

National Park Service  
U.S. Department of the Interior  
Natural Resource Program Center

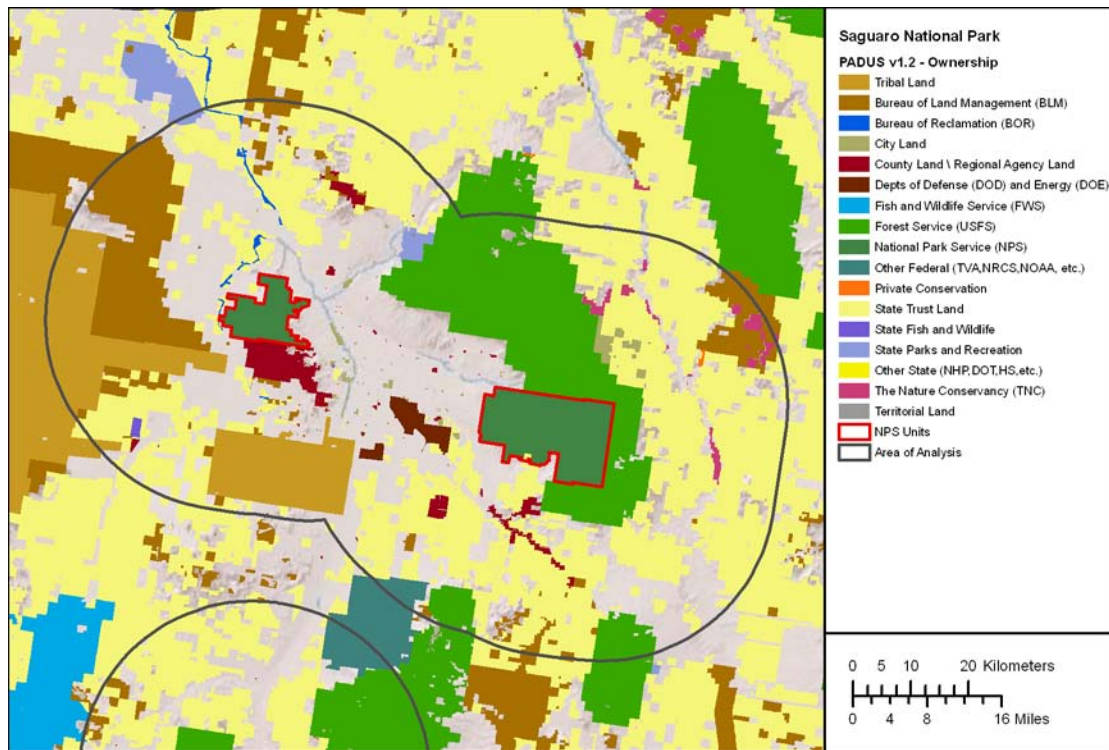


**NOTE: This document reflects the processes used to generate the spring 2011 release of NPScape data. There may be revised processes and documentation available.**  
**Check Reference Application ( <http://nrinfo.nps.gov> ) for most current version.**

## NPScape Conservation Status Measure – Phase 2 Protected Areas Database of the United States Metrics Processing SOP

### *Protected Area and Ownership Category Metrics*

Version: 201100405



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## 1. Overview

This SOP provides guidance on how to process the following metrics for the Conservation Status Measure from the Protected Areas Database of the United States (PAD-US) 1.2: Protected Area (PADUS\_CAP) and Ownership Category (PADUS\_CAC). These metrics are derived from the version 1.2 PAD-US geodatabase (PADUS1\_2.gdb) feature class named PADUS1\_2.

Download the NPScape conservation status metrics methods zip file from the NPScape website (<http://science.nature.nps.gov/im/monitor/npscape/methods.cfm>). The zip file includes an ArcGIS™ toolbox containing NPScape conservation status script tools, an ArcMap™ document for displaying outputs, and a copy of this SOP document. The PADUS1\_2.gdb can be downloaded from the USGS GAP web page (see section 2.1 below).

The purpose of this SOP is threefold. First, because these directions were followed for the processing of the NPS dataset, it provides detailed documentation on the methodology the NPS Landscape Dynamics Project (NPScape) used to calculate these metrics. Second, this SOP provides any user with the ability to replicate the creation of these data. Finally, if a Park or Network has a need to process conservation status metrics, this SOP provides a template for how protected areas data can be processed to generate these metrics.

