

Puget Sound Partnership GIS Program and Standards

Puget Sound Partnership Quality Assurance Program Plan

January 2014

Executive Summary

The Puget Sound Partnership (PSP) initiated a GIS program in early 2013 to address the growing need to develop and manage geospatial data, analyses, and maps within the agency. This document is intended to detail PSP's GIS program and address the quality assurance, quality control, and other technical activities that PSP will implement to ensure our commitment to performance standards (EPA 2003). It is anticipated that PSP's GIS program will evolve and updates to this document are tracked in the Revision History section.

Content highlighted as demonstrated here was extracted from the EPA QAPP guidance document (2003) for clarification and guidance in reading this document.

Revision History

Date	Version	Description	Contact
4/15/2014	1.0	Submitted document	Jennifer Burke

Acronyms

AGOL	ArcGIS Online
DNR	Washington Department of Natural Resources
DNR	Department of Natural Resources
ECO Net	Education, Communication, and Outreach Network
ECY	Washington Department of Ecology
FGDC	Federal Geographic Data Committee
IT	Information Technology
LIOs	Local Implementing Organizations
NAIP	National Agricultural Inventory Program
NLCD	National Land Cover Database
NMAS	National Map Accuracy Standards
OCIO	Office of Chief Information Officer
PSNERP	Puget Sound Nearshore Ecosystem Restoration Project
QAPP	Quality Assurance Project Plan
RCO	Washington Recreation and Conservation Office
REST/SOAP	Representational State Transfer/Simple Object Access Protocol
SQL	Structured Query Language
USGS	United States Geologic Service
UTM	Universal Transverse Mercator
WAGIC	Washington State Geographic Information Council
WAPSP	Washington State Puget Sound Partnership
WRIA	Water Resource Inventory Area

Approval Page

Greg Tudor, IT Manager

Date

Alana Knaster, Deputy Director of Operations

Date

Katherine Boyd, Performance Manager

Date

Jennifer Burke, Performance Data Systems Manager

Date

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1. Introduction

1.1. Purpose

The Puget Sound Partnership (PSP) initiated a GIS program in early 2013 to address the growing need for and use of geospatial data and maps within the agency. This document is intended to detail PSP's GIS program and address the quality assurance, quality control, and other technical activities that PSP will implement to ensure our commitment to performance standards (EPA 2003).

The following document provides both guidelines and source material for PSP's GIS program and standards:

1. Environmental Protection Agency. 2003. Guidance for Geospatial Data Quality Assurance Project Plans. Office of Environmental Information, Washington, DC 20460. EPA/240/R-03/003
2. Chesapeake Bay Program. 2007. Geospatial Data Quality Assurance Project Plan.

A majority of the GIS tasks performed by the GIS Manager/Analyst are routine and accomplished with minimal geoprocessing of geospatial data. These geoprocesses may include: projection, selection, clipping, minor editing of vertices, and overlaying of data. The purpose of these processes is to generate maps and update PSP's four authoritative datasets. All geoprocessing is conducted with the minimum threshold settings to reduce feature movement and review for consistency with the original dataset. This document is intended to document those general procedures and the standards implemented.

For more specialized tasks or analytical projects, the GIS Manager is responsible for documenting a separate specialized QAPP with details for quality control, assurance procedures, and the geospatial methods associated with all aspects of the project.

1.2. GIS Program Organization

The purpose of this element is to provide EPA and other involved parties with a clear understanding of the role that each party plays in the investigation or study and to provide the lines of authority and reporting for the project.

Puget Sound PSP GIS Program is part of the Performance Management Team and is comprised of a single GIS Manager who reports to the Performance Manager (Figure 1). The GIS Manager serves as PSP GIS analyst, specialist, cartographer, and administrator of all geospatial data and projects. The IT Manager administers the network, hardware, and software for PSP, including Washington State Recreation and Conservation Office's (RCO) ArcGIS Server that PSP uses to host services. The GIS Manager coordinates PSP's geospatial software and hardware needs with the IT Manager.

The GIS Manager is sustained at a 0.3 FTE and the tasks and responsibilities reflect the limited time available.

