PAD-US Technical Report

Prepared by the PAD-US Technical Working Group

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1 Introduction

The PAD-US Technical Working Group, comprised of government and non-government members (Table 1), began meeting in August 2008 to develop technical specifications and standards upon which a more efficient and effective national protected areas database could be based. The recommendations presented in this report are the result of many hours of collective exploration by individuals who have considerable experience and expertise.

Table 1. Members and affiliations of the PAD-US Technical Working Group.

Non-Government	
Jim Strittholt	Conservation Biology Institute
Denny Grossman	Conservation Biology Institute
Ty Guthrie	The Nature Conservancy
Demian Rybock	NatureServe
Frank Biasi	National Geographic Society
Michael Terner	Applied Geographics, Inc.
John Waugh	IUCN
Christina Supples	Conservation Biology Institute
Government	
John Reitsma	Bureau of Land Management
Andrew Grey	USDA Forest Service
Jason Bullock	Virginia Department of Conservation
Lisa Audin	USGS Gap Analysis Program
Dan Phillips	US Geological Survey

The Technical Working Group was tasked to:

1. Carry out a user assessment for a national protected areas database
2. Review existing national and regional protected areas databases to better understand our starting point
3. Provide guidance on the content of a new national protected areas database given the current status
4. Review the inherent challenges with building a national protected areas database
5. Address the known major deficiencies with existing database models, and
6. Recommend a set of database standards (geometry and core attribution) and work flow processes necessary to construct and maintain a more complete, reliable, and useful protected areas dataset.

The group was asked to make certain that any proposed solution would be technically sound, addresses the needs of identified users, and be economically sustainable into the future.

2 Existing Protected Area Databases

There are only two databases that have tried to maintain information on protected areas for the entire country – GAP Stewardship (USGS GAP Program) and CBI-PAD (Conservation Biology Institute). Others have worked regionally and have developed detailed regional datasets. Examples include The Nature Conservancy in the Northeastern US (NE Secured Lands Dataset) and Ducks Unlimited in the Upper Great Lakes Region (CARL Database). Throughout later sections in this report, these efforts are frequently referred to as "first generation" databases.

2.1 Current Protected Lands Data Initiatives

2.1.1 GAP Stewardship Mapping

The U.S. Geological Survey Gap Analysis Program (GAP) supports biodiversity assessment at landscape scales. Protected lands data (the Stewardship Layer) are aggregated to compare the mapped distribution of biota with their representation in different categories of conservation status (GAP Status Codes). The primary objectives of GAP are: (1) Land Cover Mapping – to map the distributions of natural communities; (2) Animal Habitat Modeling and Mapping – to map the predicted habitat of native animal species; (3) Stewardship Mapping – to map the degree of management for biodiversity maintenance of land tracts focusing on intent; (4) Gap Analysis – to analyze the representation of biotic elements in the conservation network to identify "gaps" in long-term security; and (5) Data Distribution – to provide this information to the public and those entities charged with land use research, policy, planning, and management.

Beginning in 1996, stewardship data was aggregated for states before transitioning to multi-state regions in 2005. The national dataset (GAPUS) was originally compiled in spring 2008, following a request from the UNEP-World Conservation Monitoring Center (WCMC) for a federal submission of IUCN categorized holdings for the World Database for Protected Areas (WDPA). GAP submitted a draft geodatabase to WCMC in August 2008, with a significant update delivered in April 2009 that combined administrative boundaries with attributes of ownership, management, conservation measures and references.

2.1.2 CBI-PAD

Starting in 1998, scientists at CBI and World Wildlife Fund U.S. recognized the need for a national protected areas database that was more current and at a finer spatial scale than what existed at the time (the Managed Areas Database, or MAD). CBI began aggregating available digital data from every US state and federal agency as well as from all provinces and territories across Canada (scale 1:24,000 – 1:1,000,000) and began integrated them into a uniform GIS database structure. Each component was fully documented with all pertinent metadata information. The first version of the CBI Protected Areas Database (or CBI-PAD) was published in November 1999, and the first scientifically peer-reviewed journal article on the database appeared in the Natural Areas Journal in 2001 (DellaSala, D., N.L. Staus, J.R. Strittholt, A. Hackman, and T. Iacobelli, 2001. An updated protected areas database for the United States

and Canada. Natural Areas Journal 21:124-135). After version 1 was completed, WWF transferred all interest in the project to CBI and Canada was removed from the ongoing scope or work. Since 1999, the CBI-PAD has been used by a variety of users to conduct national and regional conservation assessments. The database has been used in several national and international reports by the USDA Forest Service (e.g., Criteria and Indicators) and it was provided to the UNEP-World Conservation Monitoring Center (WCMC) in 2006 for inclusion into the World Database for Protected Areas.

Like the GAP Stewardship database, the CBI-PAD is primarily a large data aggregation using a standard set of geometric and attribute rules. The GAP Stewardship layer has always been one important data source for the CBI-PAD, but over the 4 released national versions of the CBI-PAD, well over 150 different data sources have been used. Like the GAP Stewardship, the CBI-PAD has focused on protected areas from the standpoint of biodiversity protection and the emphasis has been on fee simple protected lands where protection is largely intended to be permanent.

2.1.3 TNC Northeast Data Partnership

The Secured Lands data set is a cooperative project led by The Nature Conservancy's Regional office, involving all the Conservancy's eastern state offices and relying on data from 14 state agencies and many private organizations. Building this dataset began in 2005 with annual updates. The focus includes all public and private lands that are permanently secured against conversion to development. The land may be owned in fee or held with an easement, but the protection must be permanent. The geographic area includes: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, District of Columbia and Ohio.

The dataset contains an ESRI shapefile with a record for each tract of land along with a set of standardized attributes describing the conservation management status, ownership, ownership type, designation, acreage and many other characteristics of the tract. Ensuring that the content of the attribute fields is consistent across the region has been a primary focus of the project. The TNC state offices have been the focal point for state compilations as staff compiles state data and private data together into the chosen standard.

2.1.4 Ducks Unlimited CARL - Upper Great Lakes

CARL (Conservation And Recreation Lands) is a GIS layer being managed by Ducks Unlimited in collaboration with The Nature Conservancy on conservation and recreation lands in the Great Lakes. Starting with a single watershed in Michigan in 2002, the effort became regional in 2003 with maintenance and enhancements ongoing. Concentrated effort has been applied to conservation easements in Michigan, Indiana, and Ohio since 2007.

At this time, CARL focuses on five Great Lakes states - Wisconsin, Michigan, Illinois, Indiana, and Ohio. The database was created by aggregating conservation and recreation lands from existing hard-copy maps and digital data available on-line. The data is managed using an ESRI

Geodatabase. The long-term goal of CARL is to provide a comprehensive picture of the protected areas in the Great Lakes to help monitor and measure the effectiveness of conservation activities in the region and to help influence decision makers to leverage even greater resources to conserve and preserve important conservation and recreational lands.

Each of the existing databases highlighted above have made significant contributions to our collective knowledge about conservation lands in the U.S. Each effort has used similar database construction methods and all have expressed some frustration with a) sustaining the data collection process, b) assuring quality in terms of geometry and attribution accuracy and completeness, and c) publishing products to an expanding and diverse user base. When combined, data on federal and state protected lands are largely complete with fair to excellent geometric and attribute accuracy. Data on local government and private protected lands is being developed rapidly now and remains one of several major next steps. In several states, the more detailed mapping of local government and private lands is well underway while in other states significant effort is needed to fill in this important gap in our knowledge.

The existing databases provide an extremely important and solid foundation upon which a more complete database can be constructed and managed into the future – one that is more complete, accurate, up-to-date, and readily available to many different types of users.

3 User Needs Evaluation

An informal user needs evaluation was conducted based on the CBI-PAD since it was the only national dataset for which extensive user history was available. From this framework, we attempted to generate an exhaustive list of users and use cases from which specific database requirements and end products could be generated. We classified the various user groups into three categories – Phase I, II and III – corresponding to the priority level and time sequencing of various database structure and content requirements for the PAD-US database (Table 2). We identified which groups would be important data providers, end users, or both. The Technical Working Group strongly believes that Phase I users must be satisfied from the outset as these are the prime constituencies from the standpoint of data generators and the most routine data consumers. Phase II groups are also important short-term users; however, many of these groups will benefit more as new content is added over time such as easement data, which is of great interest to Land Trusts and many corporations. Similarly, additional conservation measures information is of great interest to academics and other conservation practitioners. It is hoped that beginning with PAD-US version 1.1 these needs will begin to be accommodated with continual enhancements incorporated over time. Because of the level of spatial detail desired by Phase III users (parcel level in many cases), it will take additional time for the PAD-US database and products to fully meet their needs. However, we believe these users will find some value in even the earliest data versions provided.

