War field fortifications comprise more than the main front lines. A fieldwork complex can include secondary defensive lines, feeder trenches, covered ways, or military roads by which to move men and matériel to the front—all which can be mapped as line features. Associated with these linear features are a variety of point features that are important for understanding the layout of the defenses. The longer a military unit stayed in an area, the more elaborate the system of fortifications tended to become. Units established command posts and hospitals. Engineers laid out artillery strong points. Supply caches were established and dug in behind the main lines adjacent to military roads. Individual soldiers constructed dugouts, shelter holes, or fire pits behind the lines. Picket or skirmish holes (Civil War-era fox holes) were dug 50-200 yards in front of the main trench line to guard against a surprise assault. All of these earthworks points are important for understanding and interpreting the layout of a defensive line.

1. Gun Emplacement (no embrasure)

Some of the most important features associated with entrenched lines are the locations of the artillery. With some experience, a survey team can identify and map these gun emplacements. Field guns (mobile artillery) were sometimes entrenched individually behind crescent-shaped parapets, called demi-lunes, just large enough to cover the gun and its crew (12-15 feet across). Four to six guns were sometimes entrenched together as a "battery". Field guns were also incorporated into the main defensive lines. The cannon could be sighted across the parapet (as shown in the illustration) or through a gap in the parapet, called an embrasure (discussed below). Platforms for the guns behind the parapet were smoothed out and lined with planks or split logs, if time permitted, to provide a level surface for aiming and servicing the gun.

Gun positions without embrasures can be recognized in the field by several indicators: the parapet will be thickened relative to connecting rifle trenches; the ditch is usually in front and may have switched abruptly from the rear to the front when approaching the position; a rectangular platform (12 x 15 ft.) may be seen behind the parapet; traverses might have been erected on either side of the platform to protect from enfilading fire; a ramp or cut might be visible behind the platform where the gun was brought in and taken out; and a rectangular hole (3 x 4 feet) might be present 12 to 15 yards behind the platform where the gun's ammunition chest was entrenched. Typically, some but not all of these indicators are present.

2. Embrasure

An embrasure is an opening cut into the parapet through which an artillery crew could fire its weapon with less exposure to enemy fire. Embrasures are readily identified in the field by a narrow depression in the parapet behind which may be found some of the indicators discussed above—thickening of the parapet; ditch in front after ditch switching sides; visible platform; protective traverses; a ramp or cut leading into the platform. A single gun sometimes had more than one embrasure, particularly if sited in the angle of a work. Each embrasure should be mapped.

3. Hole/dugout

Many miscellaneous holes are associated with linear earthworks. All of these holes served a purpose for those who dug them, but understanding that purpose is now a matter of identification and interpretation. Although many of these "holes" can be described as magazines, officers' holes, dugouts, ammunition holes, supply caches, or picket holes, often the purpose remains ambiguous. It is best for the survey team to map the holes as "holes" and leave interpretation to the archeologists and historians. The point feature contains a *comment* field to allow the surveyor to label the mapped features.

4. Hump/traverse

Traverses are shorter parapets erected at right angles to the main defensive lines to prevent an enemy enfilading fire from sweeping down the length of a trench and inflicting heavy casualties. Traverses often separated guns that were entrenched as a battery. Another "hump" feature might be a "baulk", which was a narrow earthen divider left in a trench to separate two units in the line of battle. Often these baulks separated regiments. Mapping baulks might enable a historian to determine the positions and fronts of individual regiments in the line of battle. The point feature contains a COMMENT field to allow the surveyor to label the mapped features as traverses, baulks, or generic "humps".

5. Other

Including an "other" category, allows the survey team to collect features of interest that might not be categorized. An example might be a sunken portion of a parapet that resulted from the collapse of a wooden drainage culvert that passed beneath it.

Point Feature: Break in Parapet >3 meters

If the gap between one trench segment and another is wide, the survey team will turn off the earthworks line feature and start another at the beginning of the next segment. Longer parapets are often penetrated by various types of breaks that are too narrow to justify turning the earthworks line feature off and back on. These include breaks that were left by the soldiers and breaks that resulted from later activities, such as farming, logging, and erosion. For convenience in the field and because of the accuracy of the GPS equipment, breaks less than about 3 meters in width are mapped as point features, nested on the earthworks line.

