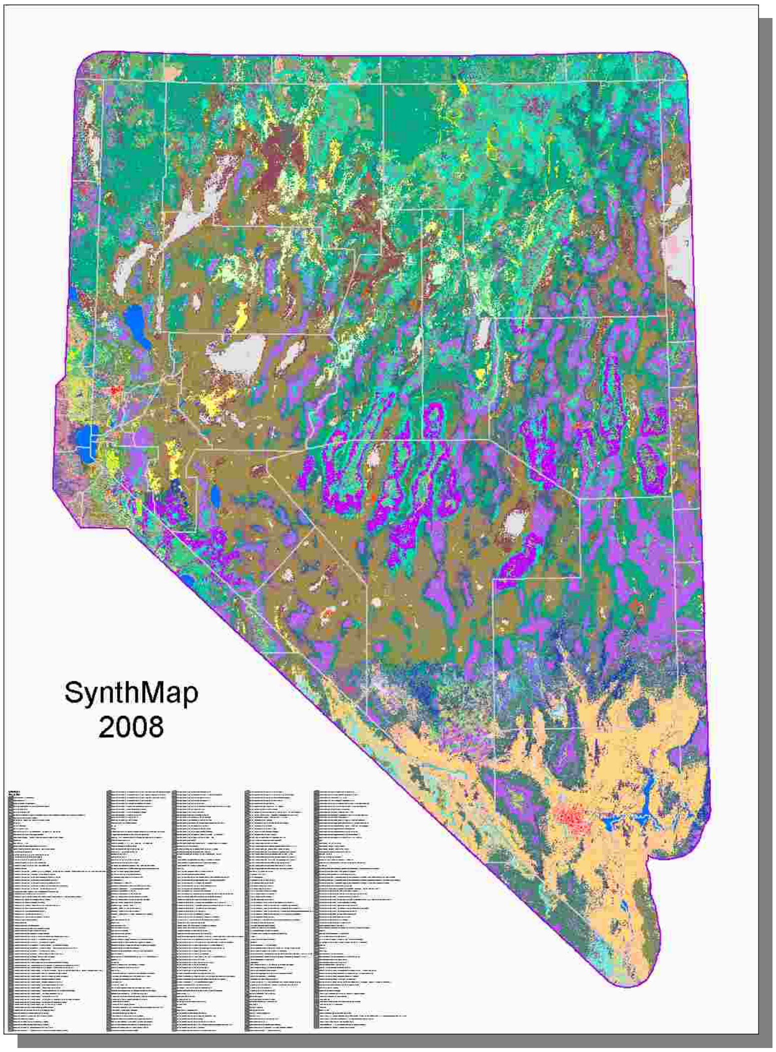
A Synthesis of Vegetation Maps for Nevada
(Initiating a 'Living' Vegetation Map)



2008 Edition (First)

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Assembled by:

Eric B. Peterson
Nevada Natural Heritage Program

Department of
Conservation and Natural Resources
901 South Stewart Street, Suite 5002
Carson City, NV 89701-5245
775-684-2900

with support from the
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The Nevada Natural Heritage Program recognizes the difficulty in producing a 100% complete compendium of vegetation for a large region and that this document is most certainly incomplete. This work is intended to be revised and updated, and perhaps this first edition should even be considered a prototype. We welcome additional information and corrections. Please see the section "How to Contribute" and contact the Vegetation Ecologist listed at http://heritage.nv.gov/contact or send mail to the Nevada Natural Heritage Program, ATTN: Vegetation Ecology, 901 South Stewart Street, Suite 5002, Carson City, NV 89701-5245.

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Preface

This product has been a long time in coming! I think I first envisioned it back in 2001 as I was developing the idea of using a 'living map' concept. At that time, I was regularly attending meetings of the Governor's Sage Grouse Conservation Team and hearing complaints about the lack of detailed geographic information on vegetation in the state. Many complaints were truly valuable criticisms about our lack of knowledge, and unfortunately many of them remain accurate today. But they emphasize the need to assemble the varied resources of information on our vegetation into a single usable format.

Other complaints were criticisms of errors in what little data was available. Some of these were major errors covering large regions. Others were people playing the 'my favorite pixel' game picking on a small spot or two that were mapped incorrectly. In all cases, people knew information that was not represented. Why not take advantage of these expert critiques and use them to improve our knowledge of Nevada's vegetation?

This got me to thinking that the Nevada Natural Heritage Program should act as a sort of food processor for blending various projects that map or classify vegetation in the state, into a single set of coherent products.

A large portion of this vision was a 'living map' of current vegetation that could be updated as new projects were completed. Most maps are developed as a single point-in-time project, with all the error associated with mapping 70 million acres in a single shot. Then the project is over. The next project to come along will then try to address the biggest problems in the previous, but often introduces new problems, then it too, is over. However, a living map can combine multiple mapping projects for a synthesis map with greater accuracy than the individual project maps. A living map can also take advantage of expert critiques, incorporating them as new or improved information, and thus rectifying errors in the future editions.

Such a synthesis may seem like an obvious idea, but can be logistically difficult in today's funding environment. Most obviously, it requires on-going work to provide regular, iterative, updates. Such a project would be difficult to house in an academic department of a University, where projects need to fit the cycling of students, fit the duration of short-term grants, and provide ample material for journal publications. A strong synthesis also requires the project to cut across jurisdictional boundaries, making it difficult to house within an agency that administers specific lands, as their focus often stops at the boarders of their land.

An office such as the Nevada Natural Heritage Program is ideal for such a project. First, continual maintenance of data on natural resources is a specialty of Natural Heritage Programs. Second, there is little pressure to publish or need for projects that can be completed within a few years. Third, we work across administrative boundaries both within states, and between states with the help of an international network of Natural Heritage Programs and their equivalents covering all 50 states, the Navajo Nation, much of Canada, and a good portion of Latin America.

That provides the argument for this document and the accompanying data layers. So, why has it taken so long? Well, at those same Sage Grouse meetings, there was a lot of discussion of the need for a map of 'habitat quality'. To me, this translates as vegetation condition. In Nevada, one of the predominant factors in vegetation condition is the invasion of annual grasses, and my work in mapping their distribution and cover took over much of my time in the intervening years.

But at last, I've had the chance to produce a map that combines most recent, available data, kicking-off the 'living map' process. These data, the documentation here, and a related document covering the alliance and association levels of the International Vegetation Classification provide a base from which users can provide valuable feedback and, along with ongoing mapping projects, move Nevada along toward an improved second edition of the SynthMap.

Introduction

Vegetation mapping over the years in Nevada has used a numerous sampling methods, classification goals, delineation scales, and output formats. The **current vegetation synthesis layer** (SynthMap) attempts to combine these into a single resource. In soliciting data for this, many people have questioned how such varied resources could be incorporated into a single layer... squeezing apples and oranges together. But, blended juices can be good. This will provide a single layer to describe our knowledge of vegetation in Nevada with respect to the International Vegetation Classification (IVC; Grossman et al. 1998; Peterson 2008a). But, given the challenges of integrating varied source layers, perhaps it will be best to first acknowledge some things that this layer is *NOT.*

- This layer is NOT a uniform product.
- The classes in this layer are NOT all thematically equal.
- The spatial resolution of source data are NOT uniform across the layer.
- This layer should NOT be used to compare the extent of one vegetation type versus another.
- This layer should NOT be used for modeling organism distribution or habitat use without some thought and understanding of the varied levels of vegetation classification and how they correspond to the organism being modeled.
- This layer is not so accurate that land management decisions should be made without field verification at appropriate spatial and thematic scales.

Instead, this layer uses multiple projects to resolve as best as possible, which IVC classifications exist where in Nevada. Some of the most extensive source projects (SWReGAP and LANDFIRE) have worked entirely at the IVC Systems level. The systems level (Comer et al. 2003) is not explicitly defined within this document, but thorough descriptions are available http://www.natureserve.org/explorer/classeco.htm. These systems are groupings of IVC associations that are ecologically meaningful and are mappable with the remote sensing and modeling methods often used for mapping vegetation over vast areas.

Where data with higher thematic resolution is available, a synthesis layer can provide more information. Many local projects provide alliance-level thematic resolution. Some even resolve Associations. See Peterson (2008) for a listing of known alliances and associations within Nevada. The synthesis map provided here takes advantage of these, using the finer classifications where possible.

- This layer CAN be used to determine the current vegetation thought to exist in an area.
- This layer CAN be used to examine the level of understanding of vegetation over an area and relative to other areas.
- This layer CAN be used used for modeling habitat use and organism distribution *if* careful thought and understanding of the varied levels of vegetation classification and how they correspond to the organism being modeled are used.
- This layer CAN be used to determine where more vegetation information is needed.
- This layer CAN be updated as more information becomes available, including expert critique and correction.

Regarding that last bullet, the NNHP acknowledges that additional data already exists that should be incorporated into the SynthMap. Data were solicited from agencies and experts, but few responses were received. Hopefully, additional datasets will surface for the next version of the SynthMap. Additionally, there are projects such as the Truckee River Riparian Vegetation and Fluvial Geomorphology Study, which are thought to exist now only in printed form; the time available for this first edition of the SynthMap prohibited digitization of such maps so they have not been included. Furthermore, the SynthMap layer is acknowledged to be rough – perhaps really a prototype for the synthesis concept, rather than a polished product. This will hopefully provide more flexibility for revision in the next edition.

Raster versus Vector - This current edition is a raster file with 30 m pixel resolution, much like some of the source layers (SWReGAP and LANDFIRE). This results in a loss of information from higher resolution source layers. A vector map (polygons) should be a goal for future editions, to better incorporate projects of varied spatial scale. However, vectorization of the LANDFIRE raster would have exceeded the 2 GB limit of ESRI shape files. An alternative does exist, the 'file geodatabase', however other limitations of current software versions prevented the use of this option at present. Additionally, most desktop computers would be very slow to load and display data from a multi-GB vector file. So for practicality sake, this edition of the SynthMap uses a raster format.

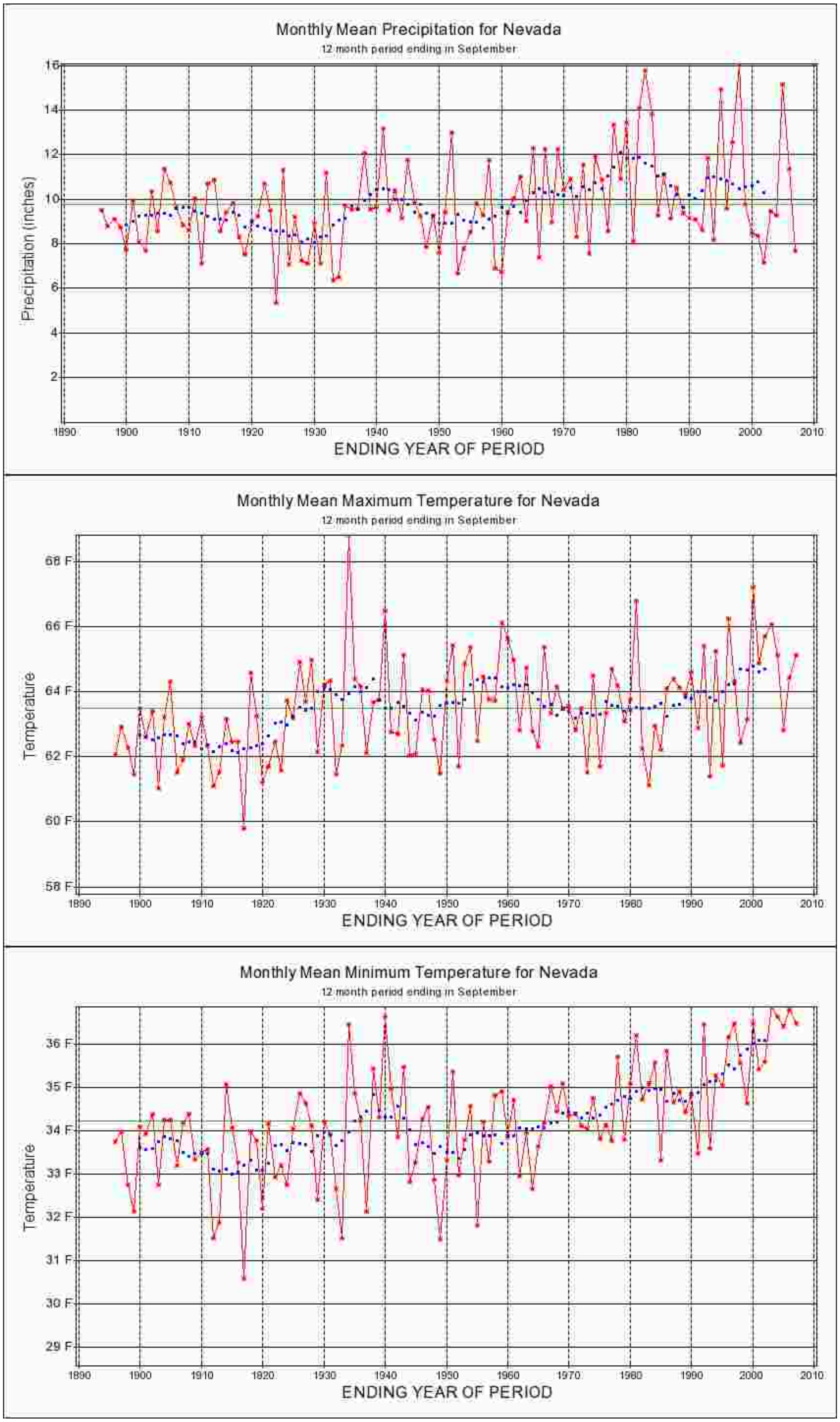
Vegetation Project Index Layer - Another comment that received, was that an index layer for vegetation projects may be even more valuable... a layer that indicates what mapping projects have addressed different portions of the state. End users could then quickly see what resources are available for the land they work with and decide for themselves which projects are useful. Thus, a Vegetation Project Index layer (VPI) is provided as well. The VPI was constructed by simply delineating the boundary of projects, then combining these boundaries with a traditional intersection method. The current edition of the VPI is limited to digital source projects; prior projects that exist only in printed form are not included.

Future Directions – Some future directions have already been mentioned, particularly utilizing a vector format rather than the current raster format. However, some consideration should be given to greater coordination of the NNHP vegetation program with vegetation mapping in other agencies and NGOs. The U.S. Forest Service has an extensive vegetation mapping program that deserves more detailed attention than could be given for this first edition. The U.S. Bureau of Land management has a long history of collecting Ecological Site Inventory data (ESI) which have been entirely ignored for this edition. These ESI data could greatly improve thematic resolution of vegetation classification over large areas of the landscape. These data are typically collected at the district level and degree of effort varies greatly between districts, so incorporating ESI data will be a substantial undertaking involving a great deal of coordination between the NNHP and numerous BLM offices.

Other groups collect vegetation data and create vegetation maps on a more local scale. The Nature Conservancy has presumably mapped a greater portion of their lands than are represented here (the Torrance Ranch project, mapped by the NNHP for the TNC). Additionally, The USGS has been mapping phreatophytes as a component of ongoing work on water relations in riparian zones in southern and eastern Nevada. It may also be possible to use some data from the National Wetlands Inventory and National Hydrography Datasets (U.S. EPA) to improve vegetation mapping in riparian zones and wetlands.

While broadening the range of source data for future versions of the SynthMap, the classification should also be refined. At present, most vegetation types in the IVC (International Vegetation Classification) are based on a multitude of publications using varied concepts of plant communities and rather few types are based on empirical analysis of vegetation data. Further collection and analysis of data by the NNHP, as well as analysis of other data sets such as the ESI data, is needed to refine the classification within Nevada.

We must also remember that the future does not just involve adding better data. Vegetation changes and a living map must accommodate this. Wildfire has been a major agent of vegetation change both recently and historically. The future will continue to see wildfire as an agent of change. The frequency and extent of these fires is partially driven by climate, and weather station data show that climate is changing in Nevada (see graphs on next page). Precipitation appears to undulate with a possible slight increase on a statewide basis. Both minimum (nightly low) and maximum (daily high) temperatures have been increasing, particularly over the last couple decades. A combination of sustained precipitation patterns and rising temperatures could exacerbate our current problems with invasive annual grasses (Peterson, in preparation). Note: these climate data may be explored by state, county, climate divisions, or hydrologic units at http://www.cefa.dri.edu/ Westmap/timeseries.php?map=States



Average precipitation, maximum temperatures, and minimum temperatures for the state of Nevada (WRCC 2008). Red points (and connecting lines) show annual data. Blue dots provide 10-year running averages (to smooth noise and reveal trends). Green lines represent average value across the entire dataset.

The living map idea is by no means novel. Similar projects are occurring worldwide, as exemplified by th Atlas of the Vegetation of Madagascar (http://www.regmad.org) project recently covered by ArcNews (Anonymous 2007). Several other Natural Heritage Programs in the western U.S. are also considering similar synthesis-map projects.

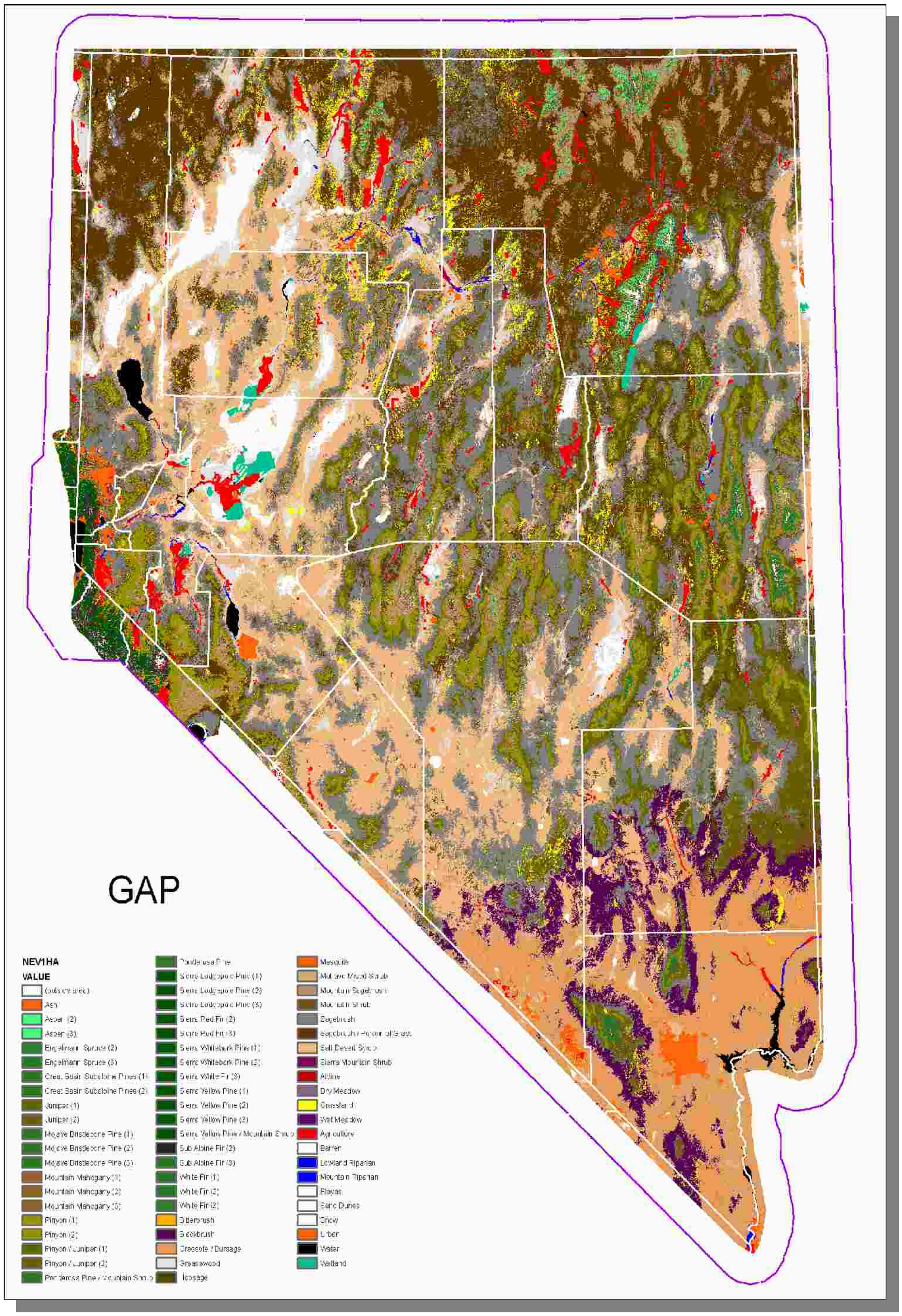
Vegetation Mapping Projects in Nevada

This list presents vegetation mapping projects that were considered for use in the CV map, in no particular order.

Gap Analysis Project (GAP) – (Homer et al. 1997, 1998) – This is the first project to map vegetation across the entire state of Nevada at moderately high resolution (30 meter pixels). Completed in 1998, this project used Landsat 5 imagery dated ca. 1990 and thus effectively is a map of vegetation ca. 1990. The vegetation classification used was developed specifically for the product as there was no national standard for such products at the time.

Not Used.

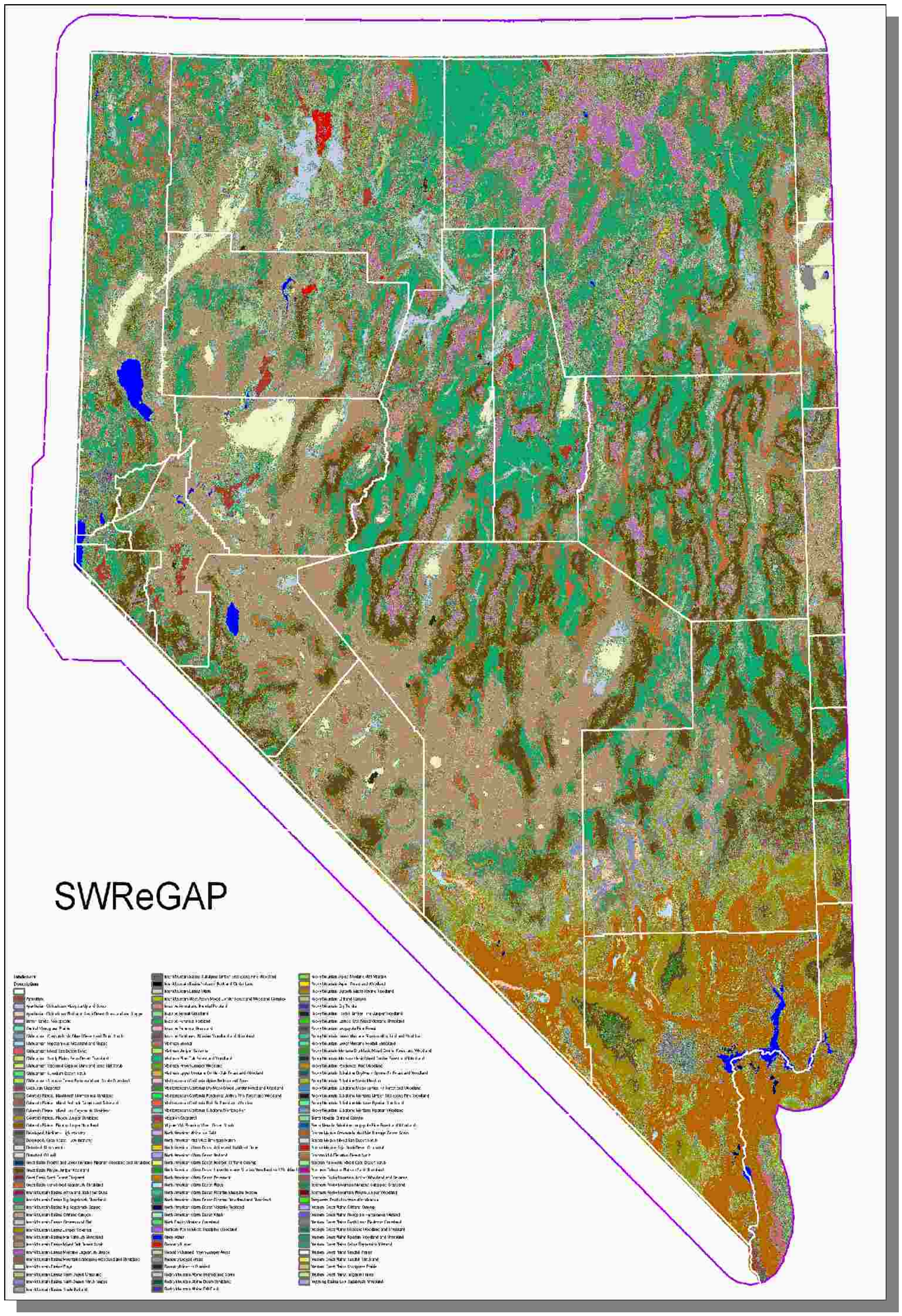
The NNHP maintains electronic copies of data and accompanying documentation.



