

National Park Service



Standard Operating Procedure 7.1.1

Inventory and Monitoring Database Documentation: Environmental Setting Protocol

Please cite this as:

Kinseth, M., L. Nelson, and S. Schupbach. 2018. Inventory and monitoring database documentation: Environmental Setting Protocol. Inventory & Monitoring Division Standard Operating Procedure NPS/NRSS/IMD/SOP-7.1.1. National Park Service, Fort Collins, Colorado.

Summary

This SOP documents database operations for the Environmental Setting databases.

Revision Log

[illegible]

Contents

	Page
Summary	1
Revision Log.....	1
Overview.....	3
Database Documentation	3
Server landscape.....	3
Database Architecture	4
Database Objects – Environmental Setting	4
Database Objects – Landscape Dynamics	4
Database Objects – Climate.....	5
Database Objects – Stream Hydrology.....	7
Maintenance process flow	8
Metric Data Qualifying.....	9
Code repositories	10
Database User and Password Information.....	10
Literature Cited	11
Appendix 1: Reporting Tables, Views, Functions, and Stored Procedures	12

Overview

The Environmental Settings protocol (DeVivo et al. In Review) relies on several SQL Server databases (Table 1). Because each environmental setting topic has a unique data flow, staging databases (Figure 1) are used to isolate the topic-specific data for QA/QC operations, summary tables, and associated interchange databases which power reports and data services (SOP 7.2.1; Nelson and Kinseth 2018).

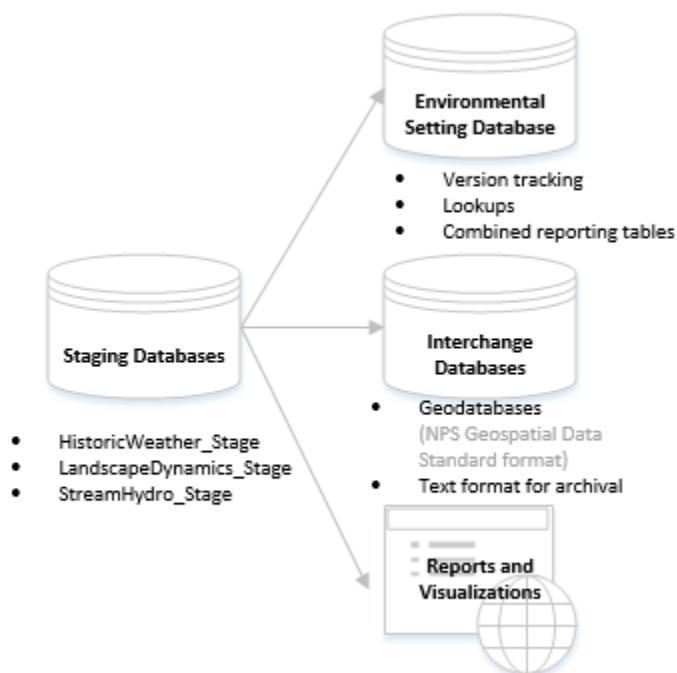


Figure 1. Database overview

Database Documentation

Server landscape

Both non-spatial and geodatabase SQL Server database are used in protocol (Table 1).

Table 1. Databases used in the Environmental Settings protocol

Database	Server Instance	Purpose	Security
LandscapeDynamics_Stage	INPNISCVDBNRSST\IMDGIS	Processing and preparation	Restricted set of domain accounts
HistoricWeather_Stage	INPNISCVDBNRSST\IMDGIS	Processing and preparation	Restricted set of domain accounts
StreamHydro_Stage	INPNISCVDBNRSST\IMDGIS	Processing and preparation	Restricted set of domain accounts
StatsQA*	INPNISCVDBNRSST\IMDGIS	QA/QC of parameter statistics	Restricted set of domain accounts
EnvironmentalSetting	INPNISCVDBNRSST\IMDGIS	Reporting database	Restricted set of domain accounts
GDB_NRSS	INPNISCVDBNRSST\IMDGIS	Reporting database	Restricted set of domain accounts
GDB_IMD	INPNISCVDBNRSST\IMDGIS	Reporting database	Restricted set of domain accounts

**Legacy database for landscape dynamics.*

Database Architecture

Database objects described below represent data structures used in the initial implementation phase of the protocol. Alterations may be made as necessary to maximize use and improve performance.

