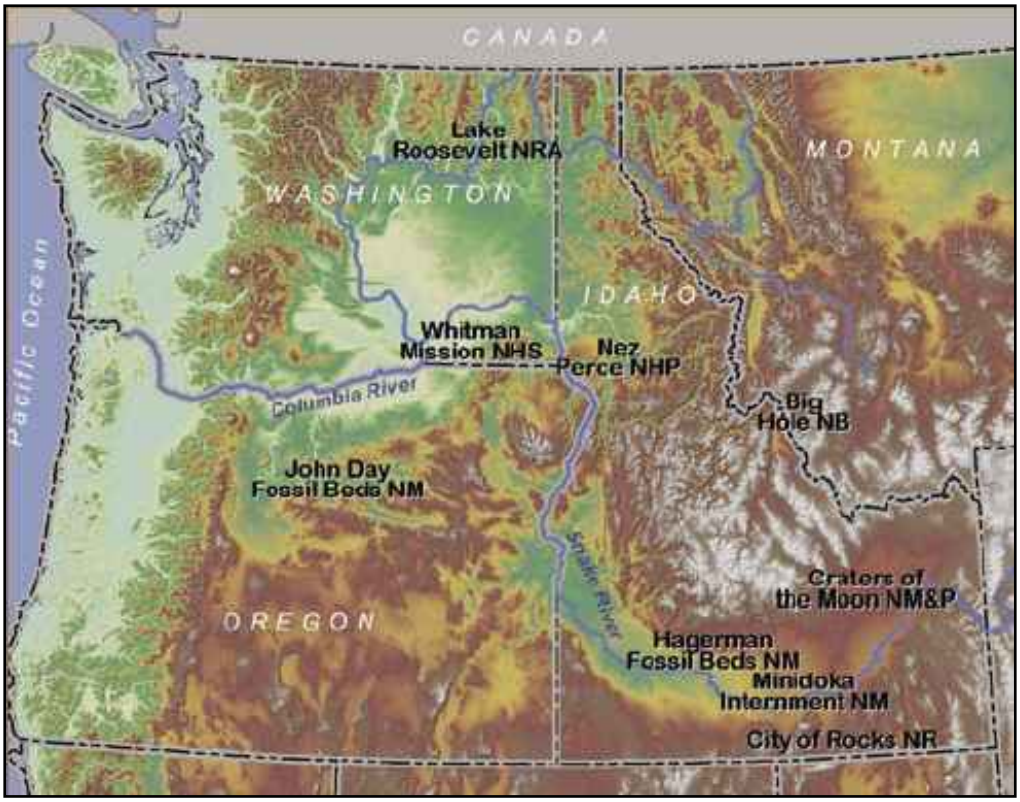
Vegetation Classification and Mapping

- Big Hole National Battlefield (BIHO)
- City of Rocks National Reserve (CIRO)
- Craters of the Moon National Monument and Preserve (CRMO)
- Hagerman Fossil Beds National Monument (HAFO)
- John Day Fossil Beds National Monument (JODA)
- Lake Roosevelt National Recreation Area (LARO)
- Minidoka Internment National Monument (MIIN)
- Nez Perce National Historical Park (NEPE)
- Whitman Mission National Historic Site (WHMI)



Work Plan

October 16, 2006

Vegetation Classification and Mapping Work Plan

Prepared For:
National Park Service

Prepared By:
Cogan Technology Inc.

Big Hole National Battlefield (BIHO)
City of Rocks National Reserve (CIRO)
Craters of the Moon National Monument and Preserve (CRMO)
Hagerman Fossil Beds National Monument (HAFO)
John Day Fossil Beds National Monument (JODA)
Lake Roosevelt National Recreation Area (LARO)
Minidoka Internment National Monument (MIIN)
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SUMMARY

This work plan presents a comprehensive package that incorporates existing and future efforts needed to create USGS-NPS Vegetation Mapping Program products for the Upper Columbia Basin Network (UCBN) of National Park Units. The UCBN consists of nine park units. For the purposes of vegetation mapping an approximate 2-km to 0.5-km (~1/4 mile) environs (buffer) was included for each park depending on funding from partnering agencies and cooperators yielding a total mapping area of about 1.1 million acres. Work is anticipated for 6 Federal Fiscal Years (FY06-FY11) and will be split by task between Cogan Technology Inc. (CTI), Northwest Management Inc. (NWM) and representative state heritage programs. CTI will coordinate all aspects of the mapping including photo interpretation, image segmentation, creating the GIS layers, compiling the necessary components for the final reports and working with, and hiring other subcontactors as needed. NWM will collect all of the field data, both plots and accuracy assessment points, and edit the final reports. The heritage programs will be solicited for National Vegetation Classification lists of plant alliances and associations. Included in this proposal are costs associated with travel to the Lake Roosevelt scoping meeting, park housing at Craters of the Moon and acquiring aerial photography for Craters of the Moon. The following is summary cost by fiscal year:

Federal Fiscal Year	**Proposed Funding**
Fiscal Year 2006	$247,900.00*
Fiscal Year 2007	$467,982.25
Fiscal Year 2008	$542,013.25
Fiscal Year 2009	$490,553.25
Fiscal Year 2010	$229,073.25
Fiscal Year 2011	$71,520.00

*indicates obligated funding in 2006

Project Total	**2,049,042.00**

CURRENT BUDGET EXPENDED TO DATE

Veg Mapping Funding in FY06
March Funding Memo $121,800
June Funding Memo $32,100
July Funding Memo $94,000
TOTAL = $247,900

SPENT TO DATE (Sept. 06)
NW Management $90,150
NW Management $26,650
ICDC $5,000
Park Housing (CRMO) $800.00

Future Obligations FY 06
ICDC $21,652
BOR $100,048
Travel $3,600 (3 trips – 2 for Brown and 1 for Lea)

TOTAL = $247,900

NATIONAL VEGETATION MAPPING PROGRAM BACKGROUND

The National Park Service (NPS) and U.S. Geological Survey (USGS) are cooperating to produce detailed vegetation classifications and digital databases, including vegetation maps, as part of the nationwide NPS Inventory and Monitoring Program. These datasets are made available through the National Biological Information Infrastructure Program (NBII) (NBII 2002a) and the NPS Data Store (URL: http://science.nature.nps.gov/nrdata/). Approximately 270 national parks and monuments will benefit from this cooperative effort upon successful program completion. The National Park Vegetation Mapping Program is a strong component of the NPS Inventory and Monitoring Program, established in 1991, and is based on a repeatable set of standards and flexible protocols produced following the flowchart presented as *Attachment A*.

At the program inception in 1994, three documents were written (and a fourth document was completed during 1996) to describe protocols and standards for data collection and analysis. The basic tenets of these documents are (from USGS 2002):

- Developing and documenting a National Vegetation Classification Standard (The Nature Conservancy [TNC] and Environmental Systems Research Institute [ESRI] 1994a);
- Establishing standards for field methods and mapping procedures (TNC and ESRI 1994b);
- Producing rigorous and consistent accuracy assessment procedures (ESRI, National Center for Geographic Information and Analysis, University of California – Santa Barbara (NCGIA), and TNC 1994); and
- Establishing standards for using existing vegetation data (TNC 1996).

Park or monument vegetation data are entered into a digital database in accordance with the Federal Geographic Data Committee (FGDC) National Vegetation Classification Standard (NVCS). Under the NVCS, national mapping accuracy standards must be met for the cover type/community type level, for a scale of 1:24,000 and with a minimum mapping unit of 0.5 hectare (ha) (NBII 2002a). This means that each well-defined object in the spatial database will be within 1/50 of an inch of its actual location (1/50 of an inch = 40 feet or 12.2 meters).

The classification accuracy standard states that each map class or unit will meet or exceed 80% accuracy at the 90% confidence level. Further, the classification accuracy will be established by the program accuracy assessment protocols. In addition to a detailed electronic database each park receives: 1) a vegetation field plot database used to characterize park vegetation classes, 2) accuracy assessment statistics of vegetation map products, 3) an illustrated key to the vegetation classification units, and 4) detailed descriptions of the vegetation communities present (NBII 2002a). A tradition of comprehensive final reports has also been established by participating ecology and GIS personnel within the national program.

All digital and tabular vegetation products are accompanied by detailed FGDC-compliant metadata. Metadata are data that describe how the spatial data set was developed, the projection of the spatial data set, the attribute definitions, etc. Metadata are critical elements of each spatial data set, allowing future users to understand its creation, data discovery and use, and by expediting the exchange of vegetation data and information.

UPPER COLUMBIA BASIN NETWORK VEGETATION CLASSIFICATION AND MAPPING PROGRAM

The Upper Columbia Basin Network (UCBN) includes nine parks with significant natural resources in the states of Idaho, Montana, Oregon and Washington. These parks collectively include and protect habitat for a variety of plant and animal species over a wide geographic area of the Pacific Northwest and include examples of most low elevation habitats. Park lands range from relatively pristine environments (Craters of the Moon) to high recreation use (Lake Roosevelt) to grazing use (City of Rocks) to significant cultural landscapes (Big Hole, Nez Perce and Whitman Mission) to significant fossil resources (Hagerman and John Day Fossil Beds). These parks represent lands in contiguous blocks (Hagerman Fossil Beds), lands fractured and scattered over four states (Nez Perce), lands linear in nature (Lake Roosevelt), and lands small in size (Minidoka Internment and Whitman Mission). The difference in size between parks is considerable with WHMI at 93 acres and CRMO (including the BLM Preserve) at approximately 740,000 acres.

These park units have limited budgets and little staff and are not able to provide personnel and funds for many of the natural resource issues they face. The operating budget for the parks varies with two parks in the Network having a budget over 1 million dollars and no park over 2 million dollars. The resources available at the Network level greatly increase their capacity to meet the increasingly complex resource management issues.

INTRODUCTION

In 1999, the National Park Service (NPS) launched the Natural Resource Challenge, a 5-year program designed to strengthen natural resource management in the Nation's national parks (National Park Service 1999). The single biggest undertaking of the Challenge was to augment ongoing park inventory and monitoring efforts into an ambitious comprehensive nationwide program. The Servicewide Inventory and Monitoring (I&M) program was introduced to 270 parks identified as having significant natural resources. Under this program, parks have been organized into 32 networks to conduct long-term vital signs monitoring. Each network links parks that share geographic and natural resource characteristics, allowing for improved efficiency and the sharing of staff and resources. The network organization facilitates the collaboration, information sharing, and economies of scale in natural resource monitoring. Parks within each of the 32 networks work together and share funding and professional staff to plan, design, and implement an integrated long-term monitoring program.

The UCBN network located in the Northwest portion of the United States is currently conducting a vegetation classification and mapping project under the leadership of the National Vegetation Mapping Program. Cogan Technology Inc. (CTI) has been tasked to provide assistance under various contracts with Engineering-environmental Management, Inc. (e^2M), Bureau of Reclamation (BOR) and the University of Idaho. One sub-task under the contract is to create a comprehensive multi-year work plan for the parks in the UCBN, with recommendations for completing the plant community classification, digital database, and map products. Elements addressed within this work plan are described more fully under the Elements section of this document and the document generally follows the NPS report style guide. This work plan will be reviewed with appropriate national vegetation mapping program leaders and will be provided to the UCBN as a hard copy and electronically on a CD.

The area to be sampled, classified, and automated into a digital database includes the nine parks and surrounding regions, known as the environs (Figures 1, 2, and 3 beginning on page 4). The total project area for the nine parks, including either a 2-km or 0.5-km (1/4 mile) environs around each unit, is approximately 1.1 million acres; of this amount CRMO occupies approximately 931,000 acres.

This proposal presents an ambitious plan for completing park vegetation maps and associated plant community classifications within the next five years (FY2006-2011). The network wishes to cost-share this project with the national USGS/NPS Vegetation Mapping Program and national Fire Program. The total projected cost for the 5-year project is $2,335,127 of which, $247,900 have already been obligated by UCBN. This represents an average cost of $2.10 per acre.

RELEVANCE OF VEGETATION CLASSIFICATION AND MAPPING TO OTHER PROJECTS IN THE UCBN

The most compelling aspect of the NPS Vegetation Mapping Program for the UCBN is the baseline vegetation data that it will provide. Historically the lack of vegetation projects across the UCBN Parks was due to limited budgets and staff available to develop and lead a park vegetation mapping project. Now with the support of the national program it is anticipated that once created the classification and digital spatial data will become the standard vegetation resource tool generating many potential uses. These include visitor education (interpretation), wildlife habitat management, archaeology, invasive plant management, forest insect pest and disease management, forest community restoration, and urban-interface issues.

Long-term monitoring of the vegetation at UCBN parks is an important consideration. Current, accurate vegetation maps that are consistent in thematic and spatial resolution are needed to allow UCBN staff to identify, map, and monitor changes in the patterns of landcover on lands within and adjacent to UCBN parks and to provide base-level support for various vital sign monitoring (e.g., sampling design, viewshed analysis, focal species occurrences). In conjunction with the Network, needs for long-term monitoring are the needs of the park resource managers. A key to management of vegetative resources at the park is knowing their current distribution and abundance and having a database available as a GIS coverage. Vegetation maps that are currently available are not helpful to resource managers or the I & M program because they lack accuracy assessments and in some cases, do not contain thematic or spatial resolution needed. Available maps for each park unit with information on year of imagery, spatial resolution, thematic resolution, spatial extent, accuracy, and imagery sensor are shown in this workplan.

To better understand ecosystem changes the UCBN is also pursuing creating coarser resolution products for monitoring purposes using their own funding. Specifically the UCBN would like to combine the vegetation mapping in the future with a combination of satellite imagery including the ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) sensor. The advantages of the ASTER data includes providing the Parks with an inexpensive ($60/scene) measurement and monitoring tool that will facilitate change detection in future years. Using the baseline vegetation data created in this project the UCBN plans to classify the ASTER images to monitor changes in landcover and use over time and update the vegetation maps as needed. These periodic updates to vegetation maps will be affordable and a valuable monitoring tool for UCBN. Once the baseline vegetation maps are completed, the second

generation of the map will likely cost approximately 30% less. Generations of mapping following the second generation should see an additional reduction in cost of another 30%.

The UCBN also wishes to collaborate with adjacent land owners and will assist the National Vegetation Mapping Program and associated contractors to cultivate and hopefully solidify such partnerships. Currently these efforts have successfully included the Idaho National Laboratory (INL) lands adjacent to CRMO. This is a Department of Energy (DOE) site that totals over 500,000 acres. Methods and contractors used at CRMO will also be used at INL and funding will be supplied by DOE. This project will yield a larger pool of vegetation information and will increase the mapping area by 50%. As other parks in the UCBN are started similar partnerships with other neighbors will be explored.

Finally a secondary emphasis of the network vegetation mapping program is to acquire on-the-ground fuels data to support fire management in the following parks: CRMO, HAFO, and JODA. This data will be used to support fire fuel management activities including the placement of fire breaks, fuel reduction and controlled burn planning It is hoped that that additional ground data collected at each plot will be used to help model the fire fuel loading and generate fuel maps and other useful products.

OVERALL STRATEGY

Following the guidelines provided by the national program UCBN proposes to create vegetation classifications to the association level of the National Vegetation Classification System (NVCS) and spatial databases (i.e. maps) to approximately the alliance level. Costs are divided between five major tasks: field reconnaissance, image processing/digitizing, creation of the spatial database, conducting an accuracy assessment including field key preparation, and generating the necessary deliverables (**Attachment A**). This project is planned to occur over a 6-year period and across five federal fiscal years. Completion of these projects will likely be incremental with all parks anticipated for completion by December 2011. The work described herein covers the complete range of activities, listed below, to finish the project cost-effectively and in a reasonable time frame.

Proposed Projects and Tasks
1. Planning Sessions and Scoping Meetings; 2. Preliminary Plant Alliance/Association and Species Lists; 3. Aerial Photography and Digital Ortho-photography Acquisition and Preparation; 4. Field Data Collection; 5. Vegetation Classification, Alliance/Association Descriptions and Field Key; 6. Aerial Photo-interpretation and/or Image Processing and Segmentation; 7. GIS Database and Vegetation Map Preparation; 8. Accuracy Assessment; 9. Final Reports and Deliverables.

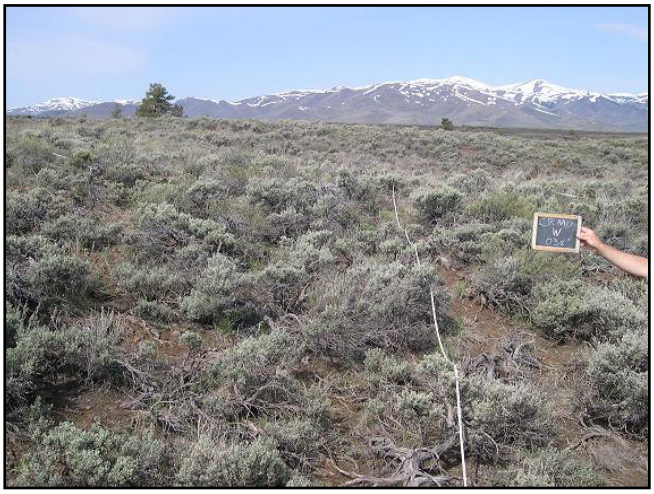
Important parameters to be reviewed at the planning meeting for each park in the UCBN:

- A review of vegetation data and driving environmental variables, including, but not limited to:
  - Elevation breaks/influence on vegetation distribution;
  - Precipitation gradient;
  - The effect of soils on plant distribution through use of available soil surveys;
  - Patterns that suggest the driving variables such as aspect, slope, slope position, and moisture gradient;
  - Evaluation of the existing GIS map of environmental polygons used in previous mapping work.
- Refine the preliminary vegetation classification, based on NPS staff knowledge of the vegetation data in this area.
- Conduct a field trip in the park to overview the vegetation for the above purposes and to discuss sampling issues and ecological characteristics of the parks.
- A review of work space, tools, and some of the products including aerial photography, any photointerpretation efforts, and legacy data summary;
- Identification of plant associations that may be sampled;
- Vegetation sampling direction concerning plot placement, size, shape, etc.
- Determining best use of legacy data for classification, allowing planning and budgeting for field data collection.
- Discuss potential partnering and cooperation with neighbors.
- Discuss and finalize the project boundary based upon contributions from partners.

The UCBN proposes to work cooperatively with Dan Cogan (CTI), Gina Wilson (University of Idaho Landscape Dynamics Lab), Karl Brown (NPS National Vegetation Mapping Program), John Erixson of Northwest Management Inc (NWM) and Jim VonLoh (e^2M) to complete these projects. CTI will coordinate all aspects of the vegetation mapping projects in close cooperation with Lisa Garrett and UCBN. It is anticipated that the field work component including plot and accuracy assessment point collection will use experienced crews provided by e^2M and NWM. The vegetation classification portion will be conducted by cooperative agreements between UCBN and the respective State Heritage programs. Finally the mapping and deliverables will be coordinated and completed by CTI.

CURRENT STATUS

In the spring of 2006 a coordination meeting was held in Moscow, Idaho with representatives from both CTI and UCBN. At this meeting it was determined that field work should start in 2006 at CRMO and proceed to HAFO if time and funds were still available. In addition a custom UBCN website specifically constructed to house all vegetation mapping-related materials would be created and hosted on the networkNPS website. To facilitate the field work a proposal was submitted and accepted by the national program. Upon receipt of the funds a competitive bid was solicited and the contract was awarded to NWM. A kickoff meeting was held at CRMO May 3-4, 2006 to familiarize the park with the program and introduce the responsible parties. Copies of the presentations and a meeting summary can be found on the website at: http://www.nature.nps.gov/im/units/ucbn/VegMapping.htm. Work started immediately after the meeting and under the contract NWM collected approximately 400 plots and 200 observations at CRMO and 84 plots and 61 observations at HAFO (Figure 1 and 2).



Northwest Management expects to deliver electronic databases (data and photos) to the UCBN data manager by September 1, 2006. A final report will be submitted by November 30, 2006.

UCBN also entered into a cooperative agreement with Idaho Conservation Data Center for the development of preliminary lists of vegetation associations for 4 southern Idaho parks (CIRO, CRMO, HAFO, and MIIN) (**Attachment B)**. These lists are completed and available as appendices in this document. Descriptions are currently in progress.

Finally the UCBN has entered into a cooperative agreement with the BOR Remote Sensing and GIS group in Denver, CO to provide GIS and Remote Sensing services (**Attachment C**). This includes funds to be used by CTI to complete the work plan, create vegetation map units and create preliminary vegetation maps for CRMO, HAGE, CIRO, and MIIN.

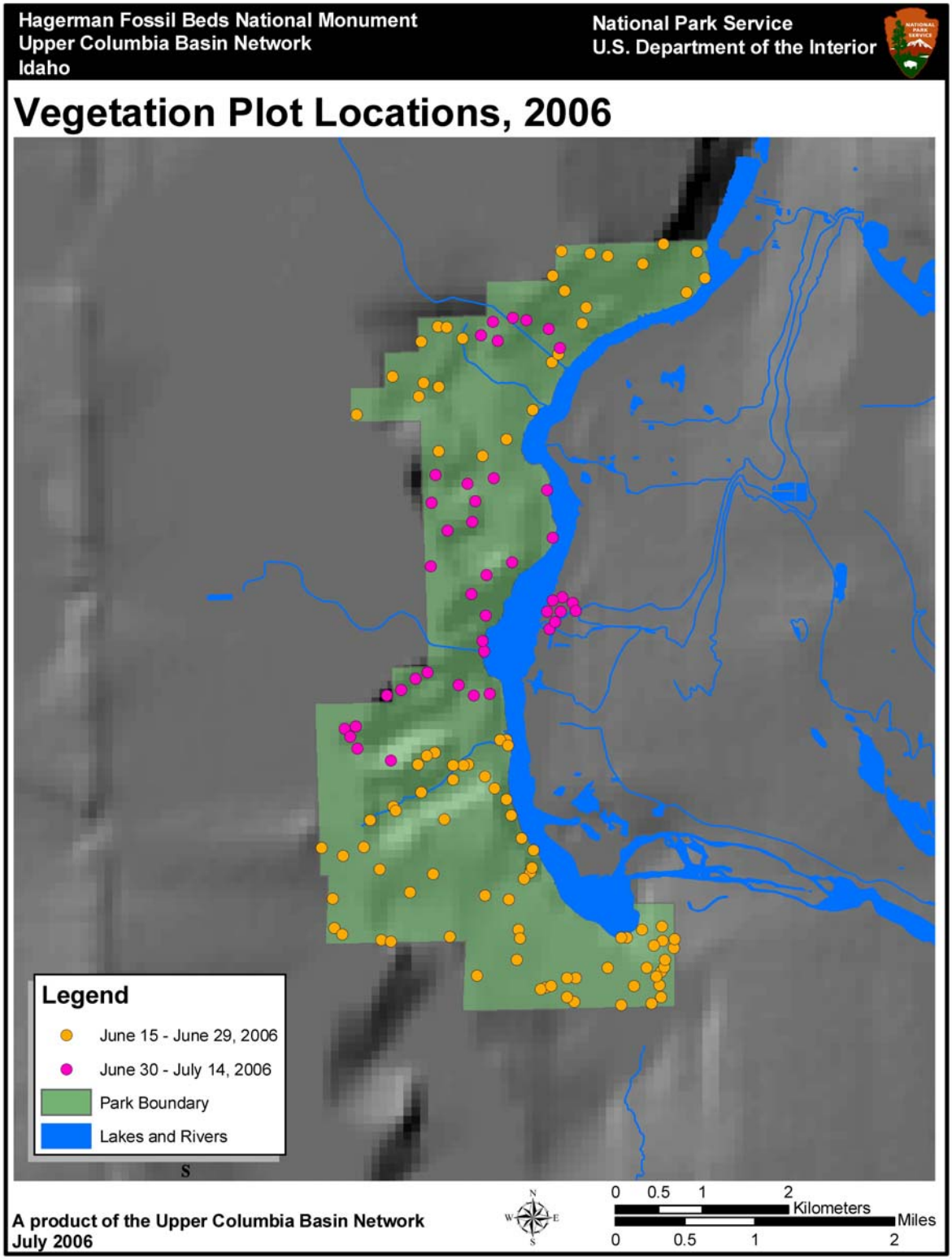


Figure 1. 2006 Vegetation Plot Locations for HAFO Vegetation Mapping Project.

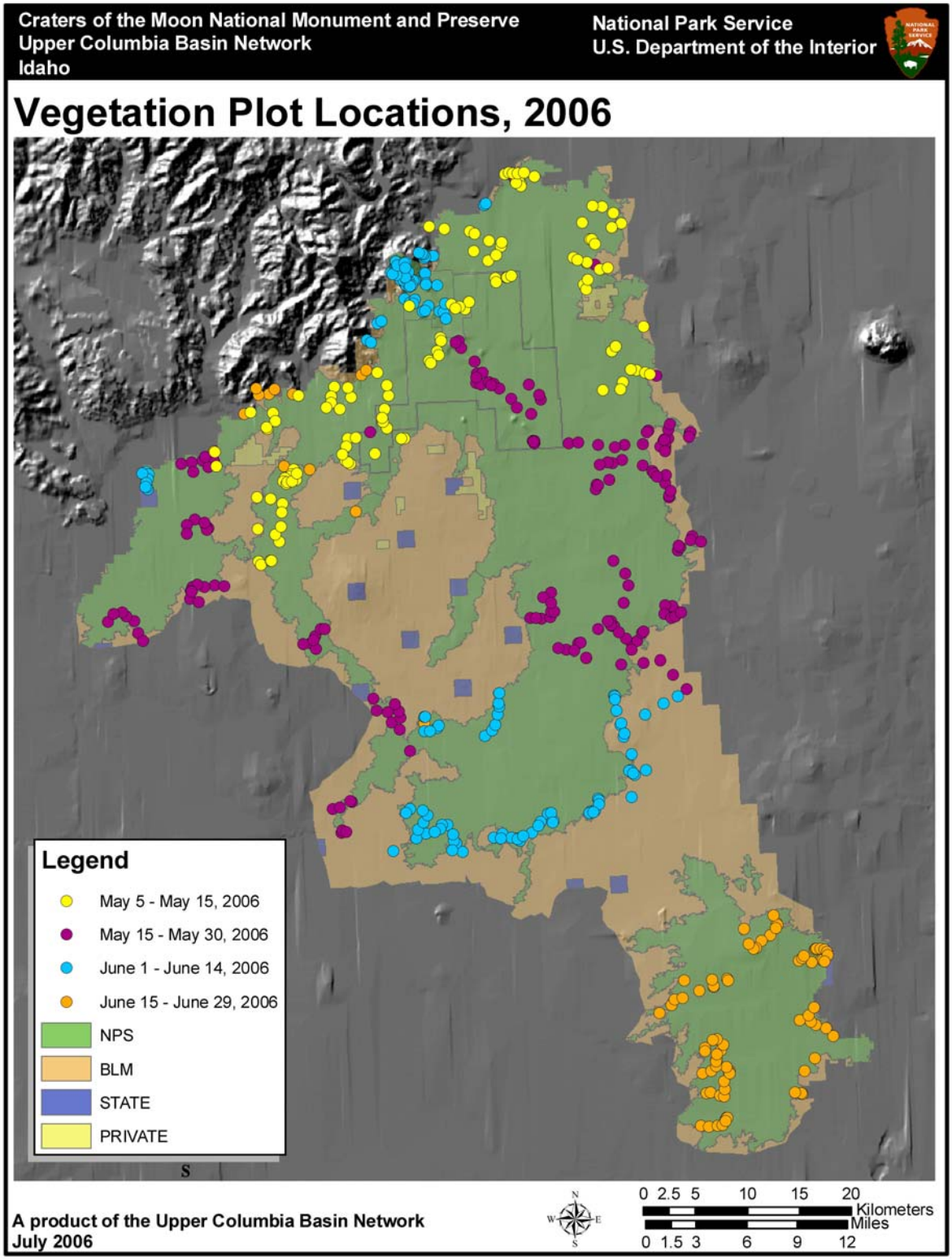


Figure 2. 2006 Vegetation Plot Locations for CRMO Vegetation Mapping Project.

BIG HOLE NATIONAL BATTLEFIELD (BIHO)

Anticipated Start Date: FY09 - Anticipated End Date: FY11

Introduction

BIHO memorializes one of the most famous battles of the Indian Wars between the Nez Perce and the U.S. It is located in the Big Hole Valley in southwestern Montana and consists of 655 acres encompassing bottom riparian, steppe and forest. The North Fork of the Big Hole River runs through the site. Prominent features include a treeless, grassy, open known as the Horse Pasture, Battle Mountain in the northwest and Ruby Bench on the southeast side. Battle Mountain is backed by the forest-covered Anaconda Range, Ruby Bench by the high, open expanse of the Big Hole Valley. The park is bounded by State Highway 43 on the south, Beaverhead National Forest on the west and north, and private ranch land on the east. Including a 2-km environs around BIHO would yield a project size of about 5,000 acres (a ¼-mile scenario would roughly be 4,000 acres).

TASK 1.0 Planning Sessions and Scoping Meetings

Preliminary planning and scoping for this project will be completed using one meeting to discuss the project design, imagery, photointerpretation/segmentation, plant distribution and ecology, and project review. Completion of the vegetation classification would involve planning and scoping with key agencies and organizations including the Montana State Heritage Program, UCBN, CTI and NWM as appropriate and as necessary.

Assumptions:

- Sufficient planning will occur to establish the approach and milestones for the field data collection, classification, PI/segmentation, and digital database production.
- Planning meetings with any contributing agencies would be informal and conducted between appropriate UCBN and on-site staff.
- Existing vs. new aerial photography/imagery will be evaluated at the meeting and through discussion between NPS, UCBN, BIHO, and CTI staff.
- The sampling approach will be discussed and finalized at the scoping meeting

At the scoping meeting the environs should be agreed upon as the project boundary for the project and confirmed. For the purposes of this work plan, acreage totals were calculated assuming a 2-km environs area (**Figure 3**). If the environs area changes as a result of planning meeting discussions, the estimated level of effort for some tasks in this plan my change.

Table 1. Proposed Level of Effort for Planning and Scoping at BIHO (in days).

Task Topic	CTI, NWM, Others	Costs	Discussion
Project planning meeting	9 days*	$4,320	A planning meeting would discuss all project needs, timelines, and assign responsibility for completion.
Totals	**9 days**	**$4,320**	--

* Several entities would be required to attend for a successful planning meeting.

Task Deliverables: A summary of the scoping meeting minutes will be created and copies of the presentations will be posted on the UCBN vegetation mapping website.

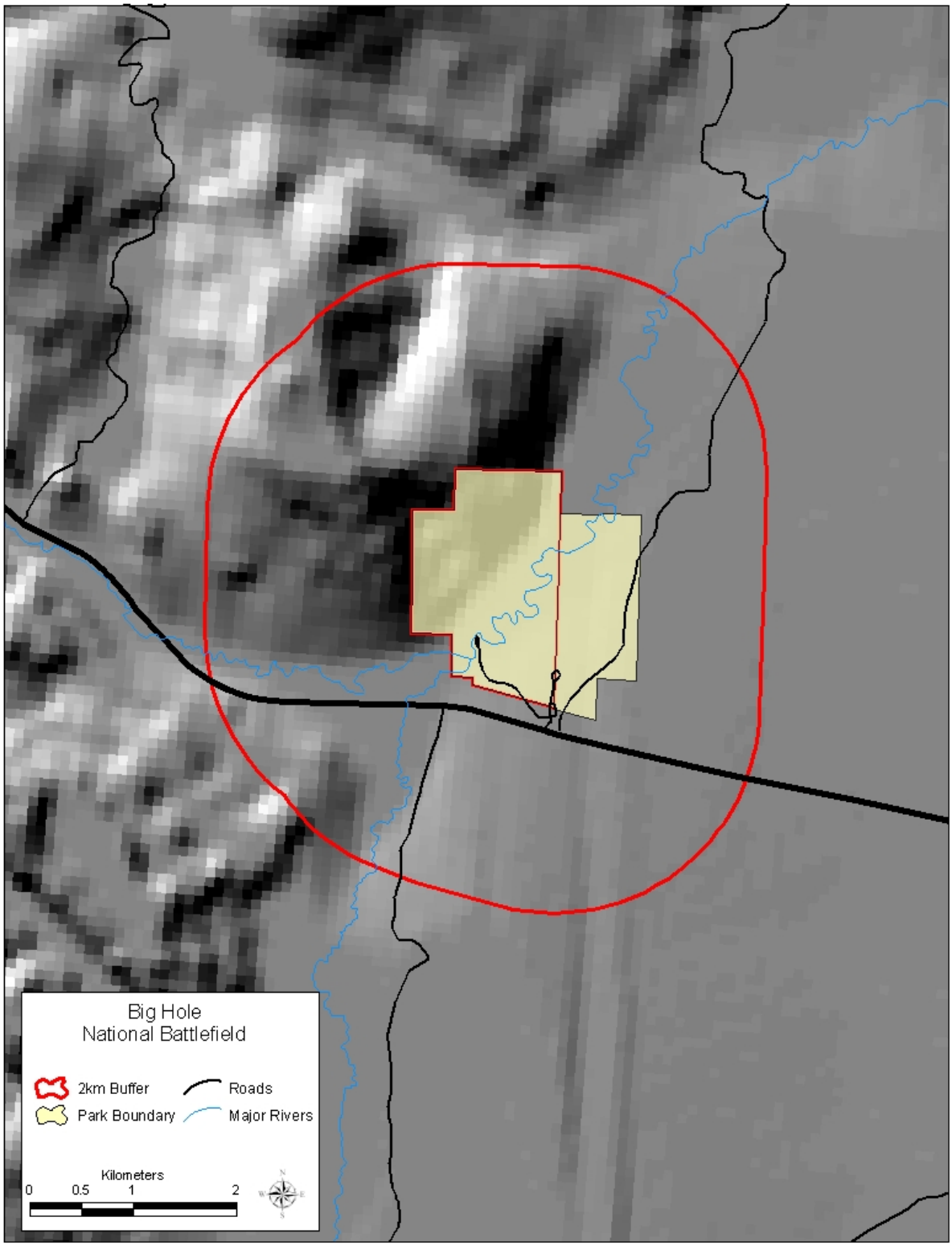


Figure 3. Approximate Project Boundary for BIHO Vegetation Mapping Project.
(Note: Figure does not show the ¼ mile buffer scenario)

TASK 2.0 Preliminary Plant Alliance/Association and Species Lists

A preliminary list of plant associations and alliances including the known ecological systems for BIHO will be solicited from the Montana Natural Heritage Program. This will include an estimate on the likeliness that the type occurs at BIHO. A review of this list will be conducted by BIHO and UCBN staff with additions added to the list and types removed that are known not to occur in the area.

Assumption:

- Sufficient vegetation data occurs for this area that a preliminary list of associations can be created.

Table 2. Estimated Costs for Preliminary Plant Associations and Alliance for BIHO

Task Topic	Montana Heritage	Costs	Discussion
Preliminary List	-	$2,700	Time needed to create and update the association list for BIHO by the Montana State Heritage Program
Totals	**-**	**$2,700**	--

Task Deliverables: A preliminary list of plant associations and alliance for BIHO prepared by the Montana Natural Heritage Program will be presented to UCBN prior to the scoping meeting.

TASK 3.0 Aerial Photography and Digital Ortho-photography Acquisition and Preparation

Available imagery includes the various products produced by the National Agricultural Imagery Program (NAIP). These typically include 1-m and 2-m products in both color infrared and true color formats. All available imagery sets will be evaluated prior to the start of work at BIHO and the latest high-quality set will be used as the basemap. Based on the resource management needs in other parks the NAIP imagery will be supplemented with any existing aerial photography, preferably color-infrared aerial photography at 1:12,000-scale

Assumptions:

- Existing aerial photography and NAIP imagery will be of sufficient quality to conduct all PI, attribution, and digital (GIS) database development.

Table 3. Estimated Costs for Imagery and Photography for BIHO

Task Topic	CTI/UCBN	Costs	Discussion
NAIP Imagery	-	-	The NAIP Imagery will be provided by UCBN
Existing Aerial Photography	-	-	It is anticipated that existing photography will be provide at little or no cost.
Totals	**-**	**-**	--

Task Deliverables: A mosaic of the NAIP imagery will be created.

TASK 4.0 Field Data Collection

Due to its size BIHO falls into the low-end of the medium size park category (TNC 1994b) for vegetation mapping. This category allows for the entire park to be the sampled using representative polygons for each vegetation type. Polygons at BIHO will likely be set up as sampling areas selected by a combination of local expertise, soils and physical characteristics and the current land-cover map. No formal stratification or delineation of each type will be done due the small size of the park. It's anticipated that all areas of the park will be visited by field crews for sampling.

To date, very minimal legacy data exists for BIHO that would be useful for this project. Again due to its small size all new vegetation plots and observation points will be collected. Standard ancillary data such as soils, geology and hydrology for the area will be used to assist in sample site selection and the photointerpretation. If existing data is presented by BIHO or others at the kick-off meeting it will be evaluated using the program standards for usefulness (**Attachment D**) and incorporated into the project.

Vegetation within BIHO will be sampled using two approaches. These are observation point data and plot data. Observation points are used to guide aerial photointerpretation and vegetation plot data collection by identifying representative or unique signatures from the aerial photos or field maps concerning the distribution of plant associations within the park. Observation points are a more rapid form of data collection, these data are not collected from a standard plot, but rather describe an area, usually up to the program minimum mapping unit of 0.5 hectares. Vegetation plot data are more rigorous than observation points and include precise location, provisional association name, physical environment information, topographic data, physiognomic data, species lists, height classes, foliar cover values, diameter at breast height measurements for trees over 10 centimeters in diameter, and environmental notes and observations by researchers. Vegetation plots are necessary to prepare the classification and as such they are subjectively placed in vegetation types that are representative of an area, relatively homogenous, and larger than the 0.5 hectare (ha) minimum mapping unit (MMU). Ecotones are avoided to the extent possible.

Unique vegetation patches less than the project MMU may also be sampled using vegetation plots. These are often termed "park specials" because of their value for overall management prescriptions, but fall below the project MMU. Resource management staff will be given the chance at the scoping meeting to discuss these options. Some common park special types include:

- Small patches of invasive and exotic plants;
- Small wetlands;
- Rare or endangered plants;

This work plan assumes that approximately 20-30 associations occur at BIHO and its environs. This would indicate that approximately 80 plots and 30 observation points would need to be collected to fully document the diversity. It is anticipated that work will be conducted by experienced field crews supplied by NWM, e^2M, or similar contractor. Experienced field crews will allow for efficient sampling, minimal instruction and little oversight. New field observation points and plots will be collected using the standard observation point and plot form (either paper or digital) created by UCBN in conjunction with the national program (**Attachment E**).

During the planning meeting it will be determined if sampling is required/permitted within project environs, and at what level sampling would proceed.

A minimum of two ground photographs for each vegetation plot will be taken. Photos would be digital, logged in a summary table, and labeled. Fire fuel and related issues will be discussed at the scoping meeting. If it is deemed necessary for BIHO, additional data forms will be used to capture basic fuel loading information (**Attachment E**). If fire is not a concern only the first pages of the field form will be used. Vegetation plot data will be collected in accordance with the methods established during the planning meeting. The following table identifies potential plot size based on the vegetation type being sampled.

Table 4. Vegetation Plot Size by Class

CLASS	AREA	DIMENSIONS
Forest or Woodland	1000 m^2	20m x 50m; 10m x 100m; or circular
Shrubland	400 m^2	10m x 40m; 20m x 20m; or circular
Herbaceous	100 m^2	10m x 10m or circular

Source: TNC and ESRI 1994a

The contractor collecting the data will be responsible for entering it into the UCBN database. This species entered into the database will follow the Integrated Taxonomic Information System (IT IS) as the standard. ITIS has broad acceptance in the taxonomic literature and by professionals working with the taxa of interest. ITIS conforms to the International Code of Botanical Nomenclature, contains botanical codes that allow for the ranks, variety, subvariety, forma, and subforma and will be evaluated using the national PLANTS Database (http://plants.usda.gov/home_page.html) (USDA, NRCS 2001). The UCBN database will be based on the TNC Plots database used in the USGS-NPS Vegetation Mapping Program. Upon entry the database will be checked for completeness and accuracy by UCBN staff.

Assumptions:

- Legacy data useful for this project are minimal at BIHO
- Approximately 80 vegetation plots (at a rate of 5/day) would be sampled to prepare an accurate classification.
- Approximately 30 observation would be recorded (at a rate of 12/day) to assist in PI efforts, and to check interpretation accuracy. These may be collected in the field by members of the vegetation sampling crew or individuals conducting aerial photointerpretation.
- Issues of access due to topography and/or private land-owners may reduce the number of plots in some plant communities.

Table 5. Proposed Level of Effort for Field Data Collection (in days).

Data Collection Topic	NWM or similar	Costs	Discussion
30 Observation Points	5 days	$1,800	Minimal Travel and Expenses are included.
80 Plots	15 days	$12,000	Minimal Travel and Expenses are included.
Total (days)	**25 days**	**$13,800**	Minimal Travel and Expenses are included.

Task Deliverables: 80 plots and 30 observation points representing the associations at BIHO will be delivered to UCBN. Data will be delivered in either paper or digital form.

TASK 5.0 Vegetation Classification, Alliance/Association Descriptions and Field Key

Following vegetation plot data collection and data entry Montana Heritage staff will analyze the data and classify it into the National Vegetation Classification System (NVCS) (Grossman et al. 1998). The NVCS as developed by The Nature Conservancy and currently maintained by NatureServe represents a national system containing 7 levels with the finest being the plant association. Associations are separated from the next highest category, alliance, through the use of total floristic composition and are named by the most dominant and/or indicator species.

For the name or title given to an association or alliance, a single dominant species may be used (*Pinus ponderosa* Woodland). If two species of the same stratum are used they are separated by a dash (*Chrysothamnus viscidiflorus – Ericameria parryi* Shrubland). If two species occur in different strata, then a slash is used to separate them (*Picea pungens / Betula occidentalis* Woodland). Parentheses are used when the diagnostic species are not consistent in the association or alliance (i.e. *Bromus inermis* – (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation).

Following entry into the Plots database, species foliar cover values for each plot will be exported into a spreadsheet format and arranged into a plot by species data matrix. Several of the species recorded in the Plots database, primarily trees and shrubs, may occupy more than one stratum within a particular plot. Such layers provide valuable information regarding the structural diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer should be subscripted with a strata code (e.g., T1, T2, S1, S2, S3). The matrix will be used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Following procedures described by Grossman et al. (1998) and McCune and Mefford (1999), the data matrix would be analyzed as necessary using TWINSPAN, Cluster Analysis, and DECORANA (an ordination technique). The matrix can be edited prior to analysis by first removing all species that had total cover values (summed over all plots) of less than or equal to 1% to keep the influence of minor species at a minimum. Raw foliar cover scores should be used in all data analysis procedures. The data matrix will then be subjectively evaluated for plots that demonstrated exceptionally low similarity to the remaining plots (outliers). Outlier plots are common in relatively large data sets and occur because of disturbed, heterogeneous, or otherwise unusual sites, or because of gaps in sampling (Gauch 1982). Removing outliers would likely help the efficiency of the analysis and substantially improve the interpretability of the results.

Draft vegetation classification efforts would be reviewed by Montana State Heritage, BIHO staff and UCBN in terms of regional data and existing classification. NPS ecologists would discuss and incorporate suggested revisions, as necessary. After the data has been classified local and global descriptions for each association will be created. Local descriptions of vegetation associations or alliance if associations can't be determined (as they occur throughout BIHO) will be drafted by Montana State Heritage ecologists with input from the field crews. Local descriptions will focus on the park-wide variation including the unique characteristics of the association. Generally, three to four local descriptions can be written in one day depending on the complexity of the vegetation type. The global descriptions for the associations will be modified and up-dated using these local descriptions.

After the data has been classified an illustrated field key will be created that will have dichotomous breaks. This key will walk an average person familiar with the vegetation at BIHO through the associations/alliances in a stepwise fashion. During construction members of the field data collection team should be used to help provide information for the key and to test it once completed. For consistency, this key will be used by the ecologists collecting accuracy assessment points to record the correct field classification. This task would require preparation of a plant association field key, annotation of each couplet in the key with diagnostic field descriptions, and illustration of the key with color slides or digital photos taken in the field at vegetation plot sites. This key will also be invaluable for future researchers, interpretive specialists, and visitors interested in vegetation distribution.

Assumptions:

- Vegetation plots will likely number around 100 for the BIHO project.
- It is assumed that approximately 30 plant associations will be determined for BIHO.
- An ecologist familiar with BIHO vegetation will prepare the illustrated plant association field key.

Table 6. Proposed Level of Effort for Classification and Descriptions (in days)

Task Topic	Montana Heritage	Costs	Discussion
Final classification	5 days	$2,400	Statistical analyses performed by Montana Heritage with NatureServe.
Local Descriptions	10 days	$4,800	Local Descriptions for the associations/alliances at BIHO
Global Descriptions	5 days	$2,400	NatureServe review of the descriptions and incorporation into the NVCS
Field Key Prep.	5 days	$2,400	Prepare Illustrated Field Key
Total (days)	**25 days**	**$12,000**	--

Task Deliverables: A preliminary list of associations and alliances will be delivered to UCBN prior to the scoping meeting. A comprehensive, classified list of plant association/alliances will be created in the NVC using the plot and observation data. Local descriptions for all associations/alliances will by used to update the global descriptions. An illustrated field key will be created for the vegetation associations/alliance at BIHO prior to the start of accuracy assessment data collection.