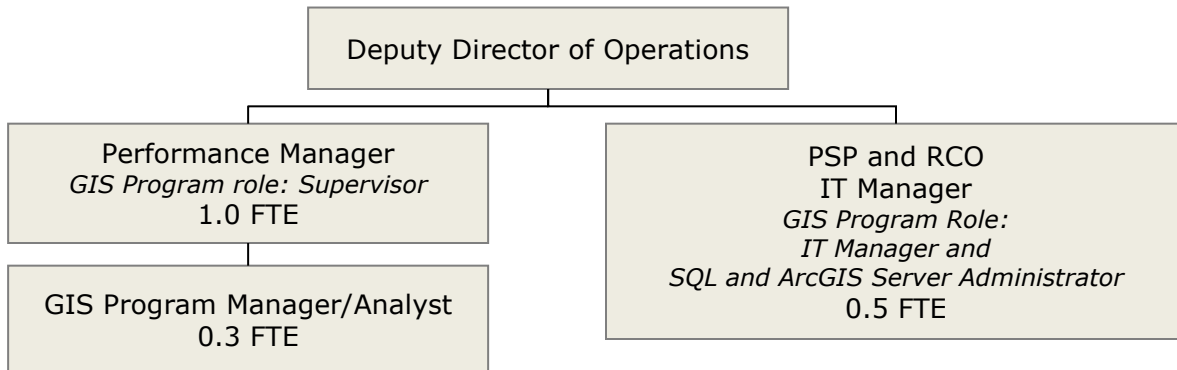


Figure 1. Organization structure of PSP’s GIS program staff.

1.3. Problem Definition/Background

The purpose of this element is to describe the background and context driving the project and to identify and describe the problem to be solved or analyzed.

1.3.1. Goal

Provide GIS support to PSP staff and to external partners, and to provide effective and accurate geospatial data, analyses, and maps to the public.

1.3.2. Objectives

1. Support the suite of strategic goals and business needs of PSP.
2. Develop and maintain PSP’s four authoritative geospatial datasets (see Section 1.4).
 - *Authoritative* datasets are datasets created and maintained by PSP for which only PSP has the authority to determine the geometry and attributes of those data, i.e. PSP is the authoritative source of these data.
3. Construct and maintain a current geospatial data library for cartography and spatial analyses.
4. Provide cartographic support for PSP’s partners.
5. Provide cartographic support for presentations, publications, and meetings.
6. Develop and maintain geospatial data and maps on PSP’s website.
7. Facilitate distribution of geospatial data and tools for the region.
 - a. Data and tools may be developed by PSP’s partners through EPA’s National Estuary Program grants.

1.4. Projects and Tasks

The purpose of this element is to provide the participants with an understanding of the project tasks and the types of activities to be conducted.

PSP’s GIS program will serve the needs of both PSP staff and its partners. PSP does *not* currently maintain an Enterprise GIS system because geospatial resources are not shared among staff. All tasks are solely the responsibility of the single GIS Manager at this time.

The GIS manager/analyst is expected to perform the following tasks:

- A. Establish and maintain the Puget Sound PSP authoritative management boundaries with geospatial datasets for:
 - a. Action Area boundaries and attributes.
 - b. Salmon Recovery Watershed boundaries and attributes.
 - c. Lead Implementation Organizations boundaries and attributes.
 - d. ECO Net boundaries and attributes.
- B. Develop and maintain:
 - a. Presentation maps, both hard copy and digital.
 - b. Outreach material.
 - c. Publication maps.
 - d. Embedded web maps.
 - e. ArcGIS Online maps.
 - f. Story maps.
 - g. Standardized map templates for:
 - i. State of the Sound
 - ii. Action Agenda
 - iii. Salmon Recovery Plans
- C. Providing analytical and cartographic support for geospatial investigations, both internal and external.
 - a. External projects must be applicable to moving PSP's Action Agenda forward.
- D. Develop and maintain:
 - a. Geospatial data on RCO's ArcGIS Server.
 - b. Feature and map services stored on RCO's SQL and ArcGIS Server.
 - c. Data download and service links on Washington State Geospatial Portal.
 - d. Map, Story Maps, PDFs, and Applications on ArcGIS online (AGOL) system.
- E. Manage PSP's AGOL account according to State OCIO GIS standards.
- F. Manage geospatial data for PSP's Project Atlas <<http://gismanager.rco.wa.gov/ProjectAtlas/>>
- G. Coordinate operations with the IT Manager and RCO and Puget Sound Institute
- H. Participate in PSP's IT Governance committee

The GIS Program QAPP does not address specialized spatial analyses. These projects are documented in individual QAPPs associated with the project.

