6 EARTHWORKS MANAGEMENT SAMPLE STRATEGIES

INTRODUCTION

In this chapter, several specific management strategies (Step 4 in the planning process) are laid out as illustrations of how field managers may apply information in this *Guide* to specific sites, or management units. Each of the sites included in this chapter might be considered a management area which would have been identified in the first step of the earthworks management planning process.

The specific "Management Program" listed with each strategy is a suggested sequence of management actions, often with recommended calendar dates for accomplishing them. The intensity of work involved, and the resources needed will influence the date for initiating the management program. In cases where the management program requires fewer resources than are presently required, of course, it might be possible to initiate the proposed management program almost immediately, with a reduction in expense.

The management programs outlined in these scenarios are acknowledged to be experimental to some degree. Hence, the degree to which any of these illustrative management scenarios is implemented may vary with different parks and at different sites or management units. Basically, three levels of adoption might occur: (1) adoption on the entire management unit with appropriate annual monitoring to determine the level of success, (2) adoption on part of the unit, to be compared with another part of the site where the existing management program is continued as a "control" for comparison, and (3) adoption of the technique(s) in test plots only, e.g. ten feet by ten feet, placed at representative locations within the management unit.

Yet another type of experiment would be to adopt the recommended management program on test plots at other locations within the subject park where conditions may be similar, but which may not be so visible.

Regardless of the degree to which one of the illustrative management scenarios is adopted, the various treatment could be interpreted to the public as research plots designed to provide additional management information.

In the scenario for Petersburg's Battery Five, (P-B5) two alternative sets of *management objectives* are identified. One is to actively increase the native herbaceous cover by supressing invasive exotics through a combination of

chemical and mechanical means. The other is to use an area of the site as a management experiment, to determine whether current management practices will produce similar results over time. With these objectives, the establishment of permanent meter-square quadrats to monitor change in cover and species composition annually is an important component of the management program. In view of the relative lack of past experience in applying several of the recommended vegetation establishment and management practices specifically to earthworks, comparative experiments are encouraged.

Among the various strategies included in this Chapter, several different types of conditions are treated. With these as starting points, and drawing on the list of recommended species for earthworks vegetation establishment, land managers dealing with similar sites may adopt these illustrative scenarios. It is strongly recommended, however, in developing such strategies, (1) that plant species not generally be planted outside their natural range; and (2) that the practices be tested in small plots, in order to evaluate their effectiveness before broad application.

MANAGEMENT STRATEGY ONE: MAINTAINING EARTHWORKS UNDER FULL FOREST COVER

Park: Colonial National Historical Park, Virginia

Site: A remote wooded area of the Yorktown Unit that is seldom visited and has limited interpretive value.

Figure 6.1. Protected earthworks at the Yorktown Unit of Colonial National Historical Park. Eighty-eight year old Loblolly Pine trees dominate the site at this remote location.

Current Management: At present, this area does not receive active maintenance.

Description: The earthworks at this site are in good condition. The forest floor is intact with a two-inch-thick organic layer. The overstory is fully stocked with the canopy primarily composed of a stand of loblolly pine eighty-eight years old.

Site conditions data is as follows:

Basal area/ac:	142 sf
No. Trees/ac:	140
No. Understory Stems/ac:	40
% Ground Cover:	2
% Forest Floor Cover:	98
% Bare Soil:	2
Forest Floor Depth:	2 in

Management Objectives

1. To maintain the fully protected condition of the earthworks in this area, including a full canopy and an intact forest floor.

2. To create a condition over time where there are not large trees rooted on the earthworks, yet where trees rooted off the earthworks provide the overstory cover and litter to maintain the forest floor intact.

Management Program

1. Active management is not necessary for these earthworks, but conditions still need to be monitored.

2. This earthwork and all others like it in the park should be inventoried and mapped, and checked every other year for hazardous conditions.

3. Trees on the earthworks that are already leaning or have low forks or splits constitute an immediate hazard and should be removed.

4. Other trees over 12 inches dbh on the earthworks can be occasionally cut as the budget allows.

Notes: Girdling is not an option in this stand since 58% of the overstory basal area is occupied by loblolly pine.

MANAGEMENT STRATEGY TWO: CREATING VIEWING OPPORTUNITIES THROUGH SELECTIVE FOREST THINNING

Park: Kennesaw Mountain National Battlefield Park, Georgia

Site: Area of earthworks located adjacent to a trail on Little Kennesaw Mountain at the Kennesaw National Battlefield Park.