The Protected Areas Database (PAD-US) 1.2 dataset, PADUS1\_2, is a polygon feature class of protected areas. The NPScape project extracted and pre-processed the area extending from Mexico to the Arctic plus the outlying Pacific and Caribbean islands. Metrics derived from this data source include:

1. PADUS\_CAP: Protected Area from PAD-US polygons
2. PADUS\_CAC: Ownership Category from PAD-US polygons

Outputs include two clipped polygon feature classes and summary tables with percent area protected and percent ownership category values. PAD-US 1.2 was updated in the winter of 2011 by the USGS Gap Analysis Program and includes NPS administrative tract polygons (where available) or legacy NPS administrative boundary polygons where NPS tract data were not present.

This document summarizes the methods used to generate these outputs for any area of analysis from the NPScape pre-processed source data. For details on how the pre-processed source data were created, see Appendix 6.2.

Unless noted, the data sources and tools used are assumed to be in ESRI ArcGIS™ format, version 9.3.1 Service Pack 1.

## 2. Data Acquisition and Preprocessing

### 2.1. Source Data

Two datasets are required for processing these metrics: the pre-processed Protected Areas Database of the United States (PAD-US) polygon feature class and area of analysis polygons.

GIS data were obtained from the following sources:

- **Source 1:** Source version of Protected Areas Database of the United States (USGS GAP Analysis Program 2011):

<http://gapanalysis.usgs.gov/data/padus-data/>

The protected area (CAP) metric (i.e. percent protected land) depends on the thematic identification of land management classes. GAP Status 1 or 2 categories represent management areas considered to be “protected” based on GAP criteria. They are derived from the GAP\_Status\_Code (GAP\_Sts) attribute in the PAD-US feature class. These two biodiversity management status ranks can generally be defined as follows (after Scott et al. 1993, Edwards et al. 1994, Crist et al. 1996):

**GAP Status 1:** An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.

**GAP Status 2:** An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.

The reclassification (or selection) is completed in an ArcGIS “select by attribute” operation and contain the following fields:

GAP Status Code = ‘1 – managed for biodiversity – disturbance events proceed or a mimicked’ or GAP Status Code = ‘2 – managed for biodiversity – disturbance events suppressed’. See Appendix 6.2.3 for details.

The Ownership Category (CAC) metric depends on the thematic identification of land Ownership Type classes (reported by land owner) as captured in the PAD-US 1.2 data set. The Ownership Type description includes actual Bureaus or Departments in the case of federal agencies, designation of the state or county ownership, and a breakdown of specific types of private ownership. The raw values in the Own\_Type attribute of the PAD-US 1.2 feature class are used without alteration. See Appendix 6.3 for details.

This polygon feature class includes protected area features from the U.S. including Alaska and the outlying islands.

#### **Source 2: Area of Analysis Polygons**

An Area of Analysis (AOA) polygon may be any topologically correct polygon feature covering an area of interest. AOA polygon geometries must be free of topological errors like slivers or donuts. If using a custom AOA polygon, run a geometry repair operation prior to using in NPScape analyses. Example AOAs include buffered NPS park areas, watershed boundaries, study areas, or ecoregion boundaries.

## 2.2. Re-Projection of Source Data

Each source dataset must be re-projected into a common spatial reference. For CONUS areas (including Puerto Rico and the Virgin Islands), the NPScape project uses USA Contiguous Albers Equal Area Conic USGS as its standard projection. For Alaska, Alaska Albers Equal Area Conic is used. NAD\_83 is the datum for both projections. For Hawaii, UTM Zone 5N NAD83 is used. The source PAD-US feature class polygons are natively in USA Contiguous Albers Equal Area Conic USGS.

## 3. Processing and Analysis

### 3.1. Processing Step 1 – Re-project Source Data

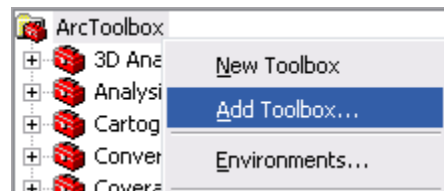
If the source AOA polygon(s) are not in the standard projection, use ArcGIS to create re-projected versions of these sources. Otherwise, this step can be skipped.

