USGS-NPS VEGETATION MAPPING PROGRAM

Photo Interpretation Report
of
Fort Laramie National Historic Site

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FORT LARAMIE NATIONAL HISTORIC SITE, WYOMING
USGS-NPS VEGETATION MAPPING PROGRAM
AERIAL INFORMATION SYSTEMS PROJECT REPORT
September 4, 1998

I. INTRODUCTION

The National Park Service (NPS), in conjunction with the Biological Resources Division of the U.S. Geological Survey (USGS BRD), has implemented a program to "develop a uniform hierarchical vegetation methodology" at a national level. The program will also create a geographic information system (GIS) database for the parks under its management. The purpose of the data is to document the state of vegetation within the NPS service area during the 1990's, thereby providing a baseline study for further analysis at the Regional or Service-wide level. Aerial Information Systems (AIS) was subcontracted by Environmental Systems Research Institute (ESRI), the prime contractor, to perform the photointerpretation for the program. ESRI also subcontracted The Nature Conservancy (TNC) to conduct the field sampling effort and to support the development of the National Standard Classification.

Several parks, representing different regions, environmental conditions, and vegetation types, were chosen by USGS BRD to be part of the prototype phase of the program. The initial goal of the prototype phase is to "develop, test, refine, and finalize the standards and protocols" to be used during the production phase of the project. This includes the development of a standardized vegetation classification system for each park and the establishment of photointerpretation, field, and accuracy assessment procedures.

Fort Laramie National Historic Site was designated as one of the prototype parks. The monument is located in the high Great Plains. It contains prairie, hill, and riverine environments, with vegetation types that include upland woodland, prairie grassland, riverine woodland, and wetlands. AIS was responsible for the photointerpretation of the vegetation units and rectification of those units to a base. TNC directed the field sampling effort and the classification assignments. Working with the field biologists from TNC, AIS photointerpreted the vegetation units from stereo-paired, natural color photography at a scale of 1:12,000.

II. FORT LARAMIE NATIONAL HISTORIC SITE - GENERAL DESCRIPTION

Fort Laramie National Historic Site was created by the National Park Service on July 16, 1938. The park occupies 833 acres of land on the Laramie River, west of its confluence with the North Platte River in western Wyoming. Bureau of Land Management land south of the park (referred to as Plot 3) and northwest of the park (referred to as Plots 1 and 5) are also within the mapping study area.

The park is primarily preserved as an historic site. The fort site was occupied first as a fur trading center, then subsequently as a military outpost. It further served as a way station for trappers, traders, and emigrants on the Oregon Trail. The old fort site, located in the western end of the park, contains a complex of restored buildings and ruins, dating from mid and late 19th century, surrounding a lawn quadrangle. The remainder of the park contains disturbed prairie and floodplains.

The park itself lies mainly on the floodplain terrace of the Laramie River, with a portion on the North Platte River floodplain terrace just west of their confluence. A small portion of the northwest corner of the park lies above the terrace. Plot 3 lies directly south of the park, across the Fort Laramie Canal. It is an area of rolling hills. Plots 1 and 5 lie 1/4 mile northwest of the park, also in rolling hills.

The park is surrounded by rolling hills that are used for grazing and some agricultural cultivation. The city of Fort Laramie is located 3 miles to the northeast of the park. State Highway 160 bounds the park on the north and west. From the fort site there is an unobstructed natural landscape view, with very few incidents of modern or man-made features observed on the visual perimeter.

Fort Laramie National Historic Site contains five main geomorphologic areas:

- **The Northern Hills** are rolling prairie hills rising very steeply from the south side of the North Platte River Valley. The vegetation is composed mainly of prairie grassland, sparse pine woodland, and rock outcrop.

- **The Southern Hills** are rolling prairie hills on the south side of the Fort Laramie Canal. The vegetation is mainly composed of prairie grassland and sparse pine woodland.

- **The Upland Valley Bottom and Upper Floodplain Terrace** are the flat upland portion of the valley located between the Laramie and North Platte Rivers. The vegetation is composed mainly of prairie grassland and floodplain woodland.

- **The Laramie River and North Platte River Floodplains** are the low areas of the floodplain. They contain the rivers and their lower and middle terraces. The vegetation is riparian, composed mainly of grassland, wet meadow, and floodplain woodland.

- **The Southern Prairie portion of the park** is composed of wet lowland and dry upland areas, located between the Laramie River floodplain and the Laramie Canal. The vegetation is composed mainly of wet meadow and prairie grassland, with some floodplain woodland.

All areas are accessible by hiking. There is dirt road access to BLM Plots 1 and 5, and to BLM Plot 3. A paved service road allows access to the southern part of the park. A graded dirt road bisects the eastern part of the park. Access within each given area of the park is mainly facilitated by hiking. There are no private in-holdings. Permission to pass on private land is required for access to BLM plot 3.

The following is a brief and general description of the major regions and their associated vegetation types:

THE NORTHERN HILLS (BLM PLOTS 1 AND 5)

The area is accessed to the northwest from the State Highway 160 by a very good graded dirt road located at the northern boundary of the park. The southern end of the area is valley bottom consisting of prairie grassland. The vegetation includes sparse to dispersed cover of shrubs, composed of *Artemisia filifolia* and *Yucca glauca* in a matrix of *Bouteloua gracilis* and *Stipa comata.*

One quickly enters the slightly dissected rolling hills and ends up on a wide flat bench. The entire area is similar to the valley bottom, consisting of *Artemisia filifolia*, *Yucca glauca*, *Bouteloua gracilis*, and *Stipa comata*. Additonally there are patches of *Calamovilfa longifolia*, and occasional small areas of *Bromus spp*. The narrow hill ridge-tops contain a cobbly surface containing variable density vegetation of *Bouteloua gracilis*, *Carex filifolia*, and low forbs. At the northern edge of this hill area is a steep escarpment dropping down to the North Platte River Valley. The escarpment is composed of sparse pine woodland intermixed with rock outcrop. The vegetation consists of *Pinus ponderosa* overstory, and an understory of rock outcrop*, Schizachyrium scoparium, Yucca glauca, Rhus trilobata, Bouteloua gracilis*, and *Carex filifolia*.

THE SOUTHERN HILLS (BLM PLOT 3)

The southern hills are located south of the Fort Laramie Canal. Access is gained from the graded dirt road at the eastern part of the park. After crossing the Fort Laramie Canal, one must travel on foot across private property along the canal to BLM Plot 3.

The character of the southern hills is very similar to the northern hills. The area is mainly slightly dissected rolling hills, with a bowl of flatter land toward the north central area. The vegetation consists of varying density of sparse to dispersed shrubs composed of *Artemisia filifolia* and *Yucca glauca* in a matrix of *Bouteloua gracilis* and *Stipa comata*. The narrow hill ridge-tops contain a cobbly surface with variable density vegetation of *Bouteloua gracilis*, *Carex filifolia*, and low forbs.

VALLEY BOTTOM PRAIRIE AND UPPER TERRACE

The valley bottom is a disturbed version of the valley bottom of the northern hills area. This is the highest area within the northern part of the park. It sits above the upper terrace separated by a short escarpment. The vegetation of the valley bottom consists of *Bouteloua gracilis* and *Stipa comata*. Also present are sparse to rare shrubs consisting of *Artemisia filifolia* and *Artemisia frigida*. Occasional patches of *Calamovilfa longifolia* are also present. Disturbed areas contain *Bromus spp*. and forbs.

The upper terrace contains a patchwork mosaic of disturbed vegetated areas. The built up historic site and an old agricultural field occupy most of the area. Some areas contain seeded *Pascopyrum smithii* and *Bouteloua gracilis*, while others contain *Sporobolus cryptandrus* and *Buchloe dachtyloides* with *Bromus tectorum*. There are also patches of *Bromus inermis*. Patches of *Kochia scoparia* are also present.

RIVER FLOODPLAIN (LOWER AND MIDDLE TERRACE)

The lower and middle floodplain terraces run along the north and south side of the Laramie and North Platte Rivers. The middle floodplain terrace contains floodplain woodland composed of *Populus deltoides*, *Salix amygdaloides*, and *Fraxinus pennsylvanica*. There is an understory of *Symphoricarpos occidentalis*, *Shepherdia argentea*, and *Salix exigua*. Saplings of *Populus deltoides* also occur. In open areas the understory may contain *Pascopyrum smithii*, *Poa pratensis*, *Stipa comata*, *Calamovilfa longifolia*, and/or *Bromus inermis*. Drier areas contain *Bouteloua gracilis*, *Stipa comata*, *Sporobolus cryptandrus*, Bromus tectorum, *Agropyron* cristatum, and *Sporobolus airoides*. Sparsely vegetated areas also occur, containing *Artemisia campestrus*, Artemisia frigida, *Bouteloua gracilis, Stipa comata*, and *Opuntia spp*.

The lower terrace is located directly adjacent to the river, or in abandoned river channels. The vegetation includes narrow bands of *Spartina pectinata, Typha latifolia, Salix exigua,* and forbs. Sparse to rare density of vegetation occur on the riverine sand and gravel bars that are along the river.

SOUTHERN PRAIRIE

The southern part of the park is prairie grassland and wetland caused by seepage from the Fort Laramie Canal. The area is slightly undulating, with the dry grassland occurring on the rises, and wetland vegetation on the low areas. The dry grassland is composed of *Bouteloua gracilis* and *Stipa comata*, with *Calamovilfa longifolia* and some *Bromus inermis*, and scattered *Artemisia filifolia*. Patches of *Bromus spp*. also occur. The higher transitional low areas are composed of *Calamovilfa longifolia*, *Pascopyrum smithii*, *Poa pratensis*, and *Equisetum laevigatum.* The wetter areas contain *Scirpus pungens*, *Carex nebrascensis*, *and Bromus inermis*. There are also clumps of *Salix exigua* and floodplain woodland composed of *Populus deltoides* and *Salix amygdaloides*. A few small saturated or ponded areas contain mudflats and *Typha latifolia.*

III. SUMMARY OF MAPPING EFFORT AT FORT LARAMIE NATIONAL HISTORIC SITE

The following section is a short outline, listed in chronological order, of the vegetation mapping effort at Fort Laramie National Historic Site. For a detailed description of the tasks listed, refer to sections IV, V, and VI.

July 1996
- Field Preparation
- Preliminary Photo Signature Delineation

August 1996
- Initial Meeting at Fort Laramie National Historic Site
- Photointerpretation Field Reconnaissance

August 1996 to December 1996
- Development of Post-Field Reconnaissance Tentative Classification by TNC
- Preliminary Photo Signature Key

January 1997 to March 1997
- Photointerpretation of Vegetation based on Tentative Classification

April 1997 to June 1997
- Review of Photo Signature/Vegetation Units by TNC

July 1997
- Development of Preliminary Classification by TNC
- Photointerpretation Verification Field Preparation

August 1997
- Photointerpretation Field Verification
- Field Revisions
- Revised Preliminary Classification, Development of Vegetation Key and Descriptions by TNC

September 1997 to November 1997

Final Classification, Vegetation Key, and Descriptions by TNC
Final Photointerpretation Revision based on Final Classification
Basemap Production
Manual Rectification
Manuscript Map Preparation

December 1997
Review of Final Photointerpretation Overlays by TNC

January 1998 to May 1998
Revise Photo Signature Key (based on final classification)
Data Conversion
- Polygon label ID
- Attribute Input
- Scanning and Vectorization
- Edit Plot QC
- Final Processing
- Interpretation of Pattern

June to September 1998
Final Documentation

IV. VEGETATION MAPPING AT FORT LARAMIE NATIONAL HISTORIC SITE

One of the most important mandates of the Vegetation Mapping Program is the consistent capture and classification of vegetation types through photointerpretation and field sampling methodologies. Mapping criteria and procedures developed during the first two prototype parks are still being tested and revised. The vegetation mapping of Assateague Island National Seashore and Tuzigoot National Monument utilized vegetation layer mapping. Layer mapping consisted of photointerpretation of individual vegetation taxa, then re-aggregating them into the appropriate association or alliance classes. For the third prototype park, Scotts Bluff National Monument, BRD determined that a different approach be used for mapping. The new approach, also used for subsequent parks, including Fort Laramie National Historic Site, involved the mapping of association/community, height, density, and pattern.

The following sections describe the tasks performed and methodologies used by AIS during the photointerpretation effort for Fort Laramie National Historic Site.