Figure 6.2. Earthworks on Little Kennesaw Mountain at the Kennesaw National Battlefield Park. Heavy shrub layer precludes viewing, but the earthwork is in a highly protected state.

Current Management: At present, this area does not receive active maintenance.

Description: The site is currently in a protected condition under an 80 year old oak/hickory forest with a dense shrub understory that precludes viewing.

Site conditions data is as follows:

Basal Area/ac:	93 sf
No. of Trees/ac:	90
No. Understory stems/ac:	850
% Ground Cover:	79
% Forest Floor Cover:	100
% Bare Soil:	0
Forest Floor Depth:	1.5 in

Management Objectives

1. To open up a 100 yard long stretch of the earthworks for viewing, by removing the understory layer, essentially creating an intermediately-managed condition.

2. To maintain the protected condition of the earthworks in this area, maintaining an intact forest floor while reducing the basal area per acre of the understory by up to 33square feet.

Management Program

1. As with all earthworks, these should be inventoried and mapped, so that the location and condition is monitored.

2. A section of earthworks that is near the trail and in good viewing condition for a 100 yard length should be identified, and the understory removed along the earthwork and in the viewing area between the trail and earthwork.

3. To reduce future brush cutting needs, as many of the larger understory stumps as possible could be painted with a herbicide approved for cut stump treatment (CST). All of the brush should be preferably chipped and left on the site, or removed.

4. The thinning should first remove all trees hazardous to visitors, then hazard trees on the earthworks. Additional trees that interrupt the view could also be removed, while maintaining the desired residual basal area.

5. The trunks and large branches of cut trees should be removed from the site, and the small branches chipped.

Notes: To reduce sprouting the stumps could be treated with an approved CST herbicide. If herbicide use is not desirable, cutting should be done from May through July. During these months tree root reserves are lowest and subsequent sprouting is reduced, though not eliminated. Maximum sprouting occurs when cutting is done during the dormant season.

MANAGEMENT STRATEGY THREE: ENHANCING EARTHWORKS LEGIBILITY THROUGH SELECTIVE FOREST THINNING

Park: Petersburg National Battlefield Park, Virginia

Site: Fort Conahey. Point feature, extensive berms up to 3-4 meters high enclosing Fort. Partially wooded on both berms and floor of fort. Moderately interpreted.

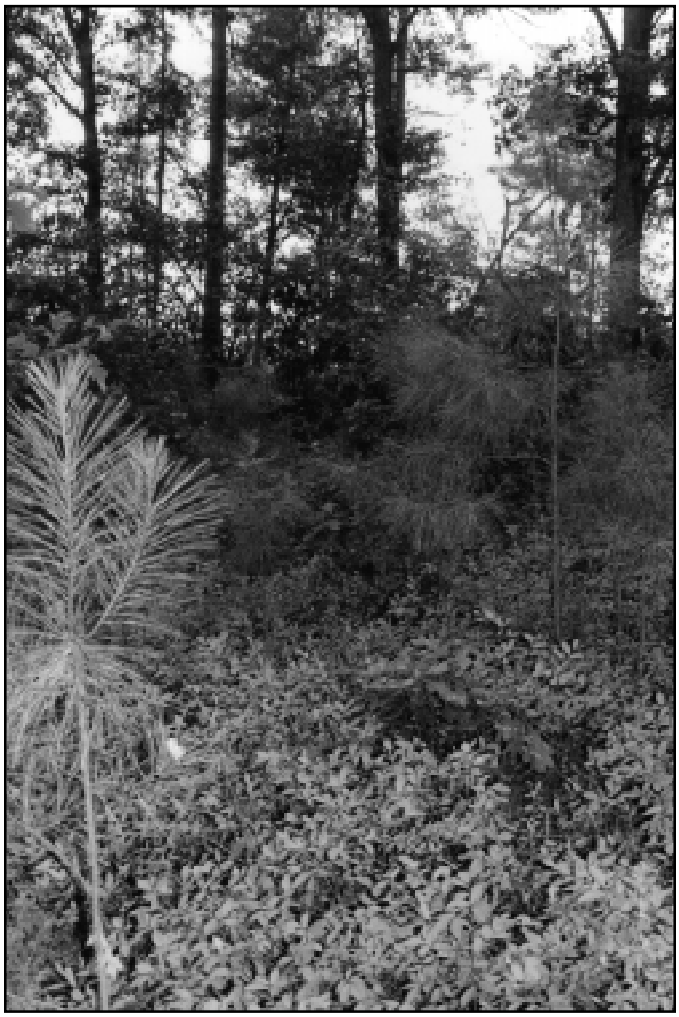

Figure 6.3 . A mix of shrubs, young trees, and herbaceous vegetation on Fort Conahey, Petersburg National Battlefield Park, Virginia.