ArcToolbox → Data Management Tools → Projections and Transformations → Feature → Project

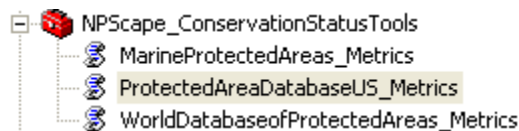
### 3.2. Processing Step 2 – Clip PAD-US Polygons and Create Summary Tables

ArcGIS <sup>TM</sup>script tools using Python scripts are used to produce PAD-US metric outputs.

Open ArcMap<sup>TM</sup>, add layers for the desired area of analysis and the PAD-US source feature class. Open ArcToolbox. Right-click on ArcToolbox and choose ‘Add Toolbox...’.



Navigate to the folder where the methods zip file was unzipped. Select the NPScape\_ConservationStatusTools.tbx file to add.

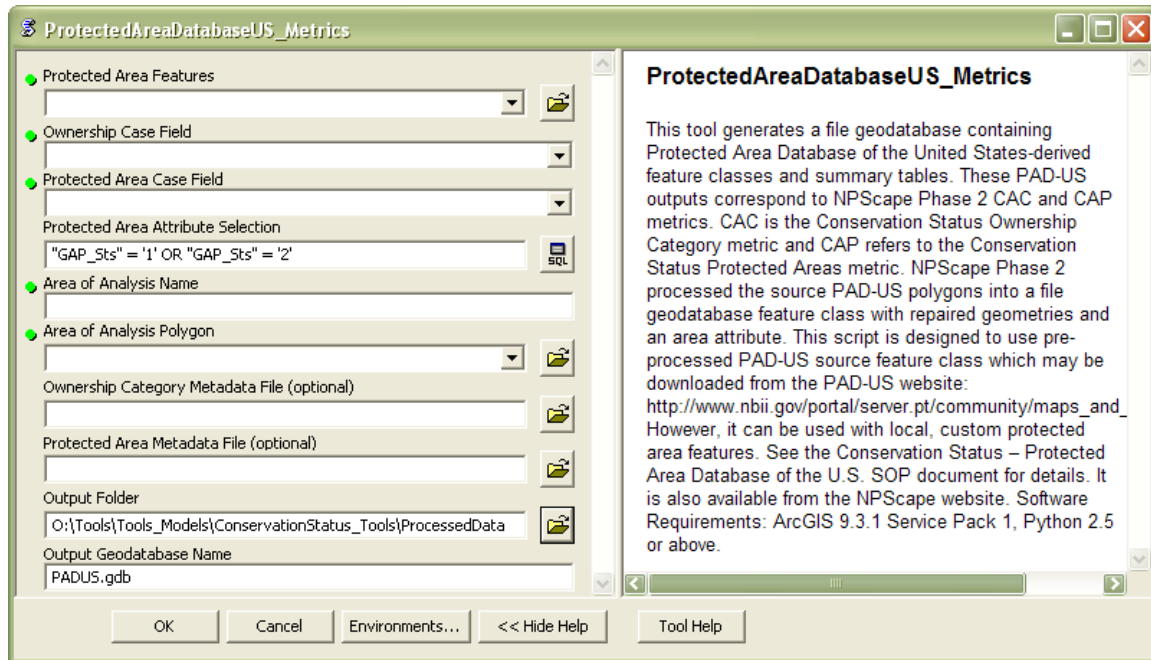


General processing steps are:

- Clip source polygon features to the area of analysis
- Generate summary statistics tables for the protected area polygons (PAD\_CAP) and the governance polygons (PAD\_CAC) using case fields from the source protected areas polygons to group the area statistics

- Import metadata (optional)

Open the ProtectedAreasDatabaseUS\_Metrics tool and enter the parameters as shown. The output folder defaults to the ConservationStatus\_Tools\ProcessedData subfolder from the unzipped archive but may be set to any folder to which you have write permissions. Depending on the size of the area of analysis, the script may take several minutes to run. When finished, the layers and statistics tables should be added to the map.