TASK 6.0 Aerial Photointerpretation and Segmentation

Delineation and mapping of the vegetation at BIHO will include a combination of automated image segmentation using eCognition or similar software and traditional photointerpretation (PI). Segmentation will be used to delineate easily observed features and features with high contrast such as open water, roads, and bare rock using the existing NAIP imagery. Once completed this initial map will be further refined though PI using the new photos acquired in 2007. PI will use the standard photo signature characteristics (tone, texture, color, shape, etc…) and ancillary data (slope, elevation, aspect, etc…) to further delineate the final detail of the map classes. Map classes will strive to maintain a 1:1 ratio of map class to plant association. The final mapping scheme will be determined by at a meeting or conference call between the NPS and contract staff. Typically the map classes in these project cover three basic considerations, 1) incorporating the NVC associations/alliances, 2) recognizing the limitations of the imagery (i.e. can you reliably see the plant association on the photo), and 3) covering the management needs of BIHO. The final mapping product will also include all necessary attribution consisting of the vegetation map classes, general height and density modifiers and links to the NVC. It is anticipated that approximately 30 plant associations/alliances and up to 20 land use/bare ground/geology types will be considered as potential map classes. One reconnaissance field trip to ground-truth and obtain photo-signature information by the photo interpreters will be conducted annually during the project.

Photointerpretation is most effectively accomplished when an initial classification has been performed, limiting the amount of cross-walk necessary between interpreted map units and the final classification (developed with the input of NatureServe). The individual responsible for PI should also provide input into the GIS process and review the final GIS layer for quality and consistency. An accurate, descriptive photo-interpretive key will be created to allow all future researchers to understand the interpretive cues used to delineate polygons, which may help to refine the process for future efforts. Typically photo interpretation for these efforts proceeds at about 1000/acres per day.

Assumptions:

- PI work will be conducted at 1000 acres/day. These rates may require adjustment during the process, as photointerpretation proceeds.
- Level of effort will be calculated based an approximate 5000 acre project area.
- The PI investigator will assist the GIS technician to produce a photo-interpretive key.

Table 7. Proposed Level of Effort for PI (in days)

PI Topic	CTI	Costs	Discussion
Photointerpretation	5 days	$2,400	--
Quality Check of GIS	5 days	$2,400	Check draft vegetation plots back to interpreted photography.
Photointerpretation key	5 days	$2,400	Provide representative signatures to the GIS technicians to document PI work for future database users.
Field Recon	4 days	$5,000	Includes time and travel costs for trip.
Total (days)	**15 days**	**$12,200**	--

Task Deliverables: A preliminary vegetation map to the formation level will be created using segmentation techniques. Final detail will be created on aerial photo overlays.

TASK 7.0 Digital Database and Vegetation Map Preparation

Once all of the image processing and PI is completed the final digital database and vegetation map will be created and populated. This will include creating a spatial GIS layer using ArcGIS software. One seamless GIS layer will be created for BIHO by transferring the PI and segmentation information onto the NAIP imagery. Steps required for this task include: digitizing the linework, rectifying it to the basemap, edge-matching, performing a thorough cleaning and weeding process and finally attributing all of the polygons with the necessary vegetation information.

Quality control cannot be overstated in the automation of interpreted vegetation data. One of the more useful practices is to review draft digital data (hard-copy map), usually a quarter-quadrangle at a time, back to the interpreted aerial photograph. GIS quality checks are most effectively performed by the PI specialists. In addition, it is a common practice for producers of a digital database to perform an accuracy check or vegetation map field validation check following initial transfer, digitization, and quality checking. The map validation field check allows a visual review of PI work versus plant associations and land use types. Some observation points may be recorded to more adequately define confusing plant association signatures.

Assumptions:

- GIS automation and preparation of the final database will include a hybrid combination of scanning, on-screen digitizing, and image processing/segmentation techniques to delineate and automate interpreted data.
- GIS database building – geo-referencing, attributing, edge matching, and quality checking will occur at a rate approximately one-half that of the PI effort.
- Appropriate metadata files will be created as the GIS process proceeds.
- All GIS products will meet or exceed FGDC and USGS/NPS Map Accuracy Standards for 1:12,000-scale maps.

Table 8. Proposed Level of Effort for Digital Database and Vegetation Map Preparation

Task Topic	CTI	Costs	Discussion
Data automation, georeferencing	5 days	$2,400	Includes scanning Mylar overlays and georeferencing.
Attribution and edge matching	5 days	$2,400	--
Quality checking	5 days	$2,400	Provide hard-copy plot to PI technician for field verification.
Metadata	2 days	$960	This task could include training, metadata development, and metadata review.
Total (days)	**17 days**	**$8,160**	

Task Deliverables: A final vegetation digital GIS layer for BIHO will be created. This will include all necessary attributes. FGDC-standard metadata will be created for this layer.

TASK 8.0 Accuracy Assessment

Requirements for the NPS Vegetation Mapping Program specify an 80% accuracy for each vegetation class that is mapped (map unit) which infers an 80% accurate vegetation map. In terms of spatial accuracy, the data are expected to meet national map accuracy standards and typically this assumed by the use of standard basemap such as the NAIP orthophotography. The AA procedures employed should be able to determine whether the vegetation map meets these requirements. The following recommendations have been made for AA efforts (TNC, NCGIA, and ESRI 1994):

- The AA should be independent of the mapping process;
- The AA should be point based with an observational unit equivalent to or larger than the minimum mapping unit;
- The recommended number of AA samples per map class should reflect the abundance of each map class in the project area;
- Thematic accuracy should be expressed using contingency matrices adjusted for chance agreement with a Kappa index (Foody 1994);
- AA should ideally capture all components of uncertainty associated with vegetation mapping; and
- AA procedures should be tested operationally to determine if methodology would need to be refined.

Randomly pre-selected accuracy assessment (AA) point coordinates would be plotted on a coded base map by the GIS group/agency responsible for producing the vegetation map. This plot will be used in the field as a point distribution guide, and would be most useful with polygon lines (but not attributes) in place. An ecologist would navigate to the coordinates using a global positioning system (GPS) receiver, use the plant association classification key to determine the appropriate type, and record data for an area the size of the minimum mapping unit around the point, on a modified observation point form. Two representative photos of the site will be taken to document the vegetation. **Attachment E** presents a sample accuracy assessment data collection form that could be modified for UCBN use.

Sample sizes for the AA would be calculated from analysis of the electronic database prepared from the PI. Abundant vegetation types would be sampled at least 30 times, relatively abundant and relatively rare types at least 20 times, and rare types at least 5 times. Very rare types would require visits to all polygons (TNC, NCGIA, and ESRI 1994).

It is anticipated that 100 to 300 randomly located AA points will be used. Ten to 20 AA points can typically be recorded by an ecologist per field day (8 hours), considering the limitations of navigating to individual GPS coordinates present in BIHO. It is estimated that the accuracy assessment point collection would take approximately 10 researcher days (average of 20 AA points per day). Upon completion all of the data will be entered into the UCBN Plots database. These will reviewed by UCBN staff for quality and accuracy.

Following collection of AA points in the field, the points are overlain on the map and error matrix or contingency table is created. The error matrix reports both the user's and producer's error (i.e. errors of omission and commission) and represents the AA points label vs. the map label. Once completed the error matrix will be presented at a meeting or conference call to the UCBN and BIHO staff. Any deficiencies in the map will be addressed by either aggregating similar types to achieve the 80% standard or agreeing to live with the lower accuracy. Upon approval

of the accuracy statistics for each map class will be calculated and the map modified accordingly.

Assumptions:

- One contracted AA field team (two researchers) would be used.
- All GPS units for field navigation will be supplied by the contracted field crews.
- Approximately 10 days will be needed to collect the AA data.
- The AA contractor will be responsible for entering the data into the UCBN database.
- All field maps and target points will be supplied by the GIS contractor.
- All analyses will be performed by the GIS contractor and reported as appropriate error matrices.

Table 9. Proposed Level of Effort for Accuracy Assessment (in days).

AA Topic	CTI and NWM	Costs	Discussion
Select random AA points and create maps	2 days	$960	Selection would be conducted by the GIS staff.
Collect field data	10 days	$12,000	Includes 2 ecologists and travel.
Analyze field data	5 days	$4,320	Preparation would be performed by GIS staff.
Modifications to the map	2 days	$960	Any changes will be updated in the GIS layer by GIS staff.
Total (days)	**19 days**	**$18,240**	

Task Deliverables: Approximately 200 completed field forms, to be entered into the UCBN database will be collected at BIHO. An overlay exercise will produce a preliminary contingency table of map accuracy to be used in an AA meeting. The results of the AA meeting will be published as detailed meeting minutes. All AA methods and results will be included in the final report.

TASK 9.0 Final Report and Deliverables

Several elements are required for a comprehensive report including the National Vegetation Mapping Program summation and methodology; general site information that can affect or be affected by vegetation (e.g., climate, topography, geology, soils, hydrology, historic land use, etc.); current land uses (particularly important for the environs); BIHO and UCBN management goals, and the methods and results for field data that were collected and analyzed. A detailed discussion of results related to the classification and PI work is also necessary to improve understanding by and provide guidance to BIHO and UCBN managers and other database users. These are aided by illustrations of the park landscape and plant associations and by illustrated keys to aerial photography signatures. In addition, it is important for users to understand the assessment of accuracy and its implications when using the base vegetation map. The report will also contain a discussion on future recommendations, how to improve the products and possible add-on projects.

Along with the report other deliverables include a final paper map and layout to highlight the vegetation layer. All digital data will be contained on a CD-Rom or DVD including copies of the report and map layout. All graphics included in the report will also be included. Typically a draft of all the deliverables will be created and presented to BIHO and UCBN staff for review and input. CTI will be responsible for the final editing and formatting. All material supplied by other contractors and agencies will be edited by CTI and included in one final comprehensive report.

Assumptions:

- NWI or similar contract ecologists will provide the methodology and summation of the field research; CTI will provide the methodology for the interpretive effort; GIS methodology and digital database production; and Montana State Heritage will provide the classification documents.
- UCBN will provide the desired outline of site-specific report topics, if they differ from traditionally written reports and map layouts.
- CTI will be responsible for editing and producing the final report and other deliverables.

Table 10. Proposed Level of Effort for Report Production (in days)

Report Topic	CTI	Costs	Discussion
Draft Report	15 days	$7,200	Two days each assumed for UCBN and BIHO review.
Final Map	3 days	$1,440	Includes minor expenses for report production (CDs, copies, etc.)
Final Report	15 days	$7,200	
Total (days)	**38 days**	**$15,840**	Minor expenses for report production (CDs, copies, etc.)

Task Deliverables: A final report covering all methods, results and discussions used in the vegetation mapping at BIHO will be created. A final map highlighting the vegetation will be created. All documents will be provided to BIHO and UCBN as paper and electronic versions.

CITY OF ROCKS NATIONAL RESERVE (CIRO)

Anticipated Start Date: FY07 - Anticipated End Date: FY09

Introduction

City of Rocks is a 14,107 acre site located in south-central Idaho known for its granite outcrops and unique geologic formations. It is managed jointly by NPS and Idaho Department of Parks and Recreation. CIRO is situated in the northern Great Basin and is a crossroads for many habitats. As a result it has a high level of biological diversity concentrated in a relatively small area including examples of piñon-juniper woodlands, aspen-riparian communities, sagebrush steppe, mountain mahogany woodlands and high elevation meadows. Including a 2-km environs around CIRO would yield a project size of about 50,000 acres (a ¼-mile scenario around CIRO would yield a project size of about 40,000 acres).

TASK 1.0 Planning Sessions and Scoping Meetings

Preliminary planning and scoping for this project will be completed using one meeting to discuss the project design, imagery, photointerpretation/segmentation, plant distribution and ecology, and project review. Completion of the vegetation classification would involve planning and scoping with key agencies and organizations including the Idaho Conservation Data Center (ICDC), UCBN, CTI and NWM as appropriate and as necessary.

Assumptions:

- Sufficient planning and scoping will occur to establish project approach and milestones, complete field data collection to support a vegetation classification, photointerpretation/segmentation, and digital database production.
- Planning meetings with any contributing agencies would be informal and conducted between appropriate UCBN on-site staff.
- Existing vs. new aerial photography/imagery will be evaluated at the meeting and through discussion between NPS, UCBN, CIRO, and CTI staff.
- The sampling approach will be discussed and finalized at the scoping meeting

At the scoping meeting a buffer area, or environs, should be agreed upon as the project boundary for the vegetation classification and mapping project and confirmed. For the purposes of this work plan, acreage totals were calculated assuming a 2-km environs area (**Figure 4**). If the environs area changes as a result of planning meeting discussions, the estimated level of effort for some tasks in this plan my change.

Table 11. Proposed Level of Effort for Planning and Scoping at CIRO (in days).

Task Topic	CTI, NWM, Others	Costs	Discussion
Project planning meeting	6 days*	$2,880	A planning meeting would discuss all project needs, timelines, and assign responsibility for completion.
Totals	**9 days**	**$4,320**	--

* Several entities would be required to attend for a successful planning meeting.

Task Deliverables: A summary of the scoping meeting minutes and copies of the presentations will be created and posted on the UCBN vegetation mapping website.

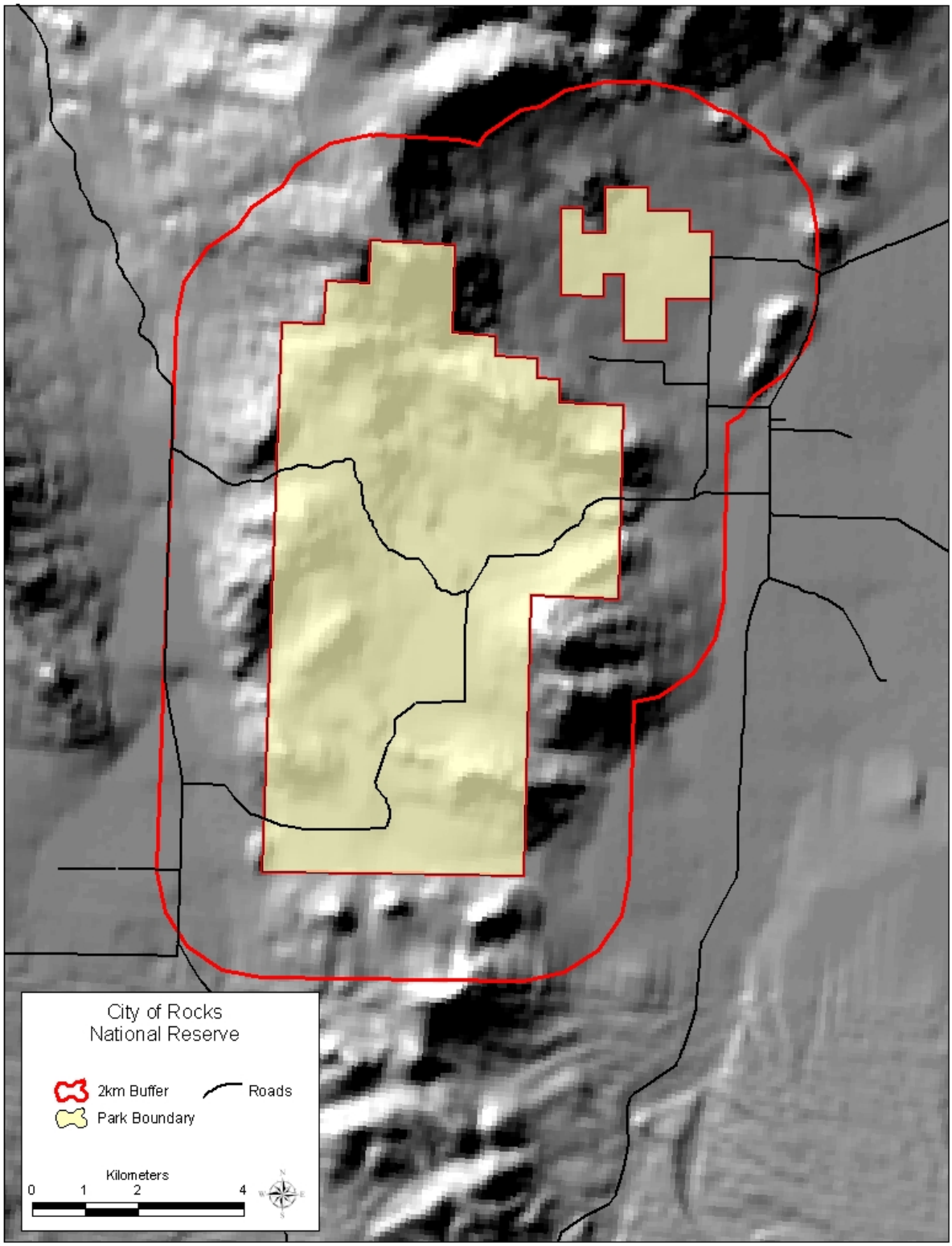


Figure 4. Approximate Project Boundary for CIRO Vegetation Mapping Project.
(Note: Figure does not show the ¼ mile buffer scenario)

TASK 2.0 Preliminary Plant Alliance/Association and Species Lists

A preliminary list of plant associations and alliances including the known ecological systems for CIRO has been solicited from the ICDC (**Attachment B**). This will include an estimate on the likeliness that the type occurs at CIRO. A review of this list will be conducted by CIRO and UCBN staff with additions added to the list and types removed that are known not to occur in the area.

Assumption:

- Sufficient vegetation data occurs for this area that a preliminary list of associations can be created.

Table 12. Estimated Costs for Preliminary Plant Associations and Alliance for CIRO

Task Topic	ICDC	Costs	Discussion
Preliminary List	-	$5,413	Currently obligated to ICDC as part of CRMO, HAFO, MIIN and CIRO agreement.
Totals	**-**	**$5,413**	--

Task Deliverables: A preliminary list of plant associations and alliance for CIRO prepared by the IDCD will be presented to UCBN prior to the scoping meeting

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TASK 3.0 Aerial Photography and Digital Ortho-photography Acquisition and Preparation

Available imagery includes the various products produced by the National Agricultural Imagery Program (NAIP). These typically include 1-m and 2-m products in both color infrared and true color formats. All available imagery sets will be evaluated prior to the start of work at CIRO and the latest high-quality set will be used as the basemap. Based on the resource management needs in other parks the NAIP imagery will be supplemented with any existing aerial photography, preferably color-infrared aerial photography at 1:12,000-scale

Assumptions:

- Existing aerial photography and NAIP imagery will be of sufficient quality to conduct all PI, attribution, and digital (GIS) database development.

Table 13. Estimated Costs for Imagery and Photography for CIRO

Task Topic	CTI/UCBN	Costs	Discussion
NAIP Imagery	-	-	The NAIP Imagery will be provided by UCBN
Existing Aerial Photography	-	-	It is anticipated that existing photography will be provide at little or no cost.
Totals	**-**	**-**	--

Task Deliverables: A mosaic of the NAIP imagery will be created.

TASK 4.0 Field Data Collection

Due to its size, CIRO falls into the large size park category (TNC 1994b) for vegetation mapping. This category calls for a gradsect approach (Austin and Heyligers, 1989), and the resulting map of biophysical units should be used to determine the pilot area(s) that will be sampled. In lieu of a formal gradsect it is anticipated that CTI will work with the CIRO staff and the existing land cover maps created recently by UCBN to create sampling units. These units will be visited by the field crews and supplemented by local knowledge of the vegetation by contract and NPS staff. Since there is a mixture of private land within the project area it is anticipated that all areas of within CIRO will be visited by field crews for sampling. This approach will be reviewed at the scoping meeting and modified if necessary

To date, very minimal legacy data exists for CIRO that would be useful for this project. Standard ancillary data such as soils, geology and hydrology for the area will be used to assist in sample site selection and the photointerpretation. If existing data is presented by CIRO or others at the kick-off meeting it will be evaluated using the program standards for usefulness (**Attachment D**) and incorporated into the project.

Vegetation within CIRO will be sampled using two approaches. These are observation point data and plot data. Observation points are used to guide aerial photointerpretation and vegetation plot data collection by identifying representative or unique signatures from the aerial photos or field maps concerning the distribution of plant associations within the park. Observation points are a more rapid form of data collection, these data are not collected from a standard plot, but rather describe an area, usually up to the program minimum mapping unit of 0.5 hectares. Vegetation plot data are more rigorous than observation points and include precise location, provisional association name, physical environment information, topographic data, physiognomic data, species lists, height classes, foliar cover values, diameter at breast height measurements for trees over 10 centimeters in diameter, and environmental notes and observations by researchers. Vegetation plots are necessary to prepare the classification and as such they are subjectively placed in vegetation types that are representative of an area, relatively homogenous, and larger than the 0.5 hectare (ha) minimum mapping unit (MMU). Ecotones are avoided to the extent possible.

Unique vegetation patches less than the project MMU may also be sampled using vegetation plots. These are often termed “park specials” because of their value for overall management prescriptions, but fall below the project MMU. Resource management staff will be given the chance at the scoping meeting to discuss these options. Some common park special types include:

- Small patches of invasive and exotic plants;
- Small wetlands;
- Rare or endangered plants;

Due to the high diversity this work plan assumes that approximately 60 associations occur at CIRO and its environs. This would indicate that approximately 200 plots and 50 observation points would need to be collected to fully document the diversity. It is anticipated that work will be conducted by experienced field crews supplied by NWM, e^2M, or similar contractor. Experienced field crews will allow for efficient sampling, minimal instruction and little oversight. New field observation points and plots will be collected using the standard observation point and plot form (either paper or digital) created by UCBN in conjunction with the national program

(**Attachment E**). During the planning meeting it will be determined if sampling is required/permitted within project environs, and at what level sampling would proceed.

A minimum of two ground photographs for each vegetation plot will be taken. Photos would be digital, logged in a summary table, and labeled. Fire fuel and related issues will be discussed at the scoping meeting. If it is deemed necessary for CIRO, additional data forms will be used to capture basic fuel loading information (**Attachment E**). If fire is not a concern only the first pages of the field form will be used. Vegetation plot data will be collected in accordance with the methods established during the planning meeting. **Table 4** identifies potential plot size based on the vegetation type being sampled.

The contractor collecting the data will be responsible for entering it into the UCBN database. This species entered into the database will follow ITIS as a standard. The UCBN database will be based on the TNC Plots database used in the USGS-NPS Vegetation Mapping Program. Upon entry the database will be checked for completeness and accuracy by UCBN staff.

Assumptions:

- Legacy data useful for this project are minimal at CIRO
- Approximately 80 vegetation plots (at a rate of 5/day) would be sampled to prepare an accurate classification.
- Approximately 30 observation would be recorded (at a rate of 12/day) to assist in PI efforts, and to check interpretation accuracy. These may be collected in the field by members of the vegetation sampling crew or individuals conducting aerial photointerpretation.
- Issues of access due to topography and/or private land-owners may reduce the number of plots in some plant communities.

Table 14. Proposed Level of Effort for Field Data Collection (in days).

Data Collection Topic	NWM or similar	Costs	Discussion
100 Observation Points	10 days	$ 7,600	--
260 Plots	50 days	$42,400	--
Total (days)	**60 days**	**$50,000**	--

Task Deliverables: 260 plots and 100 observation points representing the vegetation communities at CIRO will be delivered to UCBN. Data will be delivered in either paper or digital form.

TASK 5.0 Vegetation Classification, Alliance/Association Descriptions and Field Key

Following vegetation plot data collection and data entry ICDC staff will analyze the data and classify it into the National Vegetation Classification System (NVCS) (Grossman et al. 1998). The NVCS as developed by The Nature Conservancy and currently maintained by NatureServe represents a national system containing seven classification levels with the finest being the plant association.

Following entry into the Plots database, species foliar cover values for each plot will be exported into a spreadsheet format and arranged into a plot by species data matrix. Several of the species recorded in the Plots database, primarily trees and shrubs, may occupy more than one stratum within a particular plot. Such layers provide valuable information regarding the structural diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer should be subscripted with a strata code (e.g., T1, T2, S1, S2, S3). The matrix will be used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Following procedures described by Grossman et al. (1998) and McCune and Mefford (1999), the data matrix would be analyzed as necessary using TWINSPAN, Cluster Analysis (relative Euclidian distance measure with Ward's method of group linkage), and DECORANA (an ordination technique). The matrix can be edited prior to analysis by first removing all species that had total cover values (summed over all plots) of less than or equal to 1 percent to keep the influence of minor species at a minimum. Raw foliar cover scores should be used in all data analysis procedures. The data matrix will then be subjectively evaluated for plots that demonstrated exceptionally low similarity to the remaining plots (outliers). Outlier plots are common in relatively large data sets and occur because of disturbed, heterogeneous, or otherwise unusual sites, or because of gaps in sampling (Gauch 1982). Removing outliers would likely increase the efficiency of the analysis and substantially improve the interpretability of the results.

Draft vegetation classification efforts would be reviewed by ICDC, CIRO staff and UCBN in terms of regional data and existing classification. NPS ecologists would discuss and incorporate suggested revisions, as necessary. After the data has been classified local and global descriptions for each association will be created. Local descriptions of vegetation associations or alliance if associations can't be determined (as they occur throughout CIRO) will be drafted by ICDC ecologists with input from the field crews. Local descriptions will focus on the park-wide variation including the unique characteristics of the association. Generally, three to four local descriptions can be written in one day depending on the complexity of the vegetation type. The global descriptions for the associations will be modified and up-dated using these local descriptions.

After the data has been classified an illustrated field key will be created that will have dichotomous breaks. This key will walk an average person familiar with the vegetation at CIRO through the associations/alliances in a stepwise fashion. During construction members of the field data collection team should be used to help provide information for the key and to test it once completed. For consistency, this key will be used by the ecologists collecting accuracy assessment points to record the correct field classification. This task would require preparation of a plant association field key, annotation of each couplet in the key with diagnostic field descriptions, and illustration of the key with color slides or digital photos taken in the field at

vegetation plot sites. This key will also be invaluable for future researchers, interpretive specialists, and visitors interested in vegetation distribution.

Assumptions:

- Vegetation plots will likely number around 100 for the CIRO project.
- It is assumed that approximately 30 plant associations will be determined for CIRO.
- An ecologist familiar with CIRO vegetation will prepare the illustrated plant association field key.

Table 15. Proposed Level of Effort for Classification and Descriptions (in days)

Task Topic	ICDC	Costs	Discussion
Final classification	10 days	$2,400	Statistical analyses performed by ICDC with NatureServe.
Local Descriptions	20 days	$4,800	Local Descriptions for the associations/alliances at CIRO
Global Descriptions	10 days	$2,400	NatureServe review of the descriptions and incorporation into the NVCS
Field Key Prep.	4 days	$1353.25	Obligated (**Attachment B**)
Total (days)	**44 days**	**$10,953.25**	--

Task Deliverables: A preliminary list of associations and alliances will be delivered to UCBN prior to the scoping meeting. A comprehensive, classified list of plant association/alliances will be created in the NVC using the plot and observation data. Local descriptions for all associations/alliances will by used to update the global descriptions. An illustrated field key will be created for the vegetation associations/alliance at CIRO prior to the start of accuracy assessment data collection.

TASK 6.0 Aerial Photointerpretation and Segmentation

Delineation and mapping of the vegetation at CIRO will include a combination of automated image segmentation using eCognition or similar software and traditional photointerpretation (PI). Segmentation will be used to delineate easily observed features and features with high contrast such as open water, roads, and bare rock using the existing NAIP imagery. Once completed this initial map will be further refined though PI using the new photos acquired in 2007. PI will use the standard photo signature characteristics (tone, texture, color, shape, etc…) and ancillary data (slope, elevation, aspect, etc…) to further delineate the final detail of the map classes. Map classes will strive to maintain a 1:1 ratio of map class to plant association. The final mapping scheme will be determined by at a meeting or conference call between the NPS and contract staff. Typically the map classes in these project cover three basic considerations, 1) incorporating the NVC associations/alliances, 2) recognizing the limitations of the imagery (i.e. can you reliably see the plant association on the photo), and 3) covering the management needs of CIRO. The final mapping product will also include all necessary attribution consisting of the vegetation map classes, general height and density modifiers and links to the NVC. It is anticipated that approximately 30 plant associations/alliances and up to 20 land use/bare ground/geology types will be considered as potential map classes. One reconnaissance field trip to ground-truth and obtain photo-signature information by the photo interpreters will be conducted annually during the project.

Photointerpretation is most effectively accomplished when an initial classification has been performed, limiting the amount of cross-walk necessary between interpreted map units and the final classification (developed with the input of NatureServe). The individual responsible for PI should also provide input into the GIS process and review the final GIS layer for quality and consistency. An accurate, descriptive photointerpretive key will be created to allow all future researchers to understand the interpretive cues used to delineate polygons, which may help to refine the process for future efforts. Typically photo interpretation for these efforts proceeds at about 1000/acres per day.

Assumptions:

- PI work will be conducted at 1000 acres/day. These rates may require adjustment during the process, as photointerpretation proceeds.
- Level of effort will be calculated based an approximate 50,000 acre project area.
- The PI investigator will assist the GIS technician to produce a photointerpretive key.

Table 16. Proposed Level of Effort for PI (in days)

PI Topic	CTI	Costs	Discussion
Photointerpretation	50 days	$24,000	--
Quality Check of GIS	10 days	$4,800	Check draft vegetation plots back to interpreted photography.
Photointerpretation key	5 days	$2,400	Provide representative signatures to the GIS technicians to document PI work for future database users.
Field Recon	5 days	$6,000	Includes time and travel costs for trip.
Total (days)	**70 days**	**$37,200**	--

Task Deliverables: A preliminary vegetation map to the formation level will be created using segmentation techniques. Final detail will be created on aerial photo overlays.

TASK 7.0 Digital Database and Vegetation Map Preparation

Once all of the image processing and PI is completed the final digital database and vegetation map will be created and populated. This will include creating a spatial GIS layer using ArcGIS software. One seamless GIS layer will be created for CIRO by transferring the PI and segmentation information onto the NAIP imagery. Steps required for this task include: digitizing the linework, rectifying it to the basemap, edge-matching, performing a thorough cleaning and weeding process and finally attributing all of the polygons with the necessary vegetation information.

Quality control cannot be overstated in the automation of interpreted vegetation data. One of the more useful practices is to review draft digital data (hard-copy map), usually a quarter-quadrangle at a time, back to the interpreted aerial photograph. GIS quality checks are most effectively performed by the PI specialists. In addition, it is a common practice for producers of a digital database to perform an accuracy check or vegetation map field validation check following initial transfer, digitization, and quality checking. The map validation field check allows a visual review of PI work versus plant associations and land use types. Some observation points may be recorded to more adequately define confusing plant association signatures.

Assumptions:

- GIS automation and preparation of the final database will include a hybrid combination of scanning, on-screen digitizing, and image processing/segmentation techniques to delineate and automate interpreted data.
- GIS database building – geo-referencing, attributing, edge matching, and quality checking will occur at a rate approximately one-half that of the PI effort.
- Appropriate metadata files will be created as the GIS process proceeds.
- All GIS products will meet or exceed FGDC and USGS/NPS Map Accuracy Standards for 1:12,000-scale maps.

Table 17. Proposed Level of Effort for Digital Database and Vegetation Map Preparation

Task Topic	CTI	Costs	Discussion
Data automation, georeferencing	30 days	$14,400	Includes scanning Mylar overlays and georeferencing.
Attribution and edge matching	15 days	$7,200	--
Quality checking	10 days	$4,800	Provide hard-copy plot to PI technician for field verification.
Metadata	2 days	$960	This task could include training, metadata development, and metadata review.
Total (days)	**57 days**	**$27,360**	

Task Deliverables: A final vegetation digital GIS layer for CIRO will be created. This will include all necessary attributes. FGDC-standard metadata will be created for this layer.

TASK 8.0 Accuracy Assessment

Requirements for the NPS Vegetation Mapping Program specify an 80% accuracy for each vegetation class that is mapped (map unit) which infers an 80% accurate vegetation map. In terms of spatial accuracy, the data are expected to meet national map accuracy standards and typically this assumed by the use of standard basemap such as the NAIP orthophotography. The AA procedures employed should be able to determine whether the vegetation map meets these requirements. The following recommendations have been made for AA efforts (TNC, NCGIA, and ESRI 1994):

- The AA should be independent of the mapping process;
- The AA should be point based with an observational unit equivalent to or larger than the minimum mapping unit;
- The recommended number of AA samples per map class should reflect the abundance of each map class in the project area;
- Thematic accuracy should be expressed using contingency matrices adjusted for chance agreement with a Kappa index (Foody 1994);
- AA should ideally capture all components of uncertainty associated with vegetation mapping; and
- AA procedures should be tested operationally to determine if methodology would need to be refined.

Randomly pre-selected accuracy assessment (AA) point coordinates would be plotted on a coded base map by the GIS group/agency responsible for producing the vegetation map. This plot will be used in the field as a point distribution guide, and would be most useful with polygon lines (but not attributes) in place. An ecologist would navigate to the coordinates using a global positioning system (GPS) receiver, use the plant association classification key to determine the appropriate type, and record data for an area the size of the minimum mapping unit around the point, on a modified observation point form. Two representative photos of the site will be taken to document the vegetation. **Attachment E** presents a sample accuracy assessment data collection form that could be modified for UCBN use.

Sample sizes for the AA would be calculated from analysis of the electronic database prepared from the PI. Abundant vegetation types would be sampled at least 30 times, relatively abundant and relatively rare types at least 20 times, and rare types at least 5 times. Very rare types would require visits to all polygons (TNC, NCGIA, and ESRI 1994).

It is anticipated that 500 - 800 randomly located AA points will be used. Ten to 20 AA points can typically be recorded by an ecologist per field day (8 hours), considering the limitations of navigating to individual GPS coordinates present in CIRO. It is estimated that the accuracy assessment point collection would take approximately 10 researcher days (average of 20 AA points per day). Upon completion all of the data will be entered into the UCBN Plots database. These will reviewed by UCBN staff for quality and accuracy.

Following collection of AA points in the field, the points are overlain on the map and error matrix or contingency table is created. The error matrix reports both the user's and producer's error (i.e. errors of omission and commission) and represents the AA points label vs. the map label. Once completed the error matrix will be presented at a meeting or conference call to the UCBN and CIRO staff. Any deficiencies in the map will be addressed by either aggregating similar types to achieve the 80% standard or agreeing to live with the lower accuracy. Upon approval

of the accuracy statistics for each map class will be calculated and the map modified accordingly.

Assumptions:

- Two contracted AA field team (two researchers each) would be used.
- All GPS units for field navigation will be supplied by the contracted field crews.
- Approximately 15 days will be needed to collect the AA data.
- The AA contractor will be responsible for entering the data into the UCBN database.
- All field maps and target points will be supplied by the GIS contractor.
- All analyses will be performed by the GIS contractor and reported as appropriate error matrices.

Table 18. Proposed Level of Effort for Accuracy Assessment (in days).

AA Topic	CTI and NWM	Costs	Discussion
Select random AA points and create maps	3 days	$1,440	Selection would be conducted by the GIS staff.
Collect field data	15 days	$30,000	Includes 4 ecologists for 20 days each and travel.
Analyze field data	7 days	$3,360	Preparation would be performed by GIS staff.
Modifications to the map	3 days	$1,440	Any changes will be updated in the GIS layer by GIS staff.
Total (days)	**28 days**	**$36,240**	

Task Deliverables: Approximately 500 completed field forms, to be entered into the UCBN database will be collected at CIRO. An overlay exercise will produce a preliminary contingency table of map accuracy to be used in an AA meeting. The results of the AA meeting will be published as detailed meeting minutes. All AA methods and results will be included in the final report.

TASK 9.0 Final Report and Deliverables

Several elements are required for a comprehensive report including the National Vegetation Mapping Program summation and methodology; general site information that can affect or be affected by vegetation (e.g., climate, topography, geology, soils, hydrology, historic land use, etc.); current land uses (particularly important for the environs); CIRO and UCBN management goals, and the methods and results for field data that were collected and analyzed. A detailed discussion of results related to the classification and PI work is also necessary to improve understanding by and provide guidance to CIRO and UCBN managers and other database users. These are aided by illustrations of the park landscape and plant associations and by illustrated keys to aerial photography signatures. In addition, it is important for users to understand the assessment of accuracy and its implications when using the base vegetation map. The report will also contain a discussion on future recommendations, how to improve the products and possible add-on projects.

Along with the report other deliverables include a final paper map and layout to highlight the vegetation layer. All digital data will be contained on a CD-Rom or DVD including copies of the report and map layout. All graphics included in the report will also be included. Typically a draft

of all the deliverables will be created and presented to CIRO and UCBN staff for review and input. CTI will be responsible for the final editing and formatting. All material supplied by other contractors and agencies will be edited by CTI and included in one final comprehensive report.

Assumptions:

- NWI or similar contract ecologists will provide the methodology and summation of the field research; CTI will provide the methodology for the interpretive effort; GIS methodology and digital database production; and ICDC will provide the classification documents.
- UCBN will provide the desired outline of site-specific report topics, if they differ from traditionally written reports and map layouts.
- CTI will be responsible for editing and producing the final report and other deliverables.

Table 19. Proposed Level of Effort for Report Production (in days)

Report Topic	CTI	Costs	Discussion
Draft Report	15 days	$7,200	Two days each assumed for UCBN and CIRO review.
Final Map	3 days	$1,440	Includes minor expenses for report production (CDs, copies, etc.)
Final Report	15 days	$7,200	
Total (days)	**38 days**	**$15,840**	Minor expenses for report production (CDs, copies, etc.)

Task Deliverables: A final report covering all methods, results and discussions used in the vegetation mapping at CIRO will be created. A final map highlighting the vegetation will be created. All documents will be provided to CIRO and UCBN as paper and electronic versions.

CRATERS OF THE MOON NATIONAL MONUMENT AND PRESERVE (CRMO)

Start Date: FY06 - Anticipated End Date: FY08

Introduction

Craters of the Moon NM is located on the Snake River Plain spanning southern Idaho and encompasses the Great Rift volcanic rift zone. Although much of CRMO is covered by barren lava flows, it supports a surprising diversity of plant communities. Vegetation occurs here in different successional stages on lava flows, in cinder areas, on kipukas (islands of vegetation surrounded by lava), and in mountain and riparian areas. Cinder cones support three different plant communities: spring wildflower, shrub, and limber pine. Dominant kipuka vegetation includes three-tip sagebrush, big sagebrush, bluebunch wheatgrass, and needlegrass. The northern end of CRMO is characterized by mountain and riparian areas that containing douglas-fir/mountain snowberry, upland quaking aspen, and riparian. CRMO is enormous covering approximately 750,000 acres and with a 2-km environs the total project is about 930,000 acres.

TASK 1.0 Planning Sessions and Scoping Meetings

Preliminary planning and scoping for this project was completed at the 2006 CRMO scoping meeting. Summary notes from this meeting can be found in **Attachment E**. In general it was discussed that the environs should extend 2-km around the current park boundary (**Figure 5**).

Table 20. Level of Effort for Planning and Scoping at CRMO (in days).

Task Topic	CTI, NWM, Others	Costs	Discussion
Project planning meeting	-	$8,400	A planning meeting was held to discuss project needs, timelines, and assign responsibility for completion.
Totals	**-**	**$8,400**	--

* Several entities would be required to attend for a successful planning meeting.

Task Deliverables: A summary of the scoping meeting minutes and copies of the presentations were created and posted on the UCBN vegetation mapping website.

TASK 2.0 Preliminary Plant Alliance/Association and Species Lists

A preliminary list of plant associations and alliances including the known ecological systems for CRMO was solicited and complied by the ICDC (**Attachment F**). This includes an estimate on the likeliness that the type occurs at CRMO. A review of this list was conducted by CRMO and UCBN with additions added to the list and types not occurring in the park removed.

Table 21. Estimated Costs for Preliminary Plant Associations and Alliance for CRMO

Task Topic	ICDC	Costs	Discussion
Preliminary List	-	$5,000	Completed by ICDC
Totals	**-**	**$5,000**	--

Task Deliverables: A preliminary list of plant associations and alliance for CMRO is located in **Attachment F**.

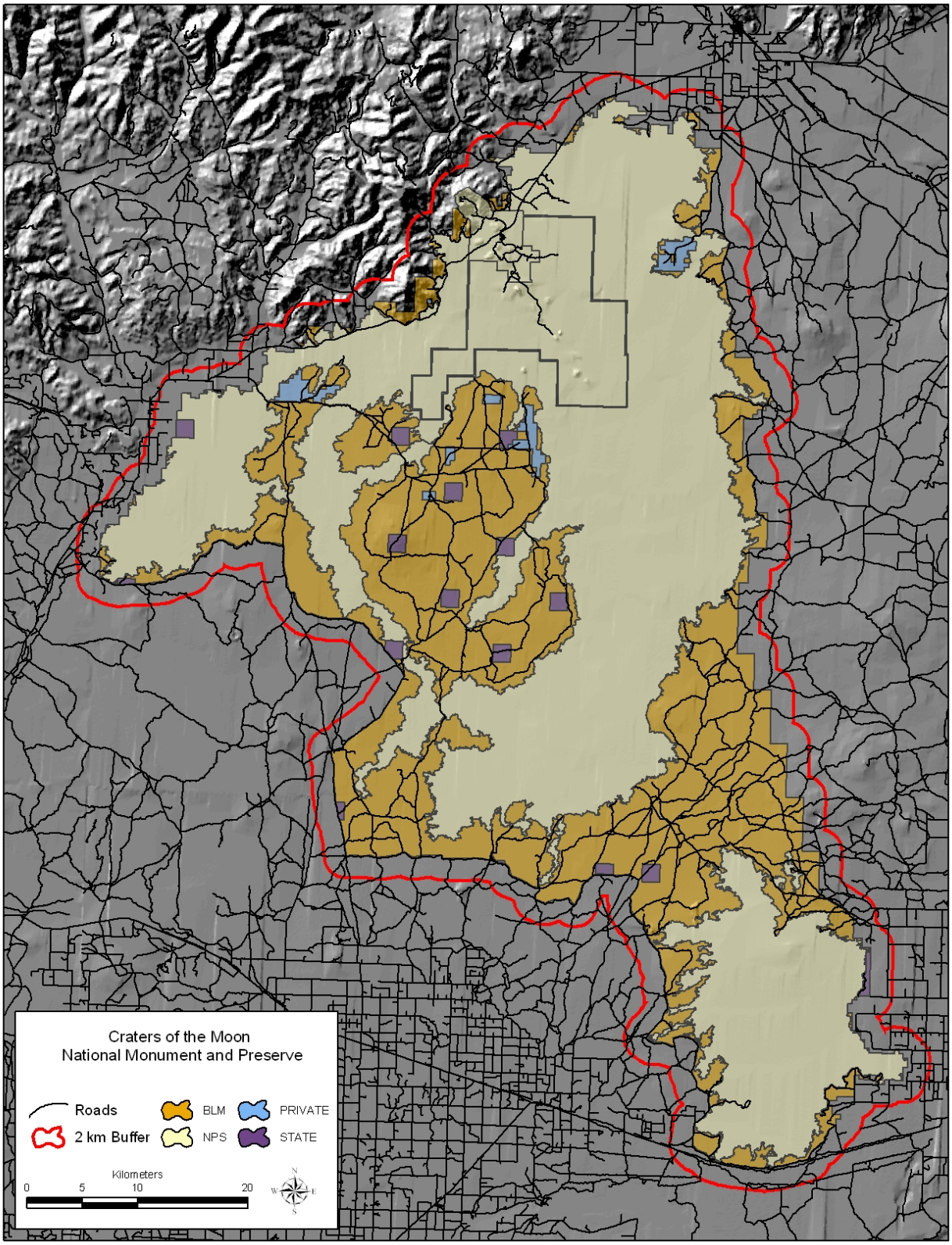


Figure 5. Approximate Project Boundary for CRMO Vegetation Mapping Project.
(Note: Figure does not show the ¼ mile buffer scenario)

TASK 3.0 Aerial Photography and Digital Ortho-photography Acquisition and Preparation

Available imagery includes the various products produced by the National Agricultural Imagery Program (NAIP). These typically include 1-m and 2-m products in both color infrared and true color formats. All available imagery sets will be evaluated prior to the start of work at CRMO and the latest high-quality set will be used as the basemap. Based on the resource management needs in other parks it is anticipated that the NAIP imagery will have to be supplemented with new color-infrared aerial photography. The new photography will insure that the vegetation is captured at peak growth and that any species of interest such as cheatgrass will be documented and delineated. If funded, the new aerial photography would be acquired by a competent contractor using UCBN specifications and acquired in the summer of 2007. The products from this effort would likely include 1:12,000-scale prints with sufficient overlap and sidelap to allow for stereoscopic photointerpretation.

Color infrared aerial photography will likely be used to help highlight subtle changes in the vegetation. Also flying near the summer solstice and around the noon hour will also help to eliminate shadows. Additionally, digital orthophotos may be prepared from the photography through scanning and rectification if needed for more accurate transfer of photointerpreted data or if the NAIP imagery is unusable. Currently the BOR has a contract with Horizon's Inc. to provide aerial photography and imagery. This funding mechanism will likely be used due to their success at other parks and the ability to have BOR photogrammatrists create the specifications and review the products.

Assumptions:

- Newly acquired aerial photography will be of sufficient quality to conduct all PI, attribution, and digital (GIS) database development.