Table 2. User assessment summary for PAD-US across three phases (Phase I = highest priority; Phase II = high priority; Phase III = medium priority).

Phase I	Phase II	Phase III
International Monitoring Organizations (end user)	Non-Land Management Federal Agencies (end user)	Local Planners (end user)
Land Management Federal Agencies (provider & end user)	Corporations (end user)	Developers/Real Estate (end user)
Large Conservation NGOs (provider & end user)	Land Trusts (provider & end user)	GIS Service Providers (end user)
State Government Agencies (provider & end user)	Small Conservation NGOs (provider & end user)	
Military (end user)	Academic Institutions (provider & end user)	
Foundations (end user)	General Public (end user)	
Publishers (end user)		

Table 3 (below) provides more detailed profiles for Phase I users with similar information for Phase II and III users provided in Appendix A. Review of the Phase I user profiles illustrates the need for the PAD-US database to be easy to construct, maintain, and update while allowing for easy customization for specific users. It is clear that not all users will want to consume the exact same data in the exact same way; therefore, careful consideration of these differences went into the technical recommendations presented in this report.

Table 3. Detailed PAD-US user profiles for Phase I users.

1. International Monitoring and Reporting Organizations			
User/Provider	Use	End Products	Database Requirements
UNEP-WCMC (end user)	For inclusion in the World Database on Protected Areas	Electronic data in WDPA standard for distribution via web publication	o Subset of the PAD-US o Needs to be modified into WDPA standard o Conservation status coding (IUCN) essential o Regular updating (annual) preferred o Date of establishment important o Small parcels (<100 ha) not priority

			o Protected areas in perpetuity only
Commission for Environmental Cooperation (end user)	For inclusion in the North American Environmental Atlas for monitoring protected areas throughout the continent	Simplified version of PAD-US for distribution via web publication	o Simple data file format and attribution preferred o Conservation status coding (IUCN) essential o Coding consistency with Mexico and Canada o Regular updating (annual) preferred o Small parcels (<100 ha) not priority o Protected areas in perpetuity only

2. Federal Land Management Agencies

User/Provider	Use	End Products	Database Requirements
USDA Forest Service (end user/data provider – Automated Lands Project)	- International accountability reporting - National planning and monitoring - Regional assessments and planning	Entire PAD-US database	o Complex data file format o Complete attribution o Conservation status codes (GAP and IUCN) essential o Protected areas in perpetuity plus additions welcomed
Bureau of Land Management (end user/data provider – National Integrated Lands System - NILS)	- National planning and monitoring - Regional assessments and planning	Entire PAD-US database	o Complex data file format o Complete attribution o Protected areas in perpetuity plus additions welcomed o Rapid movement toward transactional database to provide high level of data currency
US Fish and Wildlife Service (end user/data provider)	- National planning and monitoring - Regional assessments and planning	- Entire PAD-US database - Simplified file structure for some applications	o Simple data file format preferred o Complete attribution helpful o Conservation status codes (GAP and IUCN) essential o Protected areas in perpetuity plus additions welcomed
National Park Service (end user/data provider)	- National planning and monitoring - Regional assessments and planning - Education	- Entire PAD-US database - Simplified file structure for some applications - Some education outreach materials	o Simple data file format preferred o Complete attribution helpful o Conservation status codes (GAP and IUCN) essential o Protected areas in perpetuity plus additions welcomed

3. Large Conservation Non-Governmental Organizations

User/Provider	Use	End Products	Database Requirements
* The Nature Conservancy (end user/data provider) * NatureServe (end user/data provider) * The Wilderness Society (end user) * World Wildlife Fund (end user)	- National planning and monitoring - Regional assessments and planning - Education	- Entire PAD-US database - Simplified file structure for some applications - Some education outreach materials	o Simple data file format sometimes required o Complete attribution o Conservation status codes (GAP and IUCN) essential o Expanded conservation measures desired o Protected areas in perpetuity plus additions desired

4. Military

User/Provider	Use	End Products	Database Requirements
Air National Guard (end user)	- Risk avoidance from low flight training - FAA and Department of Defense regulation compliance	- Simplified and specifically tailored file structure	o Simple data file format required o Simplified geometry and attribution required o Additional customized attributes o Small file size o Special format to operate with Falconview software

5. State Government

User/Provider	Use	End Products	Database Requirements
Advanced State e.g., Virginia (data provider/end user)	- Regional assessments and planning - Mandated monitoring	- Entire PAD-US database	o Complex data file format o Complete attribution o Conservation status codes (GAP and IUCN) essential o More conservation measures desired o Protected areas in perpetuity plus additional desired
Less Sophisticated State (data provider/end user)	- Regional assessments and planning	- Entire PAD-US database	o Simple data file format preferred o Complete attribution o Conservation status codes (GAP and IUCN) essential o Protected areas in perpetuity plus additional desired

6. Foundations

User/Provider	Use	End Products	Database Requirements
Doris Duke Charitable Foundation (end user)	- Philanthropy guidance - Grantee accountability	- Simplified version of the PAD-US database	o Simple geometry o Complete attribution o Conservation status codes (GAP and IUCN) essential o More conservation measures desired o Protected areas in perpetuity plus additional desired
7. Publishers			
User/Provider	Use	End Products	Database Requirements
National Geographic Society (end user)	- Education	- Simplified version of the PAD-US database for printed products and web publication	o Simple geometry o Complete attribution o Conservation status codes (GAP and IUCN) essential o Protected areas in perpetuity plus additional desired

4 Deficiencies and Technical Issues with Current Protected Area Databases

Both data users and data managers have identified several shortcomings in the existing "first generation" databases and products. In a climate of ever-changing technology, building and maintaining a protected areas database through the aggregation of multiple datasets is complex both technically and politically. The main issues include:

1. Timeliness – Due to the difficult and time consuming nature of aggregating a large spatially explicit database, it has been impossible to routinely update the entire country on a regular schedule. Updates have occurred sporadically by state or by region. The result has been national dataset versions published for the country that have included original data from different time periods (e.g., 1998 – 2008 in the same file). *The goal of the PAD-US partnership is to construct a database structure and organizational framework where the entire country can be updated at least annually.*
2. Completeness – National aggregations of protected areas polygons and attributes are dependent upon multiple sources with different levels of resources to map protected lands within their jurisdictions (usually states or specific agency lands). Currently 85%-95% (by number) of federal and state lands have been mapped and aggregated into national data sets. Completeness of local and regional government and private protected lands is more sporadic. In some states, these lands have been mapped and aggregated into a digital database while in other states there are still considerable digital data deficiencies

or the data has not been adequately aggregated. *Another goal of the PAD-US partnership is to incorporate federal, state, and local government lands as well as private protected areas on a more complete and consistent basis across the nation.*

3. Geometric inconsistencies – An ongoing issue in aggregating existing polygon datasets from multiple sources is that frequently the geometric representations of the same protected area polygons do not agree among the different sources (Figure 1). Given the issues of competing authoritative sources and multiple renditions of the same protected land boundaries there must be mechanisms for detecting, avoiding and resolving the conflicts that will be present in data provided by PAD-US data sources. Some of these mechanisms will be process oriented, others will be technically oriented, but the end goal will be to promote the identification of high quality, authoritative boundaries that can be shared by all entities involved in protected lands mapping. *The PAD-US partnership will develop and finalize standards and guidelines for both protected areas geometry and attributes in the near future. An important early focus will be educating stakeholders on the existence of these standards and promoting their adoption and use.*

Figure 1. Example of lack of geometric agreement between authoritative data sources. Different colors represent different sources.