Initial Meeting

A one-day meeting was held in August 1996 at the park headquarters. Its purpose was to bring together the project team members (USGS BRD, AIS, and TNC) with park personnel to discuss the USGS-NPS Vegetation Mapping Program and specific interests of the Fort Laramie National Historic Site. USGS BRD conducted a presentation and discussion of the USGS-NPS Vegetation Mapping Program. Park personnel also presented source documents and maps for possible use in the USGS-NPS Vegetation Mapping Program.

During the meeting, imagery, basemaps, and other pertinent collateral materials were reviewed and evaluated. The study area for the project was also discussed and established to be the current park boundary and three plots of Bureau of Land Management land possible for future acquisition by the park. The amount of park support (e.g., personnel, transportation, etc.), as well as permission to pass onto private in-holdings was also discussed.

Development of Photointerpretation Mapping Procedures

The standard process in vegetation mapping is to conduct a field reconnaissance, map the vegetation units through photointerpretation, then conduct a field verification. The field reconnaissance visit serves two major functions. First, the photointerpreter keys the signature on the photos to the vegetation on the ground at each signature site. Second, the photointerpreter becomes familiar with the taxa, vegetation types, and local environments that occur in the study area. Park and/or TNC field personnel, who are familiar with the local taxa, vegetation types, and association/community units, are present to help the photointerpreter understand these elements and their relationship with the local environments.

Upon completion of the field reconnaissance, the photointerpretation of the vegetation units commences. The mapping is conducted in accordance with the TNC vegetation classification and criteria. This is followed by a field verification session, whose purpose is to verify that the vegetation units were mapped correctly, and to answer any questions.

The vegetation mapping at Fort Laramie National Historic Site in general followed standard mapping procedure. However, there were two differences. The first involves the timing of the photointerpretation, TNC field plot sampling, final classification documentation, and photointerpretation field verification. The TNC field plot sampling was scheduled to occur during the same field season as the photointerpretation field verification. It was logistically impossible to have the sampling and the final classification completed before photointerpretation or before field verification. Since the classification would not become final until after the photointerpretation field verification visit, there was a possibility of classification changes, and therefore, mapping changes. In fact, several tentative classes were later aggregated. Therefore, a redrafting of the photointerpretation overlay was necessary.

Secondly, as with Scotts Bluff National Monument, it was determined that pattern, being more of a general vegetation attribute, would best be interpreted at the completion of the vegetation mapping. All mapped features could be viewed in context of each other over the entire landscape of the park in order to assess the pattern.

Development of Photointerpretation Mapping Criteria

Since mapping for the Vegetation Inventory and Mapping Program had begun, a standardized program-wide mapping criteria was being developed. Mapping criteria are a set of documented working decision rules used to facilitate the maintenance of accuracy and consistency of interpretation in the database. They assist the user in understanding the characteristics, definition, and context for each vegetation category.

The mapping criteria for Fort Laramie National Historic Site composed of three parts: the standardized program-wide general mapping criteria, the park specific mapping criteria and the working photo signature key, and the classification descriptions. The following is a detailed description of the criteria used during the photointerpretation of Fort Laramie National Historic Site.

- General Mapping Criteria

The mapping criteria listed below is a modified version of that developed during the Assateague Island National Seashore mapping effort. The criteria will serve as the standard for future photointerpretation efforts in the Vegetation Inventory and Mapping Program to ensure a consistent standard of mapping on a nationwide basis.

- Height

  Height describes average height of the life form of the specific association/community unit. If there are significant height differences within an association/community unit, then the unit can be subdivided to reflect those differences, provided they meet the minimum mapping unit (mmu) resolution.

  - Height Categories

    <0.5 meters
    0.5 - 2 meters
    2 - 5 meters
    5 - 15 meters
    15 - 35 meters
    35 - 50 meters
    >50 meters
    Not Applicable

  - Height Mapping Criteria

    - To determine the average height of the vegetation of the same life form, determine the percentage of the vegetation at each height category. If 10% of the trees are 30m tall and 50% are 36m tall, then they will fall into a height class category of 35-50m. If 80% of the trees are 30m tall and 20% are 36m tall, then the height class category assigned to the polygon will be 15-35m.

    - If there are seedlings and mature growth of the same species, the dominant growth form will be the determining factor. For instance, if a polygon contains *Pinus palustris* seedlings <.5m tall and mature *P. palustris* trees 30m tall, the dominant cover type will determine the height assignment, i.e., if the 30m tall trees compose >50% of the tree cover, then the height class category for the trees will be 15-35m.

- Density

  Density refers to the spacing of plants in the landscape. It represents the total coverage based on the percentage of crown or canopy cover. This figure is a qualitative estimate based on the aerial photography. Two methods are used to determine densities from aerial photographs, Absolute and Relative (Continual) Density. Absolute density refers to the sum total of the visible plant and non-vegetative cover within a given mapping unit. The total density cover for all visible over-, mid-, and understory vegetated and non-vegetated surfaces must equal 100% present. The unvegetated areas are not delineated unless they can be delineated at the project minimum mapping unit (mmu). Vegetation not visible on the aerial photograph is not considered part of the total plant density. For example, in a closed canopy forest the understory grasses and shrubs are not visible, therefore only the tree overstory is visible and the density class is based on the total tree cover present.

Relative density is used when the aerial photography allows the interpreter to see the understory vegetation. This is due to the environmental conditions at the time of the photography, or when detailed field notes are available. When mapping relative density, it is possible to arrive at total vegetation cover percentages well over 100%. For example, using winter photography to capture leaf-off conditions, a closed-canopy deciduous forest (over 60% crown cover) is visible along with the shrub and grass understories. In addition to the 60-100% tree cover, shrub and grass understory may make up an additional 60-100% understory cover, totaling at least 120% vegetation cover for that mapping unit.

Absolute crown density is normally the most accurate way of estimating plant coverage and will be used to determine the percentage of vegetation cover within a polygon unless noted otherwise in the park specific mapping criteria. In certain park specific situations where understory needs to be mapped, relative density estimates will be addressed if there is sufficient data. At the very least, aerial photography showing leaf-off conditions is necessary when mapping relative crown density.

For Fort Laramie National Historic Site density describes average absolute crown density of the life form of the specific association/community unit. If there are significant density differences within an association/community unit, then the unit can be subdivided to reflect those differences, provided they meet the minimum mapping unit (mmu) resolution.

- Density Categories
    - Closed/Continuous >60% = Canopies overlapping, touching or nearly touching in most of the mapping unit.
    - Discontinuous 40%-60% = Canopies rarely touching, however spacing is fairly minimal, especially when plants are not evenly distributed throughout the polygon.
    - Dispersed 25%-40% = An open or parkland situation where large spaces occur between trees and shrubs, or where grasses are fairly sparse throughout the mapping unit.
    - Sparse 10%-25% = Trees or shrubs are widely spaced, scattered throughout the polygon, or are clumped in very small areas making up a small percentage of the entire vegetative cover.
    - Rare 2%-10% = Trees or shrubs occur only occasionally and usually do not make up enough percentage to be considered evenly dispersed. Grass coverage at this level is hard to detect on small scale aerial photography.
    - Not Applicable = Density does not apply.

- Density Mapping Criteria

  - To determine the absolute density, assign percentages to the different life forms visible on the aerial photo, including non-vegetated areas. The total percent cover of trees, shrubs, herbaceous and non-vegetated should add up to 100%. Convert the absolute density percentages into the appropriate density class.

  - Non-vegetated areas are not coded in the database unless they meet the minimum mapping resolution for the park and can be mapped as a stand-alone polygon. Otherwise, it is assumed that all vegetation polygons contain non-vegetated areas.

  - Consider the coverage pattern of the life form before assigning a density code to the polygon. Estimating densities is more straightforward when plants occupying a particular strata are evenly distributed throughout the mapping unit. However when polygons contain populations of plants that are clumped or occurring only in portions of the polygon, the photointerpreter must consider the area that is not occupied by plant cover when determining coverage density. To ensure consistency, it is helpful to count the plants in polygons with clumped and unevenly distributed vegetation and then compare them to similar sized polygons with an even distribution of plant cover.

  - Vegetation stature type and scale of the aerial photography will determine the visibility of individual plants. Trees are usually visible as individuals and with larger scale photography so are shrubs. However, grasses are rarely seen as individual plants, regardless of the scale of the photography.

  - In the case of trees and shrubs, the percent cover at a density break is adjusted downward. If the percent cover is at about 25%, the polygon is assigned a density code of sparse (10-25%) instead of dispersed (25-40%).

  - Dry grasses tend to be less dense than they appear on the aerial photographs. To accurately depict the densities, the percent cover for dry grasses should be adjusted downward. This means that if the percent cover falls at the lower end of a density category, the polygon should be assigned the next density class down. For example, if the percent cover = 25%, the polygon should be assigned a density category of sparse (10-25%) instead of dispersed (25-40%). If the percent cover falls within the middle of a density category, the polygon should be assigned that density class, i.e., if the percent cover = 35%, then the polygon is assigned to the density category dispersed (25-40%).

  - The date of the aerial photography will also influence the densities assigned to vegetation types, especially herbaceous species. Subsequent field verification must take into consideration the following factors that can cause apparent discrepancies between the densities evident on the photo and those visible in the field:

  - Seasonality - the density of most herbaceous plants is variable due to their annual growth cycle. Depending on the season the aerial photography was taken, a mapped unit could show a different density on the aerial photographs than is observed during an on-site visit at a different time of the year. Another effect of seasonality is leaf on/off conditions. Photos of forest or woodland areas with leaf on conditions obscure the understory. Photos of leaf off conditions would allow photointerpretation of the understory.

  - Different years - the environmental conditions at the time of the photography (wet vs. drought years, flooding, etc.) may affect the densities seen during the on-site field visits.

- Pattern

  Pattern describes the general distribution of vegetation types across the landscape. Pattern of vegetation can be a reflection of the landform, soil, geology, climatic gradients, and/or elevation gradients.

  - Pattern Categories

    - Evenly dispersed = Pattern of vegetation is an even or almost even distribution of individuals, clumps, or groups.

    - Clumped/Bunched = Unevenly dispersed clumps of individuals or groups.

    - Gradational/Transitional = A gradual thinning of the individuals or clumps as one moves from one area to another.

    - Alternating = The vegetation occurs in a regular repeating pattern.

    - Not applicable = Pattern does not apply.

  - Pattern Mapping Criteria

    - For Fort Laramie National Historic Site, pattern was mapped after the final association/community map was created. A plot of the association/community polygons was made and the vegetation was compared back to the aerial photography. The vegetation distribution was coded with the appropriate pattern code. If a polygon contained more than one pattern type, the polygon was subdivided as needed.

- Association/Community

  The assignment of association/community units to the vegetative cover is based on criteria formulated by TNC. In the case of Fort Laramie National Historic Site, TNC provided AIS initially with a tentative classification. After plot samples were collected, TNC generated a final vegetation classification with associated vegetation key, and vegetation descriptions of each association or community within the monument.

- Aggregation

Aggregation of multiple vegetative classes is necessary when vegetation types present within a polygon are below minimum mapping resolution (mmu).

- Like life forms should be aggregated together; trees should be aggregated with other trees, shrubs with shrubs and herbaceous with herbaceous vegetation types.
- Wet vegetation types should be aggregated with other wet vegetation types, regardless of life form class.
- If a unit that is below minimum mapping resolution is completely surrounded by another vegetation type class, the unit is aggregated with the surrounding vegetation.

- Working Photo Signature Key

A photo signature key is an important tool for maintaining consistency of interpretation. It correlates the physical descriptions of the photo signature with the appropriate vegetation type. A key may also describe other useful information that would be helpful with the interpretation. For Fort Laramie National Historic Site, a preliminary or working photo interpretation key based on signature characteristics was developed for the mapping compilation as an interim product. A final deliverable association/community photo signature key was created after completion of the mapping.

The preliminary or working photo signature key was developed for Fort Laramie National Historic Site after the field reconnaissance visit, and was based on the tentative classification. The data gathered in the field was analyzed. The photos, field overlays, and field notes were reviewed and consistent correlations between signature and vegetation types were noted. Each photo signature was given a unique code. The key, in table form, contained the photo signature code, Steve's (Rolfsmeier) nomenclature, association/community, photo signature description (color, texture, crown size, crown shape, density), height, context (supplemental useful information), notes, and inferred taxa.