Current Management: Selective clearing has been done, creating an open woodland .

Description: Dry-mesic open forest, with partial canopy cover including White Oak, Southern Red Oak, and Sweetgum. Loblolly Pines in canopy immediately surrounding. The middlestory is predominantly 6'-8' tall species and Loblolly Pines also, Flowering Dogwood, Sassafras, Amelanchier and Hickory species. Groundlayer is comprised of abundant Lowbush Blueberries and substantial leaf litter, with some Greenbrier, Muscadine Grape, and Spotted Wintergreen. Almost no exotic species are present.

Management Objectives

1. To make earthwork more legible.
2. To retain some vegetation for visual screening and protection from adjacent newly-cleared commercial area.
3. To retain and enhance existing native shrub and vine cover less than 2' tall.
4. To eliminate major trees from slopes of the Fort in the long run in order to eliminate potential tip-ups.

Management Program

1. Remove canopy trees actually growing on berms. Leave mature canopy trees inside and outside Fort.
2. Remove all sapling-size trees from berm.
3. Remove 90% of the saplings inside the Fort, over a three-year period, with 30% being removed each year. The remaining 10% should be Oak and Hickory species, to provide canopy replacement over time.
4. Annually, cut shrubs and seedling trees to 18"-24".
5. If Japanese Honeysuckle invades, it should be pulled at the earliest practicable date. Alternatively, cut the honeysuckle, and paint stumps with a 20% glyphosate solution, preferably in September.

Notes: The expected outcome of these practices is a gradually-increasing light level inside the Fort, increasing the density and vigor of the blueberry shrubs, and stimulating growth of the groundcovering grape and greenbrier vines. The thinning of saplings on an incremental basis is proposed, so that a drastic change in light level does not occur at one time, which could lead to invasion by unwanted species, rather than a gradual increase of the desirable species already present.

The management strategy described above would generally be applicable to Fort Fisher, with the following variations:

Retain existing pine canopy between roadway and the Fort. Remove pines inside Fort and on earthwork (they presently constitute only about 10% of the canopy).

Carry out the sapling thinning, and annual 18"-24" cutting of groundlayer shrubs and seedlings, as in the Fort Conahey management strategy.

MANAGEMENT STRATEGY FOUR: MAINTAINING AN OPEN UNDERSTORY TO ALLOW VIEWING OF EARTHWORKS

Park: Kennasaw Mountain National Battlefield Park, Georgia

Site: Area of low earthwork structures at Cheatham Hill. The site is currently under forest cover, and receives moderate visitation from a nearby trail.

Figure 6.4 . Intermediately managed earthworks at Cheatham Hill at Kennesaw National Battlefield Park, Georgia.

Current Management: The area receives annual weed whacking, above the level of the low groundcover vegetation.

Description: The site is covered by a canopy composed primarily of oak and hickory trees with an open understory. The stand is approximately 95 years old. The groundcover includes periwinkle, Japanese honeysuckle, Virginia creeper, and muscadine grape.

Site conditions data is as follows:

Basal Area/ac:	94
No. of trees/ac:	80
No. Understory Stems/ac:	0
0/Ground Cover:	73
% Forest Floor Cover:	100
% Bare Soil:	0
Forest Floor Depth:	3 in

Management Objectives

1. To retain the area as it is, with open conditions in the understory.
2. To retain canopy trees unless they pose a threat to visitors or earthworks.
3. To retain the forest floor and groundcover layers intact.

Management Program

1. The site should be monitored annually for hazardous trees, and such trees should be removed when necessary.
2. Understory cutting, using brush cutters or weed whackers should be conducted annually or biennially.
3. Understory cutting should not damage the forest floor or groundcover species.

Notes: This area is already in the management category for which it is suited. Since the area is carrying 94 square feet of basal area per acre, additional removal of overstory trees which pose a threat to visitors or resources would pose no problems. The same protocol for tree removal described earlier would suffice at this site. The current absence of a shrub understory is a result of annual or biennial cutting. Ground cover is prolific on this site. As long as the forest floor is intact, the ground cover plays no significant hydrologic role. However, it does dissuade visitors from walking on the earthworks. This is desirable on sites such as this that have direct trail access.