In addition to the tasks listed above, the GIS Program provides routine spatial data analyses primarily in support of cartography for PSP staff and partner organizations, e.g. Local Integrating Organizations (LIO), to support decision making associated directly with Near Term Actions. This task requires coordination and responding to the LIOs in a timely manner.

1.4.1. Schedule

All tasks as scheduled accordingly as the need arises with the exception of the Action Agenda, State of the Sound, and Salmon Recovery Plans. The Action Agenda and State of the Sound maps are updated on a biennial frequency. The Action Agenda is updated in spring 2014, spring 2016, etc. The State of the Sound report is updated in the fall of 2015, fall 2017, etc. The Salmon Recovery Plans are generated

annual in June. Maps are generated for all three publications at least 1 month prior to the rough draft submission for public review.

Figure 2 illustrates a partitioning of GIS program three main responsibilities according to the estimated time needed to fulfill the 0.3 FTE.

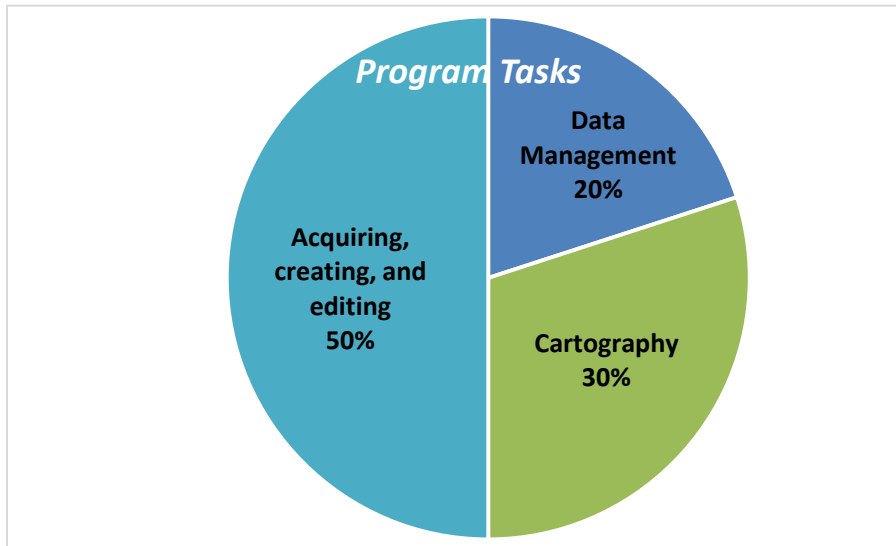


Figure 2. GIS tasks partitioned according to estimated time.

1.4.2. Coordination

The GIS Manager coordinates GIS activities with two sister agencies, and is expected to serve on a variety of committees within PSP and their sister agency, Washington State Recreation and Conservation Office (RCO).

1.4.2.1. RCO

PSP and RCO are both relatively small sister agencies that share staff and technology resources for efficiencies in cost and effort. PSP's IT Program is managed jointly with RCO by an IT Manager and team staff. PSP's GIS manager coordinates with PSP's IT Manager for matters that concern PSP's SQL and ArcGIS server, which is hosted by RCO at their facility. PSP defaults to RCO's data management standards for organizing and maintaining data on the RCO servers.

1.4.2.2. Puget Sound Institute

PSP and the Puget Sound Institute both use RCO's SQL and ArcGIS server to distribute data, and maintain feature and map services. To reduce redundancy of datasets on the server, PSP and PSI coordinate the contents of their respective GIS data libraries.

1.4.2.3. IT Governance

The GIS manager participates in two monthly meetings as a member of the IT Governance team at PSP and at RCO. Both committees oversee IT and GIS activities and are the key technology decision makers for both agencies.