Table 22. Estimated Costs for New Aerial Photography for CRMO

Task Topic	BOR	Costs	Discussion
Flight Specifications	1 day*	$800	Time needed to create the specifications for the aerial photography contract.
Aerial Photography		$142,154	This estimate is based on solicited bids from Horizons, Inc. Rapid City, SD in 2005.
Review of Aerial Photography	5 days	$4000	This includes time spent by a trained photogrammatrist to review and accept the delivered photography
Totals	**6 days**	**$146,954**	--

Task Deliverables: A complete set of 1:12,000-scale color infrared aerial photos for CRMO, reviewed and accepted by a certified photogrammatrist.

TASK 4.0 Field Data Collection

Due to its size, CRMO falls into the very large size park category (TNC 1994b) for vegetation mapping. In lieu of a formal gradsect CTI will worked with the UCBN, NWM and CRMO staff to provide existing land cover and vegetation maps already created to create sampling units. These units were visited by the field crews in 2006. A total of plots were sampled throughout the park. The distribution and completeness of this sampling effort is currently being reviewed by CTI and UCBN. If apparent short-coming are found supplemental plot collection efforts will be undertaken in 2007. To date, very minimal legacy data exists for CRMO that would be useful for this project. Standard ancillary data such as soils, geology and hydrology for the area will be used to assist in sample site selection and the photointerpretation.

Vegetation within CRMO was sampled using two approaches. These were observation point data and plot data. Observation points were used to guide aerial photointerpretation and vegetation plot data collection by identifying representative or unique signatures from the aerial photos or field maps concerning the distribution of plant associations within the park. A total of observation points were taken. Vegetation plot data were more rigorous in design than observation points and included precise location, provisional association name, physical environment information, topographic data, physiognomic data, species lists, height classes, foliar cover values, diameter at breast height measurements for trees over 10 centimeters in diameter, and environmental notes and observations by researchers. Vegetation plots are necessary to prepare the classification and as such they are subjectively placed in vegetation types that are representative of an area, relatively homogenous, and larger than the 0.5 hectare (ha) minimum mapping unit (MMU). Ecotones were avoided to the extent possible. A total of plots were taken at CRMO in 2006.

A minimum of two ground photographs for each vegetation plot were taken at each plot. Photos are digital, logged in a summary table, and labeled. Minimal fire fuel and related data were also recorded. Vegetation plot data was collected in accordance with the methods established during the planning meeting. **Table 4** identifies the plot sizes based on the vegetation types sampled.

NWM collected the data and is currently entering it into the UCBN database. This species entered into the database will follow ITIS as a standard. The UCBN database is based on the TNC Plots database used in the USGS-NPS Vegetation Mapping Program. Upon receipt from NWM the database will be checked for completeness and accuracy by UCBN staff.

Assumptions:

- Legacy data useful for this project are minimal at CRMO
- NWM collected vegetation plots (at a rate of 5/day) in 2006.
- NWM also collected observation points at a rate of 12/day to assist in PI efforts, and to check interpretation accuracy. These were collected in the field by members of the vegetation sampling crew.
- Issues of access due to topography and/or private land-owners may reduce the number of plots in some plant communities.

Table 23. Proposed Level of Effort for Field Data Collection (in days).

Data Collection Topic	NWM or similar	Costs	Discussion
Plot and Observation Points	45 days	90,150	Work was contracted to NWM in 2006
Total (days)	**45 days**	**$90,150**	--

Task Deliverables: All plots and observation points representing the vegetation communities at CRMO will be delivered to UCBN. Data will be delivered in either paper or digital form.

TASK 5.0 Vegetation Classification, Alliance/Association Descriptions and Field Key

Following vegetation plot data collection and data entry ICDC staff will analyze the data and classify it into the National Vegetation Classification System (NVCS) (Grossman et al. 1998). The NVCS as developed by The Nature Conservancy and currently maintained by NatureServe represents a national system containing seven classification levels with the finest being the plant association.

Following entry into the Plots database, species foliar cover values for each plot will be exported into a spreadsheet format and arranged into a plot by species data matrix. Several of the species recorded in the Plots database, primarily trees and shrubs, may occupy more than one stratum within a particular plot. Such layers provide valuable information regarding the structural diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer should be subscripted with a strata code (e.g., T1, T2, S1, S2, S3). The matrix will be used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Following procedures described by Grossman et al. (1998) and McCune and Mefford (1999), the data matrix would be analyzed as necessary using TWINSPAN, Cluster Analysis (relative Euclidian distance measure with Ward's method of group linkage), and DECORANA (an ordination technique). The matrix can be edited prior to analysis by first removing all species that had total cover values (summed over all plots) of less than or equal to 1 percent to keep the influence of minor species at a minimum. Raw foliar cover scores should be used in all data analysis procedures. The data matrix will then be subjectively evaluated for plots that demonstrated exceptionally low similarity to the remaining plots (outliers). Outlier plots are common in relatively large data sets and occur because of disturbed, heterogeneous, or otherwise unusual sites, or because of gaps in sampling (Gauch 1982). Removing outliers would likely increase the efficiency of the analysis and substantially improve the interpretability of the results.

Draft vegetation classification efforts would be reviewed by ICDC, CRMO staff and UCBN in terms of regional data and existing classification. NPS ecologists would discuss and incorporate suggested revisions, as necessary. After the data has been classified local and global descriptions for each association will be created. Local descriptions of vegetation associations or alliance if associations can't be determined (as they occur throughout CRMO) will be drafted by ICDC ecologists with input from the field crews. Local descriptions will focus on the park-wide variation including the unique characteristics of the association. Generally, three to four

local descriptions can be written in one day depending on the complexity of the vegetation type. The global descriptions for the associations will be modified and up-dated using these local descriptions.

After the data has been classified an illustrated field key will be created that will have dichotomous breaks. This key will walk an average person familiar with the vegetation at CRMO through the associations/alliances in a stepwise fashion. During construction members of the field data collection team should be used to help provide information for the key and to test it once completed. For consistency, this key will be used by the ecologists collecting accuracy assessment points to record the correct field classification. This task would require preparation of a plant association field key, annotation of each couplet in the key with diagnostic field descriptions, and illustration of the key with color slides or digital photos taken in the field at vegetation plot sites. This key will also be invaluable for future researchers, interpretive specialists, and visitors interested in vegetation distribution.

Assumptions:

- It is assumed that approximately 45 plant associations will be determined for CRMO.
- An ecologist familiar with CRMO vegetation will prepare the illustrated plant association field key.

Table 24. Proposed Level of Effort for Classification and Descriptions (in days)

Task Topic	ICDC	Costs	Discussion
Final classification	-	-	Statistical analyses performed by ICDC with NatureServe.
Local Descriptions	5 days	$2,400	Local Descriptions for the associations/alliances at CRMO
Global Descriptions	5 days	$2,400	NatureServe review of the descriptions and incorporation into the NVCS
Field Key Prep.	1 day	$613	Obligated (**Attachment B**)
Total (days)	**16 days**	**$5,413**	--

Task Deliverables: A preliminary list of associations and alliances will be delivered to UCBN prior to the scoping meeting. A comprehensive, classified list of plant association/alliances will be created in the NVC using the plot and observation data. Local descriptions for all associations/alliances will by used to update the global descriptions. An illustrated field key will be created for the vegetation associations/alliance at CRMO prior to the start of accuracy assessment data collection.

TASK 6.0 Aerial Photointerpretation and Segmentation

Delineation and mapping of the vegetation at CRMO will include a combination of automated image segmentation using eCognition or similar software and traditional photointerpretation (PI). Segmentation will be used to delineate easily observed features and features with high contrast such as open water, roads, and bare rock using the existing NAIP imagery. Once completed this initial map will be further refined though PI using the new photos acquired in 2007. PI will use the standard photo signature characteristics (tone, texture, color, shape, etc…) and ancillary data (slope, elevation, aspect, etc…) to further delineate the final detail of the map classes. Map classes will strive to maintain a 1:1 ratio of map class to plant association. The final mapping scheme will be determined by at a meeting or conference call between the NPS and contract staff. Typically the map classes in these project cover three basic considerations, 1) incorporating the NVC associations/alliances, 2) recognizing the limitations of the imagery (i.e. can you reliably see the plant association on the photo), and 3) covering the management needs of CRMO. The final mapping product will also include all necessary attribution consisting of the vegetation map classes, general height and density modifiers and links to the NVC. It is anticipated that approximately 45 plant associations/alliances and up to 20 land use/bare ground/geology types will be considered as potential map classes. One reconnaissance field trip to ground-truth and obtain photo-signature information by the photo interpreters will be conducted annually during the project.

Photointerpretation is most effectively accomplished when an initial classification has been performed, limiting the amount of cross-walk necessary between interpreted map units and the final classification (developed with the input of NatureServe). The individual responsible for PI should also provide input into the GIS process and review the final GIS layer for quality and consistency. An accurate, descriptive photointerpretive key will be created to allow all future researchers to understand the interpretive cues used to delineate polygons, which may help to refine the process for future efforts. Typically photo interpretation for these efforts proceeds at about 1000/acres per day.

Assumptions:

- PI work will be conducted at 1500 acres/day. These rates may require adjustment during the process, as photointerpretation proceeds.
- Level of effort will be calculated based an approximate 50,000 acre project area.
- The PI investigator will assist the GIS technician to produce a photointerpretive key.

Table 25. Proposed Level of Effort for PI (in days)

PI Topic	CTI	Costs	Discussion
Photointerpretation	600 days	$288,000	--
Quality Check of GIS	10 days	$4,800	Check draft vegetation plots back to interpreted photography.
Photointerpretation key	5 days	$2,400	Provide representative signatures to the GIS technicians to document PI work for future database users.
Field Recon	10 days	$10,000	Includes time and travel costs for trip.
Total (days)	**625 days**	**$305,200**	--

Task Deliverables: A preliminary vegetation map to the formation level will be created using segmentation techniques. Final detail will be created on aerial photo overlays.

TASK 7.0 Digital Database and Vegetation Map Preparation

Once all of the image processing and PI is completed the final digital database and vegetation map will be created and populated. This will include creating a spatial GIS layer using ArcGIS software. One seamless GIS layer will be created for CRMO by transferring the PI and segmentation information onto the NAIP imagery. Steps required for this task include: digitizing the linework, rectifying it to the basemap, edge-matching, performing a thorough cleaning and weeding process and finally attributing all of the polygons with the necessary vegetation information.

Quality control cannot be overstated in the automation of interpreted vegetation data. One of the more useful practices is to review draft digital data (hard-copy map), usually a quarter-quadrangle at a time, back to the interpreted aerial photograph. GIS quality checks are most effectively performed by the PI specialists. In addition, it is a common practice for producers of a digital database to perform an accuracy check or vegetation map field validation check following initial transfer, digitization, and quality checking. The map validation field check allows a visual review of PI work versus plant associations and land use types. Some observation points may be recorded to more adequately define confusing plant association signatures.

Assumptions:

- GIS automation and preparation of the final database will include a hybrid combination of scanning, on-screen digitizing, and image processing/segmentation techniques to delineate and automate interpreted data.
- GIS database building – geo-referencing, attributing, edge matching, and quality checking will occur at a rate approximately one-half that of the PI effort.
- Appropriate metadata files will be created as the GIS process proceeds.
- All GIS products will meet or exceed FGDC and USGS/NPS Map Accuracy Standards for 1:12,000-scale maps.

Table 26. Proposed Level of Effort for Digital Database and Vegetation Map Preparation

Task Topic	CTI	Costs	Discussion
Data automation, georeferencing	167 days	$80,123	Includes scanning Mylar overlays and georeferencing.
Attribution and edge matching	25 days	$12,000	--
Quality checking	20 days	$9,600	Provide hard-copy plot to PI technician for field verification.
Metadata	2 days	$960	This task could include training, metadata development, and metadata review.
Total (days)	**197 days**	**$102,683**	

Task Deliverables: A final vegetation digital GIS layer for CRMO will be created. This will include all necessary attributes. FGDC-standard metadata will be created for this layer.

TASK 8.0 Accuracy Assessment

Requirements for the NPS Vegetation Mapping Program specify an 80% accuracy for each vegetation class that is mapped (map unit) which infers an 80% accurate vegetation map. In terms of spatial accuracy, the data are expected to meet national map accuracy standards and typically this assumed by the use of standard basemap such as the NAIP orthophotography. The AA procedures employed should be able to determine whether the vegetation map meets these requirements. The following recommendations have been made for AA efforts (TNC, NCGIA, and ESRI 1994):

- The AA should be independent of the mapping process;
- The AA should be point based with an observational unit equivalent to or larger than the minimum mapping unit;
- The recommended number of AA samples per map class should reflect the abundance of each map class in the project area;
- Thematic accuracy should be expressed using contingency matrices adjusted for chance agreement with a Kappa index (Foody 1994);
- AA should ideally capture all components of uncertainty associated with vegetation mapping; and
- AA procedures should be tested operationally to determine if methodology would need to be refined.

Randomly pre-selected accuracy assessment (AA) point coordinates would be plotted on a coded base map by the GIS group/agency responsible for producing the vegetation map. This plot will be used in the field as a point distribution guide, and would be most useful with polygon lines (but not attributes) in place. An ecologist would navigate to the coordinates using a global positioning system (GPS) receiver, use the plant association classification key to determine the appropriate type, and record data for an area the size of the minimum mapping unit around the point, on a modified observation point form. Two representative photos of the site will be taken to document the vegetation. **Attachment E** presents a sample accuracy assessment data collection form that could be modified for UCBN use.

Sample sizes for the AA would be calculated from analysis of the electronic database prepared from the PI. Abundant vegetation types would be sampled at least 30 times, relatively abundant and relatively rare types at least 20 times, and rare types at least 5 times. Very rare types would require visits to all polygons (TNC, NCGIA, and ESRI 1994).

It is anticipated that 1000 - 1500 randomly located AA points will be used. Ten to 20 AA points can typically be recorded by an ecologist per field day (8 hours), considering the limitations of navigating to individual GPS coordinates present in CRMO. It is estimated that the accuracy assessment point collection would take approximately 10 researcher days (average of 20 AA points per day). Upon completion all of the data will be entered into the UCBN Plots database. These will reviewed by UCBN staff for quality and accuracy.

Following collection of AA points in the field, the points are overlain on the map and error matrix or contingency table is created. The error matrix reports both the user's and producer's error (i.e. errors of omission and commission) and represents the AA points label vs. the map label. Once completed the error matrix will be presented at a meeting or conference call to the UCBN and CRMO staff. Any deficiencies in the map will be addressed by either aggregating similar types to achieve the 80% standard or agreeing to live with the lower accuracy. Upon approval

of the accuracy statistics for each map class will be calculated and the map modified accordingly.

Assumptions:

- Two contracted AA field team (two researchers each) would be used.
- All GPS units for field navigation will be supplied by the contracted field crews.
- Approximately 40 days will be needed to collect the AA data.
- The AA contractor will be responsible for entering the data into the UCBN database.
- All field maps and target points will be supplied by the GIS contractor.
- All analyses will be performed by the GIS contractor and reported as appropriate error matrices.

Table 27. Proposed Level of Effort for Accuracy Assessment (in days).

AA Topic	CTI and NWM	Costs	Discussion
Select random AA points and create maps	3 days	$1,440	Selection would be conducted by the GIS staff.
Collect field data	40 days	$72,000	Includes 4 ecologists for 20 days each and travel.
Analyze field data	7 days	$3,360	Preparation would be performed by GIS staff.
Modifications to the map	3 days	$1,440	Any changes will be updated in the GIS layer by GIS staff.
Total (days)	**53 days**	**$78,240**	

Task Deliverables: Approximately 1200 completed field forms, to be entered into the UCBN database will be collected at CRMO. An overlay exercise will produce a preliminary contingency table of map accuracy to be used in an AA meeting. The results of the AA meeting will be published as detailed meeting minutes. All AA methods and results will be included in the final report.

TASK 9.0 Final Report and Deliverables

Several elements are required for a comprehensive report including the National Vegetation Mapping Program summation and methodology; general site information that can affect or be affected by vegetation (e.g., climate, topography, geology, soils, hydrology, historic land use, etc.); current land uses (particularly important for the environs); CRMO and UCBN management goals, and the methods and results for field data that were collected and analyzed. A detailed discussion of results related to the classification and PI work is also necessary to improve understanding by and provide guidance to CRMO and UCBN managers and other database users. These are aided by illustrations of the park landscape and plant associations and by illustrated keys to aerial photography signatures. In addition, it is important for users to understand the assessment of accuracy and its implications when using the base vegetation map. The report will also contain a discussion on future recommendations, how to improve the products and possible add-on projects.

Along with the report other deliverables include a final paper map and layout to highlight the vegetation layer. All digital data will be contained on a CD-Rom or DVD including copies of the report and map layout. All graphics included in the report will also be included. Typically a draft of all the deliverables will be created and presented to CRMO and UCBN staff for review and input. CTI will be responsible for the final editing and formatting. All material supplied by other contractors and agencies will be edited by CTI and included in one final comprehensive report.

Assumptions:

- NWI or similar contract ecologists will provide the methodology and summation of the field research; CTI will provide the methodology for the interpretive effort; GIS methodology and digital database production; and ICDC will provide the classification documents.
- UCBN will provide the desired outline of site-specific report topics, if they differ from traditionally written reports and map layouts.
- CTI will be responsible for editing and producing the final report and other deliverables.

Table 28. Proposed Level of Effort for Report Production (in days)

Report Topic	CTI	Costs	Discussion
Draft Report	15 days	$7,200	Two days each assumed for UCBN and CRMO review.
Final Map	3 days	$1,440	Includes minor expenses for report production (CDs, copies, etc.)
Final Report	15 days	$7,200	
Total (days)	**33 days**	**$15,840**	Minor expenses for report production (CDs, copies, etc.)

Task Deliverables: A final report covering all methods, results and discussions used in the vegetation mapping at CRMO will be created. A final map highlighting the vegetation will be created. All documents will be provided to CRMO and UCBN as paper and electronic versions.

HAGERMAN FOSSIL BEDS NATIONAL MONUMENT (HAFO)

Start Date: FY06 - Anticipated End Date: FY08

Introduction

Hagerman Fossil Beds National Monument, known mostly for its fossils from the late Pliocene and Pleistocene epochs, contains one of the world's richest known deposits of fossil horses, *Equus simplicidens*. Located on steep slopes west of the Snake River and the predominant naturally-occurring vegetation on the monument is composed of the sagebrush steppe plant communities along with a riparian zone and localized wetlands. Non-native plant species known to be present include Russian olive (*Eleagnus angustifolia*), Russian thistle (*Salsola kali*), quackgrass (*Agropyron repens*), cheat grass (*Bromus tectorum*), blue mustard (*Chorispora tenella*), tansymustard (*Descurainia sophia*), tumble-mustard (*Sisymbrium altissimum*), and medusa head *(Taeniatherum caput-medusae*). These and other non-native species compete with the monument's native plant communities, disrupting ecosystem processes. HAFO encompasses 4,264 acres and a 2-km environs enlarges the project area to 17,258 acres (a ¼-mile mile buffer scenario would be roughly 10,000 acres).

TASK 1.0 Planning Sessions and Scoping Meetings

Preliminary planning and scoping for this project has been completed in conjunction with the Crater's of the Moon scoping meeting. Current NPS staff at Hagerman Fossil Beds were present at the CRMO meeting. Summary notes from this meeting can be found in **Attachment E**. In general it was discussed that the environs should extend 2-km around the current park boundary (**Figure 6**).

TASK 2.0 Preliminary Plant Alliance/Association and Species Lists

A preliminary list of plant associations and alliances including the known ecological systems for HAFO was solicited and complied by the ICDC (**Attachment F**). This includes an estimate on the likeliness that the type occurs at HAGO. A review of this list will be conducted by HAGO and UCBN staff with additions added to the list and types removed that are known not to occur in the area.

Table 29. Estimated Costs for Preliminary Plant Associations and Alliance for CRMO

Task Topic	ICDC	Costs	Discussion
Preliminary List	-	**$5,413**	Completed by ICDC
Totals	**-**	**$5,413**	--

Task Deliverables: A preliminary list of plant associations and alliance for HAGO is located in the **Attachment F**.

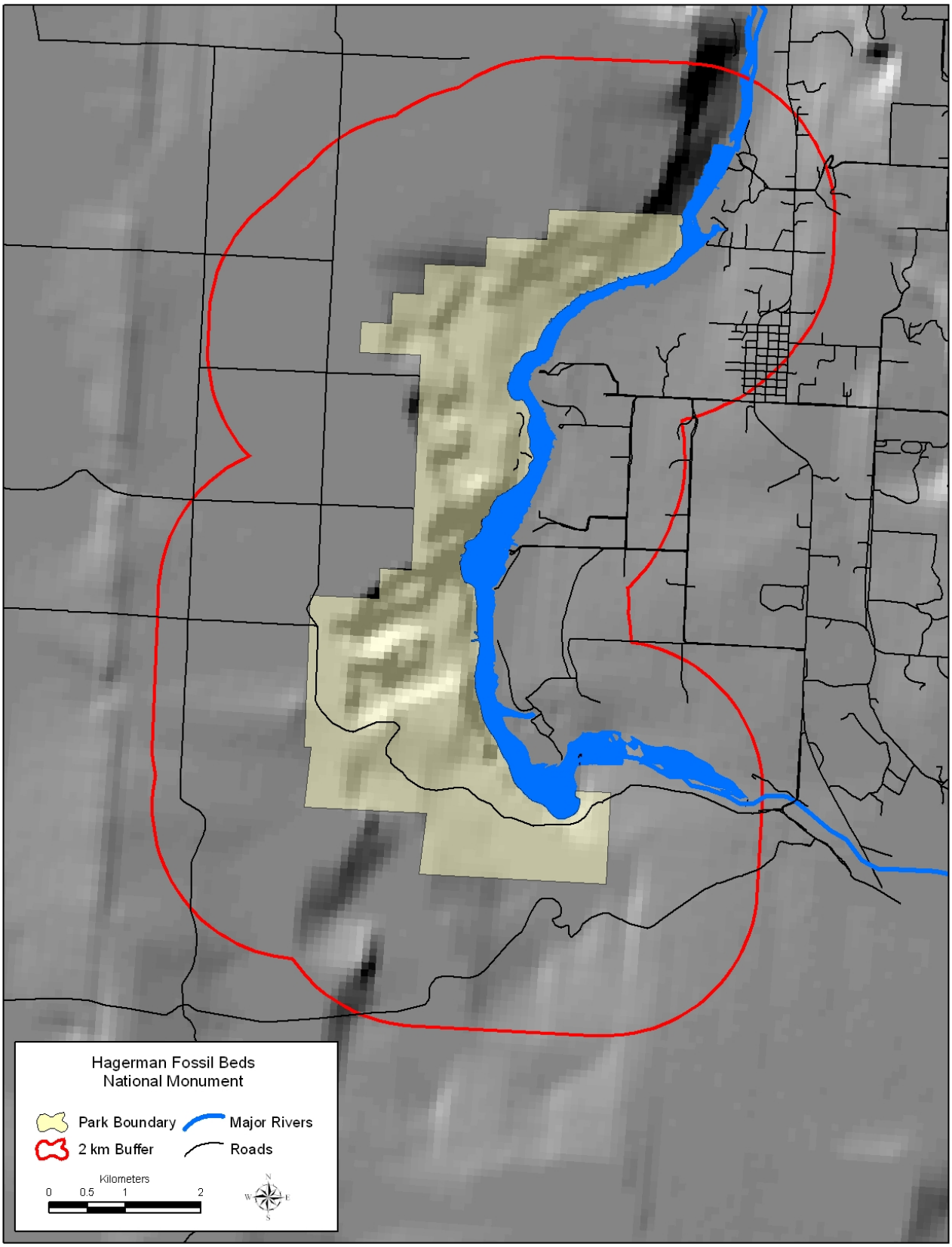


Figure 6. Approximate Project Boundary for HAFO Vegetation Mapping Project.
(Note: Figure does not show the ¼ mile buffer scenario)

TASK 3.0 Aerial Photography and Digital Ortho-photography Acquisition and Preparation

Available imagery includes the various products produced by the National Agricultural Imagery Program (NAIP). These typically include 1-m and 2-m products in both color infrared and true color formats. All available imagery sets will be evaluated prior to the start of work at HAFO and the latest high-quality set will be used as the basemap. Based on the resource management needs in other parks the NAIP imagery will be supplemented with any existing aerial photography, preferably color-infrared aerial photography at 1:12,000-scale

Assumptions:

- Existing aerial photography and NAIP imagery will be of sufficient quality to conduct all PI, attribution, and digital (GIS) database development.

Table 30. Estimated Costs for Imagery and Photography for HAFO

Task Topic	CTI/UCBN	Costs	Discussion
NAIP Imagery	-	-	The NAIP Imagery will be provided by UCBN
Existing Aerial Photography	-	-	It is anticipated that existing photography will be provide at little or no cost.
Totals	**-**	**-**	--

Task Deliverables: A mosaic of the NAIP imagery will be created.

TASK 4.0 Field Data Collection

Due to its size HAFO falls into medium size park category (TNC 1994b) for vegetation mapping. In lieu of a formal gradsect CTI will worked with the UCBN, NWM and HAFO staff to provide existing land cover and vegetation maps already created to create sampling units. These units were visited by the field crews in 2006. A total of plots were sampled throughout the park. The distribution and completeness of this sampling effort is currently being reviewed by CTI and UCBN. If apparent short-coming are found supplemental plot collection efforts will be undertaken in 2007. To date, very minimal legacy data exists for HAFO that would be useful for this project. Standard ancillary data such as soils, geology and hydrology for the area will be used to assist in sample site selection and the photointerpretation.

Vegetation within HAFO was sampled using two approaches. These were observation point data and plot data. Observation points were used to guide aerial photointerpretation and vegetation plot data collection by identifying representative or unique signatures from the aerial photos or field maps concerning the distribution of plant associations within the park. A total of observation points were taken. Vegetation plot data were more rigorous in design than observation points and included precise location, provisional association name, physical environment information, topographic data, physiognomic data, species lists, height classes, foliar cover values, diameter at breast height measurements for trees over 10 centimeters in diameter, and environmental notes and observations by researchers. Vegetation plots are necessary to prepare the classification and as such they are subjectively placed in vegetation types that are representative of an area, relatively homogenous, and larger than the 0.5 hectare (ha) minimum mapping unit (MMU). Ecotones were avoided to the extent possible.

A minimum of two ground photographs for each vegetation plot were taken at each plot. Photos are digital, logged in a summary table, and labeled. Minimal fire fuel and related data were also recorded. Vegetation plot data was collected in accordance with the methods established during the planning meeting. **Table 4** identifies the plot sizes based on the vegetation types sampled.

NWM collected the data and is currently entering it into the UCBN database. This species entered into the database will follow ITIS as a standard. The UCBN database is based on the TNC Plots database used in the USGS-NPS Vegetation Mapping Program. Upon receipt from NWM the database will be checked for completeness and accuracy by UCBN staff.

Assumptions:

- Legacy data useful for this project are minimal at HAFO
- Vegetation plots at a rate of 5/day were sampled by NWM to prepare an accurate classification.
- Observation points were recorded at a rate of 12/day to assist in PI efforts and to check interpretation accuracy. These were collected in the field by members of the NWM vegetation sampling crew.
- Issues of access due to topography and/or private land-owners may reduce the number of plots in some plant communities.

Table 31. Proposed Level of Effort for Field Data Collection (in days).

Data Collection Topic	NWM or similar	Costs	Discussion
50 Observation Points	10 days	$4,100	Minimal Travel and Expenses are included.
150 Plots	20 days	$22,510	Minimal Travel and Expenses are included.
Total (days)	**30 days**	**$26,610**	--

Task Deliverables: All the plots and observation points representing the vegetation communities at HAFO will be delivered to UCBN. Data will be delivered in either paper or digital form.

TASK 5.0 Vegetation Classification, Alliance/Association Descriptions and Field Key

Following vegetation plot data collection and data entry ICDC staff will analyze the data and classify it into the National Vegetation Classification System (NVCS) (Grossman et al. 1998). The NVCS as developed by The Nature Conservancy and currently maintained by NatureServe represents a national system containing seven classification levels with the finest being the plant association. Associations are separated from the next highest category, alliance, through the use of total floristic composition and are named by the most dominant and/or indicator species.

Following entry into the Plots database, species foliar cover values for each plot will be exported into a spreadsheet format and arranged into a plot by species data matrix. Several of the species recorded in the Plots database, primarily trees and shrubs, may occupy more than one stratum within a particular plot. Such layers provide valuable information regarding the structural

diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer should be subscripted with a strata code (e.g., T1, T2, S1, S2, S3). The matrix will be used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Following procedures described by Grossman et al. (1998) and McCune and Mefford (1999), the data matrix would be analyzed as necessary using TWINSPAN, Cluster Analysis (relative Euclidian distance measure with Ward's method of group linkage), and DECORANA (an ordination technique). The matrix can be edited prior to analysis by first removing all species that had total cover values (summed over all plots) of less than or equal to 1 percent to keep the influence of minor species at a minimum. Raw foliar cover scores should be used in all data analysis procedures. The data matrix will then be subjectively evaluated for plots that demonstrated exceptionally low similarity to the remaining plots (outliers). Outlier plots are common in relatively large data sets and occur because of disturbed, heterogeneous, or otherwise unusual sites, or because of gaps in sampling (Gauch 1982). Removing outliers would likely increase the efficiency of the analysis and substantially improve the interpretability of the results.

Draft vegetation classification efforts would be reviewed by ICDC, HAFO staff and UCBN in terms of regional data and existing classification. NPS ecologists would discuss and incorporate suggested revisions, as necessary. After the data has been classified local and global descriptions for each association will be created. Local descriptions of vegetation associations or alliance if associations can't be determined (as they occur throughout HAFO) will be drafted by either ICDC ecologists with input from the field crews. Local descriptions will focus on the park-wide variation including the unique characteristics of the association. Generally, three to four local descriptions can be written in one day depending on the complexity of the vegetation type. The global descriptions for the associations will be modified and up-dated using these local descriptions.

After the data has been classified an illustrated field key will be created that will have dichotomous breaks. This key will walk an average person familiar with the vegetation at HAFO through the associations/alliances in a stepwise fashion. During construction members of the field data collection team should be used to help provide information for the key and to test it once completed. For consistency, this key will be used by the ecologists collecting accuracy assessment points to record the correct field classification. This task would require preparation of a plant association field key, annotation of each couplet in the key with diagnostic field descriptions, and illustration of the key with color slides or digital photos taken in the field at vegetation plot sites. This key will also be invaluable for future researchers, interpretive specialists, and visitors interested in vegetation distribution.

Assumptions:

- It is assumed that approximately 30 plant associations will be determined for HAFO.
- An ecologist familiar with HAFO vegetation will prepare the illustrated plant association field key.

Table 32. Proposed Level of Effort for Classification and Descriptions (in days)

Task Topic	Washington Heritage	Costs	Discussion
Final classification	2 days	$500	Statistical analyses performed by ICDC with NatureServe.
Local Descriptions	5 days	$2,400	Local Descriptions for the associations/alliances at HAFO
Global Descriptions	5 days	$2,400	NatureServe review of the descriptions and incorporation into the NVCS
Field Key Prep.	4 days	$113	Prepare Illustrated Field Key
Total (days)	**24 days**	**$5413.00**	--

Task Deliverables: A preliminary list of associations and alliances will be delivered to UCBN prior to the scoping meeting. A comprehensive, classified list of plant association/alliances will be created in the NVC using the plot and observation data. Local descriptions for all associations/alliances will by used to update the global descriptions. An illustrated field key will be created for the vegetation associations/alliance at HAFO prior to the start of accuracy assessment data collection.

TASK 6.0 Aerial Photointerpretation and Segmentation

Delineation and mapping of the vegetation at HAFO will include a combination of automated image segmentation using eCognition or similar software and traditional photointerpretation (PI). Segmentation will be used to delineate easily observed features and features with high contrast such as open water, roads, and bare rock using the existing NAIP imagery. Once completed this initial map will be further refined though PI using the new photos acquired in 2007. PI will use the standard photo signature characteristics (tone, texture, color, shape, etc…) and ancillary data (slope, elevation, aspect, etc…) to further delineate the final detail of the map classes. Map classes will strive to maintain a 1:1 ratio of map class to plant association. The final mapping scheme will be determined by at a meeting or conference call between the NPS and contract staff. Typically the map classes in these project cover three basic considerations, 1) incorporating the NVC associations/alliances, 2) recognizing the limitations of the imagery (i.e. can you reliably see the plant association on the photo), and 3) covering the management needs of HAFO. The final mapping product will also include all necessary attribution consisting of the vegetation map classes, general height and density modifiers and links to the NVC. It is anticipated that approximately 30 plant associations/alliances and up to 20 land use/bare ground/geology types will be considered as potential map classes. One reconnaissance field trip to ground-truth and obtain photo-signature information by the photo interpreters will be conducted annually during the project.

Photointerpretation is most effectively accomplished when an initial classification has been performed, limiting the amount of cross-walk necessary between interpreted map units and the final classification (developed with the input of NatureServe). The individual responsible for PI should also provide input into the GIS process and review the final GIS layer for quality and consistency. An accurate, descriptive photointerpretive key will be created to allow all future

researchers to understand the interpretive cues used to delineate polygons, which may help to refine the process for future efforts. Typically photo interpretation for these efforts proceeds at about 1000/acres per day.

Assumptions:

- PI work will be conducted at 1000 acres/day. These rates may require adjustment during the process, as photointerpretation proceeds.
- Level of effort will be calculated based an approximate 20,000 acre project area.
- The PI investigator will assist the GIS technician to produce a photointerpretive key.

Table 33. Proposed Level of Effort for PI (in days)

PI Topic	CTI	Costs	Discussion
Photointerpretation	25 days	$12,000	--
Quality Check of GIS	3 days	$1,440	Check draft vegetation plots back to interpreted photography.
Photointerpretation key	3 days	$1,440	Provide representative signatures to the GIS technicians to document PI work for future database users.
Field Recon	5 days	$3,000	Includes time and travel costs for trip.
Total (days)	**36 days**	**$17,880**	--

Task Deliverables: A preliminary vegetation map to the formation level will be created using segmentation techniques. Final detail will be created on aerial photo overlays.

TASK 7.0 Digital Database and Vegetation Map Preparation

Once all of the image processing and PI is completed the final digital database and vegetation map will be created and populated. This will include creating a spatial GIS layer using ArcGIS software. One seamless GIS layer will be created for HAFO by transferring the PI and segmentation information onto the NAIP imagery. Steps required for this task include: digitizing the linework, rectifying it to the basemap, edge-matching, performing a thorough cleaning and weeding process and finally attributing all of the polygons with the necessary vegetation information.

Quality control cannot be overstated in the automation of interpreted vegetation data. One of the more useful practices is to review draft digital data (hard-copy map), usually a quarter-quadrangle at a time, back to the interpreted aerial photograph. GIS quality checks are most effectively performed by the PI specialists. In addition, it is a common practice for producers of a digital database to perform an accuracy check or vegetation map field validation check following initial transfer, digitization, and quality checking. The map validation field check allows a visual review of PI work versus plant associations and land use types. Some observation points may be recorded to more adequately define confusing plant association signatures.

Assumptions:

- GIS automation and preparation of the final database will include a hybrid combination of scanning, on-screen digitizing, and image processing/segmentation techniques to delineate and automate interpreted data.
- GIS database building – geo-referencing, attributing, edge matching, and quality checking will occur at a rate approximately one-half that of the PI effort.
- Appropriate metadata files will be created as the GIS process proceeds.
- All GIS products will meet or exceed FGDC and USGS/NPS Map Accuracy Standards for 1:12,000-scale maps.

Table 34. Proposed Level of Effort for Digital Database and Vegetation Map Preparation

Task Topic	CTI	Costs	Discussion
Data automation, georeferencing	10 days	$4,800	Includes scanning Mylar overlays and georeferencing.
Attribution and edge matching	10 days	$4,800	--
Quality checking	10 days	$4,800	Provide hard-copy plot to PI technician for field verification.
Metadata	2 days	$960	This task could include training, metadata development, and metadata review.
Total (days)	**17 days**	**$15,360**	

Task Deliverables: A final vegetation digital GIS layer for HAFO will be created. This will include all necessary attributes. FGDC-standard metadata will be created for this layer.

TASK 8.0 Accuracy Assessment

Requirements for the NPS Vegetation Mapping Program specify an 80% accuracy for each vegetation class that is mapped (map unit) which infers an 80% accurate vegetation map. In terms of spatial accuracy, the data are expected to meet national map accuracy standards and typically this assumed by the use of standard basemap such as the NAIP orthophotography. The AA procedures employed should be able to determine whether the vegetation map meets these requirements. The following recommendations have been made for AA efforts (TNC, NCGIA, and ESRI 1994):

- The AA should be independent of the mapping process;
- The AA should be point based with an observational unit equivalent to or larger than the minimum mapping unit;
- The recommended number of AA samples per map class should reflect the abundance of each map class in the project area;
- Thematic accuracy should be expressed using contingency matrices adjusted for chance agreement with a Kappa index (Foody 1994);
- AA should ideally capture all components of uncertainty associated with vegetation mapping; and
- AA procedures should be tested operationally to determine if methodology would need to be refined.

Randomly pre-selected accuracy assessment (AA) point coordinates would be plotted on a coded base map by the GIS group/agency responsible for producing the vegetation map. This plot will be used in the field as a point distribution guide, and would be most useful with polygon lines (but not attributes) in place. An ecologist would navigate to the coordinates using a global positioning system (GPS) receiver, use the plant association classification key to determine the appropriate type, and record data for an area the size of the minimum mapping unit around the point, on a modified observation point form. Two representative photos of the site will be taken to document the vegetation. **Attachment E** presents a sample accuracy assessment data collection form that could be modified for UCBN use.

Sample sizes for the AA would be calculated from analysis of the electronic database prepared from the PI. Abundant vegetation types would be sampled at least 30 times, relatively abundant and relatively rare types at least 20 times, and rare types at least 5 times. Very rare types would require visits to all polygons (TNC, NCGIA, and ESRI 1994).

It is anticipated that 500 randomly located AA points will be used. Ten to 20 AA points can typically be recorded by an ecologist per field day (8 hours), considering the limitations of navigating to individual GPS coordinates present in HAFO. It is estimated that the accuracy assessment point collection would take approximately 10 researcher days (average of 20 AA points per day). Upon completion all of the data will be entered into the UCBN Plots database. These will reviewed by UCBN staff for quality and accuracy.

Following collection of AA points in the field, the points are overlain on the map and error matrix or contingency table is created. The error matrix reports both the user's and producer's error (i.e. errors of omission and commission) and represents the AA points label vs. the map label. Once completed the error matrix will be presented at a meeting or conference call to the UCBN and HAFO staff. Any deficiencies in the map will be addressed by either aggregating similar types to achieve the 80% standard or agreeing to live with the lower accuracy. Upon approval of the accuracy statistics for each map class will be calculated and the map modified accordingly.

Assumptions:

- One contracted AA field team (two researchers) would be used.
- All GPS units for field navigation will be supplied by the contracted field crews.
- Approximately 15 days will be needed to collect the AA data.
- The AA contractor will be responsible for entering the data into the UCBN database.
- All field maps and target points will be supplied by the GIS contractor.
- All analyses will be performed by the GIS contractor and reported as appropriate error matrices.

Table 35. Proposed Level of Effort for Accuracy Assessment (in days).

AA Topic	CTI and NWM	Costs	Discussion
Select random AA points and create maps	1 day	$480	Selection would be conducted by the GIS staff.
Collect field data	25 days	$30,000	Includes 2 ecologists and travel.
Analyze field data	2 days	$960	Preparation would be performed by GIS staff.
Modifications to the map	2 days	$960	Any changes will be updated in the GIS layer by GIS staff.
Total (days)	**30 days**	**$32,400**	

Task Deliverables: Approximately 300 completed field forms, to be entered into the UCBN database will be collected at HAFO. An overlay exercise will produce a preliminary contingency table of map accuracy to be used in an AA meeting. The results of the AA meeting will be published as detailed meeting minutes. All AA methods and results will be included in the final report.

TASK 9.0 Final Report and Deliverables

Several elements are required for a comprehensive report including the National Vegetation Mapping Program summation and methodology; general site information that can affect or be affected by vegetation (e.g., climate, topography, geology, soils, hydrology, historic land use, etc.); current land uses (particularly important for the environs); HAFO and UCBN management goals, and the methods and results for field data that were collected and analyzed. A detailed discussion of results related to the classification and PI work is also necessary to improve understanding by and provide guidance to HAFO and UCBN managers and other database users. These are aided by illustrations of the park landscape and plant associations and by illustrated keys to aerial photography signatures. In addition, it is important for users to understand the assessment of accuracy and its implications when using the base vegetation map. The report will also contain a discussion on future recommendations, how to improve the products and possible add-on projects.

Along with the report other deliverables include a final paper map and layout to highlight the vegetation layer. All digital data will be contained on a CD-Rom or DVD including copies of the report and map layout. All graphics included in the report will also be included. Typically a draft of all the deliverables will be created and presented to HAFO and UCBN staff for review and input. CTI will be responsible for the final editing and formatting. All material supplied by other contractors and agencies will be edited by CTI and included in one final comprehensive report.

Assumptions:

- NWI or similar contract ecologists will provide the methodology and summation of the field research; CTI will provide the methodology for the interpretive effort; GIS methodology and digital database production; and ICDC will provide the classification documents.
- UCBN will provide the desired outline of site-specific report topics, if they differ from traditionally written reports and map layouts.
- CTI will be responsible for editing and producing the final report and other deliverables.

Table 36. Proposed Level of Effort for Report Production (in days)

Report Topic	CTI	Costs	Discussion
Draft Report	10 days	$4,800	Two days each assumed for UCBN and HAFO review.
Final Map	3 days	$1,440	Includes minor expenses for report production (CDs, copies, etc.)
Final Report	10 days	$4,800	
Total (days)	**23 days**	**$11,040**	Minor expenses for report production (CDs, copies, etc.)

Task Deliverables: A final report covering all methods, results and discussions used in the vegetation mapping at HAFO will be created. A final map highlighting the vegetation will be created. All documents will be provided to HAFO and UCBN as paper and electronic versions.

JOHN DAY FOSSIL BEDS NATIONAL MONUMENT (JODA)

Start Date: FY10 - Anticipated End Date: FY11

Introduction

John Day Fossil Beds National Monument includes over 14,000 acres found in 3 separated units, the Sheep Rock Unit, Painted Hills Unit, and Clarno Unit. All 3 units are in the John Day River Basin, a major tributary of the Columbia River. The park is known for its deep ravines and erosive, fossil bearing formations cut into the mountainous terrain. In general all three units have steep terrain that recedes to a river or stream valley bottom. Old juniper trees are scattered around the hills with sagebrush, shadscale, and mountain mahogany. Bluebunch wheatgrass, Idaho fescue, Indian ricegrass, and needle and thread are common grasses. With a 2-km environs around all three units, the total project size is approximately 63,000 acres (a ¼-mile mile scenario would be roughly 43,000 acres).

TASK 1.0 Planning Sessions and Scoping Meetings

Preliminary planning and scoping for this project will be completed using one meeting to discuss the project design, imagery, photointerpretation/segmentation, plant distribution and ecology, and project review. Completion of the vegetation classification would involve planning and scoping with key agencies and organizations including the Oregon Natural Heritage program UCBN, CTI and NWM as appropriate and as necessary.

Assumptions:

- Sufficient planning and scoping will occur to establish project approach and milestones, complete field data collection to support a vegetation classification, photointerpretation/segmentation, and digital database production.
- Planning meetings with any contributing agencies would be informal and conducted between appropriate UCBN on-site staff.
- Existing vs. new aerial photography/imagery will be evaluated at the meeting and through discussion between NPS, UCBN, JODA, and CTI staff.
- The sampling approach for field work will be finalized at the scoping meeting

At the scoping meeting a buffer area, or environs, should be agreed upon as the project boundary for the vegetation classification and mapping project and confirmed. For the purposes of this work plan, acreage totals were calculated assuming a 2-km environs area (**Figure 7**). If the environs area changes as a result of planning meeting discussions, the estimated level of effort for some tasks in this plan my change.

Table 37. Proposed Level of Effort for Planning and Scoping at JODA (in days).

Task Topic	CTI, NWM, Others	Costs	Discussion
Project planning meeting	6 days*	$2,880	A planning meeting would discuss all project needs, timelines, and assign responsibility for completion.
AA planning and evaluation	3 days	$1,440	Prepare AA point data set and evaluate the results.
Totals	**9 days**	**$4,320**	--

* Several entities would be required to attend for a successful planning meeting.

Task Deliverables: A summary of the scoping meeting minutes and copies of the presentations will be created and posted on the UCBN vegetation mapping website.

