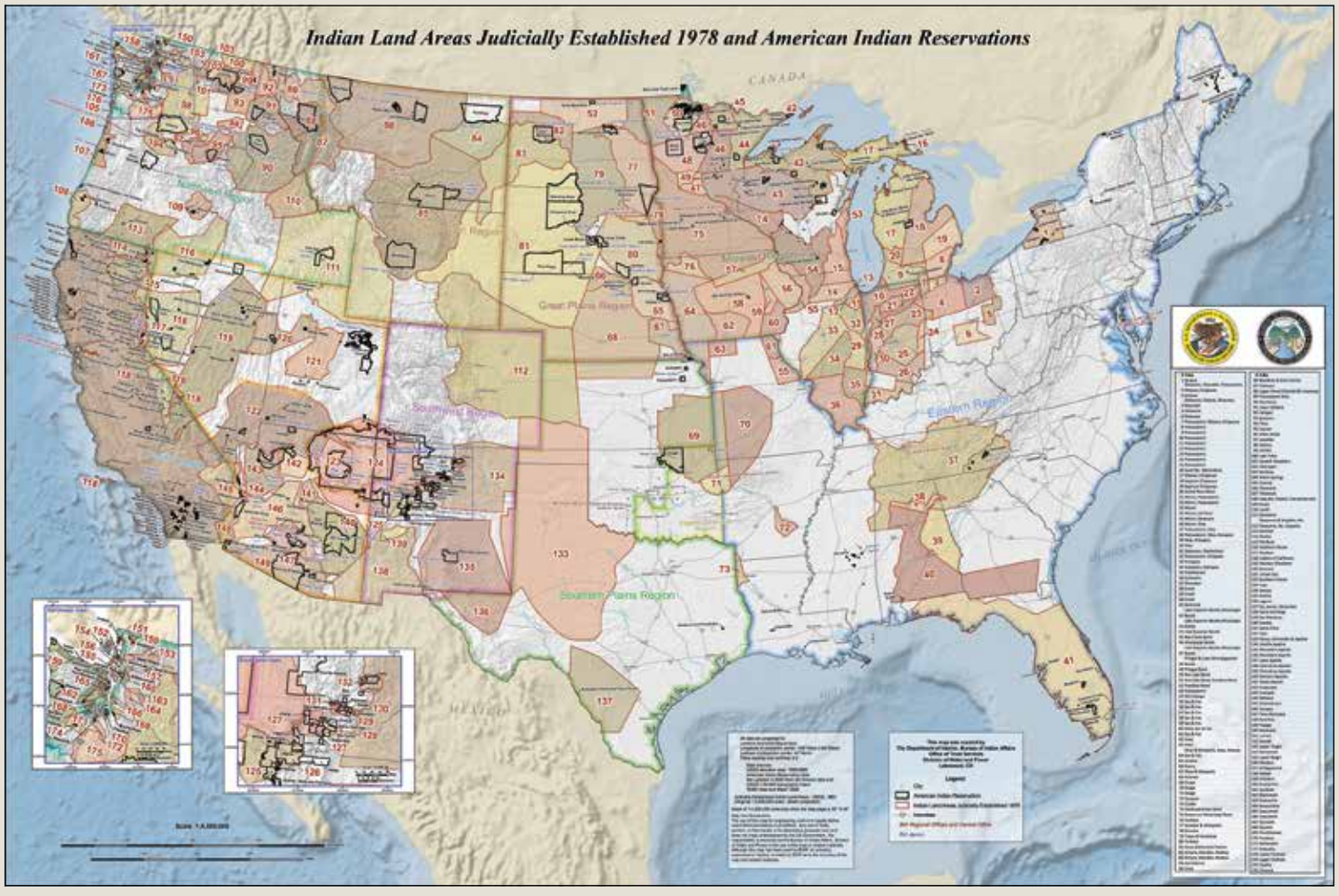
US DEPARTMENT OF THE INTERIOR

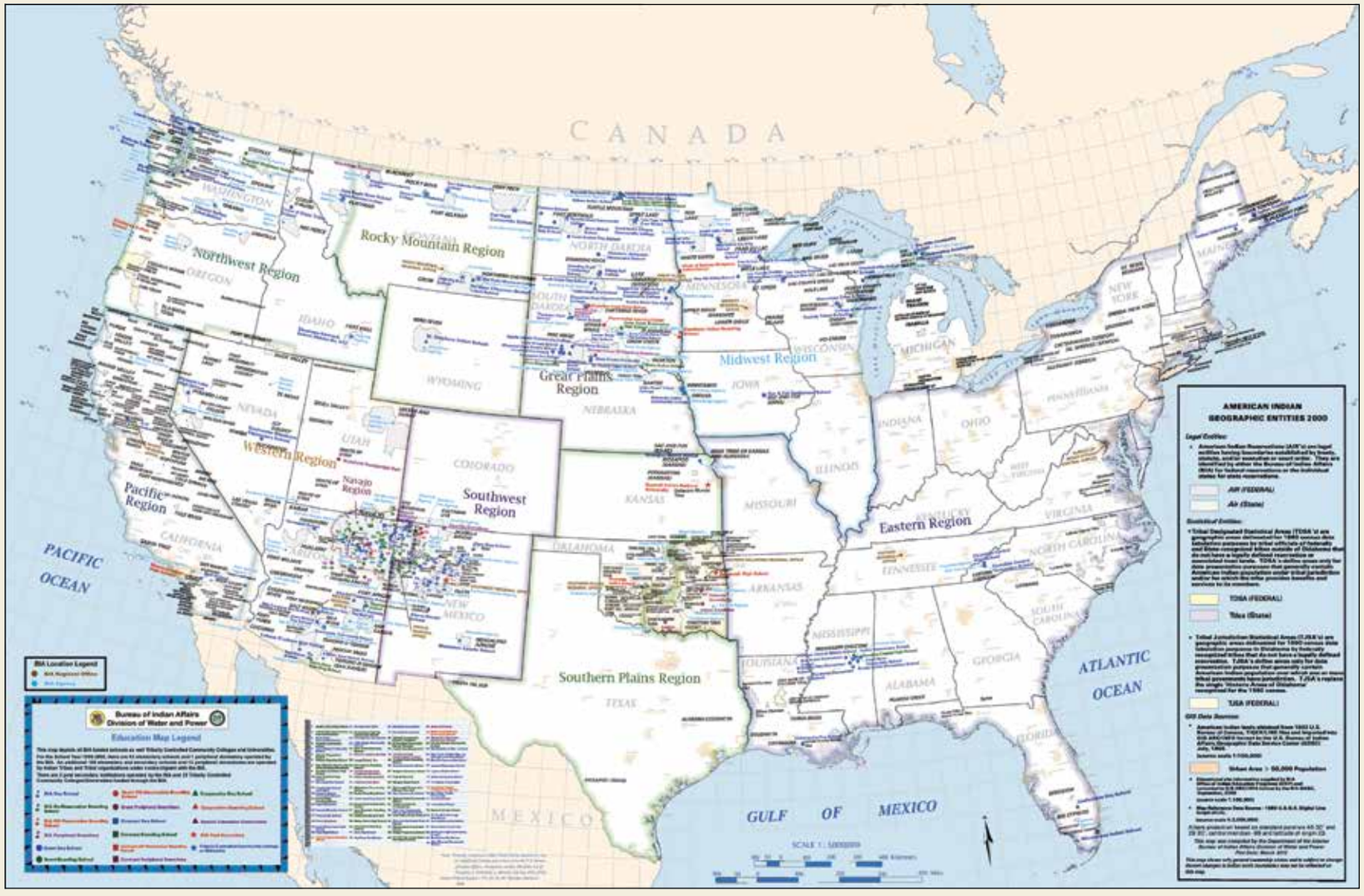
The US Department of the Interior honors and protects the nation's natural resources, heritage cultures, and tribal communities. The department uses GIS for natural resource management, habitat restoration, land-use planning, and facilities management. GIS is also used for modeling and predicting potential scenarios such as the impact of climate change on endangered species and other wildlife.