After completion of the mapping, a final association/community photo signature key was created from the information compiled on the working photo signature key and from the final vegetation classification. This key contained association/community code, association/community name, photo signature (describing the community association life form), height, context, and notes.

- Park Specific Mapping Criteria

The park specific mapping criteria addressed items of specific interest to the park that were not covered under the general mapping criteria:

- The minimum mapping unit (mmu) was established at 1/4 hectare. (The program standard is 1/2 hectare).
- The mapping scale at Fort Laramie National Historic Site was 1:12,000.

- A general correlation could be made between topography and vegetation types. Therefore, the park was divided into five unique physiographic areas. The regions are listed below:

    - Northern Hills (BLM Plots 1 and 5)
    - Southern Hills (BLM Plot 3)
    - Valley Bottom and Upper Terrace
    - River Floodplain (Lower and Middle Terrace)
    - Southern Prairie

- Since vegetation disturbance identification and restoration is an on-going goal of the park, knowledge of vegetation disturbance locations and their rehabilitation over time is important. Areas with highly disturbed vegetation containing exotic forbs, annual forb disturbance, and *Bromus* spp. can be discerned on the aerial photography. Every attempt was made to create a polygon to capture these disturbance areas.

Project Set-Up

Two types of aerial photography were provided for the project. The photography received was natural color and color infrared (CIR), nominal scale of 1:12,000, dated July 1995. Each type consisted of prints and diapositives. Both sets of imagery were evaluated to determine which film type would be used as the primary source. Upon review it was determined to use the natural color photography as the primary source. The CIR photos were very dark with a vignette effect.

Upon receipt of the project materials a formal study area had to be identified. During the initial meeting, the park had expressed an interest in having BLM Plots 1, 3 and 5 included in the mapping. The park provided a copy of the USGS topographic quadrangle map with the park boundary and the BLM plots delineated.

A flight line index was created, showing the relationship of the photos to the preliminary study area. The photos were compared to one another to ensure there were no gaps in the imagery and that there was full coverage of the study area.

Preliminary Photo Signature Delineation

A total of 3 photos (non-stereo pairs) were needed to provide full photo coverage of the study area for photointerpretation. Each photo was prepared with one mylar overlay for the photo signature delineations. All attribute codes were assigned after tentative initial classification development, subsequent to the photointerpretation field reconnaissance visit. The photo overlays were pin-registered to the photos and labeled appropriately. A study area boundary was determined for each photo, defining the area of photointerpretation. These boundaries were drafted onto the photo overlays and edgematched with adjacent photos to ensure full coverage. Using a mirror stereoscope, the photo signature units were delineated onto the mylar overlays. The delineation of the units was based on signature characteristics including color, tone, texture and relative height. The units were edgematched between photo study areas.

Field Reconnaissance Effort

A one-day photointerpretation field reconnaissance visit was conducted. As stated earlier, the purpose of the field reconnaissance visit was to familiarize the photointerpreter with the vegetation types and their photo signatures before the actual attribute coding process. The field crew consisted of Ed Reyes of AIS, Steve Rolfsmeier of TNC, and Ralph Root of BRD.

Before the field session, several in-house preparations were made. Each photo was set-up with a field mylar overlay. Registration features (e.g., roads and trails) were drafted onto the overlays. Each photo was reviewed and field sites were chosen representing different signature types, environmental conditions and topography. The sites were drafted onto the field overlays with notations as needed. Multiple sites were chosen to provide alternatives if one or more sites were inaccessible.

The field crew conducted on-site field investigations over the one-day period. During the field visit, the photointerpreter worked with the field biologist to identify the vegetation species found at the park. A field site number was annotated directly onto the photo field overlay, thereby correlating the field site to a specific location and photo signature. A field notebook was used to record pertinent information, e.g., species present, past disturbances, general topography, etc. Ground photos were taken at selected locations and referenced back to the aerial photos and field sites. Sites not previously identified in field preparation were also visited. These included areas between identified sites, and any unusual or notable areas as they were encountered. Most readily accessible areas were visited, representing most vegetation types within the park.

Photointerpretation of Vegetation

Photointerpretation is the process of identifying map units based on their photo signature. All land cover features have a photo signature. These signatures are defined by color, texture, pattern, relative height, and tone on the aerial photography. By observing the context and extent of the photo signatures associated with specific vegetation types, the photointerpreter is able to identify and delineate the boundaries of the vegetation. Additional collateral sources (e.g., existing vegetation maps, supplemental photography, soil data, etc.) can be of great utility to the photointerpreter. Understanding the relationship between the vegetation and the context in which they appear is very useful in the interpretation process. Familiarity with regional differences also helps interpretation by establishing a context for a specific area.

The approach and development of the vegetation classification and photointerpretation utilized an integrated series of photointerpretation procedures and field ecology. At Fort Laramie National Historic Site, the classification would not be fully developed until vegetation plot samples had been collected and analyzed. In order to maximize the field effort and schedule, the vegetation field plot sampling and the photointerpretation field verification were scheduled to occur over the same summer field season. Logistically, the field plot sampling and classification development had to occur before photointerpretation and the eventual photointerpretation field verification. It was not possible for the classification to be fully developed in time for photointerpretation and field verification to occur. As a solution, the photointerpretation process utilized an initial vegetation classification developed by the field ecologist. This approach promoted feedback from the photointerpreter to the field ecologist throughout the field plot sampling and classification development. After the photointerpretation was completed, a second field effort was initiated for the photointerpretation field verification and final edit process.

The vegetation was mapped using an initial community signature code methodology. A tentative initial classification was developed by TNC based on the photointerpretation field reconnaissance. The photo signature units were based on the initial classification development and given pseudo-community signature codes. The photointerpreter also identified other photo signatures that might possibly be subunits of the communities, or communities that had not already been identified. These additional photo signature units were given unique codes to differentiate them from the other classes. This additional information was passed on to the field ecologist. It was possible that these areas would require additional field plot sampling. The photointerpretation overlays were attached to their corresponding natural color diapositives. The stereo-paired natural color diapositives were viewed through a mirror stereoscope. Each photo was analyzed for photo signature units, photo signature description, inferred taxa, context, and the inferred initial community association. Knowledge gained from the field reconnaissance visit formed the basis of decision making. An initial community/photo signature polygon was delineated and corresponding code for each polygon was written on the photointerpretation overlay. The initial community/photo signature code, its color and texture description, the context of the unit, the inferred taxa, and inferred association/community were noted.

Each photo overlay was edgematched to the adjacent corresponding photo overlays to ensure a seamless coverage in the database. Delineations and codes were compared and discrepancies between photos were resolved and corrected on the appropriate mylar overlays. Any uncertain interpretations were flagged on the mylar overlay for review during the quality control task.

Upon completion, the photointerpretation overlays were copied onto transparencies and forwarded to TNC for review and use as supplemental information for the field plot sampling task. Any questions or clarification request on the vegetation classification criteria or photo signature units were also forwarded to TNC.

Photointerpretation Field Verification

A two-day photointerpretation field verification visit was conducted. Since the vegetation classification had not been fully developed, the field visit was not a true photointerpretation field verification, but was a verification of the preliminary mapping. The purpose of the field verification visit was to verify the initial community/photo signature units that were mapped, and further communicate with the TNC field ecologist regarding the classification vegetation types and their photo signatures. The field crew consisted of Ed Reyes of AIS and Hollis Marriott of TNC.

Before the field session, several in-house preparations were made. Each photo was set-up with a field mylar overlay. Registration features (e.g., roads and trails) were drafted onto the overlays. Each photo was reviewed and field question sites were chosen. In addition, a general field route plan was identified. The route would use primarily foot travel in order to visit the question sites and as many photo signature units as possible.

The field crew conducted on-site field investigations over the two-day period. During the field visit, the photointerpreter worked with the field biologist to identify the vegetation species found at the sites. A field site number was annotated directly onto the photo field overlay, thereby correlating the field site to a specific location and photo signature. A field notebook was used to record pertinent information, e.g., species present, past disturbances, general topography, vegetation class, etc.

Ground photos were taken at selected locations and referenced back to the aerial photos and field sites. Sites not previously identified in field preparation were also visited. These included areas between identified sites, and any unusual or notable areas as they were encountered. Most readily accessible areas were visited, representing all vegetation types within the park.

Final Photointerpretation

Final photointerpretation/revision of the initial community/photo signature units and codes did not commence until after the revised preliminary vegetation classification, vegetation key and code descriptions were developed. The tentative post-field reconnaissance classification differed from the revised preliminary classification enough that it was decided to draft a new photointerpretation overlay, but base it on the previous one.

The original photointerpretation overlay was attached to its corresponding natural color diapositive. Three additional mylar overlays were attached to each photo, one was the new vegetation delineation overlay, the second was the association/community code overlay, the third was the height/density code overlay. The stereo-paired natural color diapositives were viewed through a mirror stereoscope. The height/density and the association/community code overlays were flipped up so that the photointerpretation overlay and the vegetation delineation overlays were viewed over the stereo image. Each photointerpretation delineation unit was analyzed for photo signature units, photo signature description, inferred taxa, context, and final community association. Knowledge gained from the field verification visit and information from the classification descriptions in association with the photo signature observations formed the basis of decision making. The community association polygon was delineated on the vegetation delineation overlay. A community association code was written on the association/community code overlay. The photo was then analyzed for height and density of the association/community life form. The codes for height and density were written on the height/density code overlay. Where necessary, lines were revised or added to the vegetation delineation overlay. Attribute assignments were based on the mapping criteria and descriptions in the key.

Each photo overlay was edgematched to the adjacent corresponding photo overlays to ensure a seamless coverage in the database. Delineations and codes were compared and discrepancies between photos were resolved and corrected on the appropriate mylar overlays. Any uncertain interpretations were flagged on the mylar overlay for review during the quality control task.

Quality Control of Photointerpretations

A separate quality control step was performed for each photo upon completion of the photointerpretation. The photos and their delineation and code attribute overlays were reviewed by a senior photointerpreter. The interpreted overlays were checked for completeness, consistency, and adherence to the mapping criteria and guidelines. For those polygons flagged by the photointerpreter, the reviewer either assigned the appropriate vegetation code and/or discussed the change with the interpreter.

Upon completion, the photointerpretation overlays were copied onto transparencies and forwarded to TNC for review.

V. DATA CONVERSION

Converting the vegetation delineations to a digital format involved several steps that fall within four main procedures. The first step was the preparation of a manuscript map and attribute code file. The second was the input of the spatial data or geographic locations of the mapped features. The third was the population of the attribute table or the information that describes the geographic features. Finally, the fourth procedure involved making the data usable for analysis within the GIS.

The following are descriptions of the broad tasks that apply to the data conversion of vegetation for Fort Laramie National Historic Site.

Basemap Production

In order to begin the data conversion process, a hardcopy version of the base was needed. The designated base was the USGS black and white digital orthophoto quarter quad (DOQQ) series for the Fort Laramie 7.5 minute quadrangle.

Creation of the DOQQ required having the image ploted onto clear mylar at the mapping input scale, which would be 1:12,000. The aerial photographs were not scaled at exactly 1:12,000. To facilitate rectification, it was decided to determine the actual scale of the photography and have the DOQQ basemap plotted at that scale. The photography was determined to average 1" = 1080'.

Manual Rectification

Manual rectification was conducted by attaching a new mylar overlay to the base. The photo signature delineation units were transferred to the overlay through local registration of the photos with the attached photo signature delineation overlay. A small area of the photo was registered to the base at a time. By matching photo image to orthophoto image, the delineations were transferred to the base overlay. Because the parallax of the photo differs from that of the orthophoto base, care was required in transfer. Inconsistent stretching or shortening of the images was common from the photo to the base. When one area was completed, the photo was shifted to register to another small area. The process continued until the manual rectification and transfer of polygons was complete. Two code attribute overlays were produced, one containing association/community codes, the other the height and density codes. The codes were transferred from the corresponding photo overlays. An additional land use code attribute overlay was also created at this time.

A quality control step was performed in order to assure accuracy of the rectification and delineation, and transfer of the codes. A senior interpreter reviewed the overlays for accuracy and completeness of transfer and made the appropriate changes where needed.