Database Objects – Environmental Setting

Master lookup tables for parameters, qualifiers, and version tracking tables for area of analysis and other polygons are present in this database. These tables are maintained with SQL scripts and are populated from CSV files and geodatabase tables. In both cases, sources are imported using ArcGIS which has a more robust data import capability than native SSMS tools. See the Version Tracking section for details.

Master lookup tables are created and maintained with the `CreateParameterTables.sql` script.

1. Step through statements in `CreateParameterTables.sql` to create and populate `config.EnvironmentalSettingParameters` table.
2. Use statements in `AddLookupTables_ES.sql` to create and populate change and redact lookups and master qualifier lookup.

Database Objects – Landscape Dynamics

Annually, summary statistics are calculated using Python toolboxes in ArcGIS. After QA is complete, statistics tables are uploaded to the `LandscapeDynamics_Stage` database in SQL Server. Reporting tables and views are generated for each landscape dynamics metric.

When parameter statistics tables are updated (Figure 2), previous tables are date stamped and moved to the `zArchive` database schema (SOPs 3.11.9-3.11.16; Kinseth and Nelson 2018h, g, f, b, c, d, a, e).

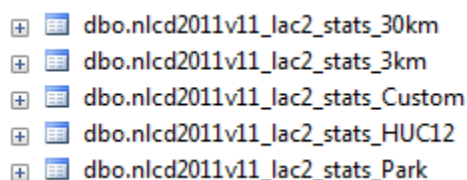


Figure 2. Example landscape dynamics statistics tables (i.e. view sources)

Scripts are used to create reporting tables and views (Figures 3 and 4).

1. Use create view scripts in the `LandscapeDynamicsDatabaseScripts` of the code repository. The scripts will drop and create views in the target database. Note some view scripts will require editing if new data years are added.
2. Verify select privileges are granted correctly.



Figure 3. Example landscape dynamics statistics reporting tables (land cover)

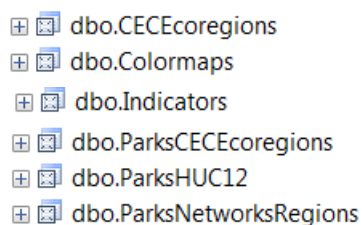


Figure 4. Reporting tables used for lookups and service support

Database Objects – Climate

Annually for climate parameters (DeVivo et al. In Review), station-based metrics are requested from the Applied Climate Information System (ACIS) using the functions in the IMD Environmental Setting toolkit (Nelson and Frakes 2017). Also, the Toolkit generates gridded metrics from the NPS PRISM 800m long-term archive maintained by the NPS Climate Change Response Program. These data are loaded into the HistoricWeather_Stage database for QA checks. When QA is complete, records are imported into the active tables (SOP 3.6.1; Nelson, 2018b). Reporting tables are generated for use by data services (SOP 4.1.2; Nelson and Kinseth, 2018) and summary reports.

1. Create the HistoricWeather_Stage database by running the HistoricWeather_Stage.sql script.
2. Verify schema resembles Figure 5.