Southwest Regional Gap Analysis Project (SWReGAP) – (Lowry et al. 2005, 2007) – This was probably the most massive vegetation mapping project ever conducted within the state of Nevada. In total, it covered 5 southwestern states. Within Nevada alone, some 17,000 sites were sampled in the field for training data. Data analysts were intimately involved in the field work and thus had excellent personal knowledge of the landscape to help guide their analyses. The project, completed in 2005, used Landsat 5/7 imagery from the years 1999 – 2001 (mainly 2000) and thus is effectively a map of vegetation ca. 2000. The entire state was mapped for IVC Ecological Systems (Comer et al. 2003; see also Peterson 2008a) with 30 meter pixels.

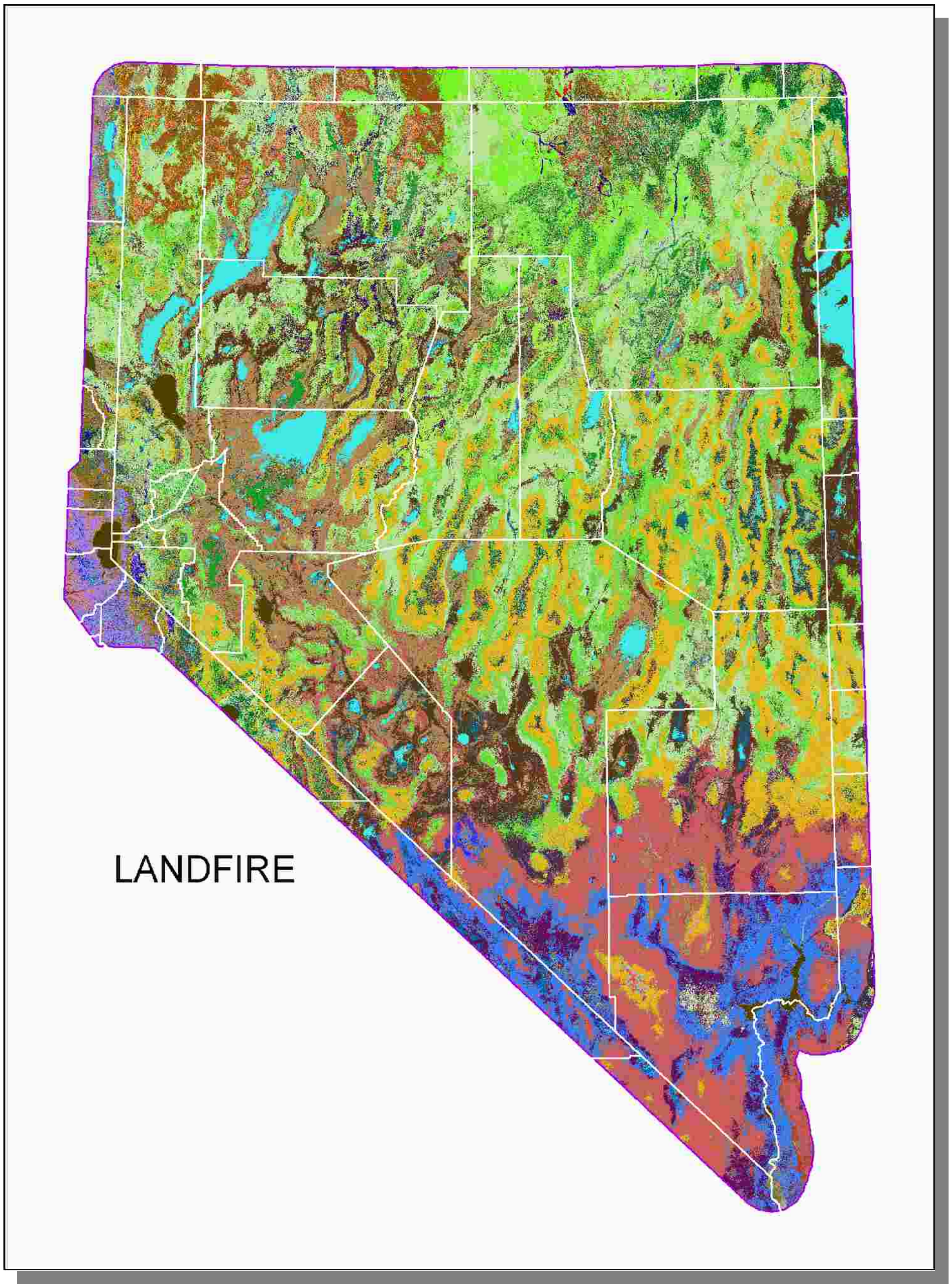
Used in the SynthMap; these data formed the base for the SynthMap, with the exception of North American Warm Desert Wash which appears to have been mis-classified over broad areas including flat table landscape positions.

The NNHP maintains electronic copies of data and accompanying documentation, except for the photographs of all field plots that may be joined into the database. Used as base for synthesis map.



Landscape Fire and Resource Management Planning Tools Project (LANDFIRE) – This is an ongoing project headed by the U.S. Forest Service, but involving multiple agencies and private entities. LANDFIRE involves several vegetation products, however the focus here is on the Existing Vegetation Type (EVT) layer. The goal is to map Ecological Systems over the entire nation with a 30 meter pixel resolution. In addition to Ecological Systems, map classifications indicate that several Alliances have been included. Currently, the western U.S. is complete, while the eastern U.S. is in process. Furthermore, it is suggested that the map will be updated occasionally.

LANDFIRE builds upon SWReGAP, incorporating additional data as well. One additional item is use of the National Hydrography Dataset to aid predictive mapping of vegetation, thus providing potential for better mapping of narrow riparian zones or small area wetlands. The project, however, is housed in Montana and data analysts may not have the same opportunity to become intimately aware of vegetation patterns in other parts of the nation, making it more difficult to judge alternative models. The project is also working quickly to complete a nation-wide vegetation map. Examples of the repercussions of this remoteness and rush can be found in pixels mapped as Mediterranean California Mixed Oak Woodland on the north slope of the Pah Rah Range near Pyramid Lake, or *Quercus gambelii* Shrubland Alliance among the Swamp Cedars of White Pine County.



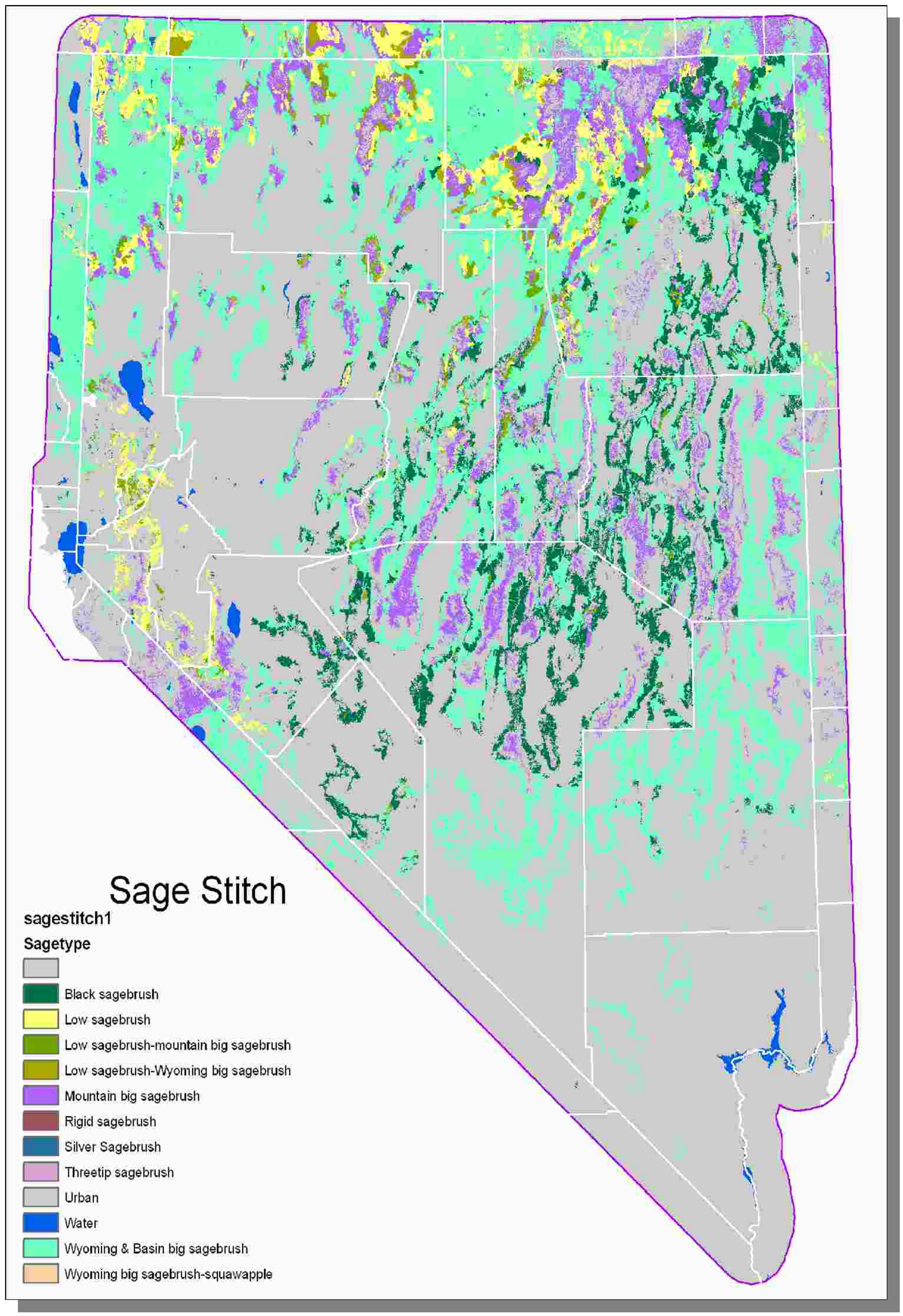
LANDFIRE was used in the SynthMap to fill missing data from SWReGAP (the northern and western border buffers), to fill the areas mapped by SWReGAP as North American Warm Desert Wash, to fill most areas mapped by SWReGAP as a cliff and canyon complex, to burn in riparian types, and to burn in most Alliance-level data.

The NNHP maintains an electronic copy of the data as of December 2007. Documentation can be found on the web at http://www.landfire.gov/.

Sagebrush Stitch Map (SageStitch) – (Comer et al. 2002) **–** This was performed partly in parallel with the SWReGAP. A combination of field data from SWReGAP, field data adopted from agencies who collected it for other reasons, additional field data collected specifically for the product, and NRCS SSURGO data on soil-plant community relations, were used to predictively model sagebrush vegetation types classified by the dominant species (approximately an alliance-level classification).

Used in SynthMap, to resolve sagebrush systems to the alliance-level when possible.

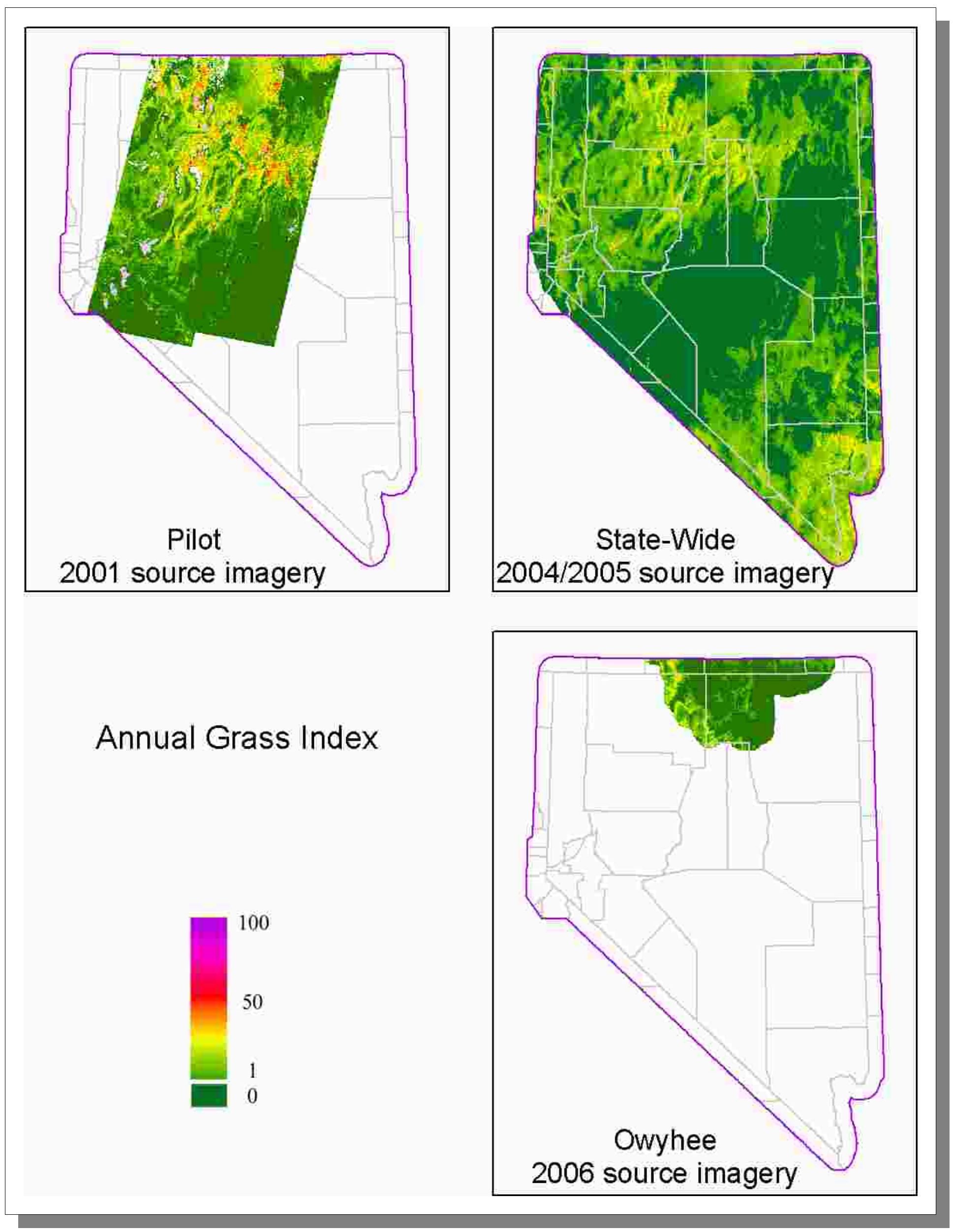
The NNHP maintains an electronic copy of the data and accompanying metadata (dated February 2002).



NNHP Annual Grass Index Maps – (Peterson 2003, 2005, 2006, 2007) – The NNHP conducted a series of projects that mapped the abundance of annual grasses (primarily *Bromus rubens*, *Bromus tectorum*, and *Schismus barbatus*). The first project covered a portion of northern Nevada to test the methodology that involved predictive modeling based on field data and multi-temporal Landsat satellite imagery (to capture the early phenological signature of most annual grasses). Imagery for this project was from 2001, thus the resultant map is effectively for annual grasses in that year. A second project extended the methodology across the entire state of Nevada, although significant problems were found in the Mojave region due to temporal compression of phenology. Imagery data were from 2004 in the north and 2005 in the south. The third project focused on the Owyhee Uplands, extending into Idaho and Oregon, and providing a more thorough examination of the Nevada portion of the Owyhee based on 2006 satellite imagery.

Not used. These data provide information on vegetation condition, rather than classification. High cover of annual grasses can be found with overstory shrubs retained, thus distinctions between grasslands and shrublands are weak from these data.

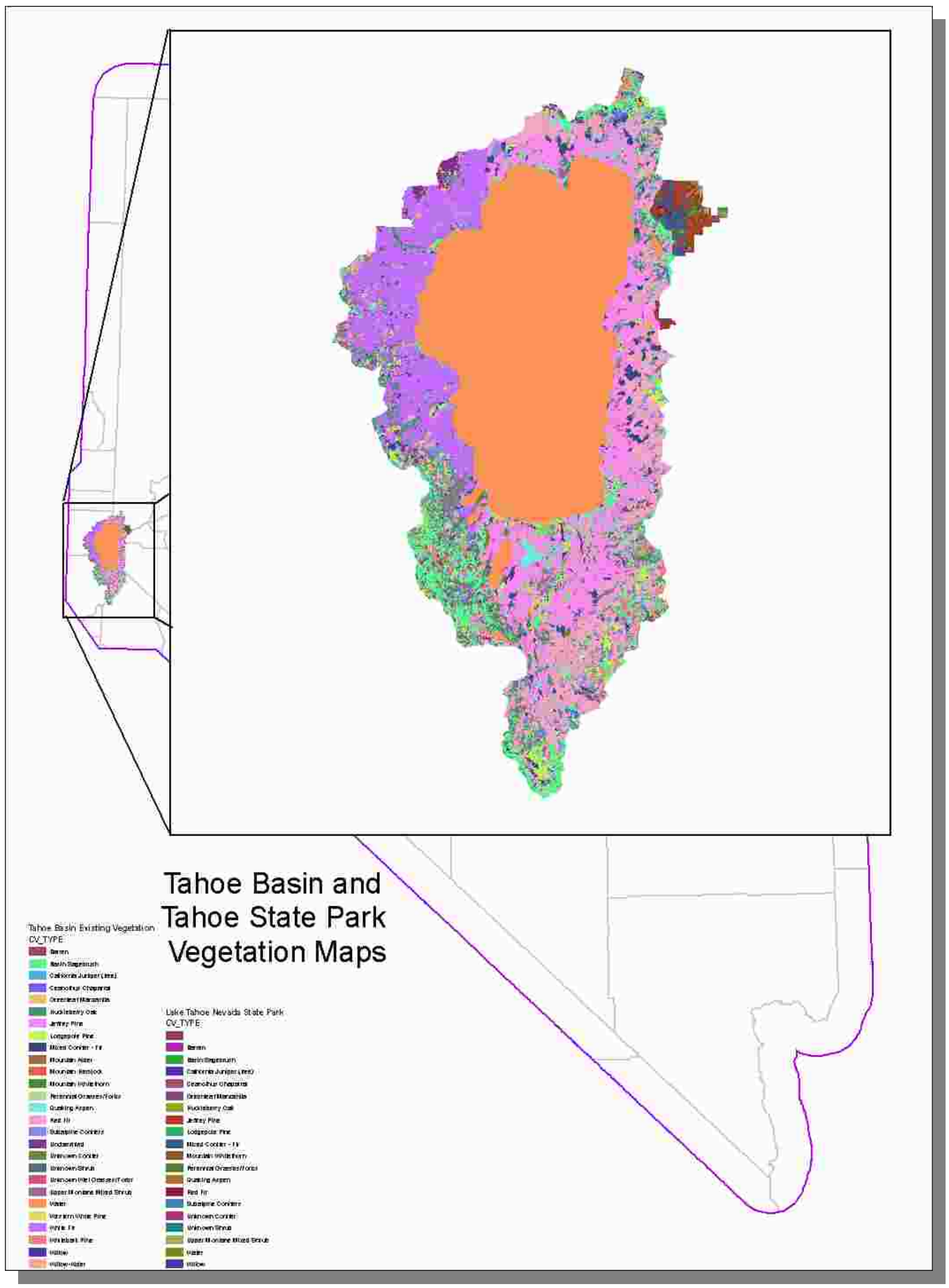
The NNHP maintains electronic copies of product layers, supporting documentation, and a database of field plots. These data are also available over the internet from the NNHP website: http://heritage.nv.gov.



Tahoe Basin Existing Vegetation Map (TBEVM) – (Greenberg et al. 2005, 2006) – This project collected original field data and related it to high resolution Ikonos satellite imagery using image segmentation methods. This provided a roughly alliance-level classification mapped with a vector layer (polygons) rather than a raster map. Several iterations of image segmentation and analysis with field data refined the accuracy to a greater degree than many other vegetation mapping projects in Nevada.

Used in SynthMap. Most classes were burned over SWReGAP data. However, U.S. Forest Service mapping that has continued since the TBEVM completion was assumed to have adopted from, and improved upon, this project. Thus much of the TBEVM was removed from the SynthMap by subsequent burning of Forest Service data.

The NNHP maintains an electronic copy of the completed layer and some supporting documentation. Data and additional documentation may be obtained from the California Spatial Information Library (CALSIL) at http://gforge.casil.ucdavis.edu/projects/tbevm/ and from the U.C. Davis Center for Spatial Technologies and Remote Sensing (CSTARS) at http://www.cstars.ucdavis.edu/ .



Lake Tahoe Nevada State Park Extension of TBEVM – (Longmire & Evans 2007) - After the TBEVM, the state park in Nevada realized that a large portion of its land had been mapped, but that it really should have a map covering the entire park. This project completed vegetation mapping for the park on the east slope of the Carson Front Range. The project was specifically designed to match the TBEVM.

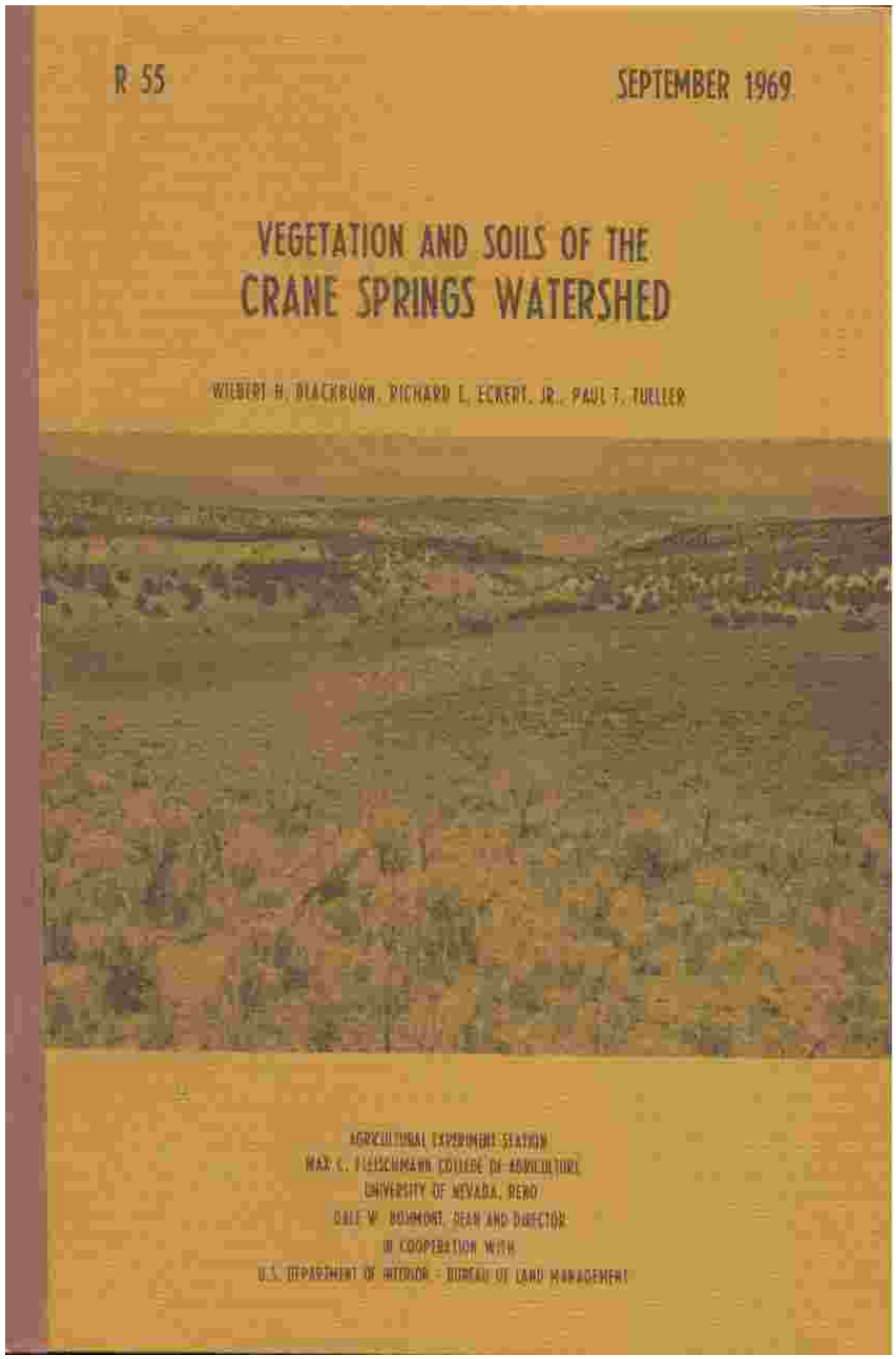
Used in SynthMap similarly to the TBEVM.