1. Engineered outlet

Breaks were often left in the parapets to allow skirmishers or artillery to go to the front or to allow egress for a road or path. An engineered outlet is an integral part of the fortification and should be noted when it can be identified.

2. Stream /gully

Narrow breaks were left in the parapet for drainage. Although many of these technically were "engineered", it is good to note geographic features, such as streams and gullies, that later can be lined up with other geographic data layers in the GIS.

3. Intrusion

Post-construction intrusions, caused by farming or logging, account for many breaks in the parapet encountered in the field. An intrusion for a logging or farm road is typically made by pushing a portion of the parapet back into the trench with a bulldozer or front-end loader. This leaves tell-tale traces—disturbed ground surface, slumping along the original ditch, slumping in the ditch on both sides of the opening, and often vehicle ruts. An engineered break usually left the ground between the segments of parapet undug—the ground surface appears level and firm. When there is doubt about whether a break is engineered or not, it should be mapped as an intrusion. The width of the break can be collected as an attribute value.

4. Erosion

The action of water and wind can erode gaps into a parapet. Large trees sometimes gouge out gaps in the parapet when they throw. Foot paths, mountain bike or ATV paths, and animal traffic may erode gaps or depressions into the line. Mapping these gaps will indicate areas where the parapet is endangered by erosion.

Point Feature: Line Point

Parapets may be full of bends and angles that should be mapped during the GPS survey. Because many positions are averaged to compute a point feature during GPS data collection, point features are inherently more accurate than line or polygon features. To take advantage of this higher accuracy, it is important to collect point features in conjunction with a line to tie it down to the ground and assist in the editing process. These line points are used to mark the beginning, end, an angle, or an intersection on a line, thus improving confidence in the shape and accuracy of the line feature. Line points should be included in all data dictionaries.

Suggested GPS Data Dictionary for Collecting Earthworks Inventory Features

The inventory portion of the data dictionary contains one line feature with four required attributes and a comment field, and four point features.

LINE FEATURE: Earthwork

Attribute: Type of Construction (menu)

Ditch in front
Ditch in rear
Ditch both sides

Attribute: Relief in <units> (numeric)

Attribute: Width of Parapet in <units> (numeric)

Attribute: Predominant Ground Cover (menu)

Evergreen forest
Mixed forest (evergreen & deciduous)
Deciduous forest
Meadow/pasture/grassland
Marsh/wetland
Scrub regrowth
Maintained cover
Other

Attribute: Comment (character)

POINT FEATURE: Earthworks Point

Attribute: Feature Type (menu)

Gun platform
Embrasure
Hole/dugout
Hump/traverse
Other

Attribute: Length in <units> (numeric)

Attribute: Width in <units> (numeric)

Attribute: Height in <units> (numeric)

Attribute: Comment (character)

POINT FEATURE Break in Parapet <3 meters

Attribute: Type of Break (menu)

Engineered outlet (e.g. sally)
Stream /gully
Intrusion (e.g. vehicle cut)
Erosion

Attribute: Width of break in <units> (numeric)

Attribute: Comment (character)

POINT FEATURE Line Point

Attribute: Line Point Type

Begin
End
Angle
Intersection

POINT FEATURE Photo Point

Attribute: Photo ID (character)

Attribute: Direction of View (menu)

N
NE
E
SE
S
SW
W
NW

Attribute: Comment (character)

Note: Units of measure collected in the field should be consistent with the database that is used in the park. Collect data in meters if the database projection is in utms, in feet if the projection is in state plane.

Vegetation Evaluation and Condition Assessment

This data dictionary item would consist of a single Point Feature, called an assessment point, with the following attributes and menu choices:

Cover as indication of erosion control (x 10)

5 pts. >80% living cover
4 pts. >80% living cover & mulch/litter
3 pts. 60-80% cover
2 pts. 40-60% cover
1 pt. <40% cover

Maintenance/management required (cutting, mowing, burning) (x 2)

5 pts. once annually or less
4 pts. 2-4 treatments /yr.
3 pts. 5-6 treatments /yr.
2 pts. 6-8 treatments /yr.
1 pt. >8 treatments /yr.