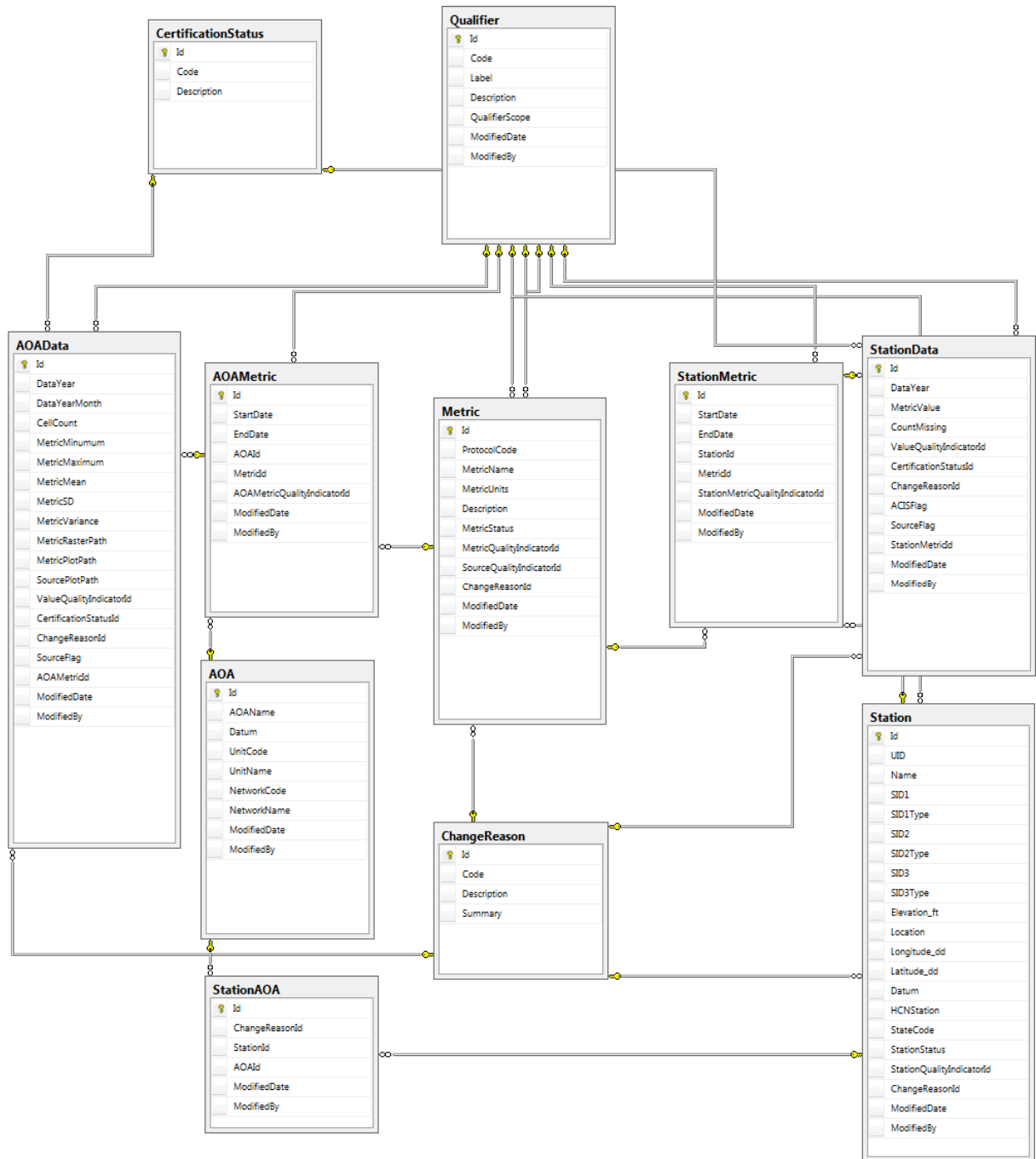


Figure 5. Schema of HistoricWeather_Stage database

Create reporting tables and views:

1. Execute the statements in `CreateClimateReportingTablesViews.sql` to add reporting tables and views (Figure 6). Script is located in the Climate\Scripts folder of the Environmental Setting repository.

2. Verify select privileges are granted correctly.

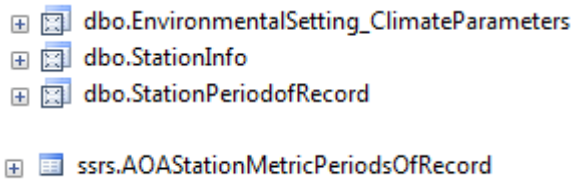


Figure 6. Example Climate reporting database tables and views

Database Objects – Stream Hydrology

Each year, hydrology metric statistics are generated using the Environmental Setting Hydrology toolkit (DeVivo, 2018) and loaded into a staging database in SQL Server. Once complete, reporting tables are created for data services (SOP 4.2.1; Nelson and Kinseth, 2018) and reports.