1.5. Quality Objective and Criteria

The purpose of this element is to document the quality objectives of the project and to detail performance and acceptance criteria from the systematic planning process that will be employed in generating the data.

The objective of quality control and quality assessment are (NPS 2008):

1. Ensure that PSP projects and products are high-quality and credible data that can be confidently used by staff and the public.
2. Design, document, and implement standard quality control and assurance procedures that minimize or eliminate errors.

Quality control and assessment procedures pertain to the acquisition, creation, editing, and geoprocessing of geospatial data and the construction of maps for any purpose. Preferred source data includes federal and state agency authoritative datasets, e.g. National Hydrography Dataset, WA Department of Ecology Drift Cells geospatial data.

The Federal Geographic Data Committee has identified six components of data quality (FGDC 1998) that are applied to all geospatial data generated, manipulated, or acquired by PSP:

- Accuracy – positional
- Accuracy – attribute
- Completeness
- Logical consistency
- Precision
- Lineage

In addition to the six components above, all geospatial data generated and acquired are reviewed for:

- Best availability
- Appropriateness
 - Scale
 - Accuracy
 - Resolution
 - Time period
 - Format
 - Content
- Topology errors
 - Overlap
 - Gaps
 - Sliver polygons/segments
- Attribute errors
- Geometry errors
 - Empty geometry

Specific details related to the items above are addressed in Section 3.9 Quality Control and Assessment.

1.6. Training, Certification, and Professional Development

The purpose of this element is to document any specialized training necessary to complete the project. This element may be used to discuss how these needs will be met and how to verify that they have been met.

The GIS manager may obtain additional training and certification in the GIS field at the Performance Manager's discretion. Training is strongly encouraged on an annual cycle to maintain and develop the necessary skills for the program and to stay current with changing technologies. Certification supports agency credibility through establishing minimum standards and skills. Opportunities for both training and certification are available at:

- ESRI (www.esri.com)
 - Virtual classroom
 - Technical certification
 - Workshops at conferences
 - Local and International (San Diego) conference attendance
- GIS Certification Institute (www.GISCI.org)
- Online institutes of higher education

ESRI complimentary conference registration may be available at RCO's discretion for PSP's GIS staff to attend ESRI's annual international conference in San Diego.

1.6.1. Geospatial Skills

Table 1 lists the skills and software proficiency expected from PSP's GIS Manager.

Table 1. Skills expected of PSP’s GIS Manager.

Skill	Skill Level
Software proficiency	
ArcGIS Advanced (ArcInfo) and extensions	Spatial Analyst, Geostatistical Analyst, Model Builder
ArcGIS Online	Feature services, map services, map applications, story maps
Python	Task efficiency
SQL server and queries	Familiarity with using
Microsoft Office Suite	Access, Excel (advanced features), Word, PowerPoint
Data Management	
Organization structure and maintenance	Best practices Hard drive folders, network, ArcGIS and SQL Server, AGOL
Geospatial formats	Vector and raster
File Geodatabases	Geodatabase structure, building and managing single user databases, converting data
Back-up and archiving data	
Horizontal coordinate systems and datums	Manage, Project (convert), Define
Vertical datums	Understanding
Dissemination	REST/SOAP services, data download, AGOL
Cartography	
Principles	Design, scale, resolution, coordinate systems
Map composition	Elements
Data Generation, Acquisition, Geoprocessing, and Analyses	
Project management	
Establish essential and robust workflows	
Quality control and assessment	Standardized methods, topology
Familiar with geographic coordinates	Geographic coordinate systems
Generate and edit geospatial data	Best practices Vector, Raster
Metadata	Create and edit using FGDC standards
Data acquisition	
Converting geospatial data formats	
Geoprocessing	Buffer, extract, overlay, generalization, summaries, feature conversion, project,
Analytical	Spatial Analyst, Geostatistical Analyst, pattern analyses, prioritization
Familiar with spatial data collection methods	GPS, remote sensing, aerial photography

1.7. Documents and Records

This element defines which documents and records are critical to the project. It provides guidance to ensure that important documentation is collected, maintained, and managed so that others can properly evaluate project procedures and methods.