Indian Land Areas Judicially Established 1978 and American Indian Reservations



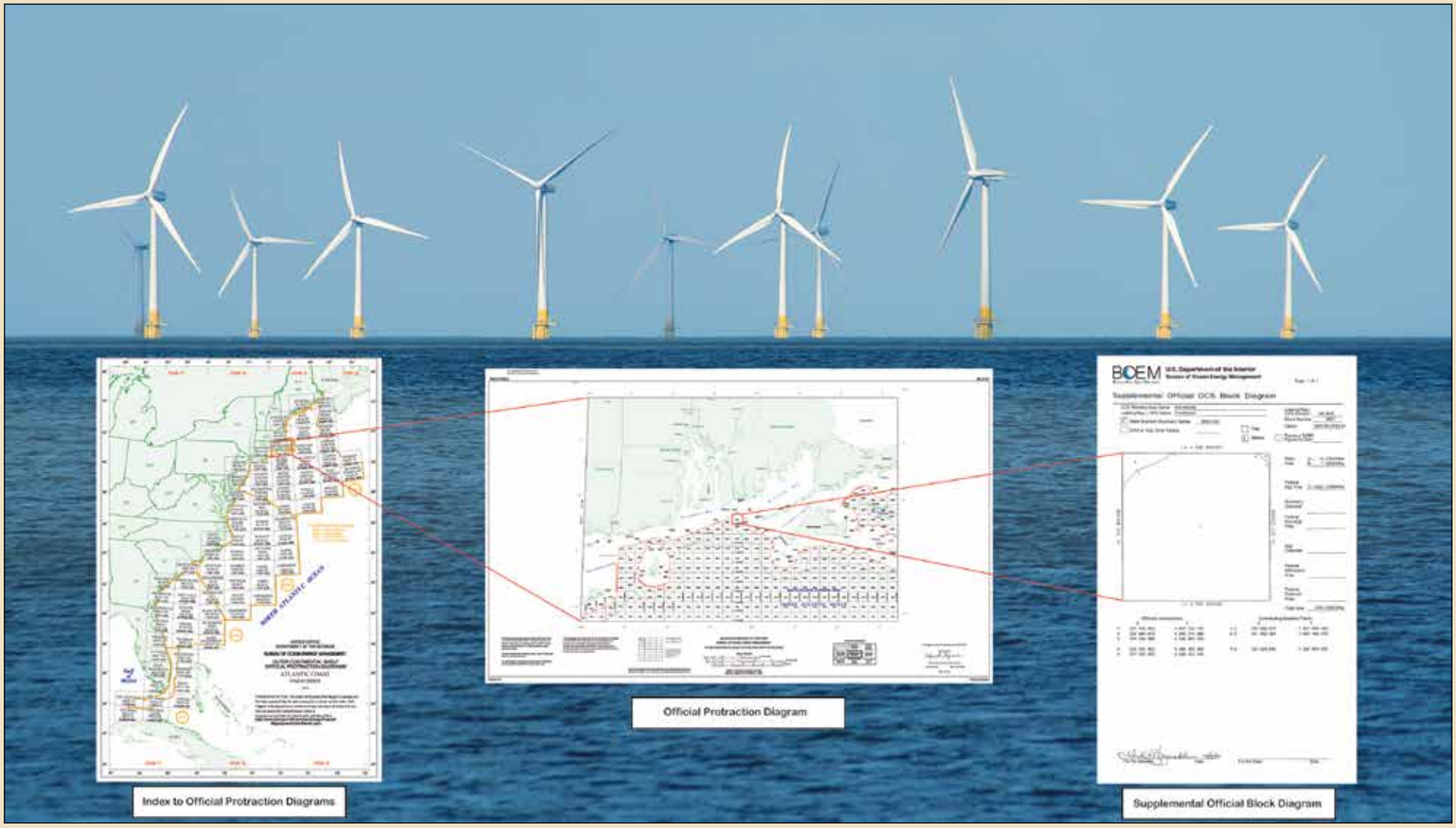
Judicially established Indian lands are based on information provided by the Indian Claims Commission. The Indian Claims Commission was established by Congress in 1946 to settle land claim disputes between American Indians and the US government. This map portrays the 1978 judicially established American Indian land areas that resulted from the cases before the US Indian Claims Commission or US Court of Claims in which an American Indian tribe proved its original tribal occupancy of a tract within the continental United States. These areas are shown in relation to the federally recognized tribal entity boundaries last updated in 2005 along with the Bureau of Indian Affairs (BIA) and regional office locations. The raster data layer used for this map was rectified and then digitized using ArcGIS for Desktop. The source of this data is from the 1993 US Geological Survey (USGS) map *Indian Land Areas Judicially Established 1978* (original 1:4,000,000 scale, Albers projection). Each tract is outlined with a solid black line. The number on each tract refers to the Indian land area map index in the commission's final report. A dashed line around an area indicates that the case was settled before an exact area was defined. Adjacent tracts with the same color indicate a tribal relationship. Otherwise, the color is arbitrary.

Educational Centers in Indian Country



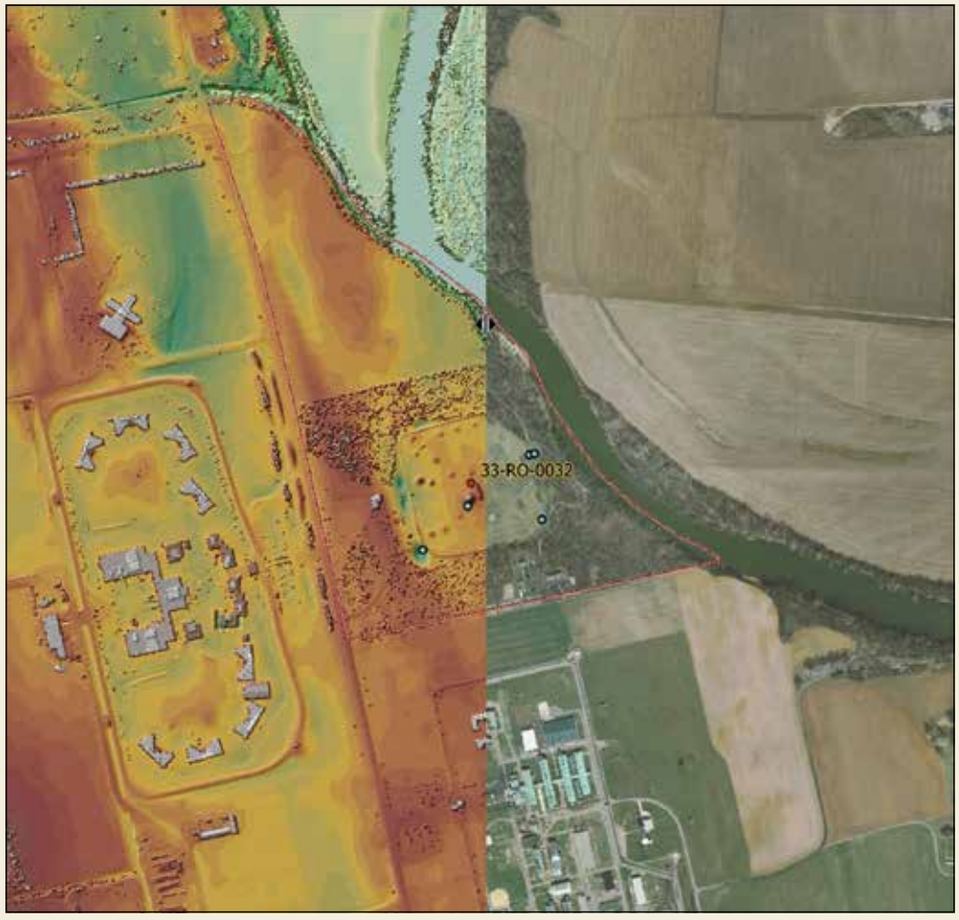
This is a general purpose map relating Bureau of Indian Affairs (BIA) organizational data with education centers in Indian country. This quick reference map for high-level coordination and planning shows the educational centers in Indian country as of the fall of 2000, along with BIA agency and regional offices that support these facilities as updated to new BIA cartographic standards. This map was created by the Bureau of Indian Affairs Division of Water and Power (BIA-DWP) using ArcGIS for Desktop to support the Bureau of Indian Education. The BIA-DWP mission is to promote self-determination, economic opportunities, and public safety through the sound management of irrigation, dam, and power facilities owned by the BIA. The BIA-related data shown in this map was created by the agency's Geographic Data Service Center using multiple sources as base layers. This map is representative of the nationwide BIA cartographic support that BIA-DWP provides.

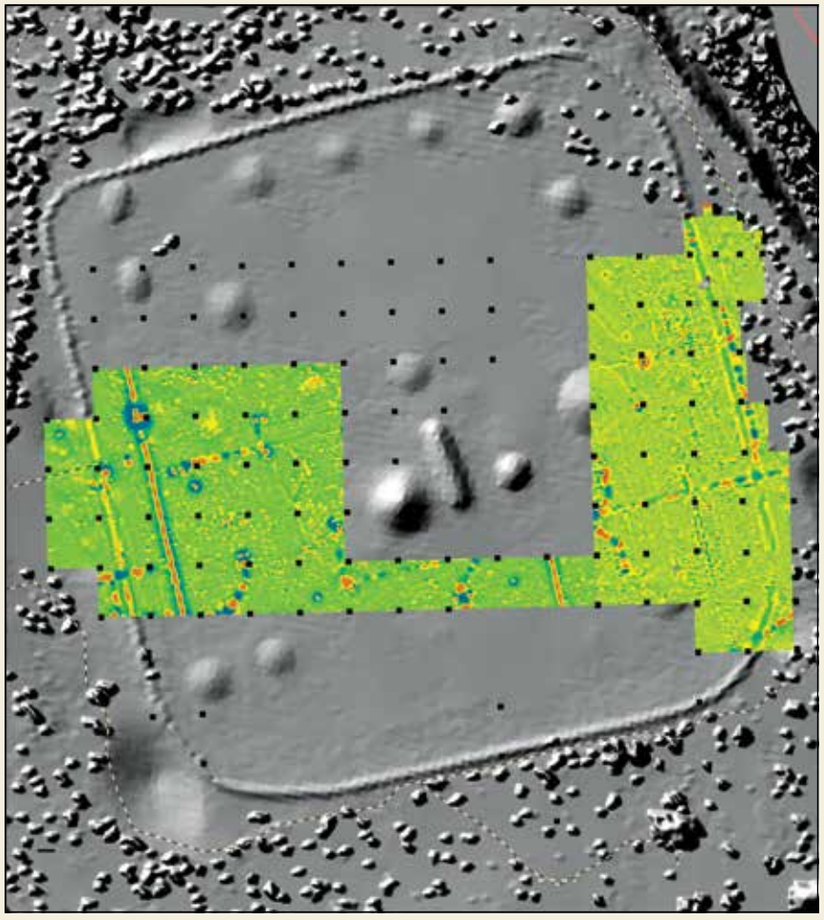
Primary Mapping Products Used by BOEM



This graphic shows three primary mapping products used by the Bureau of Ocean Energy Management (BOEM) to identify the official marine cadastre for the Outer Continental Shelf (OCS) areas of the United States. The marine cadastre is a comprehensive spatial data infrastructure whereby rights, restrictions, and responsibilities in the marine environment can be assessed, administered, and managed. The marine cadastre includes the lease block grids and various offshore boundaries, which provide the base for nearly all BOEM offshore maps and leasing processes. It also gives BOEM the means to define, describe, analyze, and account for every acre/hectare of federal offshore submerged lands. The map at left is an index to the Official Protraction Diagrams (OPDs) for the Atlantic Ocean. The Providence OPD is displayed in the middle, reflecting the OCS blocks and boundaries. The Supplemental Official OCS Block Diagram for block no. 6617 is shown in detail on the right. These mapping products, generated using ArcGIS for Desktop, allow BOEM to lease the individual blocks to conventional energy (oil and gas) companies as well as for renewable energy projects, such as wind turbines.