MANAGEMENT STRATEGY FIVE: ESTABLISHING NATIVE HERBACEOUS COVER IN A SEMI-SHADED ENVIRONMENT

Park: Kennesaw Mountain National Battlefield Park, Georgia

Site: Small circular earthwork at "Camouflaged Cannons" Interpretive Station, Cheatham Hill. Berms 1.5 meters high surrounding flat interior, 20 meters across. Partly shaded by adjacent forest.

Figure 6.5. Herbaceous vegetation and leaf litter covering small earthwork along Cheatham Hill Trail at Kennesaw Mountain National Battlefield Park, Georgia..

Current Management: Interior "floor" is kept in a short-mown turf condition; earthwork berms are mowed infrequently, probably annually, to 2"-4" height.

Description: While the earthwork itself was cleared of trees within the past six to eight years (estimate by Dennis Kelley, formerly on staff), the site and site vegetation are influenced by the presence of shade from oak-dogwood forests immediately surrounding two sides of the earthwork, and tall pines 50' away. Vegetation on the earthwork is dominated by Tall Fescue, but there is a high occurrence of Poison Ivy (50% frequency); Blackberry (40%); Japanese Honeysuckle (40%); Virginia Creeper (40%); and Pine seedlings (50%).

These frequencies were based on ten representative one-square-meter quadrats in which vegetation was recorded. Other measures obtained in this sampling procedure were:

Average number of species per plot 6.8
Average % herbaceous cover 49.2%
Average % woody plant cover 11.5%
Average % litter (leaves, clippings) 35.8%
Average % bare soil 3.5%

Management Objectives

1. To establish >80% vegetative cover by native species that are tolerant of the semi-shaded environment .

2. To diminish or eradicate exotic species, especially the Tall Fescue and Japanese Honeysuckle.

Management Program

1. Eradicate Tall Fescue and Honeysuckle with early spring application of glyphosate herbicide (e.g., in March-April).

2. Also in April, mow vegetation that has been treated with herbicide to 1"; rake surface, and seed with a mix to include:

   Carex pennsylvanica (Pennsylvania Sedge)
   Chamaecrista fasciculata (Partridge Pea)
   Elymus virginicus (Virginia Wildrye)
   Parthenocissus quinquefolia (Virginia Creeper)
   Potentilla canadensis (Five-finger Cinquefoil)
   Tridens flavus (Purple Top)

   Plant Bracken Fern (*Pteridium aquilinum*) roots on 5' spacing over the earthwork.

3. Mow to a height of 6" each year in April-May. If Japanese Honeysuckle recurs, it should be treated locally with glyphosate application before mowing.

Note: This management strategy is experimental in nature, in that it is designed for an uncanopied but semi-shaded environment. There are grasses included, but these are species that are tolerant of more shade than the *Andropogons*. The other species proposed here are semi-shade tolerant to varying degrees.

MANAGEMENT STRATEGY SIX: DEVELOPING MIXED NATIVE GRASSES ON A SITE WITH INVADING WOODY SPECIES

Park: Richmond National Battlefield Park, Virginia

Site: Fort Harrison, Traverse #1

Figure 6.6. Woody species invading a planting of little bluestem on Traverse #1 of Fort Harrison, Richmond National Battlefield Park, Virginia.

Current Management: Major linear earthwork, 3-4 meters high, 10 meters wide. Full sun exposure. Surrounding area mown as turf. Heavily visited and interpreted.

This site utilized the recommendations of the *1989 Manual*, with an initial planting of *Schizachyrium scoparium* (Little Bluestem) plugs in the Spring of 1990. For the next three years, woody invasive species on the earthwork were pulled or cut on an annual basis. This was followed, however, by a hands-off policy until the Spring of 1995, when a prescribed burn was conducted on approximately one-half this earthwork on April 20, with the other half left unburned for comparison. Several changes in park staff occurred between 1991 and 1995, and some lack of management continuity occurred.

Description: During the four years that elapsed between the 1992 and the August 1995 assessment, woody species gained prominence visually and ecologically on this earthwork. These include native species (Sweetgum, Post Oak, Shiny Sumac, Blackberry and Loblolly Pine) and the exotic, Japanese Honeysuckle. Both the burned and unburned portions of the earthwork

have an uneven, chaotic appearance. This is due in large part to the presence of woody species. The average amount of aerial cover provided by herbaceous plants (mainly Little Bluestem) in ten one-square-meter plots was approximately 20% in both the burned and unburned plots. Woody plant cover was substantial in both burned and unburned plots; in the burned plots, however, it was generally under 3' tall; in the unburned, it ranged up to 10-15' tall. There was almost no litter in burned plots, and up to 30% bare soil. (Note: the percentage of bare soil should diminish as successive burns eradicate woody plants and stimulate grass cover). Unburned plots had a general litter cover on the ground, and less than 2% bare soil. Average species diversity on burned plots was 5.7 per square meter; it was 4.2 on unburned plots. Japanese Honeysuckle occurred in 60% of burned plots; 90% of unburned.