The following documents or documentation are developed and maintained by PSP:

1. PSP GIS Program Standards
2. Metadata for all PSP authoritative datasets
3. Existing documentation for secondary data sources if data are distributed by PSP

1.7.1. PSP GIS Standards

This document is available on the shared drive on PSP network in the GIS folder. This document is also available for viewing and download as a PDF on PSP website on the GIS webpage. Both versions will be updated concurrently as needed.

1.7.2. Metadata

The State of Washington adopted the Federal Geographic Data Committee (FGDC) FGDC-STD-001-1998 *Content Standard for Digital Geospatial Metadata* as the standard to follow when documenting geospatial data sets (OCIO TSB 2012). To facilitate the implementation of this standard the Washington State Geographic Information Council (WAGIC) provides a working metadata standard, a subset of the FGDC Content Standard for Digital Geospatial Metadata, the approved pathway toward the adoption of the FGDC Content (OCIO TSB 2012).

1.7.2.1. Authoritative data

All authoritative datasets generated by PSP will comply with the Washington State GIS program standards. The working metadata standard is available at <http://ofm.wa.gov/ocio/policies/documents/161.11.pdf>.

In addition to dataset metadata, all PSP authoritative elements published on ArcGIS Online requires summary metadata as detailed by the Washington State OCIO GIS program office. The standards are currently in draft form and provided upon request by the Washington State OCIO program office.

1.7.2.2. Secondary Data

Data obtained from secondary sources will have existing metadata that will not be altered and will be maintained in the GIS library with the original source data.

1.7.2.3. Operational Data

A majority of the operational datasets will not have updated metadata due to the temporary nature of the data, interim purpose, or the secondary source for a majority of these data. Examples include the creation of new datasets for maps such as the selection of Puget Source WRIA polygons from the statewide ECY WRIA dataset or extraction of NLCD land use land cover for Skagit County. Both newly created datasets in the example have existing metadata from the authoritative source agency, are not distributed by PSP, and are processed only for cartographic effects required to develop the map.

In lieu of fully compliant FGDC metadata, the GIS manager may edit the Summary section of the dataset's metadata or generate a memo or a report to detail how the data were geoprocessed and the purpose of creating the data for future reference. In addition, standardized naming conventions of operational data provides additional metadata for the GIS Manager, e.g. retain the original data source name and add “_sel_PS”, which refers to the sub-selection of Puget Sound features from the larger source dataset. Non-embedded metadata and memos are stored with the dataset in a folder.

1.7.2.4. AGOL Metadata

The Washington State OCIO GIS Program provides guidance on metadata requirements for data, services, maps, and PDFs on the WA State AGOL Portal. PSP will provide all metadata required.

Metadata is limited by Esri to the following elements:

- Title

- Description
- Service URL (auto-generated)
- Originator
- Resource Type (auto-generated)
- Publication Date (auto-generated by Esri)
- Theme Topic (ISO Categories 11975)
- Projection
- Bounding Coordinates

1.7.2.5. Metadata Keywords and Tags

PSP products will include the appropriate metadata keywords and tags prior to publishing online or distribution. The tags will be selected from a list created by PSP to standardize the naming conventions. The list is currently under development as products are still being identified. At a minimum, all maps, datasets, and distributed items will include the following metadata tags/keywords:

- Puget Sound Partnership
- PSP
- Washington
- WA
- Applicable ISO 19115 Topic Categories as required by the Washington State OCIO GIS program
 - List available at http://geography.wa.gov/GeospatialPortal/iso_19115_metadata_topic_categories.pdf
- Name of the dataset, such as Action Areas.
- Subject of the data, such as Salmon.

2. Data Generation and Acquisition

Geospatial projects may involve the creation of new geospatial data from field measurements (e.g., from GPS measurement, aerial photography, or satellite imagery) or may involve the acquisition and use of existing geospatial data originally created for some other use.

PSP does not collect field measurements for spatial data generation. The GIS program is primarily responsible for maintaining PSP's four authoritative datasets, providing cartographic and spatial analytical products to staff and PSP outreach publications, presentations, and websites, and supporting PSP's partners if GIS resources are not available to them. This requires the development and maintenance of PSP's authoritative data, and the acquisition and geoprocessing of secondary data. Secondary use of data is the use of environmental data collected for other purposes or from other sources (EPA 2007).