The following parameters are necessary to run the script tool:

- Protected Area Features: PAD-US source feature layer from the map or full path to the source NPScape PAD-US source polygons. Alternatively, local custom protected area features can be used.
- Ownership Case Field: Field from Protected Area feature class used to group Ownership Category area statistics
- Protected Area Case Field: Field from Protected Area feature class used to group Protected Area area statistics
- Protected Area Attribute Selection: clause used to select protected area features from source feature class
- AOA Name: name of the area of analysis (110 character limit)
- Area of Analysis: AOA polygon feature layer from the map or full path to the location AOA polygon feature class
- Ownership Category Metadata File (optional): full path to the governance metadata XML file

- Protected Area Metadata File (optional): full path to the protected area metadata XML file
- Output Folder: full path location of output folder
- Output Geodatabase Name: name of the file geodatabase to create

Output Feature Classes and Table:

PAD\_CAP = clipped protected area polygons for the AOA

PAD\_CAC = clipped ownership category polygons for the AOA

A summary statistics table is produced for each feature class: PAD\_CAP\_stats and PAD\_CAC\_stats. The feature classes and tables should be added to the map automatically when processing finishes. If not, navigate to the output folder to add them. Summary table attributes include:

FREQUENCY: number of source polygons contributing to the CAP or CAC category

TAREA\_SQKM: total area in square kilometers of the area of analysis:

$$\text{TAREA\_SQKM} = (\text{AOA area in square meters}) / 1,000,000$$

AREA\_SQKM: total area in square kilometers of each Protected Area or Ownership Category:

$$\text{AREA\_SQKM} = (\text{feature category area in square meters}) / 1,000,000$$

PCT\_AREA: percent total area of each Protected Area or Ownership Category:

$$\text{PCT\_AREA} = (\text{AREA\_SQKM} / \text{TAREA\_SQKM}) * 100$$

AOA\_NAME = the name entered in the script tool parameter

## 4. Quality Control

### 4.1. Verify spatial and thematic integrity

Use the ArcMap™ document (ConservationStatus\_Tools\ConservationStatus\_Metrics.mxd) provided to open the PAD-US feature classes. Overlay them with area of analysis polygon.

Verify that edges align correctly and that the polygon features align from feature class to feature class. Use the Effects → Swipe tool to help verify this. Note that the NPSCape layer files for conservation status (ConservationStatus\_Tools\ProcessedData\\*.lyr) are used to standardize the polygon symbology.

Add the source feature class to the map and use the Swipe tool to verify that the processed feature classes' polygons align with the source polygons.

Look for the existence of donuts or slivers (polygons may not cover the entire AOA extent).

Zoom into an area and visually compare the outputs of each feature class by identifying all layers for a few points using the Identify tool. Verify the following values:



If using PAD-US as the source, the Owner Type (Own\_Type) value for the output feature class should equal the Owner Type value in the source feature class. Otherwise, the values of the attribute containing Ownership Category values should match between the source and the output.

If using PAD-US as the source, the GAP Status Code (GAP\_Sts) value for the output feature class should equal the GAP Status Code value in the source feature class. Otherwise, the values of the attribute containing the Protected Area values should match between the source and the output.

## **4.2. Verify Values for Calculated Areas**

Open each statistics table and compare them to verify that the TAREA\_SQKM values are equivalent across all of the tables. Sort the PCT\_AREA field in descending order and look for outliers (zero or negative values, more than one value near 100; value greater than 100).

Select one record from each statistics table and double-check the result column values by re-calculating them by hand:

1. Select one record from each statistics table and double-check the result column values by re-calculating it by hand:

$$\text{PCT\_AREA} = (\text{AREA\_SQKM} / \text{TAREA\_SQKM}) * 100$$

## **5. Literature Cited**

Crist, P.J. 2007. Mapping and Categorizing Land Stewardship, Version 2.1.1. Pages 119-136 in: Scott, J.M., ed. A Handbook for Conducting Gap Analysis, Gap Analysis Program, US Geological Survey, Moscow, ID. Available from:  
<ftp://ftp.gap.uidaho.edu/products/handbookpdf/CompleteHandbook.pdf>

Crist, P.J., B. Thompson, and J. Prior-Magee. 1996. Land management status categorization for Gap Analysis: A potential enhancement. Gap Analysis Bulletin #5, National Biological Service, Moscow, ID

Edwards, T.C., C. Homer, and S. Bassett. 1994. Land management categorization: A users' guide. A Handbook for Gap Analysis, Version 1, Gap Analysis Program.