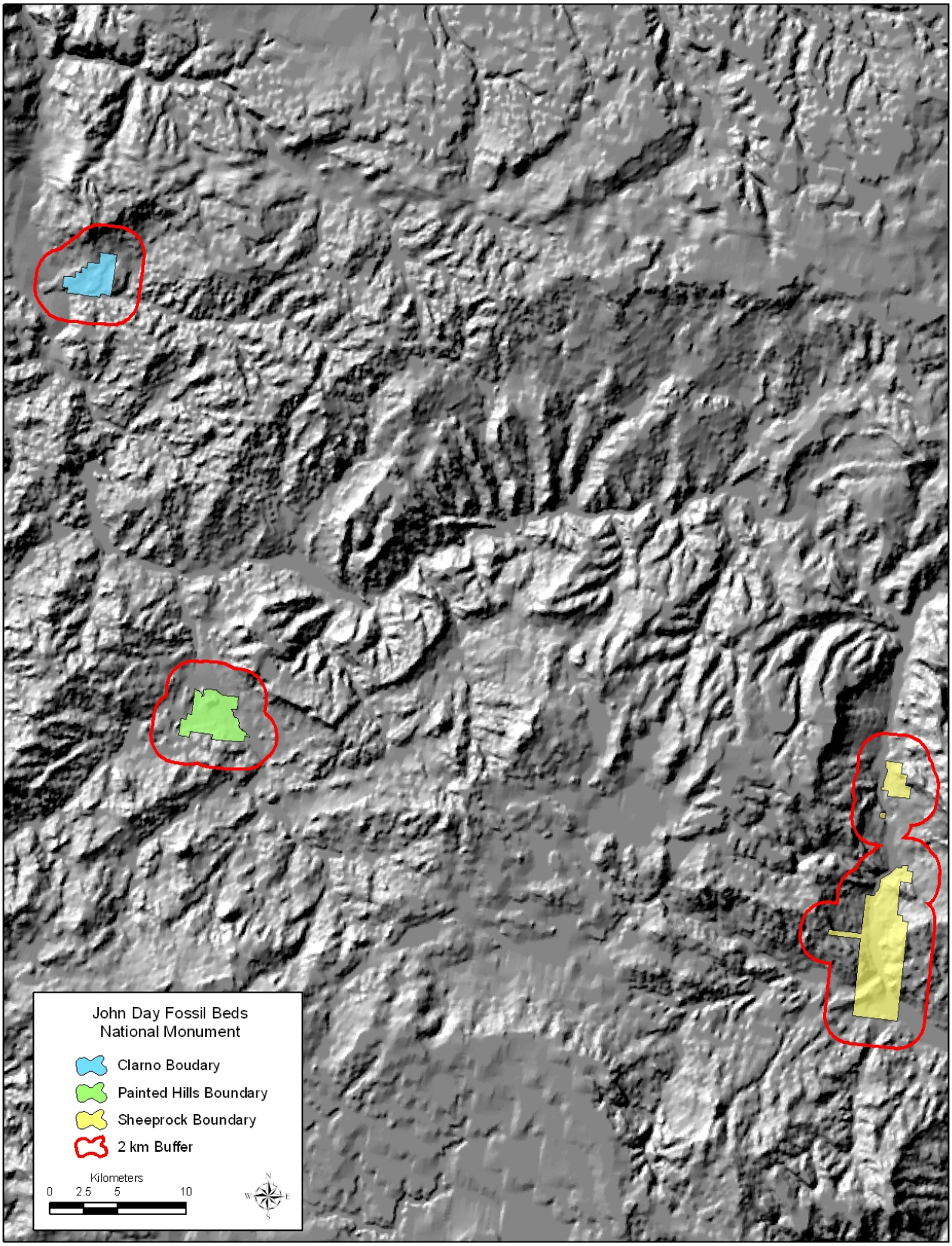


Figure 7. Approximate Project Boundary for JODA Vegetation Mapping Project.
(Note: Figure does not show the ¼ mile buffer scenario)

TASK 2.0 Preliminary Plant Alliance/Association and Species Lists

A preliminary list of plant associations and alliances for JODA will be reviewed by the Oregon Heritage Program (**Attachment E**). This will include an estimate on the likeliness that the type occurs at JODA. A review of this list will be conducted by JODA and UCBN staff with additions added to the list and types removed that are known not to occur in the area.

Assumption:

- Sufficient vegetation data occurs for this area that a preliminary list of associations can be created.

Table 38. Estimated Costs for Preliminary Plant Associations and Alliance for JODA

Task Topic	Oregon Heritage	Costs	Discussion
Preliminary List	-	$3000	Lists will reviewed by the Oregon Heritage Program
Totals	**-**	**$3000**	--

Task Deliverables: A preliminary list of plant associations and alliance for JODA prepared by the IDCD will be presented to UCBN prior to the scoping meeting.

TASK 3.0 Aerial Photography and Digital Ortho-photography Acquisition and Preparation

Available imagery includes the various products produced by the National Agricultural Imagery Program (NAIP). These typically include 1-m and 2-m products in both color infrared and true color formats. All available imagery sets will be evaluated prior to the start of work at JODA and the latest high-quality set will be used as the basemap. Based on the resource management needs in other parks the NAIP imagery will be supplemented with any existing aerial photography, preferably color-infrared aerial photography at 1:12,000-scale

Assumptions:

- Existing aerial photography and NAIP imagery will be of sufficient quality to conduct all PI, attribution, and digital (GIS) database development.

Table 39. Estimated Costs for Imagery and Photography for JODA

Task Topic	CTI/UCBN	Costs	Discussion
NAIP Imagery	-	-	The NAIP Imagery will be provided by UCBN
Existing Aerial Photography	-	-	It is anticipated that existing photography will be provide at little or no cost.
Totals	**-**	**-**	--

Task Deliverables: A mosaic of the NAIP imagery will be created.

TASK 4.0 Field Data Collection

Due to its size, JODA falls into the large size park category (TNC 1994b) for vegetation mapping. This category calls for a gradsect approach (Austin and Heyligers, 1989), and the resulting map of biophysical units should be used to determine the pilot area(s) that will be sampled. In lieu of a formal gradsect it is anticipated that CTI will work with the JODA staff and the existing land cover maps created recently by UCBN to create sampling units. These units will be visited by the field crews and supplemented by local knowledge of the vegetation by contract and NPS staff. Since there is a mixture of private land within the project area it is anticipated that all areas of within JODA will be visited by field crews for sampling. This approach will be reviewed at the scoping meeting and modified if necessary

To date, very minimal legacy data exists for JODA that would be useful for this project. Standard ancillary data such as soils, geology and hydrology for the area will be used to assist in sample site selection and the photointerpretation. If existing data is presented by JODA or others at the kick-off meeting it will be evaluated using the program standards for usefulness (**Attachment D**) and incorporated into the project.

Vegetation within JODA will be sampled using two approaches. These are observation point data and plot data. Observation points are used to guide aerial photointerpretation and vegetation plot data collection by identifying representative or unique signatures from the aerial photos or field maps concerning the distribution of plant associations within the park. Observation points are a more rapid form of data collection, these data are not collected from a standard plot, but rather describe an area, usually up to the program minimum mapping unit of 0.5 hectares. Vegetation plot data are more rigorous than observation points and include precise location, provisional association name, physical environment information, topographic data, physiognomic data, species lists, height classes, foliar cover values, diameter at breast height measurements for trees over 10 centimeters in diameter, and environmental notes and observations by researchers. Vegetation plots are necessary to prepare the classification and as such they are subjectively placed in vegetation types that are representative of an area, relatively homogenous, and larger than the 0.5 hectare (ha) minimum mapping unit (MMU). Ecotones are avoided to the extent possible.

Unique vegetation patches less than the project MMU may also be sampled using vegetation plots. These are often termed “park specials” because of their value for overall management prescriptions, but fall below the project MMU. Resource management staff will be given the chance at the scoping meeting to discuss these options. Some common park special types include:

- Small patches of invasive and exotic plants;
- Small wetlands;
- Rare or endangered plants;

Due to the high diversity this work plan assumes that approximately 100 associations occur at JODA and its environs. This would indicate that approximately 300 plots and 100 observation points would need to be collected to fully document the diversity. It is anticipated that work will be conducted by experienced field crews supplied by NWM, e^2M, or similar contractor. Experienced field crews will allow for efficient sampling, minimal instruction and little oversight. New field observation points and plots will be collected using the standard observation point and plot form (either paper or digital) created by UCBN in conjunction with the national program

(**Attachment E**). During the planning meeting it will be determined if sampling is required/permitted within project environs, and at what level sampling would proceed.

A minimum of two ground photographs for each vegetation plot will be taken. Photos would be digital, logged in a summary table, and labeled. Fire fuel and related issues will be discussed at the scoping meeting. If it is deemed necessary for JODA, additional data forms will be used to capture basic fuel loading information (**Attachment E**). If fire is not a concern only the first pages of the field form will be used. Vegetation plot data will be collected in accordance with the methods established during the planning meeting. **Table 4** identifies potential plot size based on the vegetation type being sampled.

The contractor collecting the data will be responsible for entering it into the UCBN database. This species entered into the database will follow ITIS as a standard. The UCBN database will be based on the TNC Plots database used in the USGS-NPS Vegetation Mapping Program. Upon entry the database will be checked for completeness and accuracy by UCBN staff.

Assumptions:

- Legacy data useful for this project are minimal at JODA
- Approximately 300 vegetation plots (at a rate of 5/day) would be sampled to prepare an accurate classification.
- Approximately 100 observation would be recorded (at a rate of 12/day) to assist in PI efforts, and to check interpretation accuracy. These may be collected in the field by members of the vegetation sampling crew or individuals conducting aerial photointerpretation.
- Issues of access due to topography and/or private land-owners may reduce the number of plots in some plant communities.

Table 40. Proposed Level of Effort for Field Data Collection (in days).

Data Collection Topic	NWM or similar	Costs	Discussion
50 Observation Points	15 days	$5,000	--
300 Plots	60 days	$45,000	--
Total (days)	**75 days**	**$50,000**	--

Task Deliverables: A 300 plots and 50 observation points representing the vegetation communities at JODA will be delivered to UCBN. Data will be delivered in either paper or digital form.

TASK 5.0 Vegetation Classification, Alliance/Association Descriptions and Field Key

Following vegetation plot data collection and data entry Oregon Heritage staff will analyze the data and classify it into the National Vegetation Classification System (NVCS) (Grossman et al. 1998). The NVCS as developed by The Nature Conservancy and currently maintained by NatureServe represents a national system containing seven classification levels with the finest being the plant association.

Following entry into the Plots database, species foliar cover values for each plot will be exported into a spreadsheet format and arranged into a plot by species data matrix. Several of the species recorded in the Plots database, primarily trees and shrubs, may occupy more than one stratum within a particular plot. Such layers provide valuable information regarding the structural diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer should be subscripted with a strata code (e.g., T1, T2, S1, S2, S3). The matrix will be used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Following procedures described by Grossman et al. (1998) and McCune and Mefford (1999), the data matrix would be analyzed as necessary using TWINSPAN, Cluster Analysis (relative Euclidian distance measure with Ward's method of group linkage), and DECORANA (an ordination technique). The matrix can be edited prior to analysis by first removing all species that had total cover values (summed over all plots) of less than or equal to 1 percent to keep the influence of minor species at a minimum. Raw foliar cover scores should be used in all data analysis procedures. The data matrix will then be subjectively evaluated for plots that demonstrated exceptionally low similarity to the remaining plots (outliers). Outlier plots are common in relatively large data sets and occur because of disturbed, heterogeneous, or otherwise unusual sites, or because of gaps in sampling (Gauch 1982). Removing outliers would likely increase the efficiency of the analysis and substantially improve the interpretability of the results.

Draft vegetation classification efforts would be reviewed by Oregon Heritage Staff, JODA staff and UCBN in terms of regional data and existing classification. NPS ecologists would discuss and incorporate suggested revisions, as necessary. After the data has been classified local and global descriptions for each association will be created. Local descriptions of vegetation associations or alliance if associations can't be determined (as they occur throughout JODA) will be drafted by Oregon Heritage ecologists with input from the field crews. Local descriptions will focus on the park-wide variation including the unique characteristics of the association. Generally, three to four local descriptions can be written in one day depending on the complexity of the vegetation type. The global descriptions for the associations will be modified and up-dated using these local descriptions.

After the data has been classified an illustrated field key will be created that will have dichotomous breaks. This key will walk an average person familiar with the vegetation at JODA through the associations/alliances in a stepwise fashion. During construction members of the field data collection team should be used to help provide information for the key and to test it once completed. For consistency, this key will be used by the ecologists collecting accuracy assessment points to record the correct field classification. This task would require preparation of a plant association field key, annotation of each couplet in the key with diagnostic field descriptions, and illustration of the key with color slides or digital photos taken in the field at

vegetation plot sites. This key will also be invaluable for future researchers, interpretive specialists, and visitors interested in vegetation distribution.

Assumptions:

- Vegetation plots will likely number around 150 for the JODA project.
- It is assumed that approximately 50 plant associations will be determined for JODA.
- An ecologist familiar with JODA vegetation will prepare the illustrated plant association field key.

Table 41. Proposed Level of Effort for Classification and Descriptions (in days)

Task Topic	Oregon Heritage	Costs	Discussion
Final classification	10 days	$2,400	Statistical analyses performed by Oregon Heritage with NatureServe.
Local Descriptions	20 days	$4,800	Local Descriptions for the associations/alliances at JODA
Global Descriptions	10 days	$2,400	NatureServe review of the descriptions and incorporation into the NVCS
Field Key Prep.	4 days	$1353.25	Obligated (**Attachment B**)
Total (days)	**44 days**	**$10,953.25**	--

Task Deliverables: A preliminary list of associations and alliances will be delivered to UCBN prior to the scoping meeting. A comprehensive, classified list of plant association/alliances will be created in the NVC using the plot and observation data. Local descriptions for all associations/alliances will by used to update the global descriptions. An illustrated field key will be created for the vegetation associations/alliance at JODA prior to the start of accuracy assessment data collection.

TASK 6.0 Aerial Photointerpretation and Segmentation

Delineation and mapping of the vegetation at JODA will include a combination of automated image segmentation using eCognition or similar software and traditional photointerpretation (PI). Segmentation will be used to delineate easily observed features and features with high contrast such as open water, roads, and bare rock using the existing NAIP imagery. Once completed this initial map will be further refined though PI using the new photos acquired in 2007. PI will use the standard photo signature characteristics (tone, texture, color, shape, etc…) and ancillary data (slope, elevation, aspect, etc…) to further delineate the final detail of the map classes. Map classes will strive to maintain a 1:1 ratio of map class to plant association. The final mapping scheme will be determined by at a meeting or conference call between the NPS and contract staff. Typically the map classes in these project cover three basic considerations, 1) incorporating the NVC associations/alliances, 2) recognizing the limitations of the imagery (i.e. can you reliably see the plant association on the photo), and 3) covering the management needs of JODA. The final mapping product will also include all necessary attribution consisting of the vegetation map classes, general height and density modifiers and links to the NVC. It is

anticipated that approximately 40 plant associations/alliances and up to 20 land use/bare ground/geology types will be considered as potential map classes. One reconnaissance field trip to ground-truth and obtain photo-signature information by the photo interpreters will be conducted annually during the project.

Photointerpretation is most effectively accomplished when an initial classification has been performed, limiting the amount of cross-walk necessary between interpreted map units and the final classification (developed with the input of NatureServe). The individual responsible for PI should also provide input into the GIS process and review the final GIS layer for quality and consistency. An accurate, descriptive photointerpretive key will be created to allow all future researchers to understand the interpretive cues used to delineate polygons, which may help to refine the process for future efforts. Typically photo interpretation for these efforts proceeds at about 1000/acres per day.

Assumptions:

- PI work will be conducted at 1000 acres/day. These rates may require adjustment during the process, as photointerpretation proceeds.
- Level of effort will be calculated based an approximate 50,000 acre project area.
- The PI investigator will assist the GIS technician to produce a photointerpretive key.

Table 42. Proposed Level of Effort for PI (in days)

PI Topic	CTI	Costs	Discussion
Photointerpretation	65 days	$31,200	--
Quality Check of GIS	10 days	$4,800	Check draft vegetation plots back to interpreted photography.
Photointerpretation key	5 days	$2,400	Provide representative signatures to the GIS technicians to document PI work for future database users.
Field Recon	5 days	$6,000	Includes time and travel costs for trip.
Total (days)	**85 days**	**$44,400**	--

Task Deliverables: A preliminary vegetation map to the formation level will be created using segmentation techniques. Final detail will be created on aerial photo overlays.

TASK 7.0: Digital Database and Vegetation Map Preparation

Once all of the image processing and PI is completed the final digital database and vegetation map will be created and populated. This will include creating a spatial GIS layer using ArcGIS software. One seamless GIS layer will be created for JODA by transferring the PI and segmentation information onto the NAIP imagery. Steps required for this task include: digitizing the linework, rectifying it to the basemap, edge-matching, performing a thorough cleaning and weeding process and finally attributing all of the polygons with the necessary vegetation information.

Quality control cannot be overstated in the automation of interpreted vegetation data. One of the more useful practices is to review draft digital data (hard-copy map), usually a quarter-quadrangle at a time, back to the interpreted aerial photograph. GIS quality checks are most effectively performed by the PI specialists. In addition, it is a common practice for producers of a

digital database to perform an accuracy check or vegetation map field validation check following initial transfer, digitization, and quality checking. The map validation field check allows a visual review of PI work versus plant associations and land use types. Some observation points may be recorded to more adequately define confusing plant association signatures.

Assumptions:

- GIS automation and preparation of the final database will include a hybrid combination of scanning, on-screen digitizing, and image processing/segmentation techniques to delineate and automate interpreted data.
- GIS database building – geo-referencing, attributing, edge matching, and quality checking will occur at a rate approximately one-half that of the PI effort.
- Appropriate metadata files will be created as the GIS process proceeds.
- All GIS products will meet or exceed FGDC and USGS/NPS Map Accuracy Standards for 1:12,000-scale maps.

Table 43. Proposed Level of Effort for Digital Database and Vegetation Map Preparation

Task Topic	CTI	Costs	Discussion
Data automation, georeferencing	30 days	$14,400	Includes scanning Mylar overlays and georeferencing.
Attribution and edge matching	15 days	$7,200	--
Quality checking	10 days	$4,800	Provide hard-copy plot to PI technician for field verification.
Metadata	2 days	$960	This task could include training, metadata development, and metadata review.
Total (days)	**57 days**	**$27,360**	

Task Deliverables: A final vegetation digital GIS layer for JODA will be created. This will include all necessary attributes. FGDC-standard metadata will be created for this layer.

TASK 8.0: Accuracy Assessment

Requirements for the NPS Vegetation Mapping Program specify an 80% accuracy for each vegetation class that is mapped (map unit) which infers an 80% accurate vegetation map. In terms of spatial accuracy, the data are expected to meet national map accuracy standards and typically this assumed by the use of standard basemap such as the NAIP orthophotography. The AA procedures employed should be able to determine whether the vegetation map meets these requirements. The following recommendations have been made for AA efforts (TNC, NCGIA, and ESRI 1994):

- The AA should be independent of the mapping process;
- The AA should be point based with an observational unit equivalent to or larger than the minimum mapping unit;
- The recommended number of AA samples per map class should reflect the abundance of each map class in the project area;
- Thematic accuracy should be expressed using contingency matrices adjusted for chance agreement with a Kappa index (Foody 1994);

- AA should ideally capture all components of uncertainty associated with vegetation mapping; and
- AA procedures should be tested operationally to determine if methodology would need to be refined.

Randomly pre-selected accuracy assessment (AA) point coordinates would be plotted on a coded base map by the GIS group/agency responsible for producing the vegetation map. This plot will be used in the field as a point distribution guide, and would be most useful with polygon lines (but not attributes) in place. An ecologist would navigate to the coordinates using a global positioning system (GPS) receiver, use the plant association classification key to determine the appropriate type, and record data for an area the size of the minimum mapping unit around the point, on a modified observation point form. Two representative photos of the site will be taken to document the vegetation. **Attachment E** presents a sample accuracy assessment data collection form that could be modified for UCBN use.

Sample sizes for the AA would be calculated from analysis of the electronic database prepared from the PI. Abundant vegetation types would be sampled at least 30 times, relatively abundant and relatively rare types at least 20 times, and rare types at least 5 times. Very rare types would require visits to all polygons (TNC, NCGIA, and ESRI 1994).

It is anticipated that 500 - 700 randomly located AA points will be used. Ten to 20 AA points can typically be recorded by an ecologist per field day (8 hours), considering the limitations of navigating to individual GPS coordinates present in JODA. It is estimated that the accuracy assessment point collection would take approximately 10 researcher days (average of 20 AA points per day). Upon completion all of the data will be entered into the UCBN Plots database. These will reviewed by UCBN staff for quality and accuracy.

Following collection of AA points in the field, the points are overlain on the map and error matrix or contingency table is created. The error matrix reports both the user's and producer's error (i.e. errors of omission and commission) and represents the AA points label vs. the map label. Once completed the error matrix will be presented at a meeting or conference call to the UCBN and JODA staff. Any deficiencies in the map will be addressed by either aggregating similar types to achieve the 80% standard or agreeing to live with the lower accuracy. Upon approval of the accuracy statistics for each map class will be calculated and the map modified accordingly.

Assumptions:

- Two contracted AA field team (two researchers each) would be used.
- All GPS units for field navigation will be supplied by the contracted field crews.
- Approximately 15 days will be needed to collect the AA data.
- The AA contractor will be responsible for entering the data into the UCBN database.
- All field maps and target points will be supplied by the GIS contractor.
- All analyses will be performed by the GIS contractor and reported as appropriate error matrices.

Table 44. Proposed Level of Effort for Accuracy Assessment (in days).

AA Topic	CTI and NWM	Costs	Discussion
Select random AA points and create maps	3 days	$1,440	Selection would be conducted by the GIS staff.
Collect field data	20 days	$30,000	Includes 4 ecologists for 20 days each and travel.
Analyze field data	7 days	$3,360	Preparation would be performed by GIS staff.
Modifications to the map	3 days	$1,440	Any changes will be updated in the GIS layer by GIS staff.
Total (days)	**33 days**	**$36,240**	

Task Deliverables: Approximately 500 completed field forms, to be entered into the UCBN database will be collected at JODA. An overlay exercise will produce a preliminary contingency table of map accuracy to be used in an AA meeting. The results of the AA meeting will be published as detailed meeting minutes. All AA methods and results will be included in the final report.

TASK 9.0 Final Report and Deliverables

Several elements are required for a comprehensive report including the National Vegetation Mapping Program summation and methodology; general site information that can affect or be affected by vegetation (e.g., climate, topography, geology, soils, hydrology, historic land use, etc.); current land uses (particularly important for the environs); JODA and UCBN management goals, and the methods and results for field data that were collected and analyzed. A detailed discussion of results related to the classification and PI work is also necessary to improve understanding by and provide guidance to JODA and UCBN managers and other database users. These are aided by illustrations of the park landscape and plant associations and by illustrated keys to aerial photography signatures. In addition, it is important for users to understand the assessment of accuracy and its implications when using the base vegetation map. The report will also contain a discussion on future recommendations, how to improve the products and possible add-on projects.

Along with the report other deliverables include a final paper map and layout to highlight the vegetation layer. All digital data will be contained on a CD-Rom or DVD including copies of the report and map layout. All graphics included in the report will also be included. Typically a draft of all the deliverables will be created and presented to JODA and UCBN staff for review and input. CTI will be responsible for the final editing and formatting. All material supplied by other contractors and agencies will be edited by CTI and included in one final comprehensive report.

Assumptions:

- NWI or similar contract ecologists will provide the methodology and summation of the field research; CTI will provide the methodology for the interpretive effort; GIS methodology and digital database production; and Oregon Heritage will provide the classification documents.
- UCBN will provide the desired outline of site-specific report topics, if they differ from traditionally written reports and map layouts.
- CTI will be responsible for editing and producing the final report and other deliverables.

Table 45. Proposed Level of Effort for Report Production (in days)

Report Topic	CTI	Costs	Discussion
Draft Report	15 days	$7,200	Two days each assumed for UCBN and JODA review.
Final Map	3 days	$1,440	Includes minor expenses for report production (CDs, copies, etc.)
Final Report	15 days	$7,200	
Total (days)	**38 days**	**$15,840**	Minor expenses for report production (CDs, copies, etc.)

Task Deliverables: A final report covering all methods, results and discussions used in the vegetation mapping at JODA will be created. A final map highlighting the vegetation will be created. All documents will be provided to JODA and UCBN as paper and electronic versions.

LAKE ROOSEVELT NATIONAL RECREATION AREA (LARO)

Start Date: FY07 - Anticipated End Date: FY09

Introduction

LARO is a recreation area surrounding Lake Roosevelt Reservoir on the Columbia River. The reservoir was created by Grand Coulee Dam and offers a wide variety of recreation opportunities in a diverse natural setting. LARO contains a 144-mile-long reservoir bordered by 312 miles of publicly owned shoreline that is available for public use. It contains a large section of the upper Columbia River and lies within three distinct geologic provinces – the Okanogan Highlands, the Columbia Plateau, and the Kootenay Arc. With 2-km in environs the total project area is approximately 188,000 acres, which does not include the open water (a ¼-mile scenario would yield about 158,000 acres).

Due to its management jointly by the BOR and NPS a proposal was submitted by the BOR Remote Sensing and GIS Group in Denver (**Attachment G)**. This proposal contains all steps needed to complete the project at LARO. For the purposes of this work plan only the costs associated with mapping, photo-interpretation and preparing the digital database were incorporated.

TASK 1.0 Planning Sessions and Scoping Meetings

Preliminary planning and scoping for this project will be completed using one meeting to discuss the project design, imagery, photointerpretation/segmentation, plant distribution and ecology, and project review. Completion of the vegetation classification would involve planning and scoping with key agencies and organizations including the Idaho Conservation Data Center (ICDC), UCBN, CTI and NWM as appropriate and as necessary.

Assumptions:

- Sufficient planning and scoping will occur to establish project approach and milestones, complete field data collection to support a vegetation classification, photointerpretation/segmentation, and digital database production.
- Planning meetings with any contributing agencies would be informal and conducted between appropriate UCBN on-site staff.
- Existing vs. new aerial photography/imagery will be evaluated at the meeting and through discussion between NPS, UCBN, LARO, and CTI staff.
- The sampling approach for field work will be discussed and finalized at the meeting.

At the scoping meeting a buffer area, or environs, should be agreed upon as the project boundary for the vegetation classification and mapping project and confirmed. For the purposes of this work plan, acreage totals were calculated assuming a 2-km environs area (**Figure 8**). If the environs area changes as a result of planning meeting discussions, the estimated level of effort for some tasks in this plan my change.

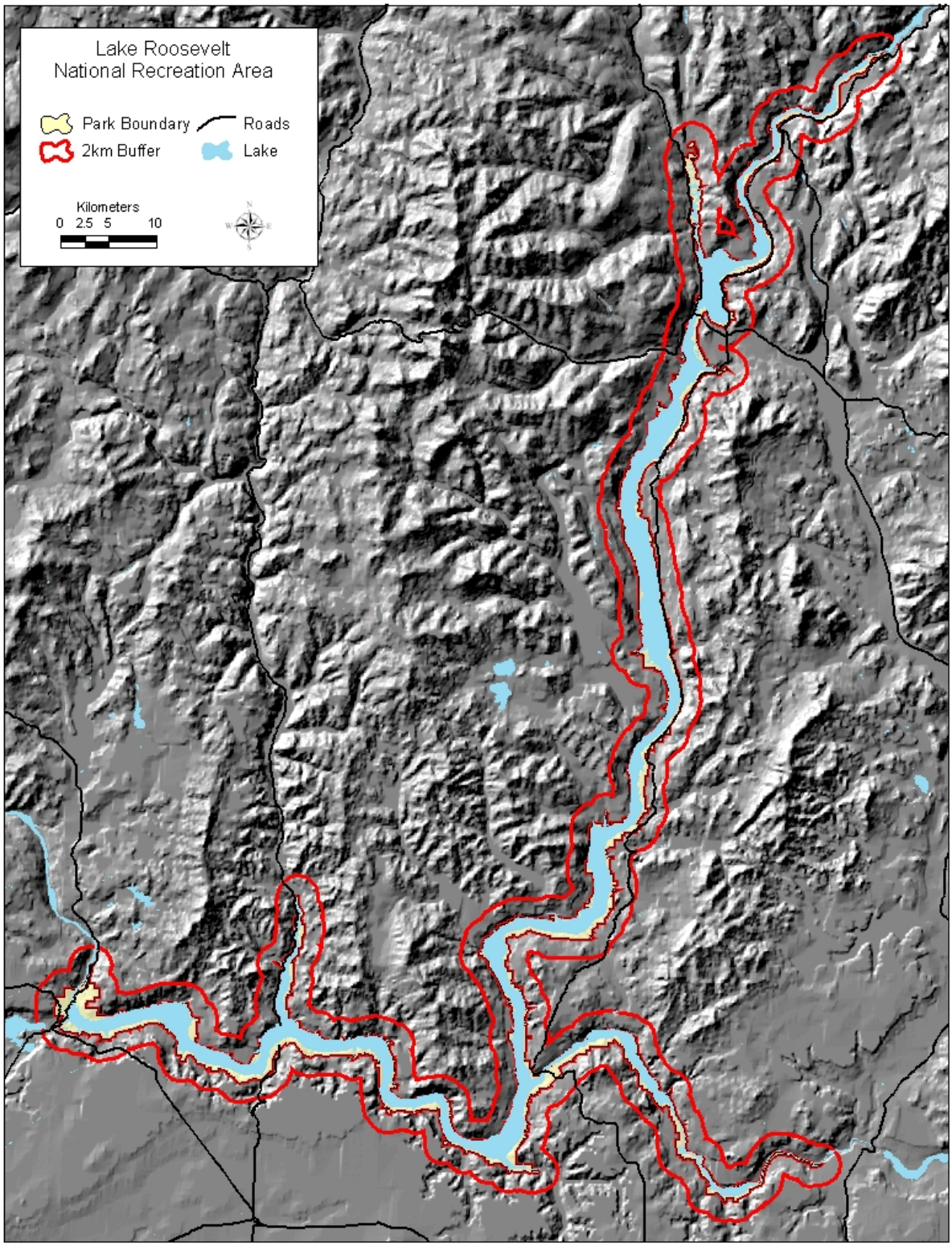


Figure 8. Approximate Project Boundary for LARO Vegetation Mapping Project.
(Note: Figure does not show the ¼ mile buffer scenario)

Table 46. Proposed Level of Effort for Planning and Scoping at LARO (in days).

Task Topic	CTI, NWM, Others	Costs	Discussion
Project planning meeting	3 days*	$1,880	A planning meeting would discuss all project needs, timelines, and assign responsibility for completion.
Compile existing Data	1 day	$1,000	Examine existing data and compile.
AA planning and evaluation	3 days	$1,440	Prepare AA point data set and evaluate the results.
Travel	-	$11,860	-
Totals	**7 days**	**$16,180**	--

* Several entities would be required to attend for a successful planning meeting.

Task Deliverables: A summary of the scoping meeting minutes and copies of the presentations will be created and posted on the UCBN vegetation mapping website.

TASK 2.0 Preliminary Plant Alliance/Association and Species Lists

A preliminary list of plant associations and alliances for LARO will be reviewed by the Washington State Heritage Program. This will include an estimate on the likeliness that the type occurs at LARO. A review of this list will be conducted by LARO and UCBN staff with additions added to the list and types removed that are known not to occur in the area.

Assumption:

- Sufficient vegetation data occurs for this area that a preliminary list of associations can be created.

Table 47. Estimated Costs for Preliminary Plant Associations and Alliance for LARO

Task Topic	Washington Heritage	Costs	Discussion
Preliminary List	-	$3,000	Lists will reviewed by the Washington State Heritage Program
Totals	**-**	**$3,000**	--

Task Deliverables: A preliminary list of plant associations and alliance for LARO prepared by the Washington State Heritage Program will be presented to UCBN prior to the scoping meeting.

TASK 3.0 Aerial Photography and Digital Ortho-photography Acquisition and Preparation

Available imagery includes the various products produced by the National Agricultural Imagery Program (NAIP) and those collected by the BOR. These typically include 1-m and 2-m products in both color infrared and true color formats. All available imagery sets will be evaluated prior to the start of work at LARO and the latest high-quality set will be used as the basemap. Based on the resource management needs in other parks the NAIP imagery will be supplemented with any existing aerial photography, preferably color-infrared aerial photography at 1:12,000-scale

Assumptions:

- Existing aerial photography and NAIP imagery will be of sufficient quality to conduct all PI, attribution, and digital (GIS) database development.

Table 48. Estimated Costs for Imagery and Photography for LARO

Task Topic	CTI/UCBN	Costs	Discussion
NAIP Imagery	-	-	The NAIP Imagery will be provided by UCBN
Existing Aerial Photography	-	-	It is anticipated that existing photography will be provide at little or no cost.
Totals	**-**	**-**	--

Task Deliverables: A mosaic of the NAIP imagery will be created.

TASK 4.0 Field Data Collection

Due to its size, LARO falls into the very large size park category (TNC 1994b) for vegetation mapping. In lieu of a formal gradsect CTI will work with the UCBN, NWM and LARO staff to provide existing land cover and vegetation maps already created to create sampling units. These units will by visited by the field crews in 2007. The distribution and completeness of this sampling effort will be reviewed by CTI and UCBN. If apparent short-coming are found supplemental plot collection efforts will be undertaken in 2008. To date, very minimal legacy data exists for LARO that would be useful for this project. Standard ancillary data such as soils, geology and hydrology for the area will be used to assist in sample site selection and the photointerpretation.

Vegetation within LARO will be sampled using two approaches. These are observation point data and plot data. Observation points are used to guide aerial photointerpretation and vegetation plot data collection by identifying representative or unique signatures from the aerial photos or field maps concerning the distribution of plant associations within the park. Vegetation plot data are more rigorous in design than observation points and included precise location, provisional association name, physical environment information, topographic data, physiognomic data, species lists, height classes, foliar cover values, diameter at breast height measurements for trees over 10 centimeters in diameter, and environmental notes and observations by researchers. Vegetation plots are necessary to prepare the classification and as such they are subjectively placed in vegetation types that are representative of an area, relatively homogenous, and larger than the 0.5 hectare (ha) minimum mapping unit (MMU). Ecotones were avoided to the extent possible.

A minimum of two ground photographs for each vegetation plot will be taken at each plot. Photos are digital, logged in a summary table, and labeled. Minimal fire fuel and related data may also be recorded if deemed necessary at the scoping meeting. Vegetation plot data will be collected in accordance with the methods established during the planning meeting. **Table 4** identifies the plot sizes based on the vegetation types sampled.

The contractor collecting the plots will be responsible for entering it into the UCBN database. This species entered into the database will follow ITIS as a standard. The UCBN database is based on the TNC Plots database used in the USGS-NPS Vegetation Mapping Program. Upon receipt the database will be checked for completeness and accuracy by UCBN staff.

Assumptions:

- Legacy data useful for this project are minimal at LARO
- Approximately 400 vegetation plots (at a rate of 5/day) would be sampled to prepare an accurate classification.
- Approximately 200 observation would be recorded (at a rate of 12/day) to assist in PI efforts, and to check interpretation accuracy. These may be collected in the field by members of the vegetation sampling crew or individuals conducting aerial photointerpretation.
- Issues of access due to topography and/or private land-owners may reduce the number of plots in some plant communities.

Table 49. Proposed Level of Effort for Field Data Collection (in days).

Data Collection Topic	NWM or similar	Costs	Discussion
200 Observation Points	20 days	$15,200	--
400 Plots	40 days	$60,000	--
Misc. (Boat, Supplies)	-	$28,975	
Total (days)	**45 days**	**$ 104,175**	--

Task Deliverables: 400 plots and 200 observation points representing the vegetation communities at LARO will be delivered to UCBN. Data will be delivered in either paper or digital form.

TASK 5.0 Vegetation Classification, Alliance/Association Descriptions and Field Key

Following vegetation plot data collection and data entry Washington Heritage staff will analyze the data and classify it into the National Vegetation Classification System (NVCS) (Grossman et al. 1998). The NVCS as developed by The Nature Conservancy and currently maintained by NatureServe represents a national system containing seven classification levels with the finest being the plant association.

Following entry into the Plots database, species foliar cover values for each plot will be exported into a spreadsheet format and arranged into a plot by species data matrix. Several of the species recorded in the Plots database, primarily trees and shrubs, may occupy more than one stratum within a particular plot. Such layers provide valuable information regarding the structural

diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer should be subscripted with a strata code (e.g., T1, T2, S1, S2, S3). The matrix will be used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Following procedures described by Grossman et al. (1998) and McCune and Mefford (1999), the data matrix would be analyzed as necessary using TWINSPAN, Cluster Analysis (relative Euclidian distance measure with Ward's method of group linkage), and DECORANA (an ordination technique). The matrix can be edited prior to analysis by first removing all species that had total cover values (summed over all plots) of less than or equal to 1 percent to keep the influence of minor species at a minimum. Raw foliar cover scores should be used in all data analysis procedures. The data matrix will then be subjectively evaluated for plots that demonstrated exceptionally low similarity to the remaining plots (outliers). Outlier plots are common in relatively large data sets and occur because of disturbed, heterogeneous, or otherwise unusual sites, or because of gaps in sampling (Gauch 1982). Removing outliers would likely increase the efficiency of the analysis and substantially improve the interpretability of the results.

Draft vegetation classification efforts would be reviewed by Washington Heritage staff, LARO staff and UCBN in terms of regional data and existing classification. NPS ecologists would discuss and incorporate suggested revisions, as necessary. After the data has been classified local and global descriptions for each association will be created. Local descriptions of vegetation associations or alliance if associations can't be determined (as they occur throughout LARO) will be drafted by Washington Heritage ecologists with input from the field crews. Local descriptions will focus on the park-wide variation including the unique characteristics of the association. Generally, three to four local descriptions can be written in one day depending on the complexity of the vegetation type. The global descriptions for the associations will be modified and up-dated using these local descriptions.

After the data has been classified an illustrated field key will be created that will have dichotomous breaks. This key will walk an average person familiar with the vegetation at LARO through the associations/alliances in a stepwise fashion. During construction members of the field data collection team should be used to help provide information for the key and to test it once completed. For consistency, this key will be used by the ecologists collecting accuracy assessment points to record the correct field classification. This task would require preparation of a plant association field key, annotation of each couplet in the key with diagnostic field descriptions, and illustration of the key with color slides or digital photos taken in the field at vegetation plot sites. This key will also be invaluable for future researchers, interpretive specialists, and visitors interested in vegetation distribution.

Assumptions:

- Vegetation plots will likely number around 200 for the LARO project.
- It is assumed that approximately 40 plant associations will be determined for LARO.
- An ecologist familiar with LARO vegetation will prepare the illustrated plant association field key.

Table 50. Proposed Level of Effort for Classification and Descriptions (in days)

Task Topic	Washington Heritage	Costs	Discussion
Final classification	10 days	$4,800	Statistical analyses performed by Washington Heritage with NatureServe.
Local Descriptions	30 days	$14,400	Local Descriptions for the associations/alliances at LARO
Global Descriptions	10 days	$4,800	NatureServe review of the descriptions and incorporation into the NVCS
Field Key Prep.	4 days	$1353.25	Obligated (**Attachment B**)
Total (days)	**44 days**	**$25,353.25**	--

Task Deliverables: A preliminary list of associations and alliances will be delivered to UCBN prior to the scoping meeting. A comprehensive, classified list of plant association/alliances will be created in the NVC using the plot and observation data. Local descriptions for all associations/alliances will by used to update the global descriptions. An illustrated field key will be created for the vegetation associations/alliance at LARO prior to the start of accuracy assessment data collection.

TASK 6.0 Aerial Photointerpretation and Segmentation

Delineation and mapping of the vegetation at LARO will include a combination of automated image segmentation using eCognition or similar software and traditional photointerpretation (PI). Segmentation will be used to delineate easily observed features and features with high contrast such as open water, roads, and bare rock using the existing NAIP imagery. Once completed this initial map will be further refined though PI using the new photos acquired in 2007. PI will use the standard photo signature characteristics (tone, texture, color, shape, etc…) and ancillary data (slope, elevation, aspect, etc…) to further delineate the final detail of the map classes. Map classes will strive to maintain a 1:1 ratio of map class to plant association. The final mapping scheme will be determined by at a meeting or conference call between the NPS and contract staff. Typically the map classes in these project cover three basic considerations, 1) incorporating the NVC associations/alliances, 2) recognizing the limitations of the imagery (i.e. can you reliably see the plant association on the photo), and 3) covering the management needs of LARO. The final mapping product will also include all necessary attribution consisting of the vegetation map classes, general height and density modifiers and links to the NVC. It is anticipated that approximately 45 plant associations/alliances and up to 20 land use/bare ground/geology types will be considered as potential map classes. One reconnaissance field trip to ground-truth and obtain photo-signature information by the photo interpreters will be conducted annually during the project.

Photointerpretation is most effectively accomplished when an initial classification has been performed, limiting the amount of cross-walk necessary between interpreted map units and the final classification (developed with the input of NatureServe). The individual responsible for PI should also provide input into the GIS process and review the final GIS layer for quality and consistency. An accurate, descriptive photointerpretive key will be created to allow all future

researchers to understand the interpretive cues used to delineate polygons, which may help to refine the process for future efforts.

Assumptions:

- The BOR Remote Sensing and GIS Group will perform the PI
- PI work will be conducted at 1500 acres/day. These rates may require adjustment during the process, as photointerpretation proceeds.
- Level of effort will be calculated based an approximate 50,000 acre project area.
- The PI investigator will assist the GIS technician to produce a photointerpretive key.

Table 51. Proposed Level of Effort for PI (in days)

PI Topic	CTI	Costs	Discussion
Photointerpretation	250 days	$120,296	--
Quality Check of GIS	6 days	$5,328	Check draft vegetation plots back to interpreted photography.
Photointerpretation key	10 days	$8,800	Provide representative signatures to the GIS technicians to document PI work for future database users.
Field Recon	20 days	$17,760	Includes time and travel costs for trip.
Total (days)	**218 days**	**$152,200**	--

Task Deliverables: A preliminary vegetation map to the formation level will be created using segmentation techniques. Final detail will be created on aerial photo overlays.

TASK 7.0 Digital Database and Vegetation Map Preparation

Once all of the image processing and PI is completed the final digital database and vegetation map will be created and populated. This will include creating a spatial GIS layer using ArcGIS software. One seamless GIS layer will be created for LARO by transferring the PI and segmentation information onto the NAIP imagery. Steps required for this task include: digitizing the linework, rectifying it to the basemap, edge-matching, performing a thorough cleaning and weeding process and finally attributing all of the polygons with the necessary vegetation information.

Quality control cannot be overstated in the automation of interpreted vegetation data. One of the more useful practices is to review draft digital data (hard-copy map), usually a quarter-quadrangle at a time, back to the interpreted aerial photograph. GIS quality checks are most effectively performed by the PI specialists. In addition, it is a common practice for producers of a digital database to perform an accuracy check or vegetation map field validation check following initial transfer, digitization, and quality checking. The map validation field check allows a visual review of PI work versus plant associations and land use types. Some observation points may be recorded to more adequately define confusing plant association signatures.

Assumptions:

- The BOR Remote Sensing and GIS Group will create the database and map.
- GIS automation and preparation of the final database will include a hybrid combination of scanning, on-screen digitizing, and image processing/segmentation techniques to delineate and automate interpreted data.
- GIS database building – geo-referencing, attributing, edge matching, and quality checking will occur at a rate approximately one-half that of the PI effort.
- Appropriate metadata files will be created as the GIS process proceeds.
- All GIS products will meet or exceed FGDC and USGS/NPS Map Accuracy Standards for 1:12,000-scale maps.

Table 52. Proposed Level of Effort for Digital Database and Vegetation Map Preparation

Task Topic	CTI	Costs	Discussion
Data automation, georeferencing	114 days	$54,840	Includes scanning Mylar overlays and georeferencing.
Attribution and edge matching	22 days	$10,560	--
Quality checking	10 days	$4,800	Provide hard-copy plot to PI technician for field verification.
Metadata	10 days	$4,800	This task could include training, metadata development, and metadata review.
Total (days)	**130 days**	**$75,000**	

Task Deliverables: A final vegetation digital GIS layer for LARO will be created. This will include all necessary attributes. FGDC-standard metadata will be created for this layer.

TASK 8.0 Accuracy Assessment

Requirements for the NPS Vegetation Mapping Program specify an 80% accuracy for each vegetation class that is mapped (map unit) which infers an 80% accurate vegetation map. In terms of spatial accuracy, the data are expected to meet national map accuracy standards and typically this assumed by the use of standard basemap such as the NAIP orthophotography. The AA procedures employed should be able to determine whether the vegetation map meets these requirements. The following recommendations have been made for AA efforts (TNC, NCGIA, and ESRI 1994):

- The AA should be independent of the mapping process;
- The AA should be point based with an observational unit equivalent to or larger than the minimum mapping unit;
- The recommended number of AA samples per map class should reflect the abundance of each map class in the project area;
- Thematic accuracy should be expressed using contingency matrices adjusted for chance agreement with a Kappa index (Foody 1994);
- AA should ideally capture all components of uncertainty associated with vegetation mapping; and
- AA procedures should be tested operationally to determine if methodology would need to be refined.

Randomly pre-selected accuracy assessment (AA) point coordinates would be plotted on a coded base map by the GIS group/agency responsible for producing the vegetation map. This plot will be used in the field as a point distribution guide, and would be most useful with polygon lines (but not attributes) in place. An ecologist would navigate to the coordinates using a global positioning system (GPS) receiver, use the plant association classification key to determine the appropriate type, and record data for an area the size of the minimum mapping unit around the point, on a modified observation point form. Two representative photos of the site will be taken to document the vegetation. **Attachment E** presents a sample accuracy assessment data collection form that could be modified for UCBN use.