Visually, the burned plots were less chaotic than the unburned, since the woody plants generally had been set back and were approximately the same height as the grasses present. Still the color and texture of woody plants contrast sharply with those of the grasses.

Management Objectives

1. To increase the cover provided by herbaceous plants to greater than 70%, with the majority provided by native grasses.
2. To reduce the presence of woody species to less than 10% cover.
3. To eradicate Japanese Honeysuckle.

Management Program

1. Cut woody vegetation (including Japanese Honeysuckle) to the ground in April or September, and paint the stumps with a 20% glyphosate solution. Remove the clipped material.
2. Scarify any open soil with a rake. Seed these areas with a seed mix containing as many of the following species as are obtainable:

   Elymus virginicus (Virginia Wildrye)
   Bouteloua curtipendula (Sideoats Grama)
   Andropogon ternarius (Splitbeard Bluestem)
   Andropogon virginicus (Broomsedge)
   Tridens flavus (Purpletop)
   Eragrostis spectabilis (Purple Lovegrass)
   Aristida purpurascens (Arrowfeather Threeawn)
   Chamaecrista fasciculata (Partridge Pea)

   Seeding rate of all species combined should be approximately 20 lbs/acre; or for estimating purposes, 1/2 lb. per 100 square feet. After seeding into scarified surface, rake again, and compact soil over seed.

As an alternative to the above seeding treatment, mulch site in October with native hay obtained from Fredericksburg (Prospect Hill field, or Widow Tapp's field) or Petersburg (field adjacent to Battery 5 at Visitor Center). Most of the above species are present in those stands. Areas to be mulched should be scarified before mulching, to provide "niches" for seed.

3. Repeat woody plant suppression method second year if necessary, i.e., cut and paint stumps.

4. Monitor herbaceous vegetation; clip once in early summer at 6"; then permit it to flower and produce seed.

5. Burn in March-April of second growing season, *or* clip to 6" height.

Notes: Once a 70%+ herbaceous cover of mixed grass species is established, and an annual spring burn or 6" mowing is done, woody species should diminish. Honeysuckle might persist, however. An alternate treatment for its eradication could be to spray locally a glyphosate herbicide on it in early spring before native grasses begin growth.

The above treatment would be appropriate for other Traverses in Fort Harrison open field.

MANAGEMENT STRATEGY SEVEN: ESTABLISHING IMMEDIATE, LONG-TERM HERBACEOUS COVER

Park: Stones River National Battlefield, Tennessee

***Site*:** Redoubt Brannan. Major earthwork, with 5-meter high enclosure around flat interior; approximately 2 acres, cleared. Not interpreted to date.

Figure 6.7. View toward the southwest along the traverse of Redoubt Brannan, Stones River National Battlefield.

Current Management: After being almost totally covered by invasive species for many years, including a dense stand of Kudzu (*Pueraria lobata*), the entire site was treated with herbicide in the fall of 1995 and cleared of vegetation. In late fall, site was seeded with a combination that included annual rye grasses, Virginia Wildrye, Partridge Pea, and Crimson Clover, to provide cover in 1996. It is expected that an additional herbicide treatment will be necessary in the summer of 1996, to kill any recurrent Kudzu. Groundhog activity has created major impacts in places.

Management Objectives

1. To establish a predominantly herbaceous cover on an essentially barren site with steep slopes and a high erosion potential.
2. To provide immediate cover, as well as a long-term cover.
3. To reduce or eliminate groundhogs' impact on site.

Management Program

1. In late spring of 1996, spray any re-emerging Kudzu foliage with Garlon 3, or equivalent selective herbicide which kills only broad-leafed plants, leaving annual ryegrass and Virginia Wildrye to provide cover.

2. *Either* hydroseed the earthwork in late May, and apply a straw mulch, *or* seed in October, with a mix to include as many of the following species as are available:

   Andropogon ternarius (Splitbeard Bluestem)
   Andropogon virginicus (Broomsedge)
   Aristida purpurascens (Arrowfeather Threeawn)
   Bouteloua curtipendula (Sideoats Grama)
   Elymus virginicus (Virginia Wildrye)
   Eragrostis spectabilis (Purple Lovegrass)
   Panicum virgatum (Switchgrass)
   Schizachyrium scoparium (Little Bluestem)
   Sorghastrum nutans (Indiangrass)
   Tridens flavus (Purpletop)
   Chamaecrista fasiculata (Partridge Pea)

   Seed at a rate of 20 lbs/Acre, Pure Live Seed. Mulch with clean oat straw, or if available, baled native hay, harvested from a local Broomsedge/Little Bluestem field.

