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Philadelphia, Pennsylvania

Vegetation Classification and Mapping of Valley Forge National Historical Park

Technical Report NPS/NER/NRTR--2005/028

Dry Oak–Heath Forest at Valley Forge National Historical Park
Photograph by: Greg Podniesinski, Pennsylvania Science Office of The Nature Conservancy

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Executive Summary

The vegetation of Valley Forge National Historical Park was mapped during 2000 and 2001 as part of the U.S. Geological Survey (USGS) / National Park Service (NPS) Vegetation Mapping Program. The goal of the mapping effort was to produce an up-to-date digital geospatial vegetation database for the park. New aerial photography was obtained for the park in spring 1999 by Air Photographics, Inc., and converted to a digital orthophoto mosaic image by the North Carolina State University Center for Earth Observation (CEO) in winter 1999-2000. CEO interpreted the photography and developed a digital formation-level vegetation map. Pennsylvania Science Office of The Nature Conservancy (PSO-TNC) sampled 80 vegetation classification plots during the summer of 2000. Data analysis identified eight natural vegetation types and 13 anthropogenic types (ranging from managed grasslands to hard infrastructure such as transportation corridors). Vegetation analysis information was used by CEO to reclassify formation-level polygons to develop an association-level vegetation map. Accuracy assessment of the association-level map was performed by PSO-TNC using 308 sampling points distributed across all polygon types according to vegetation mapping program guidelines. Overall accuracy was 82.8%, adjusted accuracy (Kappa index, to account for correct classifications occurring by chance), was 81.2% ± 3.8% (90% C.I.). Approximately 50% of the mapping errors were associated with four pairs of associations or cover types: Cropland and Grassland (tall grass), Dry Oak Forest and Tuliptree – Oak Forest, Grassland (mowed) and Grassland (tall grass), and Riverine Floodplain Forest and Silver Maple Floodplain Forest. NatureServe provided crosswalk information between park vegetation types and National Vegetation Classification System (NVCS) association types as well as association descriptions. The resulting vegetation mapping product represents current vegetation types within the park and is consistent with the standards of the USGS/NPS Vegetation Mapping Program.

Natural vegetation types that are relatively undisturbed were easily crosswalked to the corresponding NVCS association. Some natural vegetation types characterized by past anthropogenic disturbance or landuse, especially the Northeastern Modified Successional Forest, initially had no NVCS equivalent. An NVCS association has been developed for the Northeastern Modified Successional Forest, as it has been found in all other national parks in Pennsylvania. The Successional Old Field / Shrubland type remains a local type with no NVCS crosswalk. Anthropogenic vegetation types were crosswalked to the NVCS where possible, usually as cultivated or planted vegetation types.

The most common natural vegetation types were Northeastern Modified Successional Forest (190 ha, 11.4% of mapped area) and Tuliptree - Oak Forest (110 ha, 6.8% of mapped area). The least common natural vegetation type was the Chestnut Oak – Black Birch Talus Slope (0.39 ha, <0.01% of mapped area). The most common managed or planted vegetation types were Grassland (mowed and tall grass combined) (538 ha, 32.3% of the mapped area) and White Pine Plantation (155 ha, 9.3% of the mapped area). None of the vegetation types described at Valley Forge National Historical Park are rare in Pennsylvania.

Natural vegetation quality within the park ranged from poor to fair. In general, heavy deer browse has created a depauperate herb and shrub layer in most vegetation types and reduced or eliminated forest regeneration. Exotic plant species are a significant problem in recently

disturbed area, successional forests, and old fields, as well as mesic forest types (e.g., Tuliptree – Oak Forests and floodplain forests).

Introduction

Purpose

The purpose of the vegetation mapping effort at Valley Forge National Historical Park is two-fold. First, a vegetation classification is developed to identify the types of vegetation within the park. The collection of quantitative vegetation data allows the development of descriptions for each type and the development of a vegetation key. The vegetation descriptions and key allow vegetation mappers, as well as park resource managers, to identify various vegetation types in the field. The second purpose of the vegetation mapping effort is the production of a digital vegetation map. Using new aerial photography and information gathered for vegetation classification, photointerpreters develop a digital map showing the distribution and extent of each vegetation type within the park. The accuracy of the vegetation mapping is assessed and the map is corrected as appropriate. The resulting digital map provides park managers with a spatial data layer that can be used in assessing park resources as well as planning and management needs.

General Background

A detailed description and map of the vegetation of Valley Forge National Historical Park was developed using the National Vegetation Classification System developed by The Nature Conservancy and NatureServe (formerly the Association for Biodiversity Information) in conjunction with the Federal Geographic Data Committee and the Ecological Society of America Vegetation Subcommittee. The final product, a digital map with descriptions of the component vegetation types and all relating metadata files, provides vegetation information in a format that can be useful for the various operations of the National Park Service, including natural resource managers, planners, acquisition specialists, and biologists. Similar products are currently being applied at other national parks elsewhere across the country. The product was also developed to provide the natural resource managers with baseline information about the site. Current information exists about the flora of Valley Forge National Historical Park (e.g. Newbold 1993-1996), stand data on forest plots (Bowersox and Larrick 1999), and locations of rare species (PNDI database), but a more comprehensive and up-to-date map and description of the park's vegetation are needed. This report also provides a means of comparing and evaluating the park's resources in the context of a regional and national vegetation classification. Information on community composition and rarity can inform decisions on the management of particular areas and natural communities within the park. Such information is critical to ensure the persistence of the native plant and animal species in the park in light of human use, invasion of nonnative plant species, deer browse impacts, and other disturbances to the habitats.

Vegetation Classification System

The Nature Conservancy, in partnership with the network of Natural Heritage Programs, has developed a classification of vegetation of the United States (Grossman et al. 1998). This system has been adopted by the Federal Geographic Data Committee and the Ecological Society of America Vegetation Subcommittee as the national vegetation mapping standard, the National Vegetation Classification System (NVCS). Although the two systems (Grossman et al. 1998 and

the NVCS) are nearly identical, The Nature Conservancy continues to refine the classification through an active review process with state Natural Heritage Programs and academics. The responsibility of the NVCS, including review and revision, is now under jurisdiction of NatureServe, with central offices in Arlington, VA. Portions of the classification are now available online at www.natureserve.org (NatureServe 2001).

The classification system is hierarchical with the upper levels defined by vegetation physiognomy. This level is the formation and "represents vegetation types that share a definite physiognomy or structure within broadly defined environmental factors, relative landscape positions, or hydrologic regimes" (Grossman et al. 1998). Physiognomy is the characteristic architecture and life form found within a vegetation type. Nested within formations are alliances. An alliance is a physiognomically uniform group of plant associations sharing one or more dominant or diagnostic species usually found in the uppermost stratum of the vegetation. Alliance names typically include the dominant or diagnostic species. Alliances are generally more wide-ranging geographically than are associations, although many monotypic alliances have been classified.

The basic unit of the classification system, the association, is roughly equivalent in scale to the plant association of European phytosociologists. The association is a unit of vegetation that is more or less homogeneous in composition and structure and occurs on uniform habitat. Although associations are defined by the plants that comprise them, they are, in fact, communities of all the component organisms of that association including animals, protozoans, bacteria, and fungi. Associations are classified from a national perspective and are assigned global rarity ranks, as well as ranking specifications to be applied to individual occurrences of associations across their range.

Vegetation mapping at Valley Forge National Historical Park was done at the association level, with all of the alliances being monotypic (one association per alliance). A map of associations occurring at a site can provide information about the abundance and distribution of each type and the significance of the individual occurrences, as well as providing surrogate information about the location and abundance of individual species characteristic of the association within the park.

An example of the NVCS hierarchy for the Dry Oak Heath association found in the park is as follows.

Formation: Lowland or submontane broad-leaved cold-deciduous forest
Alliance: *Quercus prinus* – (*Quercus coccinea, Quercus velutina*) Forest Alliance
Association: *Quercus prinus – Quercus* (*rubra, velutina*) / *Vaccinium angustifolium* Forest.

Project Area

General Description

Valley Forge National Historical Park is located in Chester and Montgomery counties, Pennsylvania, within the Northern Appalachian Piedmont ecological region (Keys and Carpenter 1995) (Figure 1). The 1,416 ha (3,500 ac) park is now an oasis of fields and forests surrounded by residential development and transportation corridors.

The Valley Forge National Historical Park, established by an Act of Congress in 1976, is an important part of the national system of parks, monuments, battlefields, recreation areas, and other natural and cultural resources. The park preserves cultural and natural resources associated with the winter encampment of General George Washington and the Continental Army in perpetuity and makes this valuable part of America's heritage available to over 2 million visitors each year for their experience, enjoyment, understanding, and appreciation.

Established as the first Pennsylvania state park in 1893, Valley Forge State Park was identified as having national significance and was incorporated into the National Park Service in 1976. The National Park Service is charged with the responsibility to manage natural resources within the park with emphasis on the restoration and maintenance of the historic scene. Natural resource management within the park requires an accurate representation of current park resources, especially with regards to the distribution of vegetation types. In support of this goal, the Service's Inventory and Monitoring Program has instituted a vegetation mapping program for all 270 national parks with significant natural resources, including Valley Forge National Historical Park. This vegetation mapping effort provides a baseline for the distribution of vegetation types within the park and informs natural resource managers when planning management activites within the park (e.g., habitat restoration, forest and trail management).

Geology

The vegetation within the park is influenced by many factors, especially the underlying geology, the Schuylkill River, and human activity (past and present). The park is underlain by four major rock formations (Pennsylvania Bureau of Topographic and Geographic Survey 2001) (Figure 2). The Triassic Age Stockton Formation (sandstone, siltstone, and mudstone) covers the entire portion of the park north of the Schuylkill River and most of the park between Route 23 and the south side of the river. The topography associated with the Stockton Formation is that of low rolling hills north of the river and a generally north-facing slope south of the river. Along the west side of the park, Mount Misery consists of the Cambrian Age Chickies Formation (primarily quartzite and quartz schist), a very hard, erosion-resistant rock. Nearby hills associated with Mount Joy and Wayne's Woods are associated with slightly younger Cambrian Age Antietam and Harpers (undivided) formations (composed of quartzite, schist, and phyllite) which are also fairly erosion resistant.

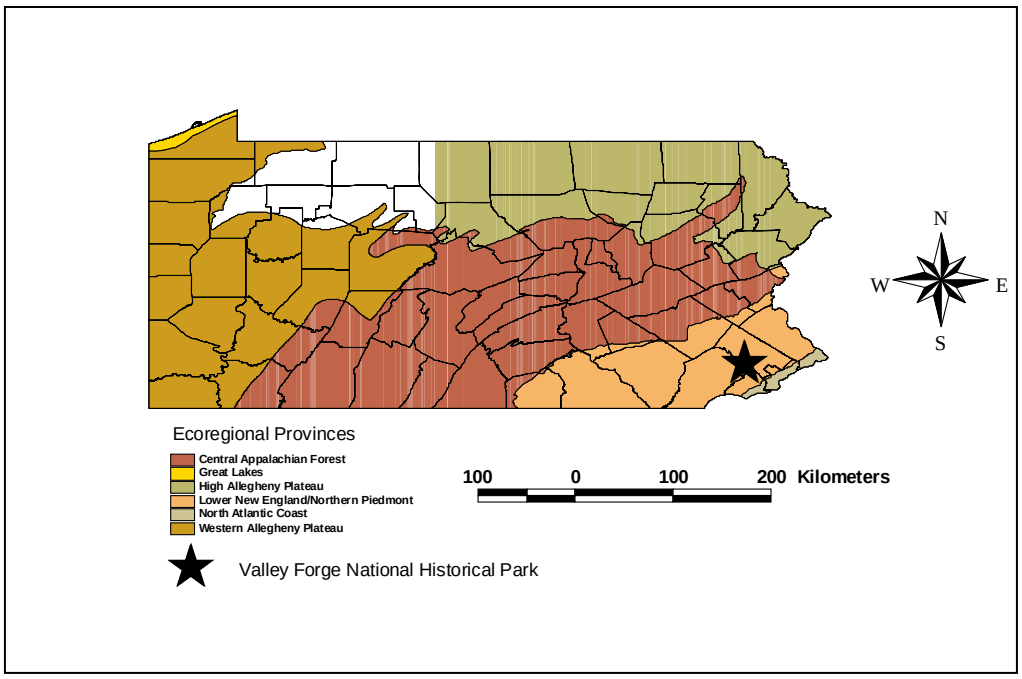

Figure 1. Location of Valley Forge National Historical Park in relation to The Nature Conservancy's ecoregional provinces within Pennsylvania. (Ecoregional province data derived from "Terrestrial and Marine Ecoregions of the United States," The Nature Conservancy, Arlington, VA, 2004.)

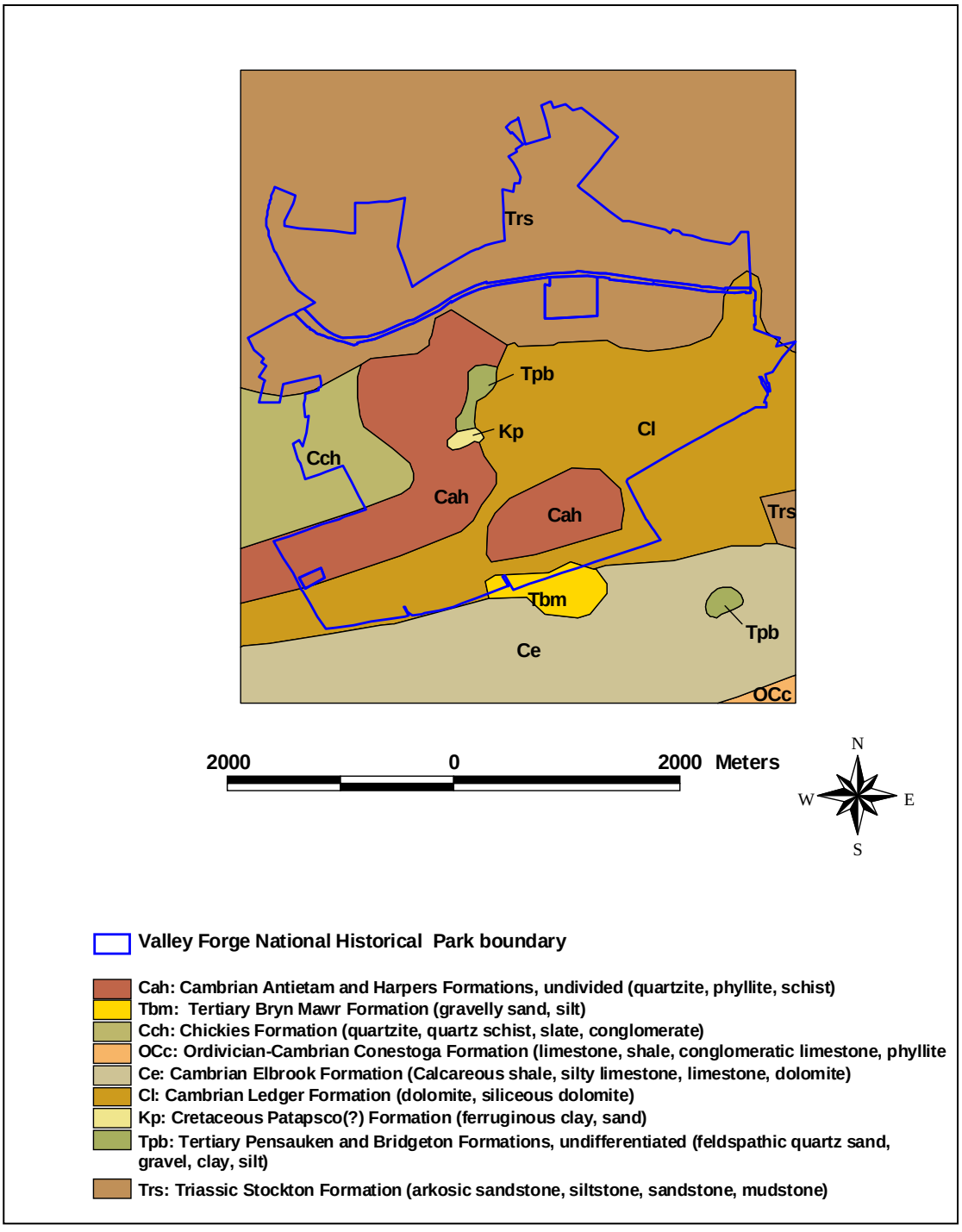

Figure 2. Bedrock geology of Valley Forge National Historical Park. (Geologic formation spatial data derived from "Bedrock Geology of Pennsylvania: shape-file format, Reading 30'x 60' quadrangle," Pennsylvania Bureau of Topographic and Geographic Survey, Dept. of Conservation and Natural Resources, 2001.)

The Cambrian Age Ledger Formation (dolomite, siliceous dolomite) underlies much of the rest of the park south of Route 23 and east of Mount Joy, Mount Misery, and Wayne's Woods. This area is composed of gently rolling terrain and some karst features, including several sinkhole/karst depressions.

The Antietam and Harpers (undivided) and Chickies formations tend to have well-drained to excessively well-drained soils and are characterized by drought-tolerant plant community types along the ridges and upper slopes of Mount Joy and Mount Misery. The east slopes of Mount Joy and most of Wayne's Woods have gentler slopes and less droughty soils and likely supported dry oak-heath or dry oak-mixed hardwood forest prior to clearing centuries ago. These areas are now mostly stands of planted tuliptree forest with some volunteer oaks and other hardwood species mixed in. The soils of the Stockton and Ledger formations are more fertile than the Chickies and Antietam formations and, consisting of rolling topography, are more suitable for agriculture. At present these areas consist of open grassland, crop land, tree plantations, and young successional forest on former agricultural land. The degree to which Valley Forge National Historical Park plant communities have a "natural" character appears to be directly related to the ease at which the land could be cleared and farmed. Mount Misery, with its shallow droughty soils and steep slopes, was likely never farmed, though probably cut for lumber and fuel several times. The dry oak forest on Mount Misery and portions of Mount Joy is similar to dry oak forests elsewhere in southeastern Pennsylvania. In contrast, the Stockton and Ledger formation areas have likely been farmed intensively for several hundred years. The legacy of this land use is the maintenance of extensive grasslands on the Stockton and Ledger formations (managed by the park to reflect agricultural use of these areas in the colonial period) and young successional forests on reverting farmland. These young forests contain many exotic and invasive plant species typically associated with disturbance and human settlement.

Schuylkill River

The Schuylkill River also has important impacts on the distribution of plant communities within the park. The Schuylkill River floodplain has deep, rich alluvial soils that support several types of floodplain forest. The canopy trees on the floodplain are typical of the region, but some areas of the forest floor are heavily infested with invasive and/or exotic species, particularly lesser celandine (*Ranunculus ficaria*) and several vine species. South of the river some of the floodplain has been altered or filled by the construction of railroad beds. Along the river in the northwest corner of the park the floodplain has been drastically altered by the construction of a large dike. This dike was constructed as part of a coal silt removal operation in the Schuylkill River. As a result, the active floodplain is very narrow in this area. The area behind the dike is severely altered due to deposition and subsequent removal of coal silt. Shallow excavations north of the dike support open and forested wetlands. Drier areas support grasslands and successional forests. Some open areas with significant remnant coal silt deposits have dry, droughty soil conditions and sparse vegetation.

Land Use History

Human activity has had the greatest impact on the vegetation of the park. The park is currently managed to reflect (to the extent practicable) the land uses of the area immediately preceding the encampment of the Continental Army during the Revolutionary War. As a result, a significant

portion of the park is maintained as open tall grassland (seasonally mowed) to mimic small grain agriculture. A large portion of the park is also maintained as open lawn, primarily in association with structures, picnic areas, and transportation corridors. Some areas north of the river are still in agricultural use or have been recently abandoned and are now succeeding into old field and shrubland vegetation types. In addition, the northeastern portion of the park contains an abandoned tree and shrub nursery with extensive plantings that are slowly reverting to succesional old field and young forest.

Invasive and Exotic Species

Biological impacts on the vegetation of Valley Forge National Historical Park are significant. Several invasive native and exotic plant species have altered the structure and composition of vegetated stands within the Park. Several vines species, especially oriental bittersweet (*Celastrus orbiculatus*), summer grape (*Vitis aestivalis*), and Japanese honeysuckle (*Lonicera japonica*) can slow or reverse forest succession in areas where young forest stands are developing. Several areas of the park are so infested by these vine species that young trees and shrubs are smothered and eventually die, thereby preventing, or at least delaying, succession to mature forest. Examples of this impact can be found in the southcentral portion of the park along the Pennsylvania Turnpike, in the center of the park on the floodplain of the Schuylkill River (south of the river), and in several areas north of the river. Some of these vine species (e.g., Japanese honeysuckle) were also observed in open grassland areas during vegetation mapping field work.

Deer

The white-tailed deer (*Odocoileus virginianus*) population within the park has significantly impacted vegetation structure within the park, particularly within wooded areas. Deer browse activity has been implicated in the reduction of tree regeneration within the park and the decline of native woodland wildflower abundance (O'Donnell et al. 1996). The reduction of native woody plants and wildflowers in the forest understory has likely favored the expansion of non-preferred browse species, especially Japanese stiltgrass (*Microstegium vimineum*) which forms extensive carpets in many wooded areas of the park.

Methods

Overview of Vegetation Mapping Methodology

The outline below explains the sequence of steps used to develop a vegetation classification and map for the Valley Forge National Historical Park. The methodology is based on procedures developed by Environmental Systems Research Institute (ESRI) and The Nature Conservancy (TNC) for the United States Geological Survey (USGS) and National Park Service (NPS) Vegetation Mapping Program.

A planning and scoping meeting was held at Valley Forge National Historical Park in August 1999. At that meeting the scope of the project, the roles of each participant, and anticipated products were discussed. North Carolina State University Center for Earth Observation (CEO) assumed responsibility for developing a digital orthophoto mosaic of the park, assessing the positional accuracy of the mosaic, and developing the digital draft formation-level and final association-level vegetation maps. The Pennsylvania Science Office of The Nature Conservancy (PSO-TNC) assumed responsibility for developing and implementing a vegetation classification sampling design and a thematic accuracy assessment sampling design, and developing a draft vegetation classification and a draft vegetation key. NatureServe assumed responsibility for reviewing the vegetation classification and vegetation key, developing the cross-walks from the park vegetation types to the National Vegetation Classification System, and providing oversight to ensure the mapping effort was consistent with the USGS/NPS Vegetation Mapping Program.

Acquisition of Aerial Photography of Park

Recent aerial photography (usually less than five years old) that provides sufficient resolution and detail for classifying vegetation to the association level is required for mapping current park vegetation. At Valley Forge National Historical Park no such imagery was available, so new aerial photography was required. Color infrared, stereo pair 1:6,000 scale aerial photography of Valley Forge National Historical Park was acquired from an overflight on September 12, 1999, during leaf-on conditions, by Air Photographics, Inc. The photography was delivered to the National Park Service (NPS) and then forwarded to North Carolina State University where the digital orthophoto mosaic was produced.

Development of Digital Orthophoto Mosaic and Positional Accuracy Assessment

The delineation of mapping polygons using onscreen digitizing is greatly facilitated by the availability of a single seamless digital image of the target area (i.e., extent of park). This is accomplished by scanning hard copies of aerial photography to create digital images and then geo-referencing and ortho-correcting each scanned image. These individual images are then digitally joined to create a single seamless digital aerial photo mosaic. The positional accuracy of the photo mosaic is then assessed by obtaining actual field coordinates for distinct landmarks in the digital image using global positioning system equipment. Field and digital image coordinates are then compared to assess the spatial accuracy of the digital image.

North Carolina State University Center for Earth Observation (CEO) processed the aerial photography, scanning each photograph and assembling them into a digital orthophoto mosaic

(Figure 3) as described above (Koch 2001). Horizontal accuracy was assessed on the basis of 50 field survey points distributed throughout the image. The actual field coordinates for these points were recorded with a Trimble ProXRS GPS unit with real-time differential correction. The field coordinates were then post-processed using differential correction. The field coordinates were then compared to the image mosaic coordinates for these points determined in ESRI ArcMap software. Refer to Appendix A for a complete description of aerial photo mosaic development and positional accuracy assessment.

Air Photo Interpretation

The initial interpretation of the aerial photography delineates polygons to the formation level of the National Vegetation Classification System (NVCS) (e.g, Lowland or submontane cold-deciduous forest, Conical crowned temperate or subpolar needle-leaved evergreen forest). Polygons are delineated and labeled based on signatures observed on the photography and information from preliminary field surveys and notes.

Formation-level Map

Photo interpretation was completed by CEO (Koch 2001). From the mosaic, CEO delineated individual polygons on the computer screen representing distinct vegetation formations as defined by NVCS. Aerial photo stereo pairs were used, as necessary, to obtain finer image details during interpretation. In addition, 1,993 black and white digital ortho-quarter quads (DOQQ) were used to aid in distinguishing conifer-dominated areas. CEO photointerpreters also performed several informal surveys of the park to familiarize themselves with formations within the park before attributing formation names to mapping polygons. A total of 17 formation-level polygon types were distinguished in the final formation-level map, including 11 anthropogenic and six natural (Figure 4). A summary of polygon distribution and total area by formation is given in Table 1.

CEO delineated polygons representing homogeneous vegetation areas. Some distinctions were based on obvious differences in land cover (i.e., developed versus vegetated). With respect to vegetation, distinction between polygons came from clear differences in stand height, color/spectral data (and thus, at least in theory, species) composition, and texture. Polygons were attributed using decision rules based on physiognomic and hydrologic regime categories of the NVCS, as well as a visual evergreen-deciduous identification key. Since NVCS formation-level classes are based largely on broad physiognomic characteristics, this approach seemed appropriate. Furthermore, the leaf-on photography limited the visual distinction between coniferous and deciduous stands, making a stereoscopic view far less valuable. Ultimately, distinction between certain of the vegetated polygons came from the DOQQs. For example, if there was a lot of dark but patterned texture in a polygon, it was classified as mixed or coniferous. Moreover, if an area showed new growth (i.e, the mosaic showed greater forest cover than 1,993 DOQQs) it was assumed to be successional vegetation, which was initially assumed to be coniferous forest. However, after visiting Valley Forge it became clear that conifers had only a minor presence in the park except where explicitly planted.