2.1. Data Generation

This section will address data generation of the authoritative datasets that are not already discussed in the Quality Control sections (1.5 Quality Objective and Criteria and 3.9 Quality Control and Assessment).

PSP establishes and maintains four authoritative boundary (polygon) datasets:

1. Action Areas.
2. Salmon Recovery Watershed boundaries.
3. Lead Implementation Organizations boundaries.

4. ECO Net boundaries.

To maintain consistent edge-matching for boundaries and spatial analyses of the authoritative PSP datasets, the boundary lines will, where applicable, default to PSP's Action Areas, WA Department of Ecology WRIA boundaries, WA Department of Natural Resource's ShoreZone, or another agency or organization's authoritative dataset if applicable.

In addition to the spatial data mentioned previously, PSP generates the following types of data for our partners as a service in relation to the management of PSP's Near Term Actions and tracking of Puget Sound recovery actions. Examples include:

1. Point locations of recovery projects derived from latitude and longitude coordinates provided by partners.
2. Polygon or polylines of recovery projects derived from annotated maps or provided by the partners.

These data are not distributed, do not serve as authoritative datasets, and are not intended for general public use. Dissemination of the data is at the discretion of our partners who own the data. The accuracy of the geospatial data is the responsibility of the source providing the coordinates. PSP reviews the geospatial data for location integrity in the general vicinity, but PSP does not assess the accuracy of the point, polyline, or polygons provided by partners when PSP is providing GIS support to them.

In the event that PSP develops and distributes latitude and longitude coordinates for public use or mapping, PSP will follow the FGDC Geospatial Positioning Accuracy Standards, Part 1 and 3 (1998).

2.1.1. Action Agenda and Salmon Recovery Plans

PSP produces a biennial Action Agenda and the Salmon Recovery Watersheds generated annual Salmon Recovery Plans. PSP's GIS Manager develops maps for both publications. No new data are acquired but PSP's authoritative dataset are used in these maps.

2.2. Data Acquisition

Quality assurance includes not only the collection of new data, but also an evaluation of any existing data used. The secondary use of existing data (or "nondirect measurements") is an important component of many geospatial data projects. These data can be evaluated to determine that they are of adequate quality for the project's needs. This element documents the sources of data and the criteria used to evaluate the quality of this data.

PSP will adhere to WAGIC state standards for geospatial data acquisition recommendations, which currently directs state agencies to use the National Hydrologic Dataset for hydrography data. No further recommendations are provided.

A majority of PSP's GIS projects will use authoritative spatial data from partner agencies, termed secondary data. While PSP will assume that the partner agency has diligently upheld State standards for data quality, the GIS Manager will review the data according to the [six FGDC components](#) of data quality (FGDC 1998). PSP will acquire and manage these data according to the specifications of this document.

The following datasets are the preferred or state standard for mapping and spatial analyses and are maintained in PSP's GIS library:

1. WA Department of Natural Resources (DNR) Counties
2. WA DNR State boundary
3. National Hydrography Dataset (State Standard) (available as a feature service)
4. National Elevation Data
5. WA Department of Ecology (ECY) WRIA boundary data set
6. DNR ShoreZone shoreline
7. Esri basemaps (map services)
8. USGS Topographic maps (map service)
9. NAIP aerial imagery (map service)
10. National Land Cover Database (NLCD)
11. Latitude and longitude coordinates for point projects
12. Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) geodatabases

The follow criteria are applied to acquired data:

1. Geodatabase, Imagine, or Mr.Sid format
 - a. If data are distributed as shapefiles, the data are converted to a geodatabase format and reviewed with the original.
2. Distributed by the source of the data
 - a. Tertiary sources are discourages except in the case of the National Hydrography Dataset Plus
3. Most current available or most appropriate for the project
4. Latitude and longitude coordinates are provided as:
 - a. An Excel spreadsheet
 - b. 5 digit precision, if appropriate.
 - c. Decimal degrees format.
5. Reviewed with comparative datasets, such as aerial imagery, for consistency and accuracy.