Electronic copies of data and documentation will be maintained by the NNHP.

Various Blackburn, Tueller, and Eckert projects – (Blackburn et al. 1968a, 1968b, 1968c, 1969a, 1969b, 1969c, 1969d, 1969e, 1971; Heinze et al. 1962; Tueller et al. 1972) – A number of watersheds were mapped at the equivalent of IVC association levels, primarily in the late 1960's. These were done from field data collection and reconnaissance. While thematic resolution is high, spatial resolution is moderate, with polygons drawn over a section grid that does not always match with current PLSS data. Thus, boundaries between vegetation types must be considered approximate. Inclusions of alternate vegetation types within a polygon are likely numerous. Most polygons also represent groups of associations – perhaps association mosaics.

Not used in SynthMap. The obvious reason to not use these are that the data are decades old and vegetation may well have changed. Still, where vegetation has not burned in the intervening years, these reports may be useful for the SynthMap if generalized to an alliance level. The data are in printed form, not convenient for use in the current SynthMap. A couple of the maps have been photographed and georeferenced by the NNHP, however vegetation types have not been delineated from the images and time is not available to complete digitization of the maps at present. Outer bounding polygons from a couple have been digitized and are included in the project index layer.

The NNHP has physical copies of most of these projects and has scanned several to PDF.

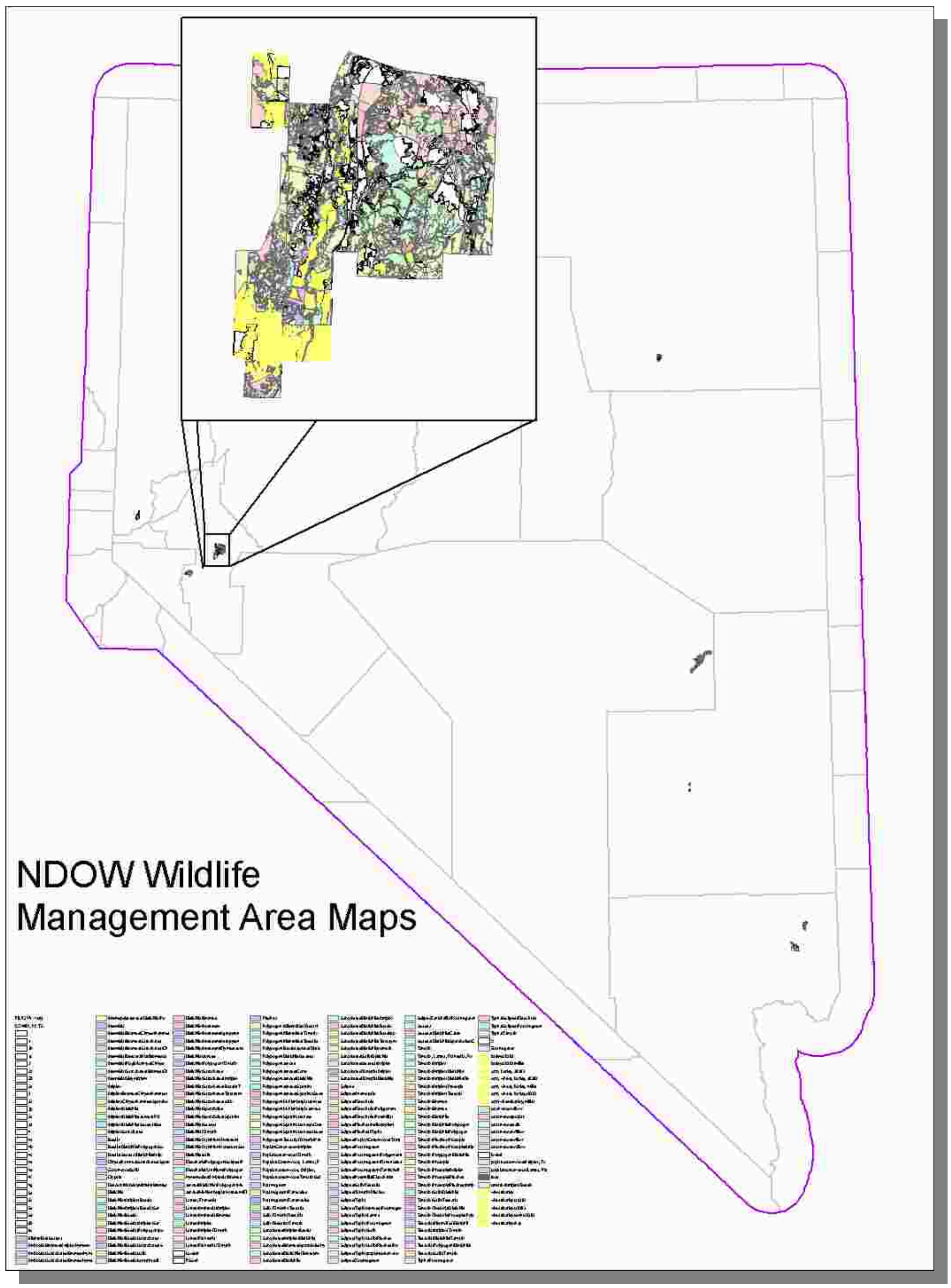


One of many vegetation mapping documents from the Blackburn-Tueller-Eckert trio.

NDOW, Wildlife Management Areas – The Nevada Department of Wildlife (NDOW) manages a number of wildlife areas around the state. These were mapped in the mid to late 1990's, primarily through a consulting firm; precise methodology has not been tracked down by the NNHP. Resulting map data appear to be at alliance-level, or mosaics of alliances. The NNHP crosswalk focused on the first species given for a polygon, assuming it's alliance occupied the greatest proportion of the polygon. Many polygons lacked vegetation data. This may be the only data source for the synthesis map that incorporated aquatic vegetation.

Used in the Synthesis map where vegetation data was given.

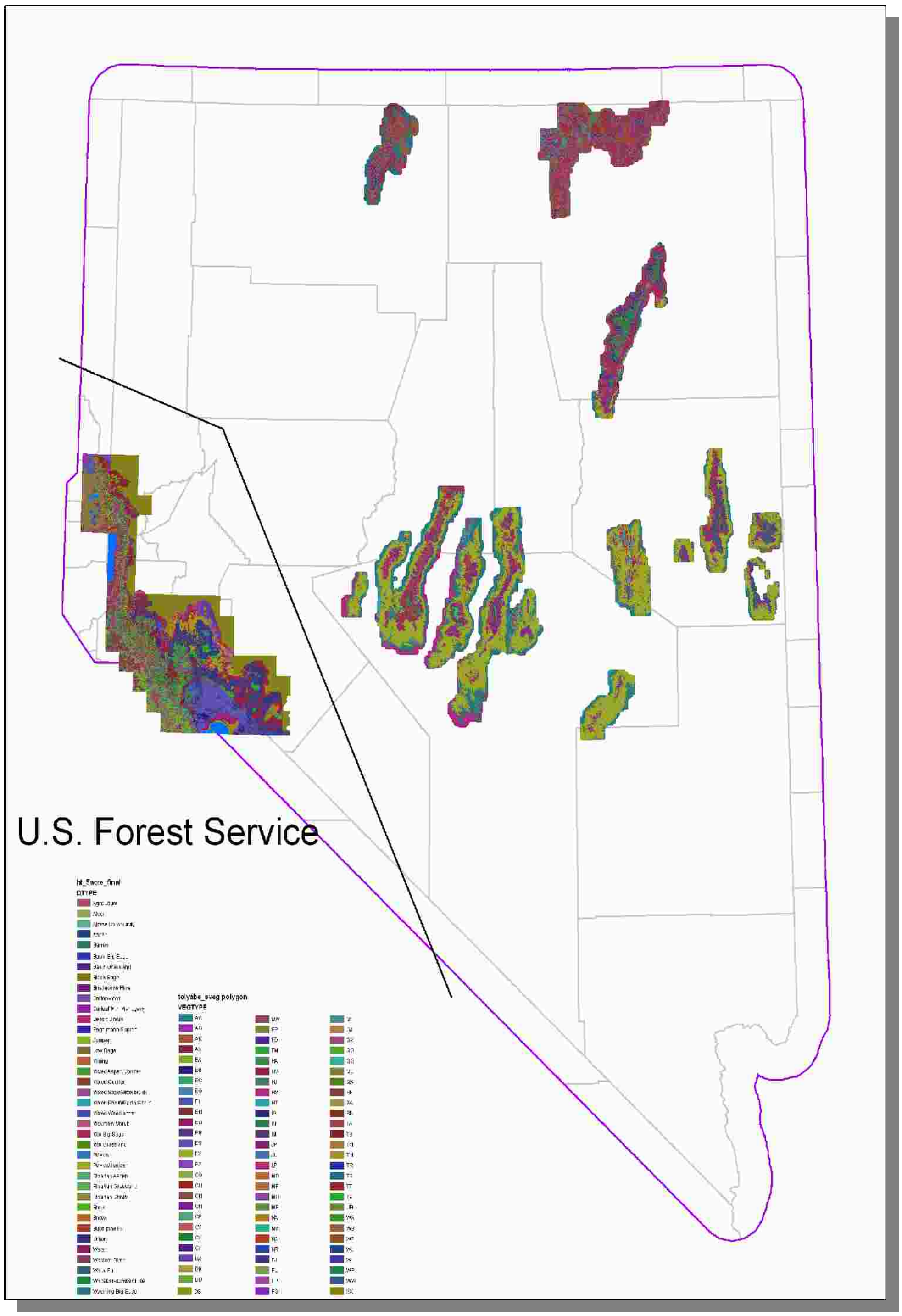
A copy of the data as used for the SynthMap will be maintained by the NNHP.



U.S. Forest Service Veg Mapping – (Gillham et al. 2004) – The Forest Service has undertaken mapping of lands under their administration at roughly an alliance level. This vector based project has been completed for Forest Service lands in Nevada, though revisions are ongoing. The work has been divided into three regions: The Sierra-Nevada, the Great Basin, and the Spring Mountains. The latter was completed in the late 1990's and is now being completely revised.

The Great Basin and Sierra-Nevada portions were used for the SynthMap. The Spring Mountains were omitted due to the age of the data and the current revision. This revision should be incorporated into the next version of the SynthMap.

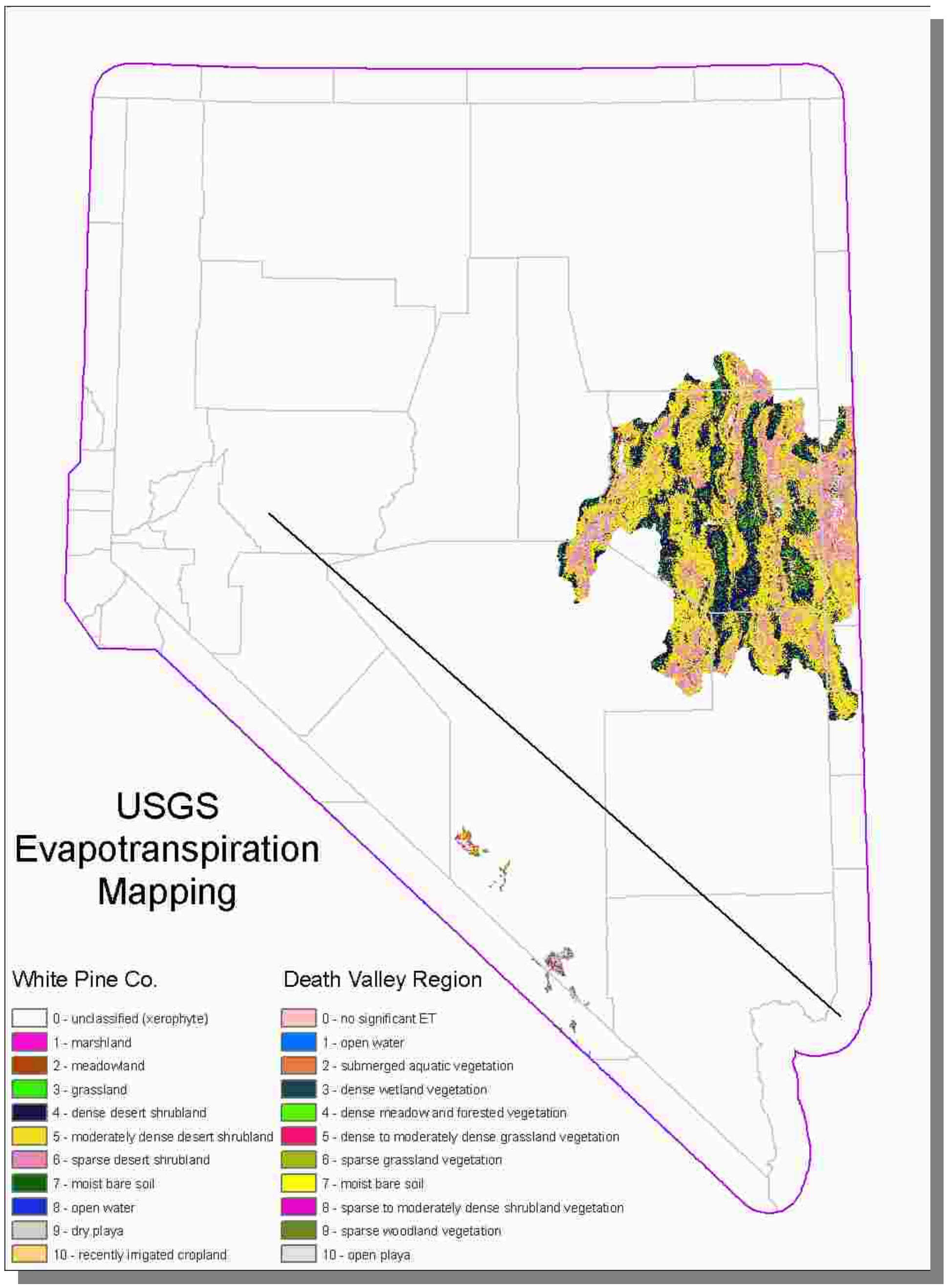
A copy of Great Basin and Sierra-Nevada data used in the SynthMap will be maintained by the NNHP but since all data are regularly revised, we recommend contacting the U.S. Forest Service directly to obtain data.



U.S. Geological Survey Evapotranspiration Unit Mapping – (Laczniak et al. 2001; Smith et al. 2007) – The USGS has conducted several projects mapping evapotranspiration in wetlands and riparian zones. These maps effectively delineate phreatophytic vegetation types. While some of these are available only in hard-copy, two datasets are readily downloadable: one for the Death Valley region (including the Amargosa and Sarcobatus Flats areas) and one for a portion of eastern Nevada with focus on White Pine County.. Classification is coarse, but with some useful at a level similar to Ecological Systems.

The data from Death Valley region project was used in SynthMap. The data from White Pine County were not used both due to poor thematic resolution for SynthMap purposes and due to frequent misclassification of agriculture and disturbed sites as wetland vegetation types – error that might not be problematic for the original purpose of the project but could be annoying for use in SynthMap.

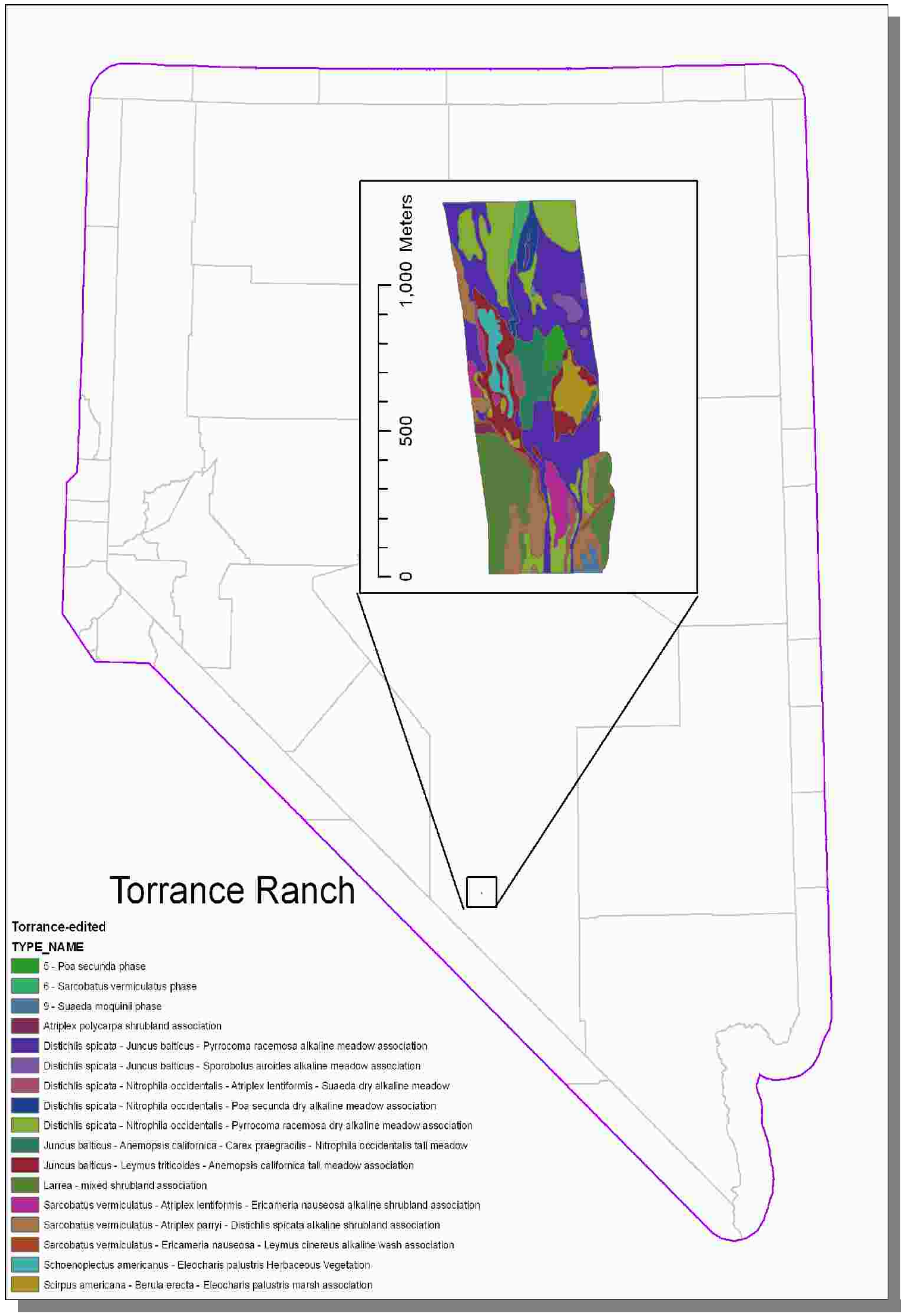
Copies of the data used for the SynthMap and documentation will be maintained by the NNHP.



NNHP Torrance Ranch Map – (Morefield 2000) – This is a small vegetation mapping project conducted by the NNHP in 1999. Mapping was performed at the association level, though cross-walking was necessary to fit the project classification into the current IVC concepts.

Used in SynthMap, burned over all other data sources.

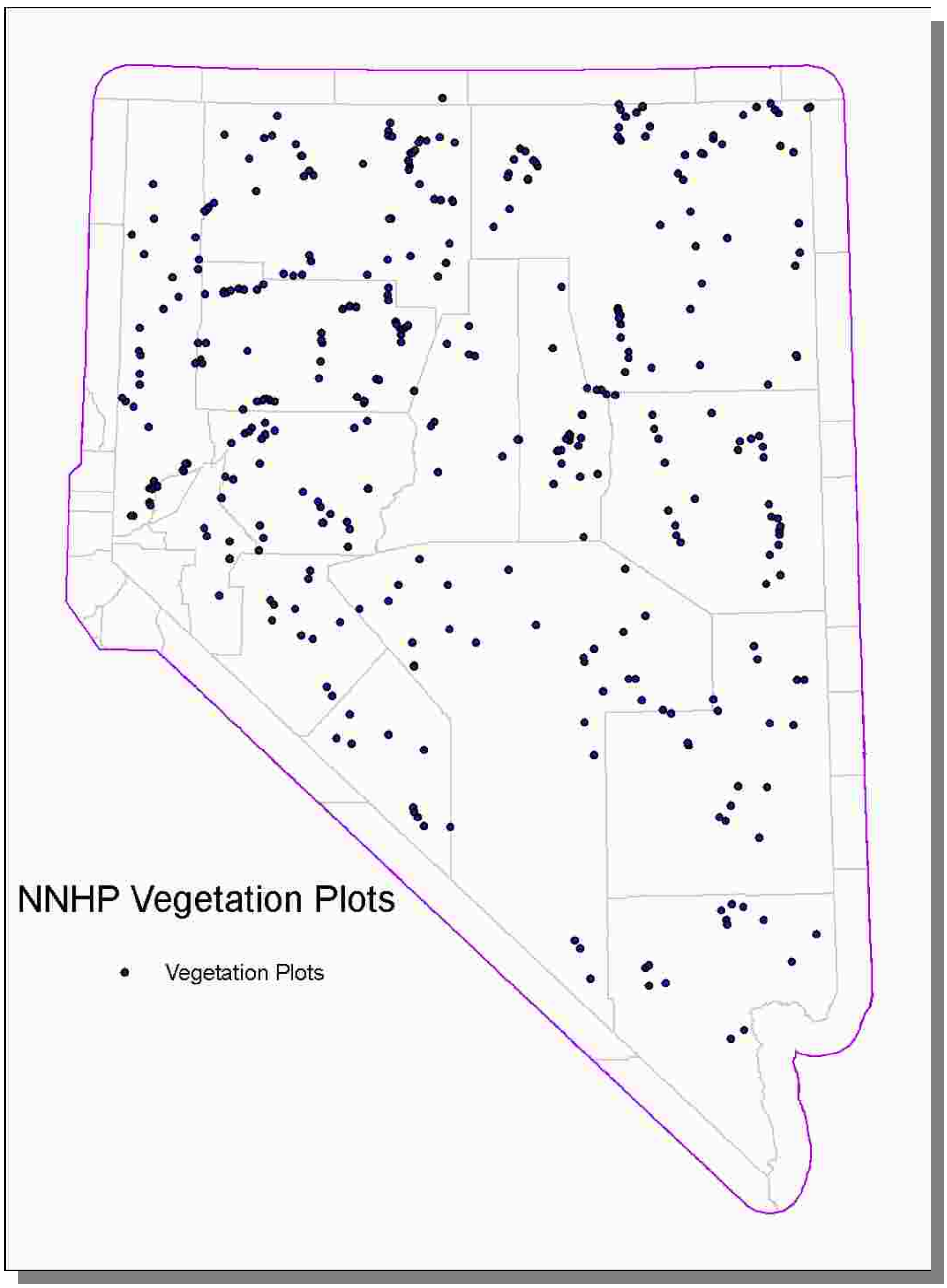
Geospatial data and supporting documentation are maintained by the NNHP.