Sample sizes for the AA would be calculated from analysis of the electronic database prepared from the PI. Abundant vegetation types would be sampled at least 30 times, relatively abundant and relatively rare types at least 20 times, and rare types at least 5 times. Very rare types would require visits to all polygons (TNC, NCGIA, and ESRI 1994).

It is anticipated that 800 - 1000 randomly located AA points will be used. Ten to 20 AA points can typically be recorded by an ecologist per field day (8 hours), considering the limitations of navigating to individual GPS coordinates present in LARO. It is estimated that the accuracy assessment point collection would take approximately 10 researcher days (average of 20 AA points per day). Upon completion all of the data will be entered into the UCBN Plots database. These will reviewed by UCBN staff for quality and accuracy.

Following collection of AA points in the field, the points are overlain on the map and error matrix or contingency table is created. The error matrix reports both the user's and producer's error (i.e. errors of omission and commission) and represents the AA points label vs. the map label. Once completed the error matrix will be presented at a meeting or conference call to the UCBN and LARO staff. Any deficiencies in the map will be addressed by either aggregating similar types to achieve the 80% standard or agreeing to live with the lower accuracy. Upon approval of the accuracy statistics for each map class will be calculated and the map modified accordingly.

Assumptions:

- Two contracted AA field team (two researchers each) would be used.
- All GPS units for field navigation will be supplied by the contracted field crews.
- Approximately 30 days will be needed to collect the AA data.
- The AA contractor will be responsible for entering the data into the UCBN database.
- All field maps and target points will be supplied by the GIS contractor.
- All analyses will be performed by the GIS contractor and reported as appropriate error matrices.

Table 53. Proposed Level of Effort for Accuracy Assessment (in days).

AA Topic	BOR and NWM	Costs	Discussion
Select random AA points and create maps	5 days	$4,440	Selection would be conducted by the GIS staff.
Collect field data	30 days	$48,000	Includes 4 ecologists for 20 days each and travel.
Analyze field data	5 days	$4,440	Preparation would be performed by GIS staff.
Modifications to the map	5 days	$4,440	Any changes will be updated in the GIS layer by GIS staff.
Total (days)	**45 days**	**$61,320**	

Task Deliverables: Approximately 1200 completed field forms, to be entered into the UCBN database will be collected at LARO. A preliminary contingency table of map accuracy will be produced and used in an AA meeting. The results of the AA meeting will be published as detailed meeting minutes. All AA methods and results will be included in the final report.

TASK 9.0 Final Report and Deliverables

Several elements are required for a comprehensive report including the National Vegetation Mapping Program summation and methodology; general site information that can affect or be affected by vegetation (e.g., climate, topography, geology, soils, hydrology, historic land use, etc.); current land uses (particularly important for the environs); LARO and UCBN management goals, and the methods and results for field data that were collected and analyzed. A detailed discussion of results related to the classification and PI work is also necessary to improve understanding by and provide guidance to LARO and UCBN managers and other database users. These are aided by illustrations of the park landscape and plant associations and by illustrated keys to aerial photography signatures. In addition, it is important for users to understand the assessment of accuracy and its implications when using the base vegetation map. The report will also contain a discussion on future recommendations, how to improve the products and possible add-on projects.

Along with the report other deliverables include a final paper map and layout to highlight the vegetation layer. All digital data will be contained on a CD-Rom or DVD including copies of the report and map layout. All graphics included in the report will also be included. Typically a draft of all the deliverables will be created and presented to LARO and UCBN staff for review and input. BOR will be responsible for the final editing and formatting. All material supplied by other contractors and agencies will be edited by BOR and included in one final comprehensive report. The final report will be submitted to CTI and UCBN for approval

Assumptions:

- NWI or similar contract ecologists will provide the methodology and summation of the field research; BOR will provide the methodology for the interpretive effort; GIS methodology and digital database production; and Washington Heritage will provide the classification documents.
- UCBN will provide the desired outline of site-specific report topics, if they differ from traditionally written reports and map layouts.
- BOR will be responsible for editing and producing the final report and other deliverables.

Table 54. Proposed Level of Effort for Report Production (in days)

Report Topic	CTI	Costs	Discussion
Draft Report	24 days	$11,520	Two days each assumed for UCBN and LARO review.
Final Map	20 days	$9,600	Includes minor expenses for report production (CDs, copies, etc.)
Final Report	60 days	$28,880	
Total (days)	**104 days**	**$50,000**	Minor expenses for report production (CDs, copies, etc.)

Task Deliverables: A final report covering all methods, results and discussions used in the vegetation mapping at LARO will be created. A final map highlighting the vegetation will be created. All documents will be provided to LARO and UCBN as paper and electronic versions.

MINIDOKA INTERNMENT NATIONAL MONUMENT (MIIN)

Start Date: FY06 - Anticipated End Date: FY08

Introduction

The Minidoka Relocation Internment Center is located in Jerome County, Idaho, 15 miles east of Jerome and 15 miles north of Twin Falls. The former Japanese relocation center lies within the Snake River Plain at an elevation of 4000 feet. The natural vegetation of this high desert area is dominated by sagebrush and other shrubs. Dominant geological features of the area are thin basaltic lava flows and cinder cones overlying thick rhyolite ash. The site covered up to 33,000 acres at one time. Currently the present monument is 73 acres. With a 2-km environs the total mapping area is expected to be around 300 acres (a ¼-mile scenario would yield about 200 acres).

TASK 1.0 Planning Sessions and Scoping Meetings

Preliminary planning and scoping for this project has been completed in conjunction with the Crater's of the Moon scoping meeting. Current NPS staff at Hagerman Fossil Beds also manages MIIN and they were present at the CRMO meeting. In general it was discussed that the environs should extend 2-km around the current park boundary (**Figure 3**). However if the boundary changes due to land acquisitions during the mapping stage this may be enlarged.

TASK 2.0 Preliminary Plant Alliance/Association and Species Lists

A preliminary list of plant associations and alliances including the known ecological systems for MIIN has been solicited from the ICDC (**Attachment B**). This will include an estimate on the likeliness that the type occurs at MIIN. A review of this list will be conducted by MIIN and UCBN staff with additions added to the list and types removed that are known not to occur in the area.

Assumption:

- Sufficient vegetation data occurs for this area that a preliminary list of associations can be created.

Table 55. Estimated Costs for Preliminary Plant Associations and Alliance for MIIN

Task Topic	ICDC	Costs	Discussion
Preliminary List	-	-	Currently obligated to ICDC as part of CRMO, HAFO, MIIN and CIRO agreement.
Totals	**-**	**-**	--

Task Deliverables: A preliminary list of plant associations and alliance for MIIN prepared by the ICDC will be presented to UCBN prior to the scoping meeting.

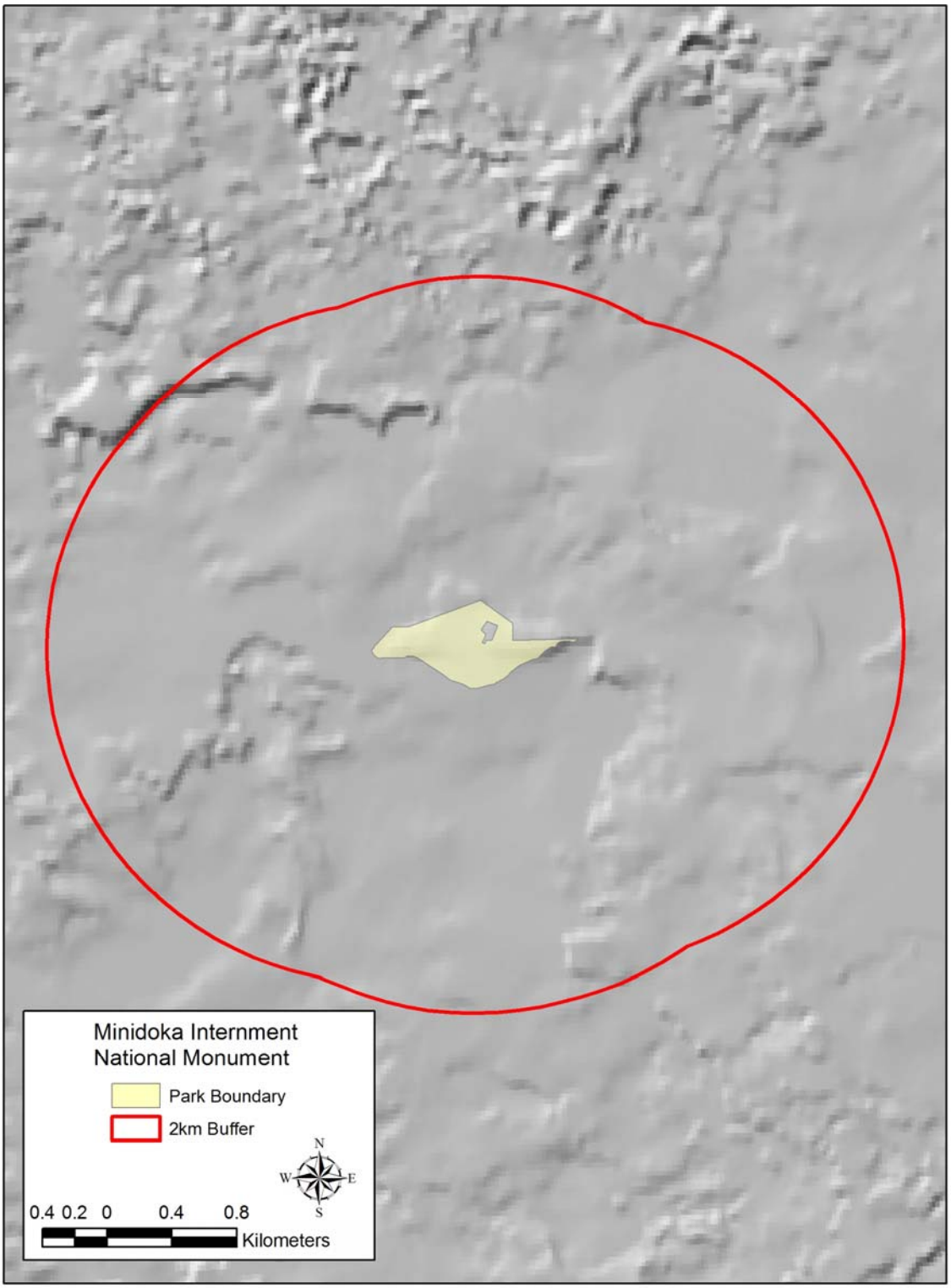


Figure 9. Approximate Project Boundary for MIIN Vegetation Mapping Project.
(Note: Figure does not show the ¼ mile buffer scenario)

TASK 3.0 Aerial Photography and Digital Ortho-photography Acquisition and Preparation

Available imagery includes the various products produced by the National Agricultural Imagery Program (NAIP). These typically include 1-m and 2-m products in both color infrared and true color formats. All available imagery sets will be evaluated prior to the start of work at LARO and the latest high-quality set will be used as the basemap. Based on the resource management needs in other parks the NAIP imagery will be supplemented with any existing aerial photography, preferably color-infrared aerial photography at 1:12,000-scale

Assumptions:

- Existing aerial photography and NAIP imagery will be of sufficient quality to conduct all PI, attribution, and digital (GIS) database development.

Table 56. Estimated Costs or Imagery and Photography for LARO

Task Topic	CTI/UCBN	Costs	Discussion
NAIP Imagery	-	-	The NAIP Imagery will be provided by UCBN
Existing Aerial Photography	-	-	It is anticipated that existing photography will be provide at little or no cost.
Totals	**-**	**-**	--

Task Deliverables: A mosaic of the NAIP imagery will be created.

TASK 4.0 Field Data Collection

Due to its size MIIN falls into the small size park category (TNC 1994b) for vegetation mapping. This category allows for the every polygon in the entire park to be the sampled. This small park protocol involves creating preliminary vegetation polygons beforehand using characteristics from the existing photography. Once created these polygons will be visited by the field crews and plot data will be collected at representative sites in each. It is anticipated that all areas of the park will be visited by field crews for sampling.

To date, very minimal legacy data exists for MIIN that would be useful for this project. Again due to its small size all new vegetation plots and observation points will be collected. Standard ancillary data such as soils, geology and hydrology for the area will be used to assist in sample site selection and the photointerpretation. If existing data is presented by MIIN or others at the kick-off meeting it will be evaluated using the program standards for usefulness (**Attachment D**) and incorporated into the project.

Vegetation within MIIN will be sampled using two approaches. These are observation point data and plot data. Observation points are used to guide aerial photointerpretation and vegetation plot data collection by identifying representative or unique signatures from the aerial photos or field maps concerning the distribution of plant associations within the park. Observation points are a more rapid form of data collection, these data are not collected from a standard plot, but rather describe an area, usually up to the program minimum mapping unit of 0.5 hectares. Vegetation plot data are more rigorous than observation points and include precise location, provisional association name, physical environment information, topographic data,

physiognomic data, species lists, height classes, foliar cover values, diameter at breast height measurements for trees over 10 centimeters in diameter, and environmental notes and observations by researchers. Vegetation plots are necessary to prepare the classification and as such they are subjectively placed in vegetation types that are representative of an area, relatively homogenous, and larger than the 0.5 hectare (ha) minimum mapping unit (MMU). Ecotones are avoided to the extent possible.

Unique vegetation patches less than the project MMU may also be sampled using vegetation plots. These are often termed "park specials" because of their value for overall management prescriptions, but fall below the project MMU. Again due its small size the multiple park specials will likely be mapping at MIIN. Resource management staff will be given the chance at the scoping meeting to discuss these options. Some common park special types include:

- Small patches of invasive and exotic plants;
- Small wetlands;
- Rare or endangered plants;

This work plan assumes that approximately 10 associations occur at MIIN and its environs. This would indicate that approximately 30 plots and 10 observation points would need to be collected to fully document the diversity. It is anticipated that work will be conducted by experienced field crews supplied by NWM, e^2M, or similar contractor. Experienced field crews will allow for efficient sampling, minimal instruction and little oversight. New field observation points and plots will be collected using the standard observation point and plot form (either paper or digital) created by UCBN in conjunction with the national program (**Attachment E**). During the planning meeting it will be determined if sampling is required/permitted within project environs, and at what level sampling would proceed.

A minimum of two ground photographs for each vegetation plot will be taken. Photos would be digital, logged in a summary table, and labeled. Fire fuel and related issues will be discussed at the scoping meeting. If it is deemed necessary for MIIN, additional data forms will be used to capture basic fuel loading information (**Attachment E**). If fire is not a concern only the first pages of the field form will be used. Vegetation plot data will be collected in accordance with the methods established during the planning meeting and will follow size guidelines provided in **Table 4**.

The contractor collecting the data will be responsible for entering it into the UCBN database. This species entered into the database will follow ITIS as a standard. The UCBN database will be based on the TNC Plots database used in the USGS-NPS Vegetation Mapping Program. Upon entry the database will be checked for completeness and accuracy by UCBN staff.

Assumptions:

- Legacy data useful for this project are minimal at MIIN
- Approximately 30 vegetation plots (at a rate of 5/day) would be sampled to prepare an accurate classification.
- Approximately 10 observation would be recorded (at a rate of 12/day) to assist in PI efforts, and to check interpretation accuracy. These may be collected in the field by members of the vegetation sampling crew or individuals conducting aerial photointerpretation.
- Issues of access due to topography and/or private land-owners may reduce the number of plots in some plant communities.

Table 57. Proposed Level of Effort for Field Data Collection (in days).

Data Collection Topic	NWM or similar	Costs	Discussion
10 Observation Points	3 days	$600	Minimal Travel and Expenses are included.
30 Plots	5 days	$4,500	Minimal Travel and Expenses are included.
Total (days)	**8 days**	**$5,100**	--

Task Deliverables: 30 plots and 10 observation points representing the vegetation communities at MIIN will be delivered to UCBN. Data will be delivered in either paper or digital form.

TASK 5.0 Vegetation Classification, Alliance/Association Descriptions and Field Key

Following vegetation plot data collection and data entry ICDC staff will analyze the data and classify it into the National Vegetation Classification System (NVCS) (Grossman et al. 1998). The NVCS as developed by The Nature Conservancy and currently maintained by NatureServe represents a national system containing seven classification levels with the finest being the plant association. Associations are separated from the next highest category, alliance, through the use of total floristic composition and are named by the most dominant and/or indicator species.

Following entry into the Plots database, species foliar cover values for each plot will be exported into a spreadsheet format and arranged into a plot by species data matrix. Several of the species recorded in the Plots database, primarily trees and shrubs, may occupy more than one stratum within a particular plot. Such layers provide valuable information regarding the structural diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer should be subscripted with a strata code (e.g., T1, T2, S1, S2, S3). The matrix will be used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Since MIIN is a small park it is anticipated that the analyses of the plot data will be minimal. Hopefully most of the types have already been described for Idaho and will only have to be verified. Draft vegetation classification efforts would be reviewed by ICDC, MIIN staff and UCBN in terms of regional data and existing classification. NPS ecologists would discuss and incorporate suggested revisions, as necessary. After the data has been classified local and global descriptions for each association will be created. Local descriptions of vegetation associations or alliance if associations can't be determined (as they occur throughout MIIN) will be drafted by ICDC ecologists with input from the field crews. Local descriptions will focus on the park-wide variation including the unique characteristics of the association. Generally, three to four local descriptions can be written in one day depending on the complexity of the vegetation type. The global descriptions for the associations will be modified and up-dated using these local descriptions.

After the data has been classified an illustrated field key will be created that will have dichotomous breaks. This key will walk an average person familiar with the vegetation at MIIN through the associations/alliances in a stepwise fashion. During construction members of the field data collection team should be used to help provide information for the key and to test it once completed. For consistency, this key will be used by the ecologists collecting accuracy assessment points to record the correct field classification. This task would require preparation of a plant association field key, annotation of each couplet in the key with diagnostic field descriptions, and illustration of the key with color slides or digital photos taken in the field at vegetation plot sites. This key will also be invaluable for future researchers, interpretive specialists, and visitors interested in vegetation distribution.

Assumptions:

- Vegetation plots will likely number around 60 for the MIIN project.
- It is assumed that approximately 20 plant associations will be determined for MIIN.
- An ecologist familiar with MIIN vegetation will prepare the illustrated plant association field key.

Table 58. Proposed Level of Effort for Classification and Descriptions (in days)

Task Topic	Washington Heritage	Costs	Discussion
Final classification	1 days	$640	Statistical analyses performed by ICDC with NatureServe.
Local Descriptions	5 days	$2,400	Local Descriptions for the associations/alliances at MIIN
Global Descriptions	1 days	$640	NatureServe review of the descriptions and incorporation into the NVCS
Field Key Prep.	4 days	$1353.25	Obligated (**Attachment B**)
Total (days)	**11 days**	**$5,033.25**	--

Task Deliverables: A preliminary list of associations and alliances will be delivered to UCBN prior to the scoping meeting. A comprehensive, classified list of plant association/alliances will be created in the NVC using the plot and observation data. Local descriptions for all associations/alliances will by used to update the global descriptions. An illustrated field key will be created for the vegetation associations/alliance at MIIN prior to the start of accuracy assessment data collection.

TASK 6.0 Aerial Photointerpretation and Segmentation

Delineation and mapping of the vegetation at MIIN will include a combination of automated image segmentation using eCognition or similar software and traditional photointerpretation (PI). Segmentation will be used to delineate easily observed features and features with high contrast such as open water, roads, and bare rock using the existing NAIP imagery. Once completed this initial map will be further refined though PI using the new photos acquired in 2007. PI will use the standard photo signature characteristics (tone, texture, color, shape, etc…) and ancillary data (slope, elevation, aspect, etc…) to further delineate the final detail of the map

classes. Map classes will strive to maintain a 1:1 ratio of map class to plant association. The final mapping scheme will be determined by at a meeting or conference call between the NPS and contract staff. Typically the map classes in these project cover three basic considerations, 1) incorporating the NVC associations/alliances, 2) recognizing the limitations of the imagery (i.e. can you reliably see the plant association on the photo), and 3) covering the management needs of MIIN. The final mapping product will also include all necessary attribution consisting of the vegetation map classes, general height and density modifiers and links to the NVC. It is anticipated that approximately 20 plant associations/alliances and up to 20 land use/bare ground/geology types will be considered as potential map classes. One reconnaissance field trip to ground-truth and obtain photo-signature information by the photo interpreters will be conducted annually during the project.

Photointerpretation is most effectively accomplished when an initial classification has been performed, limiting the amount of cross-walk necessary between interpreted map units and the final classification (developed with the input of NatureServe). The individual responsible for PI should also provide input into the GIS process and review the final GIS layer for quality and consistency. An accurate, descriptive photointerpretive key will be created to allow all future researchers to understand the interpretive cues used to delineate polygons, which may help to refine the process for future efforts. Typically photo interpretation for these efforts proceeds at about 1000/acres per day.

Assumptions:

- PI work will be conducted at 1000 acres/day. These rates may require adjustment during the process, as photointerpretation proceeds.
- Level of effort will be calculated based an approximate 500 acre project area.
- The PI investigator will assist the GIS technician to produce a photointerpretive key.

Table 59. Proposed Level of Effort for PI (in days)

PI Topic	CTI	Costs	Discussion
Photointerpretation	15 days	$7,200	--
Quality Check of GIS	10 days	$4,800	Check draft vegetation plots back to interpreted photography.
Photointerpretation key	10 days	$4,800	Provide representative signatures to the GIS technicians to document PI work for future database users.
Field Recon	4 days	$1,920	Includes time and travel costs for trip.
Total (days)	**39 days**	**$18,720**	--

Task Deliverables: A preliminary vegetation map to the formation level will be created using segmentation techniques. Final detail will be created on aerial photo overlays.

TASK 7.0 Digital Database and Vegetation Map Preparation

Once all of the image processing and PI is completed the final digital database and vegetation map will be created and populated. This will include creating a spatial GIS layer using ArcGIS software. One seamless GIS layer will be created for MIIN by transferring the PI and segmentation information onto the NAIP imagery. Steps required for this task include: digitizing the linework, rectifying it to the basemap, edge-matching, performing a thorough cleaning and weeding process and finally attributing all of the polygons with the necessary vegetation information.

Quality control cannot be overstated in the automation of interpreted vegetation data. One of the more useful practices is to review draft digital data (hard-copy map), usually a quarter-quadrangle at a time, back to the interpreted aerial photograph. GIS quality checks are most effectively performed by the PI specialists. In addition, it is a common practice for producers of a digital database to perform an accuracy check or vegetation map field validation check following initial transfer, digitization, and quality checking. The map validation field check allows a visual review of PI work versus plant associations and land use types. Some observation points may be recorded to more adequately define confusing plant association signatures.

Assumptions:

- GIS automation and preparation of the final database will include a hybrid combination of scanning, on-screen digitizing, and image processing/segmentation techniques to delineate and automate interpreted data.
- GIS database building – geo-referencing, attributing, edge matching, and quality checking will occur at a rate approximately one-half that of the PI effort.
- Appropriate metadata files will be created as the GIS process proceeds.
- All GIS products will meet or exceed FGDC and USGS/NPS Map Accuracy Standards for 1:12,000-scale maps.

Table 60. Proposed Level of Effort for Digital Database and Vegetation Map Preparation

Task Topic	CTI	Costs	Discussion
Data automation, georeferencing	10 days	$4,800	Includes scanning Mylar overlays and georeferencing.
Attribution and edge matching	10 days	$4,800	--
Quality checking	10 days	$4,800	Provide hard-copy plot to PI technician for field verification.
Metadata	9 days	$4,320	This task could include training, metadata development, and metadata review.
Total (days)	**39 days**	**$18,720**	

Task Deliverables: A final vegetation digital GIS layer for MIIN will be created. This will include all necessary attributes. FGDC-standard metadata will be created for this layer.

TASK 8.0 Accuracy Assessment

Requirements for the NPS Vegetation Mapping Program specify an 80% accuracy for each vegetation class that is mapped (map unit) which infers an 80% accurate vegetation map. In terms of spatial accuracy, the data are expected to meet national map accuracy standards and typically this assumed by the use of standard basemap such as the NAIP orthophotography. The AA procedures employed should be able to determine whether the vegetation map meets these requirements. The following recommendations have been made for AA efforts (TNC, NCGIA, and ESRI 1994):

- The AA should be independent of the mapping process;
- The AA should be point based with an observational unit equivalent to or larger than the minimum mapping unit;
- The recommended number of AA samples per map class should reflect the abundance of each map class in the project area;
- Thematic accuracy should be expressed using contingency matrices adjusted for chance agreement with a Kappa index (Foody 1994);
- AA should ideally capture all components of uncertainty associated with vegetation mapping; and
- AA procedures should be tested operationally to determine if methodology would need to be refined.

Randomly pre-selected accuracy assessment (AA) point coordinates would be plotted on a coded base map by the GIS group/agency responsible for producing the vegetation map. This plot will be used in the field as a point distribution guide, and would be most useful with polygon lines (but not attributes) in place. An ecologist would navigate to the coordinates using a global positioning system (GPS) receiver, use the plant association classification key to determine the appropriate type, and record data for an area the size of the minimum mapping unit around the point, on a modified observation point form. Two representative photos of the site will be taken to document the vegetation. **Attachment E** presents a sample accuracy assessment data collection form that could be modified for UCBN use.

Sample sizes for the AA would be calculated from analysis of the electronic database prepared from the PI. Abundant vegetation types would be sampled at least 30 times, relatively abundant and relatively rare types at least 20 times, and rare types at least 5 times. Very rare types would require visits to all polygons (TNC, NCGIA, and ESRI 1994).

It is anticipated that 100 randomly located AA points will be used. Ten to 20 AA points can typically be recorded by an ecologist per field day (8 hours), considering the limitations of navigating to individual GPS coordinates present in MIIN. It is estimated that the accuracy assessment point collection would take approximately 10 researcher days (average of 20 AA points per day). Upon completion all of the data will be entered into the UCBN Plots database. These will reviewed by UCBN staff for quality and accuracy.

Following collection of AA points in the field, the points are overlain on the map and error matrix or contingency table is created. The error matrix reports both the user's and producer's error (i.e. errors of omission and commission) and represents the AA points label vs. the map label. Once completed the error matrix will be presented at a meeting or conference call to the UCBN and MIIN staff. Any deficiencies in the map will be addressed by either aggregating similar types to achieve the 80% standard or agreeing to live with the lower accuracy. Upon approval

of the accuracy statistics for each map class will be calculated and the map modified accordingly.

Assumptions:

- One contracted AA field team (two researchers) would be used.
- All GPS units for field navigation will be supplied by the contracted field crews.
- Approximately 5 days will be needed to collect the AA data.
- The AA contractor will be responsible for entering the data into the UCBN database.
- All field maps and target points will be supplied by the GIS contractor.
- All analyses will be performed by the GIS contractor and reported as appropriate error matrices.

Table 61. Proposed Level of Effort for Accuracy Assessment (in days).

AA Topic	CTI and NWM	Costs	Discussion
Select random AA points and create maps	1 day	$480	Selection would be conducted by the GIS staff.
Collect field data	5 days	$6,000	Includes 2 ecologists and travel.
Analyze field data	2 days	$960	Preparation would be performed by GIS staff.
Modifications to the map	2 days	$960	Any changes will be updated in the GIS layer by GIS staff.
Total (days)	**10 days**	**$8,400**	

Task Deliverables: Approximately 100 completed field forms, to be entered into the UCBN database will be collected at MIIN. An overlay exercise will produce a preliminary contingency table of map accuracy to be used in an AA meeting. The results of the AA meeting will be published as detailed meeting minutes. All AA methods and results will be included in the final report.

TASK 9.0 Final Report and Deliverables

Several elements are required for a comprehensive report including the National Vegetation Mapping Program summation and methodology; general site information that can affect or be affected by vegetation (e.g., climate, topography, geology, soils, hydrology, historic land use, etc.); current land uses (particularly important for the environs); MIIN and UCBN management goals, and the methods and results for field data that were collected and analyzed. A detailed discussion of results related to the classification and PI work is also necessary to improve understanding by and provide guidance to MIIN and UCBN managers and other database users. These are aided by illustrations of the park landscape and plant associations and by illustrated keys to aerial photography signatures. In addition, it is important for users to understand the assessment of accuracy and its implications when using the base vegetation map. The report will also contain a discussion on future recommendations, how to improve the products and possible add-on projects.

Along with the report other deliverables include a final paper map and layout to highlight the vegetation layer. All digital data will be contained on a CD-Rom or DVD including copies of the report and map layout. All graphics included in the report will also be included. Typically a draft of all the deliverables will be created and presented to MIIN and UCBN staff for review and

input. CTI will be responsible for the final editing and formatting. All material supplied by other contractors and agencies will be edited by CTI and included in one final comprehensive report.

Assumptions:

- NWI or similar contract ecologists will provide the methodology and summation of the field research; CTI will provide the methodology for the interpretive effort; GIS methodology and digital database production; and ICDC will provide the classification documents.
- UCBN will provide the desired outline of site-specific report topics, if they differ from traditionally written reports and map layouts.
- CTI will be responsible for editing and producing the final report and other deliverables.

Table 62. Proposed Level of Effort for Report Production (in days)

Report Topic	CTI	Costs	Discussion
Draft Report	10 days	$4,800	Two days each assumed for UCBN and MIIN review.
Final Map	3 days	$1,440	Includes minor expenses for report production (CDs, copies, etc.)
Final Report	10 days	$4,800	
Total (days)	**23 days**	**$11,040**	Minor expenses for report production (CDs, copies, etc.)

Task Deliverables: A final report covering all methods, results and discussions used in the vegetation mapping at MIIN will be created. A final map highlighting the vegetation will be created. All documents will be provided to MIIN and UCBN as paper and electronic versions.

NEZ PERCE NATIONAL HISTORICAL PARK (NEPE)

Introduction

Nez Perce National Historical Park has thirty-eight sites spread over four states (Idaho, Montana, Oregon and Washington). Park sites exist on varied geography consisting of mountains, plains, prairies, and river corridors. The natural features extend across most of the eastern Pacific Northwest, through the north central Rocky Mountains, and into the Great Plains. For this project estimates are for the seven largest sites. These include the Bearpaw, Buffalo Eddy, Heart of the Monster, Old Chief Joseph, Spalding, Weippe Prairie and the White Bird Units. Total acreage is estimated at 20,000 acres that includes a 2-km environs around all sites (a ¼-mile buffer would be about 15,000 acres). Since the sites are spread out across a large area it should be noted that costs presented here are higher due travel, logistics, and increased data demands.

TASK 1.0 Planning Sessions and Scoping Meetings

Preliminary planning and scoping for this project is anticipated to be completed in conjunction with the Big Hole scoping meeting. This will minimize the amount of travel and expense. This meeting will be used to discuss the project design, imagery, photointerpretation/segmentation, plant distribution and ecology, and project review. Completion of the vegetation classification would involve planning and scoping with key agencies and organizations including the Montana State Heritage Program, ICDC, UCBN, CTI and NWM as appropriate and as necessary.

Assumptions:

- Sufficient planning and scoping will occur to establish project approach and milestones, complete field data collection to support a vegetation classification, photointerpretation/segmentation, and digital database production.
- Planning meetings with any contributing agencies would be informal and conducted between appropriate UCBN on-site staff.
- Existing vs. new aerial photography/imagery will be evaluated at the meeting and through discussion between NPS, UCBN, NEPE, and CTI staff.
- The sampling approach for field work will be discussed and finalized at the scoping meeting

At the scoping meeting a buffer area, or environs, should be agreed upon as the project boundary for the vegetation classification and mapping project and confirmed. For the purposes of this work plan, acreage totals were calculated assuming a 2-km environs area (**Figure 3**). If the environs area changes as a result of planning meeting discussions, the estimated level of effort for some tasks in this plan my change.

Task Deliverables: A summary of the scoping meeting minutes and copies of the presentations will be created and posted on the UCBN vegetation mapping website.

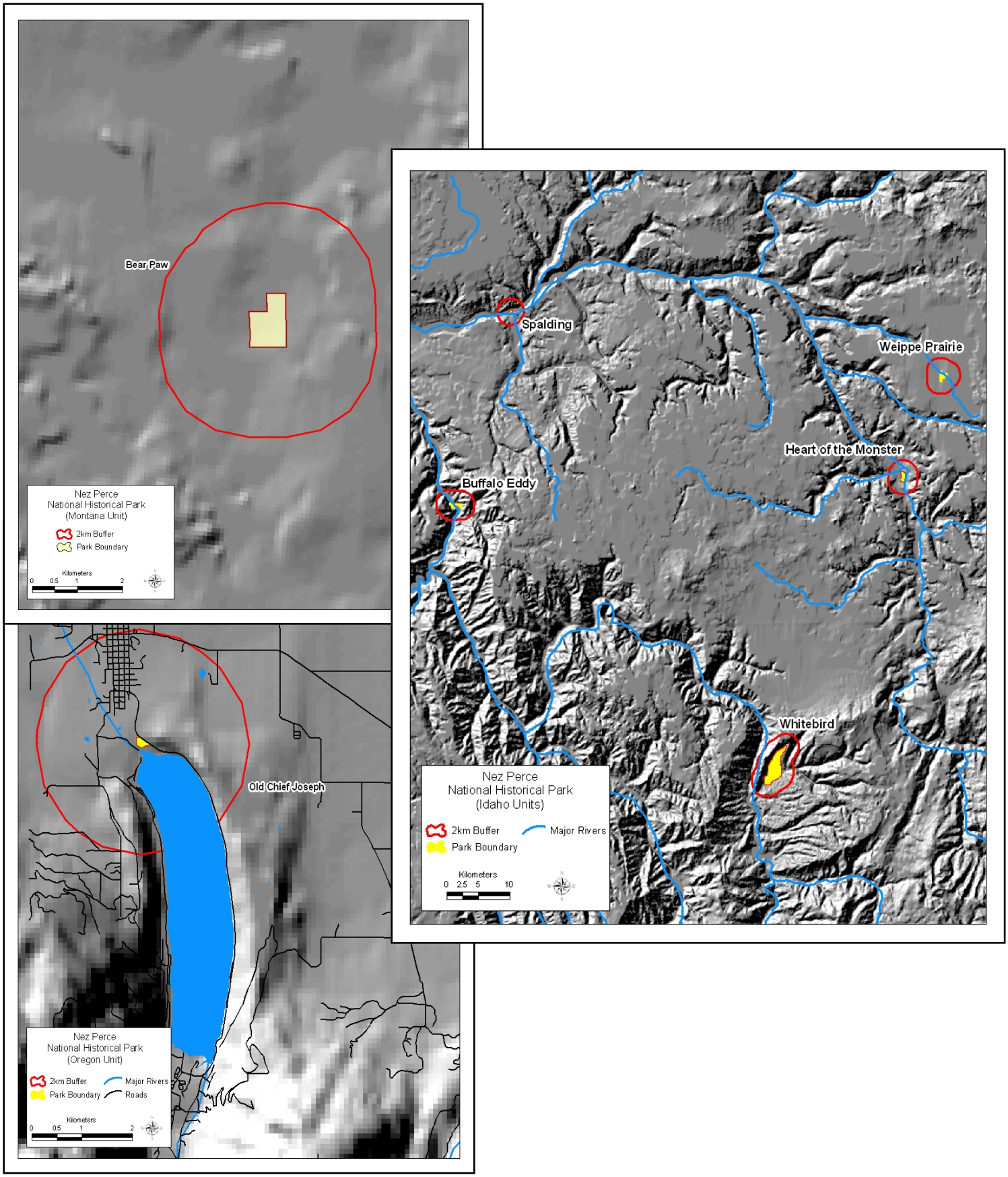


Figure 10. Approximate Project Boundary for NEPE Vegetation Mapping Project.
(Note: Figure does not show the ¼ mile buffer scenario)

TASK 2.0 Preliminary Plant Alliance/Association and Species Lists

A preliminary list of plant associations and alliances including the known ecological systems for NEPE will be solicited from the Montana State Natural Heritage Program and/or ICDC. This will include an estimate on the likeliness that the type occurs at NEPE. A review of this list will be conducted by NEPE and UCBN staff with additions added to the list and types removed that are known not to occur in the area.

Assumption:

- Sufficient vegetation data occurs for this area that a preliminary list of associations can be created.

Table 63. Estimated Costs for Preliminary Plant Associations and Alliance for NEPE

Task Topic	Montana Heritage	Costs	Discussion
Preliminary List	-	-	Time needed to create and update the association list for NEPE by the Montana State Heritage Program
Totals	**-**	**-**	--

Task Deliverables: A preliminary list of plant associations and alliance for NEPE prepared by the Montana State Natural Heritage Program will be presented to UCBN prior to the scoping meeting.

TASK 3.0 Aerial Photography and Digital Ortho-photography Acquisition and Preparation

Available imagery includes the various products produced by the National Agricultural Imagery Program (NAIP). These typically include 1-m and 2-m products in both color infrared and true color formats. All available imagery sets will be evaluated prior to the start of work at LARO and the latest high-quality set will be used as the basemap. Based on the resource management needs in other parks the NAIP imagery will be supplemented with any existing aerial photography, preferably color-infrared aerial photography at 1:12,000-scale

Assumptions:

- Existing aerial photography and NAIP imagery will be of sufficient quality to conduct all PI, attribution, and digital (GIS) database development.

Table 64. Estimated Costs for Imagery and Photography for LARO

Task Topic	CTI/UCBN	Costs	Discussion
NAIP Imagery	-	-	The NAIP Imagery will be provided by UCBN
Existing Aerial Photography	-	-	It is anticipated that existing photography will be provide at little or no cost.
Totals	**-**	**-**	--

Task Deliverables: A mosaic of the NAIP imagery will be created.

TASK 4.0 Field Data Collection

Due to its size NEPE falls into medium size park category (TNC 1994b) for vegetation mapping. This category allows for the entire park to be the sampled using representative polygons for each vegetation type. Polygons at NEPE will likely be set up as sampling areas selected by a combination of local expertise, soils and physical characteristics and the current land-cover map. No formal stratification or delineation of each type will be done due the small size of the actual individual park sites. It's anticipated that all areas of the park will be visited by field crews for sampling.

To date, very minimal legacy data exists for NEPE that would be useful for this project. Again due to its small size all new vegetation plots and observation points will be collected. Standard ancillary data such as soils, geology and hydrology for the area will be used to assist in sample site selection and the photointerpretation. If existing data is presented by NEPE or others at the kick-off meeting it will be evaluated using the program standards for usefulness (**Attachment D**) and incorporated into the project.

Vegetation within NEPE will be sampled using two approaches. These are observation point data and plot data. Observation points are used to guide aerial photointerpretation and vegetation plot data collection by identifying representative or unique signatures from the aerial photos or field maps concerning the distribution of plant associations within the park. Observation points are a more rapid form of data collection, these data are not collected from a standard plot, but rather describe an area, usually up to the program minimum mapping unit of 0.5 hectares. Vegetation plot data are more rigorous than observation points and include precise location, provisional association name, physical environment information, topographic data, physiognomic data, species lists, height classes, foliar cover values, diameter at breast height measurements for trees over 10 centimeters in diameter, and environmental notes and observations by researchers. Vegetation plots are necessary to prepare the classification and as such they are subjectively placed in vegetation types that are representative of an area, relatively homogenous, and larger than the 0.5 hectare (ha) minimum mapping unit (MMU). Ecotones are avoided to the extent possible.

Unique vegetation patches less than the project MMU may also be sampled using vegetation plots. These are often termed "park specials" because of their value for overall management prescriptions, but fall below the project MMU. Again due its small size the multiple park specials will likely be mapping at NEPE. Resource management staff will be given the chance at the scoping meeting to discuss these options. Some common park special types include:

- Small patches of invasive and exotic plants;
- Small wetlands;
- Rare or endangered plants;

This work plan assumes that approximately 40 - 60 associations occur at NEPE and its environs. This would indicate that approximately150 plots and 50 observation points would need to be collected to fully document the diversity. It is anticipated that work will be conducted by experienced field crews supplied by NWM, e^2M, or similar contractor. Experienced field crews will allow for efficient sampling, minimal instruction and little oversight. New field observation points and plots will be collected using the standard observation point and plot form (either paper or digital) created by UCBN in conjunction with the national program (**Attachment**

E). During the planning meeting it will be determined if sampling is required/permitted within project environs, and at what level sampling would proceed.

A minimum of two ground photographs for each vegetation plot will be taken. Photos would be digital, logged in a summary table, and labeled. Fire fuel and related issues will be discussed at the scoping meeting. If it is deemed necessary for NEPE, additional data forms will be used to capture basic fuel loading information (**Attachment E**). If fire is not a concern only the first pages of the field form will be used. Vegetation plot data will be collected in accordance with the methods established during the planning meeting and will follow size guidelines provided in **Table 4**.

The contractor collecting the data will be responsible for entering it into the UCBN database. This species entered into the database will follow ITIS as a standard. The UCBN database will be based on the TNC Plots database used in the USGS-NPS Vegetation Mapping Program. Upon entry the database will be checked for completeness and accuracy by UCBN staff.

Assumptions:

- Legacy data useful for this project are minimal at NEPE
- Approximately 150 vegetation plots (at a rate of 5/day) would be sampled to prepare an accurate classification.
- Approximately 50 observation would be recorded (at a rate of 12/day) to assist in PI efforts, and to check interpretation accuracy. These may be collected in the field by members of the vegetation sampling crew or individuals conducting aerial photointerpretation.
- Issues of access due to topography and/or private land-owners may reduce the number of plots in some plant communities.

Table 65. Proposed Level of Effort for Field Data Collection (in days).

Data Collection Topic	NWM or similar	Costs	Discussion
50 Observation Points	10 days	$3,000	Minimal Travel and Expenses are included.
150 Plots	20 days	$22,500	Minimal Travel and Expenses are included.
Total (days)	**30 days**	**$25,500**	--

Task Deliverables: 150 plots and 50 observation points representing the vegetation communities at NEPE will be delivered to UCBN. Data will be delivered in either paper or digital form.

TASK 5.0 Vegetation Classification, Alliance/Association Descriptions and Field Key

Following vegetation plot data collection and data entry Montana State Heritage or ICDC staff will analyze the data and classify it into the National Vegetation Classification System (NVCS) (Grossman et al. 1998). The NVCS as developed by The Nature Conservancy and currently maintained by NatureServe represents a national system containing seven classification levels with the finest being the plant association. Associations are separated from the next highest category, alliance, through the use of total floristic composition and are named by the most dominant and/or indicator species.

Following entry into the Plots database, species foliar cover values for each plot will be exported into a spreadsheet format and arranged into a plot by species data matrix. Several of the species recorded in the Plots database, primarily trees and shrubs, may occupy more than one stratum within a particular plot. Such layers provide valuable information regarding the structural diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer should be subscripted with a strata code (e.g., T1, T2, S1, S2, S3). The matrix will be used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Following procedures described by Grossman et al. (1998) and McCune and Mefford (1999), the data matrix would be analyzed as necessary using TWINSPAN, Cluster Analysis (relative Euclidian distance measure with Ward's method of group linkage), and DECORANA (an ordination technique). The matrix can be edited prior to analysis by first removing all species that had total cover values (summed over all plots) of less than or equal to 1 percent to keep the influence of minor species at a minimum. Raw foliar cover scores should be used in all data analysis procedures. The data matrix will then be subjectively evaluated for plots that demonstrated exceptionally low similarity to the remaining plots (outliers). Outlier plots are common in relatively large data sets and occur because of disturbed, heterogeneous, or otherwise unusual sites, or because of gaps in sampling (Gauch 1982). Removing outliers would likely increase the efficiency of the analysis and substantially improve the interpretability of the results.

Draft vegetation classification efforts would be reviewed by Montana State Heritage, ICDC, NEPE staff and UCBN in terms of regional data and existing classification. NPS ecologists would discuss and incorporate suggested revisions, as necessary. After the data has been classified local and global descriptions for each association will be created. Local descriptions of vegetation associations or alliance if associations can't be determined (as they occur throughout NEPE) will be drafted by either Montana State Heritage or ICDC ecologists with input from the field crews. Local descriptions will focus on the park-wide variation including the unique characteristics of the association. Generally, three to four local descriptions can be written in one day depending on the complexity of the vegetation type. The global descriptions for the associations will be modified and up-dated using these local descriptions.

After the data has been classified an illustrated field key will be created that will have dichotomous breaks. This key will walk an average person familiar with the vegetation at NEPE through the associations/alliances in a stepwise fashion. During construction members of the field data collection team should be used to help provide information for the key and to test it once completed. For consistency, this key will be used by the ecologists collecting accuracy

assessment points to record the correct field classification. This task would require preparation of a plant association field key, annotation of each couplet in the key with diagnostic field descriptions, and illustration of the key with color slides or digital photos taken in the field at vegetation plot sites. This key will also be invaluable for future researchers, interpretive specialists, and visitors interested in vegetation distribution.

Assumptions:

- Vegetation plots will likely number around 150 for the NEPE project.
- It is assumed that approximately 50 plant associations will be determined for NEPE.
- An ecologist familiar with NEPE vegetation will prepare the illustrated plant association field key.