3. Clip once during the first growing season, to a height of 6", if equipment is available.

4. In Fall of 1996 or Spring of 1997, apply a broadleaf-selective herbicide to any recurrent Kudzu or privet plants.

5. In March-April of 1998, conduct a prescribed burn on the Redoubt *or* clip grasses to 6".

6. Throughout this period, trap and relocate groundhogs and repair earthwork, filling holes with soil mounded up by groundhogs.

Notes: Grass mix could be supplemented with easily-grown forbs (e.g., *Coreopsis lanceolata* and *Rudbeckia hirta*), for some flowering. Their presence, however, will complicate removal of other broadleafed plants with a selective herbicide.

MANAGEMENT STRATEGY EIGHT: ENRICHING NATIVE SPECIES

Park: Petersburg National Battlefield Park, Virginia

Site: Battery 5, at Visitor Center. Berms 3-4 meters high, circular areas 35 meters across, full sun. Heavily visisted and interpreted.

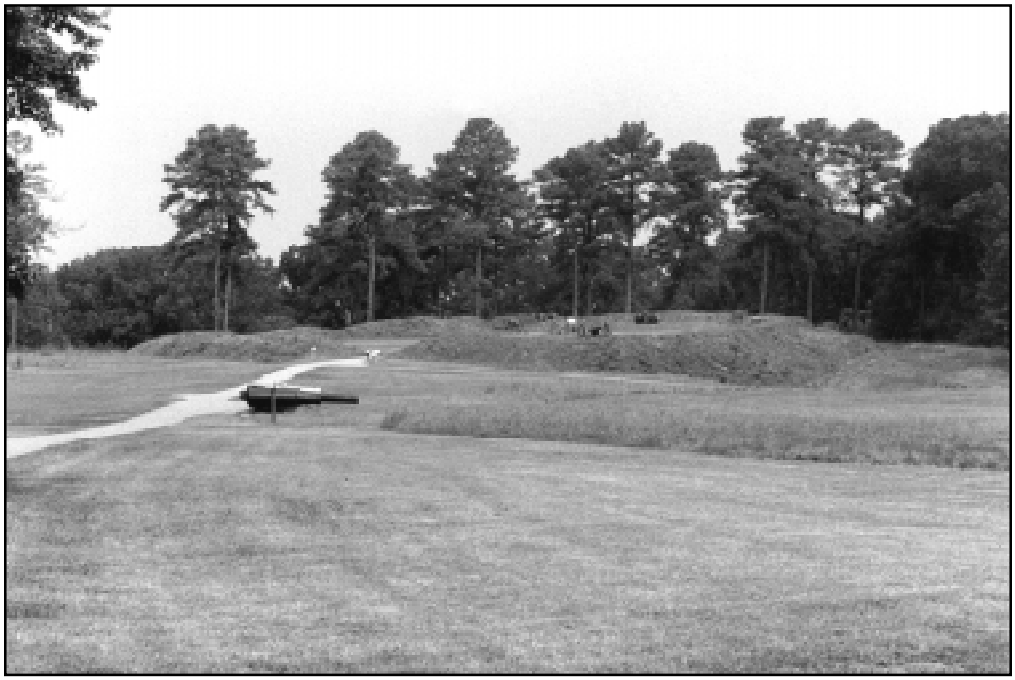

Figure 6.8. Mown turf shown on and around Battery Five, Petersburg National Battlefield Park, Virginia.

Current Management: Mowing, every three-four weeks during the growing season with Dew-Eze self-levelling mower, to a height of 4"-5".

Description: Variable cover is provided by a mix of native grasses, low-growing forbs, shrubs and vines, early-successional tree seedlings, and litter consisting mainly of clippings. Cover is generally greater on the outside slopes than on the inside slopes. Ten one-square-meter quadrats distributed evenly around the outside of berm, midslope, revealed the following conditions:

Average number of species per plot 7.5
Average % herbaceous cover 31.5%
Average % woody plant cover 17.7%
Average % litter (leaves and stems) 42.8%
Average % bare soil 8.0%

Japanese Honeysuckle occurred in 70% of the plots, Blackberry in 40%, and Trumpet Creeper in 30%, along with several tree species in seedling sizes.