NNHP Vegetation Plots – (Peterson 2008b) – These data were collected by the NNHP for multiple reasons, though the majority were collected while gathering data for mapping annual grasses. A portion of the plot data have been classified to IVC associations.

Used in SynthMap. The classified plots were converted into a raster format such that a single 30 meter pixel represented each plot. These were burned into the SynthMap layer over all other data. Although the data represent a minuscule portion of the entire SynthMap dataset, they can provide insight into surrounding vegetation types mapped with more coarse thematic resolution.

Data and documentation on field methods are maintained by the NNHP.



NNHP Altered Andesite Mapping – (Peterson 2004) – This is an incomplete project that sought to map vegetation related to altered andesitic soils. These highly acidic soils host very unusual vegetation, which forms the proposed Geothermally Acidified Soil Coniferous Woodland Alliance. These soils are clustered primarily in western Nevada and are best known around the Reno area for outcrops in Hidden Valley and around Truckee Meadows Community College. Mapping primarily involved digitization from DOQQs and satellite sensor data, with substantial field verification. However, few formal plots were sampled. Completion of the project was interrupted by annual grass mapping projects and numerous outcrops remain unmapped.

Used in the SynthMap layer by burning all mapped polygons as the Geothermally Acidified Soil Coniferous Woodland Alliance.

Data are maintained by the NNHP.

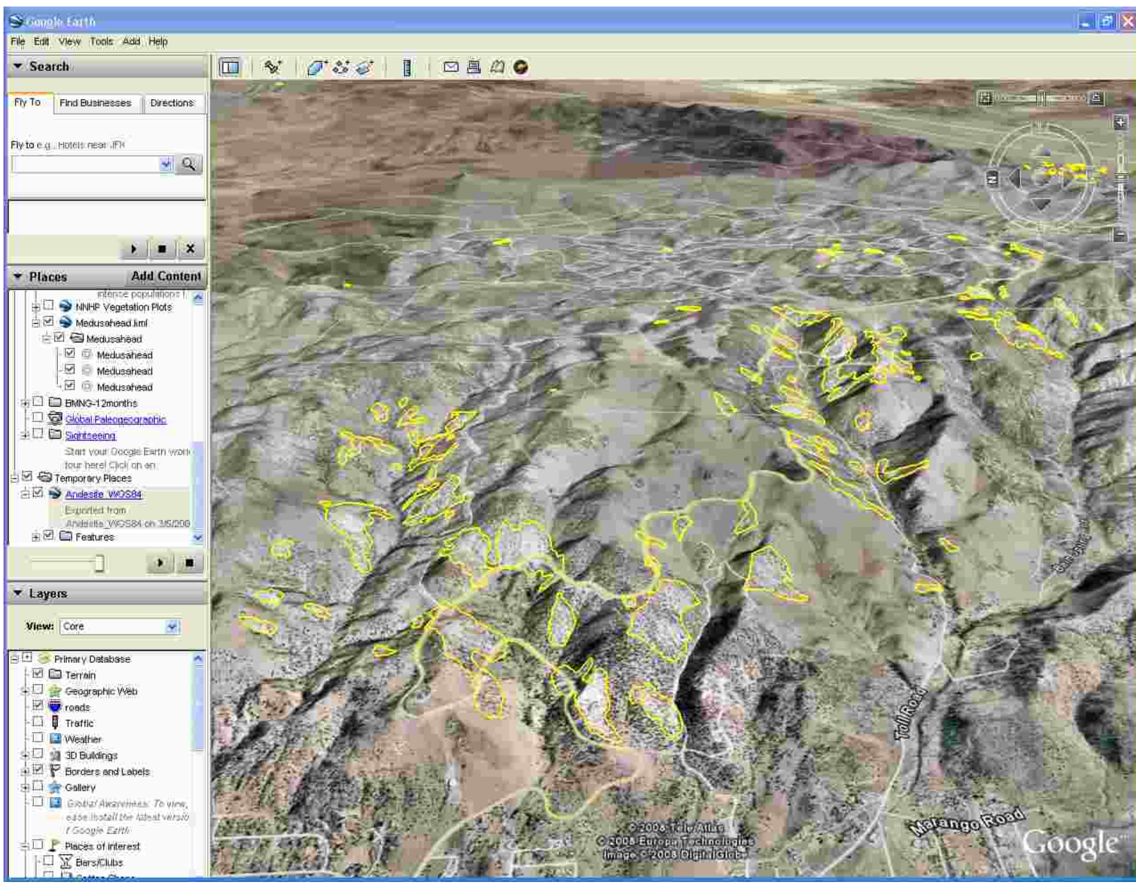


Illustration 1: Geiger Grade portion of the Geothermally Acidified Soil Coniferous Woodland Alliance, incompletely delineated from field work and DOQQs, shown here in Google Earth.

Swamp Cedars – The delineation of these sites was done by the NNHP specifically for the SynthMap because neither LANDFIRE nor SWReGAP adequately represent these unusual sites. Delineation was done in Google Earth with guidance from a small amount of field experience and a rough map in Charlet (2006). All areas were mapped as "*Juniperus scopulorum* Seasonally Saturated Woodland Alliance".

The data and the report from Charlet will be maintained by NNHP.

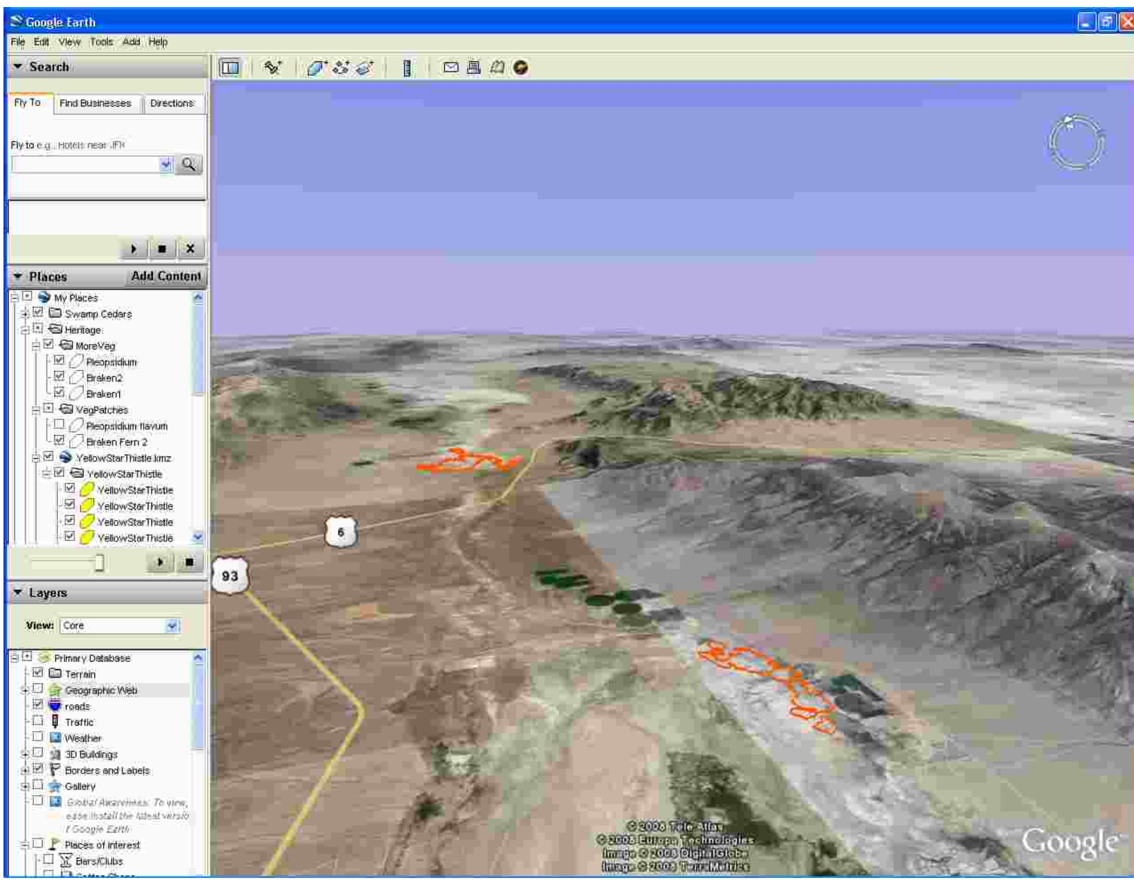


Illustration 2: Swamp Cedar delineation (orange outline) in Google Earth.

NNHP Vegetation Observations – This represents a couple casual observations of unusual vegetation that can be accurately mapped from Google Earth. One is a patch of *Pteridium aquilinum*, which inspired the proposal of a *Pteridium aquilinum* Herbaceous Alliance (Peterson 2008a). The other is a distinctive patch of lichen that can be placed into the proposed *Pleopsidium flavum* Sparse Vegetation association. In the future, user input and corrections may be incorporated into the SynthMap much the same as these observations.

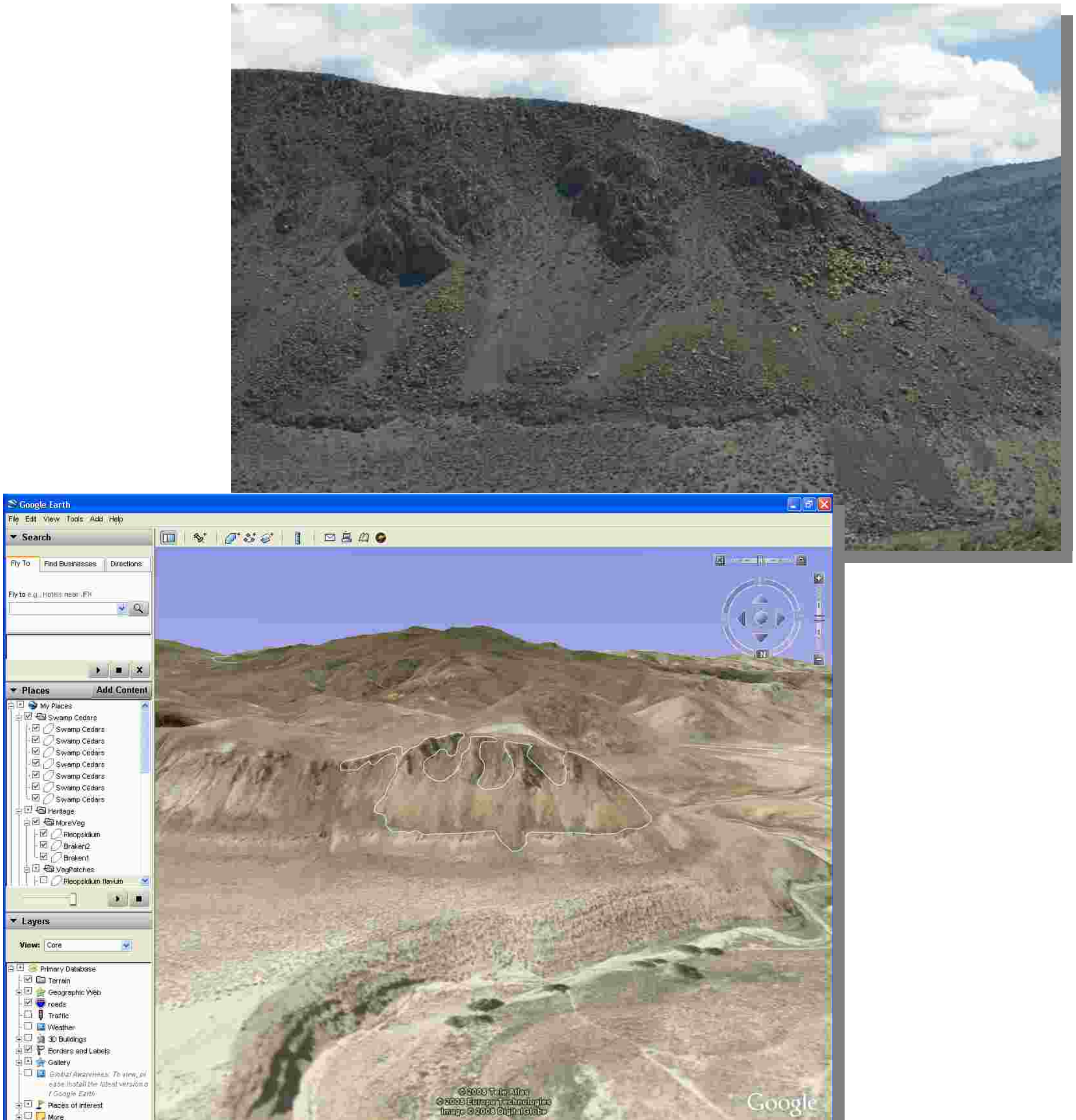


Illustration 3: *Pleopsidium flavum* Sparse Vegetation association delineated (white outline) in Google Earth.

National Land Cover Dataset (NLCD) – This project by the U.S.G.S. and U.S. E.P.A. mapped the entire nation at moderately-high spatial resolution, but with low thematic resolution (11 vegetation types for the entire nation). The uniform map for the nation was a first, but the LANDFIRE project will soon have the entire nation mapped with much greater thematic resolution (and Nevada is already complete). Therefore, the NLCD was not found to be useful for the synthesis map.

Truckee River Riparian Vegetation – (U.S.F.W.S. 1995) – This project utilized a combination of field work and manual delineation of stands from aerial photography to map the riparian zone of the Truckee River.

This was not used in synthesis map because electronic data could not be found and re-digitizing would have consumed more time that was available for this project. This project should be considered for future editions of the synthesis map, but classification methods should not be assumed to be dominance types compatible with IVC alliances (S. Caico, personal communication by email, December 2007). Additionally, this product precedes a great deal of *Lepidium latifolium* invasion, the 1997 New Year's flood, and a large restoration by The Nature Conservancy.

The NNHP has a hard-copy of the landcover maps (Appendix C) and a 1992 interim progress report for for documentation. Both have been scanned to PDF.

Eastern Sierra Front Vegetation Map – (Tueller et al. 2000) – This project sought to map vegetation through the east slope of the Sierra, including the entire Tahoe basin, and adjacent areas in Nevada (e.g. much of the Virginia Range was included). An analysis of elevation modeling and imagery from the Indian Remote Sensing satellite, guided by field reconnaissance by David Charlet, was used to conduct the project. With 14 landcover types, thematic resolution is a little less than that of Ecological Systems. Apparently, little effort was made to match satellite imagery scenes during computer analysis and the resulting map has numerous oddly mapped vegetation types at scene edges (figure). These errors, combined with the low thematic resolution, rendered the project less useful for the SynthMap than most other available projects. The NNHP does have scanned copies of the imagery that Charlet marked with field notes.

Scene boundary intersection showing Washoe Lake (blue) westward into the Carson Front Range. Note mis-classified areas along boundary, particularly the stripe of *Ephedra* Shrubland (orange) and "Pinyon-Juniper Woodland" (dark-blue) mapped as crossing the lake (arrow).

Neighboring State Projects – Various projects have occurred in neighboring states. Of particular note are CalVeg (U.S.F.S. 2008) and the Central Mojave Vegetation Map (Thomas et al. 2002). CalVeg, in fact, crosses over the state line into Nevada in several areas (see the CalVeg status map). A number of varied, smaller, projects have been conducted such as the mapping of the 45 Ranch allotment in Idaho (Murphy & Rust 2000).

Given the short time available for this initial version of the SynthMap, and the focus on Nevada, these other projects have been omitted for now. Future projects should consider inclusion of out-of-state projects that occur within the buffer zone, as one intent of the buffer zone is to provide better landscape context to land management along the borders Nevada.

How to contribute to the next edition

Additional vegetation mapping projects may be submitted for future versions of the SynthMap. Both digital geospatial data and documentation should be submitted to the vegetation ecologist at the Nevada Natural Heritage Program (see title page or http://heritage.nv.gov for address). Documentation should detail the methods (field and analysis), classification, and accuracy assessment.

Other types of data may be submitted as well. Anything that could improve the accuracy of the SynthMap may be considered. This may include corrections. Ideally, corrections should include a digitized polygon in a format compatible with ArcGIS or in Google Earth's KML format with projection and datum clearly identified. Mapping scale must also be included and should be at 1:100,000 (1 mile = 0.64 inches; e.g. showing most visible pattern in Google Earth at an 'Eye alt' of about 15 miles), or better (at 1:24,000 1 mile = 2.64 inches and Google Earth 'Eye Alt' will be about 20,000 feet. Vegetation should be classified at the IVC alliance or association level, though ecological systems or simple dominant species will be considered (see Peterson 2008a). Point location data will be treated much like the NNHP field plot data in the current SynthMap – represented only by a small point location. Narrative descriptions of the extent of the vegetation around a GPS point will not be interpreted into larger polygons due to risk of introducing new errors. GPS coordinates for point locations must include the projection and datum. The GPS system uses latitude/longitude in WGS 1984 internally, but most receivers can be configured to read out other coordinate systems and other datums. Note that in some areas the difference between WGS 1984 and NAD 1927 may be a couple hundred meters!

Assembly of the Synthesis Map

General concepts – In general, the production of this map began with regional data and gradually built in more localized data. The SWReGAP layer was used as the base map. This was chosen over LANDFIRE for several reasons: (1) the analysts for SWReGAP were intimately involved in fieldwork and thus had a robust personal knowledge of the landscape to guide their analyses, (2) SWReGAP currently has greater use and understanding among land managers in the state of Nevada, (3) LANDFIRE does not appear to have made use of minimum mapping units, sieve and cluster techniques, or other 'noise removal' methods resulting in a peppering of the landscape of vegetation class patches of only one or a few pixels. However, a couple riparian vegetation types were taken from LANDFIRE and burned directly into the synthesis map. Furthermore, the synthesis map includes a significant buffer around the state, much of which did not have SWReGAP data, so LANDFIRE was used to fill in the gap. In filling this gap, and in burning in local projects, no effort was made at edge matching the project boundary to the outside data, leaving numerous straight edges to vegetation types.

> **“Burning”**
> This refers to accepting a mapped class or set of classes without regard to what the pixels or polygons had been mapped as previously. Say a particular location is mapped in SWReGAP with a combination of a sagebrush class and a juniper class. A more localized (and presumably more accurate) project then maps the entire area as bitterbrush. The bitterbrush information could be burned into the synthesis map, replacing all the old sagebrush and juniper pixels with bitterbrush pixels.

The choice of using SWReGAP as the base of the synthesis map was a conservative choice. Further experience among agencies in the state with the LANDFIRE data may well conclude that it would be the better choice for the basis of the next edition of the synthesis map.

For the Tahoe vegetation mapping project, tables were available that provided accuracy statistics for each mapped type. Types were incorporated into the synthesis layer individually, according to information content and user's accuracy (for a high user accuracy score, many occurrences may be missed, but those that are mapped are generally mapped correctly). First, only Alliance-level types were incorporated from the Tahoe project with the exception of the barren type, crosswalked to an Ecological System. All with user accuracies at or above 50% were simply burned into the synthesis map (except for pixels previously mapped as disturbed or agriculture). For those with lower user accuracy, types were burned only over select vegetation types from previously incorporated layers.

Most data incorporated into the synthesis map utilized some sort of dominance-based classification. There are numerous ways to determine dominance types. Differences between methods are often minor, but can be major in some cases. No effort was made to revise original project layers to align all projects to a single method of classification. Dominance types provided from these projects are simply taken at face value. Hopefully, error introduced from this lack of revision will not be great and can be corrected in future editions through the 'living map' process.

Software used for processing included ArcGIS 9.2 (ArcView) with the Spatial Analyst extension, and ENVI 4.3 with IDL. The synthesis map will utilize UTM zone 11, WGS 1984, with 30 m pixels and will be clipped to a previously established area of interest for NNHP vegetation work (NeVeg). This area of interest involved a 25 km buffer around the state border (plus additional buffer around Tahoe to capture the entire basin) to provide landscape context for management along the state borders and to improve potential for edge-matching with mapping projects in neighboring states.

Step-by-step creation of the synthesis map (precise classes burned over or in can be traced in the IDL scripts included in this document as an appendix):

1. Begin with SWReGAP
    a. reproject to UTM zone 11, WGS 1984 in ArcGIS
    b. convert to GeoTIFF
    c. clip to extent, and mask with the NeVeg Boundary
    d. Revise values to range 1000 – 1999.
    [these or similar steps were repeated for nearly all datasets]
2. Add LANDFIRE to empty buffer areas
    a. Mosaicked SWReGAP on top of LANDFIRE
    b. SWReGAP has many pixels around the edge erroneously coded as water, these were replaced with LANDFIRE data using a shapefile to mask the pixels eligible for replacement.
3. Combined SWReGAP & LANDFIRE as follows
    a. Removed 'Sierra Nevada Cliff and Canyon' and 'Inter-mountain Basins Cliff and Canyon' types from SWReGAP, replacing with whatever LANDFIRE had for the same pixels
    b. Synonymize 'Open Water' values
    c. Burn 'Developed' from LANDFIRE
    d. Synonymize it's 'Developed Low Intensity' with equivalent from SWReGAP
    e. Synonymize LANDFIRE 'Developed Medium Intensity with SWReGAP medium and high intensity (mapped as a single class).
    f. Burn 'Disturbed-Mining' from LANDFIRE and synonymize with SWReGAP equivalent
    g. Burn 'Agriculture-General' from LANDFIRE and synonymize with SWReGAP equivalent.
    h. Burn other LANDFIRE agriculture classes
    i. Burn riparian systems 'Inter-Mountain Basins Montane Riparian Systems' and 'North American Warm Desert Riparian Systems'.
    j. Synonymize codes where the same system is used in both SWReGAP and LANDFIRE (substantial changes have been made even in the short time since the classification for SWReGAP was solidified). These were given values 100-139.
    k. All alliance-level classes in LANDFIRE (ranging 2600-2632, no change to value) were burned over SWReGAP.
4. Add Tahoe Basin Existing Vegetation Map (TBEVM). This data is distributed with readily available accuracy data. These accuracy data were utilized to determine the degree of use for the SynthMap. TBEVM classes with ≥ 50% user accuracy were fully burned into Synth08 (except for pixels previously coded as water, agriculture, developed, or disturbed), while classes with lower accuracy were burned only into pixels where previous values were for ecological systems that were agreeable with the TBEVM classes. See TBEVM crosswalk table below.