Manuscript Map Preparation

A manuscript map, suitable for automation, was created to input the spatial component of the vegetation mapping units. The manuscript was produced by pin-registering a clean sheet of mylar to the base. The vegetation delineations from the manually rectified overlay were transferred to the new overlay in ink. The manuscript map was carefully edited to ensure completeness and correctness. The editing included comparing the manuscript with the original delineations on the aerial photos.

Quality Assurance of the Manuscript Map

The final manuscript map underwent a quality assurance review. The manuscript map was compared to its manual rectification overlays to ensure that all line-work had been transferred correctly. Particular attention was given to the quality of the line delineations with respect to gaps and other irregularities.

Sequence Number Assignment

A sequential identification number overlay was produced for the manuscript map. A clean sheet of mylar was pin-registered to the manuscript, and the polygons were labeled in sequence. The identification number labels were used to tie the spatial file to the keypunched attribute file.

Polygon Attribute Encoding

To expedite the encoding of the vegetation attributes for each polygon, a Quattro Pro spreadsheet file was created for the manuscript map. A separate field was created for the polygon sequence number, community association code, height code, density code, and land use code attributes. The manuscript map, sequence number overlay and attribute overlays were pin-registered together on a light table. The coder, following the numbers on the sequence number overlay, entered the vegetation attributes for each polygon. During this task, the coder verified the accuracy of the sequence number labels. Any errors found on the sequence number overlay were corrected to ensure that each polygon had a unique identifier.

Spatial Data Input/Scanning

The manuscript map was scanned and converted into an ARC/INFO coverage at ESRI. Prior to any production scanning, test scans of small areas of the data map were conducted to determine the optimum raster to vector conversion settings. The critical settings that determine the output resolution and completeness are the TOLERANCE and THRESHOLD. The TOLERANCE, which governs the output resolution and is comparable to fuzzy tolerance, would be set to .01 inches (10 feet at 1:12,000 scale). The THRESHOLD is a reflectance measure. It is dependent on the physical characteristics of the data maps and their contents and is determined through testing. Once the THRESHOLD was derived, production scanning of manuscript map began.

Assigning Polygon Identifiers

In an earlier step, the vegetation polygons were assigned a unique identifier. The numbers were sequenced 1 through "n" (4-digit item width) and were drawn on the sequence number overlay. The manuscript map and the sequence number overlay were registered together on the digitizing board. The polygon identifiers were sequentially input as label points. To ensure that all labels points were entered, the processor marked off each label as it was digitized.

Creation of Topology

Topology is the mathematical procedure for explicitly defining spatial relationships. In the case of maps, topology defines connections between features, identifies adjacent polygons, and can define one feature such as an area, as a set of other feature types (i.e., lines).

A topological database has several advantages: efficient data storage, faster processing, and the ability to perform analysis, such as modeling transportation networks or overlaying geographic features on one another.

Once the manuscript map's polygon boundaries and label points had been input into the computer, the ARC/INFO software CLEAN command was used to create the "coverage topology." The CLEAN fuzzy tolerance was set to .002 inches to preserve the required data resolution. When other coordinate edits were made to a coverage after the CLEAN command was run, topology was recreated utilizing the BUILD command.

Label Entry Error Processing

Label errors were identified by using the LABELERRORS command in ARC through an ARCEDIT session. Any label errors identified were corrected by entering the missing label number and placing it within the correct polygon. Once all the errors were corrected, the coverage was ready for the polygon rectification process.

Joining of Attribute and Spatial Data

The Quattro Pro code file was converted into an INFO file. Once converted it was related to the feature attribute table by the sequence number found in both files. An INFO item, named "SEQNO" was added to the feature attribute table. The sequence number for each polygon was calculated to equal its coverage I.D. number. The ARC/INFO command JOINITEM was used to join the code file to the feature attribute table. The spreadsheet file was joined with its corresponding coverage. Each variable interpreted from the aerial photography was assigned a unique item (field).

Code Verification and Edit Plot Quality Assurance

Code verification involved running each coverage attribute file through a series of ARC/INFO commands that checked for invalid codes. These commands produced listings that aided in identifying abnormal codes. The errors were checked against the vegetation delineation and attribute overlays. Corrections were made to the listings and input into the database.

ESRI produced a plot of the converted spatial data and sequence numbers (label I.D.s) for the manuscript. The plot was checked by AIS for cartographic quality of the arcs defining the polygon features and the accuracy of the label I.D. assignments. The plot was overlaid to the manuscript map to verify that the scanned data was not distorted beyond .02 map inches. Other problems were noted on the plots, such as overshoots and undershoots, missing lines, premature convergence of polygon boundary lines that intersected arcs at acute angles, and incorrect sequence number assignments.

ESRI also produced code verification plots of the community association codes, height and density codes, and land use code attributes. The plots were checked by AIS for coding errors that may have occurred during the polygon attribute encoding step. The plots were overlaid on the manuscript map with attached corresponding code attribute overlay created in the manual rectification step. Code changes were noted on the plot. The edited plots were delivered back to ESRI for correction of the attribute files. Processors conducted interactive ARCEDIT sessions to make the necessary corrections to the coverages.

Georeferencing and Digital Registration of Data

The georeferencing and digital registration of the data was a simple process. The data had to be transformed into real world coordinates and the data had to be adjusted to fit the orthophoto image. These steps were all performed digitally using ARCEDIT.

- Conversion to "Real-World" Coordinates

  This task involved the transformation of the database from "digitizer inches" into "real world" coordinates. The initial vector file contained coordinates stored as digitizer inches that does not allow the data to be used effectively. To utilize geographic data, it must be converted into a common coordinate system. The coordinate system used was the Universal Transverse Mercator (UTM), Zone 13, NAD83 Coordinate System. All coordinates were in meter units.

  The first step was the creation of a master tic file, linking features on the orthophoto to the same features in the polygon coverages. Wherever possible, easily identified points were chosen to ensure a more accurate transformation. Four to six points were chosen per coverage and labeled with a tic number I.D. The points were then transformed into real world coordinates, x and y values only (the orthophotos did not have a z value).

- Compare Transformed Delineation Coverages to Digital Image

  The transformed coverages were then compared to the digital orthophotos. Manual rectification had been chosen instead of digital rectification because it was assumed that a minimal amount of adjustment would need to be performed once the coverages were transformed. This was based on the photointerpretations being created from entirely different images as the digital orthophotos. Also, parallax differences between the photos and the orthophotos would not be consistent. Human observations and decisions were more likely to produce a better rectified product, thus minimizing any subsequent digital rectification.

  Upon comparison of the transformed coverages to the orthophoto, it was apparent that the data did indeed fit the image well in most places. Interactive ARCEDIT sessions were conducted to improve the registration of the data to the digital image. The data was compared to the orthophoto image on a polygon by polygon basis. Special attention was given to obvious feature boundaries such as land use/vegetation and land/water interfaces. If necessary a specific adjust was performed. The vertices of the line segments were modified (moved, added, or deleted) until the linework conformed to the orthophoto image. In some instances, entire line segments were deleted and redigitized on-screen. This process was repeated until all of the coverages were completed. The final digital coverages met NMAP standards for linework accuracy within 20 feet at 1:12,000 scale.

VI. ACCURACY ASSESSMENT

Upon Completion of the georeferencing and digital registration of the data, the TNC and Fort Laramie National Historic Site Staff performed an Accuracy Assessment (AA) of the mapped vegetation associations/communities. AA point coordinate locations were generated throughout the Site. TNC and Site staff identified the coordinate locations in the field using a highly accurate global positioning system (GPS). The association/community was identified and recorded in the field for each coordinate.

ESRI created a point-polygon match/no-match matrix for the accuracy assessment data. The accuracy assessment materials included a table of the AA point number, x and y coordinate location, AA point community code, corresponding polygon number, and corresponding polygon association/community code. In addition, a plot of AA points/AA Ids and all polygons with polygon Ids was provided. Using the aerial photography, AIS reviewed each match/no-match occurance. The polygon code was found to be either incorrect, or there was an explanation for the difference between the AA point community code and the polygon code.

The accompanying Original Matrix, Revised Matrix and Table of Results located in the appendices summarizes the results of the accuracy assessment by AIS. Accompanying the Table of the Results in the Appendices is the Explanation of Headings which provides a brief description of the column headings. Based on the final results of 167 valid AA points, nine are considered incorrect, 158 are considered correct. The resultant accuracy is 95%.

VII. PATTERN

Once the mapping of the association/community classes was completed and the attribute items populated, a final community association plot was created. The plot was compared back to the original natural color photos and photo overlays and reviewed for accuracy and consistency of community association class assignments. Corrections to the community association assignments were made to the database.

The pattern attribute was mapped by interpreting the pattern of the corresponding life form of each association/community polygon. The units were drafted onto an overlay of the manuscript map. The pattern attribute was then input by keypunching the -ID and corresponding pattern attribute code into an Excel file. The Excel file was converted into and joined to the existing INFO file. An edit plot was created for review, and any corrections or changes noted, then corrected into the file.

The final coverage of the vegetation database was delivered to ESRI for input into the final project database structure.

Fort Laramie National Historic Site
Photo Interpretation Report
Appendices

Appendix A
USGS-NPS VEGETATION MAPPING PROGRAM
FORT LARAMIE NATIONAL HISTORIC SITE, WYOMING
FINAL ASSOCIATION/COMMUNITY CLASSIFICATION
September 4, 1998

Association/Community

01 = Populus Deltoides Temporarily Flooded Woodland Association
Populus deltoides / Symphoricarpos occidentalis Woodland

02 = Pinus Ponderosa Wooded Medium-Tall Herbaceous Association
Pinus ponderosa – Schizachyrium scoparium Wooded Herbaceous Vegetation

03 = Not Used

04 = Salix Exigua Temporarily Flooded Shrubland Association
Salix exigua Shrubland

05 = Stipa Comata Bunch Herbaceous Assocaition
Stipa comata - Yucca glauca Herbaceous Vegetation

06 = Typha (Angustifolia, Latifolia) – (Scirpus spp.) Semipermanently Flooded Herbaceous Association
Typha latifolia Western Herbaceous Vegetation

07 = Spartina Pectinata Temporarily Flooded Herbaceous Association
Spartina pectinata - Scirpus pungens Herbaceous Vegetation

08 = Carex Nebrascensis Seasonally Flooded Herbaceous Association
Carex nebrascencis Herbaceous Vegetation

09 = Association Undefined
Bromus inermis Disturbed Herbaceous Vegetation

10 = Association Undefined
Upland Weedy Herbaceous Vegetation

11 = Pascopyrum Smithii Herbaceous Association
Pascopyrum smithii Herbaceous Vegetation

12 = Stipa Comata – Bouteloua Gracilis Herbaceous Association
Stipa comata – Bouteloua gracilis – Carex filifolia Herbaceous Vegetation

13 = Association Undefined
Sporobolus cryptandrus Disturbed Herbaceous Vegetation

14 = Sand Flats Temporarily Flooded Sparse Vegetation
Riverine Sand Flats - Bar Sparse Vegetation

15 = Association Undefined

Upland Sand and Gravel Sparse Vegetation

16 = Bouteloua Gracilis Herbaceous Association
Bouteloua gracilis - Carex filifolia Herbaceous Vegetation

17 = Rock Outcrop / Butte Sparse Vegetation
Sandstone Rock Outcrop Sparse Vegetation

98 = Water Body

99 = Urban/Built-Up/Maintained Lawn/Canal/Road/Mowed Road ROW/Cut and Fill

HEIGHT

1 = <0.5 meters
2 = 0.5 - 2 meters
3 = 2 - 5 meters
4 = 5 - 15 meters
5 = 15 - 35 meters
6 = 35 - 50 meters
7 = >50 meters
9 = Not Applicable

ABSOLUTE CROWN DENSITY

1 = Closed/Continuous > 60 %
2 = Discontinuous 40% - 60%
3 = Dispersed 25% - 40%
4 = Sparse 10% - 25%
5 = Rare 2% - 10%
9 = Not Applicable

PATTERN

1 = Evenly Dispersed
2 = Clumped/Bunched
3 = Gradational/Transitional
4 = Alternating
9 = Not Applicable

LAND USE

100 = Urban or Built-Up
110 = Residential
120 = Commercial
130 = Industrial
140 = Transportation, Communication, and Utilities

141 = Canal, Canal Water, Maintained Right-of-Way, Canal Access Road, Adjacent Disturbed and Maintained Area, Levee, Cut and Fill
150 = Mixed Commercial and Industrial
160 = Mixed Urban
170 = Under Construction
180 = Open Space and Recreation
181 = Oregon Trail Ruts Parking Area (Plot 1)
190 = Vacant within Urban Context
200 = Agriculture
300 = Mining
400 = National Park/Monument Facilities
401 = Fort Laramie Site Area, Visitor Center, Ruins, Parking Area, Parade Grounds and Associated Facilities
402 = Visitor Picnic Area
403 = Road/Maintained Right-of-Way
404 = Maintenance Area
405 = Old North Platte River Bridge Parking Area
500 = Water Body
600 = Vacant

Appendix B
USGS-NPS VEGETATION MAPPING PROGRAM
FORT LARAMIE NATIONAL HISTORIC SITE
ASSOCIATION/COMMUNITY PHOTO SIGNATURE KEY
Table Descriptions

The Final Alliance/Community Association Photo Signature Key Table is divided into six columns. The column descriptions are as follows:

- **Column 1 - ASSOCIATION/COMMUNITY CODE**
  This column contains the code in the database representing the association/community association category.