4. Boundary Issues – Aggregating data from different states, government agencies, and NGOs often leads to misalignments along borders (Figure 2). *The PAD-US partnership will establish guidelines, best practices and procedures for aligning datasets along various political/jurisdictional borders.*

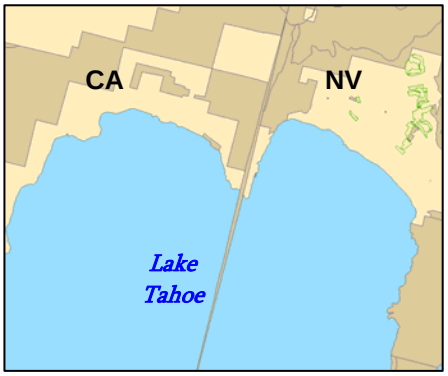

Figure 2. Example of lack of geometric agreement between state boundaries. In this case, between California and Nevada.

5. Inconsistent Geometric Detail in Source Data – Frequently, datasets are provided that contain different levels of spatial detail (Figure 3). For instance, some data sets are provided at the "facility" levels (e.g. a state park) while others are provided at the parcel

level (e.g. the 6 parcel polygons that comprises a given state park). Historically, first generation databases have dissolved interior polygons that did not provide detail on different conservation status codes. However, at a database level, it is far easier to aggregate data than it is to disaggregate data. This technical reality would argue that whenever possible the larger number of "disaggregated pieces" should be collected and stored in the database, even as this makes the database larger. Ultimately, if the pieces exist and are properly coded, GIS technology can easily aggregate them so that they can be depicted as a single entity. The opposite is not possible. *As the PAD-US database migrates to the proposed database structure, all geometric detail provided in the source data will be retained to facilitate updates. Spatially simplified derivative versions of the data resulting in smaller file sizes and easy-to-use file formats will be generated for consumption by specific user groups. Maintaining these derivative products is fundamentally important into the future.*

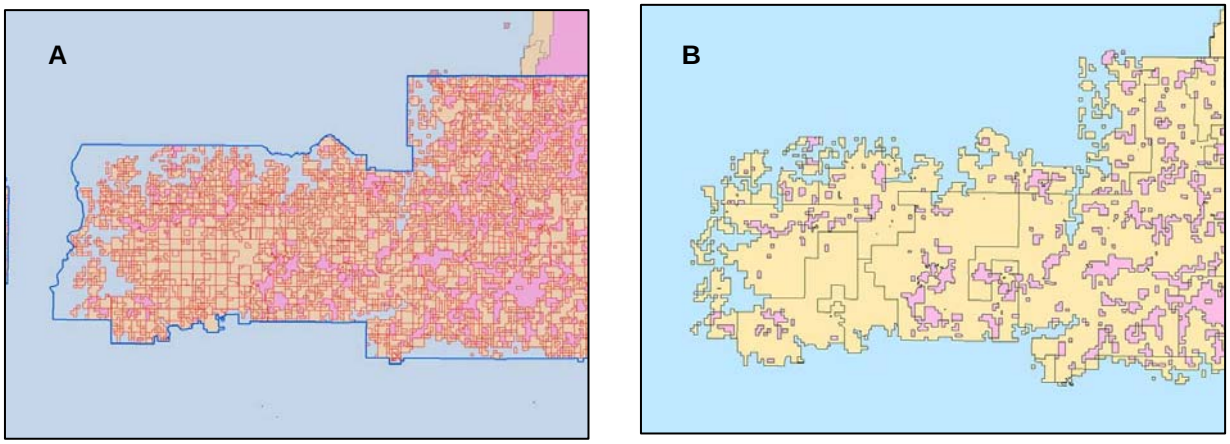

Figure 3. Example of inconsistency in spatial detail between data sources. Panel A contains all management and/or parcel "interior polygons" within a national forest. Panel B is a simplified version of the same national forest with most of the interior management polygons dissolved.

6. Inconsistencies of Polygon Attributes from Source Data – Datasets which are contributed for nationwide aggregation come from a variety of sources and can have widely varied attribute tables For example, some source datasets contain a minimal set of attributes, others many more. Attributes such as Name, Agency, Acreage and Designation are generally available and provide a lowest common denominator; however, very few contributors provide any information on things such as conservation status or primary purpose of the protected area. *The PAD-US Partnership has developed a core set of standard attributes (described later in this document). Over the longer term, the Partnership hopes to forge data sharing relationships with state and agency stewards who will be encouraged to provide data to the PAD-US while utilizing the standardized core attribute tables and domains. Until then, PAD-US efforts will populate core attributes directly from submitted data files using automated techniques to "crosswalk" original data into the standardized core attribute tables.*

7. Overlapping Polygon Designations – One of the ongoing issues complicating the existing protected areas databases is the frequent occurrence of overlapping or "stacked" designations (Figure 4). This is particularly problematic with simpler, flatter database designs as they require a cumbersome attribute table to portray all of the various designations observed in a single location (e.g., a Wild & Scenic River within a Wilderness Area within a National Recreation Area within a National Forest). Overlapping of two designations is quite common; while there can be as many as five separate designations for a single location. *The PAD-US Partnership plans to transition away from a flat file format (e.g., simple shapefile) in favor of a more robust database structure that separates overlapping polygons into distinct feature classes (more detailed description of the proposed database format is found later in the report).*

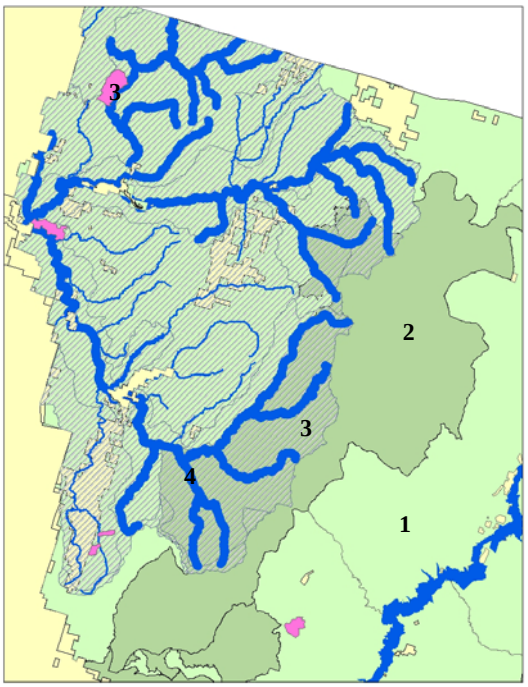

Figure 4. Example of overlapping designations in northern California.

National Wild & Scenic River = blue
Natural Research Areas = pink
National Recreation Area = crosshatched
Wilderness Area = olive green
National Forest matrix = light green
Private land = yellow

Numbers on the map denote the number of overlapping designations at that location.

8. Conflicting or Confusing Conservation Measures – In cases where data suppliers have provided conservation measures (e.g., GAP status codes), it is common to have discrepancies from state to state or from region to region for the same or similar designations. This is most evident in cases where a protected area falls within two or more states. *It is important to differentiate opportunities where management designation is an accurate predictor of management intent or where additional inquiry is necessary To avoid this ongoing problem, the PAD-US Partnership will explore categorical assignment of conservation status codes for particular designations suggested by the PAD-US Conservation Measures Team (e.g., FWS National Wildlife Refuges as designations likely to be managed with similar intent. Assignment may be aided by a new proposed attribute that denotes primary purpose of the polygon, for instance,*

biodiversity protection, sustainable forestry, recreation, etc. (more detailed description is found in the Conservation Measures section of this report for more information).

9. Inconsistencies Across Data Providers – Over the last decade of generating a national database on protected areas, one reoccurring problem is the turnover or instability of data providers. In some cases, programs have not been able to sustain their mapping efforts over time, in other cases new organizations may have new data covering a jurisdiction that was previously provided by another entity. *A goal of the PAD-US Partnership is to identify and work with the state and/or national thematic (e.g. Federal lands) data stewards that are most likely to have enduring protected areas data management responsibilities. The goal is to have regular and long-lasting relationships and to work with these data sources to provide ever-improving quality and completeness.*
10. Routine Data Update Challenges – Completing routine protected areas data updates has proven challenging for a number of reasons, including:
    - Shifting landscape of data providers for a jurisdiction
    - Competing data sources for the same jurisdiction
    - Data quality evolution from contributed data and ripple effects across neighboring parcels and/or jurisdictions
    - Varying levels of database sophistication across data contributors
    - Varying file formats and attributes
    - Lack of national standards and a common work plan

    A goal of the PAD-US Partnership is to provide Data Partners and Stewards with the guidance and standards necessary to establish an organizational foundation that empowers and supports states and other data providers to continually improve their data holdings., which in turn will lead to easier, more efficient updating.