5. Add DOE data (Yucca & Little Skull Mtn, plus Test Site). All crosswalked values (see table below) were used.
   a. The two projects (Yucca & Little Skull Mountains, and the Nevada Test Site) were first mosaicked with the more recent Nevada Test Site data placed at the top.
   b. These data were fully burned into Synth08 (except for pixels previously coded as water, agriculture, developed, or disturbed).
6. Add Sagebrush Stitch data. The SageStitch data were used to refine prior sagebrush classes, improving the taxonomic resolution in order to push classification toward Alliance-level classes (see crosswalk table below). Therefore, each sagebrush taxon class in the SageStitch data were burned into SynthMap pixels previously assigned a sagebrush type.
7. Add USFS data for Great Basin. All classes crosswalked (see table below) were burned into Synth08 where prior values were greater than 99 (not an anthropogenic type) and less than 4000 (not a sagebrush type modified by SageStitch), not already determined at alliance level by LANDFIRE (values 2600 – 2699), and not a riparian type broadly burned from LANDFIRE.
8. Add USFS data for Sierra. Ditto of the HTNF Great Basin data. This revises much of the pixels mapped from TBEVM. Since the USFS data have been revised since the TBEVM data became available, it was presumed that the USFS would have already taken advantage of TBEVM and incorporated it where appropriate with greater attention than could be provided here due to time limitations.
9. Add Tahoe E-side (State Park). This really should have been inserted into SynthMap simultaneous TBEVM, since the project was designed to match TBEVM methods. Crosswalked data were inserted at this point by burning over values from SWReGAP, LANDFIRE, and SageStitch data ranges.
10. Add NDOW. These data were crosswalked (see table below), rasterized, and burned directly into SynthMap over SWReGAP and LANDFIRE systems-level data except for water and anthropomorphic classes (< 100)
11. Add NNHP Data.
    a. Torrance Ranch data were rasterized and fully burned into the SynthMap by use of a mosaic function.
    b. NNHP field observations plus "swamp cedar" areas - these polygon data were rasterized and fully burned, without exception, into the SynthMap.
    c. NNHP classified field plots – plots that had been classified to association level (See Peterson 2008a) were rasterized such that each plot occupies a single pixel based on the centroid of the plot. These pixels were burned fully into the SynthMap.
12. Removal of odd LANDFIRE classes. Pixels with these values were reset to SWReGAP values.
    a. 2517 – a LANDFIRE class not specified in LANDFIRE documentation (18 pixels).
    b. LANDFIRE *Quercus garryana* Woodland Alliance (98 pixels)
    c. LANDFIRE *Abies grandis* Forest Alliance (1586 pixels) – this resulted in a return of some SWReGAP pixels mapped as "Inter-Mountain Basins Cliff and Canyon", which were left in the final map for lack of a better classification.
    d. LANDFIRE Quercus gambellii Woodland Alliance removed from much of map. Pixels had been discovered mapped to this type in White Pine County in the area of the swamp cedars – outside of the range of *Q. gambellii*. A mask was created covering roughly the northern ¾ of the state and this classification was removed within the mask.
13. Removal of an odd SWReGAP class, "North American Warm Desert Wash", replaced with LANDFIRE values
14. USGS Evapotranspiration data obtained and incorporated with select types burned only over SWReGAP and LANDFIRE data, not including anthropogenic types (if any other data was in the same area, it was assumed to be more accurate).
15. Decision made to retain data source of LANDFIRE vs SWReGAP (allowing more duplication of vegetation types among raster values). Therefore earlier synonymies were un-done. Synonymies

were originally accepted thinking little LANDFIRE data would be used within the state, however, that has proven not the case and with the removal of one SWReGAP desert wash class in step 13, data source tracking could become difficult. Removal of synonymies makes the data source for a particular area much more traceable.

Final Raster Values and Legend Table for the SynthMap

The SynthMap is provided as a raster dataset with cell values corresponding to both vegetation classification *and source project*. Since both are involved with the value determination, the same vegetation type from two different source projects will have different values. This allows users to understand the origin of a particular mapped vegetation. These differing values can be displayed as the same in ArcGIS by symbolizing with unique values based on your preferred column in the associated legend table.

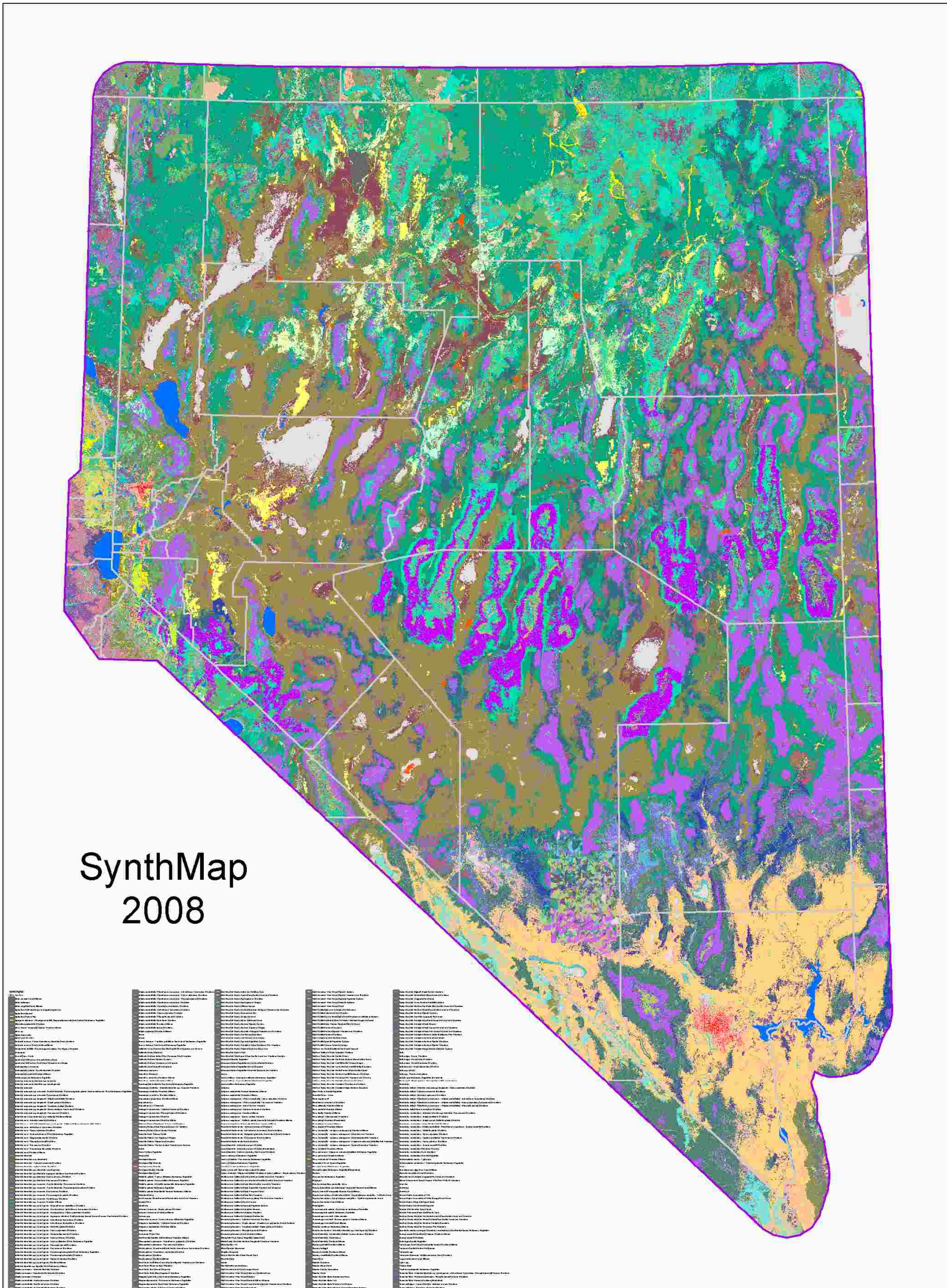
The exception is that where the same Ecological System was used both in SWReGAP and in LANDFIRE, the values were synonymized. These cases do not mean that particular pixels were mapped identically between the two projects; just that the two projects used the same thematic class.

The legend table contains a number of data fields, which are somewhat repetitive. The purpose of the VALUE field should be obvious – linking to raster cell values. The remainder are:

- SOURCE – This indicates the source project which mapped a particular value.
- FINE_CLASS - This specifies the finest-level IVC classification for a pixel. This field may be the most frequently used for developing map legends.
- FINE_LEVEL – This specifies the level of the prior classification value.
- SYS_CODE – This provides the Ecological System code for the raster value (where classified).
- SYS_LEVEL – This provides the name of the Ecological System for the value.
- ALLI_CODE – This provides the alliance code for the raster value (where classified).
- ALLIANCE – This provides the name of the Alliance for the value.
- ELCODE – This provides the association code for the raster value (where classified).
- ASSOCIATION – This provides the name of the Association for the value.
- OTHER – This provides the name of a non-IVC classification for the value.

Here is an outline of how the data values are structured within the table associated with the SynthMap. Upper values given here represent the entire range reserved for source projects; the actual range of values in-use is much smaller. A total of 525 values are in use.

- 0 – No data.
- 10 – Open Water (and aquatic vegetation).
- 20 – 99 – Anthropomorphic landcover types.
- 1000 – 1999 – SWReGAP.
- 2000 – 2999 – LANDFIRE (downloaded December 2007).
- 3000 – 3099 – Tahoe Basin Existing Vegetation Map.
- 3100 – 3199 – DOE: Yucca and Little Skull Mountains.
- 3200 – 3299 – DOE: Nevada Test Site.
- 3300 – 3399 – US Forest Service: Great Basin (obtained January 2008).
- 3400 – 3499 – US Forest Service: Sierra Nevada (obtained January 2008).
- 3500 – 3549 – Lake Tahoe Nevada State Park.
- 3550 – 3599 – USGS Evapotranspiration Units.
- 3600 – 3699 – NDOW Wildlife Management Areas.
- 3700 – 3999 – NNHP multiple vegetation projects.
- 4100 – 4199 – SageStitch.


SynthMap
2008

Literature Cited

Anonymous 2007 GIS Instrumental in Creating First Vegetation Atlas for Madagascar. ArcNews, summer issue. [view online]

Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1968a. Vegetation and soils of the Mill Creek Watershed. Nevada Agricultural Experiment Station Bulletin R-43. Reno. 69 pp.

Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1968b. Vegetation and soils of the Crowley Creek Watershed. Nevada Agricultural Experiment Station Bulletin R-42. Reno. 60 pp.

Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1968c. Vegetation and soils of the Duckwater Watershed. Nevada Agricultural Experiment Station Bulletin R-40. Reno. 76 pp.

Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1969a. Vegetation and soils of the Cow Creek Watershed. Nevada Agricultural Experiment Station Bulletin R-49. Reno. 80 pp.

Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1969b. Vegetation and soils of the Coils Creek Watershed. Nevada Agricultural Experiment Station Bulletin R-48. Reno. 81 pp.

Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1969c. Vegetation and soils of the Churchill Canyon Watershed. Nevada Agricultural Experiment Station Bulletin R-45. Reno. 157 pp.

Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1969d. Vegetation and soils of the Pine and Mathews Canyon Watersheds. Nevada Agricultural Experiment Station Bulletin R-46. Reno. 111 pp.

Blackburn, W. H., R. E. Eckert, Jr., and P. T. Tueller. 1969e. Vegetation and soils of the Crane Springs Watershed. Nevada Agricultural Experiment Station Bulletin R-55. Reno. 63 pp.

Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1971. Vegetation and soils of the Rock Springs Watershed. Nevada Agricultural Experiment Station Bulletin R-83. Reno. 116 pp.

Heinze, D. H., R. E. Eckert, and P. T. Tueller. 1962. The vegetation and soils of the Steptoe Watershed. Unpublished report prepared for the USDI Bureau of Land Management. 40 pp.

Tueller, P.T., A. D. Bruner, and J. B. Davis. 1972. Ecology of Hot Creek Valley – Vegetation and soil response to underground detonation. Nevada Agricultural Experiment Station Report NVO-409-1. Reno. 51 pp.

Charlet, D. 2006. Effects of interbasin water transport on ecosystems of Spring Valley, White Pine County, Nevada. Unpublished Report.

Comer P., J. Kagan, M. Heiner, and C. Tobalske. 2002. Current distrubution of sagebrush and associated vegetation in the western United States (excluding NM). [Geospatial data.] Interagency Sagebrush Working Group. [data available from Sagemap: http://sagemap.wr.usgs.gov]

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological systems of the United States: a working classification of U.S. terrestrial systems. NatureServe, Arlington, Virginia. [Downloadable]

Gillham, J., H. Fisk, W. Goetz, H. Lachowski. 2004. Existing Vegetation Mapping: Humboldt-Toiyabe National Forest. RSAC-65-RPT1. Remote Sensing Applications Center, Salt Lake City, Utah.

Greenberg, J., S. Dobrowski, and S. L. Ustin. 2005. Shadow allometry: estimating tree structural parameters using hyperspectral image analysis. Remote Sensing of Environment 97, 15 – 25.

Greenberg, J.A., S.Z. Dobrowski, C.M.Ramirez, J.L. Tull, & S.L. Ustin. 2006. A bottom-up approach to vegetation mapping of the Lake Tahoe Basin using hyperspatial image analysis. Photogrammetric Engineering & Remote Sensing 72 (5): 581-589.

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

Homer, C. G., R. D. Ramsey, T. C. Edwards, Jr. and A. Falconer, 1997. Landscape cover-type modeling using a multi-scene Thematic Mapper mosaic. Photogrammetric Engineering and Remote Sensing 63(1): 59-67.

Homer, C., 1998, Intermountain region land cover characterization CD-ROM, Utah State University, Remote Sensing/GIS Laboratories, Logan, Utah.

Laczniak, R. J., J. L. Smith, P. E. Elliot, G. A. DeMeo, M. A. Chatigny, and G. J. Roemer. 2001. Ground-water discharge determined from estimates of evapotranspiration, Death Valley regional flow system, Nevada and California. Water-Resources Investigation Report 2001-4195. U.S. Geological Survey, Nevada Science Center, Carson City, Nevada. [download]

Longmire, P. & K. Evans. 2007. Imagery and vegetation mapping for the Lake Tahoe Nevada State Park. Report to the Nevada Division of State Parks, Sandborn Map Company, Sacramento, California.

Lowry, J. H, Jr., R. D. Ramsey, K. Boykin, D. Bradford, P. Comer, S. Falzarano, W. Kepner, J. Kirby, L. Langs, J. Prior-Magee, G. Manis, L. O'Brien, T. Sajwaj, K. A. Thomas, W. Rieth, S. Schrader, D. Schrupp, K. Schulz, B. Thompson, C. Velasquez, C. Wallace, E. Waller and B. Wolk. 2005. Southwest Regional Gap Analysis Project: final report on land cover mapping methods, RS/GIS Laboratory, Utah State University, Logan, Utah.

Lowry, J.L. Jr., R.D. Ramsey, K. Boykin, D. Bradford, P. Comer, S. Falzarano, W. Kepner, J. Kirby, L. Langs, J. Prior-Magee, G. Manis, L. O'brien, K. Pohs, W. Rieth, T. Sajwaj, S. Schrader, K.A. Thomas, D. Schrupp, K. Schulz, B. Thompson, C. Wallace, C. Velasquez, E. Waller, and B. Wolk. 2007. Mapping meso-scale land cover over very large geographic areas within a collaborative framework: a case study of the southwest regional gap analysis project (SWReGAP). Remote Sensing of Environment 108:59-73.

Morefield, J. D. 2000. Initial vegetation reconnaissance of the Torrance Ranch, Oasis Valley, Nye County, Nevada, 18 August 1999. Nevada Natural Heritage Program, Carson City, NV.

Peterson, E. B. 2003. Mapping percent-cover of the invasive species *Bromus tectorum* (cheatgrass) over a large portion of Nevada from satellite imagery. Report for the U.S. Fish and Wildlife Service, Nevada State Office, Reno, by the Nevada Natural Heritage Program, Carson City. [download]

Peterson, E. B. 2004. Altered andesite vegetation mapping [INCOMPLETE]. Nevada Natural Heritage Program, Carson City, NV.

Peterson, E. B. 2005. Estimating cover of an invasive grass (*Bromus tectorum*) using tobit regression and phenology derived from two dates of Landsat ETM+ data. International Journal of Remote Sensing, 26(12): 2491-2507.Peterson 2006

Peterson, E. B. 2006. A map of invasive annual grasses in Nevada derived from multitemporal Landsat 5 TM imagery. Report for the U.S.D.I. Bureau of Land Management, Nevada State Office, Reno, by the Nevada Natural Heritage Program, Carson City, Nevada. [download]

Peterson, E. B. 2007. A map of annual grasses in the Owyhee Uplands, Spring 2006, derived from multitemporal Landsat 5 TM imagery. Report for the U.S.D.I. Bureau of Land Management, Nevada State Office, Reno, by the Nevada Natural Heritage Program, Carson City, Nevada. [download]

Peterson, E. B. 2008a. International Vegetation Classification alliances and associations occurring in Nevada with proposed additions. Nevada Natural Heritage Program, Carson City, Nevada. [download]

Peterson, E. B. 2008b. Nevada Natural Heritage Program vegetation data – field methods and database Structure. Nevada Natural Heritage Program, Carson City, Nevada.

Smith, J. L., R. J. Randell, M. T. Moreo, T. L. Welborn. 2007. Mapping evapotranspiration units in the basin and range carbonate-rock aquifer system, White Pine County, Nevada, and adjacent areas in Nevada and Utah. Scientific Investigations Report 2007-5087. U.S. Geological Survey, Nevada Science Center, Carson City, Nevada. [download]

Thomas K., J. Franklin, T. Keeler-Wolf, P. Stine. 2002. Central Mojave vegetation map. A digital spatial database (ArcInfo). U.S. Geological Survey.

U.S.F.S. 2008 CalVeg. Online at http://www.fs.fed.us/r5/rsl/projects/mapping/accuracy.shtml. U.S.Forest Service, Remote Sensing Lab, McClellan, California. Accessed 6 March 2008.

U.S. Fish and Wildlife Service 1995 Truckee River riparian vegetation and fluvial geomorphology study, U.S.F.W.S. Sacramento Field Office, Sacramento, CA.

WRCC [Western Regional Climate Center] 2008. Time series history of monthly divisional precipitation or temperature. Online at http://www.cefa.dri.edu/Westmap/timeseries.php?zoom=NV&map=States. Accessed March 6, 2008.

Crosswalk Tables

Tahoe Basin Existing Vegetation Map (TBEVM) Crosswalk

CV_TYPE	User's Accuracy`	Crosswalk-level	IVC Type (in SynthMap)
Water			not used
Basin Sagebrush	27.0	Alliance	Artemisia tridentata ssp. vaseyana Shrubland Alliance
Whitebark Pine	54.9	Alliance	Whitebark Pine Woodland Alliance
Unclassified			not used
Barren	100.0	System	Mediterranean California Subalpine-Montane Fen
Willow			not used
Subalpine Conifers			not used
Upper Montane Mixed Shrub			lost in raster conversion
Huckleberry Oak	8.8	Alliance	Huckleberry Oak Shrubland Alliance
Ceanothus Chaparral	70.3	Alliance	Ceanothus velutinus Shrubland Alliance
Red Fir	29.5	Alliance	Abies magnifica Forest Alliance
Lodgepole Pine	35.6	Alliance	Pinus contorta Woodland Alliance
Western White Pine	20.8	Alliance	Western White Pine Woodland Alliance
Quaking Aspen	70.4	Alliance	Populus tremuloides Forest Alliance
Unknown Wet Grasses/Forbs			not used
Perennial Grasses/Forbs			not used
Greenleaf Manzanita	26.3	Alliance	Arctostaphylos patula Shrubland Alliance
Mixed Conifer - Fir			not used
Unknown Conifer			not used
Jeffery Pine	48.9	Alliance	Pinus jeffreyi Woodland Alliance
Mountain Alder			lost in raster conversion
Unknown Shrub			not used
Willow-Alder	93.5	Alliance	Alnus incana Temporarily Flooded Shrubland Alliance
Mountain Whitethorn	11.4	Alliance	lost in synthesis – no pixels matching appropriate SWReGAP/LANDFIRE types
White Fir	52.4	Alliance	Abies concolor Forest Alliance
California Juniper (tree)	38.3	Alliance	Juniperus occidentalis Woodland Alliance
Mountain Hemlock	36.7	Alliance	Mountain Hemlock Forest Alliance

Tahoe State Park (Nevada) – East slope extension

Water		not used
Willow	-	Salix
Quaking Aspen	Alliance	Populus tremuloides Forest Alliance
Huckleberry Oak	Alliance	Quercus vacciniifolia Shrubland Alliance
Jeffrey Pine	Alliance	Pinus jeffreyi Woodland Alliance
Basin Sagebrush	-	not used
Mixed Conifer - Fir	-	not used
Red Fir	Alliance	Abies magnifica Forest Alliance
Upper Montane Mixed Shrub	-	not used
Subalpine Conifers	-	not used
Ceanothus Chaparral	-	Ceanothus Chaparral
Barren	-	Barren
Lodgepole Pine	Alliance	Pinus contorta Woodland Alliance
Perennial Grasses/Forbs	-	not used
Unknown Conifer	-	not used
Unknown Shrub	-	not used
Greenleaf Manzanita	-	not used
Mountain Whitethorn	Alliance	Arctostaphylos patula Shrubland Alliance
California Juniper (tree)	Alliance	Ceanothus cordulatus Shrubland Alliance

Yucca Mountain Crosswalk

VEG_CLASS	IVC Alliance (in SynthMap)
Ambrosia dumosa	Larea tridentata - Ambrosia dumosa Shrubland Alliance
Ambrosia dumosa-Atriplex confertifolia	Atriplex confertifolia Shrubland Alliance
Ambrosia dumosa-Larrea tridentata	Larea tridentata - Ambrosia dumosa Shrubland Alliance
Artemisia tridentata	Artemisia tridentata ssp. wyomingensis Shrubland Alliance
Coleogyne ramosissima	Coleogyne ramosissima Shrubland Alliance
Ephedra nevadensis-Ambrosia dumosa	Ephedra nevadensis Shrubland Alliance
Eriogonum fasciculatum-Chrysothamnus teretifolius	Eriogonum fasciculatum Shrubland Alliance
Larrea tridentata-Ephedra nevadensis	Larrea tridentata - Ambrosia dumosa Shrubland Alliance
Menodora spinescens	Menodora spinescens Dwarf-shrubland Alliance

Nevada Test Site Crosswalk

Alliance	Associatio	IVC Alliance (in SynthMap)	IVC Association (in SynthMap)
Artemisia spp. Shrubland Alliance	Artemisia nova-Artemisia tridentata Shrubland	Artemisia nova Shrubland Alliance	Artemisia nova - Artemisia tridentata Shrubland
Artemisia spp. Shrubland Alliance	Artemisia nova-Chrysothamnus viscidiflorus Shrubland	Artemisia nova Shrubland Alliance	Artemisia nova - Chrysothamnus viscidiflorus Shrubland
Artemisia spp. Shrubland Alliance	Artemisia tridentata-Chrysothamnus viscidiflorus Shrubland	Artemisia tridentata ssp. wyomingensis Shrubland Alliance	Artemisia tridentata ssp. wyomingensis - Chrysothamnus viscidiflorus Shrubland
Artemisia spp. Shrubland Alliance	Ephedra viridis-Artemisia tridentata Shrubland	Ephedra viridis Shrubland Alliance	Artemisia tridentata - Ephedra viridis Shrubland
Atriplex confertifolia-Ambrosia dumosa Shrubland Alliance	Atriplex confertifolia-Ambrosia dumosa Shrubland	Atriplex confertifolia Shrubland Alliance	Atriplex confertifolia - Ambrosia dumosa Shrubland
Atriplex spp. Shrubland Alliance	Atriplex canescens-Krascheninnikovia lanata Shrubland	Atriplex canescens Shrubland Alliance	Atriplex canescens - Krascheninnikovia lanata Shrubland
Atriplex spp. Shrubland Alliance **	Atriplex confertifolia-Ambrosia dumosa Shrubland **	Atriplex confertifolia Shrubland Alliance	Atriplex confertifolia - Ambrosia dumosa Shrubland
Atriplex spp. Shrubland Alliance	Atriplex confertifolia-Kochia americana Shrubland	Atriplex confertifolia Shrubland Alliance	Atriplex confertifolia – Kochia americana Shrubland
Atriplex spp. Shrubland Alliance	Atriplex spp. Shrubland Alliance *	Atriplex confertifolia Shrubland Alliance	Atriplex confertifolia - Ambrosia dumosa Shrubland
Chrysothamnus-Ericameria Shrubland Alliance	Chrysothamnus viscidiflorus-Ephedra nevadensis Shrubland	Ephedra nevadensis Shrubland Alliance	Ephedra nevadensis - Grayia spinosa Shrubland
Chrysothamnus-Ericameria Shrubland Alliance	Ericameria nauseosa-Ephedra nevadensis Shrubland	Ephedra nevadensis Shrubland Alliance	Artemisia tridentata - Ephedra nevadensis Shrubland
Coleogyne ramosissima Shrubland Alliance	Coleogyne ramosissima-Ephedra nevadensis Shrubland	Coleogyne ramosissima Shrubland Alliance	Coleogyne ramosissima - Ephedra nevadensis Shrubland
Ephedra nevadensis Shrubland Alliance **	Artemisia tridentata-Chrysothamnus viscidiflorus Shrubland **	*Likely error in NTS Alliance and Association link – left out*	*Likely error in NTS Alliance and Association link – left out*
Ephedra nevadensis Shrubland Alliance	Ephedra nevadensis-Grayia spinosa Shrubland	Ephedra nevadensis Shrubland Alliance	Ephedra nevadensis - Grayia spinosa Shrubland
Ephedra nevadensis Shrubland Alliance	Eriogonum fasciculatum-Ephedra nevadensis Shrubland	Eriogonum fasciculatum Shrubland Alliance	Eriogonum fasciculatum - Ephedra nevadensis Shrubland
Ephedra nevadensis Shrubland Alliance	Krascheninnikovia lanata-Ephedra nevadensis Shrubland	Krascheninnikovia lanata Dwarf-shrubland Alliance	Krascheninnikovia lanata - Ephedra nevadensis Shrubland
Ephedra nevadensis Shrubland Alliance	Menodora spinescens-Ephedra nevadensis Shrubland	Menodora spinescens Shrubland Alliance	Menodora spinescens - Ephedra nevadensis Shrubland
Hymenoclea-Lycium Shrubland Alliance	Hymenoclea salsola-Ephedra nevadensis Shrubland	Hymenoclea salsola Shrubland Alliance	Hymenoclea salsola - Ephedra nevadensis Shrubland
Hymenoclea-Lycium Shrubland Alliance	Lycium andersonii-Hymenoclea salsola Shrubland	Lycium andersonii Shrubland Alliance	Lycium andersonii - Hymenoclea salsola Shrubland
Larrea tridentata/Ambrosia dumosa Shrubland Alliance	Larrea tridentata/Ambrosia dumosa Shrubland	Larrea tridentata - Ambrosia dumosa Shrubland Alliance	Larrea tridentata - Ambrosia dumosa Shrubland
Lycium spp. Shrubland Alliance	Lycium shockleyi-Lycium pallidum Shrubland	Lycium spp. Shrubland Alliance	Lycium shockleyi - Atriplex confertifolia Shrubland or Lycium pallidum - Grayia spinosa Shrubland
Miscellaneous	Barren	Microphytic Playa Alliance	Microphytic Playa Sparse Vegetation [placeholder]
Miscellaneous	Burn	Not used	
Miscellaneous	Disturbed	Not used	

Miscellaneous	Miscellaneous	Not used	
Pinus monophylla/Artemisia spp. Woodland Alliance	Pinus monophylla/Artemisia nova Woodland	Pinus monophylla - (Juniperus osteosperma) Woodland Alliance	Pinus monophylla - Juniperus osteosperma / Artemisia nova Woodland
Pinus monophylla/Artemisia spp. Woodland Alliance	Pinus monophylla/Artemisia tridentata Woodland	Pinus monophylla - (Juniperus osteosperma) Woodland Alliance	Pinus monophylla - Juniperus osteosperma / Artemisia tridentata Woodland

* Single polygon attributed as such.
** Single polygon attributed with this particular combination of NTS Alliance and NTS Association.