- **Column 2 - ASSOCIATION/COMMUNITY**
  This column contains the title of the association/community category.

- **Column 3 - PHOTO SIGNATURE**
  This column describes the photo signatures that characterize the life form of the association/community in this park.

  The following subcategories are included:

  Color: Describes the color tone and contrast variations of the photo signature.

  Texture: Describes the relative apparent roughness or smoothness of the signature character. Coarse being a very rough or grainy texture, fine being a very smooth texture. A forest of trees tends to have a coarse texture. Grasslands tend to have a fine texture.

  Crown Size: Describes the relative size of the tree or shrub crown diameter as viewed on the aerial photo. Typically, spreading trees tend to have large crowns while shrubs tend to have smaller crowns.

  Crown Shape: Describes the relative shape of the tree or shrub crown as viewed on the aerial photo.

  Density: Describes the general density characteristic of the association/community.

- **Column 4 - HEIGHT**
  This column describes the relative height range of the life form of the association/community.

- **Column 5 - CONTEXT**
  This column describes the general occurrence of the association/community within the park from a geomorphological, physiographic, topographical, or regional perspective.

- **Column 6 - NOTES**
  This column includes other pertinent information that may be useful in the photointerpretation of the association/community. It may contain examples of occurrences or character of the vegetation within the park.

Appendix C
USGS-NPS VEGETATION MAPPING PROGRAM
FORT LARAMIE NATIONAL HISTORIC SITE, WYOMING
FINAL ASSOCIATION/COMMUNITY PHOTO SIGNATURE KEY
The Photo Signature Key is to be Used with Aerial Photographs and Spatial Data
Natural Color Aerial Photography Flown July 1995 1:12,000 Scale
September 4, 1998

ASSOCIATION / COMMUNITY CODE	ASSOCIATION/ COMMUNITY NAME	PHOTO SIGNATURE (describes alliance life form)	HEIGHT (meters)	CONTEXT	NOTES
01	Populus deltoides / Symphoricarpos occidentalis Woodland	COLOR: Tall to short crowns of medium to dark green dots, with shorter dark green to medium green dots, in matrix of medium green to brown TEXTURE: Coarse CROWN SIZE: Large CROWN SHAPE: Round DENSITY: Moderate to high	<6 - 50	Middle and lower floodplain terrace.	Grass or shrub understory; occurs in rows, large groups, small clumps, or isolated individuals; some sapling or young trees groups also occur
02	Pinus ponderosa / Schizachyrium scoparium Wooded Herbaceous Vegetation	COLOR: Dark green dots in white to gray green matrix TEXTURE: Coarse CROWN SIZE: Large CROWN SHAPE: Round DENSITY: Low	<5-8	Rocky escarpment of northern hills, canyons of southern hills	Occurrences in northern hills have sparse understory, those in southern hills have denser, less rocky understory
04	Salix exigua Shrubland	COLOR: Blue green, gray green, to medium green TEXTURE: Moderate CROWN SIZE: Small CROWN SHAPE: Round DENSITY: Moderate to high	<3	Lower floodplain terrace, seepage area	Short on sandbars and by river, taller in seepage area
05	Stipa comata - Yucca glauca Herbaceous Vegetation	COLOR: Gray green matrix with medium green to gray green dots TEXTURE: Smooth, fine, with moderate dots CROWN SIZE: Dots are small CROWN SHAPE: Dots are round DENSITY: Moderate to high, dot density varies	<2	Northern and southern hill areas	Densities of shrubs vary greatly; shrubs denser in southern hill area
06	Typha latifolia Western Herbaceous Vegetation	COLOR: White, gray, dark green, or black, some slight mottling TEXTURE: Smooth, fine CROWN SIZE: None CROWN SHAPE: None DENSITY: High	<3	Very wet, standing water, well saturated ground	Narrow band occurrences at edge of river are below mmu

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USGS-NPS VEGETATION MAPPING PROGRAM
FORT LARAMIE NATIONAL HISTORIC SITE, WYOMING
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The Photo Signature Key is to be Used with Aerial Photographs and Spatial Data
Natural Color Aerial Photography Flown July 1995 1:12,000 Scale
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ASSOCIATION / COMMUNITY CODE	ASSOCIATION/ COMMUNITY NAME	PHOTO SIGNATURE (describes alliance life form)	HEIGHT (meters)	CONTEXT	NOTES
07	Spartina pectinata - Scirpus pungens Herbaceous Vegetation	COLOR: Deep medium green TEXTURE: Smooth, fine CROWN SIZE: None CROWN SHAPE: None DENSITY: High	<2	Lower floodplain, margins of river, and sandbars	Usually very narrow bands; sometimes in understory of trees
08	Carex nebrascensis Herbaceous Vegetation	COLOR: A) Deep medium green; B) Medium to dark green clumps in a matrix of light green to medium green TEXTURE: Smooth, fine CROWN SIZE: None CROWN SHAPE: None DENSITY: High	<1.5	Lower floodplain terrace	Primarily located in the seepage area
09	Bromus inermis Disturbed Herbaceous vegetation	COLOR: Very dark green, to dark green with light irridescent white tinge TEXTURE: Smooth, fine CROWN SIZE: None CROWN SHAPE: None DENSITY: High	<1	Upper floodplain terrace north of Laramie River, middle floodplain terrace	Sometimes occurs in understory of trees
10	Upland Weedy Herbaceous Vegetation	COLOR: A) Light yellow brown to dark yellow brown to rust; B) Dark to medium green dots TEXTURE: Smooth, fine CROWN SIZE: None CROWN SHAPE: None DENSITY: High	<2	Upper floodplain terrace, valley bottom	Dark green dots on upper floodplain are weedy forbs

Appendix C
USGS-NPS VEGETATION MAPPING PROGRAM
FORT LARAMIE NATIONAL HISTORIC SITE, WYOMING
FINAL ASSOCIATION/COMMUNITY PHOTO SIGNATURE KEY
The Photo Signature Key is to be Used with Aerial Photographs and Spatial Data
Natural Color Aerial Photography Flown July 1995 1:12,000 Scale
September 4, 1998

ASSOCIATION / COMMUNITY CODE	ASSOCIATION/ COMMUNITY NAME	PHOTO SIGNATURE (describes alliance life form)	HEIGHT (meters)	CONTEXT	NOTES
11	Pascopyrum smithii Herbaceous Vegetation	COLOR: A) Homogeneous medium to dark green, some yellow brown; B) Tan to light green to medium green to brown; C) Dark green with yellow brown mixed; D) Medium to light blue green TEXTURE: Smooth, fine CROWN SIZE: None CROWN SHAPE: None DENSITY: High	<1.5	Middle to lower floodplain terrace, seepage area, disturbed seeded old field area	Natural and artificial occurrences; sometimes as understory of trees
12	Stipa comata - Bouteloua gracilis / Carex filifolia Herbaceous Vegetation	COLOR: A) Gray green to tan green, sometimes with medium green or green dots scattered in varying densities; B) Homogeneous deep medium green to medium green; C) Dark olive green to dull tan green, sometimes with gray green dots; C) Medium light brown with medium green tinging mixing TEXTURE: Smooth, fine CROWN SIZE: None, or dots are small to moderate CROWN SHAPE: None, or dots are small to moderate DENSITY: High	<1	Northern and southern hills, valley bottom, and upper to middle floodplain terrace	Primarily in the valley bottom and hill areas and rises of the floodplain area
13	Sporobolus cryptandrus Disturbed Herbaceous Vegetation	COLOR: Medium green to yellow green, tan with green-yellow tinge TEXTURE: Smooth, velvety, fine CROWN SIZE: None CROWN SHAPE: None DENSITY: High	<1	Upper to middle floodplain terrace	Disturbed
14	Riverine Sand Flats - Bar Sparse Vegetation	COLOR: White to gray or gray brown TEXTURE: Smooth, fine, dots are moderate CROWN SIZE: None CROWN SHAPE: None DENSITY: None	<.5	Floodplain sandbars, lower floodplain terrace, dry to moist	Rare density of vegetation

Appendix C
USGS-NPS VEGETATION MAPPING PROGRAM
FORT LARAMIE NATIONAL HISTORIC SITE, WYOMING
FINAL ASSOCIATION/COMMUNITY PHOTO SIGNATURE KEY
The Photo Signature Key is to be Used with Aerial Photographs and Spatial Data
Natural Color Aerial Photography Flown July 1995 1:12,000 Scale
September 4, 1998

ASSOCIATION / COMMUNITY CODE	ASSOCIATION/ COMMUNITY NAME	PHOTO SIGNATURE (describes alliance life form)	HEIGHT (meters)	CONTEXT	NOTES
15	Upland Sand and Gravel Sparse Vegetation	COLOR: A) Light gray to dark gray to brown gray, B) Brown to yellow brown to white, with green dots TEXTURE: Smooth, fine, dots are moderate CROWN SIZE: None CROWN SHAPE: None DENSITY: Low to Moderate	<1	Middle floodplain terrace, very dry	Scattered occurrences on middle floodplain
16	Bouteloua gracilis - Carex filifolia Herbaceous Vegetation	COLOR: Very homogeneous light gray TEXTURE: Smooth, fine CROWN SIZE: None CROWN SHAPE: None DENSITY: Very low	<1	Ridgetops of the northern and southern hills	Mainly occurs on BLM Plot 5, with a few in BLM Plots 3 and 1
17	Sandstone Rock Outcrop Sparse Vegetation	COLOR: White, sometimes with widely scattered green dots or gray green to tan tinge TEXTURE: Rough CROWN SIZE: None CROWN SHAPE: None DENSITY: None	NA	Rocky escarpment	Only occurrence is in BLM Plot 1 in northern hills

Appendix D
USGS-NPS VEGETATION MAPPING PROGRAM
FORT LARAMIE NATIONAL HISTORIC SITE (FOLA)
Accuracy Assessment Review by AIS

Explanation of Headings

Match – The Accuracy Assessment Point community association and the corresponding polygon community association match. The map polygon code is correct.

Boundary line – The Accuracy Assessment Point is located very close to the boundary between two community association polygons. The Accuracy Assessment Point community association matches the community association of one of the polygons. The map polygon code is correct.

Near boundary line – The Accuracy Assessment Point is located within approximately 50 feet of the boundary between two community association polygons. The Accuracy Assessment Point community association matches the community association of one of the polygons. The map polygon code is correct.

MMU – The Accuracy Assessment Point community association represents an area of vegetation on the ground that is below the minimum mapping resolution. The map polygon code is correct.

AA call questionable – The community association determined from the Accuracy Assessment Point data is in question. The accuracy of the location of the Accuracy Association Point may also be in question. The map polygon code is correct.

Temporal change – A change in vegetation representation may have occurred between the time of photo exposure, and Accuracy Assessment site data collection. The change may be due to seasonal or annual differences (i.e. climatic). The map polygon code is correct.

Mosaic – The vegetation within the polygon is a complex or mosaic of two or more community associations, all are below minimum mapping resolution. The Accuracy Assessment Point was assigned one community association, while the polygon was assigned another. The map polygon code is correct.

Change code – The community association assigned to the polygon is incorrect. The code will need to be changed.

Needs review – The community association assigned to the polygon is incorrect. However, the polygon would need to be reviewed for further subdivision. Or, further discussion with TNC may be needed to assign the correct community association.