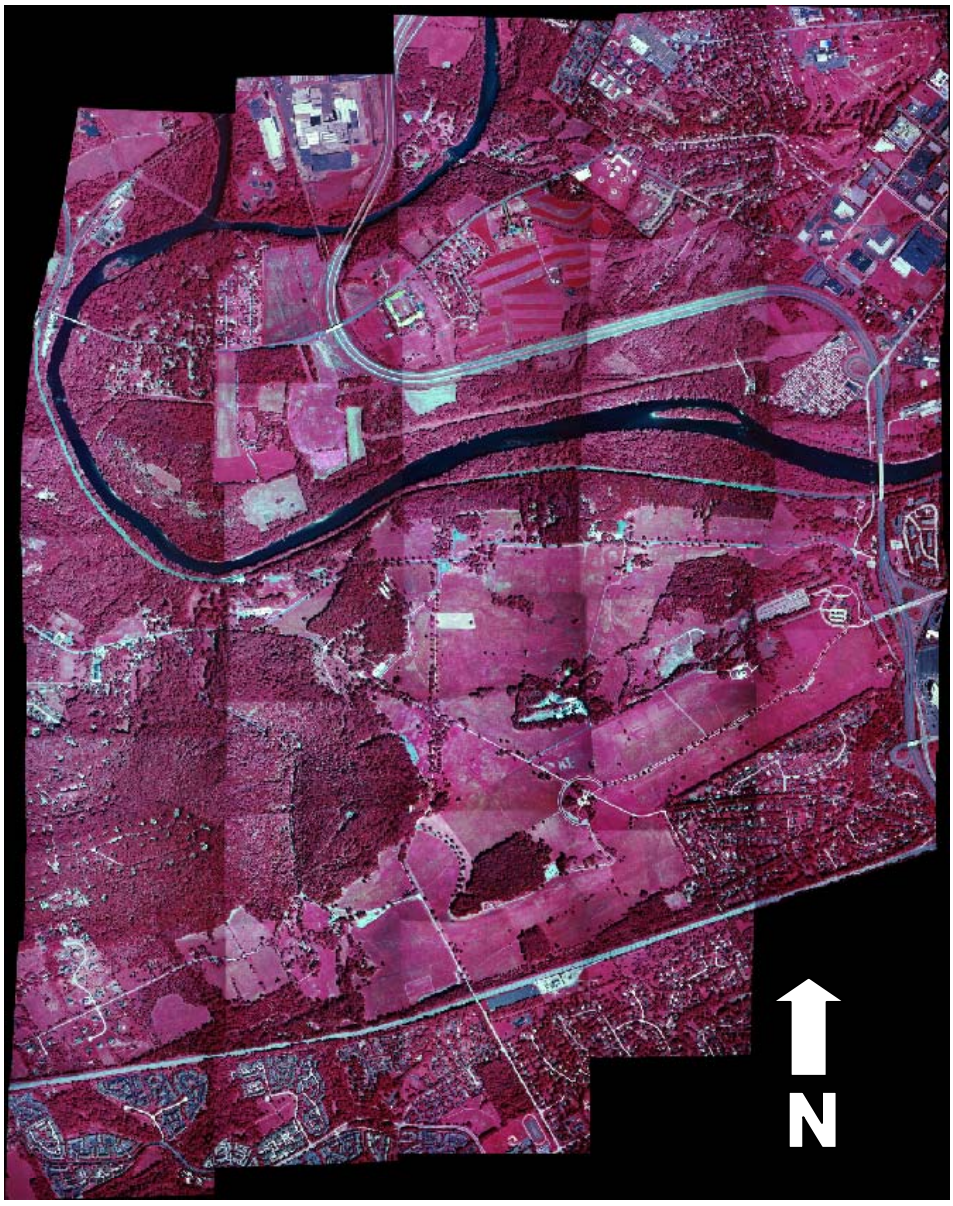

Figure 3. Digital orthophoto mosaic for Valley Forge National Historical Park.

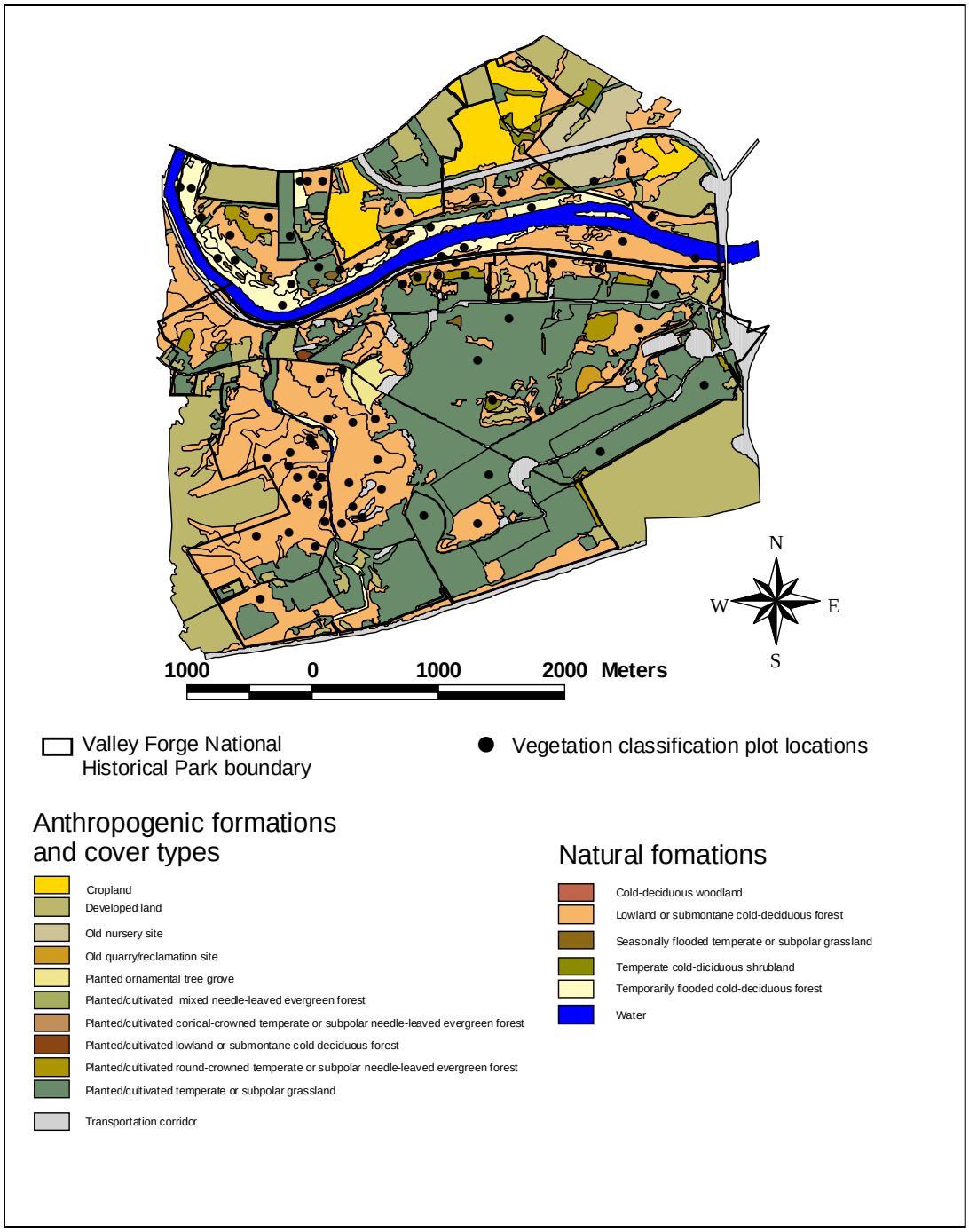

Figure 4. Formation-level map and locations of vegetation classification sampling plots at Valley Forge National Historical Park.

Table 1. A summary of the total number of polygons, total mapped hectares, hectares mapped within the park boundary, and number of plots sampled for formation-level vegetation types at Valley Forge National Historical Park.

Formation Name	Number of Polygons	Total Mapped Hectares	Hectares within Park Boundary	Number of Plots Sampled
Anthropogenic				
Cropland	6	69.29	36.58	
Developed land	35	282.59	42.80	
Old nursery site	3	33.44	0.03	
Old quarry/reclamation site	1	3.16	3.16	
Planted/cultivated temperate/lowland or submontane cold-deciduous forest	2	0.96	0.96	
Planted ornamental tree grove	3	9.14	9.14	
Planted/cultivated temperate/mixed needle-leaved evergreen forest	2	1.83	1.83	
Planted/cultivated lowland or submontane conical-crowned temperate or submontane evergreen forest	1	0.28	0.28	
Planted/cultivated round-crowned temperate or subpolar needle-leaved evergreen forest	13	20.80	20.75	2
Planted/cultivated temperate or subpolar grassland	84	532.21	499.98	9
Transportation corridor	9	120.18	70.15	
Natural				
Lowland or submontane cold-deciduous forest	117	503.02	430.22	54
Seasonally flooded temperate or subpolar grassland	10	4.60	4.60	1
Natural cold-deciduous woodland	2	0.39	0.39	1
Temporarily flooded cold-deciduous forest	25	69.23	63.58	11
Temperate cold-deciduous shrubland	5	11.07	8.15	2
Water	4	66.66	52.57	
Total	322	1,728.85	1,246.26	80

The selected minimum mapping unit was 0.21 ha (approx. 0.5 ac)—smaller than the area recommended by the Vegetation Mapping Program protocol. At times even smaller distinctive areas were discernible from the photos, so these areas were delineated as well. (Goodchild [1994] states it is quite common in a digital cartographic setting for the MMU to be the smallest area that can be drawn and labeled at the scale of the map.) To ensure that there are no problems with inaccuracies in the boundary GIS layer, the formation-level map was extended one polygon out from the park boundary.

Draft Association-level Map

Upon completion of the formation-level classification, CEO staff created a draft association-level vegetation map using a classification scheme based on The Nature Conservancy's Terrestrial Vegetation of the United States and association-level classes developed by PSO-TNC. An ERDAS Stereo Analyst workstation equipped with a color monitor with a high refresh rate and an emitter box affixed to the top of the monitor was used to view the orthorectified images in stereo. The interpreter wore a pair of battery-powered goggles that flash 115 times per second. Emitter waves strike the goggles and, with the high refresh rate of the monitor, allow the interpreter to view a photo pair on-screen in stereo. Once the workstation and working parameters were established the formation-level vegetation database was imported into ERDAS Stereo Analyst. The interpreter then viewed the formation-level polygons overlaid on each stereo orthophoto model to delineate association-level polygons. These polygons were then assigned preliminary association classes based on the formation-class descriptions and any present environmental factors including topography, aspect, recognizable individual species, and vegetation height. The resulting draft association-level vegetation database was exported to an ESRI shapefile.

Field Data Collection and Classification

Planning

Field work follows the methodology developed by The Nature Conservancy in conjunction with the USGS/NPS Vegetation Mapping Program (The Nature Conservancy 1994). The following is a summary of these methods as applied to Valley Forge National Historical Park.

Valley Forge National Historical Park is considered to be of "small size," therefore, the sample area includes the entire park. Decisions regarding number of plots and environmentally stratified plot placement were based on the whole park. By comparison, in large parks the plot placement and stratification is focused on only a portion of the park, and results extrapolated to the whole.

Field Survey Design

The development of a final association-level vegetation map requires quantitative information sufficient to identify and classify vegetation associations. The selection of formation-level polygons for quantitative classification sampling was based on best professional judgment, the number of polygons per formation, the total area of each formation, and the degree of variability within formations observed during field reconnaissance.

Vegetation Sampling

Within each polygon selected for sampling, a plot was established in an area that was most representative of the existing vegetation association (Mueller-Dombois and Ellenberg 1974). All mapped vegetation types were sampled over a range of environmental variation (primarily geology, hydrology, and topographic position) (see Appendix B for field data forms). Plot sizes were determined based on physiognomy (as defined in Strakosch-Walz 2000): 20 x 20 m for forests and woodlands, 10 x 10 m for shrublands, and 5 x 5 m for herbaceous vegetation. Forest was defined as vegetation with trees over 5 m high and canopy cover between 60 to 100%. Woodland was defined as vegetation with trees over 5 m high and canopy cover 25 to 60%. Shrubland was defined as vegetation with trees and shrubs less than 5 m high and typically more than 0.5 m high with shrub cover greater than 25%. Herbaceous vegetation was defined as vegetation dominated by herbs (graminoids, forbs, and ferns), with woody plants (trees and shrubs) typically having less than 25% total cover.

The vegetation was visually divided into eight strata, all the species of each stratum listed, and percent cover (in modified Braun–Blanquet cover classes, Strakosch-Walz 2000) estimated for each species. Vegetation strata used in sampling were emergent (individual trees significantly taller or emergent relative to the general height of the forest canopy), canopy (general forest canopy), subcanopy (trees with maximum height below general forest canopy, but taller than 5 m in height), tall shrub (saplings and shrubs 2 to 5 m in height), short shrubs (woody plants under 2 m in height), herbaceous (grasses, sedges, forbs, and ferns), vines and lianas (perennial woody vegetation with a vine habit), and non-vascular (mosses and lichens). Species that were not identifiable in the field were collected for later identification and disposed of. In addition to floristic information, the following environmental information was recorded at each plot: flooding regime, soil moisture regime, slope, aspect, and evidence of disturbance. Additional notes were recorded as appropriate on plot setting, other environmental factors, and surrounding stands. Location of each plot was recorded using a Garmin III Plus GPS unit, with datum set to North America Datum 1983 (Conus) and coordinate system set to Universal Trans-Mercator (UTM) Zone 18 North. The vegetation / topographic profile was sketched in cross-section to represent the location and setting of the plot. A color digital photo was taken of each sample plot. Vascular plant nomenclature follows Kartesz (1994).

PSO-TNC staff completed sampling of 80 plant community plots at the Valley Forge National Historical Park between May and October 2000. A complete copy of original and transcribed field data sheets was sent to the NatureServe regional ecologist in Boston for use in developing crosswalks between park vegetation types and the National Vegetation Classification System.

Data Analysis

Plot data and existing vegetation information were used to develop a complete park-based vegetation list and identify floristic patterns across the park. Plot data were analyzed using multivariate statistics to identify relationships between vegetation plots and assign them to groups. These groups were then further reviewed and vegetation descriptions developed. Based on these descriptions, groupings were crosswalked to NVCS associations, or if a crosswalk was not possible, a park-specific “association” was created (often necessary for altered or disturbed successional vegetation).

Park plot data were entered by PSO-TNC into the PLOTS Database System (The Nature Conservancy 1997) on a Microsoft Access platform. The PLOTS database provides a stable, uniform database for archiving plant community data and allows data export into formats used by analytical software. Species were assigned standardized codes and names based on the PLANTS database developed by National Resources Conservation Service (NRCS) in cooperation with the Biota of North America Program (BONAP). Species and plot data for use in ordination and classification were exported from the PLOTS database and formatted into an Excel spreadsheet for use in the PC-ORD version 4.0 Multivariate Analysis package (McCune and Mefford 1999). PSO-TNC community ecologists ran preliminary analyses of the data using Detrended Correspondence Analysis (DCA) (Hill and Gauch 1980), Two-Way Indicator Species Analysis/TWINSPAN (Hill 1979), and Non-metric Multidimensional Scaling (NMS) (Kruskal and Wish 1978, Clarke 1993). DCA ordinates both species and samples simultaneously along vegetation gradients that reflect often-complex environmental gradients (moisture, elevation, nutrients, etc.). TWINSPAN successively divides the plots into groups that are similar in species composition. NMS is an ordination method well suited to non-normal data sets. PSO-TNC ecologists reviewed the results and conducted further analyses with PC-ORD to assign plots to vegetation associations. In addition to runs of the larger set of plots, several subsets were selected and analyzed to gain further clarification.

Data from a 1998 study of deer exclosure effects were also analyzed by NatureServe for relevant information. Thirty pairs of fenced/unfenced 2 x 2 m plots (N=60) had been sampled for herbaceous and shrub vegetation as well as for tree regeneration. These data were entered into PC-ORD with associated data including the vegetation type of the two upland mature forest types included in the study and whether the plot was fenced or unfenced. DCA ordinations, Modified Bray-Curtis ordinations (McCune and Mefford 1999), and Indicator Species analyses were used to extract information useful in supplementing the vegetation descriptions. Deer exclosure analyses provided information on herbaceous and shrub species characteristic of certain associations that were absent from classification plots due to severe deer browsing. Analyses to document the overall effects of deer on the understory vegetation had already been completed and were not repeated here.

Based on these analyses, park-specific local vegetation associations were identified and described in detail. Each vegetation association was assigned a common name based on the Terrestrial and Palustrine Plant Communities of Pennsylvania (Fike 1999). If no appropriate name existed in Fike (1999), the National Vegetation Classification System common name was used or a park-specific common name was created for successional and cultural vegetation types not easily handled by Fike (1999) or the NVCS.

These vegetation associations were then crosswalked to the National Vegetation Classification System (NVCS). The NVCS was developed by ecologists of the Natural Heritage Program network and The Nature Conservancy after many years of literature review, data collection, and data anlysis. This collaborative effort culminated in the publication of *International Classification of Ecological Communities: Terrestrial Vegetation of the United States* (Grossman et al. 1998). The International Classification of Ecological Communities, now known as the International Vegetation Classification, of which the NVCS is a subset, has been revised and refined since 1998, and is now managed by NatureServe in continued collaboration with the network of Natural Heritage Programs. The classification is housed in the Biotics database and

is updated regularly. The upper levels of the NVCS were adopted as a standard by the Federal Geographic Data Committee to support the production of uniform statistics on vegetation at the national level (Federal Geographic Data Committee 1996). The Vegetation Mapping Program of the National Park Service adopted the alliance level, and where possible, the association level, as the mapping unit for national parks.

Based on the aforementioned analyses, the park-specific local vegetation associations were qualitatively compared to existing associations in the National Vegetation Classification System by searching for associations sharing similar dominant species, as well as physiognomy and environmental setting. Total floristic composition was used to determine the appropriate association. Global information on the associations from the NVCS was then appended to the local descriptions to provide resource managers with a broader context for the vegetation in the park.

Vegetation Key

A park-specific dichotomous key was also created for the vegetation associations to guide accuracy assessment and for use by the park natural resource managers and others (Appendix C). A dichotomous key is a tool for identifying unknown entities, in this case, vegetation associations. It is structured by a series of couplets, two statements that describe different, mutually exclusive characteristics of the associations. Choosing the statement that best fits the association in question leads the user to the correct association. The dichotomous key should be used in conjunction with the detailed vegetation association descriptions to confirm that the association selected with the key is appropriate.

The key included all vegetation associations mapped in the park and one association not mapped (i.e., Skunk Cabbage Seepage Meadow). The Skunk Cabbage Seepage Meadow typically occurs as small patches, well below the minimum mapping unit size. This association is included in the vegetation key so that all vegetation associations known to occur in the park can be identified.

Copies of the Valley Forge National Historical Park data in PLOTS database (MS ACCESS) format and the PC-ORD formatted data (MS EXCEL spreadsheet) were provided to NatureServe and The Nature Conservancy. A draft vegetation classification was provided to CEO photointerpreters by the end of January 2001. The draft classification was accompanied by an ARCVIEW shapefile indicating the location and plot number of each sample plot, as well as the vegetation association to which that plot was classified. CEO photointerpreters used the draft classification and related ARCVIEW shapefile to help inform the attribution of associations to the association-level map polygons

Thematic Accuracy Assessment

Thematic accuracy assessment was used to assess errors of omission and errors of commission for each vegetation association. Both of these errors are calculated by dividing the number of correctly classified points in one association by the total number of points sampled in that association. Errors of omission indicate the probability that an accuracy assessment point classification will be correct and are calculated by mapped vegetation type. Errors of commission indicate the probability that a mapped vegetation type actually represents the

vegetation on the ground. This error is calculated by observed vegetation type (The Nature Conservancy 1994).

Accuracy assessment (AA) sampling design followed the guidelines provided in the USGS/NPS Vegetation Mapping Program (The Nature Conservancy 1994) manuals with respect to the number of AA points sampled and their distribution across park polygons. The sampling design consisted of 308 points across 24 association types. PSO-TNC conducted all AA fieldwork during the 2001 field season. Natural and anthropogenic association types were included in the AA. Accuracy assessment sampling coordinates were selected by generating random points within the minimum and maximum easting and northing UTM coordinates of the park's extent. Points within 30 m of a polygon border were eliminated to avoid sampling within ecotones. If two or more points still remained in a polygon, one point was randomly chosen and the others discarded. In several of the larger polygons, up to six AA points were selected. In the case of some smaller polygons, additional random point selection was required before a random point fell into those polygons. Also, in some polygons it was not possible to locate an AA point 30 m from a border, in which case the AA point was manually located equidistant from polygon borders.

AA points were located in the field using a Garmin III Plus GPS unit. Data collection (Appendix B) included accuracy assessment plot number and GPS location information, vegetation type at the AA point, vegetation type(s) within 50 m of the AA point, dominant species by strata, canopy closure, and rationale for classification. Vegetation associations were identified using the vegetation key developed for the park. AA results were analyzed using a sample misclassification matrix. Overall accuracy, Kappa index, and 90% confidence intervals were calculated as described in the accuracy assessment procedures of the USGS/NPS Vegetation Mapping Program (The Nature Conservancy 1994).

Results

Vegetation Classification

Formation-level Map

A total of 322 polygons assigned to 17 formation-level types were identified in the park during air photo interpretation (Table 1). Of these, 11 formation-level types were considered anthropogenic (e.g., active cropland, developed land, or planted vegetation, including managed grasslands). Developed land included buildings and associated mowed lawns and any other park infrastructure other than roads. Transportation corridors included roads and mowed shoulders as well as parking lots. Grasslands were the dominant anthopogenic formation, covering 40.1% of the park. Six natural formations (not directly impacted by routine human management/activity) were also identified. The lowland or submontane cold-deciduous forest formation was the dominant natural vegetation type covering 34.5% of the park and constituted 84.9% of the natural vegetation.

Association-level Map

From May through October 2000, PSO-TNC sampled a total of 80 plots (Table 1, Figure 4) to develop an association-level vegetation classification for the park and to inform the development of the association-level vegetation map. Eleven plots were sampled in anthropogenic-influenced polygons (i.e, grassland and pine plantation), while 69 were sampled in natural vegetation. Initial analyses in TWINSPAN identified six broadly defined vegetation groups: wet meadow, grassland, tuliptree forest, oak-dominated forests, modified successional forest, and floodplain forests (Figure 5). Further analysis of data subsets and review of available literature indicated a total of 11 different groups. Nine of the 11 groups could be matched to existing associations in the National Vegetation Classification System, and these nine associations at the park were described. Six of the vegetated communities at Valley Forge National Historical Park are classified as forest, one as woodland, one as shrubland, two as grassland, and one as forb. This includes one planted forest association and two locally described successional types (forest and shrubland), as well as post-agricultural grasslands.

The vegetation of the park has been severely altered by human activities and deer browse, and, as a result, the composition often did not clearly match the global expression of a given association. The global expression reflects the composition of the association as observed over its entire range. Indicators such as infrequent native species or position on the landscape often provided the key to plot assignment. Identifying the placement of oak-dominated plots where deer browse has severely reduced the herbaceous and shrub components was particularly problematic. Initially, these oak forest plots were placed into two associations. Drier areas with more *Quercus prinus* were treated as the *Quercus prinus – (Quercus rubra, Quercus velutina)/Vaccinium angustifolium* Forest Association, while plots with indicators such as *Viburnum acerifolium, Hamamelis virginiana, Carya* spp., *Cornus florida,* and several species of herbs characteristic of slightly more mesic or richer soils were placed in the *Quercus (alba, rubra,velutina) / Cornus florida* / *Viburnum acerifolium* Forest Association. Additional review, after the draft association-level map had been produced, suggested that the plots assigned to the *Quercus (alba,*

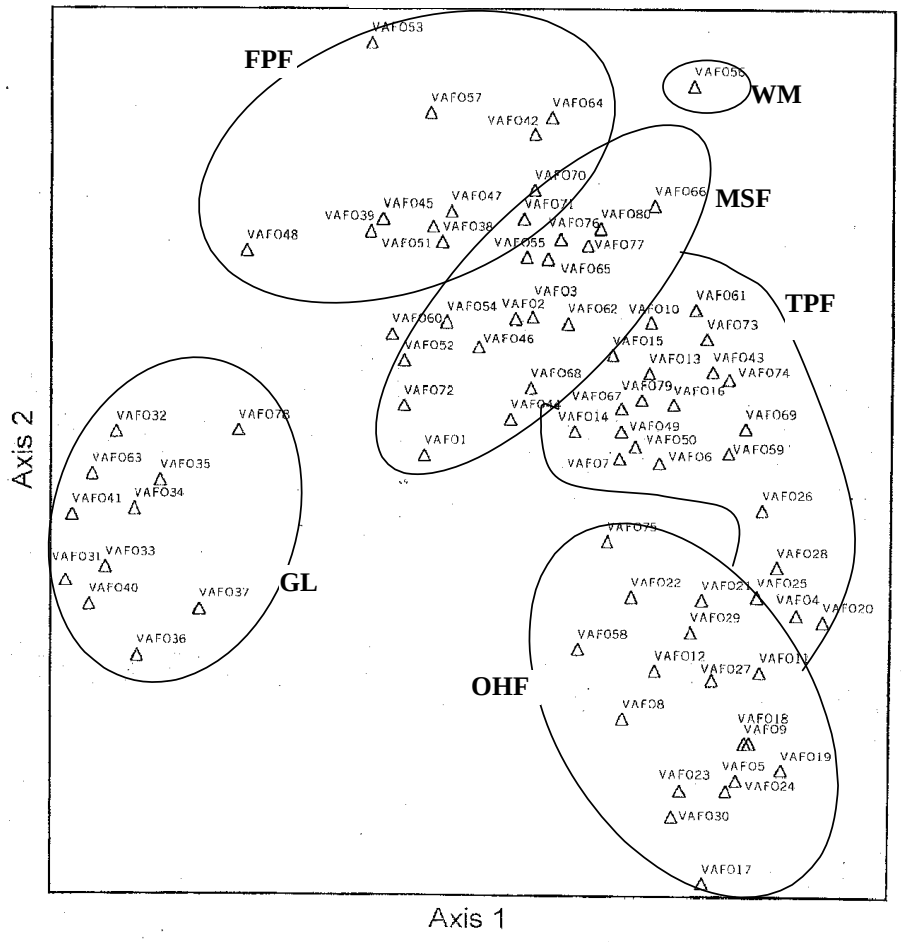

Figure 5. Non-metric Multi-dimensional Scaling (NMS) ordination of Valley Forge National Historical Park vegetation plots (N=80), showing vegetation groups. Clockwise from top: FPF- silver maple floodplain forest and riverine floodplain forest; WM- wet meadow; MSF- northeastern modified successional forest; TPF- tuliptree-oak forest; OHF- dry oak forest and chesnut oak-black birch talus slope; and GL- grassland and successional old field/shrubland.

rubra,velutina) / Cornus florida / *Viburnum acerifolium* Forest Association represent merely the mesic end of the *Quercus prinus – (Quercus rubra, Quercus velutina)/Vaccinium angustifolium* Forest Association rather than the separate type to which they had been initially assigned. Consequently, the *Quercus (alba, rubra,velutina) / Cornus florida* / *Viburnum acerifolium* Forest Association is not being attributed to Valley Forge National Historical Park; all oak-dominated forests are considered part of the *Quercus prinus – (Quercus rubra, Quercus velutina)/Vaccinium angustifolium* Forest Association.

Floodplain forests dominated by silver maple were likewise problematic. These forests clearly fit into the *Acer saccharinum* Temporarily Flooded Forest Alliance; however, assignment to an association within that alliance is difficult. Analysis and classification of floodplain forests in the northeastern states is incomplete and patchy at the association-level (for example, New England and Pennsylvania are both in process), and no regional evaluation of potential associations has taken place. The silver maple floodplain forests at Valley Forge National Historical Park doubtlessly fit with similar forests described from New Jersey and Pennsylvania, which for now are contained in a NVCS "placeholder" association (Silver Maple Floodplain Forest) pending further study.

A large group of plots was characterized by a mix of tree species and weedy vines indicative of succession from old fields and disturbed sites. This group did not fit any existing association and was initially assigned a local type of Modified Successional Forest. Subsequent work in other national parks has provided additional data, leading to the creation of a new association, *Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest (local name is Northeastern Modified Successional Forest). Several variants were noted within the Northeastern Modified Successional Forest but these were not sufficiently different to warrant recognition at the association level. The other locally defined type represented old fields that had been taken over by weedy shrubs such as mutliflora rose; this was assigned a local type of Succession Old Field/Shrubland.

