



Vegetation Classification and Mapping of Herbert Hoover National Historic Site, Iowa

Project Report

Natural Resource Report NPS/HEHO/NRR—2014/794



ON THE COVER

Birthplace Cottage in Autumn

Photograph by: Herbert Hoover National Historic Site

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Contents

	Page
Figures.....	v
Tables.....	vii
Abstract/Executive Summary	ix
Introduction.....	1
Herbert Hoover National Historic Site Vegetation Inventory Project.....	1
NPS Vegetation Inventory Program	1
Vegetation Inventory Program Standards	2
Herbert Hoover National Historic Site	2
Project Statistics.....	4
Methods.....	5
Planning, Data Gathering, and Coordination.....	5
Field Survey	5
Vegetation Classification	10
Digital Imagery and Interpretation	10
Accuracy Assessment	11
Results.....	15
Vegetation Classification.....	15
Digital Imagery and Interpretation	15
Vegetation Map.....	15
Accuracy Assessment	15
Vegetation Associations.....	19
Mapped Type Name: Bottomland Ruderal Woodland	19
Mapped Type Name: Forb Ruderal Herbaceous Vegetation.....	21

Contents (continued)

	Page
Mapped Type Name: Pasture and Oldfield.....	24
Mapped Type Name: Reed Canarygrass Western Herbaceous Vegetation.....	25
Mapped Type Name: Restored Tallgrass Prairie	26
Discussion	29
Field Survey.....	29
NVC Classification.....	29
Digital Imagery and Interpretation	29
Accuracy Assessment	29
Future Recommendations	29
Research Opportunities.....	30
Literature Cited	31
Appendix A: Contingency Table for Vegetation Mapping at Herbert Hoover National Historic Site	33
Appendix B: Example of Plot Survey Form	35
Appendix C: Herbert Hoover National Historic Site Dichotomous Key to Mapped Current Vegetation Types	39
Appendix D: Example of Accuracy Assessment Form	41
Appendix E: Species List for Herbert Hoover National Historic Site	43

Figures

	Page
Figure 1. Location of Herbert Hoover National Historic Site in Cedar County, Iowa.	3
Figure 2. Map of the Herbert Hoover National Historic Site.	7
Figure 3. Location of 24 observation points collected in Herbert Hoover National Historic Site.	8
Figure 4. Location of 15 sampled plots within Herbert Hoover National Historic Site.	9
Figure 5. Digitization of hand drawn objects.	11
Figure 6. Accuracy Assessment points for Herbert Hoover National Historic Site.	14
Figure 7. Vegetation Classification of Herbert Hoover National Historic Site.	17
Figure 8. Bottomland Ruderal Woodland at Herbert Hoover National Historic Site.	19
Figure 9. Forb Ruderal Herbaceous Vegetation at Herbert Hoover National Historic Site.	21
Figure 10. Restored Tallgrass Prairie at Herbert Hoover National Historic Site.	26

Tables

	Page
Table 1. Canopy Cover used for quantitative sampling.....	6
Table 2. Target number of Accuracy Assessment samples per map class based on number of polygons and area.....	12
Table 3. Summary of the Accuracy Assessment statistics used at Herbert Hoover National Historic Site.	13
Table 4. Mapped types identified at Herbert Hoover National Historic Site.....	16
Table 5. Species found in one plot within the Bottomland Ruderal Woodland vegetation type.....	20
Table 6. Species found within one or more of four plots taken within the Forb Ruderal Herbaceous Vegetation type.	22
Table 7. Species that occurred in at least two of ten plots sampled within the Restored Tallgrass Prairie vegetation type.	27

Abstract/Executive Summary

Herbert Hoover National Historic Site (HEHO) is situated in east central Iowa, surrounded by the small town of West Branch, just north of, and adjacent to, Interstate 80. The Herbert Hoover Library and Museum, a visitor center, and a number of restored homes and other buildings are present within the park. A restored tallgrass prairie is the most significant terrestrial natural resource within this largely agricultural landscape.

A vegetation classification and mapping project was initiated in 2011 and completed in 2013. Protocols and products were produced following National Park Service Vegetation Inventory Program guidelines. Classification was based on 15 field plots and 24 georeferenced observation points. Mapping was based on air photo interpretation and heads-up digitizing of polygons. Accuracy assessment points obtained during 2013 verified that the map was 98.7% accurate.

Five types were mapped and quantified. The restored tallgrass prairie is a striking visual component of the site, and makes up 71.6 acres, or 58% of the undeveloped area. This restored prairie patch within a largely agricultural landscape offers conservation, aesthetic, and educational value. Three other herbaceous vegetation types, including pasture and old field, forb dominated herbaceous vegetation, and reed canarygrass (*Phalaris arundinacea*), make up almost all of the remainder of the park. A ruderal bottomland woodland occupies 2.8 acres, or 1.1% of the undeveloped area.

Introduction

Herbert Hoover National Historic Site Vegetation Inventory Project

Herbert Hoover National Historic Site (HEHO) Vegetation Inventory Project was a cooperative initiative involving the Missouri Resource Assessment Partnership (MoRAP) at the University of Missouri, the Heartland Inventory and Monitoring Program (HTLN) of the National Park Service (NPS), and park managers and resource specialists. MoRAP provided the classification and mapping and HTLN provided accuracy assessment and overall project coordination. All aspects of the project conform to overall requirements set forward by the NPS Vegetation Inventory Program (see <http://science.nature.nps.gov/im/inventory/veg/index.cfm>).

The project was initiated because accurate maps of existing vegetation facilitate natural and cultural resource management and interpretation. HEHO offers opportunities for restoration of tallgrass prairie communities over deep, tillable soils, which are rare on the modern landscape. The natural landscapes provided the natural setting that helped shape Herbert Hoover, and offer additional opportunities for conservation of diminishing prairie flora and fauna.

Each NPS Vegetation Inventory Project has three major components: classification, mapping, and map accuracy assessment. This report provides details on each of these fundamental elements.

NPS Vegetation Inventory Program

The National Vegetation Inventory Program (VIP) was established to map, classify, and describe vegetation in National Park units. It is administered by the NPS Biological Resources Management Division and provides baseline vegetation information to the NPS Natural Resource Inventory and Monitoring Program (I&M).

Vegetation Inventory Program scientists have developed procedures for classification, mapping, and accuracy assessment (Lea and Curtis 2010, Lea 2011). Use of the National Vegetation Classification System (NVCS) as the standard classification is central to fulfilling the goals of this national program. This system:

- is vegetation based;
- uses a systematic approach to classify a continuum;
- emphasizes natural and existing vegetation;
- uses a combined physiognomic-floristic hierarchy;
- identifies vegetation units based on both qualitative and quantitative data; and
- is appropriate for mapping at multiple scales.

The use of the NVCS and the establishment of classification and mapping standards facilitates effective resource stewardship by ensuring compatibility and widespread use of the information throughout the NPS as well as by other federal and state agencies. These vegetation maps and associated information support a wide variety of resource assessment, park management, and planning needs. In addition they can be used to provide a structure for framing and answering critical scientific questions about vegetation communities and their relationship to environmental conditions and ecological processes across the landscape.

Before 1994, NVCS development was led by The Nature Conservancy (TNC), and further development was then passed on to the newly formed NatureServe organization. A network of state and regional ecologists involving dozens of individuals worked on the classification (TNC and ESRI 1994, Grossman et al. 1998). The NVCS is currently supported and endorsed by multiple federal agencies, the Federal Geographic Data Committee (FGDC 2008), NatureServe, state heritage programs, and the Ecological Society of America. Refinements to the classification have occurred in fits and spurts over the past decade, with funding from various federal and state agencies. A formal process for review of proposed revisions is in place (see Jennings et al. 2009), and the most accessible source for the NVCS is provided by NatureServe Explorer (<http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol>).

Vegetation Inventory Program Standards

The NPS I&M Program established guidance and standards for all vegetation inventory projects in a series of documents.

Protocols

- documenting a National Vegetation Classification System (TNC and ESRI 1994)
- standards for field methods and mapping procedures (Jennings et al. 2009, Lea 2011)
- producing rigorous and consistent accuracy assessment procedures (Lea and Curtis 2010)
- establishing standards for using existing vegetation data (TNC 1996)

Standards

- National Vegetation Classification Standard (FGDC 2008)
- Spatial Data Transfer Standard (FGDC 1998)
- Content Standard for Digital Geospatial Metadata (FGDC 1998)
- United States National Map Accuracy Standards (USGS 1999)
- Integrated Taxonomic Information System (<http://www.itis.gov/>)
- program-defined standards for map attribute accuracy and minimum mapping unit

A 12-step guidance document provides details that cover the entire process with links to information extracted or summarized from publications described above (National Parks Service 2011, available at http://science.nature.nps.gov/im/inventory/veg/docs/Veg_Inv_12step_Guidance_v1.1.pdf). Product specifications are also provided in a document (National Park Service 2011a, available at http://science.nature.nps.gov/im/inventory/veg/docs/Product_Specifications.pdf).

Herbert Hoover National Historic Site

The historic site is in West Branch, Iowa, just north of Interstate 80, in east central Iowa (Figure 1). Row crop agriculture dominates the immediate landscape, and the park itself is imbedded within an urban area, and adjacent to a major transportation corridor. A number of individual houses and other buildings, along with the Visitor Center, Library, and Museum, are maintained at the site. These cultural features are complimented by a small bottomland woodland, a newly acquired area of retired cropland, and a prairie restoration area. The tallgrass prairie restoration is currently the most significant natural feature within the park, and offers opportunities for education, interpretation, and conservation.