U.S.Forest Service – Great Basin – Crosswalk

DTYPE	Crosswalk-level	SynthMap Type
Pinyon/Juniper	Alliance	Pinus monophylla - (Juniperus osteosperma) Woodland Alliance
Low Sage	-	Artemisia arbuscula
Riparian Grassland	-	Riparian Grassland
Riparian Shrub	-	Riparian Shrub
Cottonwood	Alliance	Populus fremontii Temporarily Flooded Forest Alliance
Mtn Big Sage	Alliance	Artemisia tridentata ssp. vaseyana Shrubland Alliance
Aspen	Alliance	Populus tremuloides Forest Alliance
Mountain Shrub	-	not used
Curleaf Mtn Mahogany	Alliance	Cercocarpus ledifolius Woodland Alliance
Mixed Sage/Bitterbrush	-	not used
Basin Big Sage	-	Artemisia tridentata (ssp. tridentata?)
Barren	-	Barren
Riparian Aspen	-	Riparian Populus tremuloides
Mtn Grassland	-	not used
Mixed Shrub/Basin Shrub	-	not used
Wyoming Big Sage	Alliance	Artemisia tridentata ssp. wyomingensis Shrubland Alliance
Subalpine Fir	-	Abies lasiocarpa
Black Sage	Alliance	Artemisia nova Shrubland Alliance
Alder	-	Alnus sp.
Mixed Aspen/Conifer	-	not used
Basin Grassland	-	not used
Snow	-	not used
Pinyon	Alliance	Pinus monophylla - (Juniperus osteosperma) Woodland Alliance
Juniper	-	Juniperus
Whitebark/Limber Pine	-	not used
Mining	-	Disturbed-Mining
Mixed Conifer	-	not used
Rock	-	not used
White Fir	Alliance	Abies concolor Forest Alliance
Alpine Community	-	Alpine Community
Water	-	not used
Agriculture	-	not used
Urban	-	not used
Engelmann Spruce	-	Picea engelmannii
Mixed Woodlands	-	not used
Bristlecone Pine	Alliance	Pinus longaeva Woodland Alliance
Desert Shrub	-	not used
Western Birch	-	Western Birch

U.S.Forest Service – Sierra-Nevada Crosswalk

DESCRIPTIO	Crosswalk-level	SynthMap Type
Agriculture	-	not used
Basin Sagebrush	-	Artemisia tridentata
not yet mapped	-	not used
Wet Meadows Grass / Forbs	-	not used
Annual Grass / Forbs	-	Annual Grass / Forbs
Upper Montane Mixed Chaparral	-	not used
Mixed Conifer - Fir	-	Mixed Conifer - Fir
Bitterbrush - Sagebrush	-	Purshia tridentata - Artemisia sp
Eastside Pine	-	Eastside Pine
Curlleaf Mountain Mahogany	Alliance	Cercocarpus ledifolius Woodland Alliance
Big Basin Sagebrush	-	not used
Bitterbrush	Alliance	Purshia tridentata Shrubland Alliance
High Desert - Montane Chaparral Transition	-	not used
Perennial Grass / Forbs	-	Perennial Grass / Forbs
Willow	-	Salix
Willow (Shrub)	-	Salix spp. (shrub)
Barren	-	Barren
Snowbrush	-	Snowbrush
Red Fir	Alliance	Abies magnifica Forest Alliance
Black Sagebrush	Alliance	Artemisia nova Shrubland Alliance
Cottonwood - Alder	-	Populus (balsamifera, fremontii) - Alnus
Basin Mixed Scrub	-	not used
Urban/Developed	-	not used
Low Sagebrush	-	Artemisia arbuscula
Water	-	not used
Willow - Aspen	-	Salix spp. - Populus tremuloides
Curlleaf Mountain Mahogany (tree)	Alliance	Cercocarpus ledifolius Woodland Alliance
Quaking Aspen	Alliance	Populus tremuloides Forest Alliance
Western White Pine	Alliance	Pinus monticola Woodland Alliance
Mountain Sagebrush	Alliance	Artemisia tridentata ssp. vaseyana Shrubland Alliance
White Fir	Alliance	Abies concolor Forest Alliance
Washoe Pine	Alliance	Pinus washoensis Woodland Alliance
Jeffrey Pine	Alliance	Pinus jeffreyi Woodland Alliance
Rabbitbrush	-	Chrysothamnus / Ericameria
Mountain Alder	-	Mountain Alder
Ponderosa Pine	Alliance	Pinus ponderosa Woodland Alliance
Greenleaf Manzanita	Alliance	Arctostaphylos patula Shrubland Alliance
Western Juniper	Alliance	Juniperus occidentalis Woodland Alliance
Subalpine Conifers	-	not used
Black Cottonwood	Alliance	Populus balsamifera ssp. trichocarpa Temporarily Flooded Forest Alliance
Riparian Mixed Shrub	-	Riparian Mixed Shrub

Non-Native/Ornamental Grass	-	Non-Native/Ornamental Grass
Mixed Riparian Hardwoods	-	Mixed Riparian Hardwoods
Fremont Cottonwood	Alliance	Populus fremontii Temporarily Flooded Forest Alliance
Snowberry	-	Snowberry
Lodgepole Pine	Alliance	Pinus contorta Woodland Alliance
Singleleaf Pinyon Pine	Alliance	Pinus monophylla - (Juniperus osteosperma) Woodland Alliance
Bush Chinquapin	Alliance	Chrysolepis sempervirens Shrubland Alliance
Basin - Desert Tansition Scrub	-	not used
Alpine Cushion Plant	-	Alpine Cushion Plant
Whitebark Pine	Alliance	Pinus albicaulis Woodland Alliance
Non-Native/Ornamental Hardwood	-	not used
Mountain Hemlock	Alliance	Tsuga mertensiana Forest Alliance
Mixed Alpine Scrub	-	not used
Upper Montane Mixed Shrub	-	not used
Huckleberry Oak	Alliance	Quercus vacciniifolia Shrubland Alliance
Pinemat Manzanita	-	Arctostaphylos nevadensis
Non-Native/Ornamental Conifer/Hardwood	-	not used
Incense Cedar	-	Calocedrus decurrens
Mountain Whitethorn	Alliance	Ceanothus cordulatus Shrubland Alliance
Tule - Cattail	-	Schoenoplectus acutus - Typha spp.
Blackbush	Alliance	Coleogyne ramosissima Shrubland Alliance
High Desert Mixed Scrub	-	not used
Saltbush	-	not used
Alkaline Mixed Scrub	-	not used
Utah Juniper	Alliance	Juniperus osteosperma Woodland Alliance
Alkaline Flats	-	not used
Alkaline Mixed Grass / Forbs	-	not used
Snow/Ice	-	not used
Ephedra	-	Ephedra spp.
Douglas-Fir - White Fir	-	Pseudotsuga menziesii - Abies concolor
Limber Pine	Alliance	Pinus flexilis Woodland Alliance
Fourneedle Pinyon Pine	-	Fourneedle Pinyon Pine
Croton	-	Croton
Black Oak	-	Quercus kelloggii
Desert Buckwheat	-	Eriogonum spp.
Mixed Conifer - Pine	-	not used
Greasewood	-	Sarcobatus
Shadscale	Alliance	Atriplex confertifolia Shrubland Alliance
Rothrock Sagebrush	-	not used
Horsebrush	-	Tetradymia spp.

Nevada Division of Wildlife Crosswalk

Allenrolfae/Suaeda	Association	Allenrolfea occidentalis Shrubland
Ambrosia/Bromus/AtriplexHymeno	Alliance	Ambrosia dumosa Dwarf-shrubland Alliance
Ambrosia/Sarcobatus/Bromus/Hym	Alliance	Ambrosia dumosa Dwarf-shrubland Alliance
Ambrosia/Sarcobatus/BromusHyme	Alliance	Ambrosia dumosa Dwarf-shrubland Alliance
Anemopsis/Juncus/Distichlis/Po	-	Anemopsis
Artemisia	-	not used
Artemisia/Bromus/Chrysothamnus	-	not used
Artemisia/Bromus/Sarcobatus	-	not used
Artemisia/Bromus/Sarcobatus/Ch	-	not used
Artemisia/Descurainia/Bromus/S	-	not used
Artemisia/Plagiobothrys/Chryso	-	not used
Artemisia/Sisymbrium	-	not used
Atriplex	-	not used
Atriplex/Bromus/Chrysothamnus/	-	not used
Atriplex/Chrysothamnus/Sporobo	-	not used
Atriplex/Distichlis	-	not used
Atriplex/Distichlis/Juncus/Pol	-	not used
Atriplex/Distichlis/Suaeda/Bas	-	not used
Atriplex/Sarcobatus	-	not used
barley/alfalfa	-	Agriculture-General
barley/alfalfa/millet	-	Agriculture-General
Bassia	-	Bassia
Bassia/Distichlis/Polypogon/Sa	-	Bassia
Bassia/Suaeda/Distichlis/Atrip	-	Bassia
Chrysothamnus/Sarcobatus/Sporo	-	Chrysothamnus
corn, barley, alfalfa	-	Agriculture-General
corn, wheat, barley, alfalfa	-	Agriculture-General
corn, wheat, barley,alfalfa	-	Agriculture-General
corn/wheat/barley, millet	-	Agriculture-General
cotonwood/willow	Alliance	Populus fremontii Temporarily Flooded Forest Alliance
cottonwood/salix	Alliance	Populus fremontii Temporarily Flooded Forest Alliance
Cottonwood/Salix	Alliance	Populus fremontii Temporarily Flooded Forest Alliance
cottonwood/williow	Alliance	Populus fremontii Temporarily Flooded Forest Alliance
cottonwood/willow	Alliance	Populus fremontii Temporarily Flooded Forest Alliance
cottonwood/wollow	Alliance	Populus fremontii Temporarily Flooded Forest Alliance
Crypsis	-	Crypsis
Descurainia/Sisymbrium/Bromus	-	Descurainia
Distichlis	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Atriplex/Bassia	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Atriplex/Bassia/Sar	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Bassia	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Bassia/Atriplex/Sar	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Bassia/Polypogon(po	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance

Distichlis/Bassia/salix	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Bassia/Sarcobatus	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Bassia/Sarcobatus/S	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Bassia/tamarix/sali	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Bromus	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Hordeum	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Hordeum/Agropyron	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Hordeum/Aqropyron	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Hordeum/Elymus/Junc	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Juncus	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Polypogon/Tamarix	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/salix	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Sarcobatus	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Sarcobatus/Atriplex	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Sarcobatus/Bassia/T	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Sarcobatus/salix	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Sarcobatus/Tetradym	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Sporobolus	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Sporobolus/Spartina	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Suaeda	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Tamarix	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/Xanthium/Hordeum	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Distichlis/XanthiumHordeum/Sua	Alliance	Distichlis spicata Intermittently Flooded Herbaceous Alliance
Eleocharis/Polypogon/Scirpus/P	-	Eleocharis
Eleocharis/Xanthium/Polypogon	-	Eleocharis
Hymenoclea/Ambrosia/Bromus	Alliance	Hymenoclea salsola Shrubland Alliance
Juncus/Distichlis/Polypogon/Mu	-	Juncus
Juncus/Muhlenbergia/Hordeum/El	-	Juncus
Larrea, Franseria	-	Sonora-Mojave Creosotebush-White Bursage Desert Scrub
Larrea/Ambrosia/Atriplex	Association	Larrea tridentata - Ambrosia dumosa Shrubland
Larrea/Ambrosia/Bromus	Association	Larrea tridentata - Ambrosia dumosa Shrubland
Larrea/Atriplex	System	Sonora-Mojave Creosotebush-White Bursage Desert Scrub
Larrea/Atriplex/Tamarix	System	Sonora-Mojave Creosotebush-White Bursage Desert Scrub
Larrea/Franseria	System	Sonora-Mojave Creosotebush-White Bursage Desert Scrub
Larrea/Franseria/Tamarix	System	Sonora-Mojave Creosotebush-White Bursage Desert Scrub
Lowleft	-	not used
Pluchea	-	Pluchea
Polypogon /Allenrolfea/Tessari	-	Polypogon
Polypogon/Allenrolfea/Tamarix	-	Polypogon
Polypogon/Allenrolfea/Tessaria	-	Polypogon
Polypogon/Bassia/Juncus/Distic	-	Polypogon
Polypogon/Distichlis/Suaeda	-	Polypogon
Polypogon/Juncus	-	Polypogon
Polypogon/Juncus/Carex	-	Polypogon

Polypogon/Juncus/Distichlis	-	Polypogon
Polypogon/Juncus/Spartina	-	Polypogon
Polypogon/Juncus/Spartina/Suae	-	Polypogon
Polypogon/Muhlenbergia/Juncus	-	Polypogon
Polypogon/MuhlenbergiaJuncus	-	Polypogon
Polypogon/Spartina/Juncus	-	Polypogon
Polypogon/Spartina/Juncus/Care	-	Polypogon
Polypogon/Spartina/Juncus/Suae	-	Polypogon
Polypogon/Tessaria/Tamarix/Pro	-	Polypogon
Poplar/Cottonwood/Atriplex	-	Populus fremontii
poplar/cottonwood/Atriplex, Ta	-	Populus fremontii
Poplar/cottonwood/Tamarix	-	Populus fremontii
Popular/Cottonwood, Larrea, F	-	Populus fremontii
Popular/cottonwood, Atriplex,	-	Populus fremontii
popular/cottonwood/Larrea, Fra	-	Populus fremontii
Popular/cottonwood/Tamarix/Sci	-	Populus fremontii
Potamogeton	-	Potamogeton
Potamogeton/Ranuculus	-	Potamogeton
Potamogeton/Ranunculus	-	Potamogeton
PSS1A	-	not used
road	-	Developed-Low Intensity
Salix/Tamarix /Tessaria	-	Salix
Salix/Tamarix/Tessaria	-	Salix
Salix/Tessaria/Tamarix	-	Salix
Sarcobatus/Atriplex/Bassia	-	Sarcobatus
Sarcobatus/Atriplex/Distichlis	-	Sarcobatus
Sarcobatus/Bromus/SporobolusHy	-	Sarcobatus
Sarcobatus/Diotichlis/Tetradym	-	Sarcobatus
Sarcobatus/Distichlis	-	Sarcobatus
Sarcobatus/Distichlis/Atriplex	-	Sarcobatus
Sarcobatus/Distichlis/Bassia	-	Sarcobatus
Sarcobatus/Distichlis/Bassis(p	-	Sarcobatus
Sarcobatus/Distichlis/tamarix	-	Sarcobatus
Sarcobatus/Distichlis/Tetradym	-	Sarcobatus
Sarcobatus/Salix/Distichlis	-	Sarcobatus
Sarcobatus/Suaeda/Atriplex	-	Sarcobatus
Sarcobatus/Tamarix/Atriplex	-	Sarcobatus
Sarcobatus/Tamarix/Distichlis	-	Sarcobatus
Scirpus	-	Scirpus
Scirpus/Anemopsis	-	Scirpus
Scirpus/Eleocharis	-	Scirpus
Scirpus/Eleocharis/Polygonum	-	Scirpus
Scirpus/Eleocharis/Potentilla/	-	Scirpus
Scirpus/Pluchea/Heliotropium	-	Scirpus

Scirpus/Pluchea/Typha	-	Scirpus
Scirpus/Poplar/Cottonwood/Tama	-	Scirpus
Scirpus/Potamogeton	-	Scirpus
Scirpus/Potamogeton/Polygonum/	-	Scirpus
Scirpus/Potamogeton/Ranunculus	-	Scirpus
Scirpus/Potamogeton/Zannichell	-	Scirpus
Scirpus/Potentilla/Eleocharis/	-	Scirpus
Scirpus/Salix/Tessaria	-	Scirpus
Scirpus/Tamarix/Pluchea	-	Scirpus
Scirpus/Typha	-	Scirpus
Scirpus/Typha/Juncus/Potamoget	-	Scirpus
Scirpus/Typha/Lemna	-	Scirpus
Scirpus/Typha/poplar/cottonwoo	-	Scirpus
Scirpus/Typha/Potamogeton	-	Scirpus
Scirpus/Typha/Salix	-	Scirpus
Scirpus/Typha/Salix/Pluchea	-	Scirpus
Scirpus/Typha/Salix/Pluchea/Po	-	Scirpus
Scirpus/Zotamogeton	-	Scirpus
ScirpusZanichellia/Potamogeton	-	Scirpus
Suaeda	Alliance	Suaeda moquinii Intermittently Flooded Shrubland Alliance
Suaeda/Distichlis/Carex	Alliance	Suaeda moquinii Intermittently Flooded Shrubland Alliance
Suaeda/Distichlis/Sporobolus/C	Alliance	Suaeda moquinii Intermittently Flooded Shrubland Alliance
Tamarix	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix, Larrea, Franseria, Po	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Atriplex	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Atriplex/Distichlis/Te	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Atriplex/Prosopis	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Atriplex/Tessaria	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Bromos	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Bromus	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Distichlis	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Distichlis/Polypogon	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/DistichlisPolypogon	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Pluchea/Prosopis	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Prosopis	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Prosopis/Atriplex	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Prosopis/Pluchea/Atrip	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Salix/Distichlis	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Salix/Tessaria	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Tessaria/Distichlis	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tamarix/Tessaria/Prosopis/Poly	Alliance	Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance
Tessaria/Allenrolfea/Distichli	-	Pluchea
Tessaria/Polypogon/Distichlis/	-	Pluchea
Tessaria/Salix/Tamarix	-	Pluchea

Typha/Potamogeton	-	Typha
Typha/Scirpus/Eleocharis	-	Typha
Typha/Scirpus/Potamogeton	-	Typha
Typha/Tamarix	-	Typha
wheat/barley	-	Agriculture-General
wheat/barley/a;falfa	-	Agriculture-General
wheat/barley/alfalfa	-	Agriculture-General
wheat/barley/corn/alfalfa	-	Agriculture-General
wheat/barley/hay	-	Agriculture-General
X	-	not used
Zotamogeton	-	Potamogeton

SageStitch Crosswalk

Sagebrush Legend	Crosswalk level	SynthMap Type
Wyoming & Basin big sagebrush	-	Artemisia tridentata ssp. (tridentata, wyomingensis)
Black sagebrush	Alliance	Artemisia nova Shrubland Alliance
Low sagebrush	-	Artemisia arbuscula
Low sagebrush-mountain big sagebrush	-	Artemisia (arbuscula, tridentata ssp. vaseyana)
Low sagebrush-Wyoming big sagebrush	-	Artemisia (arbuscula, tridentata ssp. wyomingensis)
Mountain big sagebrush	Alliance	Artemisia tridentata ssp. vaseyana Shrubland Alliance
Rigid sagebrush	-	not in region
Silver sagebrush	Alliance	Artemisia cana (ssp. bolanderi, ssp. viscidula) Shrubland Alliance
Threetip sagebrush	Alliance	Artemisia tripartita ssp. tripartita Shrub Herbaceous Alliance
Wyoming big sagebrush-squawapple	-	not in region

U.S.G.S. Evapotranspiration Study – Death Valley Region

No significant evapotranspiration	Crosswalk level	SynthMap Type
Open water	-	combined with SynthMap Open Water (value 10)
Submerged aquatic vegetation	-	Submerged Aquatic Vegetation
Dense Wetland Vegetation	-	Dense Wetland Vegetation
Dense meadow and forested vegetation	-	
Dense to moderately dense grassland vegetation	-	
Sparse grassland vegetation	-	
Moist bare soil	-	
Sparse to moderately dense shrubland vegetation	-	
Sparse woodland vegetation	-	
Open playa	Association	Microphytic Playa Sparse Vegetation [placeholder]