1. Create the StreamHydro_Stage database by running the `Hydro_Stage.sql` script. Verify schema resembles Figure 7.

Figure 7. Schema of StreamHydro_Stage database

2. If working with pilot data, use data load statement to insert records into StreamHydro_Stage database tables from pilot tables. Examples in `LoadHydroData.sql` file.
3. Non-pilot data are entered directly into the StreamHydro_Stage database tables by the EnvironmentalSetting_Hydro toolkit.

Create reporting tables and views:

1. Execute the statements in `CreateHydrologyReportingTablesandViews.sql` to add reporting tables and views (Figure 8). Script is located in the StreamHydro\Scripts folder of the Environmental Setting repository.
2. Verify select privileges are granted correctly.

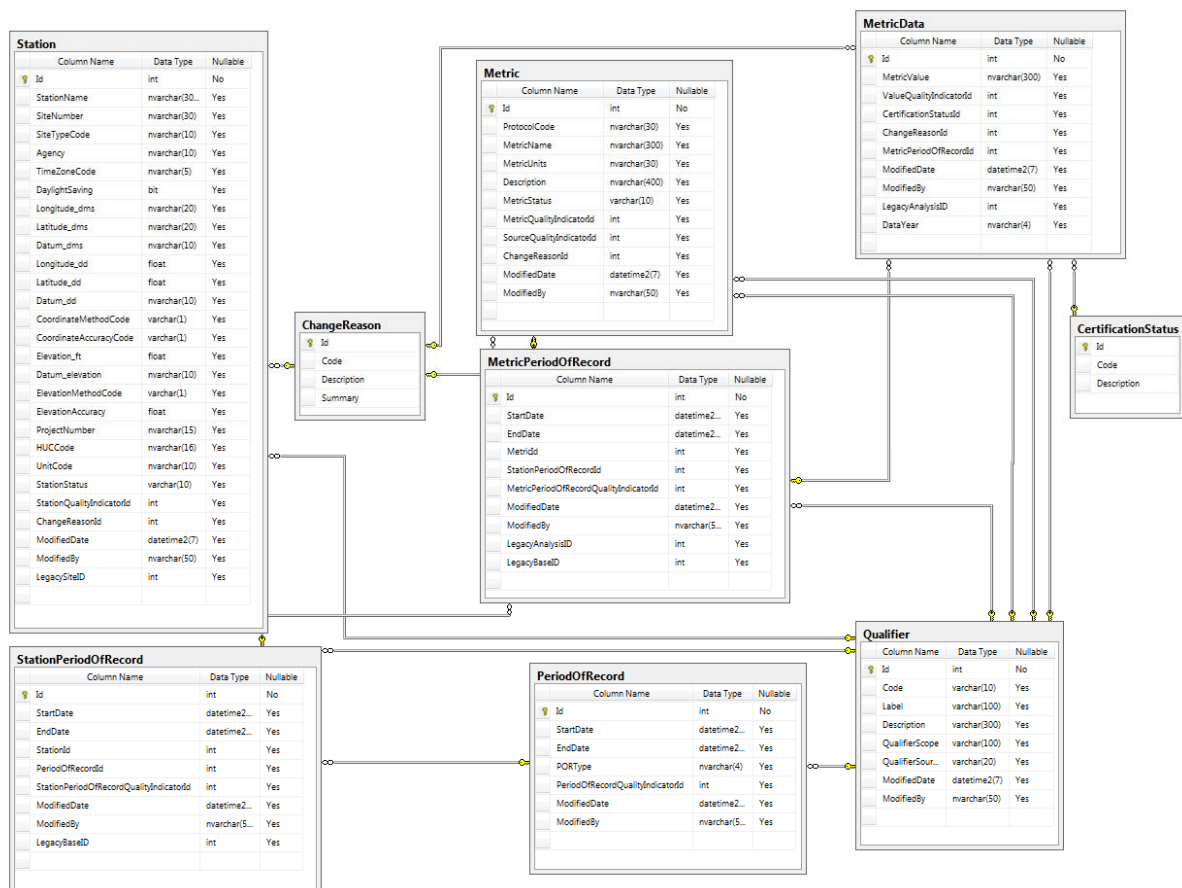


Figure 8. Example Hydrology reporting database tables and views

Maintenance process flow

Records are added to staging databases as statistics are calculated and quality assured. Imports to either summary reporting tables and views or the master Environmental Settings database will occur three times yearly (Table 2). See the Environmental Settings Protocol Timeline for details (DeVivo et al. In Review).