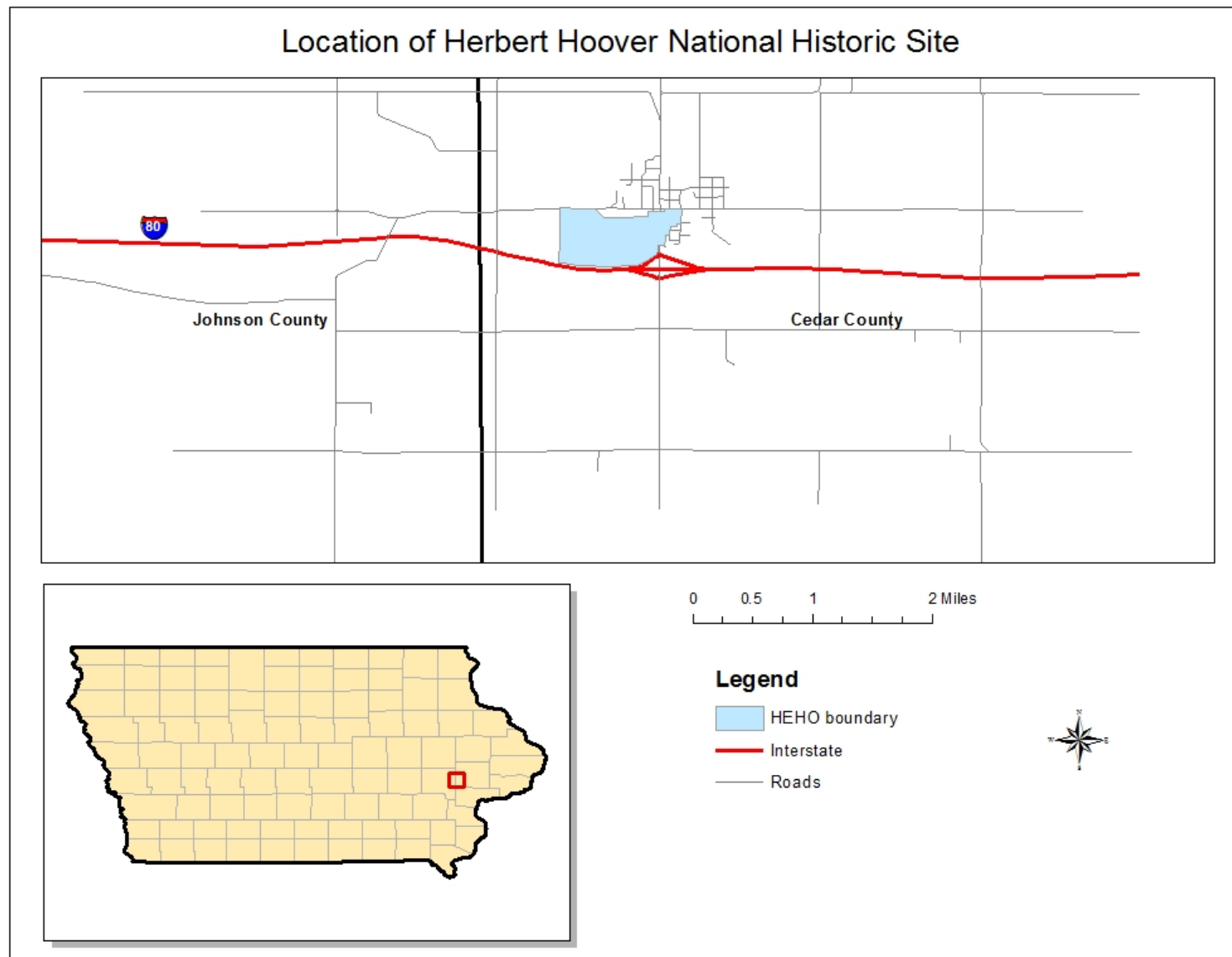


Figure 1. Location of Herbert Hoover National Historic Site in Cedar County, Iowa.

Project Statistics

Field Work 2011 - 2013:

Plot Sampling = 15

Plots sampled in June 2012 by MoRAP staff

Accuracy Assessment Points = 15

All collected in June 2013 by Heartland Inventory and Monitoring Network staff

Observation Points = 24

Collected between September 2011 and June 2012 by MoRAP staff

Classification:

1 NVC Plant Association

4 Park Special Vegetation Classes

1 Non-Vegetated Land-Use Class

GIS Database 2011 - 2013:

Herbert Hoover National Historic Site = 188 acres (76 hectares)

Base Imagery used for mapping (acquired by MoRAP):

April 2010, SPOT, color infrared, leaf-off, 10 m

2009 NAIP, leaf-on, true color, 1 m

Additional Imagery acquired and viewed by MoRAP:

2012, leaf-on, Bing Imagery

Minimum Mapping Unit = 0.5 hectare

Minimum Patch Size=.006 hectares

Total Size = 25 Polygons

Average Polygon Size = 7.52 acres (3.04 hectares)

Overall Thematic Accuracy = 98.7%

Project Completion Date: 12/2013

Methods

Herbert Hoover National Historic Site, at about 188 acres (76 hectares), is a small park as defined by sampling design protocols (TNC and ESRI 1994), so most of the mapped vegetation polygons were visited for this study. Since access to private lands outside of the park was not ensured, the project boundary consisted of the boundary of the park itself (Figure 2). Five major tasks were identified and completed, including:

1. Plan, gather data, and coordinate tasks;
2. Survey HEHO to understand and sample the vegetation;
3. Classify the vegetation using the field data to NVC standard associations and alliances and crosswalk these to recognizable map units as far as possible;
4. Acquire current digital imagery and interpret the vegetation from these using the classification scheme and a map unit crosswalk; and
5. Assess the accuracy of the final map product.

All protocols for this project are outlined by NPS and important sections are summarized or linked at <http://science.nature.nps.gov/im/inventory/veg/index.cfm>. Drilling down to additional linked documents can be accomplished via the link to the National Park Service 12-step guidance document on that web site (National Park Service 2011). Important references include TNC and ESRI (1994), Jennings et al. (2009), Lea (2011), and Lea and Curtis (2010).

Planning, Data Gathering, and Coordination

The current vegetation inventory project was discussed with appropriate park staff in coordination with Heartland Network staff and MoRAP staff. A proposal for vegetation mapping was subsequently completed and approved by NPS National Vegetation Inventory Program staff. Based on that proposal, MoRAP was responsible for classification, plot sampling, mapping, and development of digital databases. The Heartland Network was responsible for oversight of MoRAP activities in concert with NPS Vegetation Inventory Program staff, and coordinated Accuracy Assessment tasks. HEHO staff provided logistical and technical support, and helped coordinate field activities.

Field Survey

The field methods used in sampling and classifying the vegetation followed the methodology outlined by the NPS Vegetation Inventory Program team (see Jennings et al. 2009, Lea 2011, National Park Service 2011). The application of these methods to HEHO is outlined below.

National Agriculture Imagery Program (NAIP) air photos, digital soils information, and field-collected observation data were used to inform the design of field surveys and ultimately vegetation classification and mapping (Figure 3). Observation points consisted of brief visits (fewer than 15 minutes) by ecologists from MoRAP where general information on vegetation structure and composition was noted.

Vegetation data were collected at 15 plots by MoRAP staff in June of 2012 (Figure 4). In the lab, the locations of plots were randomly placed within the following general strata based on field observation points and viewing of air photos and digital soils surveys (available at <http://soildatamart.nrcs.usda.gov/>): bottomland ruderal woodland, restored tallgrass prairie, and forb ruderal herbaceous vegetation. In addition, the location of pasture, old crop fields, and small reed canarygrass patches were noted so that observation points could be placed within these vegetation types. Plots were located >30 m from an obvious land cover edge, and for each point there was at least one alternate, should the original point be determined unusable in the field (e.g. close to an un-mapped trail or road, stand too small). The stratified random plot location information was loaded into a GPS and workers navigated to the plot in the field for field sampling.

Woodlands were sampled with a 10 m x 40 m plot (400 sq m), and herbaceous vegetation with a 5 m x 20 m plot (100 sq m). Minimal flagging was used to mark the plot. Data were collected using a plot survey form (Appendix B). The survey form includes sections for plot location and description, as well as vegetation and environmental information about the plot.

Vegetation sampling included information about structure and physiognomy, with leaf phenology, leaf type and physiognomic class recorded for the dominant vegetation stratum. Cover data was collected for the following strata, where applicable.

T1 = Emergent Tree (overstory) >30 m
T2 = Tree Canopy (overstory) 20-30 m
T3 = Tree Subcanopy (midstory) 5-20 m
S1 = Tall Shrub (understory woody species, tree and shrub) 1-5 m
S2 = Short Shrub (woody species, tree and shrub) <1 m
H = Herbaceous species, does not include S2

Additionally, cover was recorded in modified Daubenmire (1959) cover classes for each species by strata (Table 1).

Table 1. Canopy Cover used for quantitative sampling.

Cover Class Codes	Range of Cover (%)
7	95-100
6	75-95
5	50-75
4	25-50
3	5-25
2	1-5
1	0-0.99