Analyses of the deer-exclosure data showed some vegetation-specific results. The prevalence of exotics in deer-exclosures was much higher in tuliptree-dominated forests than in oak-dominated forests: 86% of the tuliptree forest plots contained exotic plants in the shrub/herb layer, compared with 13% of the oak forest plots. Exotics appear less important in the tree-regeneration data, where the effects of deer are so dramatic as to overwhelm any other factor. Even in the fenced plots, however, oak regeneration was low, as is typical for present-day oak forests in much of the northeast.

Detailed vegetation descriptions follow which include local and global vegetation description, geographic range, environmental description, most abundant species, characteristic species, conservation rank (global rarity rank), confidence level of classification, and references. Conservation rank is on a scale from G1 to G5, with G1 being globally rare and G5 being widespread and common. Confidence level of classification was rated on a scale of 1 to 3, with 1 being the highest level of confidence. New types that were undocumented in the literature or where data was sparse were given the lowest confidence rank of 3, indicating that they require careful regional classification work. Where no association match was available and data did not warrant creation of a new NVCS type, a local type name was assigned.

Vegetation Association Descriptions

The following vegetation association descriptions and representative photographs are based on plot data and field observations at the Valley Forge National Historical Park. These types are treated as local expressions of the more widely occurring NVCS association to which they have been assigned. The NVCS association descriptions are considered "global" descriptions and are based on observations across the entire geographic range of each association. As such, the NVCS association descriptions (as well as association names) may include species not found at Valley Forge National Historical Park. In addition, NVCS association descriptions are constantly being refined as more quantitative data become available from this and similar vegetation mapping and classification projects. A complete list of vascular plants found in vegetation classification and thematic accuracy assessment plots can be found in Appendix D. Specific species information for each vegetation classification plot can be found in the PLOTS database for this park.

Descriptions were not developed for four anthropogenic vegetation types; northern catalpa planted forest, mixed white pine – hardwood plantation, red oak plantation, and eastern hemlock plantation. These four types were limited to one or two polygons and had a cummulative cover of 3.07 ha (7.6 ac). The northern catapla planted forest was a single small grove of planted northern catalpa (*Catalpa speciosa*) trees associated with an old homestead ruin. The mixed white pine – hardwood plantation was a narrow planted screen west of the old quarry/reclamation site consisting primarily of planted white pine (*Pinus strobus*) and pin oak (*Quercus palustris*). The red oak plantation is associated with the Washington's Headquarters grounds and consists of mature planted red oaks with mowed lawn below. The eastern hemlock plantation is a small stand of planted hemlock (*Tsuga canadensis*) just southeast of Washington's Headquarters.

Common Name (Park-specific): White Pine Plantation

SYNONYMS:
NVC English Name: **Eastern White Pine Planted Forest**
NVC Scientific Name: ***Pinus strobus* Planted Forest**
NVC Identifier: **CEGL007178**

LOCAL INFORMATION

Environmental Description: This community is found on level and gently sloping terrain.
Vegetation Description: Several conifer plantations occur within Valley Forge National Historical Park. These plantations are primarily white pine (*Pinus strobus*), though at least one stand contains some European larch (*Larix decidua*). Conifers compose at least 50 % of the canopy cover in these stands, with volunteer hardwood species occasionally obtaining codominant status. Common volunteer hardwood species include American elm (*Ulmus americana*), black cherry (*Prunus serotina*), white ash (*Fraxinus americana*), black oak (*Quercus velutina*), and scarlet oak (*Quercus coccinea*). The subcanopy is usually open, with scattered individuals of canopy hardwood species and occasional flowering dogwood (*Cornus florida*). Vines are often present, particularly summer grape (*Vitis aestivalis*), obtaining high cover in the canopy of some stands. The shrub and herbaceous layers are typically sparse to absent due to shading and abundant needle litter.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Larix decidua*, *Pinus strobus*
Shrub/sapling (tall & short)	Vine/Liana	*Vitis aestivalis*

Characteristic Species: *Pinus strobus*
Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski
Plots: VAFO.66,VAFO.69
Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Evergreen forest (I.A.)
Physiognomic Group	Temperate or subpolar needle-leaved evergreen forest (I.A.8.)
Physiognomic Subgroup	Planted/Cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.)
Formation	Planted/cultivated temperate or subpolar needle-leaved evergreen forest (I.A.8.C.x.)
Alliance	*Pinus strobus* Planted Forest Alliance (A.98)
Alliance (English name)	Eastern White Pine Planted Forest Alliance
Association	*Pinus strobus* Planted Forest
Association (English name)	Eastern White Pine Planted Forest

Ecological System(s):
Cultivated Forest (CES203.286)

GLOBAL DESCRIPTION

Concept Summary: This white pine plantation type is found throughout the northeastern and midwestern United States and adjacent Canada. Stands contain plantations of *Pinus strobus* that are maintained for the extraction of forest products. At maturity, the tree canopy is usually dense and contains a monospecific layer of *Pinus strobus*. The field layer may be sparse to absent. In some stands, mosses may be abundant. Susceptibility to a variety of pests or diseases, including white pine blister rust (*Cronartium ribicola*) and southern pine beetle (*Dendroctonus frontalis*), has had some impact on its commercial use.

Environmental Description: Stands contain plantations of *Pinus strobus* that are maintained for the extraction of forest products. The type does well on a variety of soils.

Vegetation Description: The tree canopy at maturity is usually dense and contains a mono-specific layer of *Pinus strobus*. The field layer may be sparse to absent. In some stands, mosses may be abundant.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Needle-leaved tree	*Pinus strobus*

Characteristic Species: *Pinus strobus*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System: *Not applicable.*

DISTRIBUTION

Range: This white pine plantation type is found throughout the northeastern and midwestern United States and adjacent Canada.

States/Provinces: GA, KY, MD, NC, NH, NY, PA, SC, TN, VA, VT

Federal Lands: NPS (Marsh-Billings-Rockefeller, Valley Forge); USFS (Chattahoochee, Cherokee, Daniel Boone, George Washington, Jefferson, Nantahala, Pisgah, Sumter)

CONSERVATION STATUS

Rank: GNA (cultural) (8-Aug-2000)

Reasons: This community represents vegetation which has been planted in its current location by humans and/or is treated with annual tillage, a modified conservation tillage, or other intensive management or manipulation. It is not a conservation priority and does not receive a conservation rank.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: There was a lot of planting of white pine from the 1930s into the1950s, but there has been very little planting since then (P. Manion pers. comm. 2001). On the Daniel Boone National Forest of Kentucky, *Pinus strobus* plantings are of limited extent, and are related to wildlife plantings. There has been some damage from the Southern Pine Beetle (*Dendroctonus frontalis*).

These plantations have been observed in the Peters Mountain area (James River Ranger District) and various other sites in the George Washington and Jefferson national forests.

Similar Associations: *Information not available.*

Related Concepts:

- IF3b. Plantation (Hardwood or Conifer) (Allard 1990) B
- Unclassified Clearcut Regeneration (Fleming and Moorhead 2000) ?

SOURCES

Description Authors: D. Faber-Langendoen

References: Allard 1990, Fleming and Coulling 2001, Fleming and Moorhead 2000, Reschke 1990, Southeastern Ecology Working Group n.d., TNDH unpubl. data.

Figure 6. White Pine Plantation at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 463440, northing 4439581.

Figure 7. White Pine Plantation at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 463147, northing 4439173.

Common Name (Park-specific): Tuliptree – Oak Forest

SYNONYMS:
NVC English Name: **Tuliptree - Oak species Forest**
NVC Scientific Name: ***Liriodendron tulipifera* - *Quercus* spp. Forest**
NVC Identifier: **CEGL007221**

LOCAL INFORMATION

Environmental Description: This community occurs in areas that were cleared or created by fill, usually on mesic soils. Some of the stands at Valley Forge National Historical Park were planted. Tuliptree seeds-in abundantly on cleared land and is a characteristic early-successional tree of this region.

Vegetation Description: This type is found throughout Valley Forge National Historical Park as mid-successional and mature forest stands. Some of these stands appear to have been planted 70 to 80 years ago. The most characteristic feature of this type is the dominance of tuliptree (*Liriodendron tulipifera*). Tuliptree is the only dominant in many stands, with black oak (*Quercus velutina*) and white ash (*Fraxinus americana*) codominant or subdominant in others. Other occasional canopy trees include red maple (*Acer rubrum*), red oak (*Quercus rubra*), and sassafras (*Sassafras albidum*). The subcanopy is usually open (typically less than 30% total cover, though may approach 50%), characterized by tuliptree, red maple, tall individuals of flowering dogwood (*Cornus florida*), black gum (*Nyssa sylvatica*), occasional redbud (*Cercis canadensis*), and sassafras. The shrub layer is also open and appears to be pruned below 1.5 m by heavy deer browsing. Typical shrub species are flowering dogwood (clear dominant in the shrub layer), spicebush (*Lindera benzoin*), black haw (*Viburnum prunifolium*), mountain laurel (*Kalmia latifolia*), and the non-native *Lonicera japonica*. The herbaceous layer has very low diversity and is dominated by exotics. The herbaceous layer is typically a dense growth of stiltgrass (*Microstegium vimineum*), except in stands with a very dense canopy, in which case there may be a high proportion of bare ground. Other common species, besides stiltgrass, include garlic mustard (*Alliaria petiolata*), low smartweed (*Polygonum caespitosum*), jack-in-the-pulpit (*Arisaema triphyllum*), and clearweed (*Pilea pumila*). Indicator species that occur here, but typically not in the oak forests, include downy Solomon's-seal (*Polygonatum pubescens*), black snakeroot (*Sanicula marilandica*), and small enchanter's nightshade (*Circaea alpina*).

Liriodendron tulipifera is particularly abundant in this type but can be an important component of many forest types in the region. At Valley Forge, downy Solomon's-seal (*Polygonatum pubescens*), black snakeroot (*Sanicula marilandica*), and small enchanter's nightshade (*Circaea alpina*) are differential species in the herb layer.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Liriodendron tulipifera*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum*, *Liriodendron tulipifera*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Cornus florida*
Herb (field)	Graminoid	*Microstegium vimineum*

Characteristic Species: *Circaea alpina*, *Liriodendron tulipifera*, *Polygonatum pubescens*, *Sanicula marilandica*

Other Noteworthy Species: *Information not available.*

Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski
Plots: VAFO.4, VAFO.6**,** VAFO.7, VAFO.10, VAFO.13, VAFO.16, VAFO.20, VAFO.26, VAFO.28, VAFO.29, VAFO.43, VAFO.50, VAFO.59, VAFO.61, VAFO.67, VAFO.73, VAFO.74, VAFO.79
Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Liriodendron tulipifera* Forest Alliance (A.236)
Alliance (English name)	Tuliptree Forest Alliance
Association	*Liriodendron tulipifera - Quercus* spp. Forest
Association (English name)	Tuliptree - Oak species Forest

Ecological System(s):

East Gulf Coastal Plain Southern Mesic Slope Forest (CES203.476)
Southern Interior Low Plateau Dry Oak Forest (CES202.898)
East Gulf Coastal Plain Northern Dry Upland Hardwood Forest (CES203.483)

GLOBAL DESCRIPTION

Concept Summary: This broadly defined successional community is one of several described upland associations dominated by *Liriodendron tulipifera*. It ranges from the southern Cumberland Plateau, Piedmont, and Interior Low Plateau of the southeastern U.S. north to the northern Piedmont of New Jersey. A fairly diverse and varied assemblage of species may be found in stands attributable to this type. *Acer rubrum, Quercus* spp., and occasionally *Liquidambar styraciflua* may be common in some stands of this type; *Betula lenta* often occurs at the northern end of the range. Examples are common across large areas of the upland landscape which have been previously disturbed. These successional forests often follow cropping, clearcut logging, or other severe disturbance, and are successional to mixed *Quercus - Carya* forests. The oaks in these stands are frequently multi-stemmed, resulting from coppicing. This association differs from other described types in the alliance based on the lack of a significant pine component [see *Liriodendron tulipifera - Pinus taeda* Forest (CEGL007521)] and the absence of species affiliated with circumneutral conditions [see *Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin)* Forest (CEGL007220)]; it is later successional and more diverse than *Liriodendron tulipifera* Forest (CEGL007218) or *Liriodendron tulipifera - Robinia pseudoacacia* Forest (CEGL007219).
Environmental Description: These successional upland deciduous forests are found primarily in areas which were once clearcuts, old fields, or were cleared by fire or other natural disturbances. These non-wetland forests are also found along mesic stream terraces.
Vegetation Description: The canopy of this successional upland association is dominated by *Liriodendron tulipifera*. A variety of other species may also be present, including *Acer rubrum,*

Quercus alba, Quercus falcata, Quercus nigra, Quercus velutina, Cornus florida, *Carya* spp., and other species (NatureServe Ecology unpubl. data). *Betula lenta* is a common associate at the northern range limit.

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer rubrum, Liriodendron tulipifera*
Tree subcanopy	Broad-leaved deciduous tree	*Acer rubrum*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Cornus florida*

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Information not available.*
USFWS Wetland System: *Not applicable.*

DISTRIBUTION

Range: This association is known from the southern Cumberland Plateau, Piedmont, and Interior Low Plateau of the southeastern U.S. and may also occur in the Upper East Gulf Coastal Plain. It ranges north to the northern Piedmont of New Jersey. It is also known from Alabama, Georgia, Kentucky, Maryland, North Carolina, South Carolina, Tennessee, and possibly Virginia and Delaware.
States/Provinces: AL, GA, KY, NC, NJ, PA, SC, TN, VA?
Federal Lands: DOD (Fort Benning); NPS (Big South Fork, Blue Ridge Parkway, Cowpens, Cumberland Gap, Guilford Courthouse, Kennesaw Mountain, Kings Mountain, Morristown, Natchez Trace, Ninety Six, Obed, Shiloh, Valley Forge); USFS (Bankhead, Daniel Boone, Oconee?, Talladega)

CONSERVATION STATUS

Rank: GNA (ruderal) (19-Aug-2002)
Reasons: This forest represents early-successional vegetation and is thus not of conservation concern. This is a successional vegetation type composed of native species. Its conservation value is limited, but mature examples could provide buffer for communities of greater conservation value.

CLASSIFICATION INFORMATION

Status: Standard
Confidence: 3 - Weak
Comments: *Information not available.*
Similar Associations:

- *Liriodendron tulipifera - Acer negundo* Forest (CEGL007184)--a bottomland type.
- *Liriodendron tulipifera - Robinia pseudoacacia* Forest (CEGL007219)--with Appalachian distribution and a younger example.
- *Liriodendron tulipifera / (Cercis canadensis) / (Lindera benzoin)* Forest (CEGL007220)--is generally found on calcareous soils.

Related Concepts: *Information not available.*

SOURCES

Description Authors: R. E. Evans/M. Pyne, mod. L. A. Sneddon
References: Ehrenfeld 1977, Gallyoun et al. 1996, Keever 1973, NatureServe Ecology - Southeastern U.S. unpubl. data, Overlease 1987, Russell and Schuyler 1988, Schotz pers. comm., Southeastern Ecology Working Group n.d., TNDH unpubl. data.

Figure 8. Tuliptree – Oak Forest at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 461597, northing 4437980.

Figure 9. Tuliptree – Oak Forest at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 462360, northing 4437670.

Common Name (Park-specific): Northeastern Modified Successional Forest

SYNONYMS:
NVC English Name: **Black Cherry - Tuliptree - Red Maple - White Ash Forest**
NVC Scientific Name: ***Prunus serotina - Liriodendron tulipifera - Acer rubrum -Fraxinus americana* Forest**
NVC Identifier: **CEGL006599**

LOCAL INFORMATION

Environmental Description: This type is found throughout Valley Forge National Historical Park on abandoned agricultural land, forest gaps, and other areas with a history of disturbance.
Vegetation Description: This type is very variable in composition but, in general, is dominated by early-successional species that are often weedy and invasive in nature. Typical canopy tree species are white ash (*Fraxinus americana*), black walnut (*Juglans nigra*), American elm (*Ulmus americana*), and black locust (*Robinia pseudoacacia*). Less common, but occasionally dominant species include tree-of-heaven (*Ailanthus altissima*), black cherry (*Prunus serotina*), tuliptree (*Liriodendron tulipifera*), and box-elder (*Acer negundo*). Typical subcanopy species are box-elder, American elm, and to a lesser extent, flowering dogwood (*Cornus florida*), black cherry, and sassafras (*Sassafras albidum*). The shrub layer may be sparse to moderately dense (seldom >40% total cover), and is characterized by saplings of box-elder, spicebush (*Lindera benzoin*), multiflora rose (*Rosa multiflora*), wineberry (*Rubus phoenicolasius*), and privet (*Ligustrum vulgare*) (typically heavily browsed). The herbaceous layer is dominated by weedy exotics, particularly stiltgrass (*Microstegium vimineum*) and garlic mustard (*Alliaria petiolata*). Other typical herb species include mile-a-minute (*Polygonum perfoliatum*), low smartweed (*Polygonum caespitosum*), and white snakeroot (*Ageratina altissima (= Eupatorium rugosum)*). A characteristic of many stands in this type is the moderate to high cover of invasive (exotic and native) vine species. In particular, summer grape (*Vitis aestivalis*), oriental bittersweet (*Celastrus orbiculatus*), and Japanese honeysuckle (*Lonicera japonica*) may produce dense growths that strangle and smother shrubs and trees. In some instances, vines appear to be altering the forest structure through damage and mortality to canopy trees. Wisteria (*Wisteria* sp.) occurs west of the Washington Memorial Chapel, where it forms a near monotypic ground cover and is smothering standing canopy trees as well as woody plant regeneration.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Fraxinus americana, Juglans nigra, Robinia pseudoacacia*
Tree subcanopy	Broad-leaved deciduous tree	*Acer negundo, Ulmus americana*
Tall shrub/sapling	Broad-leaved deciduous shrub	*Acer negundo*
Herb (field)	Forb	*Alliaria petiolata*
Herb (field)	Graminoid	*Microstegium vimineum*

Characteristic Species: *C. orbiculatus, Juglans nigra, Lonicera japonica, Rubus phoenicolasius, Vitis aestivalis*
Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski

Plots: VAFO.1, VAFO.2, VAFO.3**,** VAFO.14, VAFO.15, VAFO.44, VAFO.46, VAFO.52, VAFO.54, VAFO.55, VAFO.60, VAFO.62, VAFO.65, VAFO.68, VAFO.70, VAFO.72, VAFO.76, VAFO.77, VAFO.80

Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Prunus serotina - Acer rubrum - Amelanchier canadensis - Quercus* spp. Forest Alliance (A.237)
Alliance (English name)	Black Cherry - Red Maple - Canada Serviceberry - Oak species Forest Alliance
Association	*Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana* Forest
Association (English name)	Black Cherry - Tuliptree - Red Maple - White Ash Forest

Ecological System(s):

None

GLOBAL DESCRIPTION

Concept Summary: This early-successional woody vegetation of the northeastern United States occurs on sites that have generally been cleared for agriculture. Environmental setting varies, but generally sites are dry-mesic to mesic, with small seepage inclusions in some examples. Physiognomy of this vegetation is highly variable, ranging from closed forest, open forest, tall dense shrubland, to more open tall shrubland. Early-successional woody species dominate the canopy in a widely variable mix, depending on geographic location. Tree species may include *Prunus serotina, Liriodendron tulipifera, Fraxinus americana,* and *Acer rubrum*. Other associates can include *Juglans nigra, Sassafras albidum, Betula populifolia, Juniperus virginiana, Acer negundo, Acer saccharinum, Ailanthus altissima, Ulmus americana, Quercus* spp., *Betula lenta, Amelanchier* spp., and *Robinia pseudoacacia*. Other woody species may contribute to the canopy or form a tall-shrub layer, including *Lindera benzoin* and *Carpinus caroliniana*. The low-shrub layer, if present, is usually characterized by the presence of *Rubus* spp. such as *Rubus flagellaris, Rubus allegheniensis, Rubus phoenicolasius,* or *Rubus hispidus*. This layer is often dominated by exotic species such as *Lonicera tatarica, Lonicera japonica, Rhamnus cathartica, Crataegus* spp., *Rosa multiflora,* and *Berberis thunbergii*. The herbaceous layer is variable, often containing grasses and forbs of both native and exotic origin.

Environmental Description: This vegetation occurs on sites that have been cleared for agriculture or otherwise heavily modified in the past. Generally sites are dry-mesic and may have small seepage inclusions in some examples.

Vegetation Description: *Information not available.*

Most Abundant Species:

Stratum	Lifeform	Species

Information not available.

Characteristic Species: *Information not available.*

Other Noteworthy Species: *Information not available.*
USFWS Wetland System: *Not applicable.*

DISTRIBUTION
Range: This vegetation is currently described from Pennsylvania but is of broader distribution in the northeastern U.S.
States/Provinces: NJ, NY, PA
Federal Lands: NPS (Fort Necessity, Johnstown Flood, Morristown, Valley Forge)

CONSERVATION STATUS
Rank: GNA (ruderal) (29-Nov-2004)
Reasons: This vegetation is modified by human activity and not of conservation concern.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 3 - Weak
Comments: This vegetation is broadly defined and varies widely in composition across its range, presenting a classification challenge at the alliance level.
Similar Associations: *Information not available*
Related Concepts: *Information not available*

SOURCES
Description Authors: L.A. Sneddon
References: Eastern Ecology Working Group n.d., Fike 1999.

Figure 10. Northeastern Modified Successional Forest at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 460943, northing 4437464.

Figure 11. Northeastern Modified Successional Forest at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 463389, northing 4439276.

Common Name (Park-specific): Dry Oak Forest

SYNONYMS:
NVC English Name: **Rock Chestnut Oak - (Northern Red Oak, Black Oak) / Northern Lowbush Blueberry Forest**
NVC Scientific Name: ***Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest**
NVC Identifier: **CEGL006282**

LOCAL INFORMATION

Environmental Description: This community occurs on well-drained soils on moderate to steep slopes; primarily on Mount Joy and Mount Misery.
Vegetation Description: This type is most common on the slopes of Mount Joy and Mount Misery within the park. The canopy is dominated by drought-tolerant chestnut oak (*Quercus prinus*) and black oak (*Quercus velutina*), with black gum (*Nyssa sylvatica*) and scarlet oak (*Quercus coccinea*) as occasional codominants. The subcanopy is characterized by moderate to dense cover of black gum, red maple (*Acer rubrum*), and sassafras (*Sassafras albidum*). The tall-shrub layer is often diagnostic for this type, characterized by moderate to dense cover of mountain laurel (*Kalmia latifolia*). In some stands, the tall-shrub layer is dominated by young black gum. Also common in the tall-shrub layer are red maple (*Acer rubrum*), sassafras (*Sassafras albidum*), and witch-hazel (*Hamamelis virginiana*). The low-shrub and herbaceous layers are typically very sparse or absent, presumably due to heavy deer browsing. The low-shrub layer, when present, is limited to seedlings of canopy trees and a few ericad species: lowbush blueberry (*Vaccinium pallidum*), black huckleberry (*Gaylussacia baccata*), and pink azalea (*Rhododendron periclymenoides*). Herbaceous plants typically occur as solitary individuals or small clumps, when present. Common herbaceous species include pipsissewa (*Chimaphila maculata*), hay-scented fern (*Dennstaedtia punctilobula*), marginal woodfern (*Dryopteris marginalis*), and Indian cucumber-root (*Medeola virginiana*).

On more moderate slopes and areas with more mesic soils, this community is more variable. Canopy dominants are still dry-site oaks (chestnut oak, black oak and scarlet oak) but may also include a greater proportion of other hardwood species, including white oak (*Quercus alba*), red maple, tuliptree (*Liriodendron tulipifera*), beech (*Fagus grandifolia*), and sassafras (*Sassafras albidum*). A subcanopy is usually present, characterized by a mix of hardwood species such as red maple, sassafras, beech, chestnut oak and black oak. Typical tall shrubs include flowering dogwood (*Cornus florida*), witch-hazel and mountain laurel. The tall-shrub layer varies from sparse to abundant, with flowering dogwood exceeding 50% cover in some locations. The low-shrub and herbaceous layers are very sparse to nearly absent, presumably the result of intense deer browsing. The low-shrub layer is characterized by seedlings of the canopy and subcanopy woody species. Typical herb species include garlic mustard (*Alliaria petiolata*), stiltgrass (*Microstegium vimineum*), and Pennsylvania sedge (*Carex pensylvanica*).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Quercus prinus, Quercus velutina*
Tree subcanopy	Broad-leaved deciduous tree	*Nyssa sylvatica*

Characteristic Species: *Kalmia latifolia, Quercus prinus, Quercus velutina*

Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski
Plots: VAFO.5, VAFO.8, VAFO..9, VAFO.11, VAFO.12, VAFO.17, VAFO.18, VAFO.19, VAFO.21, VAFO.23, VAFO.24, VAFO.25, VAFO.27, VAFO.29, VAFO.30,.VAFO.58, VAFO.75
Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural cold-deciduous forest (I.B.2.N.)
Formation	Lowland or submontane cold-deciduous forest (I.B.2.N.a.)
Alliance	*Quercus prinus - (Quercus coccinea, Quercus velutina)* Forest Alliance (A.248)
Alliance (English name)	Rock Chestnut Oak - (Scarlet Oak, Black Oak) Forest Alliance
Association	*Quercus prinus - Quercus (rubra, velutina) / Vaccinium angustifolium* Forest
Association (English name)	Rock Chestnut Oak - (Northern Red Oak, Black Oak) / Northern Lowbush Blueberry Forest

Ecological System(s):

Central Appalachian Dry Oak-Pine Forest (CES202.591)

GLOBAL DESCRIPTION

Concept Summary: This dry to xeric chestnut oak forest of central and southern New England ranges south to the northern Piedmont and central Appalachian Mountains. It occurs on upper slopes and ridgetops with thin, nutrient-poor, acidic soils. Windthrow, fire and ice damage are common natural disturbances. The canopy is closed to partially open and is dominated by *Quercus prinus*, which can be codominant with *Quercus rubra* or *Quercus velutina*. *Quercus alba* and *Acer rubrum* are common associates, with other less frequent trees, including *Betula lenta, Quercus coccinea, Amelanchier arborea, Pinus rigida*, and *Pinus strobus*. *Sassafras albidum, Cornus florida*, and *Nyssa sylvatica* can be minor associates at the southern and western portions of the range, and *Liriodendron tulipifera* may occur in the northern Piedmont portion of the range. The low-shrub layer is well-developed and comprised chiefly of ericaceous species, including *Vaccinium angustifolium* (in the northern and higher elevation portions of the range), *Vaccinium pallidum, Vaccinium stamineum, Gaylussacia baccata*, or *Kalmia angustifolia*. A tall-shrub layer is generally lacking but, when present, may include *Castanea dentata, Kalmia latifolia, Viburnum acerifolium, Hamamelis virginiana*, and *Viburnum prunifolium*. *Ilex montana, Rhododendron prinophyllum*, and *Menziesia pilosa* are minor shrub associates at the southern end of the range. The herbaceous layer is of sparse to moderate cover and may include *Carex pensylvanica, Deschampsia flexuosa, Danthonia spicata, Antennaria plantaginifolia, Aralia nudicaulis, Aureolaria laevigata, Gaultheria procumbens, Chimaphila maculata, Carex rosea, Corydalis sempervirens, Comandra umbellata, Cypripedium acaule, Epigaea repens,*

Goodyera pubescens, Hieracium venosum, Medeola virginiana, Maianthemum canadense, Melampyrum lineare, Monotropa uniflora, Potentilla canadensis, Pteridium aquilinum, and *Uvularia sessilifolia*.