Out - When the photo interpretation overlays were prepared, the mapped area delineated on each overlay was made larger than the actual project study area. This was done to assure that no valid areas were missed. When the manuscript map for input was created, the mapped area was tightened more to match the actual study area.

None – No AA Point is represented by this number.

No AA data – The Accuracy Assessment Point has no community association assigned.

Appendix E
USGS-NPS VEGETATION MAPPING PROGRAM
FORT LARAMIE NATIONAL HISTORIC SITE (FOLA)
Accuracy Assessment Review by AIS
Results

AA 301 - Correct (Match)
AA Pt = 1, Pode
Poly = 1, Pode

AA 302 – Correct (Boundary line)
AA Pt = 14, Riverine Sand Flat
Poly A = 14, Riverine Sand Flat
Poly B = 1, Pode

AA 303 – Correct (Match)
AA Pt = 1, Pode
Poly = 1, Pode

AA 304 – Correct (Match)
AA Pt = 7, Sppe
Poly = 7, Sppe

AA 305 - Correct (Near boundary line)
AA Pt = 7, Sppe
Poly = 12, Stco-Bogr

The AA point occurs very close to but not on the boundary line of an adjacent Sppe polygon. The photo shows that there is an abrupt change from Sppe to Stco-Bogr. It is possible that there could be a margin of error in the GPS location or the orthophoto image.

AA 306 – Correct (Match)
AA Pt = 1, Pode
Poly = 1, Pode

AA 307 – Correct (Near boundary line)
AA Pt = 14, Riverine Sand Flats
Poly = 7, Sppe

The photo signature shows the polygon as definitely Sppe. The adjacent polygon to the west is Riverine Sand Flats. There is an abrupt break between the two areas. It is possible that there could be a margin of error in the GPS location or the orthophoto image.

AA 308 – Correct (MMU)
AA Pt = 7, Sppe
Poly = 1, Pode

The entire polygon is made up of a row of trees with some open canopy between them. Within this polygon there is a small patch of Sppe in an open area between the trees. The understory or the open areas between the trees may also include Sppe. Each small opening is below minimum mapping resolution. Jim should review the call on this AA point.

AA 309 – Correct (Match)
AA Pt = 15, Upland Sand and Gravel
Poly = 15, Upland Sand and Gravel

AA 310 – Correct (Match)
AA Pt = 14, Riverine Sand Flats
Poly = 14, Riverine Sand Flats

AA 311 – Correct (Match)
AA Pt = 4, Saex
Poly = 4, Saex

AA 312 – Correct (MMU or Temporal change)
AA Pt = 10, Upland Weedy
Poly = 11, Pasm

There are some small Upland Weedy patches within the polygon that are below the minimum mapping resolution. However, based on the photo signature, the “weeds” are not pervasive. The difference between the AA call and the mapped unit may be due to temporal changes in the amount of weeds in the area.

AA 313 – Correct (Match)
AA Pt = 15, Upland Sand and Gravel
Poly = 15, Upland Sand and Gravel

AA 314 – Correct (Match)
AA Pt = 14, Riverine Sand Flats
Poly = 14, Riverine Sand Flats

AA 315 – Incorrect (Change code)
AA Pt = 11, Pasm
Poly = 10, Upland Weedy

There are small patches of Upland Weedy in the polygon. However I would agree that the Pasm covers the majority of the polygon. The polygon code should be changed to 11, Pasm.

AA 316 – Correct (Match)
AA Pt = 1, Pode
Poly = 1, Pode

AA 317 – Correct (Match)
AA Pt = 9, Brin
Poly = 9, Brin

AA 318 – Correct (MMU)
AA Pt = 11, Pasm
Poly = 9, Brin

This AA point is located in the same polygon as AA point #317. The terrain in this polygon is undulating, with low areas and high areas. The high areas usually contain Brin and other upland grasses and make up the majority of the polygon. The low areas contain small patches of Pasm which are below the minimum mapping resolution.

AA 319 – Correct (Match)
AA Pt = 4, Saex
Poly = 4, Saex

AA 320 – Correct (MMU or Temporal change)
AA Pt = 6, Tyla
Poly = 8, Cane

The existing terrain within the polygon has low areas that may contain small patches of Tyla which are below the minimum mapping resolution. However, it is possible that in the two years since the photo was exposed, Tyla has come in. The photo signature shows that the majority of the area is Cane.

AA 321 – Correct (MMU)
AA Pt = 4, Saex
Poly = 8, Cane

The photo signature does show a small patch of Saex at the AA point location, but it is below the minimum mapping resolution.

AA 322 – Correct (Match)
AA Pt = 1, Pode
Poly = 1, Pode

AA 323 – Correct (Boundary line)

AA Pt = 8, Cane
Poly A = 11, Pasm
Poly B = 8, Cane

AA 324 – Correct (Match)

AA Pt = 1, Pode
Poly = 1, Pode

AA 325 – Correct (Temporal change)

AA Pt = 11, Pasm
Poly = 10, Upland Weedy

Although the photo signature shows this polygon to be Pasm, there is a rusty brown tone of weeds within it. The polygon was mapped to separate this area from the rest of the Pasm to account for this occurrence of "weeds". The polygon does not have the typical green signature of Pasm. Based on the photo, the area appears to be a low area surrounded by Pasm or Cane. It is possible that there has been a temporal change in the "weediness" of the area.

AA 326 – Correct (Temporal change)

AA Pt = 10, Upland Weedy
Poly = 11, Pasm

Any patches of Upland Weedy at the AA point location are not obvious from the photo signature. There are small patches that are more obvious to the west within the polygon, but they are below minimum mapping resolution. This may be a case of temporal change, where the AA point location contains more weeds in 1997 than in 1995.

AA 327 – Incorrect (Change code)

AA Pt = 11,Pasm
Poly = 8, Cane

The mapped unit contains both patches of Cane and areas of Pasm. After further review, the polygon is better represented as Pasm.

AA 328 – Correct (Match)

AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 329 – Correct (AA call questionable)

AA Pt = 11,Pasm
Poly = 5, Stco-Yugl

The photo signature shows this point lying in an area of obvious Stco-Yugl. There does not appear to be Pasm in the vicinity of the point. This could be an error in the GPS. The AA point number 329 does not lie anywhere near AA points 328 or 330. It would fall in sequence if it had been called 359. Jim needs to check the AA pt number and coordinates to verify correct location.

AA 330 – Correct (Match)

AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 331 – Correct (Mosaic)

AA Pt = 13, Spcr
Poly = 12, Stco-Bogr

The photo signature shows the polygon as a mixture of Spcr, Stco-Bogr and Upland Weedy. The polygon to the north shows lots of Upland Weedy and Brin. Hollis and Ed visited this point (coincidentally) during the photo interpretation field verification. AIS field notes list Sporobolus airoides, Bouteloua gracilis, some Pascopyrum smithii, and weedy inclusions. It was called a questionable Stco-Bogr at the time. This may be one for Jim to review.

AA 332 – Correct (Match)

AA Pt = 1, Pode
Poly = 1, Pode

AA 333 – Correct (Match)

AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 334 – Correct (Match)

AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 335 – Incorrect (Change code and needs review)

AA Pt = 12, Stco-Bogr
Poly = 9, Brin

The photo signature shows this polygon as Stco-Bogr with an undertone that was interpreted as Brin. This is similar to the adjacent polygon to the east, but without the patches of pure Brin. There is Calamovilfa longifolia here also. This polygon may be better mapped as Stco-Bogr. It was originally mapped as such, but changed because of the undertone in the signature. It may be that the eastern half is Stco-Bogr and the western half is Brin, but that would have to be field checked.

AA 336 – Correct (MMU)
AA Pt = 1, Pode
Poly = 11, Pasm

The photo signature shows a small patch of trees or shrubs here. The unit is below minimum mapping resolution.

AA 337 – Correct (AA call questionable)
AA Pt = 6, Tyla
Poly = 9, Brin

The photo signature shows this point to be located on an abruptly rising slope from lowland to upland. It appears to be well in the upland area of the slope and not in a lowland, where one might find Tyla. The polygon directly to the south contains a Tyla area at the boundary, but it is below minimum mapping resolution. Jim may need to review the information for this AA point.

AA 338 - Correct (AA call questionable)
AA Pt = 8,Cane
Poly = 9, Brin

The photo signature shows this point to be located on an abruptly rising slope from lowland to upland. It appears to be well in the upland area of the slope and not in a lowland, where one might find Cane. Jim may need to review the information for this AA point.

AA 339 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 340 – Correct (MMU)
AA Pt = 5, Stco-Yugl
Poly = 12, Stco-Bogr

The photo signature indicates the polygon as containing Stco-Bogr with small patches of Stco-Yugl. The Artemisia filifolia and Yucca glauca are low in density throughout the polygon, but there are patches where the density is higher. In general the denser areas may be borderline. The photo interpreter opted with Stco-Bogr for this polygon as a whole. The shrubby areas are below minimum mapping resolution.

AA 341 (Out)

AA 342 (Out)

AA 343 (Out)

AA 344 (Out)

AA 345 (Out)

AA 346 (Out)

AA 347 (None)

AA 348 – Correct (MMU)
AA Pt = 12, Stco-Bogr
Poly = 16, Bogr-Cafi

The photo signature shows that there are small inclusions of Stco-Bogr within the Bogr-Cafi polygon. The polygon is definitely Bogr-Cafi. Any Stco-Bogr areas are well below minimum mapping resolution.

AA 349 – Correct (Boundary line)
AA Pt = 12, Stco-Bogr
Poly A = 12, Stco-Bogr
Poly B = 5, Stco-Yugl

AA 350 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 351 – Correct (Match)
AA Pt = 16, Bogr-Cafi
Poly = 16, Bogr-Cafi

AA 352 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 353 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 354 – Correct (MMU)
AA Pt = 17, Sandstone
Poly = 12, Stco-Bogr

The photo signature shows some rock outcrops in the area but they are below minimum mapping resolution.

AA 355 – Correct (MMU)
AA Pt = 12, Stco-Bogr
Poly = 5, Stco-Yugl

The photo signature shows the polygon as primarily Stco-Yugl. There are small pockets of Stco-Bogr throughout the polygon, but they are below minimum mapping resolution. The entire area contains varying density of shrubs (Artemisia filifolia, Yucca glauca), mostly around 25% density. The question of whether these areas should be Stco-Bogr or Stco-Yugl was discussed with the field ecologist. It was determined that it would be better to go with Stco-Yugl, and try to identify areas of Stco-Bogr within it. The Stco-Bogr areas also are very transitional with the Stco-Yugl.

AA 356 - Correct (MMU)
AA Pt = 15, Upland Sand and Gravel
Poly = 5, Stco-Yugl

The photo signature shows the AA point located in an area of Stco-Yugl adjacent to an area of Stco-Bogr. To the west of the point is a very narrow drainage composed of what may be gravel wash. There may be a thin border of Upland Sand and Gravel next to the wash, but it is very thin, and contains shrubs (Artemisia filifolia and Yucca glauca). The gravel wash stands out on the photo, and is unique. My question to the park would be, would they prefer to have it mapped even though it is below minimum mapping resolution. If so, then it would need to be classed (Gravel Wash?).

AA 357 – Correct (Match)
AA Pt = 5, Stco-Yugl
Poly = 5, Stco-Yugl

AA 358 – Correct (Match)
AA Pt = 5, Stco-Yugl
Poly = 5,Stco-Yugl

AA 359 (None)

AA 360 – Incorrect (Needs review)
AA Pt = 12, Stco-Bogr
Poly = 5, Stco-Yugl

The photo signature shows this area of the Stco-Yugl polygon to have a lower density of shrubs. The area would need to be reviewed to possibly split a portion of the polygon out as Stco-Bogr.

AA 361 - Correct (Match)

AA Pt = 16, Bogr-Cafi
Poly = 16, Bogr-Cafi

AA 362 – Correct (MMU)

AA Pt = 16, Bogr-Cafi
Poly = 12, Stco-Bogr

The area in question is below the minimum mapping resolution, lying within Stco-Bogr. The photo signature shows the AA point located on a side slope that is a continuation of a ridge turning and going down to the canyon below. The ridge-like side slope is very narrow. It widens out a little before reaching the canyon bottom. The color is not as light as classical Bogr-Cafi, but also not as dark or well vegetated as Stco-Bogr.