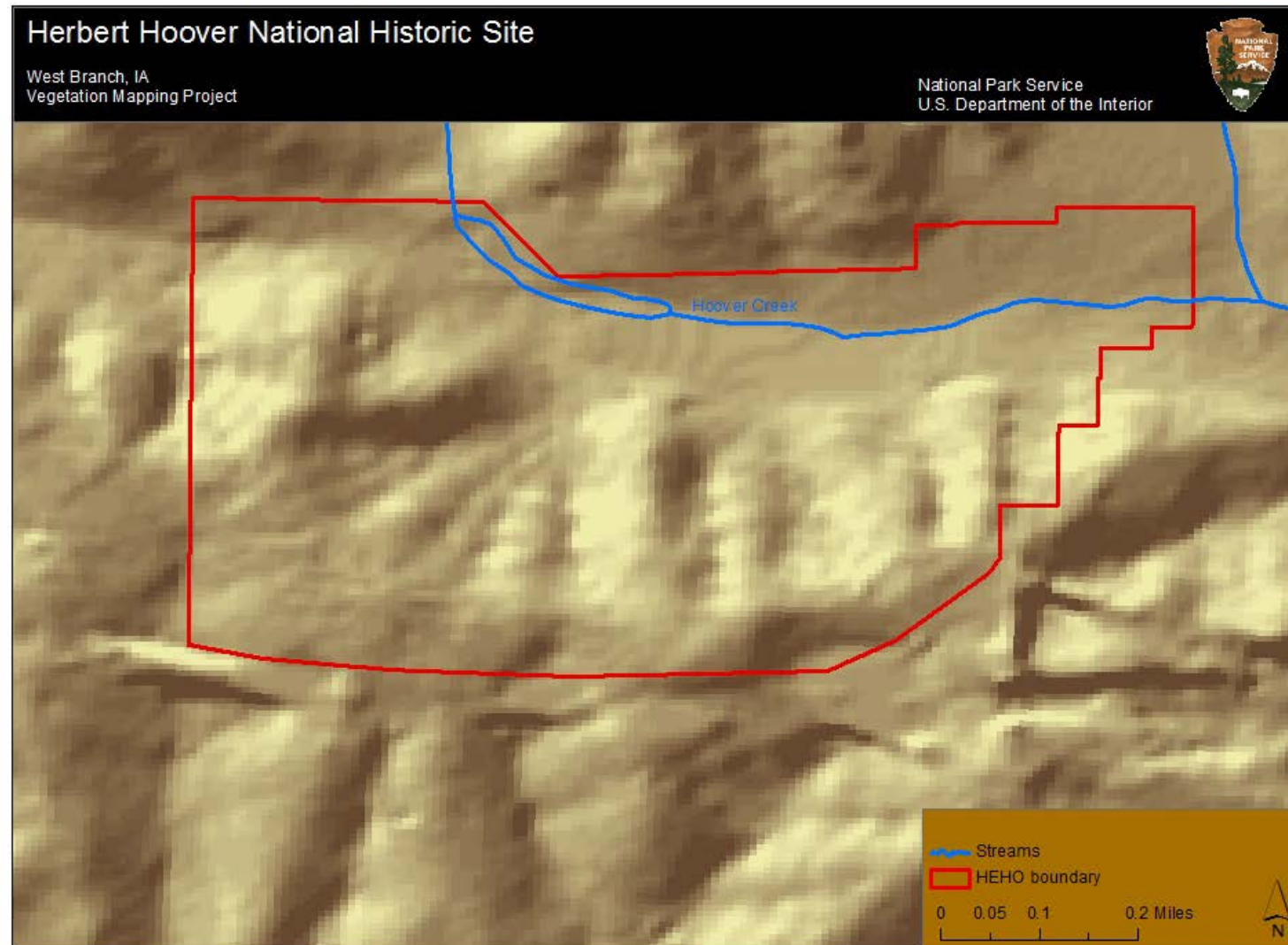


Figure 2. Map of the Herbert Hoover National Historic Site.

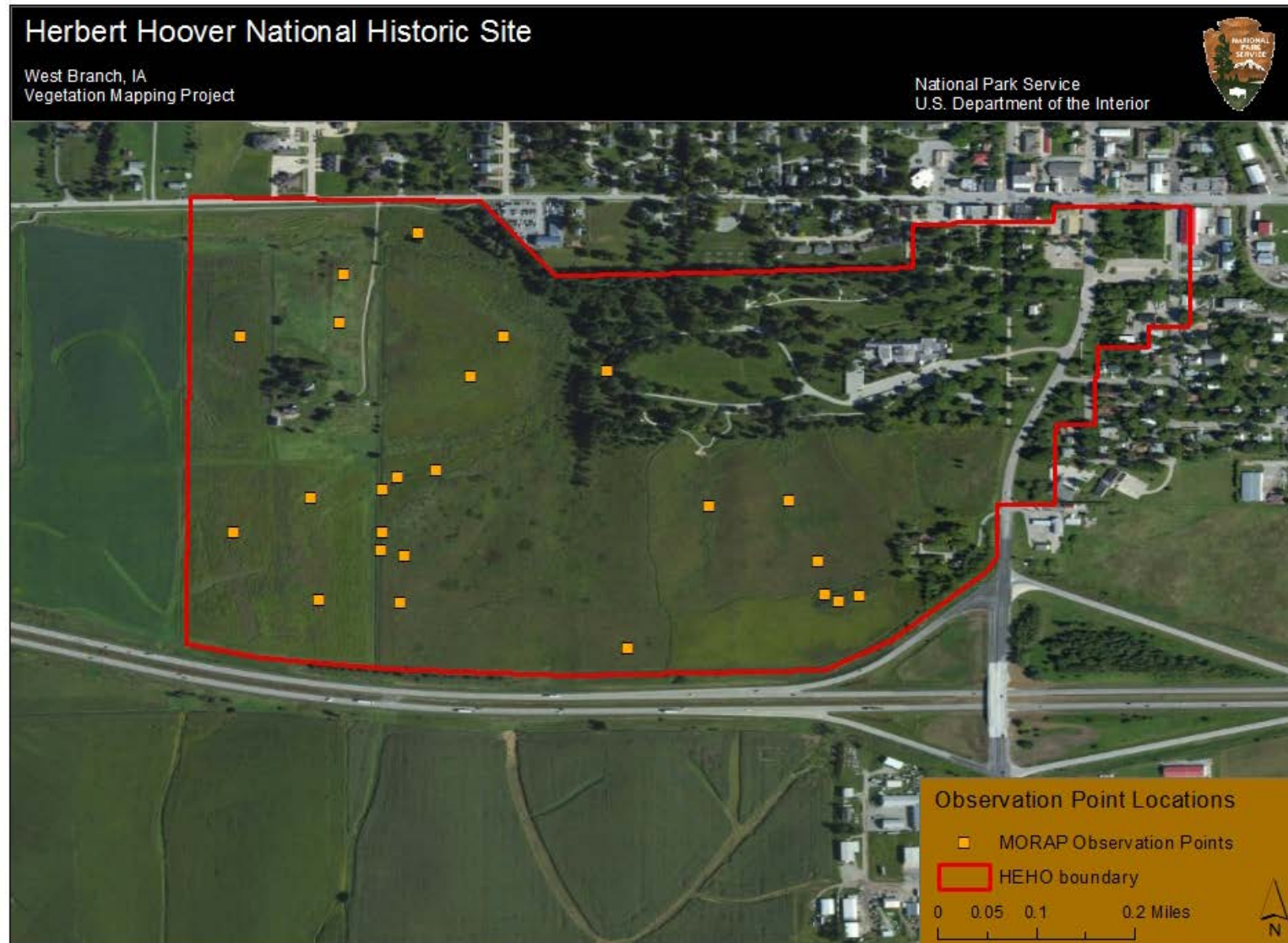


Figure 3. Location of 24 observation points collected in Herbert Hoover National Historic Site.

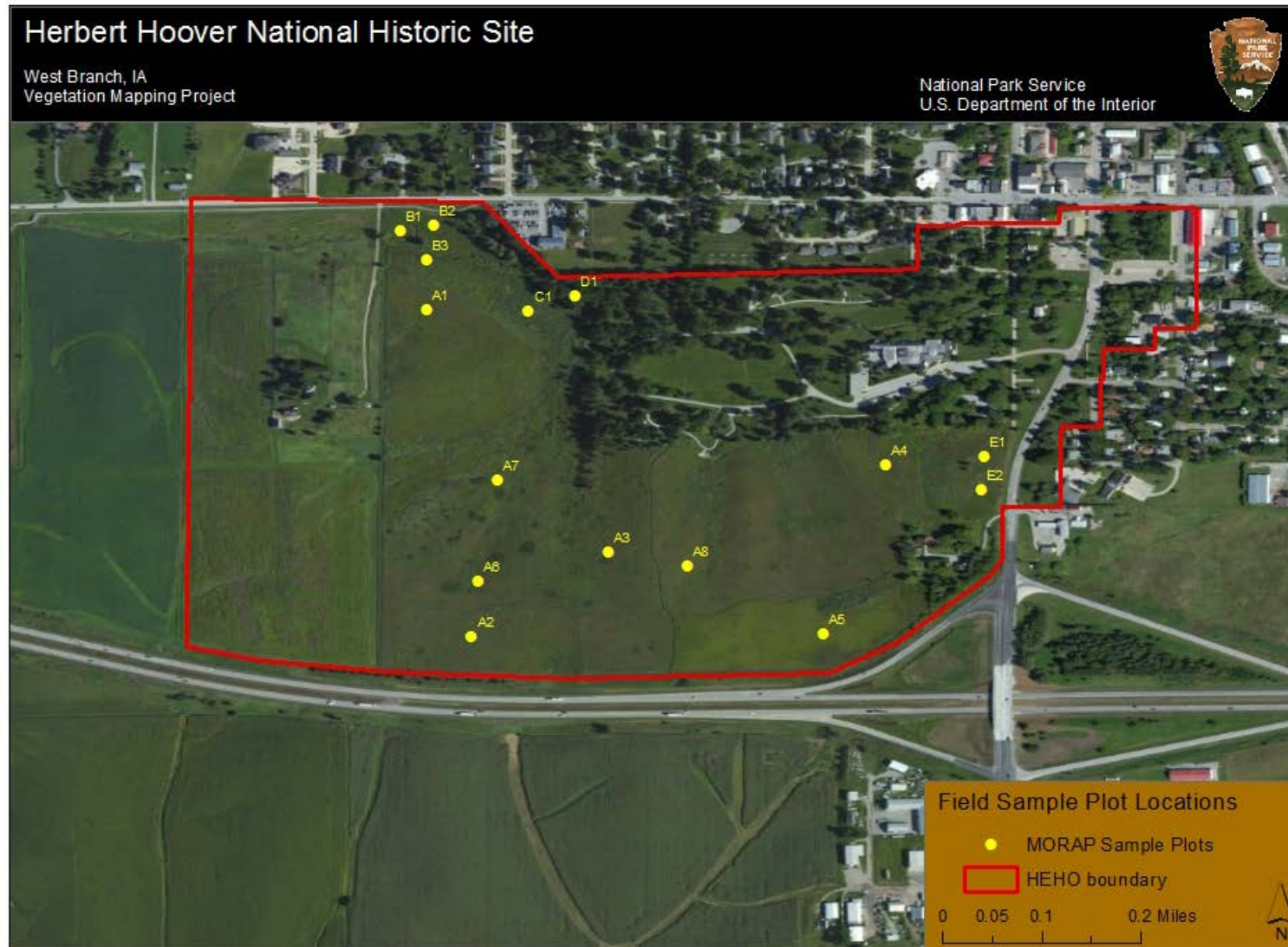


Figure 4. Location of 15 sampled plots within Herbert Hoover National Historic Site.

Vegetation Classification

All recorded data were entered into the NPS PLOTS v3 database (available at <http://science.nature.nps.gov/im/inventory/veg/plots.cfm>), a Microsoft Access-derived program. The PLOTS database was developed for the NPS National Vegetation Inventory Program so that data entry fields mirror the standard field form. Data entry was facilitated by assigning each plant taxon a unique, standardized code and name based on the PLANTS database developed by Natural Resources Conservation Service in cooperation with the Biota of North America Program (USDA and NRCS 2009, available at <http://plants.usda.gov/java/>). Data were thoroughly proofed after entry to minimize errors.