Appendix

This is the IDL script built during the processing of files to create the Synthesis map, for use with ENVI / IDL remote sensing software.

```
function ChangeVal, b1, SrcVal, DstVal
		; b1 - dataset to revise
		; SrcVal - class value to change
		; DstVal - new value to use
		b9 = ((b1 NE SrcVal) * b1) + ((b1 EQ SrcVal) * DstVal)
		return, b9
end

function Synonymize, b1, SrcVal1, SrcVal2, DstVal
		b2 = ((b1 EQ SrcVal1) OR (b1 EQ SrcVal2)) * DstVal
		b3 = ((b2 EQ 0) * b1) + b2
		return, b3
end

function BurnVal, b1, b2, SrcVal, DstVal
		; b1 - dataset to burn
		; b2 - dataset to receive burn
		; SrcVal - value in b1 to burn
		; DstVal - value to burn it as
		b8 = (b1 EQ SrcVal) * DstVal
		b9 = (b2 * (b8 EQ 0)) + b8
		return, b9
end

function BurnPartLayer, b1, b2
		; b1 - dataset to burn
		; b2 - dataset to receive burn
		b8 = ((b2 GT 99) AND (b2 NE 2554) AND (b2 NE 2555))  * b1
		b9 = (b2 * (b8 EQ 0)) + b8
		return, b9
end

function BurnValExcept, b1, b2, SrcVal, DstVal, ExceptLow, ExceptHigh
		b3 = (b1 EQ SrcVal) * DstVal
		b4 = ((b1 LT ExceptLow) OR (b1 GT ExceptHigh)) * b3
		b5 = (b2 * (b4 EQ 0)) + b4
		return, b5
end

function BurnInto, b1, b2, SrcBurn, SrcInto, DstVal
		b3 = ((b1 EQ SrcBurn) AND (b2 EQ SrcInto)) * DstVal
		b4 = (b2 * (b3 EQ 0)) + b3
		return, b4
end

function BurnRange, b1, b2, SrcLow, SrcHigh, DstMod
		b8 = ((b1 GE SrcLow) AND (b1 LE SrcHigh)) * (b1 + DstMod)
		b9 = (b2 * (b8 EQ 0)) + b8
		return, b9
end

function RemoveVal, b1, b2, Val
		b3 = ((b2 EQ Val) * b1) + ((b2 NE Val) * b2)
		return, b3
end

;  ******************************
;  *** add LANDFIRE to SWReGAP ***
;  ******************************




function Set00A, b01, b02
		b03 = ((b02 EQ 1110) AND (b01 GE 1)) * b01
		b04 = ((b03 EQ 0) * b02) + b03

		return, b04
end

function Set01, b1, b2, dummy
		b03 = RemoveVal(b1, b2, 1008) ; Inter-Mountain Basins Cliff and Canyon
		b04 = RemoveVal(b1, b03, 1006); Sierra Nevada Cliff and Canyon
		return, b04
end

function Set02, b01, b02
		b03 = ChangeVal(b02, 1110, 1)
		b04 = ChangeVal(b03, 2011, 1)
		b05 = BurnVal(b01, b04, 2020, 20)
		b06 = BurnVal(b01, b05, 2021, 21)
		b07 = ChangeVal(b06, 1111, 22)
		b08 = BurnVal(b01, b07, 2022, 22)
		b09 = ChangeVal(b08, 1112, 23)
		b10 = BurnVal(b01, b09, 2023, 23)
		b11 = BurnVal(b01, b10, 2024, 24)
		b12 = ChangeVal(b11, 1117, 32)
		b13 = BurnVal(b01, b12, 2032, 32)
		b14 = ChangeVal(b13, 1116, 50) ; recent burn
    b15 = ChangeVal(b14, 1114, 80)
		b16 = BurnVal(b01, b15, 2080, 80)
		b17 = BurnVal(b01, b16, 2082, 82)
		b18 = BurnVal(b01, b17, 2083, 83)
		b19 = BurnVal(b01, b18, 2084, 84)
		b20 = BurnVal(b01, b19, 2085, 85)
		return, b20
end

function Set03, b1, b2
		; See BurnVal for identical input bands

		; burn in riparian strips
		b03 = BurnVal(b1, b2, 2554, 2554)
		b04 = BurnVal(b1, b03, 2555, 2555)

		; missed burns from last
		b05 = BurnVal(b1, b04, 2081, 81)

		; synonymize
		b06 = Synonymize(b05, 1052, 2495, 100)
		b07 = Synonymize(b06, 1113, 2031, 101)
		b08 = Synonymize(b07, 1036, 2416, 102)
		b09 = Synonymize(b08, 1037, 2419, 103)
		b10 = Synonymize(b09, 1047, 2503, 104)
		b11 = Synonymize(b10, 1049, 2479, 105)
		b12 = Synonymize(b11, 1048, 2480, 106)
		b13 = Synonymize(b12, 1066, 2525, 107)
		b14 = Synonymize(b13, 1082, 2553, 108)
		b15 = Synonymize(b14, 1064, 2515, 109)
		return, b15
end

function Set04, b15
		b16 = Synonymize(b15, 1058, 2481, 110)
		b17 = Synonymize(b16, 1062, 2526, 111)
		b18 = Synonymize(b17, 1076, 2535, 112)
		b19 = Synonymize(b18, 1067, 2527, 113)
		b20 = Synonymize(b19, 1025, 2420, 114)
		b21 = Synonymize(b20, 1122, 2583, 115)
		b22 = Synonymize(b21, 1121, 2581, 116)
		b23 = Synonymize(b22, 1119, 2582, 117)
		b24 = Synonymize(b23, 1118, 2580, 118)
		b25 = Synonymize(b24, 1003, 2467, 119)
		return, b25
end


function Set05, b25
		b26 = Synonymize(b25, 1031, 2427, 120)
		b27 = Synonymize(b26, 1100, 2432, 121)
		b28 = Synonymize(b27, 1088, 2537, 122)
		b29 = Synonymize(b28, 1051, 2504, 123)
		b30 = Synonymize(b29, 1054, 2482, 124)
		b31 = Synonymize(b30, 1027, 2444, 125)
		b32 = Synonymize(b31, 1030, 2447, 126)
		b33 = Synonymize(b32, 1034, 2453, 127)
		b34 = Synonymize(b33, 1069, 2406, 128)
		b35 = Synonymize(b34, 1022, 2411, 129)
		return, b35
end

function Set06, b35
		b36 = Synonymize(b35, 1023, 2412, 130)
		b37 = Synonymize(b36, 1041, 2507, 131)
		b38 = Synonymize(b37, 1026, 2455, 132)
		b39 = Synonymize(b38, 1024, 2457, 133)
		b40 = Synonymize(b39, 1101, 2458, 134)
		b41 = Synonymize(b40, 1060, 2487, 135)
		b42 = Synonymize(b41, 1061, 2488, 136)
		b43 = Synonymize(b42, 1094, 2508, 137)
		b44 = Synonymize(b43, 1105, 2491, 138)
		b45 = Synonymize(b44, 1071, 2546, 139)

		return, b45
end

function ReturnVals, b1, b2
		b3 = ((b2 NE 119) * b2) + ((b2 EQ 119) * b1)
		b4 = ((b3 NE 122) * b3) + ((b3 EQ 122) * b1)
		b5 = ((b4 NE 126) * b4) + ((b4 EQ 126) * b1)
		b6 = ((b5 NE 128) * b5) + ((b5 EQ 128) * b1)
		return, b6
end

function Set07, b1, b2
		b3 = BurnRange(b1,b2,2600,2699,0)
		return, b3
end

;  ***************************
;  *** add Tahoe Vegetation ***
;  ***************************

function Set08, b01, b02
		; prior, Tahoe had 3000 added to it, so it occupies 3000 - 3099
		; +/- direct burns (except not over disturbed, agriculture, or water (Synth values<100)
		b03 = BurnValExcept(b01, b02, 3003, 3003, 0, 99)
		b04 = BurnValExcept(b01, b03, 3005, 3005, 0, 99)
		b05 = BurnValExcept(b01, b04, 3010, 3010, 0, 99)
		b06 = BurnValExcept(b01, b05, 3014, 3014, 0, 99)
		b07 = BurnValExcept(b01, b06, 3023, 3023, 0, 99)
		b08 = BurnValExcept(b01, b07, 3025, 3025, 0, 99)
		return, b08
end

function Set09, b1, b2
		; Burn only into certain previous values
		b03 = BurnInto(b1, b2, 3002, 106, 3002) ; Big Sagebrush
		b04 = BurnInto(b1, b03, 3002, 107, 3002) ; Big Sagebrush
		b05 = BurnInto(b1, b04, 3002, 2484, 3002) ; Big Sagebrush
		b06 = BurnInto(b1, b05, 3002, 2486, 3002) ; Big Sagebrush
		b07 = BurnInto(b1, b06, 3002, 2497, 3002) ; Big Sagebrush
		b08 = BurnInto(b1, b07, 3002, 2498, 3002) ; Big Sagebrush
		b09 = BurnInto(b1, b08, 3002, 2505, 3002) ; Big Sagebrush
		b10 = BurnInto(b1, b09, 3002, 2506, 3002) ; Big Sagebrush
		return, b10
end

function Set10, b1, b2
		b03 = BurnInto(b1, b2, 3009, 104, 3009) ; Huckleberry Oak
		b04 = BurnInto(b1, b03, 3009, 113, 3009) ; Huckleberry Oak
		b05 = BurnInto(b1, b04, 3009, 2484, 3009) ; Huckleberry Oak
		b06 = BurnInto(b1, b05, 3009, 2497, 3009) ; Huckleberry Oak
		b07 = BurnInto(b1, b06, 3009, 2498, 3009) ; Huckleberry Oak
		b08 = BurnInto(b1, b07, 3009, 2505, 3009) ; Huckleberry Oak
		return, b08
end

function Set11, b1, b2
		b03 = BurnInto(b1, b2, 3011, 121, 3011) ; Red Fir
		b04 = BurnInto(b1, b03, 3011, 125, 3011) ; Red Fir
		b05 = BurnInto(b1, b04, 3011, 2428, 3011) ; Red Fir
		b06 = BurnInto(b1, b05, 3011, 2433, 3011) ; Red Fir
		b07 = BurnInto(b1, b06, 3011, 2443, 3011) ; Red Fir
		b08 = BurnInto(b1, b07, 3011, 2498, 3011) ; Red Fir
		return, b08
end

function Set12, b1, b2
		b03 = BurnInto(b1, b2, 3011, 120, 3011) ; Red Fir
		b04 = BurnInto(b1, b03, 3012, 120, 3012) ; Lodgepole Pine
		b05 = BurnInto(b1, b04, 3012, 125, 3012) ; Lodgepole Pine
		b06 = BurnInto(b1, b05, 3012, 134, 3012) ; Lodgepole Pine
		b07 = BurnInto(b1, b06, 3012, 2418, 3012) ; Lodgepole Pine
		b08 = BurnInto(b1, b07, 3012, 2428, 3012) ; Lodgepole Pine
		b09 = BurnInto(b1, b08, 3012, 2433, 3012) ; Lodgepole Pine
		b10 = BurnInto(b1, b09, 3012, 2443, 3012) ; Lodgepole Pine
		b11 = BurnInto(b1, b10, 3012, 2461, 3012) ; Lodgepole Pine
		b12 = BurnInto(b1, b11, 3012, 2498, 3012) ; Lodgepole Pine
		return, b12
end

function Set13, b1, b2
		b04 = BurnInto(b1, b2, 3013, 120, 3013) ; Western White Pine
		b05 = BurnInto(b1, b04, 3013, 125, 3013) ; Western White Pine
;		b06 = BurnInto(b1, b05, 3013, 134, 3013) ; Western White Pine
		b07 = BurnInto(b1, b05, 3013, 2418, 3013) ; Western White Pine
		b08 = BurnInto(b1, b07, 3013, 2428, 3013) ; Western White Pine
		b09 = BurnInto(b1, b08, 3013, 2433, 3013) ; Western White Pine
		b10 = BurnInto(b1, b09, 3013, 2443, 3013) ; Western White Pine
		b11 = BurnInto(b1, b10, 3013, 2461, 3013) ; Western White Pine
		b12 = BurnInto(b1, b11, 3013, 2498, 3013) ; Western White Pine
		return, b12
end

function Set14, b1, b2
		b03 = BurnInto(b1, b2, 3017, 104, 3017) ; Greenleaf Manzanita
		b04 = BurnInto(b1, b03, 3017, 2484, 3017) ; Greenleaf Manzanita
		b05 = BurnInto(b1, b04, 3017, 2497, 3017) ; Greenleaf Manzanita
		b06 = BurnInto(b1, b05, 3017, 2498, 3017) ; Greenleaf Manzanita
		b07 = BurnInto(b1, b06, 3017, 2536, 3017) ; Greenleaf Manzanita
		return, b07
end

function Set15, b1, b2
		b03 = BurnInto(b1, b2, 3020, 120, 3020) ; Jeffrey Pine
		b04 = BurnInto(b1, b03, 3020, 125, 3020) ; Jeffrey Pine
		b05 = BurnInto(b1, b04, 3020, 1038, 3020) ; Jeffrey Pine
		b06 = BurnInto(b1, b05, 3020, 1102, 3020) ; Jeffrey Pine
		b07 = BurnInto(b1, b06, 3020, 2428, 3020) ; Jeffrey Pine
		b08 = BurnInto(b1, b07, 3020, 2431, 3020) ; Jeffrey Pine
		b09 = BurnInto(b1, b08, 3020, 2433, 3020) ; Jeffrey Pine
		b10 = BurnInto(b1, b09, 3020, 2454, 3020) ; Jeffrey Pine
		b10 = BurnInto(b1, b09, 3020, 2461, 3020) ; Jeffrey Pine
		b11 = BurnInto(b1, b10, 3020, 2498, 3020) ; Jeffrey Pine
		return, b11
end
```

```
function Set16, b1, b2
        b03 = BurnInto(b1, b2, 3024, 104, 3024) ; Mountain Whitethorn
        b04 = BurnInto(b1, b2, 3024, 2484, 3024) ; Mountain Whitethorn
        b05 = BurnInto(b1, b2, 3024, 2497, 3024) ; Mountain Whitethorn
        b06 = BurnInto(b1, b2, 3024, 2498, 3024) ; Mountain Whitethorn
        b07 = BurnInto(b1, b2, 3024, 2505, 3024) ; Mountain Whitethorn
        b08 = BurnInto(b1, b2, 3017, 2505, 3017) ; Greenleaf Manzanita
        b09 = BurnInto(b1, b2, 3024, 2536, 3024) ; Mountain Whitethorn
        return, b09
end

function Set17, b1, b2
        b03 = BurnInto(b1, b2, 3026, 103, 3026) ; California Juniper
        b04 = BurnInto(b1, b03, 3026, 109, 3026) ; California Juniper
        b05 = BurnInto(b1, b04, 3026, 120, 3026) ; California Juniper
        b06 = BurnInto(b1, b05, 3026, 125, 3026) ; California Juniper
        b07 = BurnInto(b1, b06, 3026, 2418, 3026) ; California Juniper
        b08 = BurnInto(b1, b07, 3026, 2428, 3026) ; California Juniper
        b09 = BurnInto(b1, b08, 3026, 2433, 3026) ; California Juniper
        return, b09
end

function Set18, b1, b2
        b03 = BurnInto(b1, b2, 3027, 120, 3027) ; Mountain Hemlock
        b04 = BurnInto(b1, b03, 3027, 125, 3027) ; Mountain Hemlock
        b05 = BurnInto(b1, b04, 3027, 2418, 3027) ; Mountain Hemlock
        b06 = BurnInto(b1, b05, 3027, 2428, 3027) ; Mountain Hemlock
        b07 = BurnInto(b1, b06, 3027, 2433, 3027) ; Mountain Hemlock
        b08 = BurnInto(b1, b07, 3027, 2441, 3027) ; Mountain Hemlock
        b09 = BurnInto(b1, b08, 3027, 2442, 3027) ; Mountain Hemlock
        b10 = BurnInto(b1, b09, 3027, 2443, 3027) ; Mountain Hemlock
        return, b10
end

;  **************************
;  *** add DOE Vegetation ***
;  **************************

; done directly in Band Math
; - added 3100 to Yucca values and 3200 to NTS values
; - removed 3207 and 3219 from NTS
; - mosaiced NTS over Yucca/Skull
; - did BurnPartLayer(mosaic, previousSynth)

;  **************************
;  *** Change Water Value ***
;  **************************
;  Reason: ArcGIS didn't seem to display value=1 - kept showing as nodata (0)

function Set19, b1
    b2 = ChangeVal(b1, 1, 10)
    return, b2
end

;  **********************
;  *** Add Sage Stitch ***
;  **********************

; Prior: Sagestitch converted to ENVI, clipped to proper extent, and masked to
;  NeVeg Boundary

function Set20, b1
        ; Add value to bring range to 4000's
        b2 = (b1 GT 0) * (b1 + 4000)
        return, b2
end

function Set21, b1, b2
        ; Wyoming & Basin big sagebrush
        b03 = BurnInto(b1, b2, 4107, 104, 4107)
        b04 = BurnInto(b1, b03, 4107, 105, 4107)
        b05 = BurnInto(b1, b04, 4107, 106, 4107)
        b06 = BurnInto(b1, b05, 4107, 107, 4107)
        b07 = BurnInto(b1, b06, 4107, 111, 4107)
        b08 = BurnInto(b1, b07, 4107, 113, 4107)
        b09 = BurnInto(b1, b08, 4107, 2484, 4107)
        b10 = BurnInto(b1, b09, 4107, 2486, 4107)
        b11 = BurnInto(b1, b10, 4107, 2497, 4107)
        b12 = BurnInto(b1, b11, 4107, 2498, 4107)
        b13 = BurnInto(b1, b12, 4107, 2505, 4107)
        b14 = BurnInto(b1, b13, 4107, 2524, 4107) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set22, b1, b2
        ; Wyoming & Basin big sagebrush
        b03 = BurnInto(b1, b2, 4108, 104, 4107)
        b04 = BurnInto(b1, b03, 4108, 105, 4107)
        b05 = BurnInto(b1, b04, 4108, 106, 4107)
        b06 = BurnInto(b1, b05, 4108, 107, 4107)
        b07 = BurnInto(b1, b06, 4108, 111, 4107)
        b08 = BurnInto(b1, b07, 4108, 113, 4107)
        b09 = BurnInto(b1, b08, 4108, 2484, 4107)
        b10 = BurnInto(b1, b09, 4108, 2486, 4107)
        b11 = BurnInto(b1, b10, 4108, 2497, 4107)
        b12 = BurnInto(b1, b11, 4108, 2498, 4107)
        b13 = BurnInto(b1, b12, 4108, 2505, 4107)
        b14 = BurnInto(b1, b13, 4108, 2524, 4107) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set23, b1, b2
        ; Black sagebrush
        b03 = BurnInto(b1, b2, 4112, 104, 4112)
        b04 = BurnInto(b1, b03, 4112, 105, 4112)
        b05 = BurnInto(b1, b04, 4112, 106, 4112)
        b06 = BurnInto(b1, b05, 4112, 107, 4112)
        b07 = BurnInto(b1, b06, 4112, 111, 4112)
        b08 = BurnInto(b1, b07, 4112, 113, 4112)
        b09 = BurnInto(b1, b08, 4112, 2484, 4112)
        b10 = BurnInto(b1, b09, 4112, 2486, 4112)
        b11 = BurnInto(b1, b10, 4112, 2497, 4112)
        b12 = BurnInto(b1, b11, 4112, 2498, 4112)
        b13 = BurnInto(b1, b12, 4112, 2505, 4112)
        b14 = BurnInto(b1, b13, 4112, 2524, 4112) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set24, b1, b2
        ; Low sagebrush
        b03 = BurnInto(b1, b2, 4119, 104, 4119)
        b04 = BurnInto(b1, b03, 4119, 105, 4119)
        b05 = BurnInto(b1, b04, 4119, 106, 4119)
        b06 = BurnInto(b1, b05, 4119, 107, 4119)
        b07 = BurnInto(b1, b06, 4119, 111, 4119)
        b08 = BurnInto(b1, b07, 4119, 113, 4119)
        b09 = BurnInto(b1, b08, 4119, 2484, 4119)
        b10 = BurnInto(b1, b09, 4119, 2486, 4119)
        b11 = BurnInto(b1, b10, 4119, 2497, 4119)
        b12 = BurnInto(b1, b11, 4119, 2498, 4119)
        b13 = BurnInto(b1, b12, 4119, 2505, 4119)
        b14 = BurnInto(b1, b13, 4119, 2524, 4119) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set25, b1, b2
        ; Low sagebrush-mountain big sagebrush
        b03 = BurnInto(b1, b2, 4126, 104, 4126)
        b04 = BurnInto(b1, b03, 4126, 105, 4126)
        b05 = BurnInto(b1, b04, 4126, 106, 4126)
        b06 = BurnInto(b1, b05, 4126, 107, 4126)
        b07 = BurnInto(b1, b06, 4126, 111, 4126)
        b08 = BurnInto(b1, b07, 4126, 113, 4126)
        b09 = BurnInto(b1, b08, 4126, 2484, 4126)
        b10 = BurnInto(b1, b09, 4126, 2486, 4126)
        b11 = BurnInto(b1, b10, 4126, 2497, 4126)
        b12 = BurnInto(b1, b11, 4126, 2498, 4126)
        b13 = BurnInto(b1, b12, 4126, 2505, 4126)
        b14 = BurnInto(b1, b13, 4126, 2524, 4126) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set26, b1, b2
        ; Low sagebrush-Wyoming big sagebrush
        b03 = BurnInto(b1, b2, 4127, 104, 4127)
        b04 = BurnInto(b1, b03, 4127, 105, 4127)
        b05 = BurnInto(b1, b04, 4127, 106, 4127)
        b06 = BurnInto(b1, b05, 4127, 107, 4127)
        b07 = BurnInto(b1, b06, 4127, 111, 4127)
        b08 = BurnInto(b1, b07, 4127, 113, 4127)
        b09 = BurnInto(b1, b08, 4127, 2484, 4127)
        b10 = BurnInto(b1, b09, 4127, 2486, 4127)
        b11 = BurnInto(b1, b10, 4127, 2497, 4127)
        b12 = BurnInto(b1, b11, 4127, 2498, 4127)
        b13 = BurnInto(b1, b12, 4127, 2505, 4127)
        b14 = BurnInto(b1, b13, 4127, 2524, 4127) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set27, b1, b2
        ; Mountain big sagebrush
        b03 = BurnInto(b1, b2, 4136, 104, 4136)
        b04 = BurnInto(b1, b03, 4136, 105, 4136)
        b05 = BurnInto(b1, b04, 4136, 106, 4136)
        b06 = BurnInto(b1, b05, 4136, 107, 4136)
        b07 = BurnInto(b1, b06, 4136, 111, 4136)
        b08 = BurnInto(b1, b07, 4136, 113, 4136)
        b09 = BurnInto(b1, b08, 4136, 2484, 4136)
        b10 = BurnInto(b1, b09, 4136, 2486, 4136)
        b11 = BurnInto(b1, b10, 4136, 2497, 4136)
        b12 = BurnInto(b1, b11, 4136, 2498, 4136)
        b13 = BurnInto(b1, b12, 4136, 2505, 4136)
        b14 = BurnInto(b1, b13, 4136, 2524, 4136) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set28, b1, b2
        ; Rigid sagebrush
        b03 = BurnInto(b1, b2, 4143, 104, 4143)
        b04 = BurnInto(b1, b03, 4143, 105, 4143)
        b05 = BurnInto(b1, b04, 4143, 106, 4143)
        b06 = BurnInto(b1, b05, 4143, 107, 4143)
        b07 = BurnInto(b1, b06, 4143, 111, 4143)
        b08 = BurnInto(b1, b07, 4143, 113, 4143)
        b09 = BurnInto(b1, b08, 4143, 2484, 4143)
        b10 = BurnInto(b1, b09, 4143, 2486, 4143)
        b11 = BurnInto(b1, b10, 4143, 2497, 4143)
        b12 = BurnInto(b1, b11, 4143, 2498, 4143)
        b13 = BurnInto(b1, b12, 4143, 2505, 4143)
        b14 = BurnInto(b1, b13, 4143, 2524, 4143) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set29, b1, b2
        ; Silver Sagebrush
        b03 = BurnInto(b1, b2, 4148, 104, 4148)
        b04 = BurnInto(b1, b03, 4148, 105, 4148)
        b05 = BurnInto(b1, b04, 4148, 106, 4148)
        b06 = BurnInto(b1, b05, 4148, 107, 4148)
        b07 = BurnInto(b1, b06, 4148, 111, 4148)