Table 2. Database record update schedule

Database	Record Load Complete	Import to Reporting Databases
LandscapeDynamics_Stage	December (non-land cover metrics) February (land cover metrics from new source)	March
HistoricWeather_Stage	February	March
StreamHydro_Stage	June	July

Alterations to table and view structure occur as needed. SQL scripts for database creation are archived in the code repository for the protocol. All databases are backed up incrementally each night. Copies of the nightly backups are archived each Monday and Thursday.

Metric Data Qualifying

Each metric data record is assigned a data qualifier value when loaded into the relevant staging database. These qualifiers are maintained in perpetuity – if a previously stored metric value changes, the original record qualifier is updated to indicate the change. The new metric value with its qualifier is added. Qualifiers are used similarly in the Inventory 2.0 databases storing ancillary information used by this protocol.

Data queries are used to filter active metric records from previous records. Qualifiers are loaded into the reporting databases along with metric values. Qualifier values vary by topic and scope as noted in Table 3. The default qualifier regardless of scope is ‘None’ with a code of ‘-’ (not shown). Also, qualifier source (USGS, ACIS, etc.) is noted for each qualifier.

Table 3. Qualifier values by protocol topic

Topic	Scope	Qualifier		
		Code	Label	Description
Climate	AOADData	TBD		
	AOAMetric	TBD		
	Metric	TBD		
	Source	TBD		
	Station	TBD		
	StationMetric	TBD		
Hydro	Metric	TBD		
	MetricData	TBD		
	MetricPeriodOfRecord	TBD		
	PeriodOfRecord	1	AZ	All daily flow values equal zero
		2	MD	Missing daily flow data
		4	FTN	Flood threshold could not be calculated and instead set to null (affects Duration H, Frequency H, and Timing A,H, & L Metrics)
		5	NAs	Error thrown during HIT calculations due to NAs in log transformed data
		6	TNCF-2	"mimic-TNC" setting set to FALSE for IHA group 2 metrics
		9	TNCF-3	"mimic-TNC" setting set to FALSE for IHA group 3 metrics
	Source			
	Station			
		1	DDDA	Daily Discharge Data Available

	2	NHP	National Hydrology Protocol Station
	3	ACTY	Active as of end of prior water year
	4	ACTN	Not active as of end of prior water year
	5	ACTM	Missing data on last day of prior water year only
	6	DDDAE	Daily Discharge Data Available but processing error
	StationPeriodOfRecord	TBD	
Landscape Dynamics		TBD	

Code repositories

Environmental setting database scripts:

IMD TFS: /IMDProjects/_git/EnvironmentalSetting

Environmental setting climate toolkit:

https://github.com/nationalparkservice/EnvironmentalSetting_Toolkit

Environmental setting hydrology toolkit:

https://github.com/nationalparkservice/EnvironmentalSettings_Hydro

Database User and Password Information

For data services, no username or password is required.

SQL Server Reporting Services exposed via the IRMA Report Portal do not require a username and password.

For ArcGIS, SQL Server Management Studio (SSMS), and PowerBI connections, a read-only login is used.