Plot data were subject to cluster analysis and ordination in order to help inform classification. Species-specific data were collected in multiple strata using cover classes, but for the purpose of analysis, the cover values for each species were combined into a single value using the midpoint of the cover class. The formula for percent overlap used to combine the strata cover values for each species was

$$1 - \prod \left(1 - \frac{\%cover}{100}\right).$$

Use of this formula reduces the effects of overlapping cover in various strata. We used a log transformation to standardize cover values using the formula $\log(\text{cover} + 1)$. Bray-Curtis dissimilarity was used as the distance metric for the cluster and ordination analyses (Legendre and Legendre 1998). Clustering was performed using the hierarchical clustering algorithm known as flexible Beta with a $\beta = -0.25$ (Lance and Williams 1967, Maechler et al. 2011). Non-metric multidimensional scaling was used to develop the ordination (Legendre and Legendre 1998, Roberts 2010).

Descriptive information on NVC community composition concepts and classification were obtained from the NatureServe Explorer (2012) website available at <http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol>. Where the observed HEHO vegetation did not fit descriptions of natural associations described for Iowa, park-specific types were assigned.

Once the classification was finalized, a dichotomous key was developed by MoRAP for use during the Accuracy Assessment (Appendix C). For types with an NVC assignment, the full NVC hierarchical classification and global descriptions are available in the results section. In addition, the final described types were linked to map classes for use in the photo-interpretation and mapping portions of the project.

In the future, HEHO classification plot data may be used by NatureServe to update and improve world-wide (i.e., global) descriptions of the NVC plant associations, especially for ruderal types which are generally lacking for the Midwest. HEHO specific (i.e., local) descriptions were written based on plot, observation, and accuracy assessment data.

Digital Imagery and Interpretation

The mapping component was produced by identifying land cover on air photos and hand digitizing on-screen. Heads-up digitizing was accomplished at a display scale of not more than

1:1,000 against a back-drop of air photos. Imagery was the most recent available from the NAIP (see http://www.fsa.usda.gov/Internet/FSA_File/naip_2009_info_final.pdf). This included 2009 leaf-on true color 1 m resolution photos. Color infrared, leaf-off was acquired from SPOT for April 2010 at 10 m resolution (Figure 5).

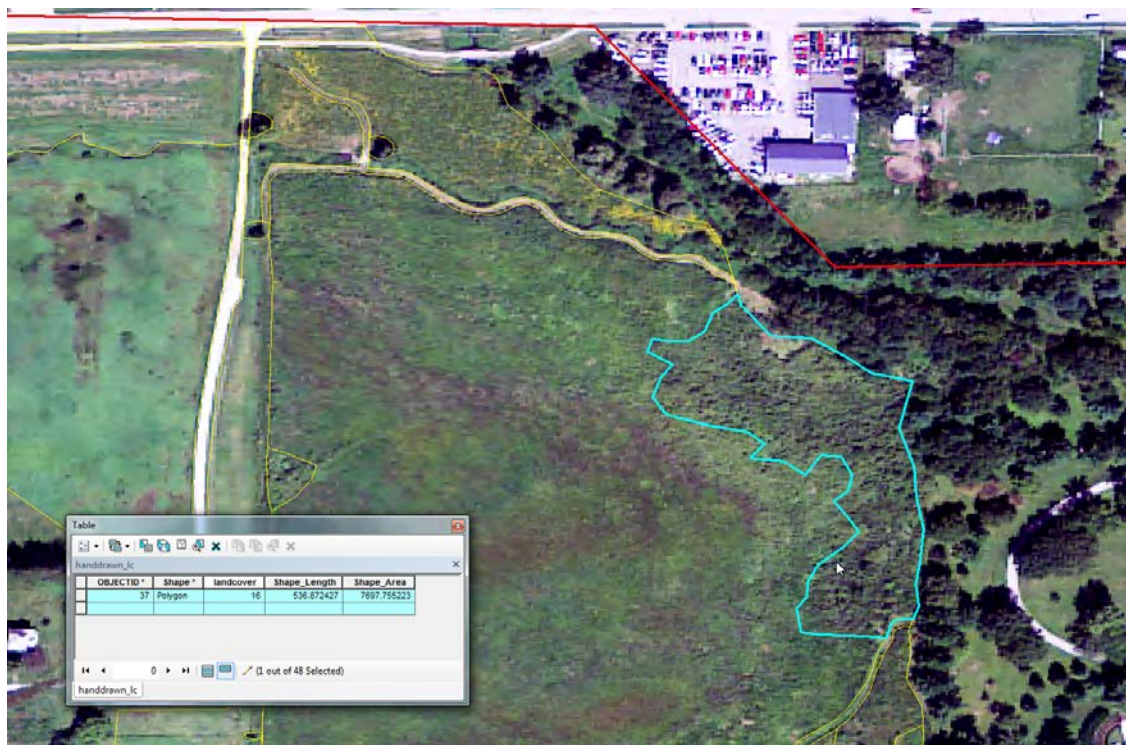


Figure 5. Digitization of hand drawn objects.

Accuracy Assessment

Thematic accuracy assessment (AA) was conducted by the HTLN. Methods and analysis for the accuracy assessment of vegetation mapping at HEHO were based on NPS standards (Lea and Curtis 2010). Thematic or attribute accuracy of mapped vegetation classes were assessed independently following the completion of the vegetation mapping by the lead authors. Representative sites were identified and visited in the field to determine if interpreted mapped classes were correctly assigned by field observers using the dichotomous key to mapped current vegetation types (Appendix C). Identifying the degree of correspondence between field observations and mapped attributes provides a measure of the maps suitability for different applications.

Accuracy assessment consisted of first evaluating the spatial pattern (total area and number of polygons) of each mapped vegetation class. The number of samples in each class was selected from five possible scenarios (Table 2). Accuracy assessment was restricted to natural vegetation map classes, thus omitting developed areas and standing water. Once the appropriate sampling scenario for each map class was determined, site selection was performed using a geographical information system (ArcGIS 10.0).

NPS Vegetation Inventory Program
Herbert Hoover National Historic Site

Table 2. Target number of Accuracy Assessment samples per map class based on number of polygons and area.

Scenario	Description	Polygons in class	Area occupied by class	Recommended number of samples in class
Scenario A:	The class is abundant. It covers more than 50 hectares of the total area and consists of at least 30 polygons. In this case, the recommended sample size is 30.	>30	>50 ha	30
Scenario B:	The class is relatively abundant. It covers more than 50 hectares of the total area but consists of fewer than 30 polygons. In this case, the recommended sample size is 20. The rationale for reducing the sample size for this type of class is that sample sites are more difficult to find because of the lower frequency of the class.	<30	>50 ha	20
Scenario C:	The class is relatively rare. It covers less than 50 hectares of the total area but consists of more than 30 polygons. In this case, the recommended sample size is 20. The rationale for reducing the sample size is that the class occupies a small area. At the same time, however, the class consists of a considerable number of distinct polygons that are possibly widely distributed. The number of samples therefore remains relatively high because of the high frequency of the class.	>30	<50 ha	20
Scenario D:	The class is rare. It has more than 5 but fewer than 30 polygons and covers less than 50 hectares of the area. In this case, the recommended number of samples is 5. The rationale for reducing the sample size is that the class consists of small polygons and the frequency of the polygons is low. Specifying more than 5 sample sites will therefore probably result in multiple sample sites within the same (small) polygon. Collecting 5 sample sites will allow an accuracy estimate to be computed, although it will not be very precise.	5 - 30	<50 ha	5
Scenario E:	The class is very rare. It has fewer than 5 polygons and occupies less than 50 hectares of the total area. In this case, it is recommended that the existence of the class be confirmed by a visit to each sample site. The rationale for the recommendation is that with fewer than 5 sample sites (assuming 1 site per polygon) no estimate of level of confidence can be established for the sample (the existence of the class can only be confirmed through field checking).	<5	<50 ha	Visit all and confirm

Random sample points were generated in ArcGIS. Points were buffered 40 meters from the park boundary and 80 meters from another point. The minimum mapping unit used in delineating vegetation polygons was 0.5 hectare. All random points were selected within the park boundary to avoid any private land issues.

Randomly selected site locations were loaded onto a Garmin GPS unit for field navigation (Figure 6). All AA field work was completed on June 26, 2012. Field staff was provided with a GPS unit, dichotomous key for mapping vegetation map classes and vegetation class definitions.

Plot shape and size varied according to the extent of the vegetation class patch containing the sample point. Circular 0.25 hectare (28 m radius) plots were used for larger patches while circular 0.1 hectare (18 m radius) plots were used for small patches approaching the minimum mapping unit. A circular plot size of 0.5 hectare (40 m radius) was used to capture information for a single large homogenous patch. In all cases, plot size exceeded the minimum patch size for HEHO.

Field staff recorded plot size and shape, positional accuracy and vegetation classification at each point (Accuracy assessment field form, Appendix D). In addition, comments regarding the plot location, plot size and vegetation were recorded on the field form. Field data from the 15 points were entered into the PLOTS database and underwent quality assurance/quality control (QA/QC) verification. In addition, the associated project geodatabase was updated in ArcGIS to reflect any changes to the point location due to offsets made in the field. All classification and spatial field observations were compared with the vegetation map and AA point locations for any differences.

Upon completion of QA/QC, the accuracy assessment analysis was performed. All analysis and evaluation of producer and user accuracy was conducted using the AA Contingency Table Calculation Spreadsheet (<http://science.nature.nps.gov/im/inventory/veg/guidance.cfm>). Statistics and calculations performed in the spreadsheet are presented in Table 3.

Table 3. Summary of the Accuracy Assessment statistics used at Herbert Hoover National Historic Site.

Statistic	Description
User's Accuracy	The fraction of the accuracy assessment observations in a map class that were found to have the correct vegetation class in the field.
Producer's Accuracy	The fraction of the accuracy assessment observations in a vegetation class in the field that were found to be mapped correctly.
Overall Accuracy	The fraction of accuracy assessment observations within all map classes that were correctly mapped.
Kappa Index	Another measure of overall accuracy, which takes into account the probability that mapped polygons will be correct due to random chance.



Figure 6. Accuracy Assessment points for Herbert Hoover National Historic Site.

Results

Vegetation Classification

Five vegetation types were identified at HEHO based on ordination and cluster analysis results (Figure 7). Developed land, undivided by type, made up a sixth class. The park represented a relatively simple set of plant communities, and hence results of the cluster analysis and ordinations are not presented here. The restored tallgrass prairie was a striking visual aspect of the park, with the flowering culms of dominant grasses often reaching past 6 feet (2 meters) high. During the sampling efforts a total of 94 taxa were recorded (Appendix E).