Aggressive, persistent exotics (x 2)

5 pts. None observed
4 pts. <25% frequency of exotics
3 pts. 25-50% frequency of exotics
2 pts. 50-75% frequency of exotics
1 pt. >75% frequency of exotics

Species diversity (x 2)

5 pts. >8 average species diversity per square meter quadrant
4 pts. 6-8 average species diversity per square meter quadrant
3 pts. 4-6 average species diversity per square meter quadrant
2 pts. 2-4 average species diversity per square meter quadrant
1 pt. 1-2 average species diversity per square meter quadrant

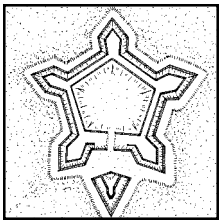
Visual quality rating (x 2)

5 pts. Legible earthwork, attractive
4 pts. Generally legible; discordant spots
3 pts. Partially legible; discordant spots
2 pts. Generally ?rough?; inconsistent
1 pt. Chaotic, illegible

Negative human, animal impacts (x 2)

5 pts. Neither is evident
4 pts. Minor trampling or animal burrowing
3 pts. Major trampling or animal burrowing
2 pts. Both trampling and burrowing
1 pt. Extreme impact (e.g., ATV compaction)

SUSTAINABLE PLANT SPECIES FOR EARTHWORKS MANAGEMENT



Technical Support Topic Four

Following is a list of plant species in different categories which appear to be well suited to the earthworks environment in the regions of this study. For the most part, these species were observed growing on or near earthworks in the subject parks. In some cases, they have been identified as primary candidates for consideration in meeting special needs, e.g. ability to grow in areas of moisture extremes or their tolerance to mowing or burning. The native ranges of these species are throughout the study area unless otherwise noted. The non-native species recommended here are known to provide good, reliable cover, but are not considered invasive, and generally require fewer additivesthan other more commonly used cool season turf grasses.

GRASSES

*Andropogon ternarius (*Splitbeard Bluestem)
Andropogon virginicus (Broomsedge)
Aristida purpurascens (Arrowfeather Threeawn Grass)
Bouteloua curtipendula (Sideoats Grama Grass)
Chasmanthium latifolium (River Oats)
Elymus virginicus (Virginia Wildrye Grass)
Eragrostis spectabilis (Purple Lovegrass)
*Festuca rubra (Red Fescue)**
Panicum virgatum (Switchgrass)
Schizachyrium scoparium (Little Bluestem)
Sorghastrum nutans (Indian Grass)
Stipa avenacea (Needle Grass)
Tridens flavus (Purple Top)

GRASS-LIKE PLANTS

Carex pensylvanica (Pennsylvania Sedge)
Juncus tenuis (Path Rush)

FORBS

Chamaecrista fasciculata (Partridge Pea)
Potentilla canadensis (Five-finger Cinquefoil)

FERNS

Pteridium aquilinum (Bracken Fern)

VINES

Parthenocissus quinquefolia (Virginia Creeper)
Vitis rotundifolia (Muscadine)

SHRUBS

Satureja georgiana (Georgia Basil)
Vaccinium vacillans (Lowbush Blackberry)

* Non-native, but considered sustainable

GRASSES

Andropogon ternarius (Splitbeard Bluestem)

Warm-season, clump-forming perennial, 2'-4' tall with reddish fall and winter color, fine texture. Sun to light shade; well drained soil on ridges and knolls. Withstands periodic burning, but not annual burning followed by grazing/mowing. Seed ripens late August to September.

Andropogon virginicus (Broomsedge)

Warm-season, clump-forming perennial, 2'-4' tall, with copper fall and winter color. Full sun, with wide variety of soils, including eroded, low-fertility sites. Withstands annual mowing, either when dormant or early in growing season (e.g. not later than mid-June. Should be cut at 6" or higher).