Digital Archeological Basemap: Hopewell Culture National Historical Park

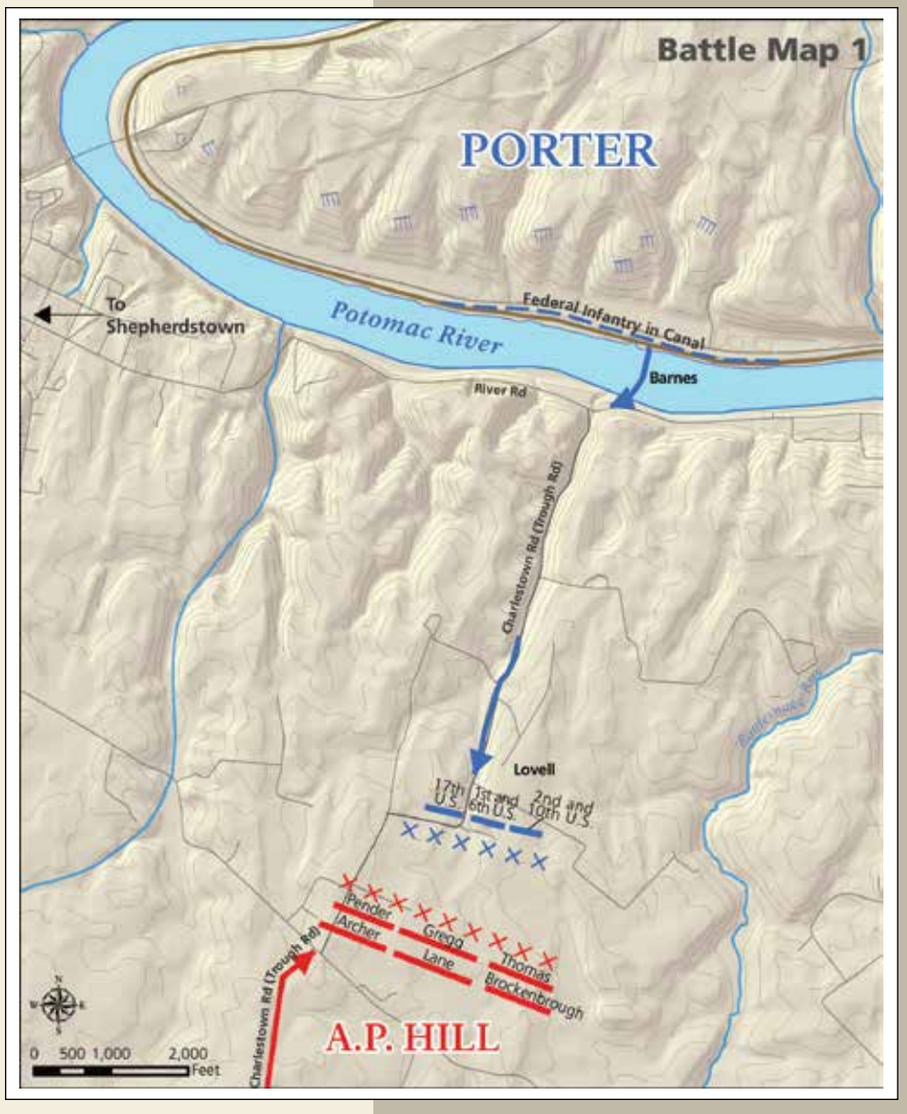


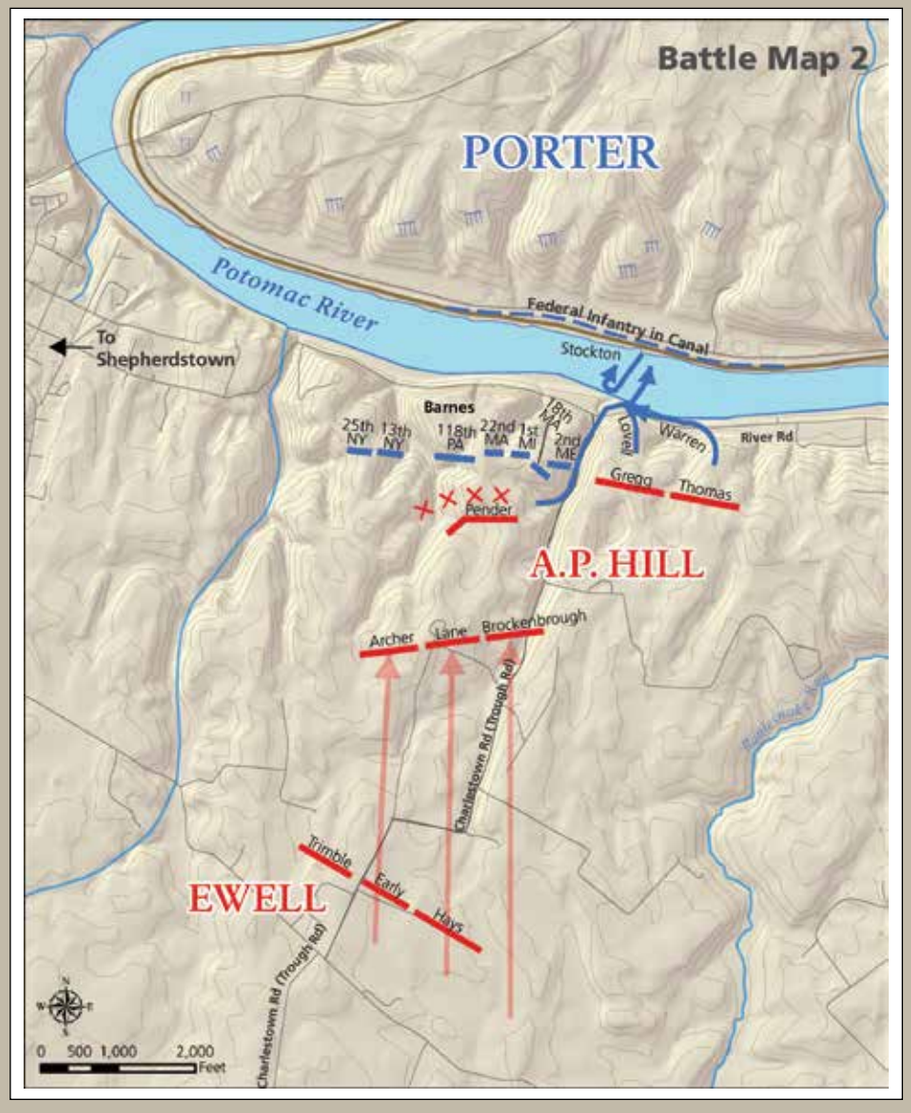


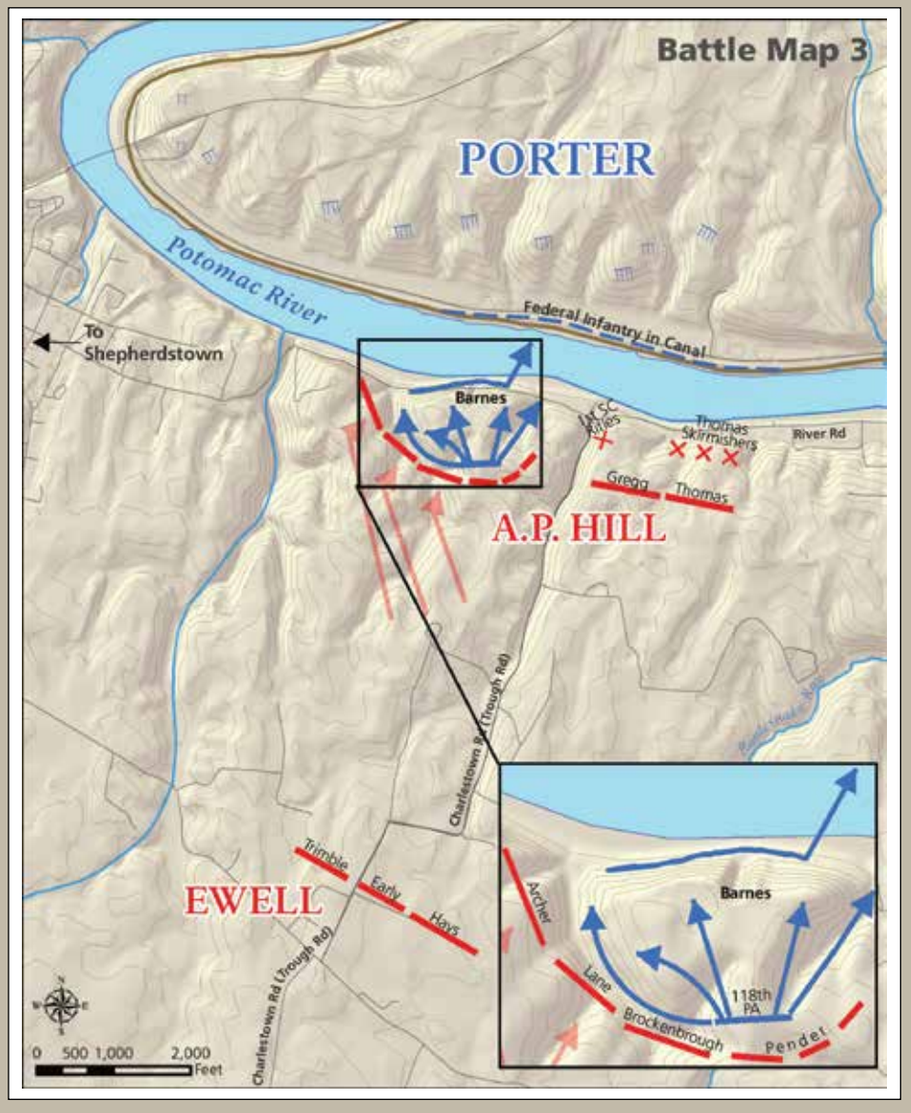
The National Park Service (NPS) Midwest Archeological Center (MWAC) provides archeological resource management services to nearly sixty national park units in thirteen midwestern states. Maintaining an up-to-date GIS with archeological site and inventory spatial data is an integral part of these services. To assist staff with National Historic Preservation Act section 106 review, archeological project planning, and other research projects, MWAC developed a standardized digital archeological basemap. ArcMap MXD templates integrate the GIS with nonspatial attribute information stored in several relational databases. By compiling map packages for download, the data is now being provided to both MWAC and park staff in a way that seamlessly combines all the spatial and nonspatial information needed for efficient project planning. Each MXD template is also equipped with a standard layout to aid in professional publication of GIS maps. This basemap for the Hopewell Culture National Historical Park in south central Ohio provides an example of the data-driven and aesthetic aspects of this critical planning, communication, and management tool. The close-up map depicts a magnetometer survey, which systematically measures the earth's magnetic field. Archeological magnetic anomalies can be caused by subsurface features, including pits filled with relatively more magnetic topsoil, burned earth, or any number of metallic artifacts. Accurately mapping these anomalies on the earth's surface helps archeologists target future excavations.

Shepherdstown Battlefield Special Resource Study