Scott, J. M., F. Davis, B. Csuti, R. Noss, B. Butterfield, S. Caicco, C. Groves, T. C. Edwards, Jr., J. Ulliman, H. Anderson, F. D'Erchia, and R. G. Wright. Gap Analysis: a geographic approach to protection of biological diversity. Wildlife Monographs No. 123.

USGS GAP Analysis Program. 2011. Protected Areas Database of the United States (PADUS) version 1.2 Geospatial Metadata. Last accessed February 28, 2011.



## 6. Appendices

### 6.1. *Known Issues*

#### Definition of Protected Area

For NPScape, Protected Area is defined as any PAD-US v1.2 polygon with a GAP Status Code attribute value of ‘1 – managed for biodiversity – disturbance events proceed or a mimicked’ or ‘2 – managed for biodiversity – disturbance events suppressed’. Polygons with these attributes are visually aggregated for display layers and their areas are added when PADUS\_CAP statistics are calculated.

#### Sliver Polygons and Topological Errors

The initial release of the PAD-US v1.2 polygon feature class contained several sliver polygons, particularly in areas near NPS units. These slivers will alter statistical outputs slightly, resulting in records with very small PCT\_Area values.

#### Discrepancies between PAD-US and NPS Administrative Boundaries

The Protected Areas Database of the United States dataset includes NPS areas. These features came from the NPS Current Administrative Boundaries dataset and therefore may be out-of-date, may lack topology, or may have incorrect attribution. Updates provided by NPS groups in the Fall of 2010 are included in the PAD-US 1.2 feature class. See Appendix 6.2.1 for more details.

#### Data Availability

The source dataset (PAD-US) is collected state-by-state and agency-by-agency. Therefore, variability in polygon features and attribution will occur across state or agency boundaries. One noticeable difference is when one state generated polygons for private land while the neighboring state did not. These areas will display as distinct divisions in output layers and maps.

#### Precision and Scale Settings for File Geodatabases

Fields used for calculating road densities have a float data type. In a file geodatabase, the float data type (single-precision floating point) does not allow explicit setting of precision and scale beyond the default precision setting of 6 digits

([http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=Geodatabase\\_field\\_data\\_type\\_s](http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=Geodatabase_field_data_type_s)). Given the generally coarse resolution of source data for NPScape, this limitation was deemed acceptable.

### 6.2. *Source Data Processing*

#### 6.2.1. Source Data

Two datasets are required for processing these metrics: the pre-processed Protected Areas Database of the United States (PAD-US) polygon feature class and area of analysis polygons.

GIS data were obtained from the following sources:

- **Source 1:** Protected Areas Database of the United States (version 1.2):  
<http://gapanalysis.usgs.gov/data/padus-data/>

This polygon feature class includes protected area features for the United States. The source spatial reference was USA Contiguous Albers Equal Area Conic USGS, so PAD-US source data were not re-projected.

NPS boundary features were updated in the PAD-US 1.2 version. According the toe PAD-US 1.2 version metadata file, these are the processing steps applied to NPS areas:

Data exported from PAD-US version 1.1 by "Owner Name = NPS" summarized by "Primary Designation Name" and distributed to NPS Networks for Category (Fee or Easement) and GAP Status Code review, coordinated by Bill Monahan (NPS Inventory and Monitoring) during the Fall 2010 in collaboration with GAP. GAP obtained best available ownership data from NPS Land Resources Division (Roger Johnson). At the time, Lands had reviewed about 275 units and created tract level ownership data within the previously defined administrative (a.k.a. legacy or proclomation) boundaries approved by congress. To aggregate best available data without major topolgy overlap errors, GAP merged nps\_tracts.shp with units from nps\_boundary.pdf Lands had not yet revised to tracts. Both were reprojected and translated into the PADUS schema following Standards (see GAP Website).

With consent from the NPS Wilderness Stewardship Division (Ashley Adams), GAP incorporated nationally compiled NPS Wilderness Area data from Wilderness.net (Lisa Edison). GAP updated the combined nps\_tracts\_boundaries file with wilderness areas to avoid overlapping polygons and inflating protected area statistics. The Primary Designation Type and Name PADUS attributes describe the Wilderness Areas, while the Secondary Designation Type and Name fields describe the original designation present in NPS Lands files (e.g. National Park) where Wilderness Areas overlap.