5 PAD-US – Focus and Phasing

5.1 What is Covered by PAD-US

Through careful consideration of the user needs evaluation, it was recommended that an expanded definition of 'Protected Area' was warranted. Rather than generate a totally new definition, the Technical Working Group elected to adopt the current International Union for Conservation of Nature (IUCN) definition:

> **"A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values".**
> http://data.iucn.org/dbtw-wpd/edocs/2008-028.pdf

In general, the Technical Working Group concluded the main focus should remain on lands that:

a) Are in a natural or semi-natural state,

b) Have been secured from future conversion and current incompatible uses, and

c) Have a designated legal intent of protection and conservation.

While lands designation for biodiversity purposes will remain the highest priority, data on other conservation lands - those that are associated with ecosystem services and cultural values (e.g., recreation lands, open space, watershed protection areas, and multi-use management lands) - will also be mapped and included in the PAD-US database. The following describes additional, overarching items and improvements to the database that should be addressed by the partnership:

1. Inclusion of Local Government and Private Protected Areas – It has taken many years to produce and aggregate federal and state protected areas for the nation. Although additional work is needed to refine the geometry of many of these lands and to fill in the remaining gaps (estimated to be between 10%-15% by number), significantly more effort will be needed to aggregate protected areas data for extensive local government and private land holdings. Unlike federal and state lands where there are generally complete tabular listings of most designations that make it relatively easy to determine levels of completeness, local government and private protected areas tend to be more disaggregated and less organized. Only select number of states routinely provide local government and private protected lands (e.g., VA and MA). Greater inclusion of local government and private protected lands over time is a high priority for the PAD-US database.

2. Protected Areas Status – Existing datasets have only included polygons that were 'designated' as protected areas. All areas pending protection (e.g., inventoried roadless areas) or degazetted (i.e., areas taken out of protection) were excluded from the existing databases. The PAD-US team recommends adding all polygons whether they be designated, pending, or degazetted and track them using appropriate 'status' attributes.

3. Non-permanent Protected Areas – Another important component of protected lands in the U.S. are those places not protected in perpetuity. Such places are not designated by a legal authority such as an Act by Congress or Presidential decree. Rather, they are protected for a designated period of time – 10 yrs., 20 yrs., 50 yrs. – through various programs and processes. Lands can have temporary protections under specific management plans designed by federal or state agencies (e.g., administratively withdrawn lands within individual National Forest Management Plans). Temporary private conservation easements are a special case that is highlighted below. While lands protected in perpetuity will remain the main focus of PAD-US efforts, incorporating temporary protected areas will become increasingly important to foster a broader understanding of conservation. As with protected area status, such characteristics can be tracked within the database by use of appropriate "status" attributes.

Greater Spatial Detail within Protected Areas – One of the difficulties with assigning accurate conservation status codes to protected areas is that areas are often mapped as a single polygon, but different subdivisions exist that reflect legal ownership and/or different levels of human disturbance and/or different management prescriptions. For

example, a typical state park contains some portions that are completely natural and strictly reserved while other areas contain extensive visitor facilities and developed recreational uses such as golf courses. Under the current system, the entire park – which may be composed of dozens of parcels – may be assigned a single conservation status code. However, with greater spatial detail in geometry, it is becoming increasingly possible to include this level of detail in conservation status assignment. The PAD-US database will strive to include increased level of geometric detail over time resource permitting.

4. Easements – An increasingly important mechanism to protect lands in the U.S. is through conservation easements. There are many different types of easements with each specifying permitted uses of the land. Some easements are closely associated with public protected areas and managed by state or federal agencies. In other cases, easements are maintained by private land owners. Since conservation easements are held by private land owners, the privacy of the data becomes an issue. The PAD-US team will work a newly forming National Easement Working Group and others to develop a mechanism that allows for the collection and aggregation of easement data while providing appropriate protection of sensitive or private information.

5. Access to Protected Lands – One attribute that has not been explicit in any national or regional dataset is accessibility by the public. The latest California dataset compiled by GreenInfo Network is the only protected areas database that contains an attribute on access. It has been proposed that access becomes one of the core attributes in the PAD-US database and implemented over time.

6. Freshwater – Inclusion of freshwater geometry (e.g. ponds and lakeshores) in previous databases has led to complications in geometry and in assigning conservation status codes. In the first PAD-US products, freshwater will largely be removed with a few exceptions (e.g., reservoirs contained within protected areas, wild & scenic rivers) -- A protected area will be defined without regard to the land-water interface. In future versions of the PAD-US database, freshwater polygons will be assigned its own feature class within the geodatabase with tailored attributes and conservation measures will be assigned to them.

7. Marine Reserves – The PAD-US Partnership will work with NOAA, who is currently responsible for mapping marine reserves, to evaluate and if appropriate obtain an authoritative source of data determined appropriate for inclusion given PAD-US attributes and feature class structure. Such an approach would help resolve overlaps between coastal reserves and protected land areas, as well as providing a more complete approach to conservation.

5.2 Technological Improvement with PAD-US Version 1.1

Considerable progress has been made between USGS-GAP and CBI in agreeing to a shared database management process and set of standards that takes full advantage of our collective experience and skills.

The PAD-US v1.1 update will utilize ESRI's geodatabase replication technology to facilitate a more productive partnership representing the most current technology for developing shared spatial data. The use of geodatabase replication between two partners, USGS-GAP and CBI, will allow for a common schema that both parties will agree on and utilize in future phases of the PAD-US project. By developing this technology, the partnership is building the capacity to share this data with additional partners and/or data providers and have them edit data as appropriate. Through replication technology and versioned databases, multiple partners will be able to make edits to the same dataset improving overall efficiency and a more timely fashion.

In addition to multiple partner access, these technologies also allow for a concurrent QA/QC process. For example, if CBI were to finish a group of edits for 10 states, CBI and USGS-GAP could synchronize the two databases. USGS-GAP could perform QA/QC on the edits while CBI continued work on other states. In a compressed time frame, achieving an increased efficiency will be critical. With the joint development of QA/QC procedures, the QA/QC process will be streamlined assuring the highest quality data with the least cost or time delays.

The use of replicated geodatabase technology and the increased level of partnership and shared technology is a major step forward over previous efforts. While the structure of the dataset itself is not changing drastically from existing file formats at this time, the level of cooperation supported by the ESRI geodatabase replication technology is a significant achievement.

5.3 Phasing Strategy for PAD-US

In order to maintain momentum and a continual flow of improved database products, the Technical Working Group recommends that changes to the PAD-US database occurs in phases. The following describes the currently envisioned phases:

1. **Phase I:** The first PAD-US product, version 1.0, was released in April 2009. This product represented the first PAD-US Partnership product and was submitted by USGS on behalf of the partnership to the UNEP World Conservation Monitoring Centre for inclusion in the-World Database on Protected Areas (Figure 5). This dataset incorporated updates from PAD-US Data Partners as well as standards required annual submission of data to the WCMC.
2. **Phase II:** Will result in a new release, titled version 1.1 that is scheduled for release by April 1, 2010. The main focus of version 1.1 is to a) complete the integration (including the necessary line editing) of the existing CBI, TNC, and USGS datasets on state-by-state basis; b) focus on federal and state updates in selected states; and c)include increasing amounts of sub-state information as possible (i.e. local government and

private non-profit). In addition, as much of the newly proposed core attribute table (described in detail later in this document) will be implemented as is feasible within this timeframe.

3. **Phase III:** The next scheduled release is scheduled for December 31, 2010. By that time, we hope to have tested the new database structure called PAD-US version 2.0 in this document (see next section) while maintaining the current structure developed for PAD-US version 1.1. If the newly proposed database structure proves to be superior, we plan to migrate to this structure without interrupting our annual updating schedule. For simplicity, we also propose to label future versions with their publication month and year (e.g., PAD-US_Dec_2010).