The National Park Service (NPS) has begun a special resource study of the Shepherdstown battlefield in West Virginia. In 2009, Congress passed legislation directing the NPS to evaluate the national significance of the battlefield. As part of the study, a series of maps and GIS datasets were created using ArcGIS for Desktop. These maps display troop movements of the Confederate and Union armies on September 20, 1862, during one of the bloodiest one-day battles in what is now West Virginia. The maps were used in a newsletter for public meetings in Shepherdstown and Harpers Ferry, West Virginia, to inform and educate the public about the cultural and historical importance of the battle. An iterative approach to developing these maps and data began with simple US Geological Survey topographic basemaps of the battlefield area. The basemaps were mailed to contractor Thomas McGrath, Civil War historian and history instructor at North Country Community College in Saranac Lake, New York. Thomas drew by hand such battle features as the initial locations of the Confederate and Union armies, location and direction of Union artillery, and specific troop movements. The NPS then digitized the features into a series of six maps. Details of topography and artillery rotation were evaluated and included in the attribute tables. For the public newsletter, various cartographic methods, including transparency levels, were applied by NPS GIS staff to represent previous troop movements into a comprehensive three-map sequence from the original series of six maps.

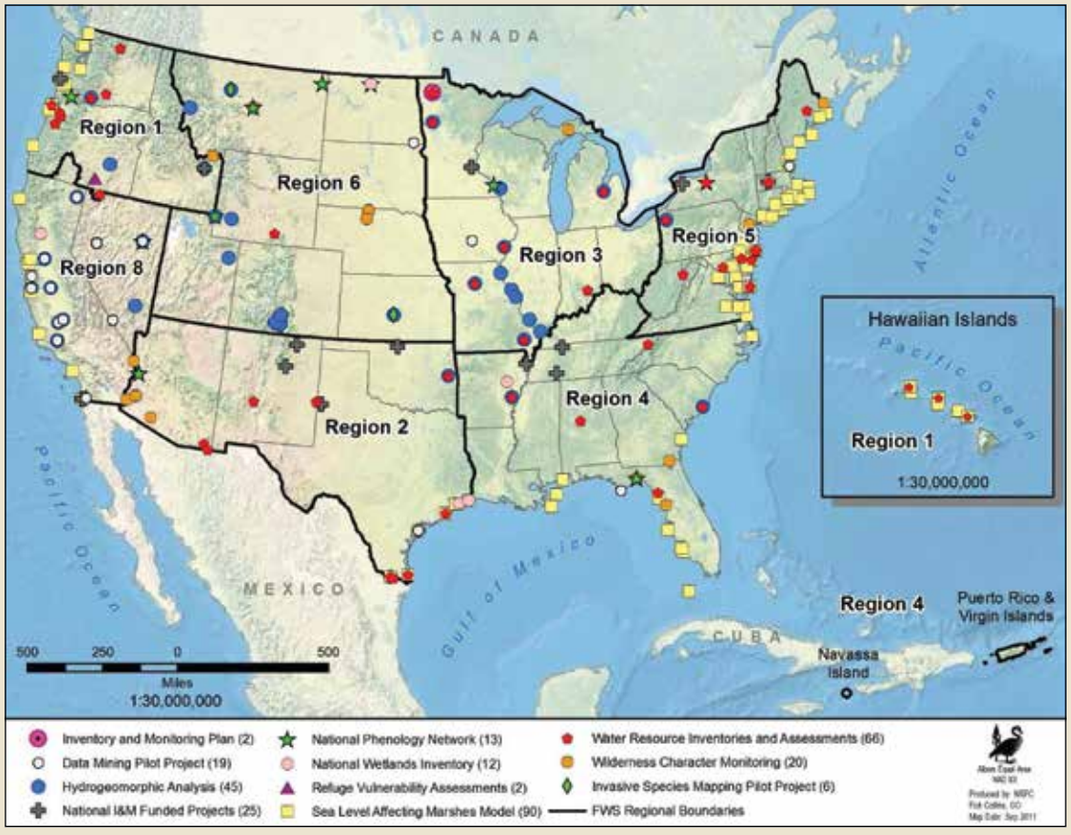


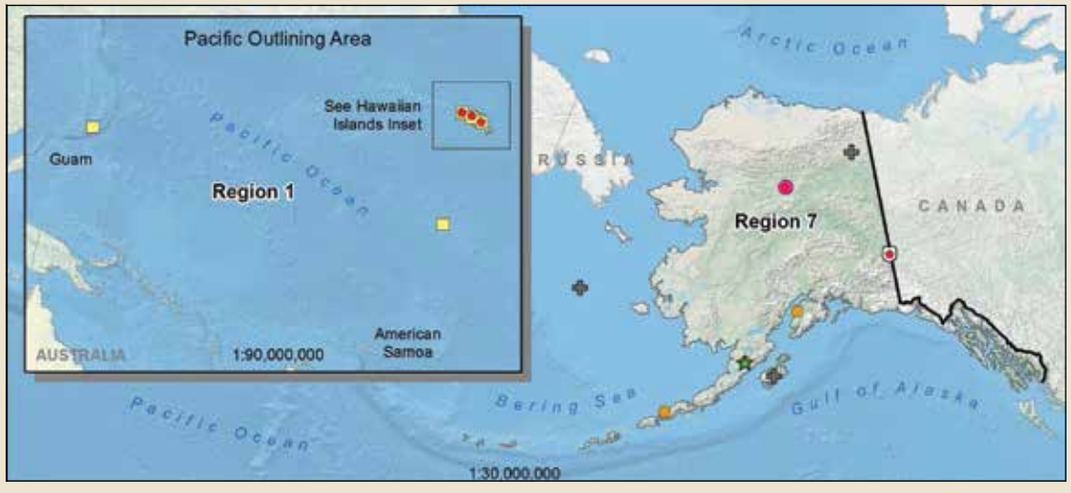

Battle Map 2
PORTER
Potomac River
Federal Infantry in Canal
To Shepherdstown
Stockton
Barnes
25th NY
13th NY
118th PA
22nd MA
1st MI
19th MA
2nd ME
Lovell
Warren
River Rd
Gregg
Thomas
Pender
A.P. HILL
Archer
Lane
Brockenbrough
Charlestown Rd (Trough Rd)
Trimble
Early
Hays
EWELL
0 500 1,000 2,000 Feet


Battle Map 3
PORTER
Potomac River
Federal Infantry in Canal
To Shepherdstown
Barnes
14th SC Rifles
Thomas Skirmishers
River Rd
Gregg
Thomas
A.P. HILL
Charlestown Rd (Trough Rd)
Trimble
Early
Hays
EWELL
Archer
Lane
Brockenbrough
118th PA
Pender
0 500 1,000 2,000 Feet