Environmental Description: This forest generally occurs on xeric upper slopes and ridgetops and steep sideslopes with shallow, acidic, infertile soils. Windthrow, fire, and ice storms are common natural disturbances in these habitats.

Vegetation Description: The canopy is dominated by *Quercus prinus*, which can be codominant with *Quercus rubra*. *Quercus alba, Quercus velutina,* and *Acer rubrum* are common associates, with other less frequent trees including *Betula lenta, Quercus coccinea, Amelanchier arborea, Pinus rigida,* and *Pinus strobus*. *Sassafras albidum, Cornus florida,* and *Nyssa sylvatica* can be minor associates at the southern and western portions of the range. The low-shrub layer is well-developed and comprised chiefly of ericaceous species, including *Vaccinium angustifolium, Vaccinium pallidum, Vaccinium stamineum, Gaylussacia baccata,* or *Kalmia angustifolia*. A tall-shrub layer is generally lacking but when present may include *Castanea dentata, Kalmia latifolia, Viburnum acerifolium, Hamamelis virginiana,* and *Viburnum prunifolium*. *Ilex montana, Rhododendron prinophyllum,* and *Menziesia pilosa* are minor shrub associates at the southern end of the range. The herbaceous layer is of sparse to moderate cover and may include *Carex pensylvanica, Deschampsia flexuosa, Danthonia spicata, Antennaria plantaginifolia, Aralia nudicaulis, Aureolaria laevigata, Gaultheria procumbens, Chimaphila maculata, Carex rosea, Corydalis sempervirens, Comandra umbellata, Cypripedium acaule, Epigaea repens, Goodyera pubescens, Hieracium venosum, Medeola virginiana, Melampyrum lineare, Monotropa uniflora, Potentilla canadensis, Pteridium aquilinum,* and *Uvularia sessilifolia*.

Most Abundant Species:

Stratum	Lifeform	Species
Information not available.		

Characteristic Species: *Acer rubrum*, *Amelanchier arborea*, *Betula papyrifera* var. *cordifolia*, *Castanea dentata, Cornus canadensis, Gaultheria procumbens, Hexastylis virginica*, *Ilex montana*, *Kalmia latifolia*, *Menziesia pilosa*, *Nyssa sylvatica*, *Quercus coccinea*, *Quercus prinus, Quercus velutina, Rhododendron periclymenoides, Rhododendron prinophyllum*, *Sassafras albidum, Vaccinium angustifolium, Vaccinium pallidum.*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System: *Not applicable.*

DISTRIBUTION

Range: This community ranges from southern Maine to Virginia and West Virginia through the Central Appalachians, and north more locally in the Piedmont.

States/Provinces: CT, DE, MA, MD, ME, NH, NJ:S3S4, NY, PA, RI, VA, VT, WV

Federal Lands: NPS (Blue Ridge Parkway, Harpers Ferry, Morristown, Rock Creek, Valley Forge, Weir Farm); USFS (George Washington, Jefferson)

CONSERVATION STATUS

Rank: G5 (1-Oct-2001)

Reasons: This is a very widely distributed oak / ericad forest that covers large areas.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: This community type is closely related to other oak / heath. It is distinguished by the presence of northern species such as *Pinus strobus* and *Vaccinium angustifolium*, and its general lack of southern Appalachian species such as *Gaylussacia ursina, Leucothoe recurva*, and *Galax urceolata*. In comparison to *Quercus prinus - Quercus (alba, coccinea, velutina) / Viburnum acerifolium - (Kalmia latifolia)* Forest (CEGL005023), it lacks *Oxydendrum arboreum, Pinus echinata*, and *Pinus virginiana*. It occupies poorer sites and has a more abundant ericaceous shrub component than *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057) and *Quercus prinus - Quercus velutina / Oxydendrum arboreum - Cornus florida* Forest (CEGL008522). The Chestnut Oak / Low-Elevation Subtype of Virginia intergrades with the more southern *Quercus (prinus, coccinea) / Kalmia latifolia / (Galax urceolata, Gaultheria procumbens)* Forest (CEGL006271) throughout west-central Virginia. A well-developed Piedmont example of the Chestnut Oak / Low-Elevation Subtype is described by Allard and Leonard (1943). The Chestnut Oak - Northern Red Oak / High-Elevation Subtype of Virginia is similar to *Quercus rubra - (Quercus prinus, Quercus velutina) / Rhododendron periclymenoides / Lysimachia quadrifolia - Hieracium paniculatum* Forest (CEGL008523) of high-elevation granitic terrain on the Northern Blue Ridge, but lacks *Quercus velutina, Rhododendron periclymenoides*, and the suite of low-cover herbaceous species characteristic of mineral soil microhabitats in that unit.

The recognition of global subtypes equivalent to two distinct state community types is well supported by quantitative analysis of compositional and environmental data. Further study may support the elevation of these subtypes to full association-level status in the USNVC.

Similar Associations:

- *Quercus (alba, rubra, velutina) / Cornus florida / Viburnum acerifolium* Forest (CEGL006336)--is similar to the more mesic end of the range of variation found in this type at Valley Forge National Historical Park.
- *Quercus (prinus, coccinea) / Kalmia latifolia / (Galax urceolata, Gaultheria procumbens)* Forest (CEGL006271)--of Southern Appalachians.
- *Quercus prinus - (Quercus coccinea, Quercus velutina) / Kalmia latifolia / Vaccinium pallidum* Forest (CEGL006299)
- *Quercus prinus - Quercus (alba, coccinea, velutina) / Viburnum acerifolium - (Kalmia latifolia)* Forest (CEGL005023)--of Western Alleghenies, Interior Low Plateau, etc.
- *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057)
- *Quercus prinus - Quercus* spp. / *Vaccinium arboreum - (Kalmia latifolia, Styrax grandifolius)* Forest (CEGL007700)
- *Quercus prinus - Quercus velutina / Oxydendrum arboreum - Cornus florida* Forest (CEGL008522)
- *Quercus rubra - (Quercus prinus, Quercus velutina) / Rhododendron periclymenoides / Lysimachia quadrifolia - Hieracium paniculatum* Forest (CEGL008523)

Related Concepts:

- *Quercus prinus - Quercus rubra / Acer pensylvanicum* Association: *Betula lenta / Ilex montana* Subassociation (Fleming and Moorhead 1996) ?
- *Quercus prinus - Quercus rubra / Kalmia latifolia / Vaccinium angustifolium - Gaultheria procumbens* Forest (Fleming and Coulling 2001) F
- *Quercus velutina - (Quercus prinus)* Forest (Metzler and Barrett 1996) ?
- CNE dry hardwood forest on acidic bedrock or till (Rawinski 1984) ?
- Chestnut Oak Forest (Breden 1989) = Chestnut Oak: 44 (Eyre 1980) B
- Dry Oak Woodland (Thompson 1996) B
- SNE dry oak/pine forests on acidic bedrock or till (Rawinski 1984) B
- SNE mesic oak/pine forest on acidic bedrock or till (Rawinski 1984) ?

SOURCES

Description Authors: G. Fleming and P. Coulling, mod. S.L. Neid and L.A. Sneddon

References: Allard and Leonard 1943, Breden 1989, Breden et al. 2001, Clancy 1996, Collins and Anderson 1994, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Eyre 1980, Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming and Moorhead 2000, Fleming et al. 2001, Gawler 2002, Harshberger 1919, Hunt 1997, Kasmer et al. 1984, Keever 1973, Metzler and Barrett 1996, Metzler and Barrett 2001, Nerurkar 1974, Overlease 1978, Overlease 1987, Pearson 1963, Pearson 1974, Pearson 1979, Rawinski 1984, Rawinski et al. 1994, Rawinski et al. 1996, Russell and Schuyler 1988, Shreve et al. 1910, Sperduto 1997a, Sperduto 2000a, Sperduto and Nichols 2004, Swain and Kearsley 2000, Thompson 1996, Thompson and Sorenson 2000, Vanderhorst 2000b.

Figure 12. Dry Oak Forest at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 461246, northing 4437832.

Figure 13. Dry Oak Forest at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 460723, northing 4437578.

Figure 14. Dry Oak Forest (mesic variant) at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 462193, northing 4440211.

Common Name (Park-specific): Silver Maple Floodplain Forest

SYNONYMS:
NVC English Name: Silver Maple Temporarily Flooded Forest
NVC Scientific Name: *Acer saccharinum* Temporarily Flooded Forest [Placeholder]
NVC Identifier: CEGL007304

LOCAL INFORMATION

Environmental Description: This type occurs along the Schuylkill River floodplain where it receives at least seasonal flooding.
Vegetation Description: Aside from silver maple (*Acer saccharinum*), which is usually dominant, other trees may include river birch (*Betula nigra*), box-elder (*Acer negundo*), American elm (*Ulmus americana*), and sycamore (*Platanus occidentalis*). Shrubs may include silky dogwood (*Cornus amomum*), swamp dogwood (*Cornus racemosa*), spicebush (*Lindera benzoin*), American elder (*Sambucus canadensis*), northern arrow-wood (*Viburnum recognitum*), and multiflora rose (*Rosa multiflora*). Herbs include false stinging nettle (*Boehmeria cylindrica*), sedges (*Carex* spp.), false pepper-smartweed (*Polygonum hydropiperoides*), stiltgrass (*Microstegium vimineum*), and often garlic mustard (*Alliaria petiolata*). Vines may be abundant, particularly poison-ivy (*Toxicodendron radicans*).
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Acer saccharinum*
Shrub/sapling (tall & short)	Vine/Liana	*Toxicodendron radicans*
Herb (field)	Forb	*Alliaria petiolata*
Herb (field)	Graminoid	*Microstegium vimineum*

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski
Plots: VAFO.57
Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural cold-deciduous forest (I.B.2.N.)
Formation	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Acer saccharinum* Temporarily Flooded Forest Alliance (A.279)
Alliance (English name)	Silver Maple Temporarily Flooded Forest Alliance
Association	*Acer saccharinum* Temporarily Flooded Forest [Placeholder]
Association (English name)	Silver Maple Temporarily Flooded Forest

Ecological System(s): *Information not available.*

GLOBAL DESCRIPTION

Concept Summary: This is a placeholder for silver maple flooded forests in Virginia.
Environmental Description: *Information not available.*
Vegetation Description: *Information not available.*
Most Abundant Species:

Stratum	Lifeform	Species
Information not available.		

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Information not available.*
USFWS Wetland System: Palustrine

DISTRIBUTION

Range: These forests occur across southern New England to New York and Pennsylvania and probably into Virginia.
States/Provinces: PA, VA
Federal Lands: NPS (Valley Forge)

CONSERVATION STATUS

Rank: GNR (3-Sep-2002)
Reasons: This conceptual placeholder type cannot be ranked until its concept and range are clarified and better defined.

CLASSIFICATION INFORMATION

Status: Nonstandard
Confidence: 3 - Weak
Comments: *Information not available.*
Similar Associations:

- *Acer saccharinum - (Populus deltoides) / Matteuccia struthiopteris - Laportea canadensis* Forest (CEGL006147)--is also dominated by silver maple but lacks *Platanus occidentalis* and *Betula nigra* (which are often present in small numbers in the present type) and has a dense fern layer dominated by *Matteuccia struthiopteris*.
- *Acer saccharinum - Ulmus americana - (Populus deltoides)* Forest (CEGL002586)--occurs in the Midwest; the relationship to this type needs further clarification.
- *Acer saccharinum / Onoclea sensibilis - Boehmeria cylindrica* Forest (CEGL006176)--tends to be in settings where flooding is of somewhat longer duration; it typically has the herb layer dominated by *Onoclea sensibilis*.

Related Concepts: *Information not available.*

SOURCES

Description Authors: L.A. Sneddon
References: Edinger et al. 2002, Fike 1999, Metzler and Barrett 1982, Overlease 1987, Southeastern Ecology Working Group n.d.

Figure 15. Silver Maple Floodplain Forest at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 462922, northing 4440184 (location of camera, looking south across Schuylkill River).

Figure 16. Silver Maple Floodplain Forest at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 462151, northing 4440043.

Common Name (Park-specific): Riverine Floodplain Forest

SYNONYMS:
NVC English Name: **Sycamore - Green Ash Forest**
NVC Scientific Name: **Platanus occidentalis - Fraxinus pennsylvanica Forest**
NVC Identifier: **CEGL006036**

LOCAL INFORMATION

Environmental Description: This community occurs primarily on the Schuylkill River floodplain but may also occur elsewhere in the park along small streams and poorly drained depressions.

Vegetation Description: The characteristic canopy trees are green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), and silver maple (*Acer saccharinum*). Other trees that may occur in this community include black walnut (*Juglans nigra*), box-elder (*Acer negundo*), river birch (*Betula nigra*), and the non-native tree-of-heaven (*Ailanthus altissima*). The subcanopy is variable, with the most common species being box-elder, green ash, silver maple, and American elm (*Ulmus americana*). The shrub layer is variable in cover, from nearly absent to moderately dense. Typical shrub species include spicebush (*Lindera benzoin*), multiflora rose (*Rosa multiflora*), raspberries (*Rubus* spp.), and saplings of canopy and subcanopy species. The herbaceous layer is also variable in cover from nearly bare ground to dense. Characteristic herbaceous species include stiltgrass (*Microstegium vimineum*), lesser celandine (*Ranunculus ficaria*), rice cutgrass (*Leersia* spp.), nettle (*Urtica dioica*), false nettle (*Boehmeria cylindrica*), false water-pepper (*Polygonum hydropiperoides*), and Pennsylvania water-pepper (*Polygonum pensylvanicum*). Non-native species are more abundant than native herbs. Vines are usually present, sometimes at high total cover, with characteristic species including Japanese honeysuckle (*Lonicera japonica*), Oriental bittersweet (*Celastrus orbiculatus*), and wild grapes (*Vitis* spp.).

Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Fraxinus pennsylvanica, Platanus occidentalis, Ulmus americana*
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Lindera benzoin, Rosa multiflora*
Shrub/sapling (tall & short)	Vine/Liana	*C. orbiculatus, Lonicera japonica*
Herb (field)	Graminoid	*Microstegium vimineum*

Characteristic Species: *Acer negundo, Fraxinus pennsylvanica, Microstegium vimineum*
Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski
Plots: VAFO.45, VAFO.48, VAFO.51, VAFO.47, VAFO.39, VAFO.42, VAFO.38, VAFO.53, VAFO.64, VAFO.71
Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION

Physiognomic Class	Forest (I)
Physiognomic Subclass	Deciduous forest (I.B.)
Physiognomic Group	Cold-deciduous forest (I.B.2.)
Physiognomic Subgroup	Natural cold-deciduous forest (I.B.2.N.)
Formation	Temporarily flooded cold-deciduous forest (I.B.2.N.d.)
Alliance	*Platanus occidentalis - (Fraxinus pennsylvanica, Celtis laevigata, Acer saccharinum)* (A.288) Temporarily Flooded Forest Alliance
Alliance (English name)	Sycamore - (Green Ash, Sugarberry, Silver Maple) Temporarily Flooded Forest Alliance
Association	*Platanus occidentalis - Fraxinus pennsylvanica* Forest
Association (English name)	Sycamore - Green Ash Forest

Ecological System(s): *Information not available.*

GLOBAL DESCRIPTION

Concept Summary: *Platanus occidentalis* floodplain forests of the northeastern United States. It is a broadly defined successional or young version of medium-gradient river floodplain forest occurring on cobble substrate. The canopy is closed to somewhat open and usually dominated by *Platanus occidentalis*. *Populus deltoides, Acer saccharinum,* and *Ulmus americana* are usually present but not common, and occasionally *Acer negundo, Juglans cinerea, Carya cordiformis, Celtis occidentalis,* and *Acer rubrum*. Shrubs or subcanopy are variable depending on geography and can include *Carpinus caroliniana, Salix nigra, Lindera benzoin,* or *Alnus serrulata,* plus exotic invasives like *Rosa multiflora* and *Lonicera morrowii*. The herbaceous layer tends to be sparse to locally abundant and can include *Matteuccia struthiopteris, Osmunda cinnamomea, Onoclea sensibilis, Geum canadense, Impatiens pallida, Boehmeria cylindrica, Urtica dioica, Solidago rugosa, Ageratina altissima (= Eupatorium rugosum),* plus vines species *Toxicodendron radicans* and *Parthenocissus quinquefolia*. There is typically a very high component of disturbance-tolerant exotic species such as *Lysimachia nummularia, Glechoma hederacea, Hesperis matronalis, Aegopodium podagraria, Polygonum cuspidatum,* and *Alliaria petiolata*.

Environmental Description: Early successional forest occurring on cobble or sand substrate of floodplain islands or cobble shores of moderate- to high-energy rivers.

Vegetation Description: Closed to somewhat open canopy floodplain forest dominated by *Platanus occidentalis*. *Populus deltoides, Acer saccharinum,* and *Ulmus americana* are usually present but not common, and occasionally *Acer negundo, Juglans cinerea, Carya cordiformis, Celtis occidentalis,* and *Acer rubrum*. Shrubs or subcanopy are variable depending on geography and can include *Carpinus caroliniana, Salix nigra, Lindera benzoin,* or *Alnus serrulata,* plus exotic invasives like *Rosa multiflora* and *Lonicera morrowii*. The herbaceous layer tends to be sparse to locally abundant and can include *Matteuccia struthiopteris, Osmunda cinnamomea, Onoclea sensibilis, Geum canadense, Impatiens pallida, Boehmeria cylindrica, Urtica dioica, Solidago rugosa, Ageratina altissima (= Eupatorium rugosum),* plus vines species *Toxicodendron radicans* and *Parthenocissus quinquefolia*. There is typically a very high component of disturbance-tolerant exotic species such as *Lysimachia nummularia, Glechoma hederacea, Hesperis matronalis, Aegopodium podagraria, Polygonum cuspidatum,* and *Alliaria petiolata*.

Most Abundant Species:
Information not available.

Stratum	Lifeform	Species

Characteristic Species: *Information not available.*
Other Noteworthy Species: *Information not available.*
USFWS Wetland System: Palustrine

DISTRIBUTION
Range: This association ranges from New England south to Pennsylvania.
States/Provinces: CT, DC, DE:S3S4, MA, NH, NY, RI, VT
Federal Lands: NPS (Rock Creek, Valley Forge)

CONSERVATION STATUS
Rank: GNR (1-Dec-1997)
Reasons: Rank has not been determined but total acreage (rangewide) is limited. Good quality examples are uncommon. Threats include development and filling, alteration in flooding regimes, excessive beaver activity and encroachment by aggressive non-native plant species. Further data are needed to define the rank.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 3 - Weak
Comments: This type is not tracked as a separate floodplain element in Vermont.
Similar Associations:
- *Acer saccharinum - (Populus deltoides) / Matteuccia struthiopteris - Laportea canadensis* Forest (CEGL006147)--is characterized by a stronger dominance of both *Acer saccharinum* and *Matteuccia struthiopteris* and has fewer early-successional species.
- *Betula nigra - Platanus occidentalis / Impatiens pallida* Forest (CEGL006184)--southern species present, plus canopy with *Betula nigra*.

Related Concepts: *Information not available.*

SOURCES
Description Authors: S.L. Neid
References: Clancy 1996, Eastern Ecology Working Group n.d., Edinger et al. 2002, Enser 1999, Fike 1999, Frye and Quinn 1979, Kearsley 1999b, Metzler and Barrett 2001, Newbold 1994, Newbold et al. 1988, Nichols et al. 2001, Overlease 1978, Overlease 1987, Russell and Schuyler 1988, Sperduto 2000a, Sperduto 2000b, Swain and Kearsley 2000, Thompson and Sorenson 2000, Wistendahl 1958.

Figure 17. Riverine Floodplain Forest at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 461296, northing 4439681.

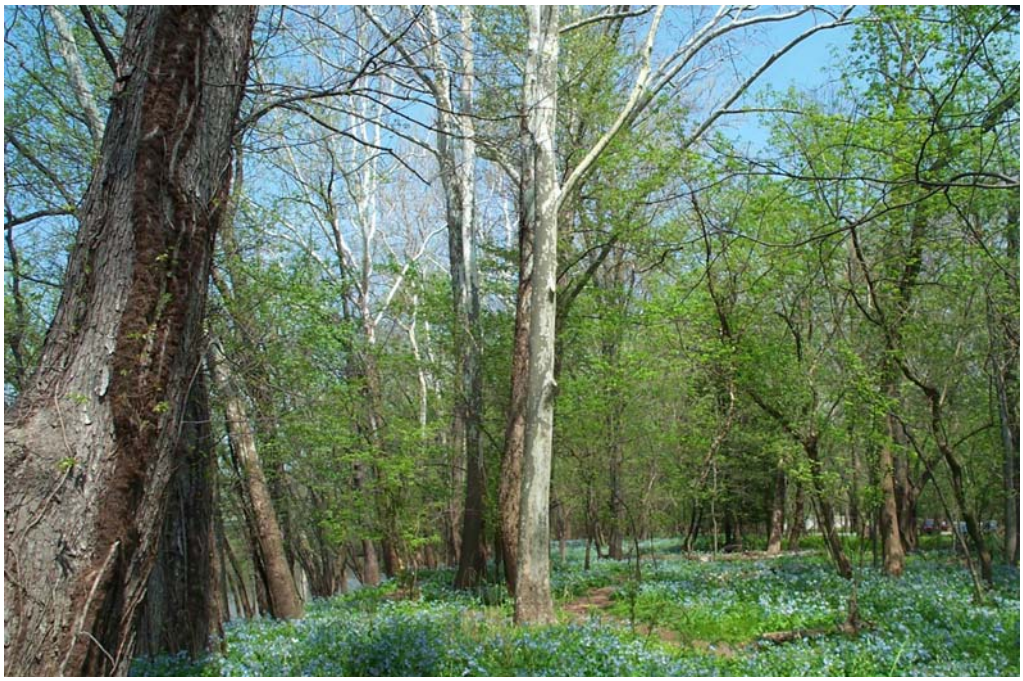

Figure 18. Riverine Floodplain Forest at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 459890, northing 4440401.

Common Name (Park-specific): Chestnut Oak - Black Birch Talus Slope

SYNONYMS:
NVC English Name: **Rock Chestnut Oak - Sweet Birch / Virginia Creeper Talus Woodland**
NVC Scientific Name: ***Quercus prinus - Betula lenta / Parthenocissus quinquefolia*** **Talus Woodland**
NVC Identifier: **CEGL006565**

LOCAL INFORMATION

Environmental Description: This community type occurs along east-facing scree slopes on Mount Misery. Moderate to steeply sloping rock/boulderfields with very little soil characterize the substrate. The tree canopy is limited to areas transitional from open talus to the adjacent oak woods, and much of the slopes are only sparsely vegetated.
Vegetation Description: At Valley Forge this community is characterized by a sparse herbaceous layer, limited to scattered individuals or clumps of jack-in-the-pulpit (*Arisaema triphyllum*), marginal woodfern (*Dryopteris marginalis*) and stiltgrass (*Microstegium vimineum*). Woody vegetation is rare and mostly occurs at the periphery of the open scree areas. Tree species include black cherry (*Prunus serotina*), red maple (*Acer rubrum*), sweet birch (*Betula lenta*), black gum (*Nyssa sylvatica*), and black oak (*Quercus velutina*). Characteristic tall-shrub or small-tree species include serviceberry (*Amelanchier arborea*), witch-hazel (*Hamamelis virginiana*) and mountain laurel (*Kalmia latifolia*). Low shrubs are nearly absent.
Most Abundant Species:

Stratum	Lifeform	Species
Tree canopy	Broad-leaved deciduous tree	*Betula lenta, Prunus serotina*
Tall shrub/sapling	Broad-leaved evergreen shrub	*Kalmia latifolia*
Herb (field)	Fern	*Dryopteris marginalis*

Characteristic Species: *Betula lenta*
Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski
Plots: VAFO.22.
Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION

Physiognomic Class	Woodland (II)
Physiognomic Subclass	Deciduous woodland (II.B.)
Physiognomic Group	Cold-deciduous woodland (II.B.2.)
Physiognomic Subgroup	Natural cold-deciduous woodland (II.B.2.N.)
Formation	Cold-deciduous woodland (II.B.2.N.a.)
Alliance	*Quercus rubra - Quercus prinus* Woodland Alliance (A.624)
Alliance (English name)	Northern Red Oak - Rock Chestnut Oak Woodland Alliance
Association	*Quercus prinus - Betula lenta / Parthenocissus quinquefolia* Talus Woodland

Association (English name) Rock Chestnut Oak - Sweet Birch / Virginia Creeper Talus Woodland

Ecological System(s):

North-Central Appalachian Acidic Cliff and Talus (CES202.601)

GLOBAL DESCRIPTION

Concept Summary: This talus or rocky slope woodland community occurs in the central Appalachian Mountains and extends west to the Western Allegheny Plateau in Pennsylvania. The substrate is generally quartzite or sandstone talus and usually sloping, but the type also occurs on benches, ridges, and boulderfields. Soils, where present, are shallow, organic, acidic and infertile. The canopy is of variable cover but generally open with gnarled, widely spaced trees. Characteristic trees are birches, primarily *Betula lenta* but less frequently including *Betula papyrifera, Betula populifolia,* or *Betula alleghaniensis,* as well as *Nyssa sylvatica*. Other tree associates may include *Tsuga canadensis, Acer rubrum, Carya glabra, Quercus prinus, Quercus alba, Quercus rubra, Quercus velutina,* or *Quercus coccinea*. Typical shrubs include *Acer spicatum, Acer pensylvanicum, Amelanchier arborea, Castanea dentata, Kalmia latifolia, Hamamelis virginiana, Menziesia pilosa, Ribes rotundifolium, Vaccinium angustifolium, Vitis* spp., *Toxicodendron radicans, Smilax rotundifolia,* and *Parthenocissus quinquefolia*. Ferns characterize the herb layer and may include *Dryopteris marginalis, Polypodium virginianum, Woodsia obtusa,* or *Asplenium platyneuron*. The forbs *Aralia nudicaulis, Heuchera* spp., and *Scutellaria saxatilis* are also well-adapted to the bouldery habitats. Lichens, especially the rock-tripes *Lasallia papulosa* and *Umbilicaria mammulata*, characterize the nonvascular layer.

Environmental Description: Sites include the edges of very large, unvegetated (except for lichens), scarcely weathered block fields, as well as a variety of more weathered boulderfields and slopes covered by coarse to fine, bouldery colluvium. Much of the bouldery rubble is weathered from resistant quartzite or sandstone caprock. The elevation range of plot-sampled stands in Virginia is 420 to 1025 m (1380-3360 feet). Slope position and aspect are variable, while associated landforms include landslide scarps, slide masses, concave hollow heads, and incised hollow bottoms. Mean cover of exposed boulders at Virginia sampling sites is 72%. In this very rocky environment, soil is limited to local, interstitial, root-rich duff deposits, or to "pads" of moss and underlying, thin, organic / sandy material that have developed on wide, flat boulder surfaces. Interstitial air spaces between boulders may be prevalent for 1.0 m or more below the surface. Soils are largely organic and usually extremely acidic and infertile. There is often some heterogeneity of boulder depth and weathering, as well as of microclimate and soil moisture, within boulderfields. In general, sites are somewhat xeric and show little evidence of subsurface drainage. However, this regime is ameliorated by higher elevations and north aspects, which probably slow evaporation and increase the moisture-holding capacity of the bouldery substrate.