Digital Imagery and Interpretation

Six map units that corresponded directly with the classified vegetation plus developed land were defined (Table 4). The developed land map class was a catch-all that included all areas without semi-natural vegetation.

Vegetation Map

A total of 188 acres (76 hectares) were within the accepted boundaries of HEHO (Figure 7). The standard minimum mapping unit for NPS vegetation inventory projects is defined as 0.5 hectare, although several mapped polygons were smaller for HEHO. Restored tallgrass prairie made up most of the current vegetation of the park, and accounted for 71.6 acres (29 hectares) in nine polygons, or 58.0% of the total non-developed area. Pasture and old field made up 38.9 acres (15.7 hectares), or 31.6% of the area, in a single polygon. Forb ruderal herbaceous vegetation made up 7.4% of the area in four polygons, and bottomland ruderal woodland made up 2.8 acres (1.1 hectares), or 1.1% of the area. Reed canarygrass, western herbaceous vegetation made up <1% of the area, and within the context of the vegetation of HEHO, is considered an undesirable, non-natural vegetation type. A total of 25 polygons were mapped, with an average area of 7.52 acres (3.04 hectares).

Accuracy Assessment

The 2013 accuracy assessment for HEHO was limited to the 123 acres (49.8 hectares) of natural and semi-natural vegetation within the park boundary. A total of 15 points were required to accurately evaluate the five natural and semi-natural mapped vegetation types identified in the park (Table 4). Navigational error (positional accuracy) of the GPS unit ranged from 2 - 3 meters for the 15 accuracy assessment points.

NPS Vegetation Inventory Program
Herbert Hoover National Historic Site

Table 4. Mapped types identified at Herbert Hoover National Historic Site.

NVC Identifier	Mapped Type Name	Scientific Name / Description	Number of Polygons	Acres	Hectares
Forest and Woodlands					
None assigned	Bottomland Ruderal Woodland	<i>Fraxinus americana</i> - <i>Celtis occidentalis</i> - <i>Quercus macrocarpa</i> Woodland	2	2.8	1.1
Herbaceous Vegetation					
CEGL001417	Reed Canarygrass Western Herbaceous Vegetation	<i>Phalaris arundinacea</i> Western Herbaceous Vegetation	2	0.6	0.2
None assigned	Forb Ruderal Herbaceous Vegetation	<i>Silphium perfoliatum</i> - <i>Monarda fistulosa</i> - <i>Conium maculatum</i> Ruderal Herbaceous Vegetation	4	9.1	3.7
None assigned	Pasture and Oldfield	<i>Bromus spp.</i> - <i>Elymus repens</i> Pasture and Oldfield	1	38.9	15.7
None assigned	Restored Tallgrass Prairie	<i>Andropogon gerardii</i> - <i>Sorghastrum nutans</i> Herbaceous Vegetation	9	71.6	29
Land Use/Land Cover					
None assigned	Developed Land	buildings, parking lots, picnic areas, roads, cemetery, garden, sewage application field	7	65	26.3
Total Land Use/Land Cover			7	65	26.3
Total Natural Vegetation			18	123	49.8
Totals			25	188	76

Overall accuracy of the final error matrix was 98.7% (the 90% confidence interval was between 96.8 and 100.6%) for the natural and semi-natural mapped vegetation types at HEHO (Appendix A). Omission accuracy (map producer's error) was 100% for all but a single map class. The Restored Prairie omission accuracy was 97.9% due to a single mis-classification. Commission accuracy (user's error) was 100% for all but the Ruderal Forb Herbaceous Vegetation map class. The commission accuracy for this type was 80% due to a single mis-classification. Of the 15 accuracy assessment points, 14 were assigned correctly. Kappa Index, or the random chance polygons were assigned correctly, was 91.3% (Appendix A)

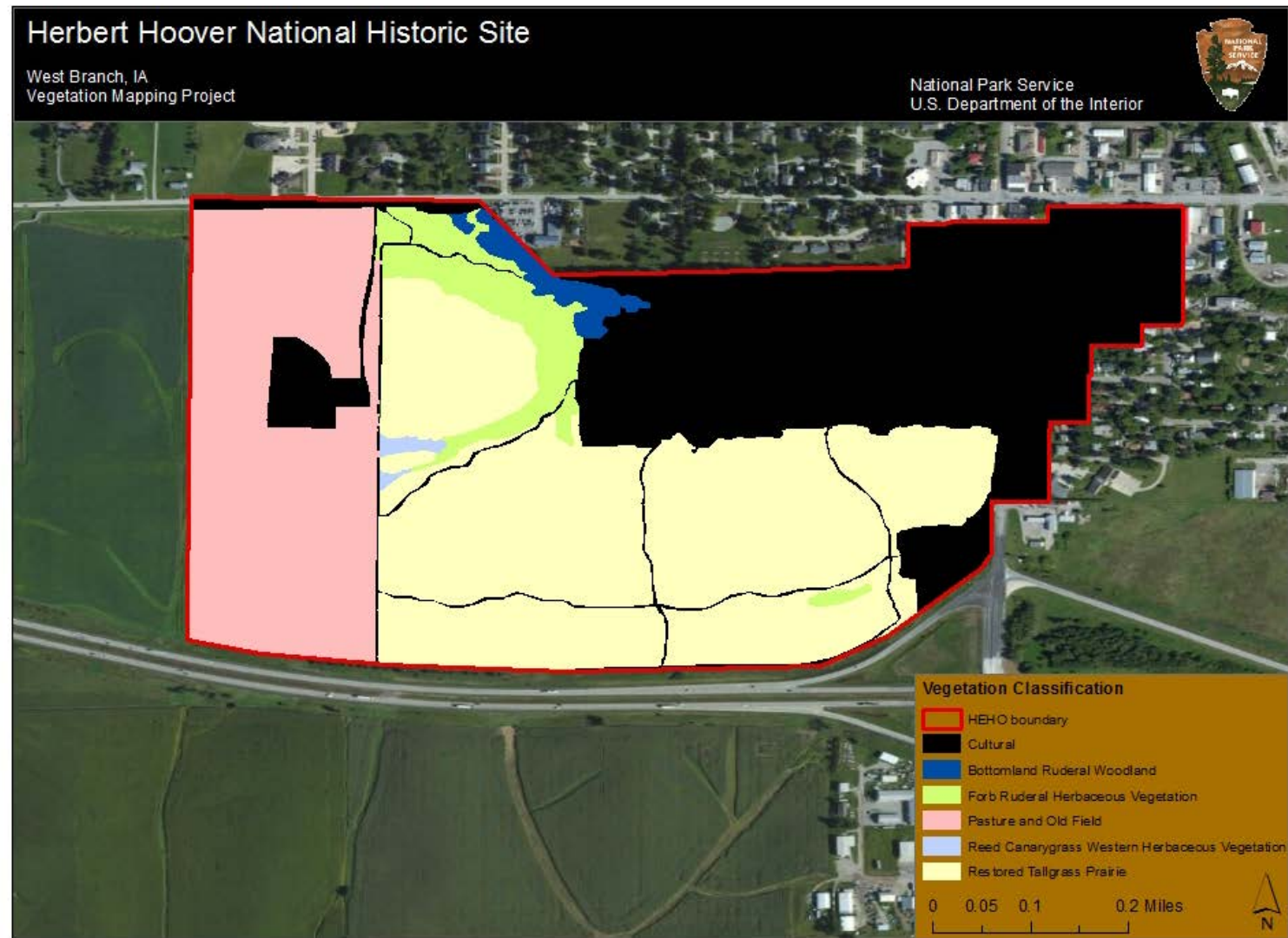


Figure 7. Vegetation Classification of Herbert Hoover National Historic Site.

Vegetation Associations

Mapped Type Name: Bottomland Ruderal Woodland

Macrogroup: None

Group: None

Association: None

Type Common Name: White Ash-Common Hackberry-Bur Oak Woodland

Type Scientific Name: *Fraxinus americana*-*Celtis occidentalis*-*Quercus macrocarpa* Woodland



Figure 8. Bottomland Ruderal Woodland at Herbert Hoover National Historic Site.

Global Summary: This type is dominated by a combination of ruderal or early successional species. White ash (*Fraxinus americana*) is a frequent early successional tree species across the eastern and central United States, and common hackberry (*Celtis occidentalis*) is an early successional species across the Midwest. These species often occur together in ruderal woodlands and may be associated with a variety of other tree and herbaceous species.

Environmental Description: At HEHO, this type was limited to a small area of moist, bottomland soils along Hoover Creek on the north central side of the park.

Vegetation Description: A few larger, emergent individual white ash, common hackberry, and bur oak (*Quercus macrocarpa*) trees characterized the general aspect of this type at HEHO (Table 5). Eastern redcedar (*Juniperus virginiana*), an early successional species, was in both the tree and shrub layer. The understory and herbaceous layers had a preponderance of ruderal species, and the most important herbaceous species included smooth brome (*Bromus inermis*) and ground ivy (*Glechoma hederacea*), which are non-native and often considered weedy.

Most Abundant Species:

Table 5. Species found in one plot within the Bottomland Ruderal Woodland vegetation type.