Literature Cited

- DeVivo, J. C., L. Nelson, M. Kineth, T. Philippi, and W. B. Monahan. In Review. Protocol for monitoring environmental setting for National Park Service units: Landscape dynamics, climate, and hydrology. Natural Resource Report NPS/IMD/NRR—2018/XXXX National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018a. Quality assurance and quality control for landscape dynamics metrics: Area without roads. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.15. National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018b. Quality assurance and quality control for landscape dynamics metrics: Pattern density. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.12. National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018c. Quality assurance and quality control for landscape dynamics metrics: Pattern morphology. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.13. National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018d. Quality assurance and quality control for landscape dynamics metrics: Population density and total population. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.14. National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018e. Quality assurance and quality control for landscape dynamics metrics: Road density. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.16. National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018f. Quality assurance and quality control for landscape dynamics metrics: Total and percent area for impervious surface. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.11. National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018g. Quality assurance and quality control for landscape dynamics metrics: Total and percent area for natural and converted lands. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.10. National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018h. Quality assurance and quality control for landscape dynamics metrics: Total and percent area per national land cover category. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.9. National Park Service, Fort Collins, Colorado.
- Nelson, L. and B. Frakes. 2017. IMD climate package website. <https://irma.nps.gov/DataStore/Reference/Profile/2239495> (accessed 09/14/2017).
- Nelson, L. and M. Kineth. 2018. NPS Inventory and Monitoring Division technical documentation: Landscape dynamics statistical services—Version 1.0. Inventory & Monitoring Division Standard Operating Procedure NPS/IMD/SOP—7.2.1. National Park Service, Fort Collins, Colorado.

Appendix 1: Reporting Tables, Views, Functions, and Stored Procedures

Available as schemas are finalized.

Reporting tables and views exist in each of the three staging databases. As statistics are calculated, views are created (or validated) in the appropriate staging database. Reports run on the SQL Server Reporting Services Servers that power the IRMA Report Portal application.

Table 4: Landscape Dynamics Tables and Views

Name	Description	Related Items
<i>LandCover_NaturalConverted_CCAP_PACN*</i>	Metric statistics organized by AOA	Report
<i>LandCover_NaturalConverted_NLCD</i>	Metric statistics organized by AOA	Report
<i>LandCoverAreaPerCategory_Level1_NLCD*</i>	Metric statistics organized by AOA	Report
<i>LandCoverAreaPerCategory_Level2_CCAP_PACN*</i>	Metric statistics organized by AOA	Report
<i>LandCoverAreaPerCategory_Level2_NLCD*</i>	Metric statistics organized by AOA	Report
<i>LandCoverImperviousSurface_Grouped_NLCD</i>	Metric statistics organized by AOA	Report
<i>LandCoverImperviousSurface_GroupedPatchSize_NLCD</i>	Metric statistics organized by AOA	Report
<i>LandCoverImperviousSurface_PatchSize_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternDensity_Grouped_2001_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternDensity_Grouped_2006_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternDensity_Grouped_2011_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternMorphology_2001_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternMorphology_2006_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternMorphology_2011_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternMorphology_PatchFrequency_2001_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternMorphology_PatchFrequency_2006_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternMorphology_PatchFrequency_2011_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternMorphology_PatchSize_Core_2001_NLCD</i>	Metric statistics organized by AOA	Report
<i>PatternMorphology_PatchSize_Core_2006_NLCD</i>	Metric statistics organized by AOA	Report

Name	Description	Related Items
	AOA	
<i>PatternMorphology_PatchSize_Core_2011_NLCD</i>	Metric statistics organized by AOA	Report
<i>PopulationDensity</i>	Metric statistics organized by AOA	Report
<i>Road_AreaWithoutRoads_PatchSize_TigerRoads</i>	Metric statistics organized by AOA	Report
<i>Road_AreaWithoutRoads_TigerRoads</i>	Metric statistics organized by AOA	
<i>RoadDensity_TigerRoads</i>	Metric statistics organized by AOA	Report

*Source is LD_Stage database

Table 5: Landscape Dynamics Functions and Stored Procedures

Name	Description	Related Items
<i>dbo.GetAOAsForNetwork</i>	Coalesces records into a lookup source; includes custom AOAs	By AOA reports
<i>dbo.GetStandardAOAsForNetwork</i>	Coalesces records into a lookup source	Graph reports
<i>dbo. VersionStatsTables</i>	Creates date-stamped tables and places them in the zArchive database schema	-