Inventory and Monitoring Achievement Tracker (IMAT) FY2011 Project Status Map

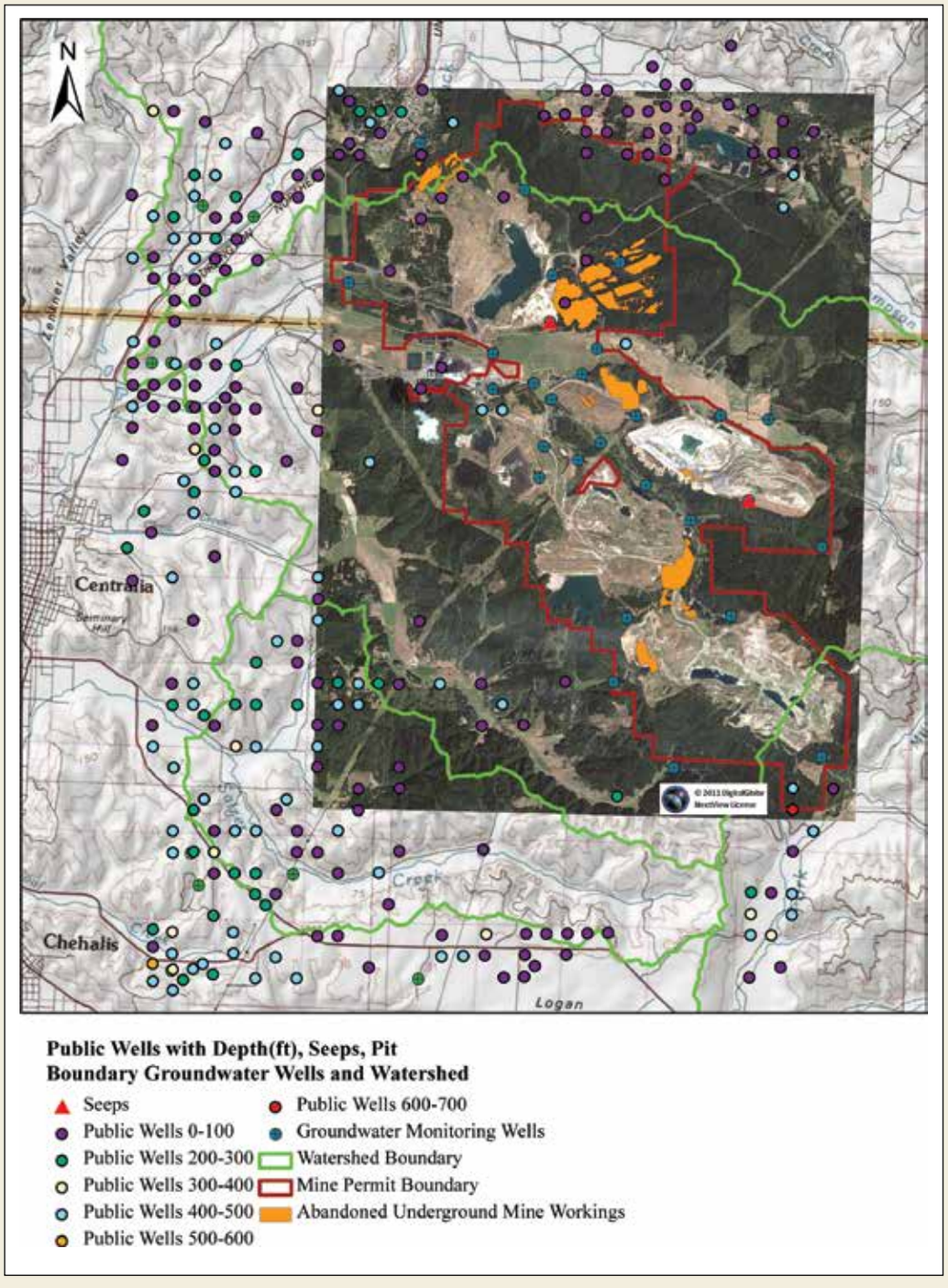
Inventory and monitoring have long been vital to the biological program of the National Wildlife Refuge System (NWRS) and have been used to inform local management actions. The need to inform adaptation strategies at multiple geographic scales means that the information must be easily accessible, standardized, and managed according to data standards of the federal government and, more specifically, in the Department of the Interior. As part of the Natural Resource Program Center (NRPC), the Inventory and Monitoring (I&M) initiative assists local managers and staff at national wildlife refuges by providing standardized, peer-reviewed scientific protocols and data to evaluate the effects of management actions. I&M streamlines and enhances the refuge system's scientific capacity by ensuring that data and other information are readily available through the implementation of a centralized data management system, thus reducing redundancy in data collection and synthesis. The Inventory and Monitoring Achievement Tracker (IMAT) database has been designed to help the national I&M office facilitate tracking of any I&M funded projects. The IMAT database can be used by regional and national I&M staff to identify common project activities occurring across the NWRS. The IMAT database connects to ArcGIS for Desktop to produce project status maps. These maps are produced on a quarterly basis and posted on SharePoint. The information in IMAT is used by the national I&M coordinator to produce status maps and statistics for the annual report.





Groundwater Location Map

The *Groundwater Location Map* is part of an ongoing cumulative hydrologic impact analysis being compiled by hydrologists at the Department of the Interior's Office of Surface Mining Reclamation and Enforcement (OSM). GIS technology, such as ArcGIS for Desktop, is used by OSM to help facilitate comprehensive analysis of groundwater location with respect to public and domestic wells within a watershed that has undergone previous mining. The watershed featured in this map focusing on an area near Centralia, Washington, also has ongoing reclamation activities. GIS allows OSM to look at groundwater from both pre- and postmining perspectives and predict potential impacts to water quality and quantity. Geomorphic reclamation is also expedited by comparing pre- and postmining topography using ArcGIS Spatial Analyst. This technology helps OSM administer the Surface Mining Control and Reclamation Act of 1977 to ensure that the coal is mined properly and the environment protected.

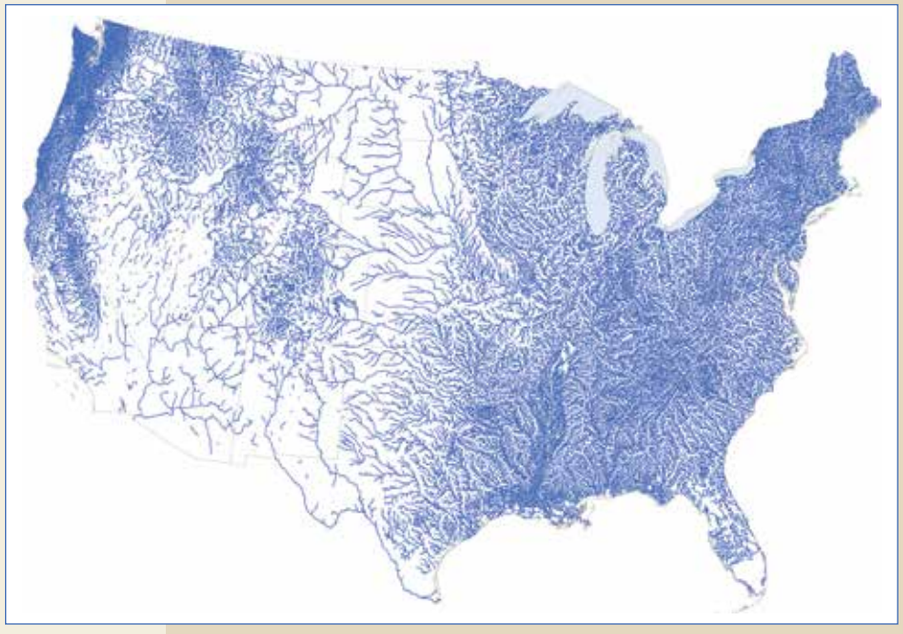


Methodology for Producing a Hydrographically Accurate Small-Scale Map of the United States

This project explores an approach to produce a small-scale representation of rivers of the conterminous United States by generalizing the 1:100,000-scale National Hydrography Dataset Plus (NHDPlus). The purpose is to show a cartographically balanced view of streams in the conterminous United States based on natural flow volume. Traditional cartography tends to underrepresent rivers in wet areas and overrepresent rivers in arid areas. The goal of this project is to strike a balance between cartographic and hydrologic representations, with the intent to improve on traditional cartographic methods to better convey the water resources of the United States. An associated goal is to establish the flow-volume criteria for this process so that it is easily repeatable as the NHDPlus is updated.

The first map in the series is the *North American Atlas* hydrography, intended for display at 1:10,000,000 scale. It shows cartographic balance, but the hydrography is misleading. For example, arid areas in the West show a similar density of flow lines to wetter areas in the East. The second map shows NHDPlus streams with flow volumes of greater than ten cubic feet per second, making the map so dense it is almost unreadable. The third map illustrates a greater threshhold volume of five hundred cubic feet per second, but the hydrography of the arid West remains misleading, with large areas devoid of features.

The final output of the process (upper right on the next page) is a map showing balance between cartographic and hydrologic representations. For the map to appear cartographically balanced, each of the eighteen hydrologic regions in the NHDPlus has its own base flow-volume threshold. In many cases, hydrologic regions have been divided into subregions, each with its own localized base flow volume threshold. In the legend accompanying this final map, the thickness of the flow lines represents the flow volume in cubic feet per second. These maps were created using ArcGIS for Desktop, exported as PDFs, and then printed with a Hewlett-Packard 5500 plotter.