Bottomland Ruderal Woodland			
Scientific Name	Common Name	Frequency	%Cover
Tree Layer			
<i>Fraxinus americana</i>	white ash	100%	62.50
<i>Juniperus virginiana</i>	eastern redcedar	100%	3.00
<i>Quercus macrocarpa</i>	bur oak	100%	15.00
Shrub Layer			
<i>Celtis occidentalis</i>	common hackberry	100%	15.00
<i>Juniperus virginiana</i>	eastern redcedar	100%	0.50
<i>Prunus serotina</i>	black cherry	100%	0.50
<i>Sambucus nigra</i> ssp. <i>canadensis</i>	American black elderberry	100%	3.00
Herbaceous Layer			
<i>Ambrosia trifida</i>	great ragweed	100%	0.50
<i>Bromus inermis</i>	smooth brome	100%	37.50
<i>Cirsium discolor</i>	field thistle	100%	0.50
<i>Conyza canadensis</i>	Canadian horseweed	100%	0.50
<i>Eupatorium altissimum</i>	tall thoroughwort	100%	0.50
<i>Galium aparine</i>	stickywilly	100%	0.50
<i>Geum canadense</i>	white avens	100%	0.50
<i>Glechoma hederacea</i>	ground ivy	100%	37.50
<i>Hackelia virginiana</i>	beggarslice	100%	0.50
<i>Leonurus cardiaca</i>	common motherwort	100%	3.00
<i>Phalaris arundinacea</i>	reed canarygrass	100%	0.50
<i>Physalis virginiana</i>	Virginia groundcherry	100%	0.50
<i>Phytolacca americana</i>	American pokeweed	100%	0.50
<i>Pilea pumila</i>	Canadian clearweed	100%	3.00
<i>Poa pratensis</i>	Kentucky bluegrass	100%	3.00
<i>Polygonum scandens</i>	climbing false buckwheat	100%	0.50
<i>Silphium perfoliatum</i>	cup plant	100%	0.50
<i>Solanum carolinense</i>	Carolina horsenettle	100%	0.50
<i>Solidago gigantea</i>	giant goldenrod	100%	0.50
<i>Urtica dioica</i>	stinging nettle	100%	3.00
<i>Verbena urticifolia</i>	white vervain	100%	0.50
<i>Viola sororia</i>	common blue violet	100%	0.50

Mapped Type Name: Forb Ruderal Herbaceous Vegetation

Macrogroup: None

Group: None

Association: None

Type Common Name: Forb Ruderal Herbaceous Vegetation

Type Scientific Name: *Silphium perfoliatum*-*Monarda fistulosa*-*Conium maculatum*
Herbaceous Vegetation



Figure 9. Forb Ruderal Herbaceous Vegetation at Herbert Hoover National Historic Site.

Global Summary: This type is truly specific to HEHO, and was created largely via efforts to restore native forbs and grasses to former croplands. A small patch of this type was created when a hill was artificially formed to improve viewsheds within the park. The preponderance of cup plant (*Silphium perfoliatum*) is directly a result of planting of this and other species via active management efforts.

Environmental Description: This type is not tied to any particular abiotic site type, but rather is the result of management efforts in specific spots.

Vegetation Description: This type was somewhat variable in composition, but tall forbs dominated all areas. Cup plant was a visual dominant in some areas, and this species, together with reed canarygrass and Canada goldenrod (*Solidago canadensis*) were present in all four plots sampled within this type with fairly high cover values (Table 6). Wild bergamont (*Monarda fistulosa*) and great ragweed (*Ambrosia trifida*) were two other tall forbs that had high cover values in plots where they occurred. Other common species included quackgrass (*Elymus repens*), Maximilian sunflower (*Helianthus maximiliani*), New England aster (*Symphyothrichum novae-angliae*), and golden zizia (*Zizia aurea*).

Most Abundant Species:

Table 6. Species found within one or more of four plots taken within the Forb Ruderal Herbaceous Vegetation type.

Forb Ruderal Herbaceous Vegetation			
Scientific Name	Common Name	Frequency	%Cover
Shrub Layer			
<i>Morus alba</i>	white mulberry	50%	0.50
Herbaceous Layer			
<i>Ambrosia trifida</i>	great ragweed	50%	32.75
<i>Andropogon gerardii</i>	big bluestem	25%	15.00
<i>Asclepias syriaca</i>	common milkweed	25%	0.50
<i>Bromus inermis</i>	smooth brome	50%	1.75
<i>Calystegia sepium</i>	hedge false bindweed	50%	0.50
<i>Chenopodium album</i>	lambsquarters	25%	0.50
<i>Cirsium discolor</i>	field thistle	25%	0.50
<i>Conium maculatum</i>	poison hemlock	25%	3.00
<i>Desmodium canescens</i>	hoary ticktrefoil	50%	0.50
<i>Echinacea purpurea</i>	purple prairie coneflower	25%	0.50
<i>Elymus canadensis</i>	Canada wildrye	25%	0.50
<i>Elymus repens</i>	quackgrass	75%	18.50
<i>Erigeron strigosus</i>	prairie fleabane	50%	0.50
<i>Galium aparine</i>	stickywilly	50%	7.75
<i>Geranium maculatum</i>	spotted geranium	50%	1.75
<i>Hackelia virginiana</i>	beggarslice	25%	0.50
<i>Helianthus hirsutus</i>	hairy sunflower	50%	1.75
<i>Helianthus maximiliani</i>	Maximilian sunflower	75%	2.17
<i>Heliopsis helianthoides</i>	smooth oxeye	50%	3.00
<i>Liatris aspera</i>	tall blazing star	25%	0.50
<i>Monarda fistulosa</i>	wild bergamot	75%	30.00
<i>Phalaris arundinacea</i>	reed canarygrass	100%	14.00
<i>Physostegia virginiana</i>	obedient plant	25%	0.50
<i>Phytolacca americana</i>	American pokeweed	25%	0.50
<i>Ratibida pinnata</i>	pinnate prairie coneflower	50%	0.50
<i>Rudbeckia hirta</i>	blackeyed Susan	25%	0.50
<i>Rudbeckia laciniata</i>	cutleaf coneflower	25%	3.00
<i>Rudbeckia triloba</i>	browneyed Susan	25%	3.00
<i>Rumex crispus</i>	curly dock	25%	3.00
<i>Silphium perfoliatum</i>	cup plant	100%	12.00
<i>Silphium terebinthinaceum</i>	prairie rosinweed	25%	0.50
<i>Solidago canadensis</i>	Canada goldenrod	100%	8.38

NPS Vegetation Inventory Program
Herbert Hoover National Historic Site

Forb Ruderal Herbaceous Vegetation			
Scientific Name	Common Name	Frequency	%Cover
<i>Symphyotrichum novae-angliae</i>	New England aster	75%	1.33
<i>Taraxacum officinale</i>	common dandelion	50%	0.50
<i>Thalictrum dasycarpum</i>	purple meadow-rue	25%	0.50
<i>Tradescantia ohiensis</i>	bluejacket	25%	0.50
<i>Verbena urticifolia</i>	white vervain	25%	0.50
<i>Vernonia fasciculata</i>	prairie ironweed	50%	0.50
<i>Zizia aurea</i>	golden zizia	75%	6.17

Mapped Type Name: Pasture and Oldfield

Macrogroup: None

Group: None

Association: None

Type Common Name: Pasture and Oldfield

Type Scientific Name: *Bromus* spp. - *Elymus repens* Pasture and Oldfield

Global Summary: Tame pastures and oldfields (former croplands) are common features throughout the Midwest. Smooth brome is the most commonly planted tame pasture grass in the Upper Midwest. Retired croplands and pastures offer some level of landscape diversity in areas that are largely in rowcrop agriculture.

Environmental Description: This type is likely to occur on former prairie soils in all landscape positions throughout the Midwest.

Vegetation Description: This type consisted of two communities: a smooth brome-dominated former pasture on the north side of farm houses on the eastern side of the park, and an oldfield on the south side of the former farmstead. Common species included quackgrass, thistle (*Cirsium* spp.), prickly lettuce (*Lactuca serriola*), Canadian horseweed (*Conyza canadensis*), common dandelion (*Taraxacum officinale*), common milkweed (*Asclepias syriaca*), blackeyed Susan (*Rudbeckia hirta*), pinnate prairie coneflower (*Ratibida pinnata*), and clover (*Trifolium* spp.).

Most Abundant Species:

No quantitative data were taken within this mapped type.

Mapped Type Name: Reed Canarygrass Western Herbaceous Vegetation

Macrogroup: Western North American Ruderal Wet Meadow & Marsh
Group: Western North American Ruderal Wet Meadow & Marsh Group
Association: None listed
Type Common Name: Reed Canarygrass Wet Meadow
Type Scientific Name: *Phalaris arundinacea* Western Herbaceous Vegetation

Global Summary: This herbaceous community occurs throughout western North America and eastward into the Great Plains and Central Lowlands. Reed canarygrass grows as a ruderal species in moist soils, including areas that may be flooded for extended periods. The vegetation is characterized by a dense, tall herbaceous layer, where reed canarygrass tends to form monocultures. Introduced and weedy species tend to be associated with this type. Common associated species include *Equisetum arvense*, *Muhlenbergia asperifolia*, *Mentha arvensis*, *Schoenoplectus acutus*, *Bromus inermis*, *Bromus tectorum*, *Cirsium arvense*, *Elymus repens*, *Hordeum brachyantherum*, *Poa pratensis*, and *Phleum pratense*.

Environmental Description: This type is likely to occur in moist soils of riparian areas, or near ponds or lakes. Soils are often fine-textured. Sites are usually flooded from brief to extended periods, and soils often remain saturated throughout the year.

Vegetation Description: At HEHO, this type was restricted to two small patches along the headwaters of a drainage on the west central side of the park. The patches occurred within the context of restored tallgrass prairie, and are considered undesirable. Reed canarygrass forms nearly pure stands in some places, and is mixed with smooth brome and tallgrass prairie species in other areas. Active management (e.g. spraying with herbicide) was evident at the time of sampling.

Most Abundant Species:

No quantitative data were taken within this mapped type.

Mapped Type Name: Restored Tallgrass Prairie

Macrogroup: None

Group: None

Association: None

Type Common Name: Restored Tallgrass Prairie

Type Scientific Name: *Andropogon gerardii* – *Sorghastrum nutans* Herbaceous Vegetation



Figure 10. Restored Tallgrass Prairie at Herbert Hoover National Historic Site.

Global Summary: Tallgrass prairie restorations have been attempted throughout the former tallgrass prairie region. The restoration at HEHO is typical of these efforts. Some combination of big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*) are typically dominant in restorations. Both native and non-native grasses and forbs tend to volunteer into areas that have been planted with prairie grasses and forbs. Typically, grasses dominate these sites with a limited complement of native prairie forbs. Culms of dominant grasses reach more than 6 feet (2 meters) in the fall, and provide a prairie-like aspect. On-going efforts are required to maintain and enhance prairie restorations, both to reduce unwanted species and enhance the complement of native prairie forbs and grasses.

Environmental Description: This type is likely to occur in deep, tillable soils that were once in rowcrop production.

Vegetation Description: Big bluestem was the prevailing dominant of the restored tallgrass prairie, and switchgrass (*Panicum virgatum*) and Indiangrass were co-dominant. Canada goldenrod was an important forb throughout the type, and two native grasses, little bluestem (*Schizachyrium scoparium*) and sideoats grama (*Bouteloua curtipendula*) were co-dominant in patches. Smooth brome, a non-native invasive, was important in patches and represents a

management concern. Woody species were also established in patches and represent a management concern. These include black walnut (*Juglans nigra*), black cherry (*Prunus serotina*), chokecherry (*Prunus virginiana*), gray dogwood (*Cornus racemosa*), and smooth sumac (*Rhus glabra*) (Table 7).