        b08 = BurnInto(b1, b07, 4148, 113, 4148)
        b09 = BurnInto(b1, b08, 4148, 2484, 4148)
        b10 = BurnInto(b1, b09, 4148, 2486, 4148)
        b11 = BurnInto(b1, b10, 4148, 2497, 4148)
        b12 = BurnInto(b1, b11, 4148, 2498, 4148)
        b13 = BurnInto(b1, b12, 4148, 2505, 4148)
        b14 = BurnInto(b1, b13, 4148, 2524, 4148) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set30, b1, b2
        ; Threetip Sagebrush
        b03 = BurnInto(b1, b2, 4152, 104, 4152)
        b04 = BurnInto(b1, b03, 4152, 105, 4152)
        b05 = BurnInto(b1, b04, 4152, 106, 4152)
        b06 = BurnInto(b1, b05, 4152, 107, 4152)
        b07 = BurnInto(b1, b06, 4152, 111, 4152)
        b08 = BurnInto(b1, b07, 4152, 113, 4152)
        b09 = BurnInto(b1, b08, 4152, 2484, 4152)
        b10 = BurnInto(b1, b09, 4152, 2486, 4152)
        b11 = BurnInto(b1, b10, 4152, 2497, 4152)
        b12 = BurnInto(b1, b11, 4152, 2498, 4152)
        b13 = BurnInto(b1, b12, 4152, 2505, 4152)
        b14 = BurnInto(b1, b13, 4152, 2524, 4152) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set31, b1, b2
        ; Wyoming & Basin big Sagebrush
        b03 = BurnInto(b1, b2, 4160, 104, 4107)
        b04 = BurnInto(b1, b03, 4160, 105, 4107)
        b05 = BurnInto(b1, b04, 4160, 106, 4107)
        b06 = BurnInto(b1, b05, 4160, 107, 4107)
        b07 = BurnInto(b1, b06, 4160, 111, 4107)
        b08 = BurnInto(b1, b07, 4160, 113, 4107)
        b09 = BurnInto(b1, b08, 4160, 2484, 4107)
        b10 = BurnInto(b1, b09, 4160, 2486, 4107)
        b11 = BurnInto(b1, b10, 4160, 2497, 4107)
        b12 = BurnInto(b1, b11, 4160, 2498, 4107)
        b13 = BurnInto(b1, b12, 4160, 2505, 4107)
        b14 = BurnInto(b1, b13, 4160, 2524, 4107) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set32, b1, b2
        ; Wyoming big sagebrush-squawapple
        b03 = BurnInto(b1, b2, 4161, 104, 4161)
        b04 = BurnInto(b1, b03, 4161, 105, 4161)
        b05 = BurnInto(b1, b04, 4161, 106, 4161)
        b06 = BurnInto(b1, b05, 4161, 107, 4161)
        b07 = BurnInto(b1, b06, 4161, 111, 4161)
        b08 = BurnInto(b1, b07, 4161, 113, 4161)
        b09 = BurnInto(b1, b08, 4161, 2484, 4161)
        b10 = BurnInto(b1, b09, 4161, 2486, 4161)
        b11 = BurnInto(b1, b10, 4161, 2497, 4161)
        b12 = BurnInto(b1, b11, 4161, 2498, 4161)
        b13 = BurnInto(b1, b12, 4161, 2505, 4161)
        b14 = BurnInto(b1, b13, 4161, 2524, 4161) ; Columbia Plateau Low Sagebrush Steppe
        return, b14
end

function Set33, b1, b2
        ; map *looks* like the riparian systems were not retained for some reason
        b3 = BurnVal(b1, b2, 2554, 2554)
        b4 = BurnVal(b1, b3, 2555, 2555)
        return, b4
end

;  **********************************
;  *** Add HTNF data - Great Basin ***
;  **********************************


function Set33, b1, b2
        ; Wyoming Big Sage (16)
        b03 = BurnInto(b1, b2, 16, 104, 3316)
        b04 = BurnInto(b1, b03, 16, 105, 3316)
        b05 = BurnInto(b1, b04, 16, 106, 3316)
        b06 = BurnInto(b1, b05, 16, 107, 3316)
        b07 = BurnInto(b1, b06, 16, 111, 3316)
        b08 = BurnInto(b1, b07, 16, 113, 3316)
        b09 = BurnInto(b1, b08, 16, 2484, 3316)
        b10 = BurnInto(b1, b09, 16, 2486, 3316)
        b11 = BurnInto(b1, b10, 16, 2497, 3316)
        b12 = BurnInto(b1, b11, 16, 2498, 3316)
        b13 = BurnInto(b1, b12, 16, 2505, 3316)
        b14 = BurnInto(b1, b13, 16, 2524, 3316) ; Columbia Plateau Low Sagebrush Steppe
        b15 = BurnInto(b1, b14, 16, 4107, 3316)
        b16 = BurnInto(b1, b15, 16, 4127, 3316)
        return, b16
end

function Set34, b1, b2
        ; Basin Big Sage (11)
        b03 = BurnInto(b1, b2, 11, 104, 3311)
        b04 = BurnInto(b1, b03, 11, 105, 3311)
        b05 = BurnInto(b1, b04, 11, 106, 3311)
        b06 = BurnInto(b1, b05, 11, 107, 3311)
        b07 = BurnInto(b1, b06, 11, 111, 3311)
```

```
		b08 = BurnInto(b1, b07, 11, 113, 3311)
		b09 = BurnInto(b1, b08, 11, 2484, 3311)
		b10 = BurnInto(b1, b09, 11, 2486, 3311)
		b11 = BurnInto(b1, b10, 11, 2497, 3311)
		b12 = BurnInto(b1, b11, 11, 2498, 3311)
		b13 = BurnInto(b1, b12, 11, 2505, 3311)
		b14 = BurnInto(b1, b13, 11, 2524, 3311) ; Columbia Plateau Low Sagebrush Steppe
		b15 = BurnInto(b1, b14, 11, 4107, 3311)
		return, b15
end

function Set35, b1, b2
		;  Low Sage (2)
		b03 = BurnInto(b1, b2, 2, 104, 3302)
		b04 = BurnInto(b1, b03, 2, 105, 3302)
		b05 = BurnInto(b1, b04, 2, 106, 3302)
		b06 = BurnInto(b1, b05, 2, 107, 3302)
		b07 = BurnInto(b1, b06, 2, 111, 3302)
		b08 = BurnInto(b1, b07, 2, 113, 3302)
		b09 = BurnInto(b1, b08, 2, 2484, 3302)
		b10 = BurnInto(b1, b09, 2, 2486, 3302)
		b11 = BurnInto(b1, b10, 2, 2497, 3302)
		b12 = BurnInto(b1, b11, 2, 2498, 3302)
		b13 = BurnInto(b1, b12, 2, 2505, 3302)
		b14 = BurnInto(b1, b13, 2, 2524, 3302) ; Columbia Plateau Low Sagebrush Steppe
		b15 = BurnInto(b1, b14, 2, 4127, 3302)
		return, b15
end

function Set36, b1, b2
		;  Black Sage (18)
		b03 = BurnInto(b1, b2, 18, 104, 3318)
		b04 = BurnInto(b1, b03, 18, 105, 3318)
		b05 = BurnInto(b1, b04, 18, 106, 3318)
		b06 = BurnInto(b1, b05, 18, 107, 3318)
		b07 = BurnInto(b1, b06, 18, 111, 3318)
		b08 = BurnInto(b1, b07, 18, 113, 3318)
		b09 = BurnInto(b1, b08, 18, 2484, 3318)
		b10 = BurnInto(b1, b09, 18, 2486, 3318)
		b11 = BurnInto(b1, b10, 18, 2497, 3318)
		b12 = BurnInto(b1, b11, 18, 2498, 3318)
		b13 = BurnInto(b1, b12, 18, 2505, 3318)
		b14 = BurnInto(b1, b13, 18, 2524, 3318) ; Columbia Plateau Low Sagebrush Steppe
		return, b14
end

function Set37, b1, b2
		;  Mtn Big Sage (6)
		b03 = BurnInto(b1, b2, 6, 104, 3306)
		b04 = BurnInto(b1, b03, 6, 105, 3306)
		b05 = BurnInto(b1, b04, 6, 106, 3306)
		b06 = BurnInto(b1, b05, 6, 107, 3306)
		b07 = BurnInto(b1, b06, 6, 111, 3306)
		b08 = BurnInto(b1, b07, 6, 113, 3306)
		b09 = BurnInto(b1, b08, 6, 2484, 3306)
		b10 = BurnInto(b1, b09, 6, 2486, 3306)
		b11 = BurnInto(b1, b10, 6, 2497, 3306)
		b12 = BurnInto(b1, b11, 6, 2498, 3306)
		b13 = BurnInto(b1, b12, 6, 2505, 3306)
		b14 = BurnInto(b1, b13, 6, 2524, 3306) ; Columbia Plateau Low Sagebrush Steppe
		b15 = BurnInto(b1, b14, 6, 4126, 3306)
		return, b15
end

; change strategy
; added 3300 to htnf-gb data

function Set38, b1, b2
    b03 = (b1 NE 3308) * b1  ; remove "Mountain Shrub"
    b04 = (b1 NE 3310) * b03 ; remove "Mixed Sage/Bitterbrush"
    b05 = (b1 NE 3314) * b04 ; remove "Mtn Grassland"
    b06 = (b1 NE 3315) * b05 ; remove "Mixed Shrub/BasinShrub"
    b07 = (b1 NE 3320) * b06 ; remove "Mixed Aspen/Conifer"
    b08 = (b1 NE 3321) * b07 ; remove "Basin Grassland"
    b09 = (b1 NE 3322) * b08 ; remove "Snow"
    b10 = (b1 NE 3325) * b09 ; remove "Whitebark/Limber Pine"
    b11 = (b1 NE 3327) * b10 ; remove "Mixed Conifer"
    b12 = (b1 NE 3328) * b11 ; remove "Rock"
    b13 = (b1 NE 3331) * b12 ; remove "Water"
    b14 = (b1 NE 3332) * b13 ; remove "Agric"
    b15 = (b1 NE 3333) * b14 ; remove "Urban"
    b16 = (b1 NE 3335) * b15 ; remove "Mixed Woodlands"
    b17 = (b1 NE 3337) * b16 ; remove "Desert Shrub"

		; b1 - dataset to burn
		; b2 - dataset to receive burn
		b20 = ((b17 GT 0) AND (b2 GT 99) AND (b2 NE 2554) AND (b2 NE 2555) AND ((b2 LT 2600) OR 
(b2 GT 4100)))
		b21 = (b17 * (b20 EQ 1)) + (b2 * (b20 EQ 0))
		return, b21
end

;  *************************************
;  *** Add HTNF data - Sierra Nevada ***
;  *************************************

; first add 3400

function Set39, b1, b2
    b03 = (b1 NE 3401) * b1  ; remove "Agriculture"
    b04 = (b1 NE 3403) * b03 ; remove "not yet mapped"
    b05 = (b1 NE 3404) * b04 ; remove "wet meadows grass/forbs"
    b06 = (b1 NE 3406) * b05 ; remove "upper montane mixed chaparral"
    b07 = (b1 NE 3411) * b06 ; remove "big basin sagebrush"
    b08 = (b1 NE 3413) * b07 ; remove "high desert - montane chaparral transition"
    b09 = (b1 NE 3422) * b08 ; remove "Basin Mixed Scrub"
    b10 = (b1 NE 3423) * b09 ; remove "Urban/Developed"
    b11 = (b1 NE 3425) * b10 ; remove "water"
    b12 = (b1 NE 3439) * b11 ; remove "Subalpine conifers"
    b13 = (b1 NE 3449) * b12 ; remove "Basin - desert transition scrub"
    b14 = (b1 NE 3452) * b13 ; remove "non-native/ornamental hardwood"
    b15 = (b1 NE 3454) * b14 ; remove "mixed alpine scrub"
    b16 = (b1 NE 3455) * b15 ; remove "upper montane mixed shrub"
    b17 = (b1 NE 3458) * b16 ; remove "non-native/ornamental conifer/hardwood"
    b18 = (b1 NE 3463) * b17 ; remove "high desert mixed scrub"
    b19 = (b1 NE 3464) * b18 ; remove "saltbush"
    b20 = (b1 NE 3465) * b19 ; remove "alkaline mixed scrub"
    b21 = (b1 NE 3467) * b20 ; remove "alkaline flats"
    b22 = (b1 NE 3468) * b21 ; remove "alkaline mixed grass/forbs"
    b23 = (b1 NE 3469) * b22 ; remove "snow/ice"
    b24 = (b1 NE 3477) * b23 ; remove "Mixed conifer - pine"

		; b1 - dataset to burn
		; b2 - dataset to receive burn
		b25 = ((b24 GT 0) AND (b2 GT 99) AND (b2 NE 2554) AND (b2 NE 2555) AND ((b2 LT 2600) OR 
(b2 GT 3000)))
		b26 = (b24 * (b25 EQ 1)) + (b2 * (b25 EQ 0))
		return, b26
end


;  *********************************
;  *** add Tahoe-EAST Vegetation ***
;  *********************************

; Generally better User's Accuracy than other Tahoe data - smaller area???
; So just burn it in, under HTNF-Sierra and over

function TEBurnValWithin, b1, b2, SrcVal, DstVal
		b3 = (b1 EQ SrcVal) * DstVal
		b4 = (((b2 GT 99) AND (b2 LT 3000)) OR (b2 GT 4000)) * b3
		b5 = (b2 * (b4 EQ 0)) + b4
		return, b5
end

function Set40, b01, b02
		; prior, Tahoe had 3000 added to it, so it occupies 3000 - 3099
		; +/- direct burns (except not over disturbed, agriculture, or water (Synth values<100)
		b03 = TEBurnValWithin(b01, b02, 3502, 3502) ; Willow
		b04 = TEBurnValWithin(b01, b03, 3503, 3503) ; Aspen
		b05 = TEBurnValWithin(b01, b04, 3504, 3504) ; Huckleberry Oak
		b06 = TEBurnValWithin(b01, b05, 3505, 3505) ; Jeffrey Pine
		b07 = TEBurnValWithin(b01, b06, 3508, 3508) ; Red Fir
		b08 = TEBurnValWithin(b01, b07, 3511, 3511) ; Ceanothus
		b09 = TEBurnValWithin(b01, b08, 3512, 3512) ; Barren
		b10 = TEBurnValWithin(b01, b09, 3513, 3513) ; Lodgepole Pine
		b11 = TEBurnValWithin(b01, b10, 3518, 3518) ; Greenleaf Manzanita
		b12 = TEBurnValWithin(b01, b11, 3519, 3519) ; Mountain Whitethorn
		b13 = TEBurnValWithin(b01, b12, 3520, 3520) ; California Juniper

		return, b13
end

;  ***************************
;  *** add NDOW Vegetation ***
;  ***************************

; Generally better User's Accuracy than other Tahoe data - smaller area???
; So just burn it in, under HTNF-Sierra and over

function NDOWBurnValWithin, b1, b2, SrcVal, DstVal
		b3 = (b1 EQ SrcVal) * DstVal
		b4 = ((b2 GT 99) AND (b2 LT 2600)) * b3
		b5 = (b2 * (b4 EQ 0)) + b4
		return, b5
end

function Set40, b01, b02
		; prior, Tahoe had 3000 added to it, so it occupies 3000 - 3099
		; +/- direct burns (except not over disturbed, agriculture, or water (Synth values<100)
		b03 = NDOWBurnValWithin(b01, b02, 3601, 3601) ;
		b04 = NDOWBurnValWithin(b01, b03, 3602, 3602) ;
		b05 = NDOWBurnValWithin(b01, b04, 3604, 3604) ;
		b06 = NDOWBurnValWithin(b01, b05, 3605, 3605) ;
		b07 = NDOWBurnValWithin(b01, b06, 3606, 3606) ;
		b08 = NDOWBurnValWithin(b01, b07, 3607, 3607) ;
		b09 = NDOWBurnValWithin(b01, b08, 3608, 3608) ;
		b10 = NDOWBurnValWithin(b01, b09, 3609, 3609) ;
		b11 = NDOWBurnValWithin(b01, b10, 3610, 3610) ;
		b12 = NDOWBurnValWithin(b01, b11, 3611, 3611) ;
		b13 = NDOWBurnValWithin(b01, b12, 3612, 3612) ;
		b14 = NDOWBurnValWithin(b01, b13, 3613, 3613) ;
		b15 = NDOWBurnValWithin(b01, b14, 3614, 3614) ;
		b16 = NDOWBurnValWithin(b01, b15, 3615, 3615) ;
		b17 = NDOWBurnValWithin(b01, b16, 3616, 3616) ;
		b18 = NDOWBurnValWithin(b01, b17, 3617, 3617) ;
		b19 = NDOWBurnValWithin(b01, b18, 3618, 3618) ;
		b20 = NDOWBurnValWithin(b01, b19, 3619, 3619) ;
		b21 = NDOWBurnValWithin(b01, b20, 3620, 3620) ;
		b22 = NDOWBurnValWithin(b01, b21, 3621, 3621) ;
		b23 = NDOWBurnValWithin(b01, b22, 3622, 3622) ;
		b24 = NDOWBurnValWithin(b01, b23, 3623, 3623) ;
		b25 = NDOWBurnValWithin(b01, b24, 3624, 3624) ;
		b26 = NDOWBurnValWithin(b01, b25, 3625, 3625) ;
		b27 = NDOWBurnValWithin(b01, b26, 3626, 3626) ;
		return, b27
end

;  ***************************
;  *** add NNHP Vegetation ***
;  ***************************

; first field observations {Pteridium, Pleopsidium, SwampCedars}
function Set41, b1, b2
		b3 = (b2 * (b1 EQ 0)) + b1
		return, b3
end

; then plot data where classified
function Set42, b1, b2
		b3 = (b2 * (b1 EQ 0)) + b1
		return, b3
end

; also Swamp Cedars using Set41



;  *********************
;  *** Final Cleaning ***
;  *********************

; remove a couple odd-balls
; these do not occur in the area, even outside the NV border
; values are replaced with SWReGAP, or nodata if SWReGAP is unavailable
function Set43, b1, b2
		; b1 = SWReGAP
		; b2 = Most recent Synth layer
		b3 = ((b2 EQ 2517) * b1) + ((b2 NE 2517) * b2) ; removes unknown type (18 pixels)
		b4 = ((b2 EQ 2601) * b1) + ((b2 NE 2601) * b3) ; removes Quercus garryana woodland 
alliance (98 pixels)
		b5 = ((b2 EQ 2632) * b1) + ((b2 NE 2632) * b4) ; removes Abies grandis forest alliance 
(1586 pixels)
		return, b5
end

; Remove SWReGAP North American Warm Desert Wash (replace with LANDFIRE)
function Set44, b1, b2
		; b1 = LANDFIRE
		; b2 = Most recent Synth layer
		b3 = ((b2 EQ 1019) * b1) + ((b2 NE 1019) * b2)
		return, b3
end

; remove odd gamble oak woodland alliance where not appropriate
; first create ROI and convert to mask for removal (mojave left out; rest covered within)
function Set45, b1, b2, b3
		; b1 mask
		; b2 SWReGAP
		; b3 Most recent Synth layer
		b4 = (((b3 EQ 2617) AND (b1 EQ 1)) * b2) + (((b3 NE 2617) OR (b1 EQ 0)) * b3)
		return, b4
end

; just within swregap + landfire systems-levels


; add phreatophytes
; Amargosa region has some value
; White Pine Co. omitted
function USGSBurnValWithin, b1, b2, SrcVal, DstVal
		; b1 phreatophyte layer
		; b2 most recent Synth layer
		b3 = (b1 EQ SrcVal) * DstVal
		b4 = (((b2 GT 99) AND (b2 LT 3000)) OR (b2 EQ 10) OR (b2 GE 4000) ) * b3
		b5 = (b2 * (b4 EQ 0)) + b4
		return, b5
end

function Set46, b01, b02
		; prior, Tahoe had 3000 added to it, so it occupies 3000 - 3099
		; +/- direct burns (except not over disturbed, agriculture, or water (Synth values<100)
		b03 = USGSBurnValWithin(b01, b02, 1, 10) ; open water
		b04 = USGSBurnValWithin(b01, b03, 2, 3651) ; submerged aquatic veg
		b05 = USGSBurnValWithin(b01, b04, 3, 3652) ; dense wetland veg
		b06 = USGSBurnValWithin(b01, b05, 10, 3653) ; open playa
		return, b06
end

; after removal of 1019, previously synonymized LANDFIRE
; classes need to be redone
; on second thought, maybe should undo synonymizing
; because 1019 will be filled with LANDFIRE values
; throughout the state

function UnSyn, b01, b02, Cur, Gap, Land
		; b01 SWReGAP+1000
		; b02 Latest Synth layer
		b03 = ((b01 EQ Gap) AND (b02 EQ Cur)) * Gap
		b04 = ((b03 GT 0) * b03) + ((b03 EQ 0) * b02)
		b05 = ((b04 EQ Cur) * Land)
		b06 = ((b05 GT 0) * b05) + ((b05 EQ 0 ) * b04)
		return, b06
end

function Set47a, b01, b02
		b03 = UnSyn(b01, b02, 100, 1052, 2495)
		b04 = UnSyn(b01, b03, 101, 1113, 2031)
		b05 = UnSyn(b01, b04, 102, 1036, 2416)
		b06 = UnSyn(b01, b05, 103, 1037, 2419)
```

```
		b07 = UnSyn(b01, b06, 104, 1047, 2503)
		return, b07
end

function Set48a, b01, b02
		b08 = UnSyn(b01, b02, 105, 1049, 2479)
		b09 = UnSyn(b01, b08, 106, 1048, 2480)
		b10 = UnSyn(b01, b09, 107, 1066, 2525)
		b11 = UnSyn(b01, b10, 108, 1082, 2553)
		b12 = UnSyn(b01, b11, 109, 1064, 2515)
		return, b12
end

function Set49a, b01, b02
		b03 = UnSyn(b01, b02, 110, 1058, 2481)
		b04 = UnSyn(b01, b03, 111, 1062, 2526)
		b05 = UnSyn(b01, b04, 112, 1076, 2535)
		b06 = UnSyn(b01, b05, 113, 1067, 2527)
		b07 = UnSyn(b01, b06, 114, 1025, 2420)
		return, b07
end


function Set50a, b01, b02
		b08 = UnSyn(b01, b02, 115, 1122, 2583)
		b09 = UnSyn(b01, b08, 116, 1121, 2581)
		b10 = UnSyn(b01, b09, 117, 1119, 2582)
		b11 = UnSyn(b01, b10, 118, 1118, 2580)
		b12 = UnSyn(b01, b11, 119, 1003, 2467)
		return, b12
end

function Set51a, b01, b02
		b03 = UnSyn(b01, b02, 120, 1031, 2427)
		b04 = UnSyn(b01, b03, 121, 1100, 2432)
		b05 = UnSyn(b01, b04, 122, 1088, 2537)
		b06 = UnSyn(b01, b05, 123, 1051, 2504)
		b07 = UnSyn(b01, b06, 124, 1054, 2482)
		return, b07
end

function Set52a, b01, b02
		b08 = UnSyn(b01, b02, 125, 1027, 2444)
		b09 = UnSyn(b01, b08, 126, 1030, 2447)
		b10 = UnSyn(b01, b09, 127, 1034, 2453)
		b11 = UnSyn(b01, b10, 128, 1069, 2406)
		b12 = UnSyn(b01, b11, 129, 1022, 2411)
		return, b12
end

function Set53a, b01, b02
		b03 = UnSyn(b01, b02, 130, 1023, 2412)
		b04 = UnSyn(b01, b03, 131, 1041, 2507)
		b05 = UnSyn(b01, b04, 132, 1026, 2455)
		b06 = UnSyn(b01, b05, 133, 1024, 2457)
		b07 = UnSyn(b01, b06, 134, 1101, 2458)
		return, b07
end

function Set54a, b01, b02
		b08 = UnSyn(b01, b02, 135, 1060, 2487)
		b09 = UnSyn(b01, b08, 136, 1061, 2488)
		b10 = UnSyn(b01, b09, 137, 1094, 2508)
		b11 = UnSyn(b01, b10, 138, 1105, 2491)
		b12 = UnSyn(b01, b11, 139, 1071, 2546)
		return, b12
end

; Remove cliff and canyon again (some was returned, above)

; re-do swamp cedars, altered andesite, and plot pixels with Set41 and Set42

; must revise some values again (not sure how these came back...)
function Set56, b01
		b03 = ChangeVal(b01, 1110, 10)
		b04 = ChangeVal(b03, 2011, 10)
    b05 = ChangeVal(b04, 1111, 22)
		b06 = ChangeVal(b05, 1112, 23)
		b07 = ChangeVal(b06, 1116, 50) ; recent burn
    b08 = ChangeVal(b07, 1114, 80)
		return, b08
end

; Set43 once more to remove LANDFIRE Abies Grandis
; that returns some cliff and canyon - just leave it
```