Table 66. Proposed Level of Effort for Classification and Descriptions (in days)

Task Topic	Montana Heritage	Costs	Discussion
Final classification	11 days	$5,400	Statistical analyses performed by Montana Heritage with NatureServe.
Local Descriptions	10 days	$4,800	Local Descriptions for the associations/alliances at NEPE
Global Descriptions	5 days	$2,400	NatureServe review of the descriptions and incorporation into the NVCS
Field Key Prep.	5 days	$2,400	Prepare Illustrated Field Key
Total (days)	**25 days**	**$15,000**	--

Task Deliverables: A preliminary list of associations and alliances will be delivered to UCBN prior to the scoping meeting. A comprehensive, classified list of plant association/alliances will be created in the NVC using the plot and observation data. Local descriptions for all associations/alliances will by used to update the global descriptions. An illustrated field key will be created for the vegetation associations/alliance at NEPE prior to the start of accuracy assessment data collection.

TASK 6.0 Aerial Photointerpretation and Segmentation

Delineation and mapping of the vegetation at NEPE will include a combination of automated image segmentation using eCognition or similar software and traditional photointerpretation (PI). Segmentation will be used to delineate easily observed features and features with high contrast such as open water, roads, and bare rock using the existing NAIP imagery. Once completed this initial map will be further refined though PI using the new photos acquired in 2007. PI will use the standard photo signature characteristics (tone, texture, color, shape, etc…) and ancillary data (slope, elevation, aspect, etc…) to further delineate the final detail of the map classes. Map classes will strive to maintain a 1:1 ratio of map class to plant association. The final mapping scheme will be determined by at a meeting or conference call between the NPS and contract staff. Typically the map classes in these project cover three basic considerations, 1) incorporating the NVC associations/alliances, 2) recognizing the limitations of the imagery (i.e. can you reliably see the plant association on the photo), and 3) covering the management

needs of NEPE. The final mapping product will also include all necessary attribution consisting of the vegetation map classes, general height and density modifiers and links to the NVC. It is anticipated that approximately 50 plant associations/alliances and up to 20 land use/bare ground/geology types will be considered as potential map classes. One reconnaissance field trip to ground-truth and obtain photo-signature information by the photo interpreters will be conducted annually during the project.

Photointerpretation is most effectively accomplished when an initial classification has been performed, limiting the amount of cross-walk necessary between interpreted map units and the final classification (developed with the input of NatureServe). The individual responsible for PI should also provide input into the GIS process and review the final GIS layer for quality and consistency. An accurate, descriptive photointerpretive key will be created to allow all future researchers to understand the interpretive cues used to delineate polygons, which may help to refine the process for future efforts. Typically photo interpretation for these efforts proceeds at about 1000/acres per day.

Assumptions:

- PI work will be conducted at 1000 acres/day. These rates may require adjustment during the process, as photointerpretation proceeds.
- Level of effort will be calculated based an approximate 20,000 acre project area.
- The PI investigator will assist the GIS technician to produce a photointerpretive key.

Table 67. Proposed Level of Effort for PI (in days)

PI Topic	CTI	Costs	Discussion
Photointerpretation	25 days	$12,000	--
Quality Check of GIS	3 days	$1,440	Check draft vegetation plots back to interpreted photography.
Photointerpretation key	3 days	$1,440	Provide representative signatures to the GIS technicians to document PI work for future database users.
Field Recon	5 days	$3,000	Includes time and travel costs for trip.
Total (days)	**36 days**	**$17,880**	--

Task Deliverables: A preliminary vegetation map to the formation level will be created using segmentation techniques. Final detail will be created on aerial photo overlays.

TASK 7.0 Digital Database and Vegetation Map Preparation

Once all of the image processing and PI is completed the final digital database and vegetation map will be created and populated. This will include creating a spatial GIS layer using ArcGIS software. One seamless GIS layer will be created for NEPE by transferring the PI and segmentation information onto the NAIP imagery. Steps required for this task include: digitizing the linework, rectifying it to the basemap, edge-matching, performing a thorough cleaning and weeding process and finally attributing all of the polygons with the necessary vegetation information.

Quality control cannot be overstated in the automation of interpreted vegetation data. One of the more useful practices is to review draft digital data (hard-copy map), usually a quarter-

quadrangle at a time, back to the interpreted aerial photograph. GIS quality checks are most effectively performed by the PI specialists. In addition, it is a common practice for producers of a digital database to perform an accuracy check or vegetation map field validation check following initial transfer, digitization, and quality checking. The map validation field check allows a visual review of PI work versus plant associations and land use types. Some observation points may be recorded to more adequately define confusing plant association signatures.

Assumptions:

- GIS automation and preparation of the final database will include a hybrid combination of scanning, on-screen digitizing, and image processing/segmentation techniques to delineate and automate interpreted data.
- GIS database building – geo-referencing, attributing, edge matching, and quality checking will occur at a rate approximately one-half that of the PI effort.
- Appropriate metadata files will be created as the GIS process proceeds.
- All GIS products will meet or exceed FGDC and USGS/NPS Map Accuracy Standards for 1:12,000-scale maps.

Table 68. Proposed Level of Effort for Digital Database and Vegetation Map Preparation

Task Topic	CTI	Costs	Discussion
Data automation, georeferencing	10 days	$4,800	Includes scanning Mylar overlays and georeferencing.
Attribution and edge matching	10 days	$4,800	--
Quality checking	10 days	$4,800	Provide hard-copy plot to PI technician for field verification.
Metadata	2 days	$960	This task could include training, metadata development, and metadata review.
Total (days)	**17 days**	**$15,360**	

Task Deliverables: A final vegetation digital GIS layer for NEPE will be created. This will include all necessary attributes. FGDC-standard metadata will be created for this layer.

TASK 8.0 Accuracy Assessment

Requirements for the NPS Vegetation Mapping Program specify an 80% accuracy for each vegetation class that is mapped (map unit) which infers an 80% accurate vegetation map. In terms of spatial accuracy, the data are expected to meet national map accuracy standards and typically this assumed by the use of standard basemap such as the NAIP orthophotography. The AA procedures employed should be able to determine whether the vegetation map meets these requirements. The following recommendations have been made for AA efforts (TNC, NCGIA, and ESRI 1994):

- The AA should be independent of the mapping process;
- The AA should be point based with an observational unit equivalent to or larger than the minimum mapping unit;
- The recommended number of AA samples per map class should reflect the abundance of each map class in the project area;

- Thematic accuracy should be expressed using contingency matrices adjusted for chance agreement with a Kappa index (Foody 1994);
- AA should ideally capture all components of uncertainty associated with vegetation mapping; and
- AA procedures should be tested operationally to determine if methodology would need to be refined.

Randomly pre-selected accuracy assessment (AA) point coordinates would be plotted on a coded base map by the GIS group/agency responsible for producing the vegetation map. This plot will be used in the field as a point distribution guide, and would be most useful with polygon lines (but not attributes) in place. An ecologist would navigate to the coordinates using a global positioning system (GPS) receiver, use the plant association classification key to determine the appropriate type, and record data for an area the size of the minimum mapping unit around the point, on a modified observation point form. Two representative photos of the site will be taken to document the vegetation. **Attachment E** presents a sample accuracy assessment data collection form that could be modified for UCBN use.

Sample sizes for the AA would be calculated from analysis of the electronic database prepared from the PI. Abundant vegetation types would be sampled at least 30 times, relatively abundant and relatively rare types at least 20 times, and rare types at least 5 times. Very rare types would require visits to all polygons (TNC, NCGIA, and ESRI 1994).

It is anticipated that 300 randomly located AA points will be used. Ten to 20 AA points can typically be recorded by an ecologist per field day (8 hours), considering the limitations of navigating to individual GPS coordinates present in NEPE. It is estimated that the accuracy assessment point collection would take approximately 10 researcher days (average of 20 AA points per day). Upon completion all of the data will be entered into the UCBN Plots database. These will reviewed by UCBN staff for quality and accuracy.

Following collection of AA points in the field, the points are overlain on the map and error matrix or contingency table is created. The error matrix reports both the user's and producer's error (i.e. errors of omission and commission) and represents the AA points label vs. the map label. Once completed the error matrix will be presented at a meeting or conference call to the UCBN and NEPE staff. Any deficiencies in the map will be addressed by either aggregating similar types to achieve the 80% standard or agreeing to live with the lower accuracy. Upon approval of the accuracy statistics for each map class will be calculated and the map modified accordingly.

Assumptions:

- One contracted AA field team (two researchers) would be used.
- All GPS units for field navigation will be supplied by the contracted field crews.
- Approximately 15 days will be needed to collect the AA data.
- The AA contractor will be responsible for entering the data into the UCBN database.
- All field maps and target points will be supplied by the GIS contractor.
- All analyses will be performed by the GIS contractor and reported as appropriate error matrices.

Table 69. Proposed Level of Effort for Accuracy Assessment (in days).

AA Topic	CTI and NWM	Costs	Discussion
Select random AA points and create maps	1 day	$480	Selection would be conducted by the GIS staff.
Collect field data	15 days	$18,000	Includes 2 ecologists and travel.
Analyze field data	2 days	$960	Preparation would be performed by GIS staff.
Modifications to the map	2 days	$960	Any changes will be updated in the GIS layer by GIS staff.
Total (days)	**20 days**	**$20,400**	

Task Deliverables: Approximately 300 completed field forms, to be entered into the UCBN database will be collected at NEPE. An overlay exercise will produce a preliminary contingency table of map accuracy to be used in an AA meeting. The results of the AA meeting will be published as detailed meeting minutes. All AA methods and results will be included in the final report.

TASK 9.0 Final Report and Deliverables

Several elements are required for a comprehensive report including the National Vegetation Mapping Program summation and methodology; general site information that can affect or be affected by vegetation (e.g., climate, topography, geology, soils, hydrology, historic land use, etc.); current land uses (particularly important for the environs); NEPE and UCBN management goals, and the methods and results for field data that were collected and analyzed. A detailed discussion of results related to the classification and PI work is also necessary to improve understanding by and provide guidance to NEPE and UCBN managers and other database users. These are aided by illustrations of the park landscape and plant associations and by illustrated keys to aerial photography signatures. In addition, it is important for users to understand the assessment of accuracy and its implications when using the base vegetation map. The report will also contain a discussion on future recommendations, how to improve the products and possible add-on projects.

Along with the report other deliverables include a final paper map and layout to highlight the vegetation layer. All digital data will be contained on a CD-Rom or DVD including copies of the report and map layout. All graphics included in the report will also be included. Typically a draft of all the deliverables will be created and presented to NEPE and UCBN staff for review and input. CTI will be responsible for the final editing and formatting. All material supplied by other contractors and agencies will be edited by CTI and included in one final comprehensive report.

Assumptions:

- NWI or similar contract ecologists will provide the methodology and summation of the field research; CTI will provide the methodology for the interpretive effort; GIS methodology and digital database production; and Montana State Heritage will provide the classification documents.
- UCBN will provide the desired outline of site-specific report topics, if they differ from traditionally written reports and map layouts.
- CTI will be responsible for editing and producing the final report and other deliverables.

Table 70. Proposed Level of Effort for Report Production (in days)

Report Topic	CTI	Costs	Discussion
Draft Report	10 days	$4,800	Two days each assumed for UCBN and NEPE review.
Final Map	3 days	$1,440	Includes minor expenses for report production (CDs, copies, etc.)
Final Report	10 days	$4,800	
Total (days)	**23 days**	**$11,040**	Minor expenses for report production (CDs, copies, etc.)

Task Deliverables: A final report covering all methods, results and discussions used in the vegetation mapping at NEPE will be created. A final map highlighting the vegetation will be created. All documents will be provided to NEPE and UCBN as paper and electronic versions.

WHITMAN MISSION NATIONAL HISTORIC SITE (WHMI)

Introduction

The Whitman Mission is located on the southern extreme of the Palouse Prairie Region in eastern Washington State, west of the Blue Mountains. In 1836, Marcus and Narcissa Whitman arrived at a valley near the confluence of the Walla Walla River and Mill Creek to set up a Christian mission for the Cayuse people. The present 98.15 acre historic site is on a portion of the original land settled by the Whitmans. Originally, this prairie was dominated by perennial grasses, principally bluebunch wheatgrass. Over the years, the vegetation in this area has been impacted by agriculture and anthropogenic disturbance. However on the floodplains along the Walla Walla River and nearby Mill Creek, a narrow plant community consisting of dense tangled thickets of willows, cottonwoods, wild dogwoods, blackberries, elderberries, and other species common to riparian areas probably occurred. A 2-km environs surrounding the park encompasses approximately 500 acres (1/4-mile environs would be about 300 acres).

TASK 1.0 Planning Sessions and Scoping Meetings

Preliminary planning and scoping for this project is anticipated to be completed in conjunction with the John Day Fossil Beds scoping meeting. This will minimize the amount of travel and expense. This meeting will be used to discuss the project design, imagery, photointerpretation/segmentation, plant distribution and ecology, and project review. Completion of the vegetation classification would involve planning and scoping with key agencies and organizations including the Washington State Heritage Program, UCBN, CTI and NWM as appropriate and as necessary.

Assumptions:

- Sufficient planning and scoping will occur to establish project approach and milestones, complete field data collection to support a vegetation classification, photointerpretation/segmentation, and digital database production.
- Planning meetings with any contributing agencies would be informal and conducted between appropriate UCBN on-site staff.
- Existing vs. new aerial photography/imagery will be evaluated at the meeting and through discussion between NPS, UCBN, WHMI, and CTI staff.
- The sampling approach for field work will be discussed and finalized at the scoping meeting

At the scoping meeting a buffer area, or environs, should be agreed upon as the project boundary for the vegetation classification and mapping project and confirmed. For the purposes of this work plan, acreage totals were calculated assuming a 2-km environs area (**Figure 3**). If the environs area changes as a result of planning meeting discussions, the estimated level of effort for some tasks in this plan my change.

Task Deliverables: A summary of the scoping meeting minutes and copies of the presentations will be created and posted on the UCBN vegetation mapping website

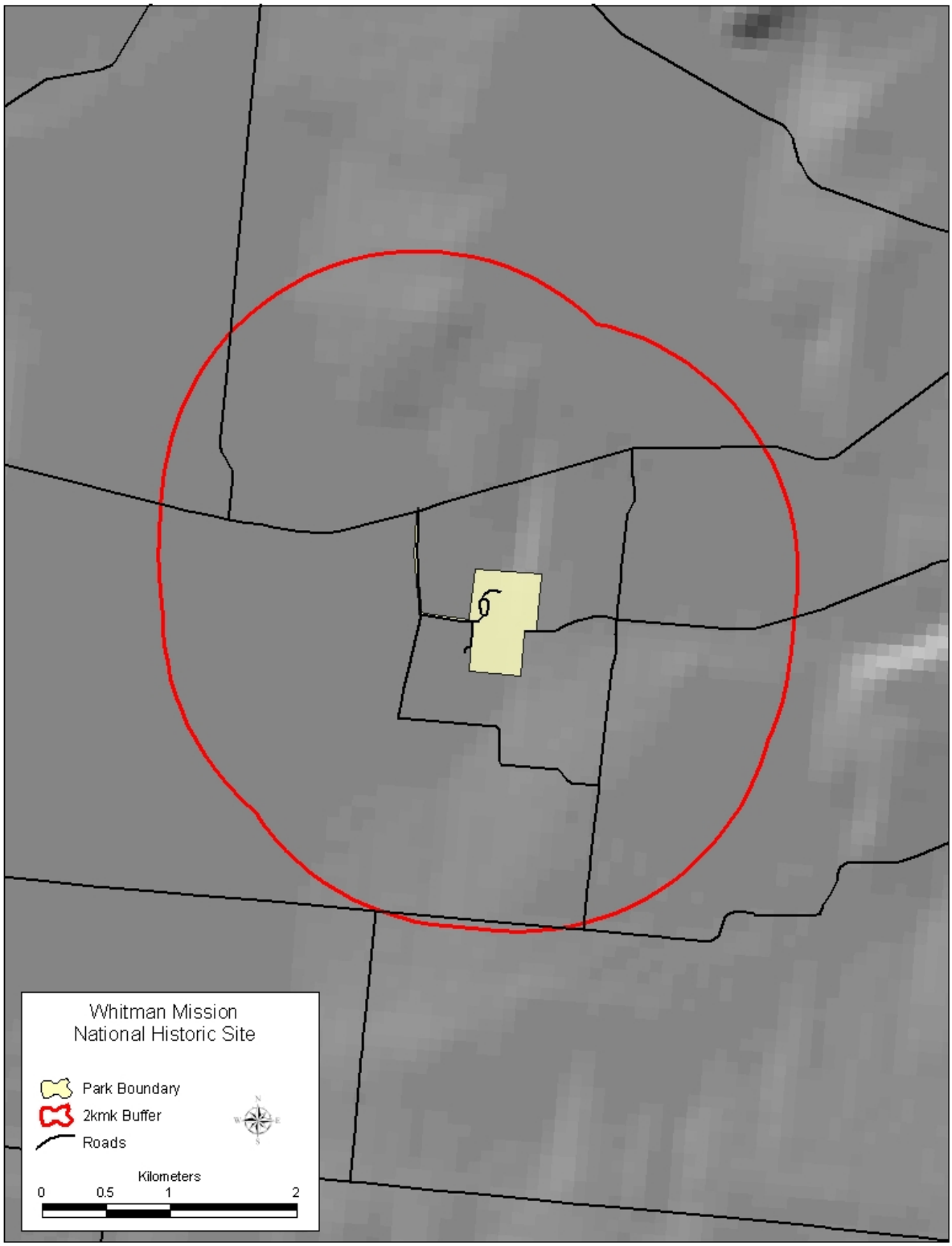


Figure 11. Approximate Project Boundary for WHMI Vegetation Mapping Project.
(Note: Figure does not show the ¼ mile buffer scenario)

TASK 2.0 Preliminary Plant Alliance/Association and Species Lists

A preliminary list of plant associations and alliances including the known ecological systems for WHMI will be solicited from the Washington State Natural Heritage Program. This will include an estimate on the likeliness that the type occurs at WHMI. A review of this list will be conducted by WHMI and UCBN staff with additions added to the list and types removed that are known not to occur in the area.

Assumption:

- Sufficient vegetation data occurs for this area that a preliminary list of associations can be created.

Table 71. Estimated Costs for Preliminary Plant Associations and Alliance for WHMI

Task Topic	Washington Heritage	Costs	Discussion
Preliminary List	-	$1,000	Time needed to create and update the association list for WHMI by the Washington State Heritage Program
Totals	**-**	**$1,000**	--

Task Deliverables: A preliminary list of plant associations and alliance for WHMI prepared by the Washington State Natural Heritage Program will be presented to UCBN prior to the scoping meeting.

TASK 3.0 Aerial Photography and Digital Ortho-photography Acquisition and Preparation

Available imagery includes the various products produced by the National Agricultural Imagery Program (NAIP) and those collected by the BOR. These typically include 1-m and 2-m products in both color infrared and true color formats. All available imagery sets will be evaluated prior to the start of work at LARO and the latest high-quality set will be used as the basemap. Based on the resource management needs in other parks the NAIP imagery will be supplemented with any existing aerial photography, preferably color-infrared aerial photography at 1:12,000-scale

Assumptions:

- Existing aerial photography and NAIP imagery will be of sufficient quality to conduct all PI, attribution, and digital (GIS) database development.

Table 72. Estimated Costs for Imagery and Photography for LARO

Task Topic	CTI/UCBN	Costs	Discussion
NAIP Imagery	-	-	The NAIP Imagery will be provided by UCBN
Existing Aerial Photography	-	-	It is anticipated that existing photography will be provide at little or no cost.
Totals	**-**	**-**	--

Task Deliverables: A mosaic of the NAIP imagery will be created.

TASK 4.0 Field Data Collection

Due to its size WHMI falls into the small size park category (TNC 1994b) for vegetation mapping. This category allows for the every polygon in the entire park to be the sampled. This small park protocol involves creating preliminary vegetation polygons beforehand using characteristics from the existing photography. Once created these polygons will be visited by the field crews and plot data will be collected at representative sites in each. It is anticipated that all areas of the park will be visited by field crews for sampling.

To date, very minimal legacy data exists for WHMI that would be useful for this project. Again due to its small size all new vegetation plots and observation points will be collected. Standard ancillary data such as soils, geology and hydrology for the area will be used to assist in sample site selection and the photointerpretation. If existing data is presented by WHMI or others at the kick-off meeting it will be evaluated using the program standards for usefulness (**Attachment D**) and incorporated into the project.

Vegetation within WHMI will be sampled using two approaches. These are observation point data and plot data. Observation points are used to guide aerial photointerpretation and vegetation plot data collection by identifying representative or unique signatures from the aerial photos or field maps concerning the distribution of plant associations within the park. Observation points are a more rapid form of data collection, these data are not collected from a standard plot, but rather describe an area, usually up to the program minimum mapping unit of 0.5 hectares. Vegetation plot data are more rigorous than observation points and include precise location, provisional association name, physical environment information, topographic data, physiognomic data, species lists, height classes, foliar cover values, diameter at breast height measurements for trees over 10 centimeters in diameter, and environmental notes and observations by researchers. Vegetation plots are necessary to prepare the classification and as such they are subjectively placed in vegetation types that are representative of an area, relatively homogenous, and larger than the 0.5 hectare (ha) minimum mapping unit (MMU). Ecotones are avoided to the extent possible.

Unique vegetation patches less than the project MMU may also be sampled using vegetation plots. These are often termed “park specials” because of their value for overall management prescriptions, but fall below the project MMU. Again due its small size the multiple park specials will likely be mapping at WHMI. Resource management staff will be given the chance at the scoping meeting to discuss these options. Some common park special types include:

- Small patches of invasive and exotic plants;
- Small wetlands;
- Rare or endangered plants;

This work plan assumes that approximately 10 - 20 associations occur at WHMI and its environs. This would indicate that approximately 60 plots and 20 observation points would need to be collected to fully document the diversity. It is anticipated that work will be conducted by experienced field crews supplied by NWM, e^2M, or similar contractor. Experienced field crews will allow for efficient sampling, minimal instruction and little oversight. New field observation points and plots will be collected using the standard observation point and plot form (either paper or digital) created by UCBN in conjunction with the national program (**Attachment E**). During the planning meeting it will be determined if sampling is required/permitted within project environs, and at what level sampling would proceed.

A minimum of two ground photographs for each vegetation plot will be taken. Photos would be digital, logged in a summary table, and labeled. Fire fuel and related issues will be discussed at the scoping meeting. If it is deemed necessary for WHMI, additional data forms will be used to capture basic fuel loading information (**Attachment E**). If fire is not a concern only the first pages of the field form will be used. Vegetation plot data will be collected in accordance with the methods established during the planning meeting and will follow size guidelines provided in **Table 4**.

The contractor collecting the data will be responsible for entering it into the UCBN database. This species entered into the database will follow ITIS as a standard. The UCBN database will be based on the TNC Plots database used in the USGS-NPS Vegetation Mapping Program. Upon entry the database will be checked for completeness and accuracy by UCBN staff.

Assumptions:

- Legacy data useful for this project are minimal at WHMI
- Approximately 60 vegetation plots (at a rate of 5/day) would be sampled to prepare an accurate classification.
- Approximately 20 observation would be recorded (at a rate of 12/day) to assist in PI efforts, and to check interpretation accuracy. These may be collected in the field by members of the vegetation sampling crew or individuals conducting aerial photointerpretation.
- Issues of access due to topography and/or private land-owners may reduce the number of plots in some plant communities.

Table 73. Proposed Level of Effort for Field Data Collection (in days).

Data Collection Topic	NWM or similar	Costs	Discussion
20 Observation Points	5 days	$1,200	Minimal Travel and Expenses are included.
60 Plots	10 days	$9,000	Minimal Travel and Expenses are included.
Total (days)	**15 days**	**$10,200**	--

Task Deliverables: 60 plots and 20 observation points representing the vegetation communities at WHMI will be delivered to UCBN. Data will be delivered in either paper or digital form.

TASK 5.0 Vegetation Classification, Alliance/Association Descriptions and Field Key

Following vegetation plot data collection and data entry Washington State Heritage staff will analyze the data and classify it into the National Vegetation Classification System (NVCS) (Grossman et al. 1998). The NVCS as developed by The Nature Conservancy and currently maintained by NatureServe represents a national system containing seven classification levels with the finest being the plant association. Associations are separated from the next highest category, alliance, through the use of total floristic composition and are named by the most dominant and/or indicator species.

Following entry into the Plots database, species foliar cover values for each plot will be exported into a spreadsheet format and arranged into a plot by species data matrix. Several of the species recorded in the Plots database, primarily trees and shrubs, may occupy more than one stratum within a particular plot. Such layers provide valuable information regarding the structural diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer should be subscripted with a strata code (e.g., T1, T2, S1, S2, S3). The matrix will be used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Since WHMI is a small park it is anticipated that the analyses of the plot data will be minimal. Hopefully most of the types have already been described for Washington and will only have to be verified. Draft vegetation classification efforts would be reviewed by Washington State Heritage, WHMI staff and UCBN in terms of regional data and existing classification. NPS ecologists would discuss and incorporate suggested revisions, as necessary. After the data has been classified local and global descriptions for each association will be created. Local descriptions of vegetation associations or alliance if associations can't be determined (as they occur throughout WHMI) will be drafted by Washington State Heritage ecologists with input from the field crews. Local descriptions will focus on the park-wide variation including the unique characteristics of the association. Generally, three to four local descriptions can be written in one day depending on the complexity of the vegetation type. The global descriptions for the associations will be modified and up-dated using these local descriptions.

After the data has been classified an illustrated field key will be created that will have dichotomous breaks. This key will walk an average person familiar with the vegetation at WHMI through the associations/alliances in a stepwise fashion. During construction members of the field data collection team should be used to help provide information for the key and to test it once completed. For consistency, this key will be used by the ecologists collecting accuracy assessment points to record the correct field classification. This task would require preparation of a plant association field key, annotation of each couplet in the key with diagnostic field descriptions, and illustration of the key with color slides or digital photos taken in the field at vegetation plot sites. This key will also be invaluable for future researchers, interpretive specialists, and visitors interested in vegetation distribution.

Assumptions:

- Vegetation plots will likely number around 60 for the WHMI project.
- It is assumed that approximately 20 plant associations will be determined for WHMI.
- An ecologist familiar with WHMI vegetation will prepare the illustrated plant association field key.

Table 74. Proposed Level of Effort for Classification and Descriptions (in days)

Task Topic	Washington Heritage	Costs	Discussion
Final classification	1 days	$640	Statistical analyses performed by Washington Heritage with NatureServe.
Local Descriptions	5 days	$3,200	Local Descriptions for the associations/alliances at WHMI
Global Descriptions	1 days	$640	NatureServe review of the descriptions and incorporation into the NVCS
Field Key Prep.	1 days	$640	Prepare Illustrated Field Key
Total (days)	**8 days**	**$5,120**	--

Task Deliverables: A preliminary list of associations and alliances will be delivered to UCBN prior to the scoping meeting. A comprehensive, classified list of plant association/alliances will be created in the NVC using the plot and observation data. Local descriptions for all associations/alliances will by used to update the global descriptions. An illustrated field key will be created for the vegetation associations/alliance at WHMI prior to the start of accuracy assessment data collection.

TASK 6.0 Aerial Photointerpretation and Segmentation

Delineation and mapping of the vegetation at WHMI will include a combination of automated image segmentation using eCognition or similar software and traditional photointerpretation (PI). Segmentation will be used to delineate easily observed features and features with high contrast such as open water, roads, and bare rock using the existing NAIP imagery. Once completed this initial map will be further refined though PI using the new photos acquired in 2007. PI will use the standard photo signature characteristics (tone, texture, color, shape, etc…) and ancillary data (slope, elevation, aspect, etc…) to further delineate the final detail of the map classes. Map classes will strive to maintain a 1:1 ratio of map class to plant association. The final mapping scheme will be determined by at a meeting or conference call between the NPS and contract staff. Typically the map classes in these project cover three basic considerations, 1) incorporating the NVC associations/alliances, 2) recognizing the limitations of the imagery (i.e. can you reliably see the plant association on the photo), and 3) covering the management needs of WHMI. The final mapping product will also include all necessary attribution consisting of the vegetation map classes, general height and density modifiers and links to the NVC. It is anticipated that approximately 20 plant associations/alliances and up to 20 land use/bare ground/geology types will be considered as potential map classes. One reconnaissance field trip to ground-truth and obtain photo-signature information by the photo interpreters will be conducted annually during the project.

Photointerpretation is most effectively accomplished when an initial classification has been performed, limiting the amount of cross-walk necessary between interpreted map units and the final classification (developed with the input of NatureServe). The individual responsible for PI should also provide input into the GIS process and review the final GIS layer for quality and consistency. An accurate, descriptive photointerpretive key will be created to allow all future

researchers to understand the interpretive cues used to delineate polygons, which may help to refine the process for future efforts. Typically photo interpretation for these efforts proceeds at about 1000/acres per day.

Assumptions:

- PI work will be conducted at 1000 acres/day. These rates may require adjustment during the process, as photointerpretation proceeds.
- Level of effort will be calculated based an approximate 500 acre project area.
- The PI investigator will assist the GIS technician to produce a photointerpretive key.

Table 75. Proposed Level of Effort for PI (in days)

PI Topic	CTI	Costs	Discussion
Photointerpretation	2 days	$960	--
Quality Check of GIS	1 days	$480	Check draft vegetation plots back to interpreted photography.
Photointerpretation key	2 days	$960	Provide representative signatures to the GIS technicians to document PI work for future database users.
Field Recon	3 days	$1,440	Includes time and travel costs for trip.
Total (days)	**8 days**	**$3,840**	--

Task Deliverables: A preliminary vegetation map to the formation level will be created using segmentation techniques. Final detail will be created on aerial photo overlays.

TASK 7.0 Digital Database and Vegetation Map Preparation

Once all of the image processing and PI is completed the final digital database and vegetation map will be created and populated. This will include creating a spatial GIS layer using ArcGIS software. One seamless GIS layer will be created for WHMI by transferring the PI and segmentation information onto the NAIP imagery. Steps required for this task include: digitizing the linework, rectifying it to the basemap, edge-matching, performing a thorough cleaning and weeding process and finally attributing all of the polygons with the necessary vegetation information.

Quality control cannot be overstated in the automation of interpreted vegetation data. One of the more useful practices is to review draft digital data (hard-copy map), usually a quarter-quadrangle at a time, back to the interpreted aerial photograph. GIS quality checks are most effectively performed by the PI specialists. In addition, it is a common practice for producers of a digital database to perform an accuracy check or vegetation map field validation check following initial transfer, digitization, and quality checking. The map validation field check allows a visual review of PI work versus plant associations and land use types. Some observation points may be recorded to more adequately define confusing plant association signatures.

Assumptions:

- GIS automation and preparation of the final database will include a hybrid combination of scanning, on-screen digitizing, and image processing/segmentation techniques to delineate and automate interpreted data.

- GIS database building – geo-referencing, attributing, edge matching, and quality checking will occur at a rate approximately one-half that of the PI effort.
- Appropriate metadata files will be created as the GIS process proceeds.
- All GIS products will meet or exceed FGDC and USGS/NPS Map Accuracy Standards for 1:12,000-scale maps.

Table 76. Proposed Level of Effort for Digital Database and Vegetation Map Preparation

Task Topic	CTI	Costs	Discussion
Data automation, georeferencing	2 days	$960	Includes scanning Mylar overlays and georeferencing.
Attribution and edge matching	2 days	$960	--
Quality checking	2 days	$960	Provide hard-copy plot to PI technician for field verification.
Metadata	1 days	$480	This task could include training, metadata development, and metadata review.
Total (days)	**5 days**	**$3,360**	

Task Deliverables: A final vegetation digital GIS layer for WHMI will be created. This will include all necessary attributes. FGDC-standard metadata will be created for this layer.

TASK 8.0 Accuracy Assessment

Requirements for the NPS Vegetation Mapping Program specify an 80% accuracy for each vegetation class that is mapped (map unit) which infers an 80% accurate vegetation map. In terms of spatial accuracy, the data are expected to meet national map accuracy standards and typically this assumed by the use of standard basemap such as the NAIP orthophotography. The AA procedures employed should be able to determine whether the vegetation map meets these requirements. The following recommendations have been made for AA efforts (TNC, NCGIA, and ESRI 1994):

- The AA should be independent of the mapping process;
- The AA should be point based with an observational unit equivalent to or larger than the minimum mapping unit;
- The recommended number of AA samples per map class should reflect the abundance of each map class in the project area;
- Thematic accuracy should be expressed using contingency matrices adjusted for chance agreement with a Kappa index (Foody 1994);
- AA should ideally capture all components of uncertainty associated with vegetation mapping; and
- AA procedures should be tested operationally to determine if methodology would need to be refined.

Randomly pre-selected accuracy assessment (AA) point coordinates would be plotted on a coded base map by the GIS group/agency responsible for producing the vegetation map. This plot will be used in the field as a point distribution guide, and would be most useful with polygon lines (but not attributes) in place. An ecologist would navigate to the coordinates using a global

positioning system (GPS) receiver, use the plant association classification key to determine the appropriate type, and record data for an area the size of the minimum mapping unit around the point, on a modified observation point form. Two representative photos of the site will be taken to document the vegetation. **Attachment E** presents a sample accuracy assessment data collection form that could be modified for UCBN use.

Sample sizes for the AA would be calculated from analysis of the electronic database prepared from the PI. Abundant vegetation types would be sampled at least 30 times, relatively abundant and relatively rare types at least 20 times, and rare types at least 5 times. Very rare types would require visits to all polygons (TNC, NCGIA, and ESRI 1994).

It is anticipated that 100 randomly located AA points will be used. Ten to 20 AA points can typically be recorded by an ecologist per field day (8 hours), considering the limitations of navigating to individual GPS coordinates present in WHMI. It is estimated that the accuracy assessment point collection would take approximately 10 researcher days (average of 20 AA points per day). Upon completion all of the data will be entered into the UCBN Plots database. These will reviewed by UCBN staff for quality and accuracy.

Following collection of AA points in the field, the points are overlain on the map and error matrix or contingency table is created. The error matrix reports both the user's and producer's error (i.e. errors of omission and commission) and represents the AA points label vs. the map label. Once completed the error matrix will be presented at a meeting or conference call to the UCBN and WHMI staff. Any deficiencies in the map will be addressed by either aggregating similar types to achieve the 80% standard or agreeing to live with the lower accuracy. Upon approval of the accuracy statistics for each map class will be calculated and the map modified accordingly.

Assumptions:

- One contracted AA field team (two researchers) would be used.
- All GPS units for field navigation will be supplied by the contracted field crews.
- Approximately 5 days will be needed to collect the AA data.
- The AA contractor will be responsible for entering the data into the UCBN database.
- All field maps and target points will be supplied by the GIS contractor.
- All analyses will be performed by the GIS contractor and reported as appropriate error matrices.

Table 77. Proposed Level of Effort for Accuracy Assessment (in days).

AA Topic	CTI and NWM	Costs	Discussion
Select random AA points and create maps	1 day	$480	Selection would be conducted by the GIS staff.
Collect field data	5 days	$6,000	Includes 2 ecologists and travel.
Analyze field data	2 days	$960	Preparation would be performed by GIS staff.
Modifications to the map	2 days	$960	Any changes will be updated in the GIS layer by GIS staff.
Total (days)	**10 days**	**$8,400**	

Task Deliverables: Approximately 100 completed field forms, to be entered into the UCBN database will be collected at WHMI. An overlay exercise will produce a preliminary contingency table of map accuracy to be used in an AA meeting. The results of the AA meeting will be published as detailed meeting minutes. All AA methods and results will be included in the final report.

TASK 9.0 Final Report and Deliverables

Several elements are required for a comprehensive report including the National Vegetation Mapping Program summation and methodology; general site information that can affect or be affected by vegetation (e.g., climate, topography, geology, soils, hydrology, historic land use, etc.); current land uses (particularly important for the environs); WHMI and UCBN management goals, and the methods and results for field data that were collected and analyzed. A detailed discussion of results related to the classification and PI work is also necessary to improve understanding by and provide guidance to WHMI and UCBN managers and other database users. These are aided by illustrations of the park landscape and plant associations and by illustrated keys to aerial photography signatures. In addition, it is important for users to understand the assessment of accuracy and its implications when using the base vegetation map. The report will also contain a discussion on future recommendations, how to improve the products and possible add-on projects.

Along with the report other deliverables include a final paper map and layout to highlight the vegetation layer. All digital data will be contained on a CD-Rom or DVD including copies of the report and map layout. All graphics included in the report will also be included. Typically a draft of all the deliverables will be created and presented to WHMI and UCBN staff for review and input. CTI will be responsible for the final editing and formatting. All material supplied by other contractors and agencies will be edited by CTI and included in one final comprehensive report.

Assumptions:

- NWI or similar contract ecologists will provide the methodology and summation of the field research; CTI will provide the methodology for the interpretive effort; GIS methodology and digital database production; and Washington State Heritage will provide the classification documents.
- UCBN will provide the desired outline of site-specific report topics, if they differ from traditionally written reports and map layouts.
- CTI will be responsible for editing and producing the final report and other deliverables.

Table 78. Proposed Level of Effort for Report Production (in days)

Report Topic	CTI	Costs	Discussion
Draft Report	10 days	$4,800	Two days each assumed for UCBN and WHMI review.
Final Map	3 days	$1,440	Includes minor expenses for report production (CDs, copies, etc.)
Final Report	10 days	$4,800	
Total (days)	**23 days**	**$11,040**	Minor expenses for report production (CDs, copies, etc.)

Task Deliverables: A final report covering all methods, results and discussions used in the vegetation mapping at WHMI will be created. A final map highlighting the vegetation will be created. All documents will be provided to WHMI and UCBN as paper and electronic versions.

TIME-LINE AND BUDGET FOR UCBN VEGETATION CLASSIFICATION AND MAPPING PROJECT COMPLETION

Figure 12 on pages 125-127 presents the project time-line that has been prepared using a 2006 through 2011 fiscal year scenario. In this secenario work would be completed for all park units in the UCBN using a staggered start approach. First on-going projects at CRMO, HAFO and MIIN would be completed. This would be followed by completing efforts at LARO and CIRO. IN FY09 BIHO and NEPE would be started followed by JODA and WHMI in FY10. Although portions of the work scope may be accelerated, both the size of the database and the effort predicted to conduct an accuracy assessment (particularly with the ruggedness of the terrain, coupled with the physical difficulty of traversing some plant communities) must be considered. Due to funding restraints alternatives may be considered that would lengthen the program by extending it into FY12 and FY13.

Figure 12. Vegetation Classification and Mapping Budget and Time-Line for UCBN Park Units

Fiscal Year	FY06				FY07					
Organization and Misc.	Scoping & Prelim. Assoc. List	Field Data Collection	Classification, Descriptions and Field Key	P.I. Segmentation and GIS	Aerial Photography	Scoping & Prelim. Assoc. List	Field Data Collection	Classification, Descriptions and Field Key	P.I. Segmentation and GIS	Accuracy Assessment
Big Hole										
MT Heritage										
NWM										
CTI										
Aerial Photography										
Total	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-
City of Rocks										
ID CDC			$5,413.00			$1,000.00		$10,953.25		
NWM						$1,500.00				
CTI						$1,820.00				
Aerial Photography										
Total	$-	$-	$5,413.00	$-	$-	$4,320.00	$-	$10,953.25	$-	$-
Craters of the Moon										
ID CDC	$5,000.00		$5,413.00							
NWM		$90,150.00								
CTI	$4,800.00			$95,248.00	$4,800.00				$150,000.00	
Aerial Photography					$142,154.00					
Park Housing		$800.00								
Total	$9,800.00	$90,950.00	$5,413.00	$95,248.00	$146,954.00	$-	$-	$-	$150,000.00	
Hagerman Fossil Beds										
ID CDC			$5,413.00							
NWM	(Combined with CRMO Scoping)	$26,650.00								
CTI										
Aerial Photography										
Total		$26,650.00	$5,413.00	$-	$-	$-	$-	$-	$-	$-
John Day Fossil Beds										
OR Heritage										
NWM										
CTI										
Aerial Photography										
Total	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-
Lake Roosevelt										
WA Heritage						$4,000.00				
NWM						$1,500.00	$90,150.00			
CTI						$1,820.00	$14,025.00			
Aerial Photography										
Travel	$3,600.00					$11,860.00				
Total	$-	$-	$-	$-	$-	$19,180.00	$104,175.00	$-	$-	$-
Minnidoka Internment										
ID CDC			$5,413.00							
NWM						(Combined with CIRO Scoping)				
CTI										
Aerial Photography										
Total	$-	$-	$5,413.00	$-	$-		$-	$-	$-	$-
Nez Perce										
Heritage										
NWM										
CTI										
Aerial Photography										
Total	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-
Whitman Missions										
WA Heritage										
NWM										
CTI										
Aerial Photography										
Total	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-
TOTALS										
Heritage	$5,000.00	$-	$21,652.00	$-	$-	$5,000.00	$-	$10,953.25	$-	$-
NWM	$-	$116,800.00	$-	$-	$-	$3,000.00	$90,150.00	$-	$-	$-
CTI	$4,800.00	$-	$-	$95,248.00	$4,800.00	$3,640.00	$14,025.00	$-	$150,000.00	$-
Sub-total	$9,800.00	$116,800.00	$21,652.00	$95,248.00	$-	$11,640.00	$104,175.00	$10,953.25	$150,000.00	$-
Aerial Photography	$-	$-	$-	$-	$142,154.00	$-	$-	$-	$-	$-
Misc.	$3,600.00	$800.00	$-	$-	$-	$11,860.00	$-	$-	$-	$-
Total	$13,400.00	$117,600.00	$21,652.00	$95,248.00	$146,954.00	$23,500.00	$104,175.00	$10,953.25	$150,000.00	$32,400.00
Total By Fiscal Year	$247,900.00				$467,982.25					

Indicates obligated funds in FY06

Fiscal Year	FY08						FY09					
Organization and Misc.	Scoping & Prelim. Assoc. List	Field Data Collection	Classification, Descriptions and Field Key	P.I. Segmentation and GIS	Accuracy Assessment	Final Deliverables	Scoping & Prelim. Assoc. List	Field Data Collection	Classification, Descriptions and Field Key	P.I. Segmentation and GIS	Accuracy Assessment	Final Deliverables
Big Hole												
MT Heritage							$3,700.00		$12,000			
NWM							$1,500.00	$13,800.00				
CTI							$1,820.00			$ 20,360.00		
Aerial Photography												
Total		$-	$-	$-	$-	$-	$7,020.00	$13,800.00	$12,000.00	$20,360.00	$-	$-
City of Rocks												
ID CDC												
NWM		$50,000.00									$30,000.00	
CTI										$64,560.00	$6,240.00	$15,840.00
Aerial Photography												
Total	$-	$50,000.00	$-	$-	$-	$-	$-	$-	$-	$64,560.00	$36,240.00	$15,840.00
Craters of the Moon												
ID CDC												
NWM					$72,000.00							
CTI				$169,760.00	$6,240.00	$15,840						
Aerial Photography												
Park Housing												
Total	$-	$-	$-	$169,760.00	$78,240.00	$15,840.00	$-	$-	$-	$-	$-	$-
Hagerman Fossil Beds												
ID CDC												
NWM												
CTI				$33,240.00		$11,040						
Aerial Photography												
Total	$-	$-	$-	$33,240.00	$-	$11,040.00	$-	$-	$-	$-	$-	$-
John Day Fossil Beds												
OR Heritage												
NWM												
CTI												
Aerial Photography												
Total	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-
Lake Roosevelt												
WA Heritage									$25,353.25			
NWM					$48,000.00							
CTI				$75,000.00	$13,320.00					$152,200.00		$50,000.00
Aerial Photography												
Travel												
Total	$-	$-	$-	$75,000.00	$61,320.00	$-	$-	$-	$25,353.25	$152,200.00	$-	$50,000.00
Minnidoka Internment												
ID CDC			$5,033.25									
NWM		$5,100									$6,000.00	
CTI				$37,440.00							$2,400.00	$11,040.00
Aerial Photography												
Total	$-	$5,100.00	$5,033.25	$37,440.00	$-	$-	$-	$-	$-	$-	$8,400.00	$11,040.00
Nez Perce												
Heritage							(Combined with BIHO Scoping)		$15,000.00			
NWM								$25,500				
CTI										$33,240.00		
Aerial Photography												
Total	$-	$-	$-	$-	$-	$-		$ 25,500.00	$15,000.00	$33,240.00	$-	$-
Whitman Missions												
WA Heritage												
NWM												
CTI												
Aerial Photography												
Total	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-
TOTALS												
Heritage	$-	$-	$5,033.25	$-	$-	$-	$3,700.00	$-	$52,353.25	$-	$-	$-
NWM	$-	$55,100.00	$-	$-	$120,000.00	$-	$1,500.00	$39,300.00	$-	$-	$36,000.00	$-
CTI	$-	$-	$-	$315,440.00	$19,560.00	$26,880.00	$1,820.00	$-	$-	$270,360.00	$8,640.00	$76,880.00
Sub-total	$-	$55,100.00	$5,033.25	$315,440.00	$139,560.00	$26,880.00	$7,020.00	$39,300.00	$52,353.25	$270,360.00	$44,640.00	$76,880.00
Aerial Photography	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-
Misc.	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-
Total	$-	$55,100.00	$5,033.25	$315,440.00	$139,560.00	$26,880.00	$7,020.00	$39,300.00	$52,353.25	$270,360.00	$44,640.00	$76,880.00
Total By Fiscal Year	$542,013.25						$490,553.25					

Fiscal Year	FY08						FY09		
Organization and Misc.	Scoping & Prelim. Assoc. List	Field Data Collection	Classification, Descriptions and Field Key	P.I. Segmentation and GIS	Accuracy Assessment	Final Deliverables	Accuracy Assessment	Final Deliverables	Totals by Park
Big Hole									
MT Heritage									$15,700.00
NWM					$12,000.00				$27,300.00
CTI					$6,240.00	$15,840.00			$44,260.00
Aerial Photography									$-
Total	$-	$-	$-	$-	$18,240.00	$15,840.00	$-	$-	$87,260.00
City of Rocks									
ID CDC									$17,366.25
NWM									$81,500.00
CTI									$88,460.00
Aerial Photography									$-
Total	$-	$-	$-	$-	$-	$-	$-	$-	$187,326.25
Craters of the Moon									
ID CDC									$10,413.00
NWM									$162,150.00
CTI									$446,688.00
Aerial Photography									$142,154.00
Park Housing									$800.00
Total	$-	$-	$-	$-	$-	$-	$-	$-	$762,205.00
Hagerman Fossil Beds									
ID CDC									$5,413.00
NWM									$56,650.00
CTI									$46,680.00
Aerial Photography									$-
Total	$-	$-	$-	$-	$-	$-	$-	$-	$108,743.00
John Day Fossil Beds									
OR Heritage	$4,000.00		$10,953.25						$14,953.25
NWM	$1,500.00	$50,000.00					$30,000.00		$81,500.00
CTI	$1,820.00			$71,760.00			$6,240.00	$15,840.00	$95,660.00
Aerial Photography									$-
Total	$7,320.00	$50,000.00	$10,953.25	$71,760.00	$-	$-	$36,240.00	$15,840.00	$192,113.25
Lake Roosevelt									
WA Heritage									$29,353.25
NWM									$139,650.00
CTI									$306,365.00
Aerial Photography									$-
Travel									$15,460.00
Total	$-	$-	$-	$-	$-	$-	$-	$-	$487,228.25
Minnidoka Internment									
ID CDC									$10,446.25
NWM									$11,100.00
CTI									$50,880.00
Aerial Photography									$-
Total	$-	$-	$-	$-	$-	$-	$-	$-	$72,426.25
Nez Perce									
Heritage									$15,000.00
NWM					$18,000				$43,500.00
CTI					$2,400.00	$11,040			$46,680.00
Aerial Photography									$-
Total	$-	$-	$-	$-	$20,400.00	$11,040.00	$-	$-	$105,180.00
Whitman Missions									
WA Heritage	(Combined with JODA Scoping)		$6,120						$6,120.00
NWM		$10,200.00					$6,000.00		$16,200.00
CTI				$7,200.00			$2,400.00	$11,040	$20,640.00
Aerial Photography									$-
Total		$10,200.00	$6,120.00	$7,200.00	$-	$-	$8,400.00	$11,040.00	$42,960.00
TOTALS									
Heritage	$ 4,000.00	$-	$17,073.25	$-	$-	$-	$-	$-	$124,765.00
NWM	$ 1,500.00	$ 60,200.00	$-	$-	$30,000.00	$ -	$36,000.00	$-	$619,550.00
CTI	$ 1,820.00	$-	$-	$78,960.00	$8,640.00	$26,880.00	$8,640.00	$26,880.00	$1,141,513.00
Sub-total	$ 7,320.00	$ 60,200.00	$17,073.25	$78,960.00	$38,640.00	$26,880.00	$44,640.00	$26,880.00	$1,885,828.00
Aerial Photography	$-	$-	$-	$-	$-	$-	$-	$-	$142,154.00
Misc.	$-	$-	$-	$-	$-	$-	$-	$-	$16,260.00
Total	$ 7,320.00	$ 60,200.00	$ 17,073.25	$ 78,960.00	$ 38,640.00	$ 26,880.00	$ 44,640.00	$ 26,880.00	
Total By Fiscal Year	$229,073.25						$71,520.00		$2,049,042.00

REFERENCES

Braun-Blanquet, J. 1965. Plant Sociology: The Study of Plant Communities. London: Hafner.