Most Abundant Species:

Table 7. Species that occurred in at least two of ten plots sampled within the Restored Tallgrass Prairie vegetation type.

Restored Tallgrass Prairie			
Scientific Name	Common Name	Frequency	%Cover
Shrub Layer			
<i>Juglans nigra</i>	black walnut	30%	0.50
<i>Prunus serotina</i>	black cherry	20%	0.50
<i>Prunus virginiana</i>	chokecherry	20%	0.50
<i>Rhus glabra</i>	smooth sumac	20%	7.75
Herbaceous Layer			
<i>Andropogon gerardii</i>	big bluestem	100%	35.75
<i>Apocynum cannabinum</i>	Indianhemp	40%	0.50
<i>Asclepias syriaca</i>	common milkweed	20%	0.50
<i>Baptisia alba</i>	white wild indigo	40%	0.50
<i>Bouteloua curtipendula</i>	sideoats grama	20%	19.00
<i>Bromus inermis</i>	smooth brome	30%	12.83
<i>Calystegia sepium</i>	hedge false bindweed	30%	0.50
<i>Cirsium discolor</i>	field thistle	50%	0.50
<i>Desmodium canescens</i>	hoary ticktrefoil	50%	0.50
<i>Elymus canadensis</i>	Canada wildrye	30%	0.50
<i>Equisetum arvense</i>	field horsetail	40%	0.50
<i>Erigeron strigosus</i>	prairie fleabane	30%	0.50
<i>Heliopsis helianthoides</i>	smooth oxeye	30%	0.50
<i>Lactuca canadensis</i>	Canada lettuce	20%	0.50
<i>Lespedeza capitata</i>	roundhead lespedeza	40%	0.50
<i>Liatis aspera</i>	tall blazing star	20%	0.50
<i>Lotus corniculatus</i>	bird's-foot trefoil	20%	19.00
<i>Melilotus officinalis</i>	yellow sweetclover	20%	1.75
<i>Monarda fistulosa</i>	wild bergamot	50%	1.00
<i>Packera plattensis</i>	prairie groundsel	50%	2.00
<i>Panicum virgatum</i>	switchgrass	100%	8.35
<i>Pastinaca sativa</i>	wild parsnip	30%	0.50
<i>Physalis heterophylla</i>	clammy groundcherry	30%	0.50
<i>Physostegia virginiana</i>	obedient plant	20%	0.50
<i>Poa pratensis</i>	Kentucky bluegrass	60%	3.75
<i>Ratibida pinnata</i>	pinnate prairie coneflower	60%	0.50

NPS Vegetation Inventory Program
Herbert Hoover National Historic Site

Restored Tallgrass Prairie			
Scientific Name	Common Name	Frequency	%Cover
<i>Schizachyrium scoparium</i>	little bluestem	40%	10.38
<i>Silphium terebinthinaceum</i>	prairie rosinweed	20%	0.50
<i>Solidago canadensis</i>	Canada goldenrod	90%	15.28
<i>Sorghastrum nutans</i>	Indiangrass	90%	22.33
<i>Symphyotrichum lanceolatum</i>	white panicle aster	20%	0.50
<i>Symphyotrichum novae-angliae</i>	New England aster	20%	0.50
<i>Symphyotrichum pilosum</i>	hairy white oldfield aster	50%	0.50
<i>Tradescantia ohiensis</i>	bluejacket	30%	5.33

Discussion

Herbert Hoover National Historic Site currently has a significant patch of restored prairie that contains prairie dominant grasses and a compliment of typical prairie forbs (James 2011, Sasseen 2005). Given that the surrounding landscape is used intensively for agricultural purposes, the vegetation of the park has real value for prairie wildlife species. The prairie also offers aesthetic, educational, and interpretive opportunities for visitors. A portion of the restoration was formerly occupied by a gas station, but even in that area, prairie grasses have been restored to a reasonable extent.

Field Survey

Management efforts will continue at HEHO, and hence the vegetation is likely to be quite dynamic over time. Documentation of response to management efforts via repeated quantitative sampling will be highly desirable.

NVC Classification

Quantitative data from the park may help in the description of ruderal bottomland woodlands for the Midwest, since no bottomland type similar to the one sampled at HEHO was described in the National Vegetation Classification. Other types at the park were truly park-specific, and were the result of past disturbance and management efforts. The prairie restoration was planted to simulate communities within the Central Great Plains Tallgrass Prairie Group described in the National Vegetation Classification (see the NVC website at <http://usnvc.org/explore-classification/>)

Digital Imagery and Interpretation

Both leaf-on and leaf-off imagery were available for the park and were used to develop map polygons. The use of leaf-on and leaf-off data helped ensure high quality results. Because the park was small, heads up digitizing was used to circumscribe polygons.

Accuracy Assessment

Overall thematic accuracy of the vegetation inventory met the required threshold. The park is dominated by the Restored Tallgrass Prairie map class which accounts for 58% of the mapped vegetation. This type is distributed across nine polygons and was sampled according to Scenario D. The remaining four map classes were sampled according to Scenario E. The single misclassified accuracy assessment point was attributed to recent management changes that occurred between the time the map was created and accuracy assessment was performed. Field staff was able to visit all polygons and assess thematic accuracy of all five mapped vegetation classes. For all vegetation map classes, the dichotomous key allowed for clear identification at the majority of points.

Future Recommendations

The past and on-going efforts at prairie restoration are logical natural resource management initiatives at HEHO (NPS 2006). The current restored tallgrass prairie is seven times more diverse in terms of non-grass herbaceous species than it was when the restoration was put in place (Williams et al. 2007). Documentation of changes would be highly desirable. The area offers visitors the aspect of a tallgrass community with the primary grasses and some forbs

represented. Efforts to enhance this restoration and use the area to enhance visitor experiences seem appropriate. The small patches of reed canary grass are clearly unwanted, and efforts to control this species are on-going (NPS 2003). The pasture and old field area is adjacent to the restored tallgrass prairie and this area might be restored in the future. Finally, the forb ruderal herbaceous vegetation is also adjacent to, or within, the tallgrass prairie restoration. Native forbs and grasses are present in this type, and efforts at restoration to a more prairie-like condition seem appropriate.

Research Opportunities

Restoration of tallgrass prairie will likely be the most important on-going activity with regard to natural resources at HEHO. Restoration activities may afford the opportunity for research on the effectiveness of various techniques (e.g. seeding, prescribed fire, mowing) on outcomes, particularly for the pasture and oldfield area. Invasive reed canarygrass patches will be managed against, as will smooth brome and native trees and shrubs that are established within the restored prairie. Tracking the effectiveness of management efforts on these species offers an avenue for research. Use of the tallgrass prairie restoration areas by wildlife, especially both nesting and wintering grassland birds, could be documented as an area of research. Tallgrass habitats are relatively rare within the landscape of the park, which is dominated by rowcrop agriculture, so use of the restoration by all types of fauna (including invertebrates) may be important, and may offer an area for investigation.

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Appendix A: Contingency Table for Vegetation Mapping at Herbert Hoover National Historic Site

	Reference Data (Accuracy Assessment Field Data)						User's Error			
Sample Data (Polygon Map Data)	Map Units	Bottomland Woodland	Canary Grass	Pasture and Old Field	Restored Prairie	Ruderal Forb Herbaceous Vegetation	Totals	Commission Accuracy	90% Conf. Interval	
									-	+
	Bottomland Woodland	2					2	100.0%	75.0%	100.0%
	Canary Grass		2				2	100.0%	75.0%	100.0%
	Pasture and Old Field			2			2	100.0%	75.0%	100.0%
	Restored Prairie				4		4	100.0%	87.5%	100.0%
	Ruderal Forb Herbaceous Vegetation				1	4	5	80.0%	40.6%	100.0%
	Totals	2	2	2	5	4				
Producer's Error	Omission Accuracy	100.0%	100.0%	100.0%	97.9%	100.0%	14 Total Correct Points			
	90% Conf. -	100.0%	100.0%	100.0%	96.7%	98.2%	15 Total Points			
	Level +	100.0%	100.0%	100.0%	99.1%	100.0%				
Overall Total Accuracy =98.7%		Overall Kappa Index =91.3%		Overall 90% Upper and Lower Confidence Interval =96.8% and 100.6%						

Accuracy Assessment Contingency Table:

The contingency table combines the sample contingency and population contingency tables in which rows represent the map classes from the vegetation map and columns are the map classes determined in the field. The shaded areas display the number of accuracy assessment points where the field determination of the map class agrees with the vegetation map. Disagreement between field data (columns) and map data result in producer's error (omission error). Conversely, disagreement between map data (rows) and field data reflect user's error (errors of commission). Both types of error are reported in terms of accuracy (100% indicates no errors) and a corresponding 90% confidence interval. The total number of correct points out of the total number of accuracy assessment points (shaded diagonal values) provides the degree to which map classes were interpreted correctly. The Kappa Index is an index that accounts for chance agreement in the contingency table.