Management Objectives (Alternative #1)

1. To increase living herbaceous cover to >80% aerial cover, predominantly with native grasses.
2. To reduce woody plant cover to less than 10%, with special efforts to suppress Sweetgum, Japanese Honeysuckle, Blackberry and Trumpet Creeper.
3. To permit native grasses to produce flowers and seeds.

Management Program

1. During April or September, cut the "target" woody species (Sweetgum, Japanese Honeysuckle, Blackberry, and Trumpet Creeper), remove the clippings, and paint stumps with a 20% glyphosate solution in water.
2. Following completion of the above treatment, hand-scarify bare areas with a rake, and hand-broadcast them with a seed mix to include as many of the following species as are obtainable:

   Elymus virginicus (Virginia Wildrye)
   Bouteloua curtipendula (Sideoats Grama)
   Andropogon ternarius (Splitbeard Bluestem)
   Aristida purpurascens (Arrowfeather Threeawn)
   Tridens flavus (Purpletop)
   Chamaecrista fasciculata (Partridge Pea)

   or in October, mow the adjacent field to a height of 6", and mulch the earthwork with the seed-bearing hay.
3. Reduce mowing frequency on earthwork to one monthly mowing (at maximum cutting height for Dew-Eze mower -5") in April, May, and June, permitting warm-season grasses to flower and produce seed after that date.
4. Repeat the woody plant suppression program (cutting, then herbiciding the stumps) the following September or April until woody cover is reduced to less than 10%.

Notes: More frequent mowing on the "floor" in the interior of the Battery, and in a 2- to 3-ft. wide zone along the sidewalk leading to Battery 5 from the Visitor Center, may be useful to provide a more cared-for appearance, and to make the earthwork more legible.

Management Objectives (Alternative #2)

1. To use this site as an experiment of the ability of native warm-season grasses to invade the berms of the earthwork under current management practices.

2. To monitor the results, i.e. change in cover, on an annual basis, to determine rate of species change under present management program.

Management Program

1. Continue the approximately monthly mowing schedule with Dew-Eze self-levelling mower.

2. Establish 20 permanent 1-meter square quadrats, equally spaced on midslope of berm. Record species composition, and percentages of cover in following categories: woody plants, herbaceous plants, litter, and bare soil. Do monitoring inventory annually in August-September.

MANAGEMENT STRATEGY NINE: CONVERTING EXOTIC TURF TO NATIVE TALLGRASS COVER

Park: Fredericksburg and Spotsylvania County Battlefields Memorial National Military Park, Virginia

Site: Prospect Hill, low, linear earthwork, parallel with Lee Drive. Low, linear earthwork, only 1-1.5 meters high; 100-meters long. Heavily visited and interpreted.

Figure 6.9. A mix of mown lawn and mixed tall grasses along Prospect Hill, Fredericksburg-Spotsylvania NMP, Virginia.

Current Management: Bi-weekly mowing to 2"$\pm$, maintaining a lawn-like character

Description: Well-drained to droughty condition, with a diversity of low herbaceous plants, predominantly native grasses with some rosette-forming plants (e.g., *Antennaria* and *Plantago* spp), and creeping forms (e.g., *Potentilla canadensis*). No planting programs have been used.

In sampling ten representative one-meter-square plots along the earthwork, the following data were obtained:

Average number of species per plot 9.6
Average % herbaceous cover 68%
Average % lichen & moss cover 11%
Average % litter/clippings 11%
Average % bare soil or exposed rock 10%

Visually, the frequent mowing has created a well-manicured look, and the earthwork form is quite legible. The frequent mowing has also suppressed any woody species. During the August 1995 drought, however, there was a brown, parched appearance.

Management Objectives

1. To perpetuate a diverse cover of herbaceous plants, with little or no presence of woody species.

2. To reduce the energy and labor demanded by the bi-weekly short-mowing.

3. To increase the live, vegetational cover to at least 80% cover during the growing season for enhanced erosion control.

4. To discourage visitor trampling on the earthworks.

Management Program

1. Change mowing height to 6".

2. Reduce mowing frequency to once a month, in April, May, June and July. Permit plants to produce flowers and seeds after the July mowing. Do not mow again until seeds have ripened, e.g., November, *or* wait until February/March for next mowing. Leave shredded clippings on site.

3. Once every two or three years, substitute a controlled burn for the late fall or early-spring mowing.

4. After four or five years, consider eliminating the monthly summer mowings and conducting only an annual mowing or controlled burn in early spring (before April 1), as a management practice.