GAP joined updated Lands data with the PADUS v1.1 NPScape review by the Primary Local Name field to transfer conservation measures. New protected areas were assigned categorical GAP Status Codes (see GAP Code Source = GAP - Default) and IUCN Categories. GAP incorporated a few protected areas in PAD-US version 1.1 reviewed by NPScape that are not in Lands data. Review comments are welcome.

Where nps\_tracts data was unavailable (i.e. GIS Source = nps\_boundaries) GAP updated overlapping protected areas from PAD-US version 1.1 into legacy admin boundaries (e.g. state wildlife management areas) assuming land ownership in PADUS is accurate. Otherwise, nps\_tracts data updated PAD-US after clipping polygons that crossed state lines to a state boundary file (USGS GAP Analysis Program, 2011).

## **Source 2:** Area of Analysis Polygons

The NPScape project uses three AOA sources: NPS parks buffered by 30 kilometers and Commission on Environmental Cooperation (CEC) ecoregions and selected upstream watersheds.

### 6.2.2. Re-Projection of Source Data

The source PAD-US feature class obtained in the standard NPScape projection. For CONUS areas, the PAD-US feature class is used without re-projection. For Alaska, Alaska Albers Equal Area Conic is used. NAD\_83 is the datum for both projections. For Hawaii, UTM Zone 5N NAD83 is used.

## 6.3. *Lookup Tables*

### 6.3.1. Ownership Category Descriptions

Native feature class values in output feature classes and statistics file for Conservation Status Ownership Category (CAC) Metric (from PAD-US v1.2):

Owner Code	Owner Type
0160	Tribal Land
0220	Tribal Land
0110	Bureau of Land Management (BLM)
0120	Bureau of Reclamation (BOR)
0510	City Land
0520	County Land \ Regional Agency Land
0410	County Land \ Regional Agency Land
0420	County Land \ Regional Agency Land
0135	Department of Defense (DOD) and Department of Energy (DOE)
0140	Department of Defense (DOD) and Department of Energy (DOE)
0125	Fish and Wildlife Service (FWS)
0130	Forest Service (USFS)
0145	National Park Service (NPS)
0115	Other Federal (TVA, NRCS, NOAA, etc.)
0165	Other Federal (TVA, NRCS, NOAA, etc.)
0155	Other Federal (TVA, NRCS, NOAA, etc.)
0150	Other Federal (TVA, NRCS, NOAA, etc.)
0170	Other Federal (TVA, NRCS, NOAA, etc.)
0100	Other Federal (TVA, NRCS, NOAA, etc.)
0670	Private Conservation
0710	Private Conservation
0610	Private Conservation
0720	Private Conservation
0620	Private Conservation
0640	Private Conservation
0650	Private Conservation
0660	Private Conservation
0340	State Trust Land
0350	State Trust Land
0320	State Trust Land
0330	State Fish and Wildlife
0310	State Parks and Recreation
0360	Other State (NHP,DOT,HS,etc.)
0370	Other State (NHP,DOT,HS,etc.)

0380	Other State (NHP,DOT,HS,etc.)
0390	Other State (NHP,DOT,HS,etc.)
0315	Other State (NHP,DOT,HS,etc.)
0325	Other State (NHP,DOT,HS,etc.)
0365	Other State (NHP,DOT,HS,etc.)
0375	Other State (NHP,DOT,HS,etc.)
0385	Other State (NHP,DOT,HS,etc.)
0395	Other State (NHP,DOT,HS,etc.)
0630	The Nature Conservancy (TNC)
1009	Territorial Land
1008	Territorial Land
1007	Territorial Land
1006	Territorial Land
1005	Territorial Land
1004	Territorial Land
1003	Territorial Land
1002	Territorial Land
1001	Territorial Land

### 6.3.1. **GAP Status Codes**

Lookup values to select polygons for the Conservation Status Area Protected (CAP) Metric (from PAD-US v1.2):

GAP Status Code	Description	Protected Area?
1	managed for biodiversity – disturbance events proceed or a mimicked	Yes
2	managed for biodiversity – disturbance events suppressed	Yes
3	managed for multiple uses – subject to extractive (e.g. mining or logging) or OHV use	No
4	no known mandate for protection	No