The National Hydrography Dataset and the WA Department of Ecology WRIA boundary dataset serve as the primary source material for PSP’s authoritative datasets. Other secondary datasets serve as reference material to validate feature locations and may be geoprocessed for cartographic and analytic purposes.

2.2.1. State of the Sound

Spatial data collection for State of the Sound updates is coordinated by the PSP Vital Signs manager and PSP’s partner agencies that serve as the Vital Sign/Indicator leads. Data are provided to the GIS Manager and used for cartography in the condition it is delivered. PSP does not own or distribute these data.

3. Data Management

This element presents an overview of the operations, calculations, transformations, or analyses performed on geospatial data or their attributes throughout the project.

This section describes the geospatial data life cycle phases, consisting of (1) design and planning for the program, (2) collection and acquisition, (3) processing and documentation, (4) storage and access, and (5) maintenance and retirement (CBP 2007).

3.1. Program Management Activities

PSP's GIS Program has several key activities that it is responsible for:

1. Creating, updating, maintaining, and disseminating PSP's four authoritative datasets
2. Providing summary data and analytical data for staff and partners
3. Generating maps for staff and partners

These tasks are accomplished successfully through sufficient technical infrastructure, a standardized methodology for managing and processing data, and effective quality control and assessment methods.

3.2. Technical Infrastructure

3.2.1. Software

PSP's geospatial technical infrastructure consists of:

1. One ArcGIS Advanced 10.1 user license for the GIS Manager.
2. A shared network drive for data back-up.
3. A shared ArcGIS Server 10.1 hosted at a partner agency's server, RCO, for storing and distributing data, maps, and services.
4. ArcGIS Viewer for Flex on PSP's web server (in the process of obtaining).
5. A Washington State agency organization account with ArcGIS Online (AGOL) for creating and sharing data, PDFs, applications, and interactive web maps.

Desktop software installation and updates, laptop hardware, and local data back-up maintenance are the responsibility of the GIS Manager. Server back-ups and server software are maintained by the IT Management Team.

3.2.2. Storage and Back-up

Data back-up is performed on a daily basis both on-site from the GIS Manager's laptop to PSP's shared drive, and automatically from the shared drive to an offsite location. System security and network back-up is maintained by the IT Management Team according to State standards and policies.

3.2.3. Financial Plan

The financial plan for the GIS Program's resources is maintained by the IT Manager, as part of PSP's software and hardware IT program needs.

3.3. Geospatial Data Types and Formats

3.3.1. Data Types

PSP acquires and maintains four types of data (Table 2).

Table 2. Data types generated or managed by PSP.

Dataset	Source	Purpose	Publicly Distributed	Update Frequency by PSP	Lifespan
Authoritative	Created and maintained by PSP	PSP Business	Yes	As needed	Indefinite
Operational	Geoprocessed data	Cartography	No, limited audience	Frequent	Very short, depends on purpose
Analytical	Geospatial analyses, simple or complex	Reporting and Cartography	Potentially	None <i>unless partner's authoritative data is updated</i>	Long
Basemap as a service	State or Federal agencies	Cartography	No	None	Indefinite

PSP's four *authoritative* datasets are limited to the boundary lines/polygons for PSP's:

1. Action Areas.
2. Salmon Recovery Watershed Chapters.
3. ECO Nets.
4. Local Implementing Organizations.

3.3.2. Dataset Format - Local

The standard formats of all data managed by PSP are:

- file geodatabase for all vector data.
 - Feature datasets for collections of features, e.g. Hydro_streams, Hydro_watersheds.
- file geodatabase or .img for raster data.
- .csv or .dbf for tabular data.
- PDF or PNG for map documents.

3.4. Coordinate System

PSP adheres to the standards set forth by WA RCW 58.20

<<http://apps.leg.wa.gov/rcw/default.aspx?cite=58.20>> to use Washington State Plane coordinate system and a horizontal datum of NAD 83 HARN. The exceptions are when another coordinate system may benefit the user, e.g. cartography, spatial analyses, and web maps, and provide improved visual display and accuracy of products (Table 3).

Feature services and map services are distributed to the public for online consumption in ArcGIS Online and ArcMap Desktop. Because the established projection for ArcGIS Online is Web Mercator Auxiliary Sphere, PSPs feature and map services are distributed in Web Mercator Auxiliary Sphere (Table 3).