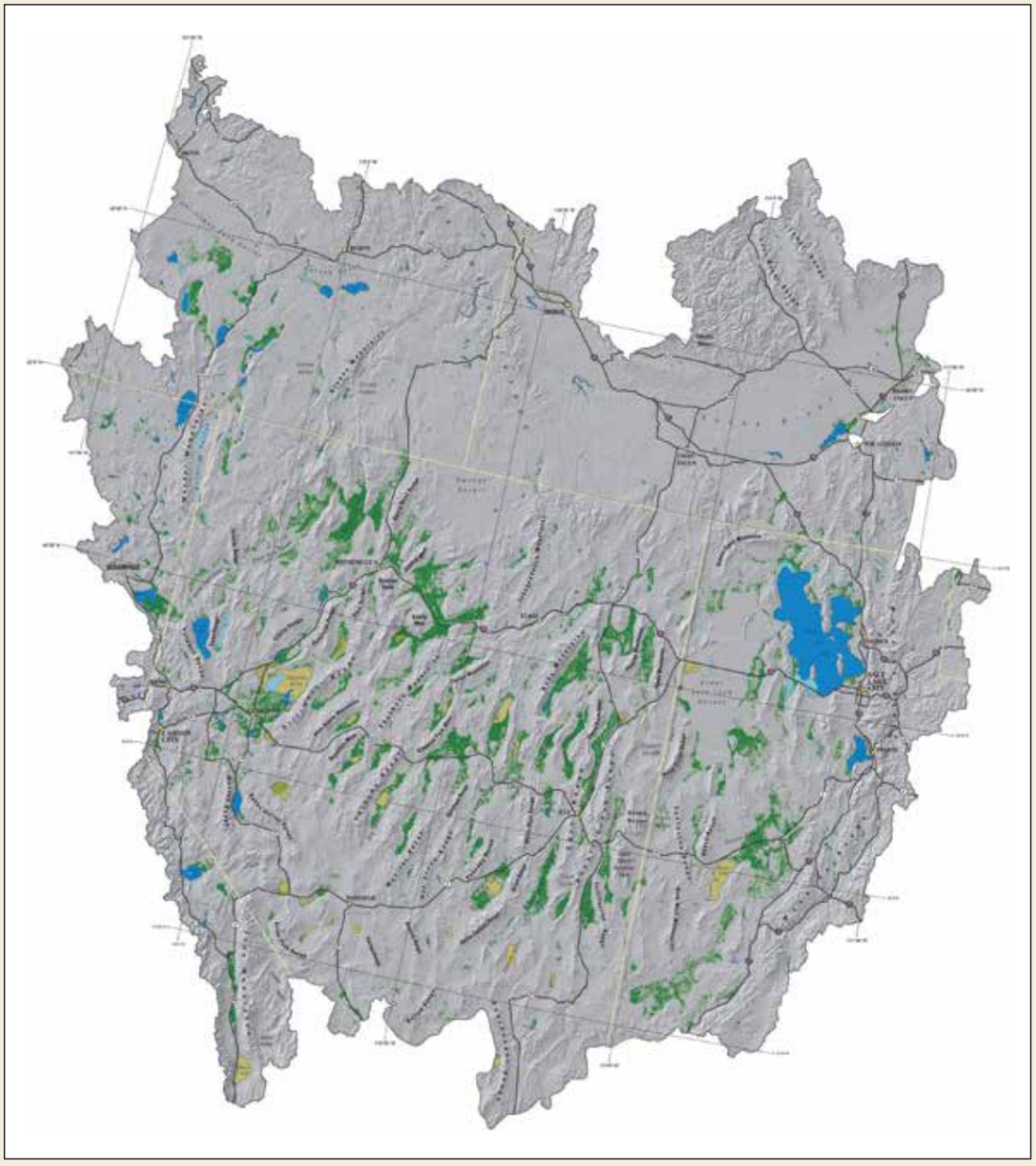
Flow volume in cubic feet per second

10 - 13	1,654 - 3,024
14 - 19	3,025 - 5,538
20 - 30	5,539 - 10,146
31 - 50	10,147 - 18,592
51 - 86	18,593 - 34,073
87 - 152	34,074 - 62,450
153 - 273	62,451 - 114,464
274 - 496	114,465 - 209,805
497 - 904	209,806 - 384,564
905 - 1,653	384,565 - 704,894

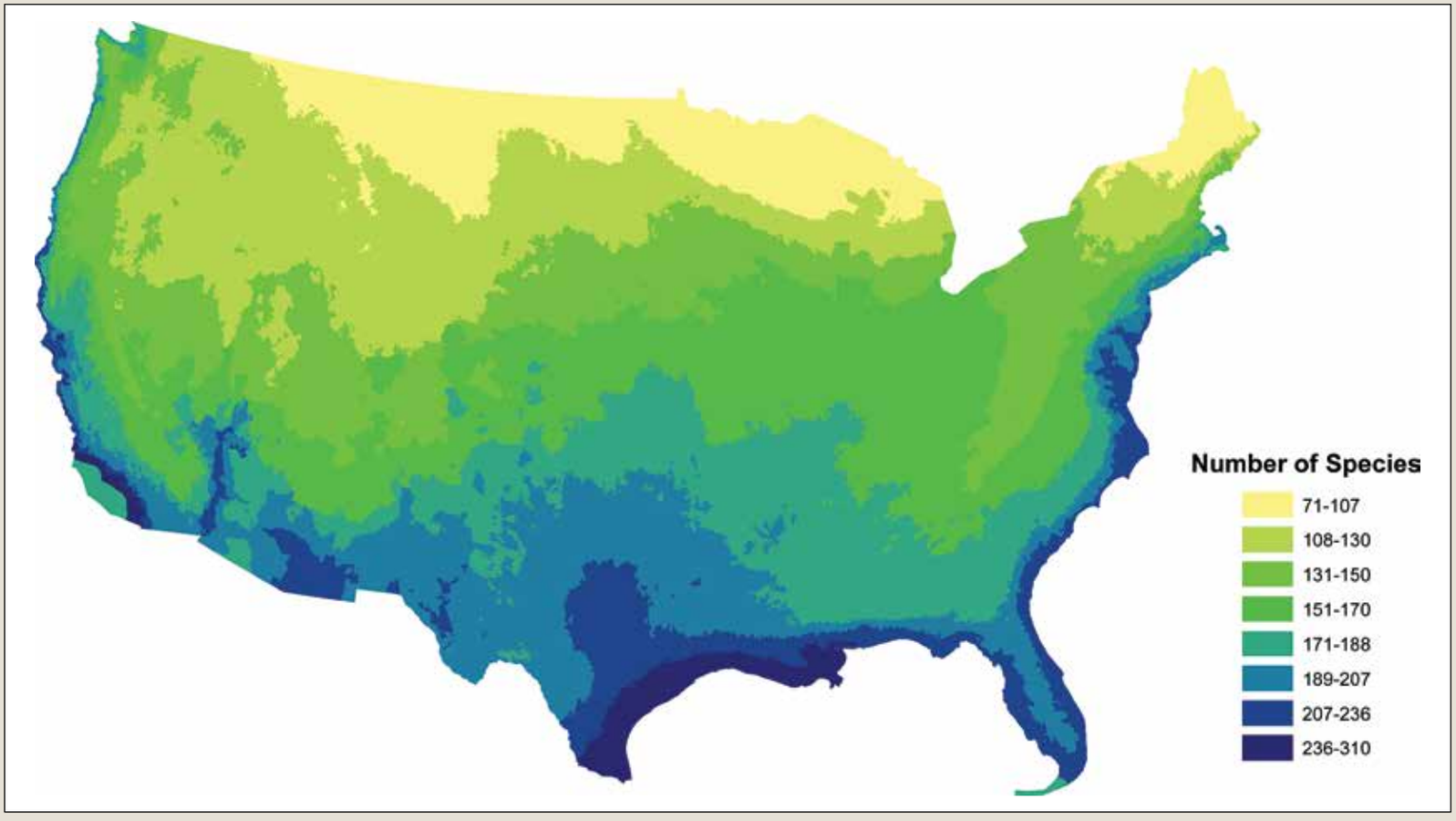
Phreatophytic Land Cover of the Northern and Central Great Basin Ecoregion: California, Idaho, Nevada, Utah, Oregon, and Wyoming, 2011

Phreatophytic plant communities that depend on groundwater are susceptible to natural and anthropogenic changes to hydrologic flow systems. Increasing water use and changing climate in the Great Basin of the western United States are likely affecting the distribution of phreatophytic vegetation (plants that draw most of their water from a permanent ground supply) in the region. The purpose of this map is to delineate areas of the Great Basin that have the greatest potential to support phreatophytic vegetation. The map was created using ArcGIS for Desktop and Adobe Illustrator CS4 software. Several datasets were used to develop the data displayed on the map. They included Shrub Map, a land-cover dataset derived from the Regional Gap Analysis Program, and Gap Analysis Program (GAP) datasets for California and Wyoming. The analysis also used the surface landforms from the US Geological Survey global ecosystems mapping project data to delineate regions of the study area—based on topographic relief—most favorable to support phreatophytic vegetation. Using ArcGIS Spatial Analyst tools, phreatophytic vegetation classes identified within Shrub Map and GAP were selected and compared to the spatial distribution of selected landforms in the study area to delineate areas of phreatophytic vegetation. Results were compared to more detailed studies conducted in selected areas. A general qualitative description of the data and the limitations of the base data determined that these results provide a reasonable regional overview but should not be used as a substitute for local field analysis. The map is intended as a decision-support aide for land managers to better understand, anticipate, and respond to ecosystem changes in the Great Basin. For the full map and report, visit http://pubs.usgs.gov/sim/3169/.