Aristida purpurascens (Arrowfeather Threeawn Grass)

Cool-season perennial forming small clumps of fine, curly leaves, 4"-12" long. Starts growth early. Full sun to intermediate shade; sandy soils. Increases under grazing/mowing, and was present in most parks in study area on sandy sites.

Bouteloua curtipendula (Sideoats Grama)

Warm-season perennial rhizomatous sod-forming grass 12"-20" tall. Full-sun, tolerant of well-drained uplands, ridges and rocky slopes, preferably moderately alkaline. Increases under grazing/ mowing, and should be tested in parks within its natural range (i.e. Tennessee and Virginia. Its natual range does not include the portions of Georgia and South Carolina with battlefields included in this study).

Chasmanthium latifolium (River Oats)

Cool-season, rhizomatous perennial that grows in colonies; medium texture, 3'-3 1/2' tall. Grows in moist, fertile bottomland soil, and mesic uplands when there is moisture (e.g. depressions or swales). Grows best in 40% or greater shade.

Elymus virginicus (Virginia Wildrye)

Cool-season perennial bunch grass, 3 1/2'- 4' tall, medium texture, with distinctive arching wheat-like seedheads, produced in May and June. Grows in both moist and well-drained soils, in 20%-30% shade. It survives grazing and mowing to 5"-6". As a cool-season grass that establishes well on open, disturbed sites, Virginia Wildrye is a likely candidate for revegetating open sites. *Elymus canadensis* may be more readily available commercially, and has similar growth habits.

Eragrostis spectabilis (Purple lovegrass)

Warm-season perennial bunch grass, 1'-3' tall, often occurring in colonies among other grasses. Seedhead is an open panicle with distinctive pinkish-purple color in late summer. Grown in medium to coarse-textured soils in full sun to light shade. Increases under annual burning.

Schizachyrium scoparium (Little Bluestem)

Warm-season, drought tolerant perennial bunch grass, with fine textured leaves, growing 2'-4' tall; reddish fall and winter color; seeds ripen in October and November. Grows on a wide variety of soils, but grows best in calcareous sites. Responds well to burning; should be cut no lower than 4" to avoid cutting growing tips; 5"-6" is preferable mowing height.

Sorghastrum nutans (Indian Grass)

Warm-season, rhizomatous perennial, with medium textured leaves up to 24" long; plume-like seedheads 5'-6' tall. Grows in full sun on soils ranging from moist, heavy clay to deep sands. Responds well to burning. Should not be mowed shorter than 5"-6".

Stipa avenacea (Needlegrass)

Cool-season clump-forming grass with open panicle of needle-like seeds; leaves form arching clumps 12" tall; often forming colonies. Grows in dry well-drained to occasionally-flooded soils under a wide range of light conditions, 30% shade to 70% shade.

Tridens flavus (Purple Top)

Warm-season perennial bunch grass, with medium-textured leaves 10"-28" long, and fine-textured open panicles of seeds, purple to almost black, 3'-5' tall. Grows on a wide variety of soils, bottomland to upland, in sun to semi-shade.

GRASS-LIKE PLANTS

Carex pensylvanica (Pennsylvania Sedge)

Perennial stoloniferous sedge, forming low clumps of fine-textured arching leaves, 6"-16" tall, often in colonies. Most often in dry, well-drained soils in wooded situations, it tolerates 30% to 70% shade. A good substitute for turf in shaded situations.

Juncus tenuis (Path Rush)

Perennial short clump-forming rush, with dark green round stems typically only 4"-12" tall. Named for its tolerance to trampling, this resilient plant grows in pastures, compacted soils of trails. Is tolerant of short mowing (e.g. 2"-3"), and of full sun to shade.

FORBS

Chamaecrista (Cassia) fasciculata (Partridge Pea)

Annual legume, 8"-16" tall, with yellow flower; grows on disturbed soils, roadsides, pastures, and open woods. Has special value because of its ability to grow in disturbed soils; and as a companion to grasses in open sites. Reseeds as long as there is open soil.

Potentilla canadensis (Five-finger Cinquefoil)

Perennial prostrate evergreen vine, which stabilizes slopes by rooting at nodes along the elongated horizontal stem. Grows on poor soils under dry to intermediate moisture conditions, from full sun to open woods. Has yellow flowers, March to June.