AA 363 – Incorrect (Needs review)

AA Pt = 12, Stco-Bogr
Poly = 5, Stco-Yugl

The area would need to be reviewed to possibly split a portion of the polygon out as Stco-Bogr. The photo signature shows the area in which the AA point is located has a mixture of shrub densities, some being enough for Stco-Yugl, others low enough for Stco-Bogr.

AA 364 – Incorrect (Code change)

AA Pt = 12, Stco-Bogr
Poly = 11, Pasm

The polygon should be re-coded. The photo signature shows a terrace on both sides of a drainage. The entire area contains a green signature which can be interpreted as either Pasm or Calamovilfa longifolia. The entire polygon was originally coded as Stco-Bogr, assuming the signature was representing Calamovilfa. However, because of the flatness of the drainage area, the polygon was changed to Pasm. The terraces probably are Stco-Bogr with Calamovilfa, and only the drainage itself, which is below minimum mapping resolution, is Pasm.

AA 365 – Correct (MMU)

AA Pt = 5, Stco-Yugl
Poly = 12, Stco-Bogr

The photo signature shows the polygon as predominantly Stco-Bogr. There is an area of Stco-Yugl with Calamovilfa longifolia within it occupying the ravine in the center of the polygon. The ravine area with Stco-Yugl, however, is below the minimum mapping resolution.

AA 366 - Correct (Match)
AA Pt = 11, Pasm
Poly = 11, Pasm

AA 367 – Correct (Near boundary line)
AA Pt = 11, Pasm
Poly A = 5, Stco-Yugl
Poly B = 11, Pasm
The adjacent polygon to the west is Pasm. It is possible that there could be a margin of error in the GPS or the orthophoto image.

AA 368 – Correct (Match)
AA Pt = 5, Stco-Yugl
Poly = 5, Stco-Yugl

AA 369 Correct (MMU)
AA Pt = 15, Upland Sand and Gravel
Poly = 5, Stco-Yugl

The photo signature shows a long narrow wash in the Stco-Yugl polygon. The wash is below minimum mapping resolution

AA 370 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 371 – Correct (Temporal change)
AA Pt = 12, Stco-Bogr
Poly = 10, Upland Weedy

The photo signature indicates this polygon as Stco-Bogr with Upland Weedy (Bromus sp.) throughout. The polygon was coded as Upland weedy to separate out the weedy areas from the Stco-Bogr.

AA 372 – Correct (Match)
AA Pt = 5, Stco-Yugl
Poly = 5, Stco-Yugl

AA 373 – Correct (Match)
AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 374 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 375 – Correct (Match)
AA Pt = 14, Riverine Sand Flats
Poly = 14, Riverine Sand Flats

AA 376 – Correct (AA call questionable)
AA Pt = 16, Bogr-Cafi
Poly = 1, Pode

The photo signature shows the AA point in Pode trees within the floodplain area. Bogr-Cafi is more typically located on ridge tops. Jim will need to review the AA point data.

AA 377 - Correct (Near boundary line)
AA Pt = 1, Pode
Poly = 7, Sppe

The Sppe polygon is a very narrow linear strip running between two Pode polygons. The AA point is located very close to the boundary line. It is also possible that there could be a margin of error in the GPS or the orthophoto image.

AA 378 – Correct (MMU)
AA Pt = 7, Sppe
Poly = 1, Pode

The photo signature shows the AA point located in a small area of open trees adjacent to an area of low shrubs or tree seedlings. There may be Sppe in the understory of the Pode, but any openings in the trees are not large enough for minimum mapping resolution.

AA 379 – Correct (Near boundary line or Temporal change)
AA Pt = 1, Pode
Poly = 15, Upland Sand and Gravel

The photo signature shows the AA point located in the Upland Sand and Gravel. However, the point is very near a Saex polygon and a Pode polygon. The Saex polygon contained young Pode, which over time, may now be large enough to be called Pode. The difference between the point and polygon codes could be a due to margin of error in the image or GPS, or a temporal change in vegetation between 1995 and 1997.

AA 380 – Correct (Match)
AA Pt = 1, Pode
AA Poly = 1, Pode

AA 381 (None)

AA 382 - Correct (Match)
AA Pt = 2, Pipo
Poly = 2, Pipo

There are two points numbered 382 in two different places. The AA point coded Pipo makes more sense in this polygon by default. See next entry.

AA 382 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

There are two points numbered 382 in two different places. The AA Pt coded Stco-Bogr makes more sense in this polygon because there are no trees here (the other AA point is coded Pipo).

AA 383 (Out)

AA 384 – Correct (Match)
AA Pt = 2, Pipo
Poly = 2, Pipo

AA 385 – Correct (Match)
AA Pt = 2, Pipo
Poly = 2 Pipo

AA 386 (Out)

AA 387 – Correct (Match)
AA Pt = 2, Pipo
Poly = 2, Pipo

AA 388 (Out)

AA 389 – Correct (Match)
AA Pt = 2, Pipo
Poly = 2, Pipo

AA 390 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 391 – Correct (Match)
AA Pt = 2, Pipo
Poly = 2, Pipo

AA 392 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 393 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 394 – Correct (Match)
AA Pt = 16, Bogr-Cafi
Poly = 16, Bogr-Cafi

AA 395 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 396 – Correct (MMU and AA call questionable)
AA Pt = 15, Upland Sand and Gravel
Poly = 5, Stco-Yugl

This is an escarpment situation with exposed rock. The outcrops themselves are below minimum mapping resolution. Upland Sand and Gravel does not normally occur in this type of situation. After consulting with Jim Drake, he questions the AA point call. He will further investigate the situation and will review the original field form for this AA point.

AA 397 – Correct (MMU)
AA Pt = 16, Bogr-Cafi
Poly = 5, Stco-Yugl

The AA point is located on the boundary between Stco-Yugl and Stco-Bogr. Based on the photo signature, there are inclusions of Bogr-Cafi. The Bogr-Cafi are below the minimum mapping resolution.

AA 398 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 399 – Correct (MMU)
AA Pt = 17, Sandstone
Poly = 5, Stco-Yugl

The AA point is located on the boundary between Stco-Yugl and Stco-Bogr. This area contains a thin cover of vegetation, but it is below the minimum mapping resolution. The photo signature looks more like a low density version of Stco-Bogr.

AA 400 – Correct (MMU)
AA Pt = 5, Stco-Yugl
Poly = 12, Stco-Bogr

The photo signature shows that the AA point is located in an area of Stipa comata and Calamovilfa longifolia with Artemisia filifolia and Yucca glauca. Field observations indicate that areas of Calamovilfa tend to have a low density of Artemisia and Yucca. The photo shows that this polygon overall has a lower density of Artemisia and Yucca making it fall into the Stco-Bogr class rather than the Stco-Yugl class. However, Artemisia tends to occur as narrow dense strips (usually below MMU) along dirt roads.

AA 401 – Correct (Temporal change)
AA Pt = 5, Stco-Yugl
Poly = 10, Upland Weedy

The photo signature for this polygon clearly shows the rusty brown signature of Bromus sp. It may be possible that over the two years since the photo was exposed that there has been a diminishing of Bromus density in favor of native species. During the photo interpretation field verification for both AGFO and FOLA, it was observed that the field occurrence of jBromus in a given area in 1997 was less prevalent than the 1995 photo showed.

AA 402 – Correct (Match)
AA Pt = 13, Spcr
Poly = 13, Spcr

AA 403 – Incorrect (Change code)
AA Pt = 13, Spcr
Poly = 11, Pasm

Photo signature shows mix of Spcr, Pasm, Upland Weedy, and Brin in the area of the AA point. All are below resolution and of equal size. Upland Weedy may be better for the northern portion along the road, while Spcr might be better for the southern portion along the road. It appears that the area used to be Spcr, and is a very disturbed extension of the Spcr running in a strip along the road from the north. Probably better to combine with adjacent Spcr rather than adjacent Pasm.

AA 404 – Correct (Near Boundary line)
AA Pt = 1, Pode
Poly = 11, Pasm

The photo signature shows an abrupt change from the old field containing Pasm (or Spcr in this area, see AA 403) and the adjacent Pode. The AA point clearly lies in the field. The polygon boundary would need to be checked against the digital image. It is also possible that there could be a margin of error in the GPS or the orthophoto image.

AA 405 – Correct (Mosaic)

AA Pt = 13, Spcr
Poly = 12, Stco-Bogr

The photo signature shows that the polygon is located in a low area on the middle floodplain terrace. The signature color does not show strong typical Spcr yellow-green, but there is a hint of it. The color is gray-brown, more typical of Stco-Bogr. There is also an area of green, which may indicate Pasm or Spcr. This is probably a mosaic situation.

AA 406 – Correct (Match)

AA Pt = 1, Pode
Poly = 1, Pode

AA 407 – Correct (Match)

AA Pt = 14, Riverine Sand Flats
Poly = 14, Riverine Sand Flats

AA 408 (AA call questionable)

AA Pt = 13, Spcr
Poly A = 1, Pode
Poly B = 15, Upland Sand and Gravel

The photo signature does not show any indication of Spcr. The northern polygon is very clearly trees, while the southern polygon is very clearly sparse density with an Upland Sand and Gravel signature. Jim may need to review the AA point data.

AA 409 – Correct (Match)

AA Pt = 13, Spcr
Poly = 13, Spcr

AA 410 – Correct (Boundary line)

AA Pt = 9, Brin
Poly A = 1, Pode
Poly B = 9, Brin

AA 411 – Correct (Match)

AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 412 – Incorrect (Change code)

AA Pt = 10, Upland Weedy
Poly = 9, Brin

Photo signature shows yellow color of Bromus sp. Polygon should be coded Upland Weedy. There does appear to be Brin patches within the polygon.

AA 413 - Correct (Boundary line)

AA Pt = 13, Spcr
Poly A = 13, Spcr
Poly B = 1, Pode

AA 414 – Correct (Boundary line)

AA Pt = 1, Pode
Poly A = 1, Pode
Poly B = 15, Upland Sand and Gravel

AA 415 – Correct (Match)

AA Pt = 15, Upland Sand and Gravel
Poly = 15, Upland Sand and Gravel

AA 416 – Correct (Match)

AA Pt = 7, Sppe
Poly = 7, Sppe

AA 417 – Correct (MMU)

AA Pt = 6, Tyla
Poly = 7, Sppe

The photo signature shows the polygon as Sppe and does not indicate Tyla near the location of the AA point. However, Tyla does occur at the edge of the river, but is below minimum mapping resolution. This particular spot was visited during photo interpretation field reconnaissance. At that time there was Typha along the shore, Russian olive trees, Bromus inermis and Canada thistle under the olive.

AA 418 – Correct (MMU)

AA Pt = 13, Spcr
Poly = 7, Sppe

The photo signature at the location of the AA point does not indicate Spcr. However, at the boundary with the adjacent Pode polygon is a small open area that looks like it may be Spcr, but it is below the minimum mapping resolution.

AA 419 – Correct (MMU)
AA Pt = 9, Brin
Poly = 1, Pode

The photo signature shows the AA point located at the boundary between a Pode area and an Upland Sand and Gravel area. There is Brin occurring in the understory of the Pode, but each patch is below minimum mapping resolution.

AA 420 – Correct (Match)
AA Pt = 13, Spcr
Poly = 13, Spcr

AA 421 – Correct (Match)
AA Pt = 13, Spcr
Poly = 13, Spcr

AA 422 – correct (Match)
AA Pt = 9, Brin
Poly = 9, Brin

AA 423 – Correct (Match)
AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 424 – Correct (MMU)
AA Py = 11, Pasm
Poly = 9. Brin

The photo signature shows the polygon containing a mixture of Pasm and Brin, with small amounts of Spcr. The signatures of Pasm and Brin grade into each other. The undertone shade of Brin appears to dominate. The AA point may be in a patch that is below minimum mapping resolution.

AA 425 – Correct (MMU)
AA Pt = 10, Upland Weedy
Poly = 15, Upland Sand and Gravel

The photo signature shows Upland Sand and Gravel predominating the polygon. There are small patches of yellow color indicating Upland Weedy or Spcr, but they are below minimum mapping resolution.

AA 426 – Correct (Match)
AA Pt = 4, Saex
Poly = 4, Saex

AA 427 – Correct (MMU)
AA Pt = 10, Upland Weedy
Poly = 15, Upland Sand and Gravel

The photo signature shows Upland Sand and Gravel with a patch of Upland Weedy that is below minimum mapping resolution. There are areas within the Upland Sand and Gravel that contain a lower density of Bromus. Overall for the polygon Upland Sand and Gravel dominates. There may be Spcr within the polygon also.