Use a device with a QR code reader to access the agency's website (http://pubs.usgs.gov/sim/3169/). Some content may require Adobe Flash Player.



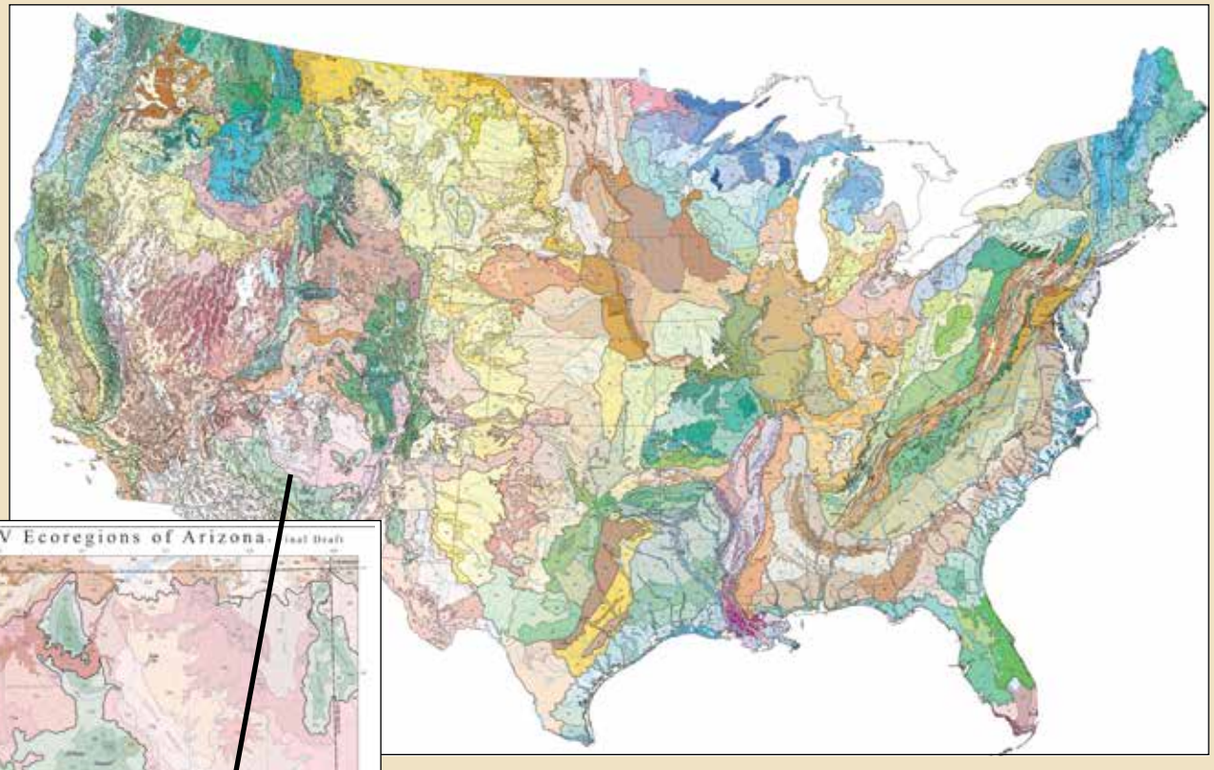
Total Bird Species Richness in the United States

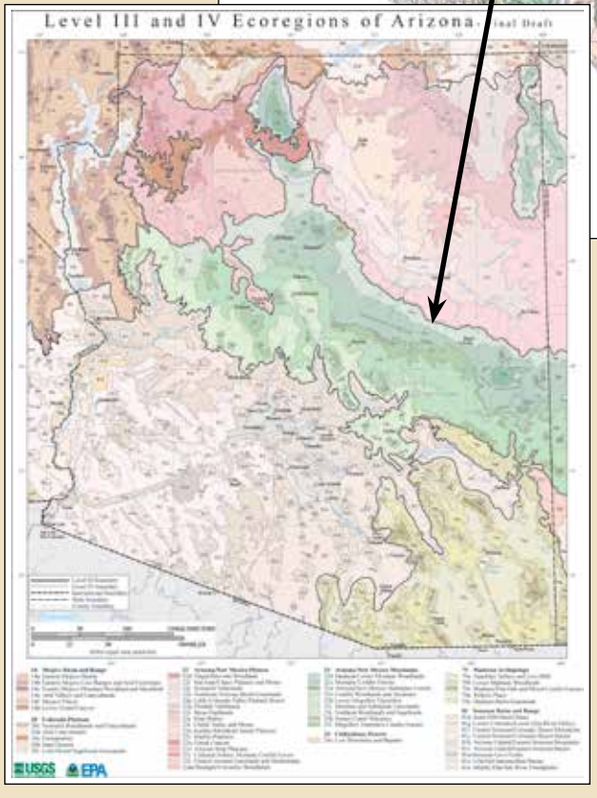


This map of bird species richness for the United States is derived from the national bird ranges dataset of the US Geological Survey Gap Analysis Program (GAP). The map represents the total number of bird species summarized by twelve-digit hydrologic unit codes (HUCs). For this map, ArcGIS for Desktop was used to conduct the spatial analysis. HUCs colored dark blue have the highest number of species, while HUCs colored yellow have the lowest. GAP is developing ranges and distribution models for more than two thousand bird, amphibian, mammal, and reptile species that spend a portion of their lives in the United States. GAP defines a species range as a coarse representation of the total areal extent of a species or the geographic limits within which a species can be found. Range maps were compiled and attributed with information from earlier regional GAP projects, the conservation organization NatureServe, and the International Union for Conservation of Nature (IUCN). Each range map contains information regarding occurrence/presence, origin, reproductive use, and seasonal use. Species range maps and distribution models developed by GAP provide valuable information regarding species geographic locations, conservation planning, and forecasting (for example, climate change). In addition to helping us understand spatial patterns of species occurrence, the data provides a basis for national biodiversity assessments and identifies species that are underrepresented or not represented at all within the current network of US protected areas. GAP produces data, tools, and analyses that help meet national challenges such as biodiversity conservation, renewable energy development, climate change adaptation, and infrastructure investment.

Level III and IV Ecoregions of the Conterminous United States

With recent projects in California and Arizona, a national map and a geospatial database of 85 Level III and 968 Level IV ecoregions of the conterminous United States are now nearly complete. The hierarchical framework of ecoregions was developed over many years in a series of collaborative projects at the state, national, and continental levels led by the US Environmental Protection Agency and US Geological Survey, with input from other federal agencies, state resource management agencies, and university and conservation organization researchers. Ecoregions are identified through the analysis of the patterns and composition of biotic, abiotic, aquatic, and terrestrial phenomena, including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. They are designed to serve as a spatial framework to help integrate the research, assessment, and monitoring of ecosystems and ecosystem components. GIS has been critical for managing, analyzing, and mapping geospatial information used to define the ecoregions, as well as for managing and mapping the final ecoregion data. These maps were created using a variety of Esri software products.