Foody, G.M. 1994. On the Compensation for Chance Agreement in Image Classification Accuracy Assessment. Photogrammetric Engineering and Remote Sensing. 58 (10): 1459-1460.

Gauch, H.G. 1982. *Multivarate Analysis in Community Ecology*. Cambridge University Press. New York, NY.

Grossman, D.H., D. Faber-Langendoen, A.S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: Terrestrial Vegetation of the United States. Volume I. The National Vegetation Classification System: development, status, and applications. The Nature Conservancy. Arlington, VA.

McCune, B. and M.J. Mefford. 1999. PC-ORD. Multivariate analysis of ecological data, Version 4. MjM Software Design. Gleneden Beach, OR.

National Biological Information Infrastructure. 2002a. USGS - NPS Vegetation Mapping Program. Retrieved January 2002 from http://www.nbii.gov/about/pubs/factsheet/factsheet4.html.

_____. 2002b. USGS – NPS Vegetation Mapping Program. Program Documents and Standards. Retrieved January 2002, from (http://www.biology.usgs.gov/npsveg/standards.html).

The Nature Conservancy. 1996. Final Draft Methodology for Assessing the Utility of Existing Data for Vegetation Mapping. NBS/NPS Vegetation Mapping Program. Prepared for the United States Department of Interior, Biological Resources Division and National Park Service. December 1996.

The Nature Conservancy and Environmental Systems Research Institute. 1994a. NBS/NPS Vegetation Mapping Program: Final Draft, Standardized National Vegetation Classification System. Prepared for USDI – National Biological Survey and National Park Service. Arlington, VA.

_____. 1994b. NBS/NPS Vegetation Mapping Program: Final Draft, Field Methods for Vegetation Mapping. Prepared for USDI – National Biological Survey and National Park Service. Arlington, VA.

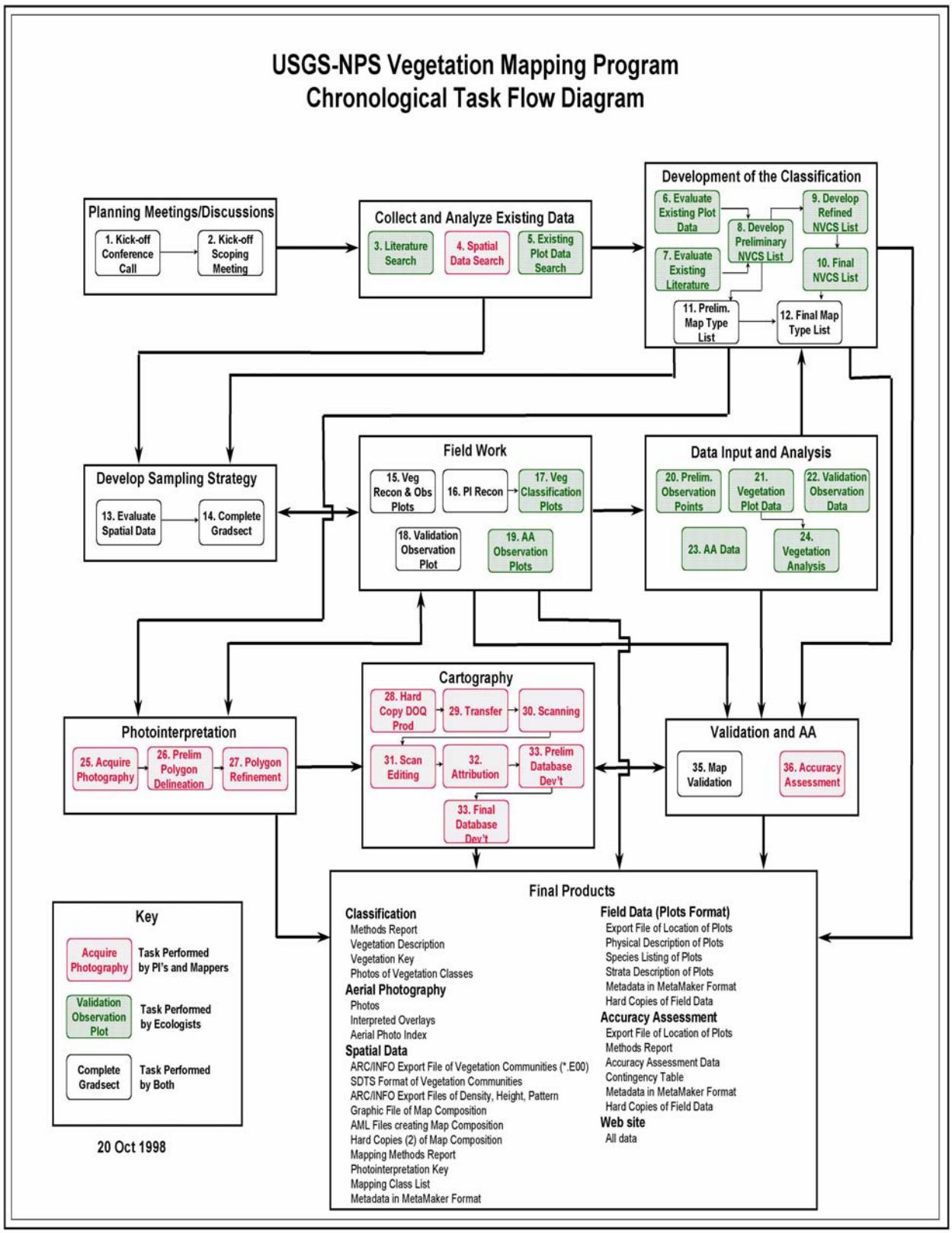
The Nature Conservancy, National Center for Geographic Information and Analysis, and Environmental Systems Research Institute. 1994. Final Draft Accuracy Assessment Procedures. NBS/NPS Vegetation Mapping Program. Prepared for the United States Department of Interior, Biological Resources Division and National Park Service. November 1994.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA, NRCS). 2001. PLANTS Database. Retrieved November 2001, from (http://plants.usda.gov/home_page.html).

U.S. Geological Survey – National Park Service. 2002a. Vegetation Mapping Program: Program Documents and Standards. Retrieved January 2002, from http://biology.usgs.gov/npsveg/standards.html.

_____. 2002b. USGS – NPS Vegetation Mapping Program. Program Documents and Standards. Retrieved January 2002, from (http://www.biology.usgs.gov/npsveg/standards.html).

ATTACHMENT A - FLOWCHART FOR THE UNITED STATES GEOLOGICAL SURVEY / NATIONAL PARK SERVICE VEGETATION MAPPING PROGRAM


USGS-NPS Vegetation Mapping Program
Chronological Task Flow Diagram
Planning Meetings/Discussions
1. Kick-off Conference Call
2. Kick-off Scoping Meeting
Collect and Analyze Existing Data
3. Literature Search
4. Spatial Data Search
5. Existing Plot Data Search
Development of the Classification
6. Evaluate Existing Plot Data
7. Evaluate Existing Literature
8. Develop Preliminary NVCS List
9. Develop Refined NVCS List
10. Final NVCS List
11. Prelim. Map Type List
12. Final Map Type List
Develop Sampling Strategy
13. Evaluate Spatial Data
14. Complete Gradsect
Field Work
15. Veg Recon & Obs Plots
16. PI Recon
17. Veg Classification Plots
18. Validation Observation Plot
19. AA Observation Plots
Data Input and Analysis
20. Prelim. Observation Points
21. Vegetation Plot Data
22. Validation Observation Data
23. AA Data
24. Vegetation Analysis
Photointerpretation
25. Acquire Photography
26. Prelim Polygon Delineation
27. Polygon Refinement
Cartography
28. Hard Copy DOQ Prod
29. Transfer
30. Scanning
31. Scan Editing
32. Attribution
33. Prelim Database Dev't
33. Final Database Dev't
Validation and AA
35. Map Validation
36. Accuracy Assessment
Key
Acquire Photography
Task Performed by PI's and Mappers
Validation Observation Plot
Task Performed by Ecologists
Complete Gradsect
Task Performed by Both
20 Oct 1998
Final Products
Classification
Methods Report
Vegetation Description
Vegetation Key
Photos of Vegetation Classes
Aerial Photography
Photos
Interpreted Overlays
Aerial Photo Index
Spatial Data
ARC/INFO Export File of Vegetation Communities (*.E00)
SDTS Format of Vegetation Communities
ARC/INFO Export Files of Density, Height, Pattern
Graphic File of Map Composition
AML Files creating Map Composition
Hard Copies (2) of Map Composition
Mapping Methods Report
Photointerpretation Key
Mapping Class List
Metadata in MetaMaker Format
Field Data (Plots Format)
Export File of Location of Plots
Physical Description of Plots
Species Listing of Plots
Strata Description of Plots
Metadata in MetaMaker Format
Hard Copies of Field Data
Accuracy Assessment
Export File of Location of Plots
Methods Report
Accuracy Assessment Data
Contingency Table
Metadata in MetaMaker Format
Hard Copies of Field Data
Web site
All data

ATTACHMENT B –AGREEMENT BETWEEN THE UCBN AND ICDC

Vegetation Classification and Mapping Assistance
Upper Columbia Basin Network Parks 2006 - 2007

Task Agreement Project Proposal to
The United States Department of the Interior
National Park Service, Upper Columbia Basin Network

Prepared by
Idaho Conservation Data Center
Department of Fish and Game

June 29, 2006

BACKGROUND AND OBJECTIVES

The purpose of this proposed Task Agreement to Cooperative Agreement # H9373060001 between the United States Department of the Interior, National Park Service (NPS), Upper Columbia Basin Network (UCBN) and Idaho Department of Fish and Game (IDFG), an agency of the State of Idaho and its subdivision, Idaho Conservation Data Center (IDCDC), is to contribute funding and mutual talents towards generation of vegetation classifications, field keys, descriptions, and associated documentation for City of Rocks National Reserve (CIRO), Craters of the Moon National Monument and Preserve (CRMO), Minidoka Internment National Monument (MIIN), and Hagerman Fossil Beds National Monument (HAFO). The original agreement was entered into to facilitate interaction between the NPS and IDCDC and to recognize that their agencies share common goals and interests in planning and management of natural resources. The terms and conditions as stated in the original Cooperative Agreement will apply to this proposed Task Agreement.

IDCDC will work as a team with Cogan Technology Inc. (CTI) and NatureServe (NS) to collaborate in the classification of plant communities and create ecologically meaningful mapping units for Upper Columbia Basin parks. All tasks will be conducted in close cooperation with NPS, NS, and CTI and will include collection of ecological data; assistance in training field crews; development of vegetation classifications, descriptions, and field keys; assistance in vegetation mapping interpretation; and preparation of a final report for the project.

Assumptions:

UCBN will work closely with the IDCDC to secure existing field data.

In order to develop this proposal and accompanying budget, we developed a series of assumptions about the amount and timing of work on each task. Since the field and classification work for these Parks will occur over several field seasons, we assumed there would be at least two iterations of alliance-level classification work, as well as at least two versions of field key(s). We estimate that a total of 50 alliances will occur in the 4 Park units.

STATEMENT OF WORK

IDCDC agrees to complete the following tasks:

Task 1. Prepare draft vegetation classification(s). IDCDC will develop a preliminary vegetation classification following the 2006 field season. IDCDC will collaborate with NS in the classification of vegetation to assure consistency with existing alliances in the National Vegetation Classification (NVC) and the identification of new vegetation alliances. IDCDC staff time budgeted for this task is 10.5 weeks including time for a staff ecologist, wetland ecologist, and data management staff. This task will be

completed in Spring 2007 and produce a report summarizing analytic methods and results.

Deliverable: Report summarizing analytical methods and results
Due Date: March 30, 2007
Budget:

Salary and benefits	$ 13,074
staff ecologist (6 weeks)	
wetland ecologist (1.5 weeks)	
research biologist (3 weeks)	
Operating costs	242
Travel	353
Sub-total	$ 13,669
Administrative overhead	2,570
Total	$ 16,239

Task 2. Prepare field key(s). IDCDC will develop vegetation keys that will enable park resource managers, biologists, and others to determine a vegetation alliance in the field through a structured decision-making process. IDCDC will collaborate with NS in the development and review of the field key(s). IDCDC time budgeted for this task is 3.5 weeks. This task will be completed by Spring 2007 and will be prepared as a stand-alone appendix to the report prepared under task 1.

Deliverable: Dichotomous key included as appendix to report for task 1
Due Date: April 27, 2007
Budget:

Salary and benefits	$ 4,358
staff ecologist (2 weeks)	
wetland ecologist (0.5 weeks)	
research biologist (1 week)	
Operating costs	81
Travel	118
Sub-total	$ 4,556
Administrative overhead	857
Total	$ 5,413

TERM OF AGREEMENT

This proposed Task Agreement shall continue through September 2007.

AWARD AND PAYMENT

IDCDC worksheet and budget for this project is shown as follows:

	Task 1	Task 2	Total
Salary and benefits	$ 13,074	$ 4,358	$ 17,432
Operating costs	242	81	323
Travel	353	118	471
Sub-total	$ 13,669	$ 4,556	$ 18,226
Administrative overhead	2,570	857	3,426
Total	$ 16,239	$ 5,413	$ 21,652

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ATTACHMENT C – INTERAGENCY AGREEMENT BETWEEN THE UCBN AND BOR

Task Agreement for Vegetation Mapping
Upper Columbia Basin Inventory and Monitoring Network
Interagency Acquisition Agreement Number _____

NAME OF PARK/NPS UNIT: Upper Columbia Basin Inventory and Monitoring Network (UCBN)

NAME OF PARTNER: Bureau of Reclamation (BOR)

NPS KEY OFFICIAL:
Lisa Garrett
Network Coordinator
Upper Columbia Basin Network
University of Idaho
Dept of Fish and Wildlife
208-885-3684
Lisa_Garrett@nps.gov

PRINCIPAL INVESTIGATOR:
Mike Pucherelli
303-445-2267
Bureau of Reclamation
Remote Sensing and Geographic Information Group
DFC Building 56, D-8260
Denver, CO 80225

COST OF PROJECT:

Total Cost: $88,123

NPS ACCOUNT NUMBER:

_____

BACKGROUND

In preparation for U.S. Geological Survey – National Park Service Vegetation Mapping Program (VMP) vegetation mapping projects in the Upper Columbia Basin Network preliminary field maps using photo interpretation and image segmentation need to be created. This will be the first step towards creating the final spatial database. Vegetation data from plots have been collected by local botanists under a separate agreement during Fiscal Year 2006. It is anticipated that this work will be completed over five fiscal years. The work planned for Fiscal Year 2006 and part of 2007 is outlined in this task agreement.

UCBN consists of nine including Big Hole National Battlefield (BIHO), City of Rocks National Reserve (CIRO), Craters of the Moon National Monument and Preserve (CRMO), Hagerman Fossil Beds National Monument (HAFO), John Day Fossil Beds National Monument (JODA), Lake Roosevelt National Recreation Area (LARO), Minidoka Internment National Monument (MIIN), Nez Perce National Historical Park (HAFO), and Whitman Mission National Historic Site (WHMI). Work in this task agreement covers work in CRMO, CIRO, HAFO, and MIIN.

OBJECTIVES

1. Preliminary delineation of land-use and land form polygons at CRMO, HAFO, MIIN and CIRO totaling over 1 million acres. Lines will be created using a combination of eCognition segmentation and head's up digitizing techniques on the NAIP imagery.
2. Create an interim product that will provide a framework for further, more detailed digitizing of the vegetation to the association/alliance level. Anticipated map units for this task include major roads, agricultural lands, barren lands, facilities, urban areas and high contrast vegetation units such as woodlands vs. shrublands vs. herbaceous vegetation.
3. Attend the scoping meeting for the LARO vegetation mapping effort.

SCOPE OF WORK

This task agreement details costs for vegetation mapping within CRMO, HAFO, MIIN and CIRO and the surrounding environs and their attendance at the LARO scoping meeting by the BOR's Remote Sensing and GIS Group. The total project area for CRMO, HAFO, MIIN, and CIRO consists of approximately 1 million acres. This project is planned to occur over two federal fiscal years (FY06 to FY07). Deliverables for this task agreement are anticipated to be complete by March 31, 2007. Additional objectives for fiscal years 2007, 2008, 2009 and 2010 are contingent upon additional funding from NPS.

Mapping at CRMO will follow the very large-size park protocols and standards defined by the NPS-USGS National Vegetation Mapping Program. Mapping at HAFO, MIIN and CIRO will follow the small park protocols and standards. All work will be performed in cooperation with the vegetation classification efforts managed by the UCBN and conducted by contracted scientists, GIS professionals, Idaho Conservation Data Center and NatureServe.

Preliminary delineation of land-use and land form polygons at CRMO, HAFO, MIIN, and CIRO will consist of creating lines using a combination of eCognition segmentation and head's up digitizing techniques on the supplied National Agriculture Inventory Photography (NAIP) imagery. The interim product from this effort will provide a framework for further, more detailed digitizing of the vegetation to the association/alliance level. Anticipated map units for this task

include major roads, agricultural lands, barren lands, facilities, urban areas and high contrast vegetation units such as woodlands vs. shrublands vs. herbaceous vegetation. These will be delineated based on standard photo signature characteristics from the NAIP imagery. Contingent upon future funding, BOR will process these preliminary lines to create a comprehensive spatial database.

To facilitate the vegetation mapping efforts at LARO a scoping meeting will be conducted in September 2006. This meeting will outline the vegetation mapping efforts, identify potential cooperators, establish the mapping boundary and determine who is responsible for future tasks.

The work will be done according to four different tasks.

1. Acquire NAIP Imagery: Imagery will be provided to the BOR by UCBN. This will consist of all the Quarter Quad products covering CRMO, HAFO, MIIN and CIRO and environs provided in digital form. BOR will process the imagery to meet the objectives of the remaining tasks.

2. Preliminary delineation: Land-use and land form polygons at CRMO, HAFO, MIIN and CIRO will be created using a combination of eCognition segmentation and head's up digitizing techniques on the NAIP imagery. The objective of the segmentation is to create a network of lines with as coarse a scale as possible without omitting most of the small, important and obvious land-cover patches. By iteratively increasing segmentation size within the eCognition program, small image objects (i.e. preliminary polygons) are continuously merged into larger ones. Completion of the segmentation is based on ocular judgment of the analyst when obvious, distinct features are lost. At this point in the process the previous segmentation is adopted as the final treatment. Outputs from this task include large networks of preliminary lines that need to be manipulated to create the interim products.

3. Interim products: Preliminary linework will be processed into GIS databases. All of the preliminary lines will be exported into ArcInfo GIS software to be cleaned, smoothed, edited and processed. Cleaning of the linework will include removing unnecessary lines and polygons. Smoothing will consist of running the lines through a serious of GIS routines to remove artifacts of the segmentation effort (i.e. stair-stepping). Editing will include on-screen digitizing of obvious features not delineated during the segmentation effort. Finally all of the linework will be processed to build topology, create attributes and record projection information. All edits will be combined into a preliminary vegetation GIS layer for each NPS unit. Efforts will be made to label all of the resulting polygons with a preliminary canopy density value and a NVC –type classification. Anticipated map units for this task include major roads, agricultural lands, barren lands, facilities, urban areas and high contrast vegetation units such as woodlands vs. shrublands vs. herbaceous vegetation.

4. Attendance at LARO Scoping Meeting: This task includes travel costs to Lake Roosevelt located Northern Idaho. Costs include plane tickets, car rentals, salaries and preparation time for three scientists.

FY 2006 Deliverables:

- ♦ A Preliminary List of Map Classes for at CRMO, HAFO, MIIN, and CIRO based on the NVC associations and the limitation of the NAIP imagery.
- ♦ Preliminary GIS spatial database containing delineated formation-level polygons for CRMO, HAFO, MIIN, and CIRO.
- ♦ Scoping Meeting Materials (Powerpoint presentations, maps, and handouts).

Schedule

July, 2006	Acquire the NAIP imagery from UCBN.
August, 2006	Start Preliminary Delineation for CRMO, HAFO, MIIN, and CIRO.
September 2006	Attend LARO Scoping Meeting
October, 2006	Finish preliminary delineation and start creating the interim products
March, 2006	Finish the interim products for CRMO, HAFO, MIIN, and CIRO

Budget:

Task #	Task	Days	Costs
1	Preliminary Delineation	145	$69,600
2	Creation of Interim Products	20	$9,600
3	Attend LARO Scoping Meeting	4	$5,760
4	Indirect Costs (Travel, Per Diem, Misc.)	n/a	$3,163

Account Number

_____ $ 88,123

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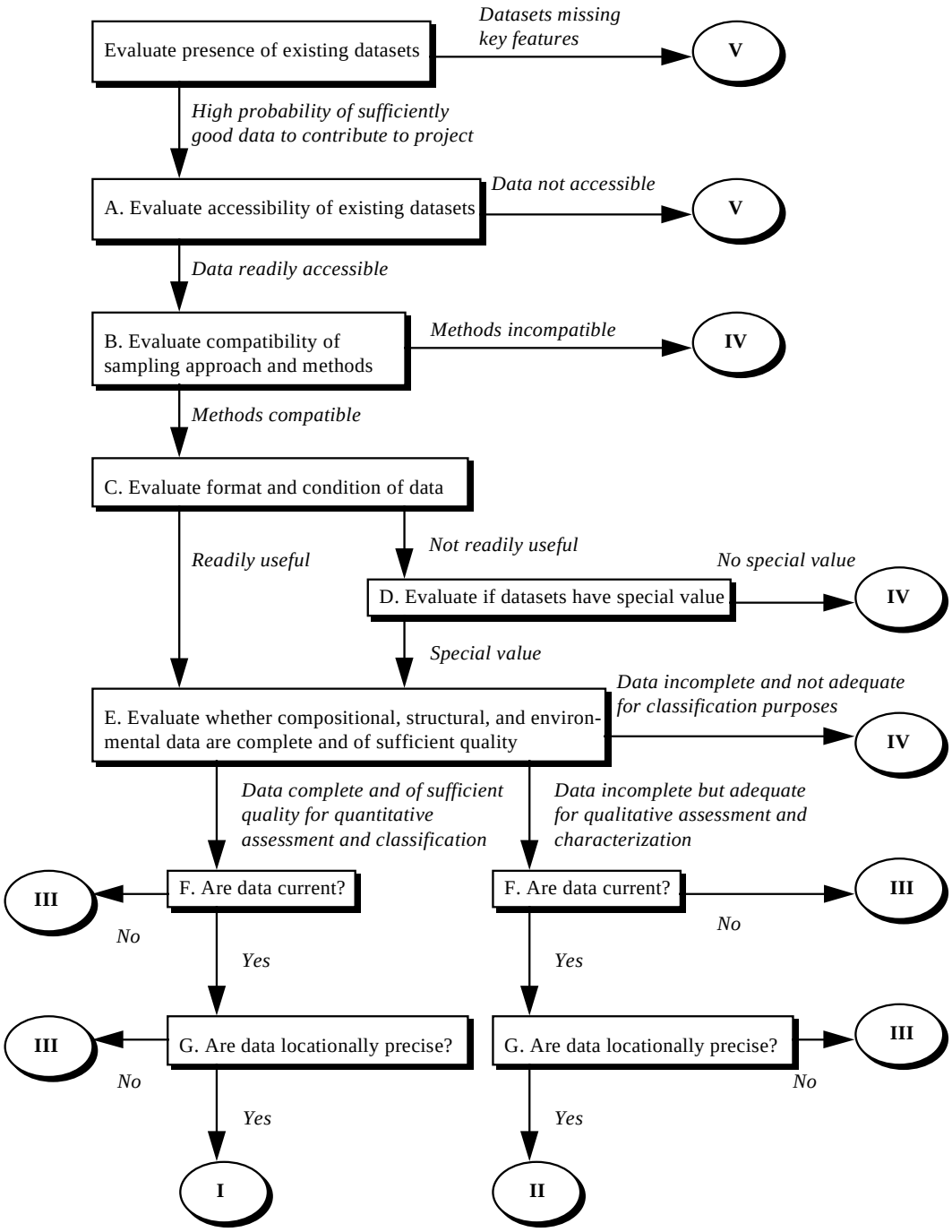
ATTACHMENT D - INFORMATION CONCERNING POTENTIAL LEGACY DATA AND SUMMARY OF RESEARCH, DATA AND IMAGERY USEFUL FOR VEGETATION CLASSIFICATION AND MAPPING AT UCBN

Figure 1. Flow chart for evaluating existing datasets.



The following tables summarize information potentially useful in the UCBN vegetation classification and mapping effort.

Table 1. Timeline for the UCBN land cover mapping effort

Park	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
BIHO										
CIRO										
CRMO										
HAFO										
MIIN										
LARO										
WHMI										
JODA										
HAFO										

Completed Project
Current Projects
Planned Projects
Planned Change Detection

Table 2. Approximate acreages of landownership within a 5 mile radius of NPS lands

ALPHACODE	OWNERNAME	Acres
CRMO	BLM	36700
(ID)	Private	16200
	State	2900
	State Fish and Game	100
	USFWS	200
HAFO	BLM	3000
(ID)	Private	5800
	State	200
	State Fish and Game	100
	TNC	40
JODA	BLM	12400
(OR)	BLMWSA	500
	Private	14000
	STATE	100
LARO	State DNR	5000
(WA)	BLM	800
	BOR	600
	Colville Reservation	28600
	Spokane Reservation	8200
	State Parks	40
	USFS	5100
	Private	979200
	State WDFW	600
MIIN	BLM	2250
(ID)	Bureau of Reclamation	100
	Private	2700
	State	60
HAFO	BLM (ID)	1200
(ID,MT,	BIA (ID)	800
OR,WA)	USFS (ID)	480
	DOD (ID)	30
	Private (ID)	25800
	State (ID)	1600
	State Fish and Game (ID)	1000
	USFWS (ID)	5
	BLM (MT)	4700
	State (MT)	500
	BIA (MT)	40
	Private (MT)	30
	BLM (OR)	70
	USFS (OR)	1100
	Private (OR)	8800
	State (OR)	2
	State Parks and Rec (OR)	20
	BLM (WA)	30
	State DNR (WA)	80

Table 3. Free remotely sensed imagery currently available

	LANDSAT (5,7 30M Multi)	ASTER (15M Multi)	SPOT (10M Pan)	AirPhotos
CRMO	2000/2001	2001/2004	2000	July 2004 1m NC
HAFO	1997/2000/2002	2001	2000	July 2004 1m NC
MIIN	2000/2001	2000/2001	2000	July 2004 1m NC
JODA	NA	2000/2001/2005	NA	June 2002 0.5m NC (part)
HAFO (Idaho)	1987-2002	2001/2002	2000	July 2004 1m NC

Table 4. Ancillary Data

Theme	Data	Scale	CRMO	HAFO	MIIN	HAFO	JODA
Hydrology	Rivers	1:100					
	Lakes	1:100					
	Springs	1:100					
	Waterholes	1:100					
	Basin and Subbasin Boundaries	1:100					
Topography / Geology	Digital Elevation Model	30m					
	Digital Elevation Model	10m				part	
	Geology	Varies	part				
	Soil Survey (SSURGO)	1:24	part			part	
	Major Lithology	1:100					
Vegetation	Land Cover (~1995)	1:100					
	Land Cover (2004)	1:24				part	
	Weed Locations	1:24	part			part	
	Kipukas	1:24					
	Rare Plant Locations	1:100	part			part	
	Vegetation Transects	1:24	part				
	Historic (1936) Vegetation	1:100					
Political	State Boundaries	1:100					
	County Boundaries	1:100					
	Park Boundaries	1:100					
	Ownership	1:100					
	Roads	1:100					
	4WD Roads	1:100					
	Trails	1:100					part
Disturbance	Fire Boundaries / History	1:100					part
	Grazing Allotments	1:100				part	
Base Layers	Quad Boundaries	1:24					
	Digital OrthoPhoto Quads	Varies					
	Digital Raster Graphics	Varies					

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ATTACHMENT E – UCBN FIELD FORMS FOR PLOTS, OBSERVATIONS AND AA POINTS

UCBN Plot Collection Data Form

IDENTIFIERS/LOCATORS (Fill out every plot)

Plot Code _____Surveyors: Vegetation _____ Date_____/ _____/2006

State ID Park Name CRMO Park Site Name (Optional) _____

Provisional Community Name_____

GPS rover file _____ Field UTM X___ ___ ___ ___ ___ ___ m E Field UTM Y___ ___ ___ ___ ___ ___ ___ m N

Zone: 12 Datum: NAD 83 Estimated Error _____ PDOP _____

Vegetation Plot **OR** Observation Point **Circle One** Plot length _____ (m) Plot width _____ (m) Plot Azimuth _____

Plot Permanent **Y/N** _____ Plot Pictures _____

Comments about plot representativeness, plot layout, and permanent tag location (Optional)

ENVIRONMENTAL DESCRIPTION (Fill out only if GPS data dictionary is not working)

Elevation (ft)_____ Slope (%) _____ Aspect (degrees)_____

Topographic Position **Circle One**

Interfluve Shoulder Backslope Footslope Toeslope Step in slope Valley floor Terrace Channel

Describe Topographic Position (Optional)

Cowardin System
___ Upland
___ Riverine
___ Palustrine
___ Lacustrine

Non-Tidal – only if not upland
___Permanently Flooded
___Semi-permanently Flooded
___Seasonally/Temporarily Flooded
___Saturated
___Intermittently Flooded
___Unknown

Unvegetated and Non-Vascular Surface: *(use the cover scale on next page)(Must approximately equal 100%)*

___ Bedrock
___ Litter, duff
___ Wood (>1 cm)
___ Bare soil
___ Large rocks (cobbles, boulders > 10 cm)
___ Small rocks (gravel, 0.2-10cm)
___ Sand (0.1-2 mm)
___ Nonvascular
___ aa lava
___ Pahoehoe lava
___ Block lava
___ Other:_____
___ Water
___ Cinder

Soil Texture (Pick one)
___ sand ___ loamy sand ___ sandy loam ___ silty clay ___ no soil
___ loam ___ clay loam ___ clay ___ silt

Soil Drainage (Pick one)
___ Well drained
___ Moderately well drained
___ Poorly drained

VEGETATION DESCRIPTION

Leaf phenology (of dominant stratum)	Leaf Type (of dominant stratum)	Physiognomic class	Cover Scale for Strata & Unvegetated Surface		Height Scale for Strata	
Pick one	Pick one	Pick one	T	<1%	T	<1ft.
			01	1-2%	01	1-5ft.
___Evergreen	___Broad-leaved	___Forest	02	2-5%	05	5-15ft.
___Deciduous	___Needle-leaved	___Woodland	05	5-10%	15	15-30ft.
___Mixed (evergreen & deciduous)	___Graminoid	___Shrubland	10	10-25%	30	>30ft
___Perennial herbs	___Forb	___Dwarf Shrubland	25	25-50%		
___Annual herbs	___Pteridophyte	___Herbaceous	50	50-75%		
		___Nonvascular	75	75-95%		
		___Sparsely Vegetated	95	>95%		

Strata	Height Class	Cover Class	Dominant species
T1 Emergent	_____	_____	_____
T2 Canopy	_____	_____	_____
T3 Sub-canopy	_____	_____	_____
S1 Tall shrub	_____	_____	_____
S2 Short shrub	_____	_____	_____
S3 Dwarf shrub	_____	_____	_____
H Herbaceous	_____	_____	_____
N Non-vascular	_____	_____	_____
O Outside	_____	_____	_____

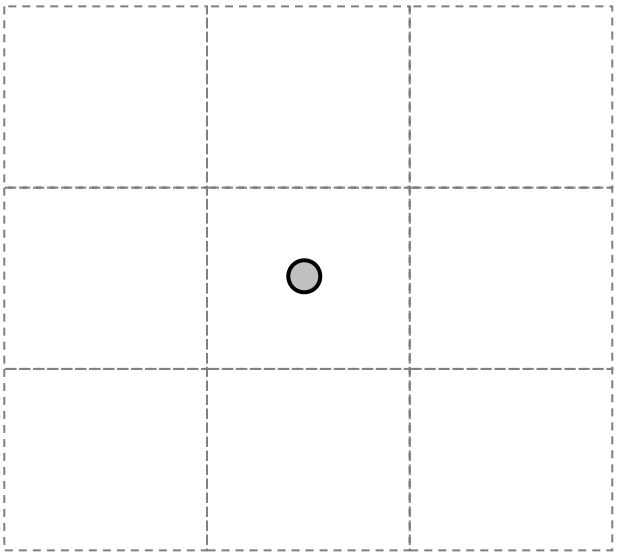
see above table for height and cover scales

Description of Vegetation and Surrounding Area

Dominant canopy species outside of plot (optional):

Evidence of Natural or Anthropogenic Disturbance:

Plot Map (20X20m cells):



Evidence of Wildlife Use

Invasives Present

Other Comments (Miscellaneous, Plot "Memory Jogger,"etc...)

Plot Code_____Surveyors: _____ Date: _____/ _____/_____

Species/percent cover: Starting with the uppermost stratum, list all species with % cover for each species in the stratum.
Put an asterisk (*) next to any species that appear to be diagnostics for the community in the classification.
Also list species outside the plot at the end of the table or designate with a 0 in Cover Class column....
LIST SPECIES BY TREES, SHRUBS, GRAMINOIDS, then ***FORBS***…….list ***Lichens, Mosses, Fungi*** here too.

Lifeform codes:	T1	T2	T3	S1	S2	S3	H	N	O
	Emergent	Canopy	Sub-canopy	Tall shrub	Short shrub	Dwarf shrub	Herbaceous	Non-vascular	Outside

Cover Class Codes:	T	01	02	05	10	25	51	75	95
	<1%	1-2%	2-5%	5-10%	10-25%	25-50%	51-75%	75-95%	>95%

Life Form Code	Cover Class	Species	Check if collected	Check if pressed

UCBN Fuels Collection Data Form

Plot ID _____	Date _____	Surveyor(s): _____

FIRE REGIME and CONDITION CLASS

Historic Fire Regime (Pick one)	Fire Condition Class (Pick one)
___ < 35yr, low severity (Fire Regime I) ___ < 35yr, stand replacement (Fire Regime II) ___ 35-100yr, mixed severity (Fire Regime III) ___ 35-100yr, stand replacement (Fire Regime IV) ___ >200yr, stand replacement (Fire Regime V)	___ CC1 ___ CC2 ___ CC3

Primary Fuel Model (Pick one)

___ None [14]	___ Chaparral [4]	___ Hardwood 1 needle [9]
___ Barren rock [0]	___ 2 ft brush [5]	___ Timber understory [10]
___ Short grass [1]	___ Dormant brush [6]	___ Light slash [11]
___ Grass timber [2]	___ Southern rough [7]	___ Medium slash [12]
___ Tall grass [3]	___ Closed timber [8]	___ Heavy slash [13]

FUEL LOADINGS and STAND STRUCTURE

Fuel Loading (tons/acre)	Fuel Loading (tons/acre)	Average Fuel bed depth (live and dead)	Average duff depth	Average litter depth
< 3 inch diameter fuels ___ < 1 ___ 1.1 - 3 ___ 3.1 - 5 ___ 5.1 - 10 ___ > 10	> 3 inch diameter fuels ___< 3 ___ 3.1 - 10 ___ 10.1 - 20 ___ > 20	___ < 1 ft ___ 1-3 ft ___ > 3 ft	___ none ___ < 1 inch ___ 1 – 1.5 inches ___ 1.6 – 2 inches ___ 2.1 – 3 inches ___ > 3 inches	___ none ___ < 1 inch ___ 1 – 3 inches ___ > 3 inches
Bare ground cover (percent) ___ None ___ < 1% ___ 1 – 5% ___ 6 – 25% ___ 26 – 50% ___ > 50%	Overstory shade (percent) *only trees > 6”dbh ___ None ___ < 1% ___ 1 – 5% ___ 6 – 25% ___ 26 – 50% ___ > 50% Dominant overstory tree species (> 6”dbh) _____	Understory shade (percent) *only trees < 6”dbh ___ None ___ < 1% ___ 1 – 5% ___ 6 – 25% ___ 26 – 50% ___ > 50% Dominant understory tree species (< 6”dbh) _____	Health Overstory ___ No overstory ___ Productive ___ Declining ___ Decadent Understory ___ No overstory ___ Productive ___ Declining ___ Decadent	Stand Structure ___ No trees ___ Early successional ___ Mid multi story ___ Mid single story ___ Late multi story ___ Late single story

VEGETATION

Primary Shrub Species	Secondary Shrub Species	Shrub cover (percent)	Average shrub height	Overall health of shrub component
_____ _____	_____ _____	___ None ___ < 1% ___ 1 – 5% ___ 6 – 25% ___ 26 – 50% ___ > 50%	___ none ___ < 1 ft ___ 1-3 ft ___ > 3 ft	___ No shrubs ___ Productive ___ Declining ___ Decadent
Primary Grass Species	**Secondary Grass Species**	**Grass cover (percent)**	**Average grass height**	**Cheatgrass cover (percent)**
_____ _____	_____ _____	___ None ___ < 1% ___ 1 – 5% ___ 6 – 25% ___ 26 – 50% ___ > 50%	___ < 4 inches ___ 4 – 7 inches ___ > 7 inches	___ None ___ < 1% ___ 1 – 5% ___ 6 – 25% ___ 26 – 50% ___ > 50%
Primary Forb Species	**Secondary Forb Species**	**Forb cover (percent)**	**Average forb height**	
_____ _____	_____ _____	___ None ___ < 1% ___ 1 – 5% ___ 6 – 25% ___ 26 – 50% ___ > 50%	___ < 4 inches ___ 4 – 7 inches ___ > 7 inches	

INVASIVE WEEDS

Species Present	Cover (%) [none, < 1, 1-5, 6-25, 26-50, > 50%]	Size of Infestation [0, < 0.1 , 0.1-1, 1-5 acres]

PHOTOS

	Azimuth (degrees	Photo Number	Comments (optional – e.g. “Looking west across plot.”)
Line 1			
Line 2			
Line 3			
Line 4			

PHOTO SERIES GUIDE DATA

Size Class	Book Name(s)	Page # (‘s)	Comments
Photo best representing General composition			
Photo for >3” diameter (1000 hr)			
*Nonforested sites (sage and grass)			

UCBN AA Form

IDENTIFIERS/LOCATORS (Fill out every point)

Field Point Code 04 __ __ __ __ Database Point Code_____ Surveyors:_____

Date ____/____/2004 Quad Name _____ Aerial photo # _____ Plot Pictures Taken (Y/N)_____

State ___ Park Name ____ Park Site Name _____

Dominant Association 1)_____

Alternate Association Name 2)_____

Alternate Association Name 3)_____

Map Code 1)_____ 2)_____ 3)_____

Adjacent Association within 50m 1)_____

Adjacent Association within 50m 2)_____

Adjacent Map Codes within 50m 1)_____ 2)_____

GPS rover file _____ Field UTM X___ ___ ___ ___ ___ ___ m E Field UTM Y___ ___ ___ ___ ___ ___ ___ m N

Zone: 12 Datum: NAD 27 PDOP _____ (PDOP 6 if not changed)

ENVIRONMENTAL DESCRIPTION (Fill out only if GPS data dictionary is not working)

Elevation (ft)_____ Slope (%) _____ Aspect (degrees)_____

Topo Position **Circle One** – Interfluve Shoulder Backslope Footslope Toeslope Step in slope Valley floor Terrace Channel

Describe Topographic Position

ANDERSON'S SURFACE FUEL MODELS

Fuel # (**1-13**)	Fuel Loading (**L, N, H** than in gu	Primary Carrier of Fire (**life form, species**)	Comments- How does this area differ from the description in Anderson's

FUELS PHOTOS

	Azimuth (degrees	Comments (optional)
Line 1		
Line 2		

Natural & Anthropogenic Disturbance Comments (i.e., fire, insects, disease, dead standing trees, ungulate browsing, weeds, avalanche, campsite, archeological, cattle etc…)

Other Comments (Miscellaneous, Plot "Memory Jogger,"etc...)

VEGETATION DESCRIPTION

Cover Scale for Strata & Unvegetated Surface						Height Scale for Strata			
Tr	<1%	20	16-25%	70	66-75%	01	<1ft.	40	30-50 ft.
01	1-2%	30	26-35%	80	76-85%	02	1-1.9 ft.	65	50-80 ft.
03	3-4%	40	36-45%	90	86-95%	04	2-5 ft.	90	80-100 ft.
07	5-9%	50	46-55%	98	96-99%	10	5-15 ft.	100	>100 ft.
12	10-15%	60	56-65%	100	>99%	25	15-30 ft.		

Strata	Height Class	Cover Class	Dominant species
T1 Emergent	_____	_____	_____
T2 Canopy	_____	_____	_____
T3 Sub-canopy	_____	_____	_____
S1 Tall shrub	_____	_____	_____
S2 Short shrub	_____	_____	_____
S3 Dwarf shrub	_____	_____	_____
H Herbaceous	_____	_____	_____
N Non-vascular	_____	_____	_____

Comments about point representativeness

Description of Vegetation within 50m of AA point and Surrounding Area

Rationale for Classification (s)

LIST SPECIES BY TREES, SHRUBS, GRAMINOIDS, then ***FORBS***…….list ***Lichens, Mosses, Fungi*** here too.