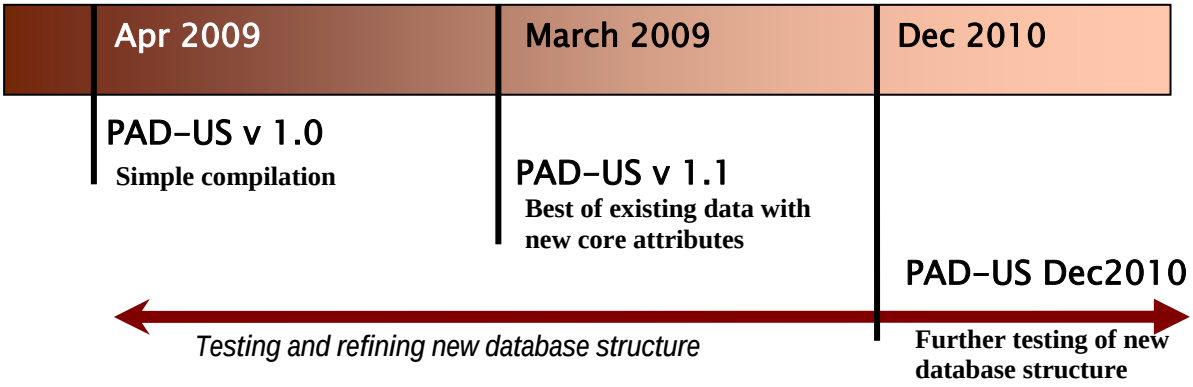

Figure 5. Phasing diagram for PAD-US process into the near future.

6 Proposed New PAD-US Database Structure

Like the first generation databases, a new PAD-US database structure (version 2.0) is being designed to be a "collection" of existing data that is regularly harvested from other entities: federal, state, local government, and non-governmental sources that provide primary geometry and attributes. The principal means of obtaining data for PAD-US will be collecting it from others and transforming and loading those data into the PAD-US database structure that takes advantage of emerging spatial data formats and tools. Over time, it is expected that the transformation and loading processes will become increasingly automated providing greater efficiency and making the effort economically sustainable.

The proposed new database design and structure for PAD-US, which remains to be fully tested, was developed with the following three objectives:

1. To *facilitate* **the ongoing *management* of the dataset**. This includes anticipating a higher transaction volume for data updates and taking advantage of automation with approved Data Stewards to the greatest extent possible.

2. To **preserve *flexibility* in the data products that can be published** from the master database. Data products include a variety of output formats (e.g. GeoDB, SHP, GML, KML, etc.), data subsets (e.g., a regional subset, or a "fee owned" only subset) and potentially consumable web services.
3. To **make the data structure as *simple* and intuitive** as possible. While simplicity will be sought, it is recognized that further complexity may be incorporated when it furthers the two goals stated above.

6.1 Geometric Structure

The newly proposed PAD-US database structure also relies on ESRI Enterprise Geodatabase format within an ARC SDE framework. As outlined in the previous section, one of the most challenging aspects of a protected areas database is the frequent and often complex geometric overlaps. This issue becomes further exacerbated as the size and scope of the database expands. To overcome the management of overlapping polygons, we propose to organize the polygon data through the use of discrete feature classes and sub-types (Figure 6).

At the present time, the final number and categories of mutually exclusive feature classes, sub-types, and corresponding attributes has not been fully developed nor adequately tested. However, a pilot database tested the new structure and demonstrated promising results.

1. Feature classes. The proposed initial design has 4-6 feature classes that represent specific types of protected area polygons. One proposed feature class is termed 'fee-owned' and forms the foundation upon which all other features are built. The fee-owned feature class contains polygon information for all public and private protected lands within the U.S. Other proposed feature classes include: easements, water, and one or more designation feature classes (Figure 6). The categories represented by feature classes should be designed to be mutually exclusive. For instance, a "fee owned" feature class would include **only** fee owned lands and since land ownership interests cannot overlap (i.e. two parcels cannot occupy the same space) it can be assumed that no entities within that feature class would overlap one another.

Action item: The initial work conducted as part of the previously referenced prototype/pilot project should be further scrutinized and refined. More testing is needed to determine the number and specific content of the feature classes. In addition to the feature classes already identified, other possible feature classes include proclamation boundaries for public agencies (e.g., USDA Forest Service lands), local and regional zoning data, and recreational lands. If this design can limit the number of feature classes sufficiently, it will allow for additional detail to be collected and maintained over time.

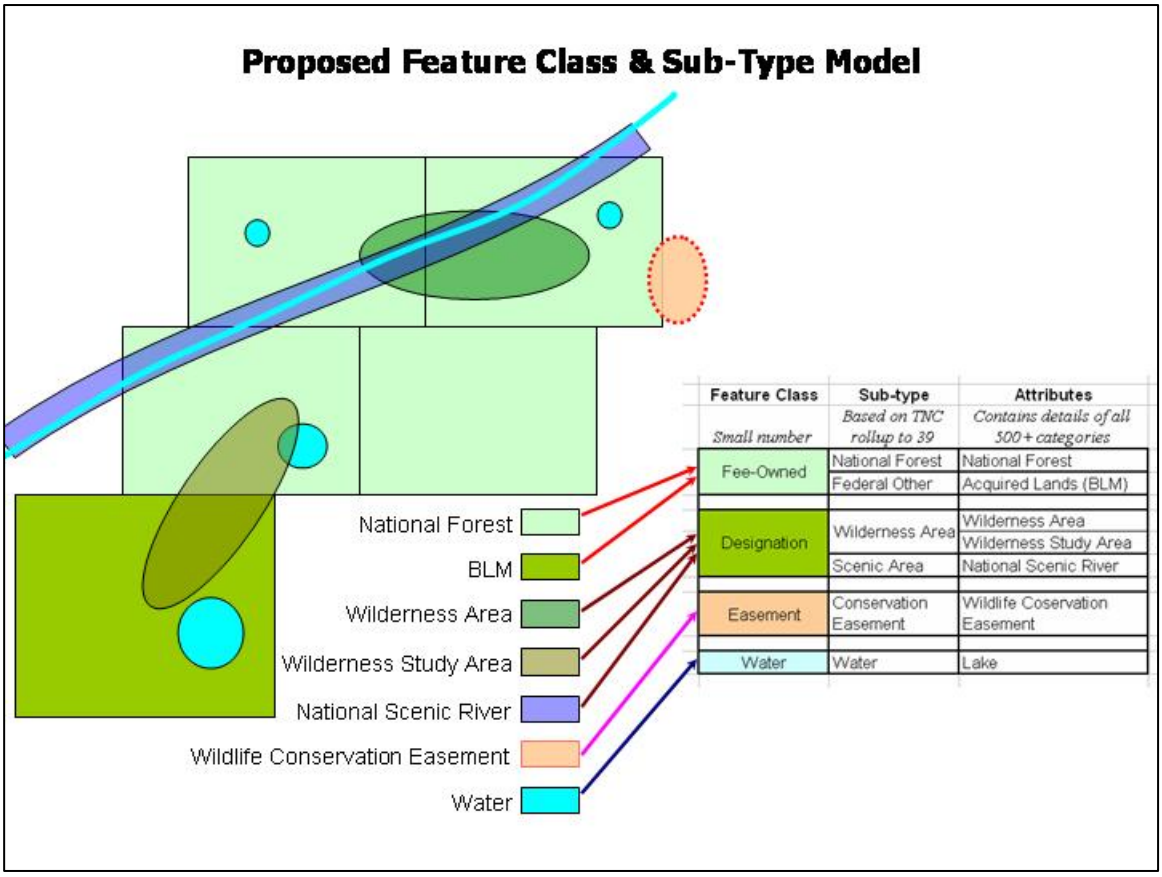

Figure 6. Generalized schematic of proposed feature class and sub-type database model for the PAD-US database.