Vegetation Description: Physiognomy varies from nearly closed forest to open woodland with widely spaced trees. The canopy is dominated by more-or-less gnarled specimens of *Betula lenta* and *Quercus prinus* generally <20 m tall. *Betula lenta* is usually the sole dominant of less weathered, steeper, more unstable boulderfield habitats, while a greater variety of trees is often codominant with *Betula lenta* on more weathered and stable habitats. Other overstory associates that may be important on some sites are *Quercus rubra, Nyssa sylvatica, Betula populifolia, Betula papyrifera var. cordifolia, Carya glabra, Tsuga canadensis,* and *Betula alleghaniensis*. The presence of well-preserved, fallen boles indicates that *Castanea dentata* was important on some boulderfields prior to the arrival of chestnut blight (Fleming and Moorhead 2000). *Acer*

rubrum and *Nyssa sylvatica* are scattered canopy associates and frequent understory species. The typically open shrub layer contains *Acer pensylvanicum, Acer spicatum, Amelanchier arborea, Castanea dentata* sprouts, *Hamamelis virginiana, Ilex montana, Kalmia latifolia, Menziesia pilosa*, and *Ribes rotundifolium*. The herb layer consists almost entirely of low-statured shrubs, particularly *Menziesia pilosa* and *Vaccinium angustifolium*, and/or scattered to abundant vines of *Parthenocissus quinquefolia, Vitis* spp., *Toxicodendron radicans*, and *Smilax rotundifolia*. Flat, mossy boulders provide rooting habitats for a few specially adapted herbaceous plants such as *Polypodium appalachianum, Dryopteris marginalis, Heuchera* spp., *Aralia nudicaulis*, and *Scutellaria saxatilis*. Bryophyte cover ranges up to 65% in some microhabitats. The rock-tripes *Lasallia papulosa* and *Umbilicaria mammulata* are generally the most conspicuous lichens. The combination of surficial boulder cover and nutrient-poor substrate results in a notably low mean species richness (n = 22 taxa per 400 square meters) in Virginia plot samples of this type.

Most Abundant Species:

Stratum	Lifeform	Species

Information not available.

Characteristic Species: *Acer spicatum, Aralia nudicaulis, Betula lenta, Betula papyrifera* var. *cordifolia, Dryopteris marginalis, Menziesia pilosa, Parthenocissus quinquefolia, Polypodium appalachianum, Quercus prinus, Ribes rotundifolium, Scutellaria saxatilis, Vaccinium angustifolium*

Other Noteworthy Species: *Gymnocarpium appalachianum, Heuchera americana* var. *hispida*

USFWS Wetland System: *Not applicable.*

DISTRIBUTION

Range: This community occurs locally throughout the Blue Ridge and Ridge and Valley sections of Pennsylvania, Virginia, West Virginia, and Maryland. In Virginia, it reaches optimal development on sideslopes of linear sandstone and quartzite strike ridges in the Ridge and Valley, and on the western, metasedimentary flank of the northern Blue Ridge. Landsliding and debris avalanches, which generate and regenerate boulderfield environments, are dominant erosional processes in these landscapes (Hack and Goodlett 1960).

States/Provinces: MD, PA, VA:S3S4, WV

Federal Lands: NPS (Catoctin Mountain, Harpers Ferry, Shenandoah, Valley Forge); USFS (George Washington, Jefferson)

CONSERVATION STATUS

Rank: G3G4 (9-Aug-2004)

Reasons: Although this community type occurs in small patches over a limited geographic range, there are probably >200 sites (if not many hundreds of sites) in Virginia and West Virginia alone. Moreover, stands occupy rugged habitats that are not prone to anthropogenic disturbances.

CLASSIFICATION INFORMATION

Status: Standard

Confidence: 2 - Moderate

Comments: This vegetation type is poorly represented by plot data and additional sampling is needed, particularly of lower elevation and south-slope stands. Even with limited data, potential variants of the type in Virginia were proposed by Fleming and Moorhead (2000). A variant of sheltered north slopes in which *Tsuga canadensis* is codominant with *Betula lenta* and/or

Quercus spp. has been reported from Virginia by Hupp (1983) and from Pennsylvania by Fike (1999). Many Virginia populations of the state-rare, northern tree *Betula papyrifera var. cordifolia* are associated with this community type.

This boulderfield woodland represents a long-term sere in the geomorphic and vegetational progression from exposed, lichen-dominated block fields to fully forested mountain slopes with well-developed mineral soils. In addition to edaphic stresses, trees of these habitats are subject to frequent damage from wind and ice storms. Boundaries between the boulderfield woodlands and adjacent forests are often obscure, with composition gradually changing along with substrate conditions and soil depth. This type frequently intergrades with several communities of the Mixed Oak / Heath Forests group, especially *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057) of somewhat sheltered, often very rocky slopes.

Similar Associations:

- *Betula alleghaniensis - Quercus rubra / Polypodium virginianum* Woodland (CEGL006320)--is known from ME, NH, VT, NY, PA and perhaps NJ, is similar but more northern in character; it lacks *Betula lenta, Nyssa sylvatica*, and *Kalmia latifolia*.
- *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057)--of somewhat sheltered, often very rocky slopes.

Related Concepts:

- *Betula lenta / Parthenocissus quinquefolia* Association (Rawinski et al. 1996) ?
- *Betula lenta / Ribes rotundifolium - Menziesia pilosa / Parthenocissus quinquefolia - Polypodium appalachianum* Woodland (Fleming and Coulling 2001) ?
- *Quercus rubra - Quercus montana - Betula lenta / Ilex montana / Menziesia pilosa* Forest (Fleming and Moorhead 2000) ?
- *Quercus rubra - Quercus montana - Betula lenta / Parthenocissus quinquefolia* Forest (Fleming and Moorhead 2000) ?

SOURCES

Description Authors: G. Fleming and P. Coulling

References: Anderson et al. 1998, Eastern Ecology Working Group n.d., Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Hack and Goodlett 1960, Hupp 1983, Lea 2003, Rawinski et al. 1996, Russell and Schuyler 1988, VADNH 2003.

Figure 19. Chestnut Oak – Black Birch Talus Slope at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 461032, northing 4438014.

Figure 20. Chestnut Oak – Black Birch Talus Slope at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 461036, northing 4437943.

Common Name (Park-specific): Grassland

SYNONYMS:
NVC English Name: Orchard Grass - Sheep-sorrel Herbaceous Vegetation
NVC Scientific Name: *Dactylis glomerata - Rumex acetosella* Herbaceous Vegetation
NVC Identifier: CEGL006107

LOCAL INFORMATION

Environmental Description: This community is found throughout the park as regularly mowed fields (mowed grass), seasonally mowed fields (tall grass) and as smaller patches within successional old fields. This community may also be present in larger forest gaps within the park.

Vegetation Description: This community is found throughout the park in as regularly mowed fields (mowed grass), seasonally mowed fields(tall grass) and as smaller patches within successional old fields. This community may also be present in larger forest gaps within the park. The grassland type is characterized the predominance of herbaceous graminoid species and the virtual lack of woody species. Typical dominant grasses include red fescue (*Festuca rubra*), knotroot-foxtail grass (*Setaria parviflora (= Setaria geniculata)*), panicgrass (*Panicum anceps*), broom-sedge (*Andropogon virginicus*), redtop (*Agrostis gigantea*), tall fescue (*Lolium pratense (= Festuca elatior)*), orchard grass (*Dactylis glomerata*), and purpletop (*Tridens flavus*). Patches of vines may occur in this type, occasionally reaching several meters in diameter. Typical vines include Japanese honeysuckle (*Lonicera japonica*), wild grapes (*Vitis* spp.), oriental bittersweet (*Celastrus orbiculatus*), and poison-ivy (*Toxicodendron radicans*). Woody plants, when present, are limited to occasional seedlings and saplings resprouting after seasonal mowing. Typical woody species are apple (*Malus sylvestris*), multiflora rose (*Rosa multiflora*), and dewberry (*Rubus* sp.).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Andropogon virginicus, Dactylis glomerata*

Characteristic Species: *Andropogon virginicus, Dactylis glomerata, Tridens flavus*
Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski
Plots: VAFO.31, VAFO.32, VAFO.33, VAFO.34, VAFO.35, VAFO.36, VAFO.37, VAFO.40, VAFO.41.
Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Medium-tall sod temperate or subpolar grassland (V.A.5.N.c.)

Alliance	*Dactylis glomerata - Rumex acetosella* Herbaceous Alliance (A.1190)
Alliance (English name)	Orchard Grass - Sheep-sorrel Herbaceous Alliance
Association	*Dactylis glomerata - Rumex acetosella* Herbaceous Vegetation
Association (English name)	Orchard Grass - Sheep-sorrel Herbaceous Vegetation

Ecological System(s): *Information not available.*

GLOBAL DESCRIPTION

Concept Summary: This broadly defined vegetation type includes pasture and post-agricultural fields and is largely composed of non-native grasses and herbs (generally of European origin) in the early stages of succession. Physiognomically, these grasslands are generally comprised of mid-height (1-3 feet tall) grasses and forbs, with occasional scattered shrubs. Species composition varies from site to site, depending on land-use history, and perhaps soil type, but in general, this vegetation is quite wide-ranging in northeastern and midwestern states, and at higher elevations (610-1220 m [2000-4000 feet]) in the southeastern states. In addition to the nominal species, other associates may include *Phleum pratense, Lolium perenne, Agrostis hyemale, Elymus repens, Oxalis stricta, Schizachyrium scoparium, Achillea millifolium, Asclepias syriaca, Chenopodium album, Bromus tectorum, Bromus inermis,* and many others.

Environmental Description: This association occurs on pastures and land that has been tilled.

Vegetation Description: In addition to *Dactylis glomerata* and *Rumex acetosella* these grassy fields are characterized by *Symphyotrichum* spp. (including *Symphyotrichum lateriflorum (= Aster lateriflorus)* and *Symphyotrichum novae-angliae (= Aster novae-angliae)), Rudbeckia hirta, Pteridium aquilinum, Chenopodium album, Asclepias syriaca, Andropogon virginicus, Schizachyrium scoparium, Phytolacca americana, Phleum pratense, Poa pratensis, Poa compressa, Elymus repens (= Agropyron repens), Bromus inermis, Solidago* spp. (including *Solidago rugosa, Solidago nemoralis, Solidago juncea, Solidago canadensis, Solidago altissima), Euthamia graminifolia, Oenothera biennis, Potentilla simplex, Daucus carota, Ambrosia artemisiifolia, Hieracium* spp., *Taraxacum officinale, Vicia cracca, Trifolium* spp., and many others.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Rumex acetosella*
Herb (field)	Graminoid	*Dactylis glomerata*

Characteristic Species: *Dactylis glomerata, Rumex acetosella*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System: *Not applicable.*

DISTRIBUTION

Range: This vegetation is quite wide-ranging in northeastern and midwestern states, and possibly occurs at higher elevations in the southeastern states.

States/Provinces: CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, TN, VA, VT, WV

Federal Lands: NPS (Cape Cod, Cumberland Gap, Fort Necessity, Johnstown Flood, Minute Man, Morristown, Valley Forge, Weir Farm)

CONSERVATION STATUS
Rank: GNA (invasive) (28-Jan-2002)
Reasons: This vegetation type includes pasture and post-agricultural fields, and is largely composed of non-native grasses and herbs (generally of European origin).

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 3 - Weak
Comments: *Information not available.*

Similar Associations:
- *Dactylis glomerata - Solidago* spp. Herbaceous Vegetation (CEGL006517)
- *Lolium (arundinaceum, pratense)* Herbaceous Vegetation (CEGL004048)
- *Phleum pratense - Bromus pubescens - Helenium autumnale* Herbaceous Vegetation (CEGL004018)

Related Concepts: *Information not available.*

SOURCES
Description Authors: Eastern Ecology Group
References: Eastern Ecology Working Group n.d., Keever 1979, Newbold et al. 1988, TNDH unpubl. data.

Figure 21. Grassland (managed for tall grass) at Valley Forge National Historical Park. April 2002. NAD 1983 /UTM easting 463067, northing 4439537.

Figure 22. Grassland (managed for tall grass) at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 462644, northing 4438967.

Figure 23. Grassland (managed for mowed grass) at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 461740, northing 4438341.

Common Name (Park-specific): Wet Meadow

SYNONYMS:
NVC English Name: **Bluejoint - Reed Canarygrass Herbaceous Vegetation**
NVC Scientific Name: ***Calamagrostis canadensis - Phalaris arundinacea* Herbaceous Vegetation**
NVC Identifier: **CEGL005174**

LOCAL INFORMATION

Environmental Description: This vegetation is typically flooded early in the growing season and may be saturated to near the surface for some of the growing season, but sites are generally dry for much of the year. The substrate is typically mineral soil with a layer of muck at the surface. Although flooding may help to keep these systems open, some are mowed.
Vegetation Description: These are open, usually graminoid-dominated meadows. On some sites, this community may be dominated by one or two species, but it is typically mixed. Representative species include rice cutgrass (*Leersia oryzoides*) wool-grass (*Scirpus cyperinus*), bugleweed (*Lycopus uniflorus*), smartweeds (*Polygonum* spp.), threeway sedge (*Dulichium arundinaceum*), marsh fern (*Thelypteris palustris*), sedges (*Carex stipata var. stipata, Carex canescens, Carex lurida, Carex cristatella, Carex tribuloides, Carex vesicaria),* soft rush (*Juncus effusus),* Virginia chainfern (*Woodwardia virginica*), beggar's ticks (*Bidens* spp.), dwarf St.-John's-wort (*Hypericum mutilum*), Joe-pyeweed (*Eupatorium* spp.), boneset (*Eupatorium perfoliatum*), cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), Canadian St. John's-wort (*Hypericum canadense*), bluejoint (*Calamagrostis canadensis*), New York ironweed (*Vernonia noveboracensis*), marsh St.-John's-wort (*Triadenum virginicum*), arrowhead (*Sagittaria rigida, Sagittaria latifolia*), reed canarygrass (*Phalaris arundinacea*), rattlesnake grass (*Glyceria canadensis*), black bulrush (*Scirpus atrovirens*), and spikerushes (*Eleocharis* spp.). Scattered shrubs may be present; representative species include hardhack (*Spiraea tomentosa*), buttonbush (*Cephalanthus occidentalis*), silky dogwood (*Cornus amomum*), swamp dogwood (*Cornus racemosa*), red-osier dogwood (*Cornus sericea*), and arrow-wood (*Viburnum recognitum*). Exotic species such as purple loosestrife (*Lythrum salicaria*) and a variety of exotic grasses are frequently found in these meadows.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Calamagrostis canadensis*

Characteristic Species: *Calamagrostis canadensis, Leersia oryzoides*
Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski
Plots: VAFO.56
Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION
Physiognomic Class Herbaceous Vegetation (V)

Physiognomic Subclass	Perennial graminoid vegetation (V.A.)
Physiognomic Group	Temperate or subpolar grassland (V.A.5.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar grassland (V.A.5.N.)
Formation	Seasonally flooded temperate or subpolar grassland (V.A.5.N.k.)
Alliance	*Calamagrostis canadensis* Seasonally Flooded Herbaceous Alliance (A.1400)
Alliance (English name)	Bluejoint Seasonally Flooded Herbaceous Alliance
Association	*Calamagrostis canadensis - Phalaris arundinacea* Herbaceous Vegetation
Association (English name)	Bluejoint - Reed Canarygrass Herbaceous Vegetation

Ecological System(s):

Laurentian-Acadian Floodplain Forest (CES201.587)
Eastern Great Plains Wet Meadow, Prairie, and Marsh (CES205.687)
Eastern Boreal Floodplain (CES103.588)
North-Central Interior Wet Meadow-Shrub Swamp (CES202.701)
Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)

GLOBAL DESCRIPTION

Concept Summary: This wet meadow vegetation is of widespread distribution in the northeastern and midwestern United States and central and eastern Canada. Stands occur on the floodplains of small streams, in poorly drained depressions, beaver meadows, and lakeshores. Soils are typically mineral soil or well-decomposed peat, with a thick root mat. Water regime varies between temporarily and seasonally flooded. Graminoid cover is typically dense, and can form hummocky microtopography. *Calamagrostis canadensis* is dominant, often occurring in almost pure stands or with tall sedges, such as *Carex aquatilis, Carex lacustris, Carex rostrata*, and *Carex stricta*. In fen transitions, *Carex lasiocarpa* can be present. *Agrostis gigantea (= Agrostis alba), Glyceria grandis, Poa palustris, Scirpus cyperinus*, and *Typha latifolia* are sometimes abundant. Forbs include *Campanula aparinoides, Epilobium leptophyllum, Eupatorium maculatum, Iris versicolor, Polygonum amphibium*, and *Comarum palustre (= Potentilla palustris).* Scattered shrubs, such as *Viburnum nudum, Viburnum dentatum, Spiraea alba, Alnus incana*, or *Alnus serrulata*, may be present.

Environmental Description: Stands occur on the floodplains of small streams, in poorly drained depressions, beaver meadows, and lakeshores. Soils are typically mineral soil or well-decomposed peat, with a thick root mat. Water regime varies between temporarily and seasonally flooded.

Vegetation Description: Graminoid cover is typically dense, and can form hummocky microtopography. *Calamagrostis canadensis* is dominant, often occurring in almost pure stands or with tall sedges, such as *Carex aquatilis, Carex lacustris, Carex rostrata*, and *Carex stricta*. In fen transitions, *Carex lasiocarpa* can be present. *Agrostis gigantea (= Agrostis alba), Glyceria grandis, Poa palustris, Scirpus cyperinus*, and *Typha latifolia* are sometimes abundant. Forbs include *Campanula aparinoides, Epilobium leptophyllum, Eupatorium maculatum, Iris versicolor, Polygonum amphibium*, and *Comarum palustre (= Potentilla palustris).* Scattered shrubs, such as *Viburnum nudum, Viburnum dentatum, Spiraea alba, Alnus incana*, or *Alnus serrulata*, may be present.

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Graminoid	*Calamagrostis canadensis*

Characteristic Species: *Calamagrostis canadensis*
Other Noteworthy Species: *Information not available.*
USFWS Wetland System: Palustrine

DISTRIBUTION
Range: This wet meadow vegetation is widely distributed in the northeastern and midwestern United States and south-central and southeastern Canada. It ranges from Maine south to West Virginia and possibly Virginia and west to Minnesota.
States/Provinces: CT, DE, MA, MD, ME, MI, MN, NH, NJ, NY, ON, PA, RI, VA?, VT, WI, WV
Federal Lands: NPS (Isle Royale, Minute Man, Saint-Gaudens, Valley Forge, Voyageurs)

CONSERVATION STATUS
Rank: G4G5 (31-Mar-2000)
Reasons: This type is widespread throughout the northeastern and upper midwestern United States and central/southern Canada.

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 3 - Weak
Comments: This type can grade into sedge meadows. A guideline of perhaps <50% sedges may be suggested as a criteria for the definition of this type compared to sedge meadow types. Harris et al. (1996) suggest that the bluejoint meadow type is drier than sedge meadows and less peaty than shore fens.
Similar Associations:
- *Calamagrostis canadensis - Doellingeria umbellata - Spartina pectinata* Herbaceous Vegetation (CEGL006427)
- *Calamagrostis canadensis - Scirpus* spp. - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL006519)
- *Carex rostrata - Carex lacustris - (Carex vesicaria)* Herbaceous Vegetation (CEGL002257)
- *Carex stricta - Carex* spp. Herbaceous Vegetation (CEGL002258)--Dominance of sedges versus grasses is much higher.
- *Phalaris arundinacea* Eastern Herbaceous Vegetation (CEGL006044)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474)
- *Phleum pratense - (Calamagrostis canadensis)* Semi-natural Herbaceous Vegetation (CEGL005249)

Related Concepts:
- Boreal alluvial tall meadow (NAP pers. comm. 1998) ?
- Canada bluejoint-tussock sedge meadow (CAP pers. comm. 1998) ?
- Meadow marsh: bluejoint grass (W13) (Harris et al. 1996) =
- Palustrine Persistent Emergent Wetland (PEM1) (Cowardin et al. 1979) ?
- SNE low-energy riverbank community (Rawinski 1984) ?
- Shallow Emergent Marsh (Thompson 1996) ?

SOURCES
Description Authors: Eastern Ecology Group
References: Breden et al. 2001, CAP pers. comm. 1998, Cowardin et al. 1979, Eastern Ecology Working Group n.d., Fike 1999, Gawler 2002, Harris et al. 1996, Metzler and Barrett 2001, NAP pers. comm. 1998, Rawinski 1984, Swain and Kearsley 2001, TNDH unpubl. data, Thompson 1996, Thompson and Sorenson 2000, WINHIP unpubl. data.

Figure 24. Wet Meadow at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 461628, northing 4439879.

Figure 25. Wet Meadow at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 462771, northing 4439072.

Common Name (Park-specific): Skunk Cabbage Seepage Meadow

SYNONYMS:
NVC English Name: **Skunk-cabbage Herbaceous Vegetation**
NVC Scientific Name: ***Symplocarpus foetidus* Herbaceous Vegetation**
NVC Identifier: **CEGL002385**

LOCAL INFORMATION

Environmental Description: This association is found in springheads and moist draws in upland forests.
Vegetation Description: These localized wet areas are small inclusions within upland forests, distinguished by their herbaceous flora of ferns and other species that prefer wet conditions. The tree canopy differs little, if any, from the surrounding forest. Dominant species can vary from seep to seep, but jack-in-the-pulpit (*Arisaema triphyllum)* is usually present. Ferns include interrupted fern (*Osmunda claytoniana*) (sometimes dominant), cinnamon fern (*Osmunda cinnamomea*), New York fern (*Thelypteris noveboracensis*), spinulose woodfern (*Dryopteris carthusiana*), and marginal woodfern (*Dryopteris marginalis*). Forbs include rue-anemone (*Thalictrum thalictroides*), *Hepatica* sp., smartweeds and tearthumbs (*Polygonum* spp.), and Solomon's seal (*Polygonatum pubescens*). A few sedges (*Carex* spp.) and grasses (e.g., *Agrostis perennans*) may also be present.
Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Fern	*Osmunda claytoniana*

Characteristic Species: *Arisaema triphyllum*
Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: Type is not currently well-defined for forested seeps in the eastern U.S.; see Fike (1999) descriptions of Pennsylvania seeps.
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski
Plots: *Information not available.*
Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION

Physiognomic Class	Herbaceous Vegetation (V)
Physiognomic Subclass	Perennial forb vegetation (V.B.)
Physiognomic Group	Temperate or subpolar perennial forb vegetation (V.B.2.)
Physiognomic Subgroup	Natural/Semi-natural temperate or subpolar perennial forb vegetation (V.B.2.N.)
Formation	Saturated temperate perennial forb vegetation (V.B.2.N.f.)
Alliance	*Symplocarpus foetidus - Caltha palustris* Saturated Herbaceous Alliance (A.1694)
Alliance (English name)	Skunk-cabbage - Yellow Marsh-marigold Saturated Herbaceous Alliance
Association	*Symplocarpus foetidus* Herbaceous Vegetation

Association (English name) Skunk-cabbage Herbaceous Vegetation

Ecological System(s):

Laurentian-Acadian Pine-Hemlock-Hardwood Forest (CES201.563)
Laurentian-Acadian Northern Hardwoods Forest (CES201.564)
North-Central Appalachian Seepage Fen (CES202.607)
North-Central Interior Shrub-Graminoid Alkaline Fen (CES202.702)

GLOBAL DESCRIPTION

Concept Summary: This community is found throughout the upper midwestern region of the United States and adjacent Canada, ranging to the Northeast, where it develops around spring heads and in broader areas of groundwater discharge. The peat layer is typically less than 0.4 m deep. Tree and shrub cover may vary, particularly from overhanging upland trees, but trees and shrubs rooted in the stand are less than 25% cover. Forbs dominate the community. *Symplocarpus foetidus* and *Angelica atropurpurea* are the dominant and indicative species in the Midwest; *Impatiens capensis* is characteristic in the East. Other forbs and ferns present include *Caltha palustris, Chelone glabra, Epilobium coloratum, Impatiens capensis (= Impatiens biflora), Pedicularis lanceolata, Pilea pumila, Saxifraga pensylvanica, Solidago patula,* and *Thelypteris palustris*. Graminoid cover is generally low, less than 25%, and may include *Carex bromoides, Carex comosa, Carex lacustris, Carex stricta*, and *Carex trichocarpa*.

Environmental Description: This community develops around spring heads and in broader areas of groundwater discharge, where water flows to the surface in a diffuse rather than concentrated flow. Peat may be present in some areas, and perhaps locally can be as deep as 1 m, but it is typically less than 0.4 m deep. Stands can occur along the lower slopes of glacial moraines, ravines and in deep glacial meltwater-cut river valleys at the bases of slopes separating stream terraces. Soils are seasonally to more-or-less permanently saturated (MNNHP 1993).

Vegetation Description: This is an herbaceous-dominated community. Tree and shrub cover may vary, particularly from overhanging upland trees, but trees and shrubs rooted in the stand are less than 25% cover. Forbs dominate the community. *Symplocarpus foetidus* and *Angelica atropurpurea* are the leading dominant and indicator species. Other forbs and ferns present include *Caltha palustris, Chelone glabra, Epilobium coloratum, Impatiens capensis (= Impatiens biflora), Impatiens capensis, Pedicularis lanceolata, Pilea pumila, Saxifraga pensylvanica, Solidago patula,* and *Thelypteris palustris*. Graminoid cover is generally low, less than 25%, and may include *Carex bromoides, Carex comosa, Carex lacustris, Carex stricta*, and *Carex trichocarpa* (MNNHP 1993, White and Madany 1978).

Most Abundant Species:

Stratum	Lifeform	Species
Herb (field)	Forb	*Symplocarpus foetidus*

Characteristic Species: *Caltha palustris*, *Thelypteris palustris*

Other Noteworthy Species: *Floerkea proserpinacoides*, *Hydrocotyle americana*, *Poa paludigena*

USFWS Wetland System: Palustrine

DISTRIBUTION

Range: This community is found throughout the upper midwestern region of the United States and adjacent Canada, where it develops around spring heads and in broader areas of groundwater discharge. The type extends from Indiana and possibly Ontario and Ohio, west to Minnesota and Iowa.

States/Provinces: IA, IL:S2, IN, MA, MI, MN:S3, NJ, OH?, ON, PA

Federal Lands: NPS (Valley Forge)

CONSERVATION STATUS
Rank: G4? (3-Oct-1996)
Reasons: *Information not available.*

CLASSIFICATION INFORMATION
Status: Standard
Confidence: 2 - Moderate
Comments: This community is defined as an herbaceous community, thereby excluding many closed canopy seepage meadows with trees or shrubs rooted in the stand. However, some herbaceous seepage meadows could be quite shaded because of surrounding upland forests. This type is not always separated out by state heritage programs, since it can be a zone in other wetland types. *Carex lacustris* may occur in this type. The presence of coarse-leaved sedges may be a structural difference as compared to fens, which typically have fine-leaved sedges (MNNHP 1993).
Similar Associations:
- *Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera / Cornus canadensis* Forest (CEGL002071)--may have a similar composition.
- *Carex crinita* - *Osmunda* spp. / *Physocarpus opulifolius* Seep Herbaceous Vegetation (CEGL002392)
- *Carex crinita* - *Osmunda* spp. / *Sphagnum* spp. Herbaceous Vegetation (CEGL002263)
- *Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186)--may have a similar composition.
- *Fraxinus nigra* - Mixed Hardwoods - Conifers / *Cornus sericea / Carex* spp. Forest (CEGL002105)--may have a similar composition.