Notes: The hillside between Lee Drive and the railroad presently has a good cover of herbaceous species, but with encroachment by shrubs and trees, but a minimum of exotic species. Periodically, e.g., every two to five years, conduct a spring burn (e.g., March 1-April 1) on this hillside, with a 10'-12'-wide firebreak mowed around the area to be burned, and one or two 15'-20' mowed breaks running parallel with the contours to provide erosion control in the period before new growth begins.

The fire should stimulate flowering and seed production of many species. In October of burn years, the field may be mowed to a 6" height, with the hay baled when it is sufficiently dry. the hay would constitute an excellent native seed-bearing mulch to apply to other sites where an increased cover of native grasses is desirable. Alternatively, seed may be collected by hand, possibly by volunteers or student interns, for use on earthworks sites.

Virginia Fish and Game Department, and local fire departments are potential cooperators in this effort.

MANAGEMENT STRATEGY TEN: ENHANCING LEGIBILITY OF FORTIFICATIONS THROUGH PLANTING AND MOWING

Park: Ninety-six National Historic Site, South Carolina

Site: Star Fort. 2 to 3-meter high berms in the form of a star, with flat interior; approximately 35 meters wide in full sun.

Figure 6.10. Slopes of the Star Fort after reseeding (September 1995) at Ninety-six National Historic Site, South Carolina.

Current Management: In spring of 1994, a warm-season grass mix was seeded into the mown turfgrass cover on the berms of the fort, which had been treated with glyphosate herbicide. Berms were left unmown during the summer of 1994. The floor of the interior of the Fort was maintained as mown turf. During 1995, berms were mowed three times to a height of 4"-6" with a sickle bar mower, in June, July, and August. The interior of the Fort continued to be mowed to a 2" height on a frequent basis.

Description: On September 9, 1996, the Star Fort berms had a consistent 6" cover of grasses which contrasted visibly with the turf-grass interior. With the benefit of late summer rains, the cover was a consistent green color.

Twenty one-square-meter quadrats were laid out to provide a representative sample of the berm vegetation, with ten plots placed on the inner slopes and ten on the outer slopes at even spacing around the perimeter. Grass species identification was complicated by the fact that the mowing had eliminated any flowering or seed stalks. Hence, not all grasses were positively identified.

Data from the sampling procedure, with that limitation, yielded the following:

Average number of species per plot 4.1
Average % herbaceous cover 82.3%
(almost all of which was grasses)
Average % woody plant cover 0.0%
Average % litter (clippings mainly) 15.6%
Average % bare soil 2.1%

The grass which occurred at the greatest frequency was the annual, Crabgrass (*Digitaria sanguinalis*), which had a 100% frequency. In contrast, *Andropogon* species occurred in only 35% of the twenty plots. A *Paspalum* grass occurred abundantly (80%). The legume, Partridge Pea (*Chamaecrista fasciculate*), which had been included in the 1994 seeding, appeared in 30% of the plots.

In summary, the cover was excellent; the aesthetic effect was pleasing; the earthwork form was highly legible. Yet, the naturally-invading grasses were more important than the species that had been planted seventeen months earlier. The invasion of Crabgrass is a common phenomenon in the Southeastern Piedmont. Being an annual, it typically performs an important soil stabilization role in the early years of oldfield succession; it typically is followed by warm-season native perennials, and especially Broomsedge (*Andropogon virginicus*).

Management Objectives

1. To maintain a herbaceous cover of greater than 80%
2. To increase the percentage of perennial warm-season grasses on the Fort berms.
3. To enhance legibility of Fort through vegetation contrast between the berm and the floor of the Fort.
4. To continue to suppress woody species on the berm.

Management Program

1. Mow berms at 6" or greater height in May, June, and July, permitting grasses to flower and produce seed after that date.
2. In March of 1997, burn the vegetation on the Fort. After the burn, scarify any bare areas, and seed with a mix of as many of the following species as are available:

Andropogon ternarius (Splitbeard Bluestem)
Andropogon virginicus (Broomsedge)
Aristida purpurascens (Arrowfeather Threeawn)
Eragrostis spectabilis (Purple Lovegrass)
Tridens flavus (Purpletop)

Rake seeds in (at a rate of 1/2 lb. seed per 100 square feet of planting area).

Alternative: If burning is not practicable in the Spring of 1997, mow at a 6" height in March; seed bare spots as above.

Notes: For the breastworks and adjacent fields, a similar mowing (and/or burning) schedule may be followed. If a good warm-season perennial grass cover is established by 1997, consider reducing mowing to one mowing per year between March and May, with a burn in March replacing the annual mowing every two or three years.