Lifeform codes:	T1	T2	T3	S1	S2	S3	H	N
	Emergent	Canopy	Sub-canopy	Tall shrub	Short shrub	Dwarf shrub	Herbaceous	Non--vascular

Life Form Code	Cover Class	Species	Check if collected	Check if pressed

Cover Class Codes:	Tr	01	03	07	12	20	30	40	50	60	70	80	90	98	100
	<1%	1-2	3-4	5-9	10-15	16-25	26-35	36-45	46-55	56-65	66-75	76-85	86-95	96-99	>99

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ATTACHMENT F – SCOPING MEETING NOTES FOR CRMO, HAFO AND MIIN

SUMMARY

Craters of the Moon National Monument and Preserve (CRMO)

Vegetation Classification and Mapping Project

Planning and Kick-off Meeting

May 3 and May 4, 2006

Participants:

- Lisa Garrett – NPS Upper Columbia Basin Network, 208-885-3084, lisa_garrett@nps.gov
- Leona Svancara – NPS UCBN, 208-885-3774, leona_svancara@nps.gov
- John Apel – NPS CRMO, 208-527-3257x501, john_apel@nps.gov
- Paige Wolken – NPS CRMO, 208-527-3257x505, pagie_wolken@nps.gov
- Gwen Kittel – NatureServe, 303-541-0364,
- Dan Cogan – CTI, 815-858-3483, dancogan@cogantech.com
- John Erixson – Northwest Management Inc (NMI), 208-883-4488, erixson@consulting-foresters.com
- Jim VonLoh – e^2M, 303-754-4216, jvonloh@e2m.net
- Matt Smith – e^2M, 303-754-4200, msmith@e2m.net
- Pete Williams – e^2M, 970-374-2504, williapa@toast.net
- Klara Varga – NPS Grand Teton Natural Resources, 208-652-3239, klara@ida.net
- Julie Hilty – BLM Shoshone Botanist (julie_hilty@blm.gov)
- Kasey Prestwich – BLM, 208-732-7204
- Steve Rust – Idaho Conservation Data Center, 208-883-4488, srust@idfg.idaho.gov
- Roger Blew – Idaho National Lab, S.M. Stoller Corp., 208-525-9358, Rblew@stoller.com
- Amy Forman – Idaho National Lab, 208-525-9358, aforman@stoller.com
- Tom Richards – NMI, 208-883-4488, richards@consulting-foresters.com
- Drake Barton – NMI, 406-449-6586, montana-moods@hughes.net
- Jim Cancroft – NMI, 406-442-7550, nwimanage@montana.com
- Jack Gunderman, NMI, 208-667-1553
- Fran Gruchy – NPS HAFE/MIIN, 208-0837-4793x5233, fran_gruchy@nps.gov
- Bob Lorkowski – HAFE, 208-837-4793x5228, robert_lorkowski@nps.gov
- Tess O'Sullivan, Ecologist (tess@lavalake.net)

Background:

A comprehensive planning and kick-off meeting was held at Craters of the Moon National Monument on May 3rd and 4th. This meeting covered a wide range of topics related to the vegetation classification and mapping project. The meeting was structured for discussion of the national vegetation mapping program scope and past approaches, discussing and outlining important project tasks, and discussing the timeline and staffing necessary to complete the project. Following the formal meeting, the field crews were trained on a representative vegetation sample plot conducted by NatureServe ecologist, Gwen Kittel. Following training two field crews started field work that will continue for approximately two months.

Cooperation:

Multiple neighbors of CRMO attended this meeting and presented opportunities for future cooperation and sharing of common data, approaches, maps, etc. Potential cooperators for CRMO include the following:

- The Idaho National Lab lands to the east and south of CRMO are in the preliminary stages of conducting their own vegetation mapping effort. They mentioned using some of the same procedures as the NPS effort and would like to be kept up-dated on the project. Also, they would very much like to pursue partnering for the acquisition of new aerial photography- possibly next year.
- The Lava Lake Land and Livestock Company to the north and east of CRMO has a completed vegetation map. They would like to have their map linked to CRMO's map and would also like to be kept up-dated on the project.
- BLM representatives attended the meeting on the first day and presented potential existing data that could be used for the CRMO project. This data will be reviewed by Steve Rust from the Idaho Conservation Data Center (CDC) and Gwen Kittel from NatureServe.

Summary:

The meeting began at 9:00 am on Wednesday morning with introductions, an overview of CRMO, an overview of the Upper Columbia Basin Network, a review of the National Vegetation Classification by NatureServe, a review of the preliminary plant associations by CDS, and a summary of the vegetation mapping project. Klara Varga from Grand Teton National Park provided a lessons learned perspective from a recently completed vegetation mapping project. The first day was completed by taking a guided tour of the Park by Doug Owens, to better understand the ecosystems, their environmental drivers, and CRMO's unique geology.

The second day of meetings began Thursday at 9:00 am with a continuation of the project overview followed by group discussions. During this time the following project specifics were decided:

- The project boundary will include a standard 2-km environs
- The minimum mapping unit will be ½ hectare except for mapping units that are of particular concern to CRMO (i.e. Park Specials).
- Special effort will be made to sample a majority of the Kipukas (islands of vegetation in the lava flows that were not covered by lava and represent undisturbed vegetation).
- Considerable time will be spent sampling the interior of CRMO where little data exists.
- Exotic species such as leafy spurge, knapweed, and rush skeletonweed will be noted by the field crews and GPS coordinates will be provided to CRMO.
- The CDC will review the existing or legacy data to determine its usefulness.
- Limber pine communities will receive special attention during the sampling and classification stages.
- The field crews will periodically keep the network and CRMO staff up-dated on their progress and if they need any logistical help.
- Access across adjacent land parcels of various ownership will require coordination throughout the project with John Apel and his staff to insure that field crews are not perceived to be trespassing.
- The point of contact for the field crews will be John Erixson of Northwest Management, Inc. The project points of contact will be Dan Cogan (general) and Lisa Garrett (financial).

The meeting was concluded on Thursday afternoon by collecting data on a sample woodland vegetation plot directed by Gwen Kittel a NatureServe ecologist. During this time the plot procedures where thoroughly reviewed, modifications made to the plot form, cover classes discussed and the sampling scheme was finalized.

Next Steps:

- The field crews will collect data throughout CRMO during the next two months. They will be finalizing the set-up of electronic data collectors, reviewing the data, and sending the preliminary database to UCBN periodically for review.
- Dan Cogan with assistance from UCBN will be providing the crews with field maps showing the Kipukas and containing the UTM coordinates of their centers.
- The CDC will review the existing or legacy data to determine its usefulness. If found to be acceptable, the field crews will be notified about which areas have already been sampled and therefore may require only field reconnaissance to verify the plant associations present.
- The UCBN will be creating a web-site to provide access to all the information related to this project.

On behalf of the UCBN I would like to personally thank everyone for attending this meeting and being active in the discussion. I would also express my appreciation to John and Paige at CRMO for helping to reserve the conference room, providing meeting equipment, coordinating the field trip and contributing to the general success of the meeting. –Dan Cogan

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ATTACHMENT G – PRELIMINARY PLANT ASSOCIATION LIST FOR UCBN

Craters of the Moon NM draft list of potential alliances / associations.

Value	ESCode	Potential Ecological System	AllCode	Alliance	Association	USDA_Symbol	Common Name	Comments
1	N11	Open water		Open water			Open water	
2	N2x	Developed		Developed			Developed	
3	N80	Agriculture		Agriculture			Agriculture	
4	D08	Invasive annual grassland		Invasive annual grassland	Bromus tectorum	BRTE	Cheatgrass	
5	CES304.791	Inter-Mountain Basins Volcanic Rock and Cinder Land	A.1517	Purshia tridentata Shrub Tall Herbaceous	Purchia tridentata	PUTR2	antelope bitterbrush	Or should this be CES304.778 - IM Basins Big Sagebrush Steppe?
6	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.2547	Artemisia arbuscula ssp. Arbuscula Shrubland	Artemisia arbuscula	ARARA	low sagebrush	Or should this be CES304.080 - Columbia Plateau Low Sagebrush Steppe?
7	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.2547	Artemisia arbuscula ssp. Arbuscula Shrubland	Artemisia arbuscula	ARLO9	early low sagebrush	Or should this be CES304.080 - Columbia Plateau Low Sagebrush Steppe?
8	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.831	Artemisia tridentata ssp. Vaseyana Shrubland	Artemisia tridentata vaseyana	ARTRV	mountain big sagebrush	
9	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.831	Artemisia tridentata ssp. Vaseyana Shrubland	Artemisia tridentata vaseyana / Symphoricarpos oreophilus	ARTRV/SYOR2	mountain big sagebrush/mountain snowberry	Some of these A.t.v. associations could also fall under CES304.791 - IM Basins Volcanic Rock and Cinderland
10	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.831	Artemisia tridentata ssp. Vaseyana Shrubland	Artemisia tridentata vaseyana / Purchia tridentata	ARTRV/PUTR2	mountain big sagebrush/Antelope bitterbrush	
11	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.829	Artemisia tridentata Shrubland	Artemisia tridentata vaseyana / A. t. tridentata	ARTRV/ARTRT	mountain big sagebrush/Big sagebrush	
12	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.829	Artemisia tridentata Shrubland	Artemisia tridentata vaseyana / Chrysothamnus nauseosus - NBG	ARTRV/CHNA-NBG	mountain big sagebrush/Rubber rabbitbrush-native bunchgrass	Association not listed

13	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.1526	Artemisia tridentata ssp. Vaseyana Shrub herbaceous	Artemisia tridentata vaseyana - NBG	ARTRV-LSNBG	mountain big sagebrush-late seral native bunchgrasses (bluebunch, needlegrasses, Idaho fescue)	
14	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.1526	Artemisia tridentata ssp. Vaseyana Shrub herbaceous	Artemisia tridentata vaseyana - Elymus cinereus complex	ARTRV-ELCI	mountain big sagebrush - basin wildrye complex	
15	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.1526	Artemisia tridentata ssp. Vaseyana Shrub herbaceous	Artemisia tridentata vaseyana - NBG	ARTRV-ESNBG	mountain big sagebrush-early seral native bunch grasses (Sandberg's bluegrass, bottlebrush squirreltail)	
16	CES304.778	Inter-Mountain Basins Big Sagebrush Steppe	A.1528	Artemisia tripartita ssp. Tripartita Shrub Herbaceous	Artemisia tripartita	ARTR4	threetip sagebrush	
17	CES304.778	Inter-Mountain Basins Big Sagebrush Steppe	A.1528	Artemisia tripartita ssp. Tripartita Shrub Herbaceous	Artemisia tripartita / Chrysothamnus viscidiflorus - NBG	ARTR4/CHVI-BG	threetip sagebrush/green rabbitbrush-bunchgrass	
18	CES304.778	Inter-Mountain Basins Big Sagebrush Steppe	A.1528	Artemisia tripartita ssp. Tripartita Shrub Herbaceous	Artemisia tripartita - Introduced BG	ARTR4-IBG (seeding)	threetip sagebrush-introduced bunchgrasses	Invasive?
19	CES304.778	Inter-Mountain Basins Big Sagebrush Steppe	A.1528	Artemisia tripartita ssp. Tripartita Shrub Herbaceous	Artemisia tripartita - NBG	ARTR4-NBG	threetip sagebrush-native bunchgrasses	
20	CES304.778	Inter-Mountain Basins Big Sagebrush Steppe	A.1528	Artemisia tripartita ssp. Tripartita Shrub Herbaceous	Artemisia tripartita - Bromus tectorum	ARTR4-BRTE/BG	threetip sagebrush-cheatgrass/bunchgrass	Invasive?
21	CES304.778	Inter-Mountain Basins Big Sagebrush Steppe	A.830	Artemisia tridentata Shrubland	Artemisia tridentata tridentata / A. tripartita - Bromus tectorum	ARTRT/ARTR4-BRTE	big sagebrush/threetip sagebrush-cheatgrass	Invasive?
22	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland	A.1522	Artemisia tridentata Shrub Herbaceous	Artemisia tridentata tridentata - Introduced BG	ARTRT-IBG (seeding)	big sagebush (basin&Wyoming)-introduced bunchgrasses	Invasive?
23	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland	A.1522	Artemisia tridentata Shrub Herbaceous	Artemisia tridentata tridentata - Pseudoroegneria spicata	ARTRT-LSNBG	big sagebrush-stipa species/bluebunch wheatgrass (late seral complex)	Or should this be CES304.778 - IM Basins Big Sagebrush Steppe?

24	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland	A.1522	Artemisia tridentata Shrub Herbaceous	Artemisia tridentata tridentata - Poa secunda	ARTRT-ESNBG	big sagebrush-Sandberg's bluegrass/bottlebrush squirreltail (early seral or soil spec. complex	Or should this be CES304.778 - IM Basins Big Sagebrush Steppe?
25	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland	A.1522	Artemisia tridentata Shrub Herbaceous	Artemisia tridentata tridentata - Poa secunda / B.tectorum	ARTRT-NBG/BRTE	big sagebrush-Sandberg's bluegrass/cheatgrass	Invasive?
26	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland	A.1522	Artemisia tridentata Shrub Herbaceous	Artemisia tridentata tridentata - Bromus tectorum	ARTRT-BRTE	big sagebrush-cheatgrass	Invasive?
27					Dead Artemisia tridentata tridentata - Bromus tectorum/ BG	D_ARTRT-BRTE/BG	dead big sagebrush-cheatgrass/bunchgrass	Disturbed category?
28	CES304.788	Inter-Mountain Basins Semi-Desert Shrub-Steppe	A.2651	Chrysothamnus viscidiflorus Shrubland	Chrysothamnus viscidiflorus / A. t. tridentata - Bromus tectorm/BG complex	CHVI/ARTRT-BG/BRTE complex	green rabbitbrush/big sagebrush/ bunchgrass/cheatgrass complex - various combinations/dominants	Invasive?
29	CES304.788	Inter-Mountain Basins Semi-Desert Shrub-Steppe	A.1524	Chrysothamnus viscidiflorus Shrub Herbaceous	Chrysothamnus viscidiflorus - IBG	CHVI-IBG (Seeding)	green rabbitbrush-introduced bunchgrass	Invasive?
30	CES304.787	Inter-Mountain Basins Semi-Desert Grassland	A.1265	Pseudoroegneria spicata Herbaceous	Pseudoroegneria spicata / Festuca idahoensis	NBG	native bunchgrass (minor shrub component)	
31					IBG	IBG (Seeding)	introduced bunchgrass (minor shrub component)	Invasive?
32	CES304.787	Inter-Mountain Basins Semi-Desert Grassland	A.1265	Pseudoroegneria spicata Herbaceous	Pseudoroegneria spicata / Festuca idahoensis / Bromus tectorum	NBG/BRTE	native bunchgrass/cheatgrass	Invasive?
33	CES304.782	Inter-Mountain Basins Juniper Savanna	A.536	Juniperus osteosperma Woodland	Juniperus osteosperma	JUNSPP (scattered or dense)	juniper (rocky mountain or Utah) (scattered or dense - sub categories?)	Or A.506 Juniperus scopulorum Woodland Alliance
34	CES306.813	Rocky Mountain Aspen Forest and Woodland	A.610	Populus tremuloides Woodland	Populus temuloides	POTR5	aspen	
35	CES304.791	Inter-Mountain Basins Volcanic Rock and Cinder Land	A.540	Pinus flexilis Woodland	Pinus flexilis	PIFL (scattered or dense)	limber pine (scattered or dense - sub categories?)	

36	CES306.823	Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	A.552	Pseudotsuga menziesii Woodland	Pseudotsuga menziesii	PSME	Douglas-fir	
37	CES304.045	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland		Riparian Woodland and Shrubland		Riparian (wooded or meadow)	cottonwood,alder,salix,carex, riparian spp.	
38	CES304.786	Inter-Mountain Basins Playa				Playa	playas (developed and undeveloped, dry or wet)	
39	CES304.791	Inter-Mountain Basins Volcanic Rock and Cinder Land				Vegetated Lava Low D	Shrubs provide less than five percent of the total cover	Alliance?
40	CES304.791	Inter-Mountain Basins Volcanic Rock and Cinder Land				Vegetated Lava Mod D	up to 15% veg. cover	Alliance?
41	CES304.791	Inter-Mountain Basins Volcanic Rock and Cinder Land				Cinder Garden	cinder areas with some to no herbaceous cover	Alliance?
42						Forbs	recently disturbed - weedy; or high forb content in kipukas	Alliance?
43	D02	Recently Burned		Recently Burned		Burned or Highly Disturbed	burned or highly disturbed so that soil is dominant signature	
44	CES304.791	Inter-Mountain Basins Volcanic Rock and Cinder Land				Lava	unvegetated lava	Alliance?

John Day Fossil Beds NM draft list of potential alliances / associations.

Value	ESCode	Potential Ecological System	AllCode	Alliance	Association	USDA Symbol	Common Name	Comments
1	CES304.083	Columbia Plateau Steppe and Grassland			Achnatherum thurberianum	ACTH7	Thurber's needlegrass	LKS: alliances not identified in system descriptions
2	CES304.770	Columbia Plateau Scabland Shrubland	A.1574	Artemisia rigida Shrub Herbaceous	Artemisia rigida / Poa secunda	ARRI2/POSE	Scabland sagebrush / Sandberg bluegrass	
3	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland	A.829	Artemisia tridentata Shrubland	Artemisia tridentata / Bromus tectorm	ARTR/BRTE	Big sagebrush / cheatgrass	Jkagan: Suggest not distinguishing between wyoming and basin big sage. Mostly Wyoming, except along stream and river terraces which is mostly basin.
4	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland			Artemisia tridentata / Leymus cinereus	ARTR/LECI4	Big sagebrush / basin wildrye	
5	CES304.778	Inter-Mountain Basins Big Sagebrush Steppe	A.1521	Artemisia tridentata Shrub Herbaceous	Artemisia tridentata / Pseudoroegneria spicata	ARTR/PSSP6	Big sagebrush / bluebunch wheatgrass	Jkagan: Suggest not distinguishing between wyoming and basin big sage. Mostly Wyoming, except along stream and river terraces which is mostly basin.
6	CES304.770	Columbia Plateau Scabland Shrubland	A.1568	Poa secunda Dwarf-shrub Herbaceous	Eriogonum compositum / Poa secunda	ERCO12/POSE	Arrowleaf buckwheat / Sandberg's bluegrass	
7	CES304.768	Columbia Basin Foothill Riparian Woodland and Shrubland				EXOTIC FLOODPLAIN	Exotic Floodplain	JKagan: Perhaps this should be exotics
8	CES304.082	Columbia Plateau Western Juniper Woodland and Savanna	A.1500	Juniperus occidentalis Wooded Herbaceous	Juniperus occidentalis / Artemisia tridentata - Purshia tridentata	JUOC/ARTR2-PUTR2	Western juniper / Big sagebrush - Antelope bitterbrush	

9	CES304.082	Columbia Plateau Western Juniper Woodland and Savanna	A.1500	Juniperus occidentalis Wooded Herbaceous	Juniperus occidentalis / Artemisia tridentata / Festuca idahoensis	JUOC/ARTR2/FEID	Western Juniper / Big sagebrush / Idaho fescue	
10	CES304.082	Columbia Plateau Western Juniper Woodland and Savanna	A.1500	Juniperus occidentalis Wooded Herbaceous	Juniperus occidentalis / Artemisia tridentata / Pseudoroegneria spicata	JUOC/ARTR2/PSSP6	Western Juniper / Big sagebrush / Bluebunch wheatgrass	
11	CES304.082	Columbia Plateau Western Juniper Woodland and Savanna			Juniperus occidentalis / Bromus tectorum	JUOC/BRTE	Western Juniper / cheatgrass	
12	CES304.082	Columbia Plateau Western Juniper Woodland and Savanna	A.535	Juniperus occidentalis Woodland	Juniperus occidentalis / Cercocarpus ledifolius / Pseudoroegneria spicata	JUOC/CELE3/PSSP6	Western Juniper / Curlleaf mountain mahogany / Bluebunch wheatgrass	
13	CES304.082	Columbia Plateau Western Juniper Woodland and Savanna	A.1500	Juniperus occidentalis Wooded Herbaceous	Juniperus occidentalis / Pseudoroegneria spicata	JUOC/PSSP6	Western juniper / Bluebunch wheatgrass	
14	CES304.082	Columbia Plateau Western Juniper Woodland and Savanna	A.1500	Juniperus occidentalis Wooded Herbaceous	Juniperus occidentalis / Pseudoroegneria spicata - Festuca idahoensis	JUOC/PSSP6-FEID	Western juniper / Bluebunch wheatgrass - Idaho fescue	
15	CES306.994	Northern Rocky Mountain Lower Montane Mesic Deciduous Shrubland		Philadelphus lewesii	Philadelphus lewesii	PHLE4	Lewis' mock orange	LKS: not listed as an alliance or association under .994
16	CES304.993	Columbia Basin Foothill and Canyon Dry Grassland	A.1265	Pseudoroegneria spicata Herbaceous	Pseudoroegnaria spicata / Eriogonum heermannii	PSSP6-ERHE	Bluebunch wheatgrass - Heermann's buckwheat	LKS: association not listed under alliance
17	CES304.993	Columbia Basin Foothill and Canyon Dry Grassland	A.1265	Pseudoroegneria spicata Herbaceous	Pseudoroegnaria spicata / Festuca idahoensis	PSSP6-FEID	Bluebunch wheatgrass - Idaho fescue	
18	CES304.993	Columbia Basin Foothill and Canyon Dry Grassland	A.1265	Pseudoroegneria spicata Herbaceous	Pseudoroegnaria spicata / Poa secunda	PSSP6-POSE	Bluebunch wheatgrass - Sandberg's bluegrass	LKS: association not listed under alliance

19	CES304.768	Columbia Basin Foothill Riparian Woodland and Shrubland	A.647	Salix lucida Temporarily Flooded Shrubland	Salix lucida	SALU	shining willow	Jkagan: suggested 304.768 but doesn't include A.647
20	CES304.787	Inter-mountain Basins Semi-Desert Grassland	A.1252	Sporobolus cryptandrus Herbaceous	Sporobolus cryptandrus	SPCR	Sand dropseed	Jkagan:Potential for mapping, but we didn't sample them enough.
21	CES304.780	Inter-mountain Basins Greasewood Flat	A.1332	Distichlis spicata Intermittently Flooded Herbaceous	Distichlis spicata	DISP	Inland saltgrass	Jkagan: Potential for mapping (CES304.787) but we didn't sample them enough. LKS: 780 better fit?
22	CES304.780	Inter-mountain Basins Greasewood Flat	A.1204	Leymus cinereus (Intermittently Flooded A.1329) Herbaceous	Leymus cinereus	LECI4	Basin wildrye	Jkagan:This perhaps could have been mapped, representing the Spirobilis, Distichlis and Leymus grasslands, but we didn't sample them enough. LKS: 780 better fit?
23	CES304.780	Inter-mountain Basins Greasewood Flat	A.1046	Sarcobatus vermiculatus Intermittently flooded Shrubland	Sarcobatus vermiculatus	SAVE4	greasewood	Rodhouse: potentially A.1054
24	CES304.768	Columbia Basin Foothill Riparian Woodland and Shrubland	A.306	Alnus rhombifolia Temporarily Flooded Forest	Alnus rhombifolia	ALRH2	White alder	Rodhouse: Rock creek at sheeprock
25	CES306.821	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	A.947	Salix exigua Temporarily Flooded Shrubland	Salix exigua	SAEX	Narrowleaf willow	Rodhouse: along John Day river at sheep rock
26	CES304.081	Columbia Plateau Ash and Tuff Badland		Bare soil			Sparsely vegetated / Bare tuffaceous soil	Jkagan: This should have been mapped, but didn't exist at the time the mapping was done / Rodhouse: much of painted hills and some sheeprock
27	CES304.779	Inter-Mountain Basins Cliff and Canyon		Rock			Rock outcrop - Cliff face	Jkagan: This should have been mapped, but didn't exist at the time the mapping was done / Rodhouse: add rock class

28		Open water		Open water			Open water	
29		Agriculture		Agriculture			Agriculture	
30		Invasive annual grassland		Invasive annual grassland	Bromus tectorum	BRTE	Cheatgrass	
31		Developed		Developed			Developed	

Hagerman Fossil Beds NM draft list of potential alliances / associations.

Value	ESCode	Potential Ecological System	AllCode	Alliance	Association	USDA_Symbol	Common Name	Comments
1	CES300.729	North American Arid West Emergent Marsh	A.1436	Typha latifolia Semipermanently Flooded Herbaceous	Typha latifolia	TYLA	Cattails / Marsh	
2	CES304.045	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland		Riparian Woodland and Shrubland	Riparian (wooded or meadow)		cottonwood,salix,carex	
3	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland	A.1522	Artemisia tridentata Shrub Herbaceous	Artemisia tridentata tridentata - Poa secunda	ARTRT-POSE	basin big sagebrush-bluegrass	Or should this be CES304.778 - IM Basins Big Sagebrush Steppe?
4	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland	A.1522	Artemisia tridentata Shrub Herbaceous	Artemisia tridentata tridentata - Bromus tectorum	ARTRT-BRTE	basin big sagebrush-cheatgrass	Invasive class?
5	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland	A.832	Artemisia tridentata ssp. Wyomingensis Shrubland	Artemisia tridentata ssp. Wyomingensis - Atriplex confertifolia	ARTRW - ATCO	Wyoming big sagebrush - Shadscale	
6	CES304.777	Inter-Mountain Basins Big Sagebrush Shrubland	A.835	Chrysothamnus (Ericameria) nauseosus Shrubland	Chrysothamnus nauseosus	CHNA	rubber rabbitbrush	
7	CES304.778	Inter-Mountain Basins Big Sagebrush Steppe	A.1527	Artemisia tridentata ssp. Wyomingensis Shrub Herbaceous	Artemisia tridentata wyomingensis / Mixed Grasses	ARTRW	Wyoming big sagebrush - NBG	Or should this be CES304.777 - IM Basins Big Sagebrush Shrubland?
8	CES304.778	Inter-Mountain Basins Big Sagebrush Steppe	A.1527	Artemisia tridentata ssp. Wyomingensis Shrub Herbaceous	Artemisia tridentata wyomingensis - Bromus tectorum	ARTRW - BRTE	Wyoming big sagebrush - cheatgrass	Invasive class?
9	CES304.778	Inter-Mountain Basins Big Sagebrush Steppe	A.1528	Artemisia tripartita ssp. Tripartita Shrub Herbaceous	Artemisia tripartita	ARTR4	threetip sagebrush	

10	CES304.779	Inter-Mountain Basins Cliff and Canyon	A.2546	Wooded Bedrock Sparsely Vegetated	Barren rock		Barren rock	
11	CES304.780	Inter-Mountain Basins Greasewood Flat	A.1041	Sarcobatus vermiculatus Shrubland	Sarcobatus vermiculatus	SAVE4	greasewood	
12	CES304.780	Inter-Mountain Basins Greasewood Flat	A.1332	Distichlis spicata Intermittently Flooded Herbaceous	Distichlis spicata Mixed Herb	DISP	saltgrass	
13	CES304.782	Inter-Mountain Basins Juniper Savanna	A.506	Juniperus scopulorum Woodland	Juniperus scopulorum	JUSC2	rocky mountain juniper	
14	CES304.784	Inter-Mountain Basins Mixed Salt Desert Scrub	A.869	Atriplex canescens Shrubland	Atriplex canescens	ATCA2	Saltbrush	
15	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.1526	Artemisia tridentata ssp. Vaseyana Shrub herbaceous	Artemisia tridentata vaseyana - Poa secunda	ARTRV-POSE	mountain big sagebrush - bluegrass	
16	CES304.785	Inter-Mountain Basins Montane Sagebrush Steppe	A.829	Artemisia tridentata Shrubland	Artemisia tridentata vaseyana / Chrysothamnus nauseosus	ARTRV/CHNA	mountain big sagebrush/Rubber rabbitbrush	Association not listed
17	CES304.788	Inter-Mountain Basins Semi-Desert Shrub-Steppe	A.1524	Chrysothamnus viscidiflorus Shrub Herbaceous	Chrysothamnus viscidiflorus - Agropyron cristatum	CHVI-AGCR	green rabbitbrush-crested wheatgrass	Invasive class?
18	CES304.788	Inter-Mountain Basins Semi-Desert Shrub-Steppe	A.2651	Chrysothamnus viscidiflorus Shrubland	Chrysothamnus viscidiflorus / Artemisia tridentata	CHVI/ARTR	green rabbitbrush/big sagebrush	Invasive class?
19	CES304.791	Inter-Mountain Basins Volcanic Rock and Cinder Land	A.1517	Purshia tridentata Shrub Tall Herbaceous	Purchia tridentata	PUTR2	antelope bitterbrush	Or should this be CES304.778 - IM Basins Big Sagebrush Steppe?
20	CES304.993	Columbia Basin Foothill and Canyon Dry Grassland	A.1291	Poa secunda Herbaceous	Poa secunda - Sporobolus cryptandrus	POSE	Sandberg bluegrass - sand dropseed	
21	CES304.993	Columbia Basin Foothill and Canyon Dry Grassland	A.1291	Poa secunda Herbaceous	Poa secunda - Bromus tectorum	POSE/BRTE	Sandberg bluegrass / cheatgrass	Invasive class?
22	D02	Recently Burned		Recently Burned	Burned or Highly Disturbed		burned or highly disturbed so that soil is dominant signature	
23	D06	Invasive Perennial Grassland		Invasive perennnial grassland	Agropyron cristatum	AGCR	crested wheatgrass	

24	D08	Invasive annual grassland		Invasive annual grassland	Bromus tectorum	BRTE	Cheatgrass	
25	N11	Open water		Open water	Open water		Open water	
26	N2x	Developed		Developed	Developed		Developed	
27	N80	Agriculture		Agriculture	Agriculture		Agriculture	

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ATTACHMENT H – BOR REMOTE SENSING AND GIS VEGETATION MAPPING PROPOSAL FOR LARO

To: Ms. Lisa Garrett

Subject: Proposal for Vegetation Mapping of Lake Roosevelt National Recreation Area (LARO)

Enclosed is a copy of our technical proposal and cost estimate for the vegetation mapping of Lake Roosevelt National Recreation Area. The total estimated cost is $848,832, which includes $95,000 estimate for acquiring aerial photographs. The total estimated cost to the program includes an in kind cooperation from BOR of $40,000 ($10,000 per fiscal year). This project is planned to occur over three years and across four fiscal years. More details of the costs and their distribution are found in section III and IV of this document. It is quite possible that we might use 2006 1 meter natural color NAIP imagery for the project that should be available by spring of 2007. If so we might eliminate the $95,000 dollars for the new imagery for a significant cost savings. We would not have available individual aerial photographs which are very useful in obtaining a 3D view of the area. This is a useful but not critical tool.

Summary of costs per fiscal year:

F.Y. 2006	**$ 267,275**
F.Y. 2007	**$ 310,000**
F.Y. 2008	**$ 278,209**
F.Y. 2009	**$ 88,348**

PROJECT TOTAL COSTS (BOR) $ 848,832

If you have any questions regarding this proposal, please call me at 303-445-3619.

Sincerely,

David Salas
Bureau of Reclamation
Technical Service Center
Remote Sensing and Geographic Information Group

The USGS-NPS Vegetation Mapping Program
COST PROPOSAL FOR VEGETATION MAPPING OF Lake Roosevelt National Recreation Area

U.S. Bureau of Reclamation (BOR) Remote Sensing and Geographic Information Group
Technical Service Center Denver, Colorado.

I. OVERVIEW

This proposal details the Bureau of Reclamation's Remote Sensing and GIS Group's (RSGIG) costs associated with mapping vegetation occurring within Lake Roosevelt National Recreation Area (LARO) and surrounding environs (1 km buffer) totaling approximately 187,200 acres (292 mi^2). These costs are necessarily preliminary given the assumed mapping extent. The mapping extent may change after consultation with other potential partners. Other partners may include the Colville Confederated Tribes, the Colville Reservation, and Ferry, Stevens, Lincoln, Grant, Douglas, and Okanogan Counties. Costs are divided between three major tasks: Initial field data collection, vegetation classification, photography and imagery acquisition, and photointerpretation, digital transfer/creation of spatial database. This project is planned to occur over a three-year period (FY06 to FY09). The total cost is estimated at $848,832.

II. SCOPE OF WORK

Vegetation at LARO will be mapped and classified by the BOR for the USGS-NPS Vegetation Mapping Program using the protocols and standards defined by the National Mapping Program and NPS Fire Program considerations. Color photography at a scale of 1:12,000 will be collected by Horizons Inc. (Rapid City, SD) under contract with the BOR and will be used to identify the vegetation mapping classes with additional field verification. The vegetation communities will be classified and mapped to the association level of the National Vegetation Classification Standard (NVCS); if the association level is not identifiable from the photography the vegetation shall be mapped to meaningful groups of associations or alliances. NVCS associations will be determined and supplied by a contractor or group to be determined later. In the past we have had good working relationships with most Natural Heritage Programs which have supplied us with this information. The minimum mapping unit will be 0.5 hectare. Photointerpretation will proceed in tandem with polygon delineation by eCognition feature recognition software using the new 1:12,000-scale true color ortho-photos (1 meter pixel), obtained by Horizons under contract with the BOR. All vegetation map classes shall achieve at least an 80% level of accuracy per class. Classification accuracy shall be estimated by the use of accuracy assessment methods described in the Program documents and will use data supplied by a contractor. The spatial accuracy shall meet the National Map Accuracy Standards at 1:12,000. Deliverables shall include both hard copy and digital data in Arc/Info export format and a comprehensive final report describing all methods. Spatial data shall be accompanied by Federal Geographic Data Committee compliant metadata. Quarterly reports shall be delivered to the NPS and USGS to provide updates on project status.

III. COST ESTIMATE

Field Work (Contracted Ecologists and Botanists)

Tasks	Staff Days	Total Costs
1. Preliminary Data Review and Orientation	4	$2,996
2. Sampling Strategy Meeting and Training	8	$5,192
3. Collect Plot Data (based on 70-day field season)	140	$90,860
4. Collect Accuracy Assessment (AA) Points (100-day field season)	200	$129,800
5. Enter Vegetation Data into Database	45	$20,250
6. Create Vegetation Class Key for AA	8	$5,200
7. Write Local Descriptions for Vegetation Classes	70	$45,500
8. Attend AA Meeting	4	$2,996
Subtotal Labor and Per Diem	479	$302,794
Materials and Associated Other Costs		$5,500
Total Field Work		$308,294

Assumptions:
Loaded Rates - Lead: $749/day = $65/hr x 10hrs/day + $99/day Per Diem
Technician: $549/day = $45/hr x 10hrs/day + $99/day Per Diem

Vegetation Types = 40 3 Plots / type collected at ~ 2 plots / day (120 Plots)

Accuracy Assessment = 1000 AA points collected at 10 AA points / day.

B.) Classification (Contracted Ecologists and Botanists)

Tasks	Staff Days	Total Costs
1. Attend Scoping Meeting 1	3	$2,247
2. Attend Scoping Meeting 2	3	$2,247
3. Preliminary Classification / Data Review	20	$13,000
4. Ecology Reconnaissance Trip	5	$3,745
5. Attend Sampling Strategy Meetings	12	$8,988
6. Finalize Classification	17	$12,733
7. Write Global Descriptions for Veg. Classes	20	$14,980
8. Create Vegetation Class Key for AA	8	$5,992
9. Final Report	6	$4,494
10. Support Final PI Work	6	$4,494
11. Scientific Overview Management	20	$14,980
Subtotal Labor and Per Diem	120	$87,900
Contract Overhead (10%)		$8,790
Total Classification		$96,690

Assumptions:
Loaded Rates - Lead: $749/day = $65/hr x 10hrs/day + $99/day Per Diem
Technician: $549/day = $45/hr x 10hrs/day + $99/day Per Diem

C.) Aerial Photograph and DOQ's (Horizons Inc – Rapid City, SD)

$95,000

D.) Photo-interpretation and Digital Transfer (BOR's Remote Sensing GIS Group)

Tasks		Staff Days	Costs
1.	Planning	8	$7,104
2.	Scoping Meetings	8	$7,104
3.	Contracting (Preparation & Monitoring)	10	$8,880
4.	Compile and Prepare Existing Data	4	$3,552
5.	Gradsect and Sampling Strategy Meeting	6	$5,328
6.	Reconnaissance Trips for PI	45	$39,960
7.	Map Classification and Meeting	7	$6,216
8.	Interpretation of Aerial Photographs (1,000 acres/day)	187	$166,056
9.	Status and Review Meeting	6	$5,328
10.	Transfer, Digitize, and GIS Database Creation	130	$97,760
11.	Database and P.I. Verification Trip	20	$17,760
12.	Metadata Generation	5	$4,440
13.	AA Support and Coordination Meeting	15	$13,320
14.	Map Production	5	$4,440
15.	Quarterly and Final Reports	30	$26,640
16.	Contingency Charges (15 days/year)	45	$39,960
Labor Subtotal		531	$453,848
Travel, Per Diem, and Other Costs			$30,000
TOTAL			$483,848

IV. SUMMARY OF COSTS BY FISCAL YEAR

	Initial Vegetation Field Work	Classification	Photointerpretation & GIS	Photo-acquisition	Cooperators (BOR)	Total per year
F.Y. 2006	$99,048	$30,227	$53,000	$95,000	-$10,000	$267,275
F.Y. 2007	$30,000	$40,000	$250,000		-$10,000	$310,000
F.Y. 2008	$153,746	$14,463	$120,000		-$10,000	$278,209
F.Y. 2009	$25,500	$12,000	$60,848		-$10,000	$88,348
Grand Total	$308,294	$96,690	$483,848		-$40,000	$848,832

VI. COOPERATORS SUPPORT

U.S. Bureau of Reclamation (Grand Coolee Dam Office)
$10,000 / Fiscal Year (Total $40,000)
Boat Support and Logistics
GIS local Support
Meeting Facilities
Possibly Partial Funding of Photography and DOQ Acquistion

VII. NARRATIVE OF TASKS

Planning. Planning for LARO encompasses all the preliminary work needed for preparation and coordination of the project. This includes creating work schedules, setting up computer databases, dedicating or acquiring necessary resources, and creating presentations for scoping and other meetings.

Scoping Meeting. This task involved the attendance of 2 BOR employees at 2 LARO scoping meetings for 2 days each.

Contracting (Preparation & Monitoring). Contracting for LARO involves preparing and overseeing the aerial photo contracts and providing assistance with the NPS inter-agency agreement.

Compile and Prepare Existing Data. A thorough collection and adaptation of previous LARO vegetation and related spatial data will be acquired and compiled for LARO in order to assist with the photo-interpretation.

Gradsect and Sampling Strategy Meeting. This task includes the participation and attendance of the BOR photo interpreters at a meeting to determine sampling areas within LARO. This will likely involve GIS support and generation of sample maps.

Reconnaissance Trips for Photointerpretation. Three weeks per year (FY 02 and 03) for 2 BOR photo interpreters is needed to link photo signatures with on the ground vegetation and ground-truth confusing vegetation polygons at LARO.

Map Classification and Meeting. This task includes preparing, coordinating, handling, and participating at a meeting to determine the final map classes to be used for the photointerpretation at LARO.

Interpretation of Aerial Photographs. For LARO, approximately 1000 (estimate) (9x9 inch true color prints will be used to interpret the baseline vegetation data. This includes three steps: 1) preliminary interpretation based on map classes determined during field reconnaissance and preliminary classification by contractor, 2) field verification and cross-walking of preliminary interpretation with contractor ecologists, and 3) complete photointerpretation based on final map classes as determined at the Map Class Meeting.

Status and Review Meeting. This task involves the preparation and attendance of 2 BOR photo interpreters at a meeting during the start of the second field season in order to review previous work and coordinate new efforts.

Transfer, Digitize, and GIS Database Creation. -For LARO, all data from the interpreted aerial photographs will be transferred in a GIS spatial database creating a digital vegetation coverage. Scanning and on-screen digitizing will be used to geo-reference the data onto 1:12,000 scale ortho-photos and all polygons will be attributed with the necessary cover-type and fire-related information.

Database and P.I. Verification Trip. A final trip to LARO by the BOR photo-interpreters will be conducted at the end of the photo-interpretation for the purpose of ground-truthing and field checking draft maps (2 weeks x 2 people).

Metadata Generation. FGDC compliant metadata will be created for all LARO spatial coverages produced during this project.

Accuracy Assessment Support and Coordination Meeting. This task involves the attendance of 2 BOR photo interpreters at a meeting held at LARO to coordinate the final field season and kick-off the collection of accuracy assessment point data. This also includes the production of preliminary draft vegetation maps and all other assistance necessary to facilitate the AA data collection.

Map Production. Numerous hardcopy, paper maps for the vegetation at LARO will be produced and sent out for review, field verification, and documentation. Digital Arc/Info export (.e00) and HP plot files (.rtl) will also be created and made available.

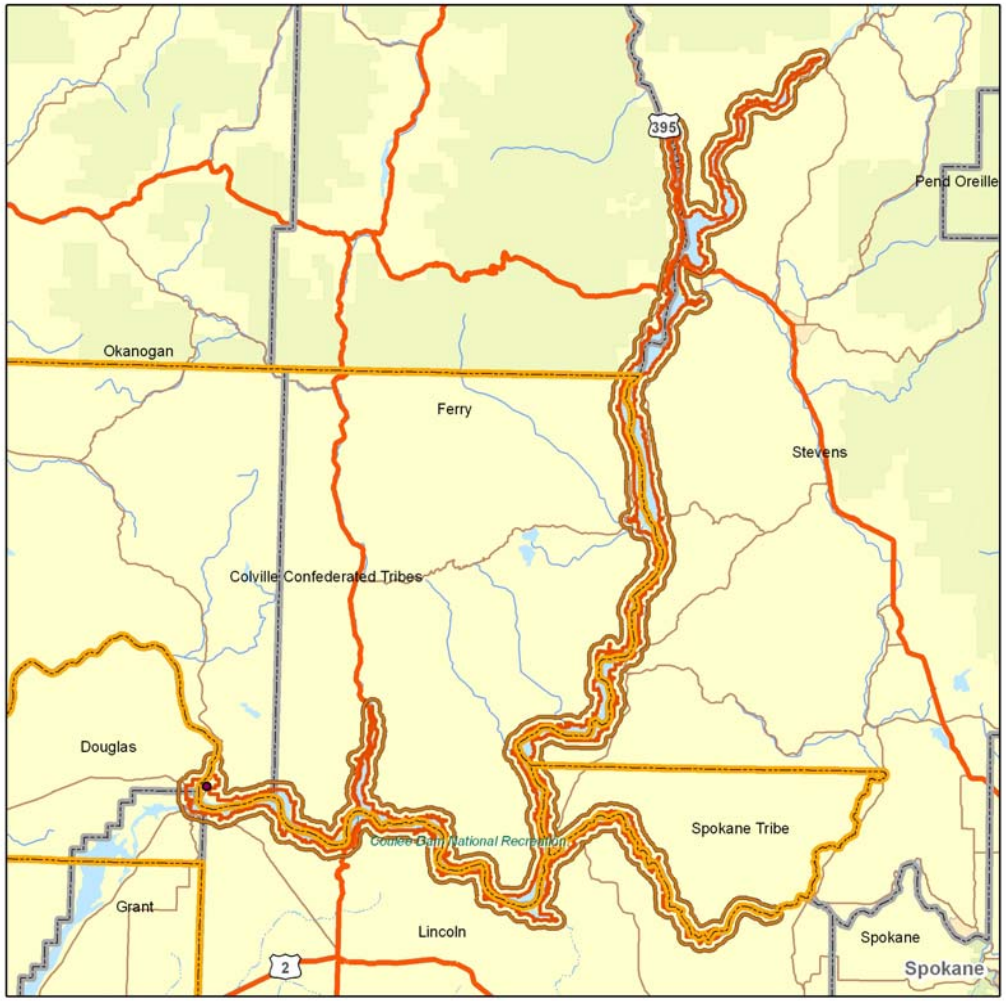
Quarterly and Final Reports. Quarterly reports will be issued throughout the project to NPS and USGS itemizing the status and progress of the work on LARO. A final technical report will be prepared and will incorporate all ABI summarized data and final vegetation maps. All final information will be included on a CD-ROM.

Contingency Charges. Contingency charges for LARO include 15 days per year necessary for covering unforeseen events such as lost time spent on coordination with other contractors, field-checking difficult signatures, assisting with the plot data collection, etc.

VIII. PROJECT TIME LINE

Task	Fiscal Years
1. 1. Planning	FY06
2. 2. Scoping Meetings	FY06
3. Contracting (Preparation & Monitoring)	FY06
4. Compile and Prepare Existing Data	FY06
5. Gradsect and Sampling Strategy Meeting	FY06
6. Reconnaissance Trips for PI	1/2 FY06 and 1/2 FY07
7. Map Classification and Meeting	FY07
8. Interpretation of Aerial Photographs (1000 acres/day)	FY07
9. Status and Review Meeting	FY08
10. Transfer, Digitize, and GIS Database Creation	FY08
11. Database and P.I. Verification Trip	FY08
12. Metadata Generation	FY09
13. AA Support and Coordination Meeting	FY09
14. Map Production	FY 06 – FY09 (intermittent)
15. Quarterly and Final Reports	FY06 – FY09

IX. PROJECT AREA



Legend

- Park Boundary
- Buffer Area (1Km)
- Tribal Lands
- Counties

N
W E
S

There are 265,000 acres within the proposed mapping area. This includes 104,000 acres within the Park of which 78,500 is water.

10 5 0 10 Miles