Related Concepts: *Information not available.*

SOURCES
Description Authors: D. Faber-Langendoen, mod. L.A. Sneddon
References: Fike 1999, IONNAI unpubl. data, MNNHP 1993, Midwestern Ecology Working Group n.d., Newbold 1993, Newbold 1996, White and Madany 1978.

Figure 26. Skunk Cabbage Seepage Meadow at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 460293, northing 4437500.

Figure 27. Skunk Cabbage Seepage Meadow at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 460243, northing 4437500.

Common Name (Park-specific): Successional Old Field / Shrubland

SYNONYMS:
NVC English Name: Successional Old Field / Shrubland / (Local Type)
NVC Scientific Name: Successional Old Field / Shrubland / (Local Type)
NVC Identifier: CEGL002796

LOCAL INFORMATION

Environmental Description: This type is found throughout Valley Forge National Historical Park on abandoned agricultural land, forest gaps, and other areas with a history of disturbance.
Vegetation Description: The successional old-field type occurs throughout the park where former grassland or agricultural land is being invaded by shrub species. Shrub cover is variable from field to field but is generally greater than 20%. Typical species include autumn olive (*Elaeagnus umbellata*), honeysuckle (*Lonicera* spp.), multiflora rose (*Rosa multiflora*), and to a lesser extent wineberry (*Rubus phoenicolasius*). Tree seedlings and saplings may also be present. Vines may be abundant in some fields as sparse to very dense patches, where they can appear as a ground cover and/or smother shrubs and tree saplings. Typical vine species include oriental bittersweet (*Celastrus orbiculatus*), Japanese honeysuckle (*Lonicera japonica*), and wild grape (*Vitis* spp.). The herbaceous layer is similar to the grassland type but with a higher cover of forb species. Typical grasses include broom-sedge (*Andropogon virginicus*), red fescue (*Festuca rubra*), tall fescue (*Lolium pratense (= Festuca elatior)*), path rush (*Juncus tenuis*), panicgrass (*Dichanthelium acuminatum (= Panicum acuminatum)*), timothy (*Phleum pratense*), and purpletop (*Tridens flavus*). Typical forb species include dogbane (*Apocynum cannabinum*), grass-leaved goldenrod (*Euthamia graminifolia*), white snakeroot (*Ageratina altissima (= Eupatorium rugosum)*), tall white beard-tongue (*Penstemon digitalis*), cinquefoil (*Potentilla* spp.), and rough-leaved goldenrod (*Solidago rugosa*).
Most Abundant Species:

Stratum	Lifeform	Species
Shrub/sapling (tall & short)	Broad-leaved deciduous shrub	*Elaeagnus umbellata, Rosa multiflora*
Shrub/sapling (tall & short)	Vine/Liana	*Celastrus orbiculatus, Lonicera japonica*
Herb (field)	Graminoid	*Andropogon virginicus, Phleum pratense, Tridens flavus*

Characteristic Species: *Andropogon virginicus, Elaeagnus umbellata, Phleum pratense, Tridens flavus*
Other Noteworthy Species: *Information not available.*
Local Range: *Information not available.*
Classification Comments: *Information not available.*
Other Comments: *Information not available.*
Local Description Authors: J. Lundgren and G. Podniesinski
Plots: VAFO.63, VAFO.78.
Valley Forge National Historical Park Inventory Notes: *Information not available.*

GLOBAL INFORMATION

NVCS CLASSIFICATION

Physiognomic Class	Shrubland (III)
Physiognomic Subclass	Deciduous shrubland (III.B.)
Physiognomic Group	Cold-deciduous shrubland (III.B.2.)

Physiognomic Subgroup	Natural/semi-natural cold-deciduous shrubland (III.B.2.N.)
Formation	Temperate cold-deciduous shrubland (III.B.2.N.a.)
Alliance	*Information not available.*
Alliance (English name)	*Information not available.*
Association	Successional Old Field / Shrubland / (Local Type)
Association (English name)	Successional Old Field / Shrubland / (Local Type)

Ecological System(s):

None

GLOBAL DESCRIPTION

Concept Summary: This is a successional type described solely from Valley Forge National Historical Park data. Shrubby old fields elsewhere in eastern Pennsylvania and Delaware have been described as thickets of *Lonicera japonica, Lonicera morrowii, Ligustrum vulgare, Euonymus alata, Rosa multiflora*, and *Celastrus orbiculatus*, sometimes with scattered clumps of *Prunus serotina, Robinia pseudoacacia*, and *Rhus typhina*. Herbs include *Solidago nemoralis, Solidago altissima*, and *Viola sororia*. Additional global information has not been compiled for this local type.

Environmental Description: *Information not available.*

Vegetation Description: *Information not available.*

Most Abundant Species:

Stratum	Lifeform	Species
Information not available.		

Characteristic Species: *Information not available.*

Other Noteworthy Species: *Information not available.*

USFWS Wetland System: *Not applicable.*

DISTRIBUTION

Range: This community is common in former agricultural areas in the eastern and northeastern U.S.

States/Provinces: PA

Federal Lands: NPS (Valley Forge)

CONSERVATION STATUS

Rank: GNA (ruderal) (6-Jun-2005)

Reasons: This type is not recognized in the National Vegetation Classification so has not been assigned a rank. This type represents early-successional vegetation and is thus not of conservation concern.

CLASSIFICATION INFORMATION

Status: Nonstandard

Confidence: *Information not available.*

Comments: *Information not available.*

Similar Associations: *Information not available.*

Related Concepts: *Information not available.*

SOURCES

Description Authors: **L.A. Sneddon and G. Podniesinski**

References: Eastern Ecology Working Group n.d., Keever 1979, Newbold et al. 1988, Overlease 1987.

Figure 28. Successional Old Field/Shrubland at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 462752, northing 4440388.

Figure 29. Successional Old Field/Shrubland at Valley Forge National Historical Park. April 2002. NAD 1983 / UTM easting 462784, northing 4440409.

Association-level Vegetation Map Production

In order to produce an association-level vegetation map, the formation-level vegetation map was edited and refined onscreen in ArcView 3.2. Based on the vegetation data analysis, each polygon was assigned one of the 13 anthropogenic (note that one type, grassland, has been differentiated into tall grass and mowed grass for mapping purposes) or nine natural associations. The vegetation types were assigned using information from plot data, field observations, aerial photography signatures, and topographic maps. Polygon boundaries were also revised based on these four information sources.

The thematic accuracy of this vegetation association map was then assessed. Based on the accuracy assessment sampling points, the association level map was revised again to correct errors and create more accurate vegetation association polygon boundaries. In this final revision, accuracy assessment data, plot data, field observations, aerial photography signatures, and topographic maps were used to revise polygon boundaries and attributes. A summary of the vegetation association distribution and abundance is provided in Table 2 and the resulting final vegetation association map is shown in Figure 30. The number of total mapped hectares listed in Table 2 is larger than the number of hectares in the park because the mapped polygons extend beyond the park boundary. Metadata for the vegetation association shapefile, the plot location and accuracy assessment sampling point location shapefiles, the digital photomosaic, and the PLOTS database were prepared according to Federal Geographic Data Committee standards and have been provided as a deliverable along with this report.

Accuracy Assessment

Positional Accuracy Assessment

Positional accuracy assessment of 50 reference points in the orthophoto mosaic used to develop the vegetation map, as reported by the North Carolina State University–Center for Earth Observation, were conducted and the horizontal positional accuracy results were:

X-coordinate accuracy +/- : 1.26 meters
Y-coordinate accuracy +/- : 2.84meters
Overall Positional Accuracy: 2.05 meters.

Positional accuracy meets the NMAS Class 1 map standard for X and the NMAS Class 2 map standard Y. Positional accuracy assessment meets requirements for the USGS/NPS Vegetation Mapping Program (Appendix A).

Thematic Accuracy Assessment

Of the 308 accuracy assessment points sampled (Figure 30), the vegetation at 255 points was mapped correctly, giving an overall accuracy of 82.8%. The Kappa index (which corrects for correct classifications occurring by chance) was 81.2% ± 3.8% (90% C.I.).

Table 2. The number of polygons, total mapped area, and hectares within the park boundary by association for the association-level vegetation map for Valley Forge National Historical Park.

Association Common Name	Number of Polygons	Total Area Mapped (hectares)	Hectares within Park Boundary
Anthropogenic			
Cropland	6	69.29	36.58
Developed land	35	282.59	42.84
Old nursery site	3	33.43	0.29
Old quarry/reclamation site	1	3.16	3.16
Transportation corridor	9	120.18	70.15
Grassland (mowed)	36	159.73	141.96
Grassland (tall grass)	48	372.40	358.47
Northern catalpa planted forest	1	0.21	0.21
Mixed white pine – hardwood plantation	2	1.83	1.826
White pine plantation	13	20.79	20.75
Planted ornamental tree grove	3	9.14	9.14
Red oak plantation	1	0.75	0.75
Eastern hemlock plantation	1	0.28	0.28
Natural			
Wet meadow	10	4.60	4.60
Silver maple floodplain forest	4	11.83	10.74
Riverine floodplain forest	21	57.39	53.44
Northeastern modified successional forest	57	198.40	164.96
Chestnut oak – black birch talus slope	2	0.39	0.39
Tuliptree – oak forest	40	151.84	127.69
Dry 0ak Forest	20	152.78	137.58
Successional old field/shrubland	5	11.07	8.15
Water	4	66.66	52.57
Total	322	1,728.74	1,246.26

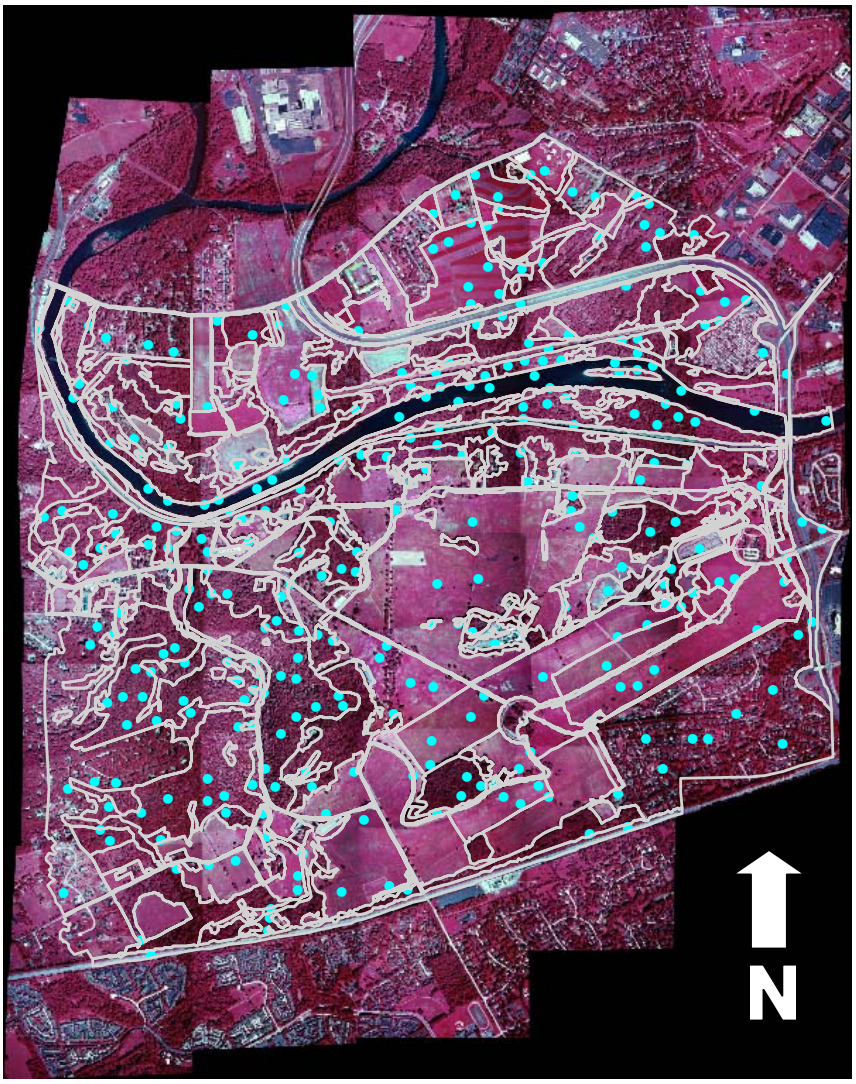

Figure 30. Location of 308 sampling points used to evaluate the thematic accuracy of the Valley Forge National Historical Park association-level vegetation map.

Thematic accuracy assessment results are summarized in Table 3. Of the incorrectly mapped accuracy assessment points, 27 of the 53 errors could be attributed to four pairs of closely related associations. Eight of 20 mapped Cropland points were assessed as Grassland (tall grass). This may have been an artifact of recent (possibly temporary) changes in landuse or resource management (e.g., fallow fields). Five of 33 mapped Dry Oak Forests were assessed as Tuliptree – Oak Forests. Since these two types occur adjacent to each other on the landscape and share a number of species it is likely that the errors reflect subtle differences in composition not captured in the mapping and/or judgment calls in stands intermediate between the two types. Nine of 30 mapped Grassland (mowed) points were assessed as Grassland (tall grass). These types are easily distinguished in the field, but may be similar in the aerial photography. In addition, the pattern of mowing within the park, while similar from year to year, does show some variation, so that mowed grass observed in the 1999 aerial photography could have been tall grass when observed during accuracy assessment in 2001. Finally, five of 19 mapped Riverine Floodplain Forests were assessed as Silver Maple Floodplain Forests. These two forest types also occur adjacent to one another on the landscape and intergrade into each other; thus the errors could stem from photointerpretation or accuracy assessment in or near ecotones.

Final Association-level Map

The association-level map was revised to resolve incorrectly mapped polygons as indicated by the thematic accuracy assesment (Figure 31). After all of the corrections were made, all AA points should be in agreement with the revised association-level map.

Project Deliverables

Final products of the vegetation mapping project are shown in Table 4. All products will be delivered to the Natioanl Park Service by the Pennsylvania Science Office of The Nature Conservancy.

Table 3. Contingency matrix and calculated errors for the thematic accuracy assessment of the association-level vegetation map at Valley Forge National Historical Park.

	Mapped Vegetation association																							Errors of Commission (Percent Correct)
Accuracy Assessment Observation	Class	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total	
Silver maple floodplain forest	1	2					5																7	28.6
Northern catalpa planted forest	2		1																				1	100.0
Cropland	3			12																			12	100.0
Developed land	4				28					1													29	96.6
Dry Oak Forest	5					33				1								2					36	91.7
Riverine floodplain forest	6						10				2												12	83.3
Grassland (mowed)	7				2			21		1									1				25	84.0
Grassland (tall grass)	8			8				9	28		1												46	60.9
Tuliptree – Oak Forest	9					6	1			24				1									32	75.0
Northeastern modified successional forest	10					1	2			2	29												34	85.3
Old nursery site	11									1		5											6	83.3
Old quarry/reclamation site	12												1										1	100.0
Planted ornamental tree grove	13													2									2	100.0
Mixed white pine - hardwood plantation	14														1								1	100.0
White pine plantation	15														2	5							7	71.4
Successional old field/shrubland	16								1								4						5	80.0
Chestnut Oak – Black Birch Talus Slope	17					1												2					3	66.7
Transportation corridor	18					1													20				21	95.2
Eastern hemlock planted forest	19																			1			1	100.0
Water	20						1														21		22	95.5
Wet meadow	21																					5	5	100.0
Total		2	1	20	30	42	19	30	29	30	32	5	1	3	3	5	4	4	21	1	21	5	308	
Errors of Omission (Percent correct)		100.0	100.0	60.0	93.3	78.6	52.6	70.0	96.6	80.0	90.6	100.0	100.0	66.7	33.3	100.0	100.0	50.0	95.2	100.0	100.0	100.0		
																						Total points Correct	255	
																						Overall Accuracy	82.80%	
																						Kappa index	81.20%	
																						90% confidence interval for Kappa index	3.80%	

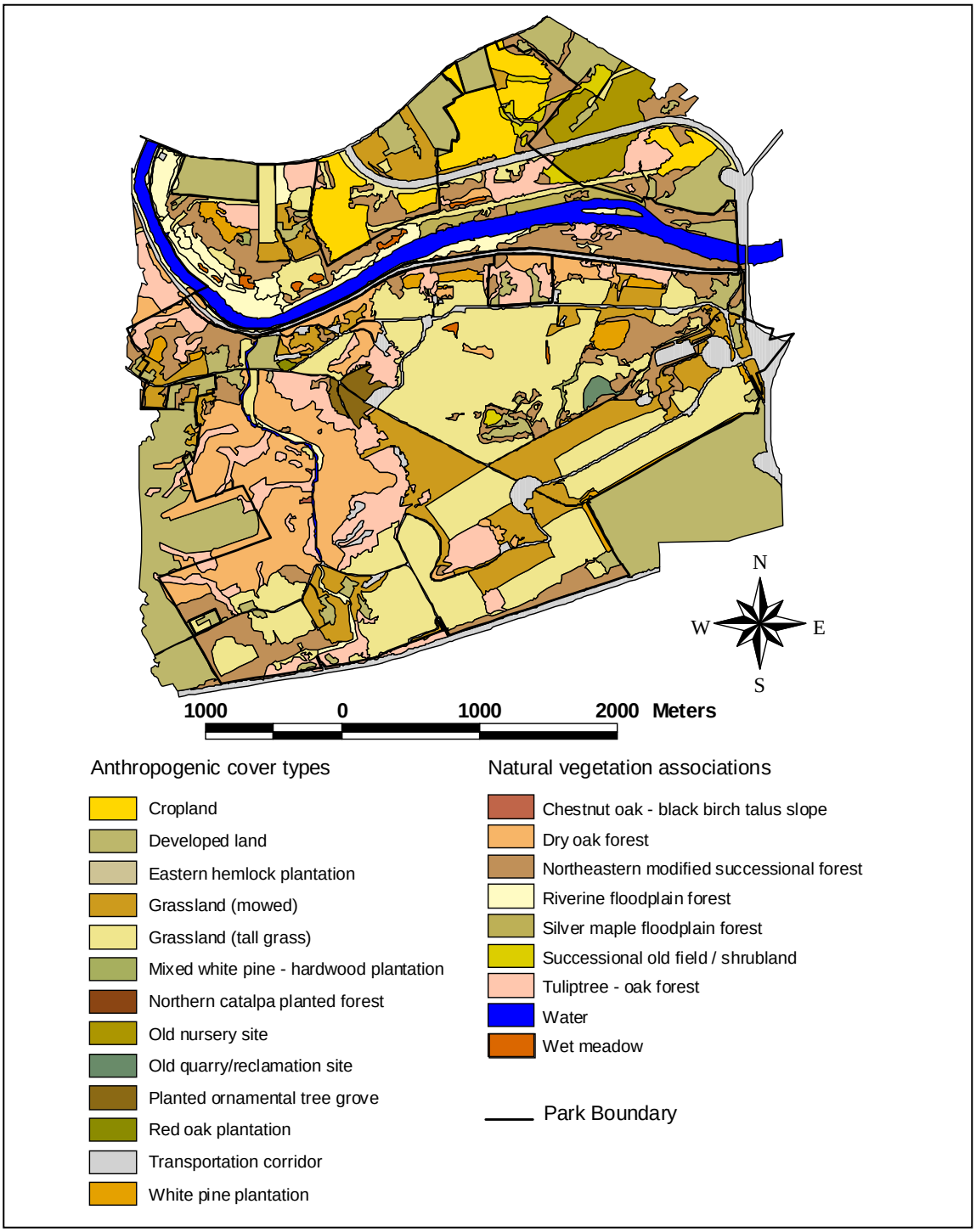

Figure 31. Final association-level vegetation map of Valley Forge National Historical Park.

Table 4. Summary of products resulting from Valley Forge National Historical Park vegetation mapping project.

Product	FGDC-compliant spatial metadata
Aerial photos, including flight line map and photoindex	Yes
Photomosaic as paper copy and digital format	Yes
Annotated field survey forms with plot data	Not applicable
Verified vegetation plot survey data (in TNC PLOTS format) with differentially corrected GPS geographic coordinates	Yes
Annotated field forms of AA data	Not applicable
Accuracy assessment (AA) data in Access format with differentially corrected GPS geographic locations	Yes
Digital photos representative of all vegetation types	Not applicable
Final map of vegetation associations in digital and paper copy (digital copy as GIS layer in ArcView 3.2 format)	Yes
Final report in paper and digital formats	Not applicable

Discussion

Vegetation Classification and Characterization

Valley Forge National Historical Park is located in Chester and Montgomery counties, within the Northern Appalachian Piedmont ecological region (the Section level of Keys and Carpenter 1995[1]). The vegetation is closely aligned with vegetation types described in the nearby states of Maryland, Delaware, and New Jersey. The underlying bedrock is of three primary types (Pennsylvania Bureau of Topographic and Geographic Survey 2001): red sandstone and shale along the river; dolostone, a carbonate rock, dominating the southern half of the park; and smaller patches of quartzite in the western part of the park (e.g., at Mt. Misery and Mt. Joy). The Schuylkill River and Valley Creek run through the park. The area has a long history of human impacts from clearing, agriculture, industrial use, and development. The park is now an oasis of open space consisting of 1,416 ha (3,500 ac) of fields and forests surrounded by residential development.

The forested and non-forested areas of Valley Forge National Historical Park and its surroundings have all been modified by human activities for nearly three hundred years. Early European settlers found areas of rich limestone-derived soils well suited to agriculture, and by Revolutionary War times about two-thirds of the area had been cleared for agricultural use with the remaining one-third forested. The forests themselves were extensively cut for firewood and charcoal and by the end of the encampment in 1777–1778 few trees remained. Stands used for charcoal were completely cleared, often at 25–30 year intervals (Hough 1882, cited in Russell and Schuyler 1988). The forests have endured many generations of cutting and regrowth, which may tend to favor stump-sprouting species such as chestnut oak, chestnut (until the blight), and, on some sites, beech (Overlease 1987).

More recent anthropogenic factors include: an overpopulation of white-tailed deer, which drastically changes forest understories as well as removes most regeneration (Alverson et al. 1988, 1994; Horseley 1992; deCalesta 1992); the proliferation of invasive exotic plant species in virtually all habitats; and gypsy moth infestations, to which virtually all of the oak species are susceptible (Overlease 1987). Aggressive management to reduce both the deer herd and the prevalence of invasive plants will be required if retaining some semblance of natural vegetation types is desired at Valley Forge National Historical Park.

The fields are periodically mowed to maintain an open appearance, reflecting the historic agricultural landscape at the time of the encampment. Although some are maintained in lawn, others are mowed less frequently. This can provide for a greater diversity of plant and animal species (odonates, lepidoptera, other invertebrates, and/or grassland birds, depending on the management regime). All of the upland fields fit into the *Dactylis glomerata – Rumex acetosella* Herbaceous Vegetation association. These plots had intially been assigned to the *Lolium (arundinaceum, pratense*) Herbaceous Vegetation association, but that association is currently being applied only to the southeastern United States. Further data and analyses would be

[1] Valley Forge NHP is placed in the Piedmont Upland subsection (221Db), but actually lies at the transition between that subsection and the Gettysburg Piedmont Lowland (221Da).

necessary to document the differences; there is significant overlap between the two associations and this should be recognized in any cross-regional comparisons among parks.

The global ranks of most of the vegetation types at Valley Forge National Historical Park have not been defined, as data on the extent of these communities is incomplete. None of the associations is considered to be rare, as they have all been documented from a number of locations. Data from this project will help to further refine the rangewide descriptions, extent, and global ranks of all of these vegetation associations.

Of the three natural upland forest types in the park, the dry oak forest is the most mature and least disturbed with respect to invasive species. It was also one of the more difficult vegetation types to characterize as it graded from very dry oak forest on the top of Mount Misery to dry-mesic forest along the toe slope with Valley Creek. Attempts to separate the dry from the dry-mesic oak forest did not produce a reliable classification and was not easily represented in the mapping. As a result, only one dry oak forest association was recognized. The dry oak forest appears to be resistant to many of the invasive species common in the rest of the park, possibly due to drier, less fertile soils. Deer herbivory threatens the long-term persistence of this and other forest types in the park through the browsing of tree seedlings. Deer browsing also appears to be depressing native wildflower populations. In the absence of reduced deer browsing pressure this forest would likely shift in composition to non-preferred browse species and possible encourage colonization by some exotic species already widespread in the park (e.g., tree-of-heaven [*Ailanthus altissima*] and princess tree [*Paulownia tomentosa*]).

The tuliptree – oak forest is a disturbed forest type, typically with abundant invasive species, especially Japanese stiltgrass (*Microstegium vimineum*). As with the dry oak forest, little or no forest regeneration is occurring and all woody plants within reach of deer are heavily browsed. Long-term trajectory for this forest type would be for increased abundance of non-preferred browse species.

The northeastern modified successional forest presented a classification challenge in that it was highly variable in composition. Stand canopies varied from a mix of early successional tree species (native and exotic) to near monotypic stands of one early successional species or another. The unifying concept for this association was the young age of most stands, dominance by shade-intolerant trees, recent (<30 years old) disturbance or succession from open land (e.g., open field, former agricultural land), and the presence of invasive herbs, shrubs, and vines. The long-term trajectory of these stands is unclear. Some of the tree species in these stands can be fairly long-lived (i.e., white ash [*Fraxinus americana*] and tuliptree [*Liriodendron tulipifera*]), and may mature into a recognizable natural forest type. However, some stands appear so overrun by invasive vines that forest succession may be arrested without management intervention. Deer browse on preferred native woody species may also skew future forest composition towards non-preferred browse species (e.g., red maple [*Acer rubrum*]).

The park contains two palustrine or riverine forest types associated with the floodplain of the Schuylkill River, the silver maple floodplain forest and the riverine floodplain forest. These two types could be readily differentiated on the relative abundance of silver maple (*Acer saccharinum*). In contrast, the riverine floodplain forest was highly variable and attempts were made to split more sycamore-dominated stands from the more green ash- or river birch-

dominated stands. As analyses failed to find clear, reliable breaks in the data along which to develop different types, it was decided to create a single, more broadly defined, riverine floodplain type. As with all other forested types in the park, heavy deer browse appears to be limiting tree regeneration, and browse damage is typically severe on most woody plants. The rich, moist soil of the Schuylkill River floodplain also favors many invasive plant species, especially the fig buttercup (*Ranunculus ficaria*), which carpets the floodplain in spring and early summer. The hydrology of this site favors flood-tolerant species, and occasional erosion and deposition of sediment will likely promote continued opportunities for native woody plant regeneration (most floodplain tree and shrub species require mineral soil for germination [Young and Young 1992]). However, successful recruitment of woody plants to shrub and tree canopies will be doubtful with current deer browsing pressures.

The chestnut oak – black birch talus slope was easily identified and characterized, as it was sparsely vegetated and defined by the limits of steep bouldery talus slopes. Although some Japanese stiltgrass occurred on the talus slopes, they were relatively free of invasive plant species. Little management is required to maintain these slopes.

The successional old field / shrubland association occurs on recently abandoned open land where shrubs and tree saplings have begun to colonize. These fields were variable in composition, but similar in physiognomy and were classified on that basis. The successional trajectory for this type under current conditions appears to be towards northeastern modified successional forest, based on the widespread occurrence of northeastern modified successional forest on former open land elsewhere in the park.