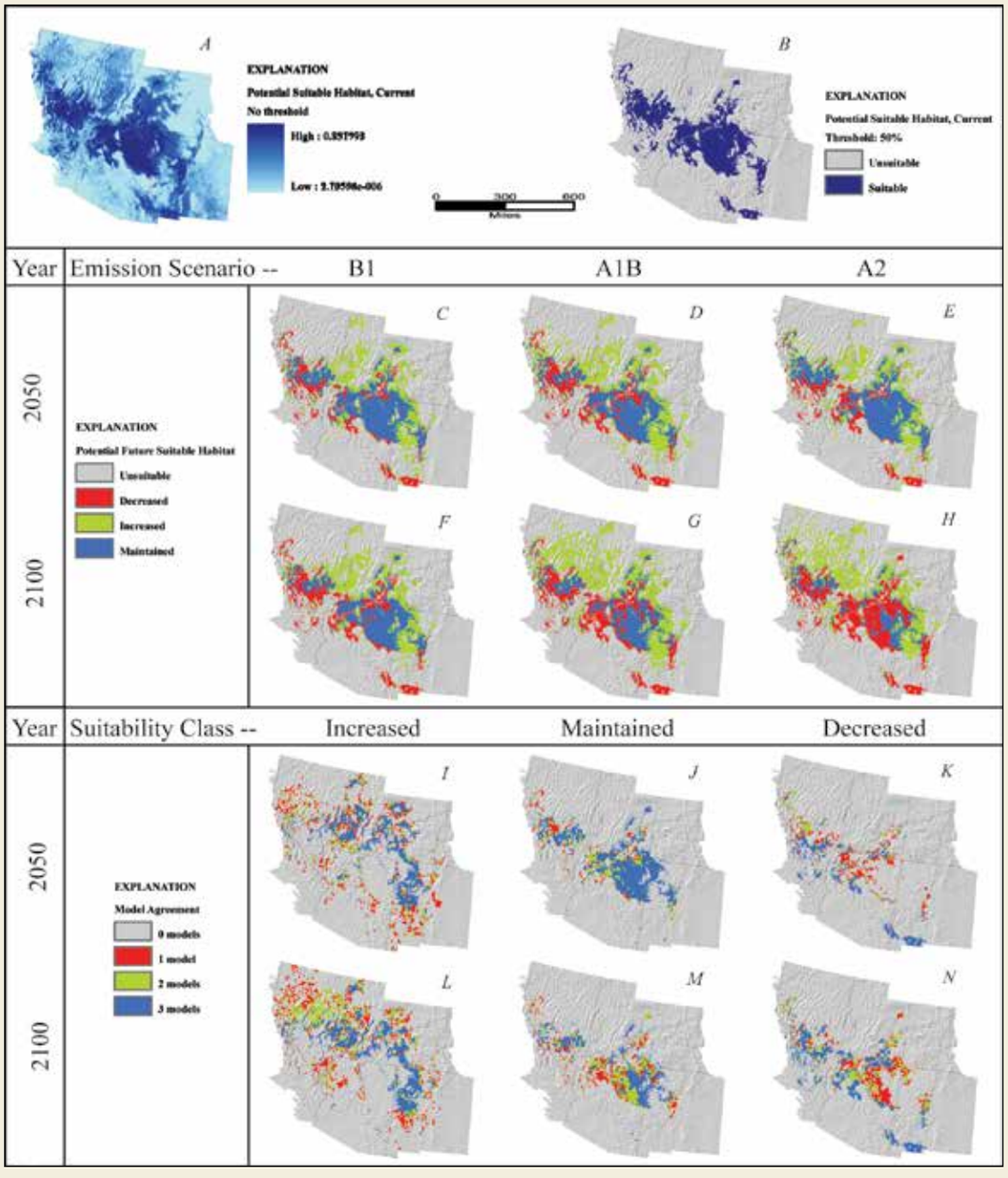




Plant Distributions in the Southwestern United States: 166 Species

This project developed predictive models of suitable habitat for characteristic plants of the US Southwest under current climate and potential future climate conditions. The research was conducted as part of the US Geological Survey's (USGS) Global Change program to examine the potential vulnerability and resiliency of plant distributions under a warming climate. The shrub species shown, *Atriplex canescens* (fourwing saltbush), is an example of the map presentation for each of the trees, grasses, and shrubs addressed in the USGS report *Plant Distributions in the Southwestern United States: A Scenario Assessment of the Modern-Day and Future Distribution Ranges of 166 Species* (http://pubs.usgs.gov/of/2012/1020/). The map display for each species illustrates the predictions using fourteen image inserts. At the top, predicted suitable habitat is illustrated for current climate as a probability distribution and with a threshold. The middle panel shows predicted change in the species' suitable habitat using three emission scenarios for climate change over two future time periods. The bottom panel shows agreement for these suitable habitat predictions among the emission scenarios. These map results provide land and resource managers with coarse spatial representations of how changes in the climate envelope of important plant species may result in range shifts. By using emission scenarios that bracket the upper and lower predictions of future climate change and by evaluating the agreement of the spatial results for each emission scenario, the maps show a range of possible habitat changes for each plant depending on how climate may change. ArcGIS for Desktop was used to prepare data for model input and process model output data.

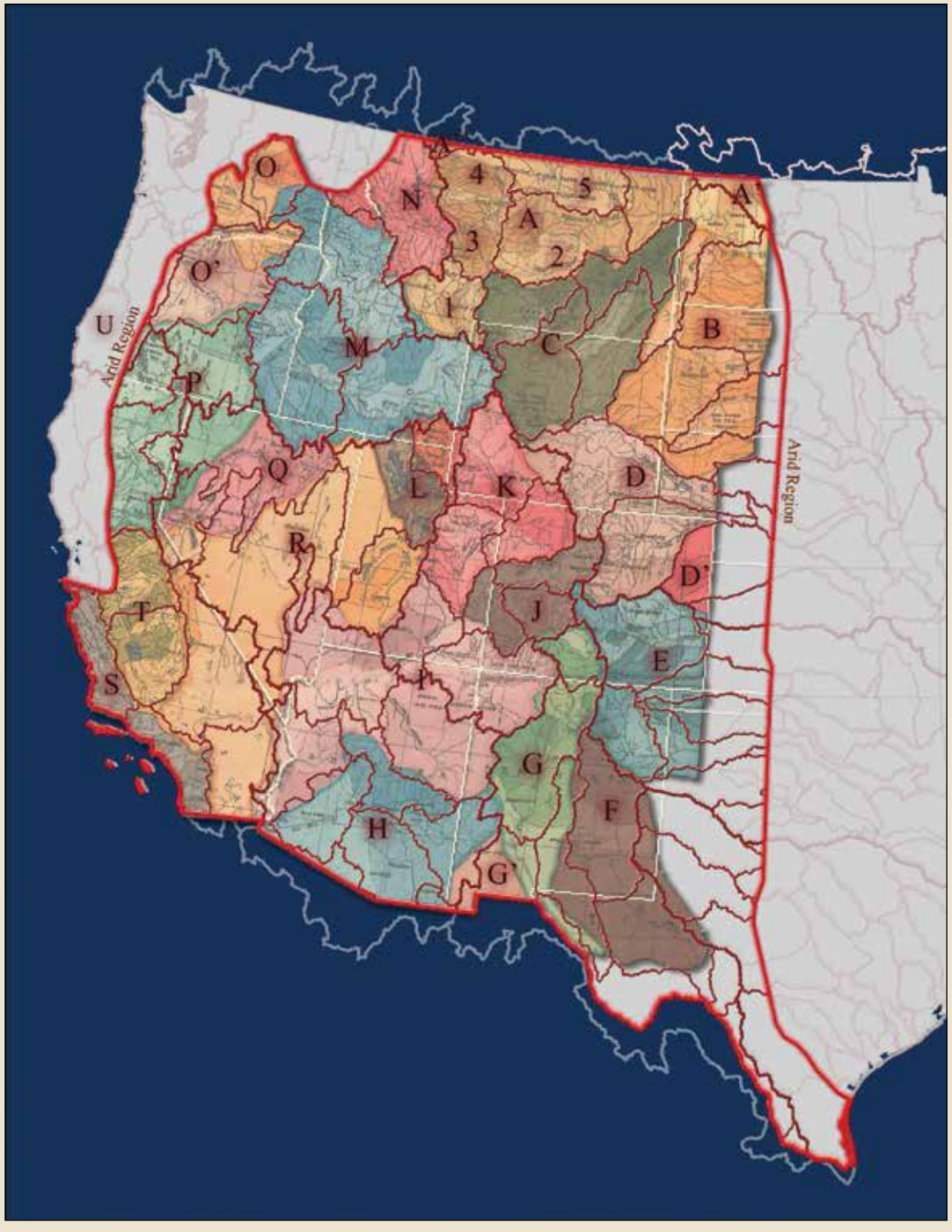
Use a device with a QR code reader to access the agency's website (http://pubs.usgs.gov/of/2012/1020/). Some content may require Adobe Flash Player.



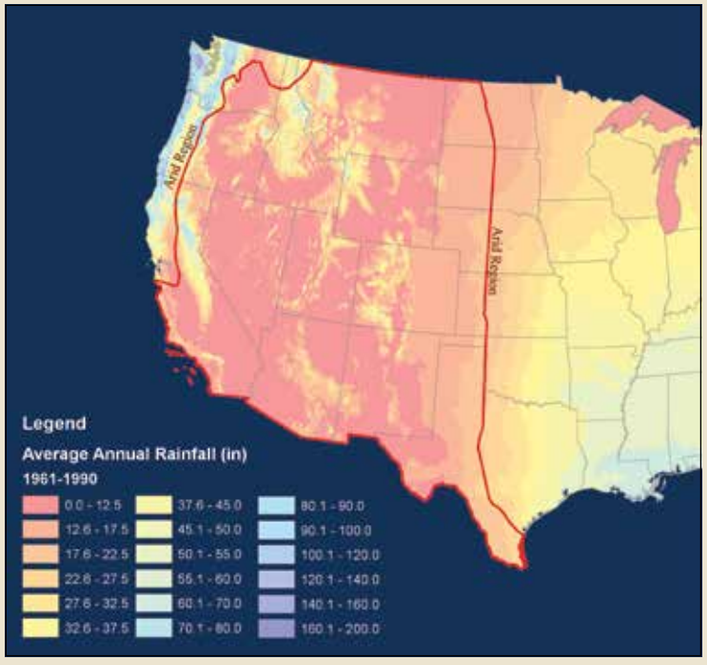
Watershed Boundary Dataset: Past and Present

The completion of the high-resolution Watershed Boundary Dataset (WBD) by the Natural Resources Conservation Service, the US Geological Survey (USGS), and partnering organizations allows a comparison of John Wesley Powell's 1890 *Arid Region of the United States* map to contemporary analytical methods. This was done by using ArcGIS software to georeference Powell's map and overlay the WBD hydrologic units over those defined by Powell. By observing this comparison, it becomes apparent that Powell's survey by horseback is remarkably accurate in describing the major drainage basins in the western United States. Only a few locations have sizable inconsistencies. For example, the well-defined Missouri River drainage outlined in both Powell's map and the WBD are very similar, while the more difficult to define Great Basin shows considerably less consistency. Powell's map of the arid region of the West was produced for the *Eleventh Annual Report of the US Geological Survey* in 1890–91 while he was agency director. Powell had hoped his map would influence the government to better use water resources in the western United States. In testimony to Congress accompanying the report in 1891, Powell explained his theory to organize the United States into another unit of government—to create a "great body of commonwealths" like county communities in the states. "Let the general government organize the arid region . . . into irrigation districts by hydrographic basins," Powell stated. This map of hydrologic basins is significant because it represents Powell's concept of the western commonwealths.

John Wesley Powell's 1890 Arid Region of the United States *map, with the western and eastern boundaries of the arid region outlined in red.*



Powell's map compared to the Watershed Boundary Dataset.



Annual rainfall from 1961 to 1990 in the arid region.

Hydrologic regions and subregions and the boundary of Powell's arid region.