AA 428 – Correct (Match)
AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 429 – Correct (Match)
AA Pt = 1, Pode
Poly = 1, Pode

AA 430- Correct (Match)
AA Pt = 13, Spcr
Poly = 13, Spcr

AA 431 – Correct (Boundary line)
AA Pt = 13, Spcr
Poly A = 13, Spcr
Poly B = 12, Stco-Bogr

AA 432 – Correct (Match)
AA Pt = 13, Spcr
Poly = 13, Spcr

AA 433 – Correct (Match)
AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 434 – Correct (Match)
AA Pt = 9, Brin
Poly = 9, Brin

AA 435 – Correct (Match)
AA Pt = 9, Brin
Poly = 9, Brin

AA 436 – Correct (AA call questionable)

AA Pt = 13, Spcr
Poly = 11, Pasm

The photo signature looks more typical of Pasm. It does not appear to be Spcr. I do not see inclusions of Spcr here either. If there is Spcr, it may be in small patches that are below minimum mapping resolution. Jim may need to review the AA point.

AA 437 – Correct (MMU)

AA Pt = 13, Spcr
Poly = 10, Upland Weedy

The photo signature indicates a strong Upland Weedy occurrence at the AA point location. There may be small patches of Spcr adjacent, but they are below minimum mapping resolution. The polygon is clearly Upland Weedy. The surrounding polygon is Pasm.

AA 438 – Correct (Match)

AA Pt = 11, Pasm
Poly = 11, Pasm

AA 439 – Correct (Match)

AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 440 – Correct (Match)

AA Pt = 11, Pasm
Poly = 11, Pasm

AA 441 – Correct (Match)

AA Pt =10, Upland Weedy
Poly = 10, Upland Weedy

AA 442 – Incorrect (Change code)

AA Pt = 13, Spcr
Poly = 10, Upland Weedy

The photo signature shows a dry, sparse gray-green-brown area. The photointerpretation field verification indicated that the surrounding area is seeded Pasm. An area to the northeast of the AA point with a similar signature was visited in the field. It was found to be seeded Pasm. There are areas to the west in the old field with similar signature that have been identified as Spcr. Based on this review, the polygon should be re-coded to Spcr.

AA 443 – Correct (Temporal change)
AA Pt = 11, Pasm
Poly = 10, Upland Weedy

The photo signature shows the polygon as a dark green textured signature of weedy forbs in a matrix of lighter green (representing Pasm). The weedy forbs are prevalent enough for mapping as Upland Weedy. There may have been more Pasm during the AA assessment data collection than at the time the photography was taken.

AA 444 – Correct (Match)
AA Pt = 11, Pasm
Poly = 11, Pasm

AA 445 – Correct (Match)
AA Pt = 13, Spcr
Poly = 13, Spcr

AA 446 – Correct (Match)
AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 447 – Correct (Match)
AA Pt = 13, Spcr
Poly = 13, Spcr

AA 448 – Correct (AA call questionable)
AA Pt = 12, Stco-Bogr
Poly = 11, Pasm

The photo signature shows Pasm in the northern portion of the polygon and Spcr toward the eastern edge. The photo does not clearly show an indication of Stco-Bogr. The entire area (old field) has been seeded for Pascopyrum smithii and Bouteloua gracilis at some time in the past. It may be that there is only Bouteloua at the AA point location. Jim may need to review the AA point data for this location.

AA 449- Correct (Near boundary line)
AA Pt = 11, Pasm
Poly = 10, Upland Weedy

The polygon to the north is Pasm. The polygon where the AA point is located occurs within the old field that was once seeded with Pascopyrum smithii and Bouteloua gracilis. The polygon contains Bromus sp. and exotic forbs. The polygon is best left as is. It is possible there could be a margin of error in GPS or the orthophoto image.

AA 450 –Correct (Match)
AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 451 – Correct (Match)
AA Pt = 11, Pasm
Poly = 11, Pasm

AA 452 – Correct (Match)
AA Pt = 13, Spcr
Poly = 13, Spcr

AA 453 - Correct (Near boundary line)
AA Pt = 15, Upland Sand and Gravel
Poly = 1, Pode

The polygon to the south is Upland Sand and Gravel. The polygon that the AA point is located in is Pode. It is possible that there could be a margin of error in the GPS or the orthophoto image.

AA 454 – Correct (Match)
AA Pt = 15, Upland Sand and Gravel
Poly = 15, Upland Sand and Gravel

AA 455 – Correct (Match)
AA Pt = 13, Spcr
Poly = 13, Spcr

AA 456 (No AA data)

AA 457 – Correct (AA call questionable)
AA Pt = 16, Bogr-Cafi
Poly = 13, Spcr

The polygon containing the AA point appears to contain a mixture of Spcr, borderline Upland Sand and Gravel, and possibly Stco-Bogr. Bogr-Cafi typically occurs on the hill ridge tops to the north and south of the park rather than in the middle floodplain. Jim would need to review the data for this AA point.

AA 458- Correct (Boundary line)
AA Pt = 15, Upland Sand and Gravel
Poly A = 14, Riverine Sand Flats
Poly B = 15, Upland Sand and Gravel

AA 459 – Correct (Boundary line)

AA Pt = 1, Pode
Poly A = 15, Upland Sand and Gravel
Poly B = 1, Pode

AA 460 – Correct (Boundary line)

AA Pt = 14, Riverine Sand Flats
Poly A = 98, Water
Poly B = 14, Riverine Sand flats

AA 461 – Correct (AA call questionable)

AA Pt = 4, Saex
Poly A = 98, Water
Poly B = 14, Riverine Sand Flats

There are two AA points at the same location (see AA point 460). Jim would need to review the data for this point to clarify. This may be an observation of the vegetation across the river. Saex is directly across the river.

AA 462 - Correct (Match)

AA Pt = 15, Upland Sand and Gravel
Poly = 15, Upland Sand and Gravel

AA 463 - Correct (Match)

AA Point = 1, Pode
Poly = 1, Pode

AA 464 – Correct (Match)

AA Pt = 9, Brin
Poly = 9, Brin

AA 465 – Correct (Near boundary line)

AA Pt = 13, Spcr
Poly = 9, Brin

The photo signature of the polygon is definitely Brin. There is a patch of Spcr to the northeast. Spcr may occur in the adjacent polygon to the east, but it is not a strong signature for Spcr.

AA 466 - Correct (Near boundary line)

AA Pt = 13, Spcr
Poly = 9, Brin

The photo signature of the polygon is definitely Brin. Spcr may occur in the adjacent polygon to the west, but it is not a strong signature for Spcr.

AA 467 – Correct (MMU or Near boundary line)
AA Pt = 9, Brin
Poly = 10, Upland Weedy

The adjacent polygon to the east is Brin. The photo signature shows that the polygon where the AA point is located is Upland Weedy with many small inclusions of Brin. These inclusions are below minimum mapping resolution.

AA 468 – Correct (MMU)
AA Pt = 9, Brin
Poly = 10, Upland Weedy

The photo signature shows many small patches of Brin within the Upland Weedy. These inclusions are below minimum mapping resolution.

AA 469 – Correct (Match)
AA Pt = 9, Brin
Poly = 9, Brin

AA 470 – Correct (AA call questionable)
AA Pt = 16, Bogr-Cafi
Poly = 15, Upland Sand and Gravel

The polygon containing the AA point appears to contain a mixture of Spcr and borderline Upland Sand and Gravel. Bogr-Cafi typically occurs on the hill ridge tops to the north and south of the park rather than in the middle floodplain. Jim would need to review the data for this AA point.

AA 471 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 472 – Correct (Match)
AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 473 – Correct (MMU)
AA Pt = 5, Stco-Yugl
Poly = 12, Stco-Bogr

The photo signature shows that at the location of the AA point there are shrubs. However, the area of shrubs is below minimum mapping resolution. The remainder of the polygon is Stco-Bogr, containing few or no shrubs.

AA 474 – Correct (Match)
AA Pt = 12, Stco-Bogr
Poly = 12, Stco-Bogr

AA 475 – Correct (MMU)
AA Pt = 7, Sppe
Poly = 12,Stco-Bogr

There is a very thin strip of Sppe along the edge of the water, but it is below minimum mapping resolution. The polygon to the northwest is coded Sppe.

AA 476 – Correct (Match)
AA Pt = 15, Upland Sand and Gravel
Poly = 15, Upland Sand and Gravel

AA 477 – Correct (Match)
AA Pt = 15, Upland Sand and Gravel
Poly = 15, Upland Sand and Gravel

AA 478 – Correct (MMU)
AA Pt = 9, Brin
Poly = 7, Sppe

The photo signature shows this polygon as green indicating the presence Sppe, and yellow indicating some Bromus. There may be Brin present, especially under the adjacent trees in the polygon to the south, but the signature does not show it as prevalent. The Brin may occur as very small patches that are below minimum mapping resolution.

AA 479 – Correct (Match)
AA Pt = 10, Upland Weedy
Poly = 10, Upland Weedy

AA 480 – Correct (Match)
AA Pt = 15, Upland Sand and Gravel
Poly = 15, Upland Sand and Gravel

Appendix F
Original Matrix

			Observation Points																	User		
																			Total	Acc	Con Interval	
Mapped		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	98		(-)	(+)
Points	1	11						2		2				1	1	1	1			19	58%	37%	79%
	2		5										1							6	83%	50%	100%
	3																			0	NA	NA	NA
	4				3										1					4	75%	27%	100%
	5					4						2	4			3	1	1		15	27%	5%	49%
	6																			0	NA	NA	NA
	7	1						2		1				1	1					6	33%	0%	73%
	8				1		1					1								3	NA	NA	NA
	9						1		1	6	1	2	1	2						14	43%	18%	68%
	10					1				2	13	4	1	1						22	59%	40%	79%
	11	2							1		2	5	2	3						15	33%	10%	57%
	12					4		2					16	3			1	1		27	59%	42%	77%
	13													10			1			11	91%	72%	100%
	14														3	1				4	75%	27%	100%
	15	2									2			1		8	1			15	53%	29%	78%
	16												1				3			4	75%	27%	100%
	17																			0	NA	NA	NA
	98				1		1								1					3	0%	-17%	17%
Total		17	5	0	5	9	3	6	2	11	18	14	26	22	7	13	8	2	0	168			
Prod Acc		65%	100%	NA	60%	44%	0%	33%	0%	55%	72%	36%	62%	45%	43%	62%	38%	0%	NA				
Con Interval -		43%	90%	NA	14%	12%	0%	-7%	0%	25%	52%	11%	44%	26%	5%	35%	3%	0%	NA				
Con Interval +		87%	110%	NA	100%	77%	17%	73%	25%	84%	92%	60%	79%	65%	81%	88%	72%	25%	NA				

Appendix G
Revised Matrix

			Observation Points																	User		
																			Total	Acc	Con Interval	
Mapped		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	98			(-)	(+)
Points	1	19																		19	100%	97%	100%
	2		5										1							6	83%	50%	100%
	3																			0	NA	NA	NA
	4				3															3	100%	83%	100%
	5					10						1	3				1			15	67%	43%	90%
	6																			0	NA	NA	NA
	7							5		1										6	83%	50%	100%
	8								2			1								3	67%	5%	100%
	9									10	1	2	1							14	71%	48%	95%
	10										14	3	1	1						22	64%	44%	83%
	11											9	2	3						15	60%	36%	84%
	12					1							22	2			1			28	79%	64%	93%
	13													10			1			11	91%	72%	100%
	14					3									4					4	100%	88%	100%
	15															12	1			13	92%	76%	100%
	16										1		1				4			6	67%	27%	100%
	17																			0	NA	NA	NA
	98				1														2	3	67%	5%	128%
Total		19	5	0	4	14	0	5	2	13	17	16	31	16	4	12	8	0	2	168			
Prod Acc		100%	100%	0%	75%	71%	0%	100%	100%	77%	82%	56%	71%	63%	100%	100%	50%	0%	100%				
Con Interval -		97%	90%	NA	27%	48%	NA	90%	75%	54%	64%	33%	56%	39%	88%	96%	15%	NA	75%				
Con Interval +		100%	100%	NA	100%	95%	NA	100%	100%	100%	100%	80%	86%	86%	100%	100%	85%	NA	100%				