2. Aggregation of similar protection activities into sub-types. Given that there are currently over 350 individual standardized designations (and this number will likely expand as the PAD-US reaches out for more types of lands) it can be difficult to develop a geospatial data structure that properly manages and provides effective cartographic display for each unique protection activity. Similarly, there may be other reasons – such as conservation effectiveness measurement – to group different types of protected lands together. The Nature Conservancy (Ty Guthrie and Christina Supples – now with CBI) had drafted a set of "designation groupings" that has resulted in the ability to aggregate the 350+ unique designations into a more manageable set of 20-35 groupings. Ideally, as these groupings continue to be refined, they will be designed to be mutually exclusive and will consider the action that was taken to create the protection status. For instance, some groupings may contain only fee owned lands. Other groupings may contain only "designated" lands. Once this is done, these groupings can be embodied within the geospatial data structure as sub-types.

Action item: The initial TNC work needs to be refined and finalized. This process might include broadening the group of people/organizations that are creating or finalizing the groupings. Input on the proposed groupings should be provided by the geospatial data modelers working on the PAD-US so that geometric issues can also be fully considered.

3. Alignment with Parcel Mapping. Over the short-term, the PAD-US database will need to rely on the best available geometry from a variety of sources, formats, levels of detail, and levels of precision. Recognizing this, the PAD-US Technical Working Group recommended that the PAD-US database move toward parcel level mapping only as parcel data becomes more widely available. It is believed that we are at least a decade away from having ubiquitous parcel data that spans the entire country. However, where good parcel level protected areas data does exist; it should be incorporated into the PAD-US database. In short, parcel level data should not be required at this juncture, but standards development and implementation should not preclude that level of detail being provided and incorporated.

6.2 Attribute Structure

1. **Core Attribute Table**. Feature attributes for each protected area provides the information foundation for the PAD-US. The development of the list of core attribute fields and conventions for these fields (e.g., naming, categories, geographic locators, etc.) is a critical component of the partnership.

   The Technical Working Group considered the existing fields that are used in a few existing databases such as the CBI-PAD, GAP Stewardship, and the World Database on Protected Areas to identify lowest common denominator fields that would constitute a core attribute table for PAD-US (Table 4). The Technical Working Group also had to consider the transition from the current database format to the new one -- meaning that some attributes should be considered "core" in the planned v 1.1 release, but later be these may be managed using other database techniques that a more robust v 2.0 database structure will enable (e.g., the use of look-up tables (LUTs) and a master contacts table). For example, Owner Name, Manager Name, and Standard Designation would be managed as a domain defined text field and treated as a core attribute in the v 1.1 release. Later, these same names would be managed through a LUT and only "agency ID numbers" would be managed in the core. The field called "Main Name" would also be considered part of the core for the v 1.1, but would later be managed as part of the feature class schema. When required, shapefile exports from the new database structure would extract this info from the feature class and reassign it as core when specific end products demanded it. Likewise, many end users will prefer names versus codes for some products and that can easily be accommodated in the new database structure. Lastly, naming conventions for the different field names are yet to be finalized; for example, it might be easier to accommodate 8-character field names to allow easier creation of specific end products.

Table 4. List of initial core attributes for PAD-US database showing Field Name, Description, whether a Domain or MSL (Master Stewardship List) code is used, inclusion in PAD-US v 1.1, and Notes. Shaded entries correspond to those fields that will be included as core in the v 1.1 release, but managed outside the core in the new database structure.

Field Name	Description	Domain / MSL	v 1.1	Notes
PADUS-GUID	Global Unique Identifier			
Category	General category of protection mechanism.	Y	Y	Fee, Easement, Other, Unknown
Owner Type	General land ownership category (e.g., State, Fed, Private) – Based on MSL "Class"	MSL LUT	Y	Names as domain for v1.1 MSL coding system for v2.0
Owner ID	Unique identifying number of agency	MSL	N	
Owner Name	Federal, state, local government, or private entity (at the departmental level) responsible for establishing policy	LUT	Y	Included as a core attribute in v 1.1 but managed in a LUT in v 2.0
Manager ID	Entity responsible for management	MSL	N	
Manager Name	Federal, state, local government or private entity (at the departmental level) responsible for implementing management.	LUT	Y	Included as a core attribute in v 1.1 but managed in a LUT in v 2.0
Name	Name of the specific polygon		Y	Name conforms to a designated set of conventions
Main Name	Name of the parent polygon within which the 'Named' polygon resides		Y	Included as a core attribute in v 1.1 but managed as feature class in v 2.0
Primary Designation Type (Standard Designation)	Primary land management description or designation expected to overlap another designation, standardized for the nation.	MSL LUT	Y	
Primary Local Designation	Primary land management description provided by data source. Not standardized for the nation.	N	Y	
Primary Designation Name	Name of parcel standardized for WDPA		Y	
Designation ID	Unique identifying number of designation	MSL		
Standard Designation	Designation label from the standards list for the polygon referenced under Name	LUT	Y	Included as a core attribute in v 1.1 but managed in a LUT in v 2.0
Parent Site Code	Common code for multiple part protected areas			Could adopt coding system needed for the WCMC
Status	Designated, Pending, or Degazetted	Y	Y	
State	U.S. state abbreviation	FIPS coding	Y	
County	County name	FIPS coding		Need a set of rules for large protected areas that extend beyond one county
IUCNCAT	IUCN conservation measure	Y	Y	IUCN Codes (Ia, Ib, II, III, IV, V, VI)
GAPCAT	GAP conservation measure	Y	Y	GAP Codes (0,1,2,3,4)
Access	Open, Restricted, Closed	Y	N	

GAP Status Code Source	The organization that applied the Gap Status Code to the polygon (e.g., GAP, CBI, TNC)		Y	
GAP Status Code Date	Year GAP status code was assigned			
Aggregator Source	Organization of aggregated datasets used in PAD-US version		Y	
GIS Source	Source of GIS spatial and attribute information aggregator obtained		Y	
GIS Source Date (Year)	Year GIS information was published according to source field metadata		Y	
GIS Area	Area of polygon calculated by the system		Y	The "actual" area if available should be retained.
Comments	Any comments from either the source or aggregator		Y	

2. **The Master Stewardship List as a Standard for Designations.** Local designations for protected land can vary from jurisdiction to jurisdiction (e.g. State Park vs. State Park Land). In the CBI-PAD, there were over 900 'local designation' categories. For better quality control, standardization and management, it is desirable to limit the number of designations to truly unique distinctions. Considerable effort has been invested in developing such a standard by USGS GAP. Their "Master Stewardship List" (MSL) has been well developed and tested for all federal and most state lands. The MSL collapses the approximately 900 'local designations' from the primary data sources into a finite list of approximately 300 'standard designations'. Considerably more work is needed to extend this to include local government and private lands as well as lands previously not tracked and now being transitioned into the database.

   Action item: Update the MSL coding scheme to provide more information (ie. 'intelligent design'), identify missing designations and remove the hierarchical nature of the current MSL based on land ownership; consolidate to create a comprehensive and concise, second generation MSL.

3. **PAD-US Globally Unique ID Number (GUID):** A key element of creating and maintaining the nationwide database will be the assignment and maintenance of a unique ID number for each feature in the database. Such numbering schemes are often referred to as GUIDs. There are many options for structuring and assigning GUIDs and these will be finalized during the v 2.0 design process. Key elements of a GUID that should be considered during the design process include:

   - Features will retain the **same** GUID for the entire time they are present in the database
   - When features are deleted/removed from the database, that GUID will be permanently retired
   - The design will need to consider how to handle GUIDs when a feature is updated (e.g. a polygon is replaced with a more accurate rendition). Will the old GUID be applied to the new shape, or will a new GUID be assigned?