Appendix B: Example of Plot Survey Form

NPS VEGETATION MAPPING PROGRAM – PLOT SURVEY FORM PLOT LOCATION AND DESCRIPTION

Plot Code _____	Surveyors _____
Date _____	
Plot Directions _____	
Plot Dimensions _____ by _____ m	Photos (y/n) _____
Provisional Community Name _____	
Relative Stand Size extensive (>100x plot), <u>large</u> (>10-100x plot), small (3-10x plot), <u>very small</u> (1-3x plot), unknown	
Representativeness _____ _____ _____	
Landform (circle) <u>interfluv</u> e, gap/saddle, side slope, terrace/bench flat plain	
Topographic Position (circle) <u>crest</u> , upper slope, middle slope, lower slope, toe slope, <u>plain/level/bottom</u> , basin/depression	
Hydrologic Regime <u>Upland</u> Permanently flooded <u>Semipermanently</u> flooded <u>Seasonally/Temporarily flooded</u> Unknown	
Plot Shape (circle) <u>concave</u> convex flat irregular	
<u>General Comments</u> _____ _____ _____	

Leaf Phenology	Leaf type	Physiognomic Class
☐ Deciduous (<25% evergreen)	☐ Broadleaf	☐ Forest
☐ Evergreen (<25% deciduous)	☐ <u>Needleleaf</u>	☐ Woodland
☐ Mixed deciduous/evergreen	☐ Mixed	☐ Sparse woodland
☐ <u>Perennial graminoid</u>	☐ <u>Graminoid</u>	☐ <u>Shrubland</u>
☐ Perennial forb	☐ Forb	☐ <u>Sparse shrubland</u>
☐ Perennial mixed	☐ <u>Pteridophyte</u>	☐ Herbaceous
☐ Annual herbaceous	☐ Non-vascular	☐ Sparse vegetation

Strata	%Cover (1=<1%, 2=1-5%, 3=5-25%, 4=25-50%, 5=50-75%, 6=75-95%, 7=95-100%)
T1 Emergent >30m	_____
T2 Tree Canopy 20-30m	_____
T3 Tree <u>Subcanopy</u> 5-20m	_____
S1 Tall Shrub 1-5m	_____
S2 Short Shrub <1m	_____
H Herbaceous	_____

%Cover (1= $\leq 1\%$, 2=1-5%, 3=5-25%, 4=25-50%, 5=50-75%, 6=75-95%, 7=95-100%)

[illegible]

NPS Vegetation Inventory Program
Herbert Hoover National Historic Site

Plot Code _____

[illegible]

Appendix C: Herbert Hoover National Historic Site Dichotomous Key to Mapped Current Vegetation Types

- 1a. Vegetation dominated by trees >5 m tall **Bottomland Ruderal Woodland**
- 1b. Vegetation dominated by herbaceous vegetation **2**
 - 2a. Vegetation dominated by reed canarygrass (*Phalaris arundinacea*)
..... **Reed Canarygrass Western Herbaceous Vegetation**
 - 2b. Vegetation not dominated by reed canarygrass (*Phalaris arundinacea*) **3**
 - 3a. Vegetation dominated by a some combination of native tall grasses including big
bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and switchgrass
(*Panicum virgatum*); if shrubs are important, they occur in a matrix of tall grasses
..... **Restored Tallgrass Prairie**
 - 3b. Vegetation not dominated by some combination of native tall grasses **4**
 - 4a. Cup plant (*Silphium perfoliatum*), wild bergamot (*Monarda fistulosa*), giant
ragweed (*Ambrosia trifida*), golden zizia (*Zizia aurea*), poison hemlock (*Conium
maculatum*), and/or lambsquarters (*Chenopodium album*) constituting a combined
cover of greater than 35%..... **Forb Ruderal Herbaceous Vegetation**
 - 4b. Combined cover of above species less than 35%. Pasture or old field appearance.
Pasture dominated by invasive grasses such as smooth brome (*Bromus inermis*),
field brome (*Bromus arvensis*), or quackgrass (*Elymus repens*). Old field with the
above grasses or forbs such as thistle (*Cirsium* spp.), prickly lettuce (*Lactuca
serriola*), Canadian horseweed (*Conyza canadensis*), common dandelion
(*Taraxacum officinale*), common milkweed (*Asclepias syriaca*), blackeyed Susan
(*Rudbeckia hirta*), pinnate prairie coneflower (*Ratibida pinnata*), or clover
(*Trifolium* spp.).....
..... **Pasture and Old Field**

Appendix D: Example of Accuracy Assessment Form

Accuracy Assessment Form

NPS Vegetation Inventory

PLOT (WAYPOINT) #: _____ 2. DATE: _____

OBSERVER (DETERMINING ASSOCIATION) _____

Observer (assisting) _____

ACCURACY OF NAVIGATION (METERS) _____

How Determined: _____

UTM EASTING: _____ 8. UTM: _____

9. UTM Zone: _____ 10. Datum: _____

11. If GPS Position is an intentional offset from the waypoint, circle the explanation:

a.) Mosaicing scenario (too heterogeneous to key because of two or more clearly distinct types within observation area)

b.) Physical constraints in reaching waypoint

c.) Other (explain as needed): _____

12. VEGETATION ASSOCIATION (Primary call): _____

13. Other possible associations (complexing scenario) (if applicable): _____

14. Explanation for # 13 (if applicable): _____

Appendix E: Species List for Herbert Hoover National Historic Site

Family	Scientific Name	Common Name
Anacardiaceae	<i>Rhus glabra</i>	smooth sumac
Apiaceae	<i>Conium maculatum</i>	poison hemlock
	<i>Eryngium yuccifolium</i>	button eryngo
	<i>Pastinaca sativa</i>	wild parsnip
	<i>Zizia aurea</i>	golden zizia
Apocynaceae	<i>Apocynum cannabinum</i>	Indianhemp
Asclepiadaceae	<i>Asclepias syriaca</i>	common milkweed
Asteraceae	<i>Ambrosia trifida</i>	great ragweed
	<i>Cirsium discolor</i>	field thistle
	<i>Conyza canadensis</i>	Canadian horseweed
	<i>Echinacea pallida</i>	pale purple coneflower
	<i>Echinacea purpurea</i>	eastern purple coneflower
	<i>Erigeron strigosus</i>	prairie fleabane
	<i>Eupatorium altissimum</i>	tall thoroughwort
	<i>Helianthus hirsutus</i>	hairy sunflower
	<i>Helianthus maximiliani</i>	Maximilian sunflower
	<i>Heliopsis helianthoides</i>	smooth oxeye
	<i>Lactuca canadensis</i>	Canada lettuce
	<i>Liatris aspera</i>	tall blazing star
	<i>Packera plattensis</i>	prairie groundsel
	<i>Ratibida pinnata</i>	pinnate prairie coneflower
	<i>Rudbeckia hirta</i>	blackeyed Susan
	<i>Rudbeckia laciniata</i>	cutleaf coneflower
	<i>Rudbeckia triloba</i>	browneyed Susan
	<i>Silphium perfoliatum</i>	cup plant
	<i>Silphium terebinthinaceum</i>	prairie rosinweed
	<i>Solidago canadensis</i>	Canada goldenrod
	<i>Solidago gigantea</i>	giant goldenrod
	<i>Solidago ulmifolia</i>	elmleaf goldenrod
	<i>Symphyotrichum lanceolatum</i>	white panicle aster
	<i>Symphyotrichum novae-angliae</i>	New England aster
	<i>Symphyotrichum pilosum</i> var. <i>pilosum</i>	hairy white oldfield aster
	<i>Taraxacum officinale</i>	common dandelion
	<i>Vernonia fasciculata</i>	prairie ironweed
Boraginaceae	<i>Hackelia virginiana</i>	beggarslice
Caprifoliaceae	<i>Lonicera morrowii</i>	Morrow's honeysuckle
	<i>Sambucus nigra</i> ssp. <i>canadensis</i>	American black elderberry

NPS Vegetation Inventory Program
Herbert Hoover National Historic Site

Family	Scientific Name	Common Name
Chenopodiaceae	<i>Chenopodium album</i>	lambsquarters
Commelinaceae	<i>Tradescantia ohiensis</i>	bluejacket
Convolvulaceae	<i>Calystegia sepium</i>	hedge false bindweed
Cornaceae	<i>Cornus racemosa</i>	gray dogwood
Cupressaceae	<i>Juniperus virginiana</i>	eastern redcedar
Cyperaceae	<i>Carex</i>	sedge
Equisetaceae	<i>Equisetum arvense</i>	field horsetail
Fabaceae	<i>Baptisia alba</i>	white wild indigo
	<i>Dalea purpurea</i>	purple prairie clover
	<i>Desmodium canescens</i>	hoary ticktrefoil
	<i>Lespedeza capitata</i>	roundhead lespedeza
	<i>Lotus corniculatus</i>	bird's-foot trefoil
	<i>Melilotus officinalis</i>	sweetclover
	<i>Trifolium pratense</i>	red clover
Fagaceae	<i>Quercus macrocarpa</i>	bur oak
Geraniaceae	<i>Geranium maculatum</i>	spotted geranium
Juglandaceae	<i>Juglans nigra</i>	black walnut
Lamiaceae	<i>Glechoma hederacea</i>	ground ivy
	<i>Leonurus cardiaca</i>	common motherwort
	<i>Monarda fistulosa</i>	wild bergamot
	<i>Physostegia virginiana</i>	obedient plant
Moraceae	<i>Morus alba</i>	white mulberry
Oleaceae	<i>Fraxinus americana</i>	white ash
Oxalidaceae	<i>Oxalis stricta</i>	common yellow oxalis
Phytolaccaceae	<i>Phytolacca americana</i>	American pokeweed
Poaceae	<i>Andropogon gerardii</i>	big bluestem
	<i>Bouteloua curtipendula</i>	sideoats grama
	<i>Bromus inermis</i>	smooth brome
	<i>Elymus canadensis</i>	Canada wildrye
	<i>Elymus repens</i>	quackgrass
	<i>Hordeum jubatum</i>	foxtail barley
	<i>Panicum virgatum</i>	switchgrass
	<i>Phalaris arundinacea</i>	reed canarygrass
	<i>Poa pratensis</i>	Kentucky bluegrass
	<i>Schizachyrium scoparium</i>	little bluestem
	<i>Sorghastrum nutans</i>	Indiangrass
Polygonaceae	<i>Polygonum scandens</i>	climbing false buckwheat
	<i>Rumex crispus</i>	curly dock
Ranunculaceae	<i>Anemone canadensis</i>	Canadian anemone
	<i>Thalictrum dasycarpum</i>	purple meadow-rue

NPS Vegetation Inventory Program
Herbert Hoover National Historic Site

Family	Scientific Name	Common Name
Rosaceae	<i>Geum canadense</i>	white avens
	<i>Potentilla arguta</i>	tall cinquefoil
	<i>Prunus serotina</i>	black cherry
	<i>Prunus virginiana</i>	chokecherry
	<i>Rosa multiflora</i>	multiflora rose
	<i>Rubus allegheniensis</i>	Allegheny blackberry
Rubiaceae	<i>Galium aparine</i>	stickywilly
Solanaceae	<i>Physalis heterophylla</i>	clammy groundcherry
	<i>Physalis virginiana</i>	Virginia groundcherry
	<i>Solanum carolinense</i>	Carolina horsenettle
Ulmaceae	<i>Celtis occidentalis</i>	common hackberry
	<i>Ulmus rubra</i>	slippery elm
Urticaceae	<i>Pilea pumila</i>	Canadian clearweed
	<i>Urtica dioica</i>	stinging nettle
Verbenaceae	<i>Verbena urticifolia</i>	white vervain
Violaceae	<i>Viola sororia</i>	common blue violet
Vitaceae	<i>Vitis vulpina</i>	frost grape

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