FERNS

Pteridium aquilinum (Bracken Fern)

Perennial, upright fern, 18"-36" tall; spreads vegetatively to form colonies. Withstands dry conditions and full sun to semi-shade. Has a wide range of soil tolerance, but most often is found on sandy soils.

VINES

Parthenocissus quinquefolia (Virginia Creeper)

Deciduous woody vine with palmately-compound leaves which climbs trees but also creeps over the ground providing a semi-open groundcover. Grows in semi-shade to shaded situations in both upland and bottomland sites.

Vitis rotundifolia (Muscadine Grape)

Deciduous woody vine which may climb trees or creep over the ground, in wooded sites ranging from well-drained uplands to poorly-drained bottomlands, semi-shade to shade.

SHRUBS

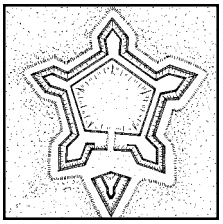
Satureja georgiana (Georgia Basil)

Small deciduous shrub with branches and branchlets spreading laterally, 8"-18" tall. Has pinkish flowers in midsummer. Grows under dry to intermediate moisture conditions, from rocky or sandy slopes to levees along streams, almost full sun to semi-shaded sites. Native to Georgia and South Carolina Piedmont.

Vaccinium vacillans (Lowbush Blueberry)

Rhizomatous, deciduous shrub 8"-20" tall, often forming colonies in open dry woods; is present at a number of sites in study area, especially at Virginia sites.

SUPPLIERS OF NATIVE SEEDS AND PLANTS IN THE SOUTHEAST



Technical Support Topic Five

The following list of nurseries/ seed producers which specialize in the production of native seeds and plants is extracted from, *Nursery Sources of Native Plants of the Southeastern United States* by Jan Midgley, July 1993. Ms. Midgley may be contacted at 234 Live Oak Trail, Wilsonville, AL 35186, or by phone at (205) 669-4097. The list has been updated to July 1996, to insure that addresses, telephone, and fax numbers are accurate.

KENTUCKY

Shooting Star Nursery
444 Bates Road
Frankfort, KY 40601
Phone:(502) 223-1679

MISSOURI

Missouri Wildflower Nursery
9814 Pleasant Hill Rd.
Jefferson City, MO 65019
Phone:(314) 496-3492

NORTH CAROLINA

Boothe Hill Wildflowers
23B Boothe Hill Rd.
Chapel Hill, NC 27514
Phone:(919) 967-4091

Hoffman Nursery
5520 Bahama Rd.
Rougemont, NC 27572
Phone:(919) 479-6620
Fax:(919) 471-3100

Niche Gardens
1111 Dawson Road
Chapel Hill, NC 27516
Phone:(919) 967-0078
Fax:(919) 967-4026

We-Du Nurseries
Rt. 5, Box 724
Marion, NC 28752
Phone:(704) 738-8300
Fax:(704) 738-8131

PENNSYLVANIA

North Creek Nurseries, Inc.
Rt. 2, Box 33
Landenberg, PA 19350
Phone:(610) 255-0100
Fax:(610) 255-4762

SOUTH CAROLINA

Wavering Place Gardens & Nursery
Rt. 2, Adams Hayne Rd, Box 269
Eastover, SC 29044
Phone:(803) 783-1682
Fax:(803) 783-3177

TENNESSEE

Native Gardens
5737 Fisher Lane
Greenback, TN 37742
Phone:(615) 856-3350
Fax:(615) 856-0220

Shadow Nursery
254 Shadow Nursery Rd.
Winchester, TN 37398
Phone:(615) 967-6059
Fax:(615) 967-6079

Sunlight Gardens, Inc.,
174 Golden Lane
Andersonville, TN 37705
Phone:(800)-272-7396

Virginia

Virginia Berry Farm
Box 4, Telegraph Rd.
Ruther Glen, VA 22546
Phone:(804) 448-4430

Virginia Natives
P.O. Box 18
Hume, VA 22639
Phone:(703) 364-1001