- A mechanism for providing the PAD-US GUIDs back to data providers should be developed (for providers who would like them). Such a mechanism could be a key tool for facilitating data synchronization
- Developing the GUID scheme so that automated tools can be used for assignment and maintenance to the greatest extent possible

4. **Ancillary Related Tables:** As described above, the PAD-US database structure will include a "core attribute" table that will contain uniform, standardized information for all features in the data set via a one-to-one relationship. In addition to the core attributes, the PAD-US database structure will accommodate ancillary attribute tables that can store additional attribute information on features (Figure 7 below illustrates this concept). When necessary, these ancillary tables can store one-to-many relationships between PAD-US features and attributes. Examples of ancillary attribute information that may reside in separate tables include, but are not limited to:
    - Feature-based metadata describing the source data and editing history for the feature
    - Local coding of names and designations that contain the original data as contributed by the data provider
    - Expanded conservation measures information
    - Ecosystem monitoring information
    - Parcel/cadastral details for protected areas (e.g. book-and-page numbers)

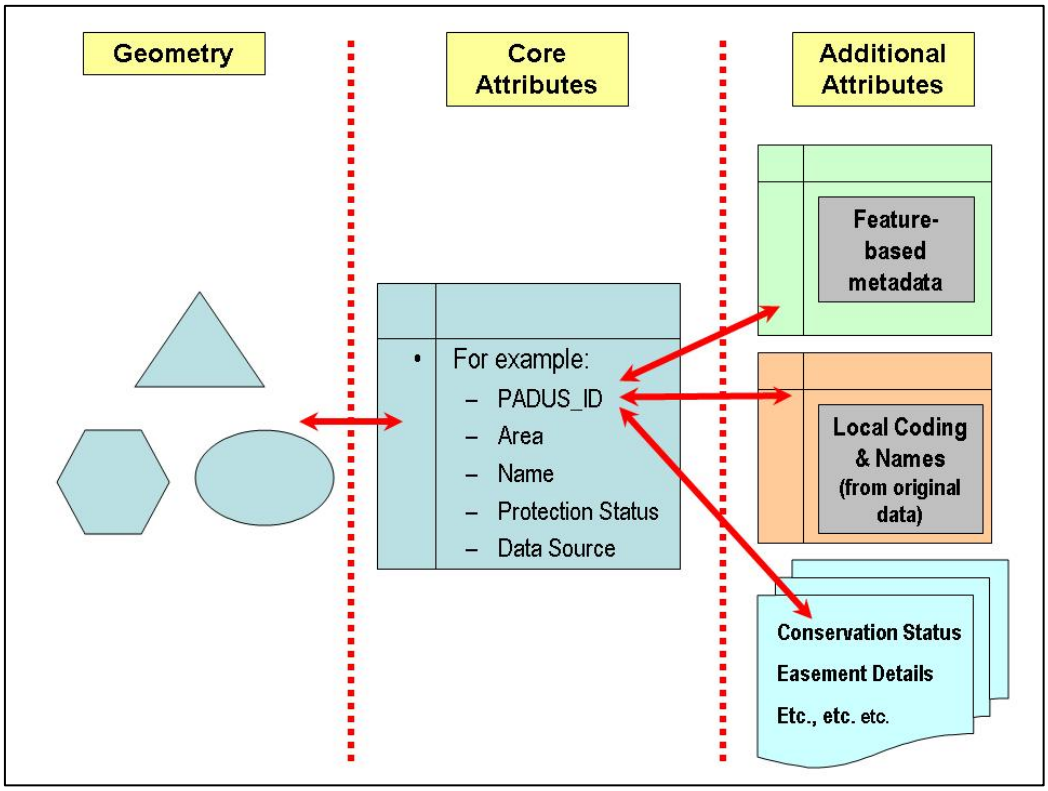

Figure 7. Generalized schematic illustrating how additional attribute tables could be linked to the core attribute table and associated geometry.

5. **Freshwater Standards**. Freshwater is a complicating factor in mapping protected areas. Understanding the interaction of land and water is important, but maintaining water as part of mapping protected areas has proven challenging in first generation aggregations. Water is not uniformly represented and attributed in protected lands data by the various sources (e.g., states default to different scale data or do not provide water at all). From a conservation measures standpoint, water is even more problematic. Some water bodies are fully contained within existing parks (e.g., Yellowstone Lake is fully contained within Yellowstone National Park) making the assignment of conservation status straightforward, but most lakes and rivers share borders with many different ownerships and conservation designations. How does one assign a meaningful conservation measure to a lake where half of its shore is within a preserve and the rest in private ownership? Assigning meaningful conservation measures to water bodies in these types of situations is complex. Major rives are even more difficult as they traverse sometimes hundreds of miles of lands with numerous designations. Conservation NGOs (e.g., TNC, World Wildlife Fund, and CBI) are working to develop approaches for addressing this important conservation issue, but there is much to do in advancing this concept. For the PAD-US, water will be managed as its own feature class initially in the simplest way possible allowing for inclusion of conservation measures when they become available, which may include special core attributes for this feature class in the future.

6. **Easement Standards**. Conservation easements are a growing component to protected lands in the United States that impose some additional challenges in creating and managing the data. Most importantly, is the need for privacy for some of the data entries. In response to this important constraint, a new collaboration is being forged to specifically focus on conservation easements. The National Easement Working Group is comprised of five conservation NGOs, including CBI, Defenders of Wildlife, Ducks Unlimited, NatureServe, and The Trust for Public Lands. This group is committed to working closely with the PAD-US Partnership to collect and maintain easement data for the country in the most compatible way possible. The easement working group will adopt the geometry from the PAD-US database, but will develop its own set of core attributes specific to easements. Data collection and aggregation, hosting, and publishing will be handled in a similar fashion as the PAD-US Partnership (Figure 8). CBI will provide the hosting functions for the national easement database and serve as the primary liaison between the Easement Working Group and the PAD-US Partnership. The complete easement database will be made available from an access controlled, single web portal (The Conservation Registry). Easements that can be made public will be subset out of the master file and contributed to the PAD-US as a unique feature class. Other publication outlets (e.g., LandScope America, Data Basin, etc.) will also be provided with the same public easement dataset.

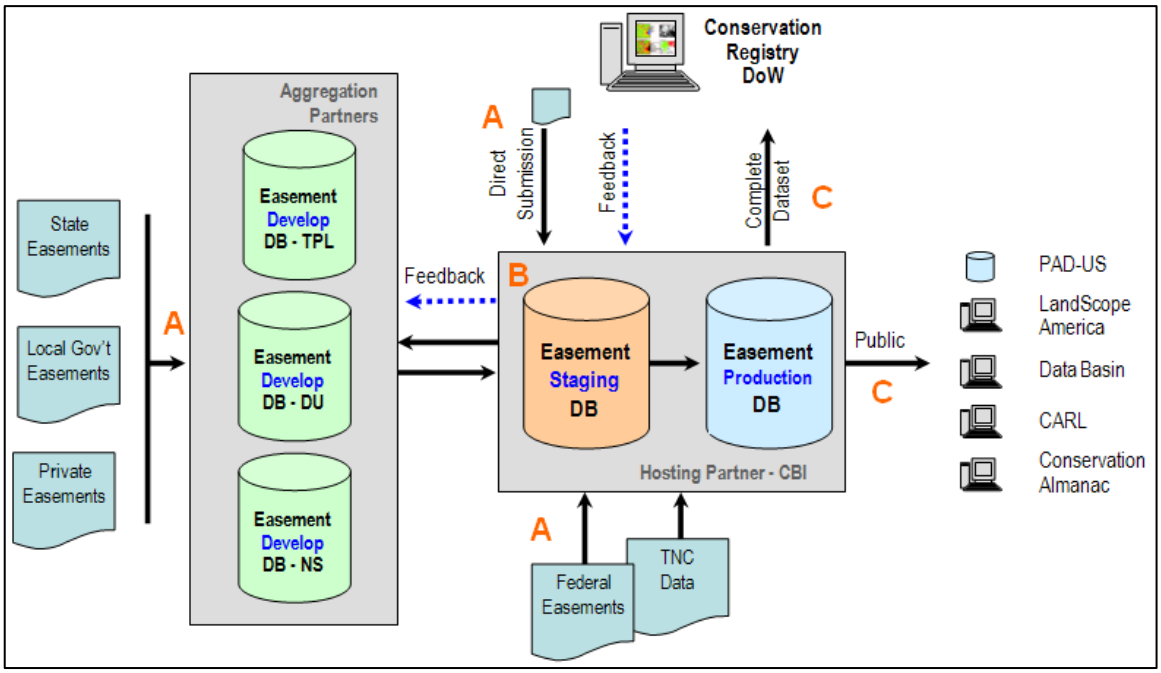

Figure 8. Data flow diagram for the U.S. national easement database showing (A) data collection and aggregation, (B) national database development and hosting, and (C) data publishing.

6.3 The Role of Automation

The Technical Working Group agrees that the PAD-US process should be as automated as much as possible with data flowing from the primary developers into a national database. The Technical Working Group agreed that this would occur most efficiently through the designation of one (or more) recognized stewards of protected area data at the state or regional level who would provide regular updates to the PAD-US.