Wet meadows are scattered throughout the park and are variable in composition. This type could probably be split into two or more herbaceous types if sampled more intensively and defined more narrowly. Some stands were relatively diverse with a mix of grasses, sedges, and wetland forbs, while several were near monotypic stands of cattails (*Typha* spp.) or reed canary grass (*Phalaris arundinacea*). These stands appear to be fairly stable. Given the current degree of deer browsing, invasion and colonization by wetland shrub species seems unlikely. Some of these wetlands may be susceptible to exotic plant invasions, especially Japanese stiltgrass.

The open grasslands are managed to mimic small grain agriculture common on the local landscape at the time of the encampment. Classification was relatively straightforward, and though the composition varied from field to field, the dominance by grasses and sedges was consistent. The only classification issue arises when tall grass (seasonally mowed to control woody plant colonization) is differentiated from mowed grass (routinely mowed as needed to meet park objectives). Since mowing plans may vary from year to year, the exact acreage in tall grass versus mowed grass is likely to vary, though the total area of grassland is constant. Since this type is actively managed, no change is expected in the vegetation classification. One potential threat to this type is the invasion of Japanese honeysuckle (*Lonicera japonica*), which was occasionally observed in large creeping patches in the course of vegetation mapping field work.

The park contains a number of conifer plantations, primarily white pine (*Pinus strobus*). These plantations are variable from nearly monotypic white pine stands to degraded stands where many pine trees have died and volunteer hardwoods constitute up to 50% of the forest canopy. In the

absence of white pine seedling and sapling recruitment, these stands will likely convert to hardwood or mixed conifer hardwood forests over time. The type of hardwood forest is unclear, as the hardwood volunteer species vary from stand to stand.

The old nursery site initially presented a unique challenge, as it was a mosaic of native and exotic horticultural species, generally occurring in single species blocks, with volunteer herb, shrub, and tree species mixed in. Due to the artificial nature of the vegetation, the site was impossible to link to a natural NVCS association. Consequently, a park-specific type could not be assigned to the site.

Other vegetation associations and cover types were relatively straightforward to classify. Planted types such as the eastern hemlock plantation, red oak plantation, mixed white pine-hardwood plantation, and the northern catalpa planted forest were relatively small (>2.0 ha) and limited to one or two occurrences. Limited effort was given to these types other than cursory field verification. Cropland, developed land, and the old quarry/reclamation site were easily distinguished but not characterized beyond cover type. The eastern hemlock plantation and the northern catalpa planted forest are embedded in larger, unmanaged forest blocks and will likely blend into those forest types over time (assuming tree regeneration can occur). The mixed white pine – hardwood plantation screens the old quarry/reclamation site and is bounded by grasslands. Since the grasslands will likely be maintained, the footprint of the planted screen will not change; however, the composition of the forest may change if shade-intolerant early successional species found elsewhere in the park colonize the open forest/grassland interface.

Map Production

Classification errors stemmed from limitations of interpreting leaf-on photography, lack of reference data, and the interpreter's lack of experience with the study area. The most common errors were:

- Classifying woodland as forest and vice versa.

- Misclassifications resulting from an occasional inability to distinguish between evergreen and deciduous vegetation.

- Inability to differentiate hydrologic regimes. This has likely led to an underestimate of riaprian wetlands, especially on the floodplain, south of the Schuylkill River.

The most prevalent errors in the association-level vegetation map were caused by inability to distinguish grasslands from croplands, and late successional forests from climax forests.

Recommendations for Future Projects

Invasive exotic plant species and deer herbivory are the main threats to the native vegetation at Valley Forge National Historical Park. Continued inventory, monitoring, and management of invasive species should continue to be a priority for the park's resource managers. The most common and problematic species include: Morrow's honeysuckle (*Lonicera morrowii*), Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis*

thunbergii), mile-a-minute (*Polygonum perfoliatum*), Japanese stiltgrass (*Microstegium vimineum*), oriental bittersweet (*Celastrus orbiculatus*), and tree-of-heaven (*Ailanthus altissima*). The documented high deer population within the park (approximately 290 deer per square mile, National Park Service 2005) is interfering with woody plant regeneration and greatly diminishing the diversity and abundance of native understory herbs and shrubs. Effective deer herd reduction strategies are necessary for the maintenance and restoration of natural communities within the park.

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Appendix A. Procedures used to develop a digital orthophoto mosaic for Valley Forge National Historical Park.

Color infrared, stereo pair 1:6,000 scale aerial photography of Valley Forge National Historical Park was acquired from an overflight on September 12, 1999, during leaf-on conditions, by Air Photographics, Inc. The photography was delivered to the National Park Service (NPS) and then forwarded to NC State University where the digital orthophoto mosaic was produced.

The mosaic was produced from 49 color infrared air photos scanned at 600 dpi with 24-bit color depth. The scanned images of the air photos were imported into ERDAS Imagine (.img) format where a photo block was created using USGS digital elevation models (DEMs) and a digital orthophoto quarter quadrangle (DOQQ) as reference. In preparation for this step, the USGS DEMs were resampled from 30 meters to 10 meters and mosaicked together. The photo block was manipulated until it could be triangulated with a root mean square error of less than 1 using Imagine Orthobase software. At this point, single frame orthophotos (one for each air photo) were generated within Imagine and exported to Imagine .lan format. Then the .lan files were imported into ER Mapper's native (.ers) format, and an ER Mapper algorithm was created which contains the color balancing information and the cutlines created for the final mosaic. In ER Mapper a band interleaved by line (.bil) image and header file of the final mosaic was generated, the .bil image was imported into Imagine .img format, and, finally, the .img image was compressed using MrSID software with a 20:1 compression ratio.

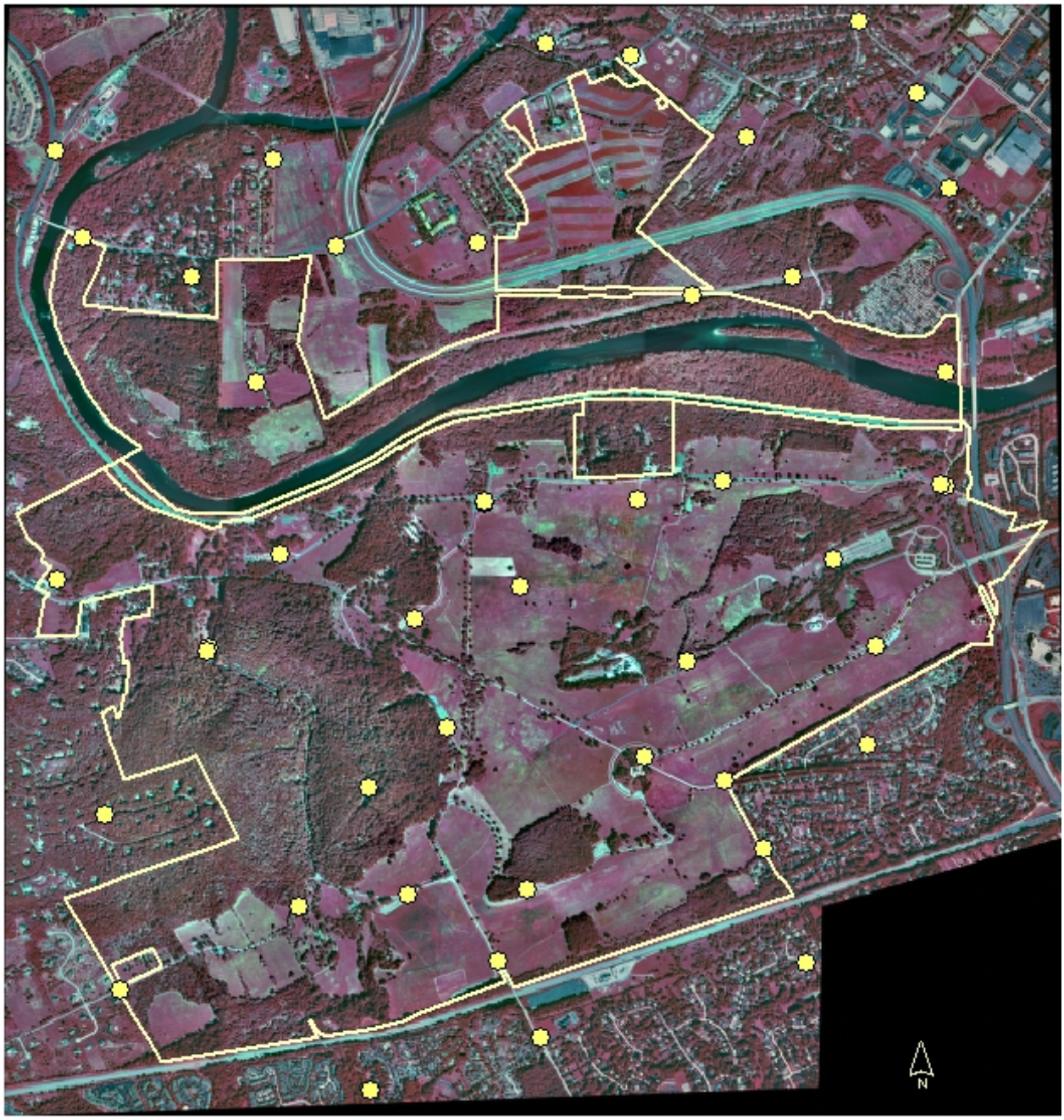
The horizontal positional accuracy of the mosaic was assessed using guidelines of the USGS/NPS Vegetation Mapping Program (ESRI, NCGIA, and TNC 1994). Well-defined positional accuracy ground control points, spaced throughout all quadrants of the mosaic, were placed on the final mosaic in ArcMap. Ground control points and zoomed-in screenshots of each point were plotted on hard copy maps with the mosaic as a background. These maps and plots were used to locate the ground control points in the field. For each plotted ground control point, field staff noted any alterations to the locations in the field, and then recorded the coordinates with a Trimble Pro XR/XRS or GeoXT. Mapped ground control points that were physically inaccessible were also noted. The field crew correctly located and collected accuracy assessment data at 50 ground control points. The coordinate data were collected with real time GPS and post processed with differential correction using Pathfinder Office software. For each point, the field-collected "true" or "reference" GPS coordinates were compared to the coordinates obtained from the mosaic viewed in ArcMap. Both pairs of coordinates for each point were entered into a spreadsheet in order to calculate horizontal accuracy (in meters). Figure A1 shows the distribution of the 50 ground control points within the park and surrounding area.

The final horizontal positional accuracy for the mosaic is 2.05 meters: 1.26 meters in the x direction which meets Class 1 National Map Accuracy Standards; and 2.84 meters in the y direction which meets Class 2 National Map Accuracy Standards (FGDC 1998b; Minnesota Governor's Council on Geographic Information and Minnesota Land Management Information Center 1999). A copy of the spreadsheet that contains the x and y coordinates for each ground control point and the root mean square error accuracy calculation formula is included in the air photo archive maintained at NCSU for the NPS Northeast Region Inventory & Monitoring Program.

A metadata record for the mosaic was prepared according to current Federal Geographic Data Committee standards (FGDC 1998a). Metadata were produced in notepad and parsed using the

USGS metadata compiler program (MP) to locate errors and omissions (USGS 2004). After all errors and omissions were corrected, MP was used to generate final TXT, HTML, and XML versions of each metadata record which are stored in the air photo archive. Key information for the Valley Forge National Historical Park mosaic is summarized in Table A1.

Figure A1. Ground control points (n=50) used to calculate horizontal positional accuracy of the Valley Forge National Historical Park mosaic[2].



[2] The park boundary shown in this figure was current at the time of field data collection in October 2000, but has since changed.

Table A1. Summary of key information for Valley Forge National Historical Park mosaic.

Title of metadata record:	Valley Forge NHP Color Photomosaic (ERDAS Imagine IMG and Mr. SID formats)
Publication date of mosaic (from metadata):	April 1, 2005
Date aerial photography was acquired:	September 12,1999
Vendor that provided aerial photography:	Air Photographics, Inc
Scale of photography:	1:6,000
Type of photography:	Color infrared, stereo pairs, leaf-on conditions
Number of air photos delivered:	49
Archive location of air photos, camera calibration certificate, and Index to Aerial Photography:	Valley Forge NHP
Scanning specifications:	600 dpi, 24-bit color depth
Horizontal positional accuracy of mosaic:	2.05 meters: 1.26 meters in the x direction(meets Class 1 NMAS); 2.84 meters in the y direction (meets Class 2 NMAS)
Number of ground control points upon which estimated accuracy is based:	50
Method of calculating positional accuracy:	Root Mean Square Error (RMSE)
Archive location of mosaic and metadata:	North Carolina State University, Center for Earth Observation
Format(s) of archived mosaic:	img (uncompressed); MrSID (20:1 compression)

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Appendix B. Vegetation classification plot sampling and accuracy assessment field forms.

3: Quantitative Community Characterization Draft: Spring, 1997

National Park Service Vegetation Sampling

A. Identifiers (general EOR information)

Sci. name: 1.SNAME:_____ 2.GNAME:_____ 3.Site name:
4.Survey site name:_____ 5.Quad name(s):_____ 6.Quad code(s):_____ 7.County name(s):_____ 8.County code(s):_____ 9.Town (LOCALJURIS):

10.Lat:_ _ _ _ _ _ N 11.Long: 0 _ _ _ _ _ _ W OR UTM Zone _____ Datum_____

Easting: 0 _ _ _, _ _ _ Northing: _, _ _ _, _ _ _

12.Directions:

13.Sourcecode:_____ 14.Survey date:_____.__.

15.Last obs:_____.__.__ 16.First obs:_____.__.__ 17.State:

18.Surveyors:_____ Image

Annotation:_____

B. Environmental Description

23.Topographic sketch

Elevation:_____
Slope aspect:_____
Parent material:

32.Stoniness:
__ Stone free <0.1%
__ Moderately stony 0.1-1%
__ Stony 3-15%
__ Very stony 15-50%
__ Exceedingly stony 50-90%
__ Stone piles >90%

Topographic position:
___ Interfluve ___ Back slope
___ High Slope ___ Step in slope
___ High level ___ Low slope
___ Midslope ___ Toe slope
___ Low level ___ Channel wall
___ Basin floor ___ Swale
___ Channel bed ___ Other (_____)

33. Soil drainage:
___ Rapidly drained ___ Somewhat poorly drained
___ Well drained ___ Poorly Drained
___ Moderately well drained ___ Very poorly drained

34.Average texture:
___ sand ___ clay loam
___ sandy loam ___ clay
___ loam ___ peat
___ silt loam ___ muck
___ other :_____

27.Soil profile description: note depth, texture, and color of each horizon. Note significant changes such as depth to mottling, depth to water table, root penetration depth (SOILCOM)

28.Organic horizon depth:
29.Organic horizon type:

30.Average pH of mineral soil:

31.Hydrologic regime:
___Permanently flooded ___Saturated
___Intermittently exposed ___Temporarily flooded
___ Semi-permanently flooded ___Intermittently flooded
flooded ___ Artificially flooded
___ Seasonally flooded ___ Never flooded

35.Unvegetated surface:
___% Bedrock ___% Wood (> 1 cm)
___% Large rocks ___ % Litter, duff (cobbles, boulders > 10 cm)
___% Small rocks (gravel, 0.2-10 cm) ___% Water
___% Sand (0.1-2 mm) ___ % Other:
___% Bare soil

36.Environmental Comments: Note homogeneity of vegetation, erosion / sedimentation, inundation, etc.

37.Plot representativeness:

C. Vegetation

38. System: _____ Terrestrial _____ Palustrine _____ Estuarine 39.Plot number: _____ 40 .Plot dimensions: _____

41.Leaf Type	42. Leaf Phenology	43. Physiognomic Type	
___ Broad-leaf	___ Deciduous	___ Forest	___ Woodland
___ Semi-broad-leaf	___ Semi-deciduous	___ Sparse Woodland	___ Scrub Thicket
___ Semi-needle-leaf	___ Semi-evergreen	___ Shrubland	___ Sparse Woodland
___ Needle-leaf	___ Evergreen	___ Dwarf Shrubland	___ Dwarf Scrub Thicket
___ Broad-leaf herbaceous	___ Perennial	___ Sparse Dwarf Shrubland	___ Herbaceous
___ Graminoid	___ Annual	___ Non-Vascular	___ Sparsely Vegetated
___ Pteridophyte			

R = 1 or few (+) = occasional 1 = <5% 2- = 5-12% 2+ = 13-25% 3 = 26-50% 4 = 51-75% 5 = 76+%

44	height	% cover
T1 Emergent tree		
T2 Tree canopy		
T3 Tree sub-canopy		
S1 Tall shrub		
S2 Short shrub		
H Herbaceous		
N Non-vascular		
E Epiphyte		
V Vine / liana		

45. Species / percent cover: starting with uppermost stratum, list all species and % cover for each in the stratum. For forests and woodlands, list on a separate line below each tree species the DBH of all trees above 10 cm diameter. Separate the measurements with a comma and note whether in cm or inches.

Accuracy Assessment Form

USGS-NPS Vegetation Mapping Program

1. Plot Number _____ 2. Park Code _____ 3. Date _____

4. Observer(s)_____ _____5. Datum _____ 6. Accuracy _____

7. UTM Coordinates: Easting __ __ __, __ __ __ Northing __, __ __ __, __ __ __

8. UTM Zone _____ 9. Offset from Point: Easting _____m Northing _____m

10. Topographic Description _____

11. Elevation _____m 12. Aspect _____

13. Veg Assoc. at Site _____

14. Veg Assoc 2 within 50m of Site _____

15. Veg Assoc 3 within 50m of Site _____

16. Major Species Present (by strata)_____

_____

_____

_____

17. Canopy Closure of Top Layer _____

18. Rationale for Classification_____

_____

_____

_____

19. Comments

_____

_____

_____

_____

Instructions for Accuracy Assessment

The basic document for accuracy assessment is "Accuracy Assessment Procedures", developed by the Program in 1994. The document can be downloaded from the Program web site at http://biology.usgs.gov/npsveg. This accuracy assessment (AA) form is the result of an additional 4 years of field experience. The purpose of this form is to generate concise data to document the accuracy assessment procedure that occurred in the field and to compare it to the mapped data.

All navigation must occur with either a Y-code GPS receiver (e.g. Rockwell PLGR) or in real time differential mode if using other types of receivers. This unit allows the user to navigate to sites within a few meters of their actual locations. The AA sites will be selected using randomly located samples stratified according to the associations. Before beginning each morning, make sure the datum is set to NAD83, and that the projection system is UTM, with the proper zone. A compass is needed to estimate aspect.

The materials you should have before you begin are a 1) plots of the DOQQ's showing the polygon boundaries, but no information on polygon attributes, and the location of the AA sites with numbers, 2) AA site coordinates loaded into your GPS receiver, 3) the field key, and 4) association descriptions.

Once you have navigated to an accuracy assessment site, and the FOM (Figure of Merit) is at 1, if using a PLGR, observe the vegetation within a 50 meter radius of the site. To gauge how far 50 meters is, it is helpful to have the navigator pace 50 meters in one direction. Document what the vegetation community is at the site, and if there are more than one community present within a 50 meter radius, document those as well under Veg Assoc 2 & 3.

Specific Instructions:

1. Plot Number - self explanatory
2. Park Code - the four character code for the park (e.g. Voyageurs is VOYA, Scotts Bluff is SCBL)
3. Date - self explanatory
4. Observor(s) - self explanatory
5. Datum - the reference system for the projection, should be NAD83 (NAR on the PLGR)
6. Accuracy - the distance in meters the GPS receiver displays, if using a PLGR
7. UTM Coordinates - easting and northing in meters
8. UTM Zone - UTM zones in continental US range between 10 (126 ^{0} W longitude on the Pacific Coast) and 19 (66 ^{o} W longitude on the Atlantic Coast)
9. Offset from Site - if you are unable to navigate directly to a site due to terrain problems (e.g., rivers, canyons), record the distance from the site displayed on your GPS receiver, record 0 if there is no offset

a. Topographic Description - where you are on the terrain; on the top of a hill, in a small valley, midslope on a south facing slope, etc.

10. Elevation - above sea level in meters
11. Aspect - using a compass estimate the aspect of the whole site, record in degrees of azimuth (0-360)
12. Veg Assoc at Site - use the field key determine the association directly on the AA site
13. Veg Assoc 2 within 50 m of Site - if a second vegetation association is found within 50 meters of the site, record that association.
14. Veg Assoc 3 within 50 m of Site - if a third vegetation association is found within 50 meters of the site, record that association
15. Major Species Present (by strata) - record the major and indicator species present
16. Canopy Closure of Top Layer - estimate canopy closure of top stratum, eliminating the contribution from lower strata.
17. Rationale for Classification - record the logical procedure you used to determine the vegetation association based on indicator species, major species, structure, etc.
18. Comments - all relevant information that does not fit into the fields above. Note such things as multiple associations near the site, indications of artificial influences on the vegetation, such as grazing, logging, animal presence or use, influences of elevation, aspect, water tables, etc

Appendix C. Key to vegetation types at Valley Forge National Historical Park.

KEY TO VEGETATION TYPES AT VALLEY FORGE NATIONAL HISTORICAL PARK

The vegetation key is intended to assist in the identification of association-level vegetation within Valley Forge National Historical Park. This key should be used in conjunction with local association descriptions within the main body of this report. Several of the anthropogenic types have no descriptions as they are easily distinguished or lack natural vegetation. Users of the key should have a good knowledge of the local flora within the park. Field guides including Pennsylvania flora may be helpful (e.g., Rhodes and Block 2000, Gleason and Cronquist 1991).

Notes on Use of Vegetation Key

Species included in an association name are not necessarily present in any particular plot or even within all plots of that type in the park, due to the fact that association names are based on the rangewide characteristics rather than local descriptions. For example, some of the mixed floodplain forests in the park, classified as "Riverine Floodplain Forest" (*Platanus occidentalis – Fraxinus pennsylvanica* Forest), are co-dominated by sycamore and contain no green ash. Association names are provided below the local name; see vegetation descriptions for full details on composition and environmental setting. Colloquial plant names are included for ease of use.

The key is broken into broad sections, easily recognizable human managed landscapes (e.g., developed land, open mowed or tall grass grasslands), sylvicultural plantings (e.g., white pine plantations, ornamental groves, single species hardwood plantings), and relatively unmanaged natural and successional vegetation.

NON-FORESTED ANTHROPOGENIC, DEVELOPED, OR INTENSIVELY MANAGED LAND OR VEGETATION

1. Uplands containing park infrastructure and severely disturbed landscape, including buildings, roads and abandoned quarries.

    2. Uplands surrounding or adjacent buildings and infrastructure (excluding roads), typically with regularly mowed lawns and ornamental landscaping.

    Developed Land

    2. Uplands associated with roads and maintained road right-of-way and abandoned quarries.

        3. Uplands associated with roads and maintained road right-of-way.

        Transportation Corridor

        3. Uplands associated with past mining operations.

        Old Quarry/Reclamation Site

1. Uplands not directly associated with park infrastructure or severley distrubed landscape. Includes current or recently fallowed agricultural land, managed grasslands and abandoned horticultural nurseries.Agricultural land, including orchards, pastures and cropland.

4. Open grassland.

    5. Mowed on a regular basis, maintained as short grass.

Grassland (mowed)
Dactylis glomerata – Rumex acetosella Herbaceous Vegetation

    5. Mowed only once or twice a year, managed as tall grass.

Grassland (tall grass)
Dactylis glomerata – Rumex acetosella Herbaceous Vegetation

4. Not open grassland, current or recently farmed cropland, also old abandoned horticultural nursery sites.

    6. Planted row crops (typically corn), or recently fallowed agricultural land.

Cropland

    6. Mass plantings of horticultural species, typically overgrown and weedy in appearance.

Old Nursery Site

FORESTED ANTHROPOGENIC STANDS, INCLUDING PLANTED FORESTS AND WOODLANDS

1. Stand dominated by planted hardwood shrubs or trees.

    2. Stand associated with former horticultural nursery, canopy or shub layer characterized by mass single species plantings, often of exotic species.

Old Nursery Site

    2. Stand not associated with former horticultural nursery.

        3. Stand dominated by ornamental shrubs, primarily dogwoods, in well-maintained, open grassland setting.

Planted Ornamental Tree Grove

        3. Stand dominated by trees, typically catalpa or red oak.

            4. Stand dominated by northern catalpa (*Catalpa speciosa*).

Northern Catalpa Planted Forest
Catalpa speciosa Planted Forest

            4. Stand dominated by red oak (*Quercus rubr*a).

Plantation Red Oak
Quercus rubra Planted Forest

1. Stand dominated by planted conifers or conifers mixed with hardwoods (often planted pin oaks (*Quercus palustris*).

    5. Stand a mix of planted conifers, especially white pine (*Pinus strobus*), and planted hardwoods.

        Mixed White Pine – Hardwood Plantation

    5. Stand dominated by planted conifers, hardwoods limited to volunteer hardwoods (not planted).

        6. Stand dominated by white pine (*Pinus strobus*), often with volunteer hardwoods.

            White Pine Plantation
            Pinus strobus Planted Forest

        6. Stand dominated by eastern hemlock (*Tsuga canadensis*) with occasional volunteer hardwoods.

            Eastern Hemlock Plantation
            Tsuga canadensis Planted Forest

NATURAL VEGETATION

1. Herbaceous and shrub vegetation with tree cover less than 25%.

    2. Uplands, not seasonally or temporarily flooded.

        3. Uplands co-dominated by grasses and over 30% cover of shrubs and vines such as multiflora rose (*Rosa multiflora*), autumn olive (*Eleagnus* sp.), Japanese honeysuckle (*Lonicera japonica*) and other weedy species.

            Successional Old Field / Shrubland
            (Local Type)

        3. Sparsely vegetated upland talus and scree slopes, not dominated by grasses and shrubs.

            Chestnut Oak – Black Birch Talus Slope
            Quercus prinus – Betula lenta / Parthenocissus quinquefolia Talus Woodland

    2. Seasonally or temporarily flooded or saturated.

        4. Open, non-forested wetland dominated by reed canary grass (*Phalaris arundinacea*) and wetland species such as rice cut-grass (*Leersia oryzoides*) and burreed (*Sparganium* spp).

            Wet Meadow
            Calamagrostis canadensis – Phalaris arundinacea Herbaceous Vegetation

4. Wetland occurs in forested setting with partial to closed canopy, herbaceous layer dominated by skunk cabbage (*Symplocarpus foetidus*).

Skunk Cabbage Seepage Meadow
Symplocarpus foetidus Herbaceous Vegetation

1. Forest and woodlands with tree cover greater than 25 %.

5. Tuliptree (*Liriodendron tulipifera*) dominant, comprising over 40% tree cover, in even age stand with or without associate tree species.

Tuliptree - Oak Forest
Liriodendron tulipifera – Acer rubrum – Quercus spp. Forest

5. Tuliptree (*Liriodendron tulipifera*) comprising less than 40% canopy and / or sub-canopy cover.

6. Oak (*Quercus* spp.) absent or sparse; oak species comprising less than 15% tree cover.

7. Silver maple (*Acer saccharinum*), sycamore (*Platanus occidentalis*) and / or green ash (*Fraxinus pennsylvanica*) dominate the canopy and / or sub-canopy (comprising over 50% cover). Temporarily flooded or with seasonally high water table. Floodplain Forests.

8. Silver maple (*Acer saccharinum*) strongly dominant, comprising over 60% canopy cover. Mature silver maple present. Temporarily flooded.