These stewards would aggregate and standardize protected area data within their jurisdictions or regions. In some geographies, there may be one steward with responsibility of public lands (e.g. a public agency) and a different steward with responsibility for the private lands (e.g., conservation NGO). In some geographies, there may be existing institutions that are working at the regional level to aggregate public and/or private protected areas data across a group of states. There would be an obvious efficiency to appropriately include these institutions in PAD-US data aggregation work flows.

Where there is not a natural or obvious steward in a specific geography, the Technical Working Group suggests that the PAD-US Project Team would be responsible for designating an organization or agency to carry out this work until the situation changes.

In an automated environment, it is critical to understand that the amount of manual data editing that is done during the aggregation process must be minimized, if not eliminated. To perform regular, automated, transactional updates the master database must not evolve so that it varies from the contributed datasets. If any manual editing is performed, it is essential that those updates be returned to the state or regional designated stewards so that they can be incorporated into the locally managed datasets.

For this automation to be successful, the PAD-US Project Team must take on an ongoing role to:

- Develop a national set of protected area data standards
- Roll up of the existing key datasets
- Designate state (and regional) level protected area data stewards
- Routinely provide a clean national database back to state and regional stewards as a substrate for further updates
- Coordinate the activities of all of the stewards
- Provide a national QA/QC role in the national database

6.4 On-line, Public Submission of Protected Area Information

Given the current state of technology and that the PAD-US database will be publicly available, it is highly desirable that the general public and other users have an opportunity to provide direct protected area submissions. For some protected area datasets, it may be more efficient to have an online mechanism for direct uploads of data for potential inclusion into the PAD-US database. While it would need to be implemented carefully and with rigorous quality control mechanisms, providing a web-based mechanism for uploading new private protected areas as they become established (fee or easement) by small groups or individuals may provide an efficient mechanism for keeping the database more current and complete. A similar mechanism could be employed so that PAD-US end-users could provide comments – including graphic map markups – that describe data issues they have encountered (e.g. missing protected lands; improperly shaped boundaries; etc.) and suggest improvements to the data set. The Easement Working Group described in a previous section is spending considerable effort in perfecting this capability via the Conservation Registry. Techniques developed or lessons learned should help guide the PAD-US team as they consider this issue.

6.5 Role of Outside Review

One of the ongoing needs for existing protected areas datasets is the role of outside peer review. USGS GAP has done the most in this regard, holding routine meetings with land managers to review basic geometry and assign GAP Status Codes. Modifications to this process are being considered and tested. Regardless of what mechanism is eventually employed, the importance of

review and feedback is an important component of a large and complex database such as the PAD-US.

Some in the Technical Working Group have suggested that there be a web-based Wiki-like input mechanism put in place where users could essentially draw on a rendering of the dataset to comment on any aspect of it. Comments would then be automatically submitted back to the overall PAD-US data stewards for consideration. Simple errors (e.g., misspelled words) might be corrected immediately and error logged. More serious or questionable errors may be reviewed by a "data stewardship committee" for a plan of action (which may include forwarding the issue back to the state/regional data stewards). For the small subset of errors which may have implications on the data structure, the data standard and/or the overall integrity of the database, the matter may be forwarded to the PAD-US Steering Committee for action.

The creation of a 'blue ribbon' panel for some attributes such as conservation measures has also been proposed. One of the ongoing problems with utilizing an aggregation model is that individual participants or data providers interpret the standards differently causing consistency problems. The Technical Working Group proposes pilots to test the categorical assignment of GAP Status Codes by management designation as a means to increase efficiency where further inquiry into individual management plans may not be necessary. Based on experience of the technical team, it is believed that the majority of federal designations will be properly coded using this approach, while the remainder may be address using standard methods and review. A blue ribbon panel of experts could be convened from time-to-time to help assign conservation measures to standard designations and resolve conflicts as they arise.

The Technical Working Group recommends that, at a minimum, individuals be provided an easy and documentable mechanism to offer feedback to the PAD-US team.

6.6 Data Dissemination and Customized Data Products and Output

The Technical Working Group recommends that there be one website or portal from which the most recent version of the PAD-US database will be accessible to the public. Other websites will consume the PAD-US dataset either in its native form (multi-feature class Geodatabase) or as simplified versions (e.g., "flattened" shapefiles) for easier use. Some additional outlets include Data Basin (www.databsin.org), LandScope America (www.landscope.org), and the Conservation Registry (www.conservationregistry.org).

Besides having links to other map-based websites, the Technical Working Group recognizes that there will be many other products generated from the original PAD-US database by members of the PAD-US Partnership as well as others. These include, but are not limited to:

1. Different electronic subsets and formats of the database
2. Consumable web mapping services (e.g. WMS)
3. Various paper/PDF map products
4. Different analytical treatments
5. Expanded attributes

The newly proposed database structure and standards has been designed to allow for these numerous and varied products to be generated as derivatives in order to achieve maximum utility across the user community.

APPENDIX A. Detailed PAD-US user profiles for Phase II and Phase III users.

1. Non-Land Management Federal Agencies (Phase II)			
User/Provider	Use	End Products	Database Requirements
EPA (end user)	- For inclusion in the national and regional assessments, monitoring, and resource modeling	Entire PAD-US database or simplified subset of it	o Complex data file format o Complete attribution o Conservation status codes (GAP and IUCN) essential o Protected areas in perpetuity plus additions welcomed o Regular updating (annual) preferred
2. Corporations (Phase II)			
User/Provider	Use	End Products	Database Requirements
Limited Brands (end user)	- Primarily used as part of risk avoidance evaluation	Simplified version of the PAD-US database	o Simple data file format o Complete attribution o Conservation status codes (GAP and IUCN) essential o Protected areas in perpetuity plus additions welcomed o Regular updating (annual) preferred
3. Land Trusts (Phase II)			
User/Provider	Use	End Products	Database Requirements
Land Trust for the Little Tennessee (end user/data provider)	- Used to track land conservation progress and in local planning efforts - Web access a plus	Simplified version of the PAD-US database	o Simple data file format o Complete attribution o Conservation status codes (GAP and IUCN) essential and expansion of measures preferred o Protected areas in perpetuity plus additions welcomed o Regular updating (annual) preferred o Easements important
4. Small Conservation NGOs (Phase II)			
User/Provider	Use	End Products	Database Requirements

Dogwood Alliance (end user)	- Used in strategic planning and public education outreach - Regional assessments and planning	Simplified version of the PAD-US database	o Simple data file format o Complete attribution o Conservation status codes (GAP and IUCN) essential and expansion of measures preferred o Protected areas in perpetuity plus additions welcomed o Regular updating (annual) preferred o Easements important
5. Academic Institutions (Phase II)			
User/Provider	Use	End Products	Database Requirements
Clemson University (end user)	- For inclusion in conservation and natural resources research and education	Entire PAD-US database or simplified subset of it	o Complex data file format o Complete attribution o Conservation status codes (GAP and IUCN) essential and expansion of measures preferred o Protected areas in perpetuity plus additions welcomed o Regular updating (annual) preferred o Easements important
6. General Public (Phase II)			
User/Provider	Use	End Products	Database Requirements
Public (end user)	- Education	Simplified version of the PAD-US database	o Simple data file format o Simplified attribution o Customized conservation status codes preferred o Protected areas in perpetuity plus additions welcomed o Regular updating (annual) preferred
7. Local Planners (Phase III)			
User/Provider	Use	End Products	Database Requirements
Benton County (end user)	- Used in local planning	Simplified version of the PAD-US database	o Subset of the PAD-US o Simplified attribution o Conservation status not essential but preferred o Regular updating (annual) preferred o Small parcels (<100 ha)

			important o Protected areas in perpetuity plus additions welcomed o Easements important o Parcel-level data preferred
8. Developers/Real Estate and GIS Service Providers (Phase III)			
User/Provider	Use	End Products	Database Requirements
Developers (end user)	- Used in local planning	Entire PAD-US database or simplified subset of it	o Subset of the PAD-US o Complete and simplified attribution o Conservation status not essential but preferred o Regular updating (annual) preferred o Small parcels (<100 ha) important o Protected areas in perpetuity plus additions welcomed o Easements important o Parcel-level data preferred