Silver Maple Floodplain Forest
Acer saccharinum Temporarily Flooded Forest

8. Canopy cover mixed with silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*) and / or sycamore (*Platanus occidentalis*) as co-dominants. Characteristic species include box elder (*Acer negundo*), spicebush (*Lindera benzoin*), false nettle (*Boehmeria cylindrica*), stiltgrass (*Microstegium vimineum*).

Riverine Floodplain Forest
Platanus occidentalis – Fraxinus pennsylvanica Forest

7. Canopy and or subcanopy not dominated by silver maple (*Acer saccharinum*), sycamore (*Platanus occidentalis*) and / or green ash (*Fraxinus pennsylvanica*) (comprising less than 50% cover). Uplands.

9. Tuliptree (*Liriodendron tulipifera*) codominant, with 10 to 40% canopy cover with less than 5% of any of the following: *Quercus prinus, Kalmia latifolia, Nyssa sylvatica, Ulmus americana* or *Fraxinus pennsylvanica*. Common associates include *Cornus florida* and *Lindera benzoin*. *Quercus velutina* or *Quercus alba* may be present at over 5%.

Tuliptree – Oak Forest
Liriodendron tulipifera – Acer rubrum – Quercus spp. Forest

9. Tuliptree rare or absent. Canopy dominated by mixed early successional hardwoods, often with black walnut (*Juglans nigra*), white ash (*Fraxinus americana*), tree-of-heaven (*Ailanthus altissima*) and / or black locust (*Robinia pseudoacacia*) dominant or codominant. Often characterized by conspicuous vine cover in tree layer: oriental bittersweet (*Celastrus orbiculatus*), Japanese honeysuckle (*Lonicera japonica*), summer grape (*Vitis aestivalis*) and others. Wineberry (*Rubus phoenicolasius*) and garlic mustard (*Alliaria petiolata*) are also frequent.

Northeastern Modified Successional Forest
Prunus serotina - Liriodendron tulipifera - Acer rubrum - Fraxinus americana Forest

6. Oak dominated (oak species comprise over 50% of tree layer), chestnut oak (*Quercus prinus*), black oak (*Quercus velutina*), white oak (*Quercus alba*) and/or scarlet oak (*Quercus coccinea*) comprise over 50% of the tree cover.

Dry Oak Forest
Quercus prinus – Quercus (rubra, velutina) / Vaccinium angustifolium Forest

Appendix D. Vascular plants identified in vegetation classification and thematic accuracy assessment plots (nomenclature follows Kartesz 1994) at Valley Forge National Historical Park.

Appendix D. Vascular plants identified in vegetation classification and thematic accuracy assessment plots (nomenclature follows Kartesz 1994) at Valley Forge National Historical Park.

Family	Scientific Name	Common Name
Aceraceae	*Acer negundo* L.	boxelder
Aceraceae	*Acer platanoides* L.	Norway maple
Aceraceae	*Acer rubrum* L.	red maple
Aceraceae	*Acer saccharinum* L.	silver maple
Aceraceae	*Acer saccharum* Marsh.	sugar maple
Alismataceae	*Alisma triviale* Pursh	northern water plantain
Anacardiaceae	*Rhus typhina* L.	staghorn sumac
Anacardiaceae	*Toxicodendron radicans* (L.) Kuntze	eastern poison ivy
Annonaceae	*Asimina triloba* (L.) Dunal	common pawpaw
Apiaceae	*Daucus carota* L.	Queen Anne's lace
Apiaceae	*Pastinaca sativa* L.	wild parsnip
Apiaceae	*Sanicula* L.	sanicle
Apocynaceae	*Apocynum cannabinum* L.	Indianhemp
Aquifoliaceae	*Ilex opaca* Ait.	American holly
Araceae	*Arisaema triphyllum* (L.) Schott	jack-in-the-pulpit
Araceae	*Symplocarpus foetidus* (L.) Salisb. ex Nutt.	skunk cabbage
Araliaceae	*Hedera helix* L.	English ivy
Araliaceae	*Panax quinquefolius* L.	American ginseng
Aristolochiaceae	*Asarum canadense* L.	Canadian wildginger
Asclepiadaceae	*Asclepias incarnata* L.	swamp milkweed
Asclepiadaceae	*Asclepias* L.	milkweed
Asclepiadaceae	*Asclepias syriaca* L.	common milkweed
Asteraceae	*Achillea millefolium* L.	common yarrow
Asteraceae	*Ambrosia artemisiifolia* L.	annual ragweed
Asteraceae	*Anaphalis margaritacea* (L.) Benth. & Hook. f.	western pearlyeverlasting
Asteraceae	*Antennaria* Gaertn.	pussytoes
Asteraceae	*Antennaria neglecta* Greene	field pussytoes
Asteraceae	*Artemisia* L.	sagebrush
Asteraceae	*Artemisia vulgaris* L.	common wormwood
Asteraceae	*Aster divaricatus* L.	white wood aster
Asteraceae	*Aster* L.	aster
Asteraceae	*Aster lateriflorus* (L.) Britt.	calico aster
Asteraceae	*Aster novae-angliae* L.	New England aster
Asteraceae	*Bidens* L.	beggartick
Asteraceae	*Cirsium discolor* (Muhl. ex Willd.) Spreng.	field thistle
Asteraceae	*Cirsium P.* Mill.	thistle
Asteraceae	*Conyza canadensis* (L.) Cronq.	Canadian horseweed
Asteraceae	*Erechtites hieraciifolia* (L.) Raf. Ex DC.	American burnweed
Asteraceae	*Erigeron* L.	fleabane
Asteraceae	*Eupatorium* L.	thoroughwort
Asteraceae	*Eupatorium rugosum* Houtt.	white snake-root
Asteraceae	*Euthamia graminifolia* (L.) Nutt.	flattop goldentop
Asteraceae	*Helenium autumnale* L.	common sneezeweed
Asteraceae	*Hieracium* L.	hawkweed
Asteraceae	*Prenanthes* L.	rattlesnakeroot
Asteraceae	*Rudbeckia hirta* L.	blackeyed Susan
Asteraceae	*Solidago canadensis* L.	Canada goldenrod

Appendix D. Vascular plants identified in vegetation classification and thematic accuracy assessment plots (nomenclature follows Kartesz 1994) at Valley Forge National Historical Park (continued).

Family	Scientific Name	Common Name
Asteraceae	*Solidago rugosa* P. Mill.	wrinkleleaf goldenrod
Asteraceae	*Tanacetum* L.	tansy
Asteraceae	*Taraxacum officinale* G.H. Weber ex Wiggers	common dandelion
Balsaminaceae	*Impatiens capensis* Meerb.	jewelweed
Balsaminaceae	*Impatiens* L.	touchmenot
Berberidaceae	*Berberis thunbergii* L.	Japanese barberry
Berberidaceae	*Podophyllum peltatum* L.	mayapple
Betulaceae	*Alnus serrulata* (Ait.) Willd.	hazel alder
Betulaceae	*Betula lenta* L.	sweet birch
Betulaceae	*Betula nigra* L.	river birch
Betulaceae	*Carpinus caroliniana* Walt.	American hornbeam
Betulaceae	*Ostrya virginiana* (P. Mill.) K. Koch	eastern hophornbeam
Bignoniaceae	*Catalpa speciosa* (Warder) Warder ex Engelm.	northern catalpa
Boraginaceae	*Hackelia virginiana* (L.) I.M. Johnston	beggarslice
Boraginaceae	*Mertensia virginica* (L.) Pers. Ex Link	Virginia bluebells
Brassicaceae	*Alliaria petiolata* (Bieb.) Cavara & Grande	garlic mustard
Brassicaceae	*Cardamine impatiens* L.	narrowleaf bittercress
Brassicaceae	*Cardamine pensylvanica* Muhl. Ex Willd.	Pennsylvania bittercress
Brassicaceae	*Cardamine pratensis* L.	cuckoo flower
Brassicaceae	*Nasturtium officinale* Ait. F.	water cress
Campanulaceae	*Lobelia spicata* Lam.	palespike lobelia
Caprifoliaceae	*Linnaea borealis* L.	twinflower
Caprifoliaceae	*Lonicera japonica* Thunb.	Japanese honeysuckle
Caprifoliaceae	*Lonicera maackii* (Rupr.) Herder	amur honeysuckle
Caprifoliaceae	*Lonicera morrowii* Gray	Morrow’s honeysuckle
Caprifoliaceae	*Lonicera tatarica* L.	tatarian honeysuckle
Caprifoliaceae	*Viburnum dilatatum* Thunb.	linden arrowwood
Caprifoliaceae	*Viburnum* L.	viburnum
Caprifoliaceae	*Viburnum prunifolium* L.	blackhaw
Caprifoliaceae	*Viburnum recognitum* Fern.	arrow-wood
Caryophyllaceae	*Cerastium arvense* L.	field chickweed
Caryophyllaceae	*Cerastium fontanum* Baumg.	common chickweed
Caryophyllaceae	*Dianthus armeria* L.	deptford pink
Caryophyllaceae	*Stellaria media* (L.) Vill.	common chickweed
Celastraceae	*Celastrus orbiculatus* Thunb.	oriental bittersweet
Clusiaceae	*Hypericum perforatum* L.	common St. Johnswort
Commelinaceae	*Commelina communis* L.	asiatic dayflower
Convolvulaceae	*Calystegia sepium* (L.) R. Br.	hedge false bindweed
Cornaceae	*Cornus amomum* P. Mill.	silky dogwood
Cornaceae	*Cornus florida* L.	flowering dogwood
Cupressaceae	*Juniperus virginiana* L.	eastern redcedar
Cupressaceae	*Thuja occidentalis* L.	eastern arborvitae
Cuscutaceae	*Cuscuta* L.	dodder
Cyperaceae	*Carex annectens* (Bickn.) Bickn.	yellowfruit sedge
Cyperaceae	*Carex bushii* Mackenzie	Bush's sedge
Cyperaceae	*Carex hirsutella* Mackenzie	fuzzy wuzzy sedge

Appendix D. Vascular plants identified in vegetation classification and thematic accuracy assessment plots (nomenclature follows Kartesz 1994) at Valley Forge National Historical Park (continued).

Family	Scientific Name	Common Name
Cyperaceae	*Carex intumescens* Rudge	greater bladder sedge
Cyperaceae	*Carex* L.	sedge
Cyperaceae	*Carex lupulina* Muhl. ex Willd.	hop sedge
Cyperaceae	*Carex ovalis* Goodenough	sedge
Cyperaceae	*Carex pensylvanica* Lam.	Pennsylvania sedge
Cyperaceae	*Carex swanii* (Fern.) Mackenzie	swan's sedge
Cyperaceae	*Cyperus* L.	flatsedge
Cyperaceae	*Cyperus lupulinus* (Spreng.) Marcks	Great Plains flatsedge
Cyperaceae	*Dulichium arundinaceum* (L.) Britt.	threeway sedge
Cyperaceae	*Eleocharis acicularis* (L.) Roemer & J.A. Schultes	needle spikerush
Cyperaceae	*Scirpus* L.	bulrush
Dennstaedtiaceae	*Dennstaedtia punctilobula* (Michx.) T. Moore	eastern hayscented fern
Dioscoreaceae	*Dioscorea villosa* L.	wild yam
Dryopteridaceae	*Dryopteris carthusiana* (Vill.) H.P. Fuchs	spinulose woodfern
Dryopteridaceae	*Dryopteris intermedia* (Muhl. ex Willd.) Gray	intermediate woodfern
Dryopteridaceae	*Dryopteris marginalis* (L.) Gray	marginal woodfern
Dryopteridaceae	*Gymnocarpium dryopteris* (L.) Newman	western oakfern
Dryopteridaceae	*Onoclea sensibilis* L.	sensitive fern
Dryopteridaceae	*Polystichum acrostichoides* (Michx.) Schott	Christmas fern
Elaeagnaceae	*Elaeagnus umbellata* Thunb.	autumn olive
Ericaceae	*Gaylussacia baccata* (Wangenh.) K. Koch	black huckleberry
Ericaceae	*Kalmia latifolia* L.	mountain laurel
Ericaceae	*Rhododendron periclymenoides* (Michx.) Shinners	pink azalea
Ericaceae	*Vaccinium pallidum* Ait.	Blue Ridge blueberry
Ericaceae	*Vaccinium stamineum* L.	deerberry
Euphorbiaceae	*Acalypha* L.	acalypha
Fabaceae	*Amphicarpaea bracteata* (L.) Fern.	American hogpeanut
Fabaceae	*Cercis canadensis* L.	eastern redbud
Fabaceae	*Coronilla* L.	crownvetch
Fabaceae	*Desmodium nudiflorum* (L.) DC.	nakedflower ticktrefoil
Fabaceae	*Desmodium paniculatum* (L.) DC.	panicledleaf ticktrefoil
Fabaceae	*Gleditsia triacanthos* L.	honeylocust
Fabaceae	*Lotus corniculatus* L.	birdfoot deervetch
Fabaceae	*Medicago lupulina* L.	black medick
Fabaceae	*Robinia pseudoacacia* L.	black locust
Fabaceae	*Trifolium* L.	clover
Fabaceae	*Trifolium pratense* L.	red clover
Fabaceae	*Trifolium repens* L.	white clover
Fabaceae	*Wisteria* Nutt.	wisteria
Fagaceae	*Castanea dentata* (Marsh.) Borkh.	American chestnut
Fagaceae	*Fagus grandifolia* Ehrh.	American beech
Fagaceae	*Fagus sylvatica* L.	European beech
Fagaceae	*Quercus alba* L.	white oak
Fagaceae	*Quercus coccinea* Muenchh.	scarlet oak
Fagaceae	*Quercus palustris* Muenchh.	pin oak

Appendix D. Vascular plants identified in vegetation classification and thematic accuracy assessment plots (nomenclature follows Kartesz 1994) at Valley Forge National Historical Park (continued).

Family	Scientific Name	Common Name
Fagaceae	*Quercus prinus* L.	chestnut oak
Fagaceae	*Quercus rubra* L.	northern red oak
Fagaceae	*Quercus velutina* Lam.	black oak
Fumariaceae	*Corydalis flavula* (Raf.) DC.	yellow fumewort
Hamamelidaceae	*Hamamelis virginiana* L.	American witchhazel
Hamamelidaceae	*Liquidambar styraciflua* L.	sweetgum
Hippocastanaceae	*Aesculus* L.	buckeye
Juglandaceae	*Carya cordiformis* (Wangenh.) K. Koch	bitternut hickory
Juglandaceae	*Carya glabra* (P. Mill.) Sweet	pignut hickory
Juglandaceae	*Carya* Nutt.	hickory
Juglandaceae	*Carya ovalis* (Wangenh.) Sarg.	red hickory
Juglandaceae	*Carya ovata* (P. Mill.) K. Koch	shagbark hickory
Juglandaceae	*Juglans cinerea* L.	butternut
Juglandaceae	*Juglans nigra* L.	black walnut
Juncaceae	*Juncus canadensis* J. Gay ex Laharpe	Canadian rush
Juncaceae	*Juncus effusus* L.	common rush
Juncaceae	*Juncus tenuis* Willd.	poverty rush
Lamiaceae	*Clinopodium vulgare* L.	wild basil
Lamiaceae	*Lycopus americanus* Muhl. Ex W. Bart.	American waterhorehound
Lamiaceae	*Lycopus* L.	waterhorehound
Lamiaceae	*Mentha* L.	mint
Lamiaceae	*Prunella vulgaris* L.	common selfheal
Lamiaceae	*Pycnanthemum* Michx.	pycnanthemum
Lamiaceae	*Scutellaria* L.	skullcap
Lamiaceae	*Scutellaria lateriflora* L.	blue skullcap
Lamiaceae	*Teucrium canadense* L.	Canada germander
Lamiaceae	*Trichostema dichotomum* L.	forked bluecurls
Lauraceae	*Lindera benzoin* (L.) Blume	northern spicebush
Lauraceae	*Sassafras albidum* (Nutt.) Nees	sassafras
Lemnaceae	*Lemna* L.	duckweed
Liliaceae	*Allium vineale* L.	wild garlic
Liliaceae	*Maianthemum canadense* Desf.	Canada beadruby
Liliaceae	*Medeola virginiana* L.	Indian cucumberroot
Liliaceae	*Polygonatum pubescens* (Willd.) Pursh	hairy Solomon's seal
Liliaceae	*Uvularia perfoliata* L.	perfoliate bellwort
Lythraceae	*Lythrum salicaria* L.	purple loosestrife
Magnoliaceae	*Liriodendron tulipifera* L.	tuliptree
Magnoliaceae	*Magnolia acuminata* (L.) L.	cucumbertree
Monotropaceae	*Monotropa uniflora* L.	Indianpipe
Moraceae	*Morus alba* L.	white mulberry
Nymphaeaceae	*Nuphar* Sm.	pondlilly
Nyssaceae	*Nyssa sylvatica* Marsh.	blackgum
Oleaceae	*Fraxinus americana* L.	white ash
Oleaceae	*Fraxinus pennsylvanica* Marsh.	green ash
Ophioglossaceae	*Botrychium dissectum* Spreng.	cutleaf grapefern

Appendix D. Vascular plants identified in vegetation classification and thematic accuracy assessment plots (nomenclature follows Kartesz 1994) at Valley Forge National Historical Park (continued).

Family	Scientific Name	Common Name
Onagraceae	*Circaea lutetiana* L.	broadleaf enchanter's nightshade
Oleaceae	*Ligustrum vulgare* L.	European privet
Orobanchaceae	*Epifagus virginiana* (L.) W. Bart.	beechdrops
Osmundaceae	*Osmunda claytoniana* L.	interrupted fern
Oxalidaceae	*Oxalis* L.	woodsorrel
Oxalidaceae	*Oxalis stricta* L.	common yellow oxalis
Phytolaccaceae	*Phytolacca americana* L.	American pokeweed
Pinaceae	*Larix decidua* P. Mill.	European larch
Pinaceae	*Picea A.* Dietr.	spruce
Pinaceae	*Pinus strobus* L.	eastern white pine
Pinaceae	*Pinus sylvestris* L.	scotch pine
Pinaceae	*Tsuga canadensis* (L.) Carr.	eastern hemlock
Plantaginaceae	*Plantago lanceolata* L.	narrowleaf plantain
Plantaginaceae	*Plantago major* L.	common plantain
Platanaceae	*Platanus occidentalis* L.	American sycamore
Poaceae	*Agrostis gigantea* Roth	redtop
Poaceae	*Agrostis perennans* (Walt.) Tuckerman	upland bentgrass
Poaceae	*Agrostis stolonifera* L.	creeping bentgrass
Poaceae	*Andropogon virginicus* L.	broomsedge bluestem
Poaceae	*Anthoxanthum odoratum* L.	sweet vernalgrass
Poaceae	*Bromus commutatus* Schrad.	meadow brome
Poaceae	*Bromus japonicus* Thunb. Ex Murr.	Japanese brome
Poaceae	*Cinna arundinacea* L.	sweet woodreed
Poaceae	*Cinna latifolia* (Trev. Ex Goepp.) Griseb.	drooping woodreed
Poaceae	*Dactylis glomerata* L.	orchardgrass
Poaceae	*Digitaria sanguinalis* (L.) Scop.	hairy crabgrass
Poaceae	*Echinochloa muricata* (Beauv.) Fern.	rough barnyardgrass
Poaceae	*Elymus hystrix* L.	eastern bottlebrush grass
Poaceae	*Elymus* L.	wildrye
Poaceae	*Elymus villosus* Muhl. Ex Willd.	hairy wildrye
Poaceae	*Elytrigia repens* (L.) Desv. Ex B.D. Jackson	creeping quackgrass
Poaceae	*Eragrostis spectabilis* (Pursh) Steud.	purple lovegrass
Poaceae	*Festuca elatior* L. p.p.	tall fescue
Poaceae	*Festuca* L.	fescue
Poaceae	*Festuca obtusa* Biehler	nodding fescue
Poaceae	*Festuca rubra* L.	red fescue
Poaceae	*Glyceria* R. Br.	mannagrass
Poaceae	*Glyceria striata* (Lam.) A.S. Hitchc.	fowl mannagrass
Poaceae	*Leersia oryzoides* (L.) Sw.	rice cutgrass
Poaceae	*Microstegium vimineum* (Trin.) A. Camus	Japanese stiltgrass
Poaceae	*Panicum acuminatum* Sw.	panic grass
Poaceae	*Panicum anceps* Michx.	beaked panicum
Poaceae	*Panicum clandestinum* L.	deer tongue
Poaceae	*Panicum* L.	panicum
Poaceae	*Paspalum setaceum* Michx.	thin paspalum

Appendix D. Vascular plants identified in vegetation classification and thematic accuracy assessment plots (nomenclature follows Kartesz 1994) at Valley Forge National Historical Park (continued).

Family	Scientific Name	Common Name
Poaceae	*Phalaris arundinacea* L.	reed canarygrass
Poaceae	*Phleum pratense* L.	timothy
Poaceae	*Poa* L.	bluegrass
Poaceae	*Poa pratensis* L.	Kentucky bluegrass
Poaceae	*Setaria* Beauv.	bristlegrass
Poaceae	*Setaria faberi* Herrm.	Japanese bristlegrass
Poaceae	*Setaria geniculata* Beauv.	perennial foxtail
Poaceae	*Tridens flavus* (L.) A.S. Hitchc.	purpletop tridens
Polygonaceae	*Polygonum amphibium* L.	water knotweed
Polygonaceae	*Polygonum arifolium* L.	halberdleaf tearthumb
Polygonaceae	*Polygonum cespitosum* Blume	oriental ladysthumb
Polygonaceae	*Polygonum cuspidatum* Sieb. & Zucc.	Japanese knotweed
Polygonaceae	*Polygonum hydropiperoides* Michx.	swamp smartweed
Polygonaceae	*Polygonum pensylvanicum* L.	Pennsylvania smartweed
Polygonaceae	*Polygonum perfoliatum* L.	asiatic tearthumb
Polygonaceae	*Polygonum persicaria* L.	spotted ladysthumb
Polygonaceae	*Polygonum sagittatum* L.	arrowleaf tearthumb
Polygonaceae	*Polygonum virginianum* L.	jumpseed
Polygonaceae	*Rumex acetosella* L.	common sheep sorrel
Polygonaceae	*Rumex crispus* L.	curly dock
Polygonaceae	*Rumex obtusifolius* L.	bitter dock
Polygonaceae	*Rumex verticillatus* L.	swamp dock
Pyrolaceae	*Chimaphila maculata* (L.) Pursh	striped prince's pine
Ranunculaceae	*Anemone quinquefolia* L.	nightcaps
Ranunculaceae	*Hepatica americana* (DC.) Ker-Gawl.	liverleaf
Ranunculaceae	*Ranunculus ficaria* L.	fig buttercup
Ranunculaceae	*Ranunculus* L.	buttercup
Rosaceae	*Agrimonia* L.	agrimony
Rosaceae	*Amelanchier arborea* (Michx. F.) Fern.	common serviceberry
Rosaceae	*Amelanchier* Medik.	serviceberry
Rosaceae	*Crataegus* L.	hawthorn
Rosaceae	*Fragaria virginiana* Duchesne	Virginia strawberry
Rosaceae	*Geum canadense* Jacq.	white avens
Rosaceae	*Geum laciniatum* Murr.	rough avens
Rosaceae	*Malus* P. Mill.	apple
Rosaceae	*Potentilla* L.	cinquefoil
Rosaceae	*Potentilla simplex* Michx.	common cinquefoil
Rosaceae	*Prunus avium* (L.) L.	sweet cherry
Rosaceae	*Prunus serotina* Ehrh.	black cherry
Rosaceae	*Prunus virginiana* L.	common chokecherry
Rosaceae	*Pyrus coronaria* L.	crab apple
Rosaceae	*Pyrus* L.	pear
Rosaceae	*Rhodotypos scandens* (Thunb.) Makino	jetbead
Rosaceae	*Rosa multiflora* Thunb. Ex Murr.	multiflora rose
Rosaceae	*Rubus allegheniensis* Porter	Allegheny blackberry
Rosaceae	*Rubus idaeus* L.	American red raspberry

Appendix D. Vascular plants identified in vegetation classification and thematic accuracy assessment plots (nomenclature follows Kartesz 1994) at Valley Forge National Historical Park (continued).

Family	Scientific Name	Common Name
Rosaceae	*Rubus philadelphicus* Blanch.	Philadelphia blackberry
Rosaceae	*Rubus phoenicolasius* Maxim.	wine raspberry
Rosaceae	*Waldsteinia fragarioides* (Michx.) Tratt.	barren strawberry
Rubiaceae	*Cephalanthus occidentalis* L.	common buttonbush
Rubiaceae	*Galium aparine* L.	stickywilly
Rubiaceae	*Galium asprellum* Michx.	rough bedstraw
Rubiaceae	*Galium circaezans* Michx.	licorice bedstraw
Rubiaceae	*Galium concinnum* Torr. & Gray	shining bedstraw
Rubiaceae	*Galium palustre* L.	common marsh bedstraw
Rubiaceae	*Galium triflorum* Michx.	fragrant bedstraw
Salicaceae	*Populus grandidentata* Michx.	bigtooth aspen
Salicaceae	*Salix nigra* Marsh.	black willow
Saururaceae	*Saururus cernuus* L.	lizards tail
Saxifragaceae	*Tiarella cordifolia* L.	heartleaf foamflower
Scrophulariaceae	*Linaria vulgaris* P. Mill.	butter and eggs
Scrophulariaceae	*Paulownia tomentosa* (Thunb.) Sieb. & Zucc. ex Steud.	princesstree
Scrophulariaceae	*Penstemon digitalis* Nutt. ex Sims	beardtongue
Scrophulariaceae	*Verbascum thapsus* L.	common mullein
Simaroubaceae	*Ailanthus altissima* (P. Mill.) Swingle	tree of heaven
Smilacaceae	*Smilax glauca* Walt.	cat greenbrier
Smilacaceae	*Smilax rotundifolia* L.	roundleaf greenbrier
Solanaceae	*Solanum carolinense* L.	Carolina horsenettle
Sparganiaceae	*Sparganium androcladum* (Engelm.) Morong	branched burreed
Sparganiaceae	*Sparganium* L.	burreed
Staphyleaceae	*Staphylea trifolia* L.	American bladdernut
Taxaceae	*Taxus* L.	yew
Tiliaceae	*Tilia americana* L.	American basswood
Typhaceae	*Typha angustifolia* L.	narrowleaf cattail
Typhaceae	*Typha latifolia* L.	broadleaf cattail
Ulmaceae	*Celtis occidentalis* L.	common hackberry
Ulmaceae	*Ulmus americana* L.	American elm
Ulmaceae	*Ulmus rubra* Muhl.	slippery elm
Urticaceae	*Boehmeria cylindrica* (L.) Sw.	smallspike false nettle
Urticaceae	*Pilea pumila* (L.) Gray	Canadian clearweed
Urticaceae	*Urtica dioica* L.	stinging nettle
Urticaceae	*Urtica procera* Muhl. ex Willd.	stinging nettle
Violaceae	*Viola hirsutula* Brainerd	southern woodland violet
Violaceae	*Viola* L.	violet
Vitaceae	*Parthenocissus quinquefolia* (L.) Planch.	Virginia creeper
Vitaceae	*Vitis aestivalis* Michx.	summer grape
Vitaceae	*Vitis riparia* Michx.	riverbank grape
Vitaceae	*Vitis vulpina* L.	frost grape

As the nation's primary conservation agency, the Department of the Interior has responsibility for most of our nationally owned public land and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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