Datasets provided as layer packages for download through AGOL and the WA State Geospatial Portal are in the State standard coordinate system.

Table 3. PSP's coordinate and projection standards

Coordinate System	Washington State Plane (<i>see details below</i>)
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Projection System	Lambert Conformal Conic
Coordinate Zone	South (<i>Sound-wide</i>), North (<i>as appropriate</i>)
Coordinate Units	U.S. Survey Foot
Horizontal Datum	NAD 83 HARN
Vertical Datum	NAVD 88
Vector Format	File Geodatabase feature class, Shapefile for distribution
Raster Format	File Geodatabase raster, TIFF, PNG, ESRI Grid
Web Service Coordinate System	Web Mercator Auxiliary Sphere
Web Service Horizontal Datum	WGS 84
Web Service Projection System	Mercator Auxiliary Sphere
Web Service Linear Units	Meters

3.4.1. *Washington State Plane South Specifications*

Washington State Plane South

NAD_1983_HARN_StatePlane_Washington_South_FIPS_4602_Feet

Authority: Custom

Projection: Lambert_Conformal_Conic

False_Easting: 1640416.666666667

False_Northing: 0.0

Central_Meridian: -120.5

Standard_Parallel_1: 45.83333333333334

Standard_Parallel_2: 47.33333333333334

Latitude_Of_Origin: 45.33333333333334

Linear Unit: Foot_US (0.3048006096012192)

Geographic Coordinate System: GCS_North_American_1983_HARN

Angular Unit: Degree (0.0174532925199433)

Prime Meridian: Greenwich (0.0)

Datum: D_North_American_1983_HARN

Spheroid: GRS_1980

Semimajor Axis: 6378137.0

Semiminor Axis: 6356752.314140356

Inverse Flattening: 298.257222101

3.4.2. Washington State Plane North Specifications

NAD_1983_HARN_StatePlane_Washington_North_FIPS_4601_Feet

WKID: 2926 Authority: EPSG
Projection: Lambert_Conformal_Conic
False_Easting: 1640416.666666667
False_Northing: 0.0
Central_Meridian: -120.83333333333333
Standard_Parallel_1: 47.5
Standard_Parallel_2: 48.73333333333333
Latitude_Of_Origin: 47.0
Linear Unit: Foot_US (0.3048006096012192)

Geographic Coordinate System: GCS_North_American_1983_HARN

Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D_North_American_1983_HARN
Spheroid: GRS_1980
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.314140356
Inverse Flattening: 298.257222101

3.4.3. Web Mercator Auxiliary Sphere Specifications

WGS_1984_Web_Mercator_Auxiliary_Sphere

WKID: 3857 Authority: EPSG
Projection: Mercator_Auxiliary_Sphere
False_Easting: 0.0
False_Northing: 0.0
Central_Meridian: 0.0
Standard_Parallel_1: 0.0
Auxiliary_Sphere_Type: 0.0
Linear Unit: Meter (1.0)

Geographic Coordinate System: GCS_WGS_1984

Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D_WGS_1984
Spheroid: WGS_1984
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.314245179
Inverse Flattening: 298.257223563

3.4.4. Transformations

The most current and appropriate transformation are used when projecting data from one datum to another datum. Table 4 lists the most current transformation to use for data within the State of Washington.

Table 4. Transformations to use as of November 2013.

Datum Transformation	Transformation to use
NAD 83 to NAD 83 HARN	NAD_1983_To_HARN_WA_OR
NAD 27 to NAD 83 HARN	NAD_1927_To_NAD_1983_NADCON
NAD 83 HARN to WGS 84	NAD_1983_HARN_To_WGS_1984_3
NAD 83 to WGS 84	NAD_1983_To_WGS_1984_5

3.5. Storage Structure and Procedures

3.5.1. Local Storage and Structure

Due to the processing power needs, the size of the spatial datasets, and the single-user GIS environment at PSP, all PSP GIS Program data are maintained on the GIS Manager’s laptop in a standardized folder structure (Table 5). The GIS Program data are managed such that secondary data are maintained unaltered as downloaded in a z_SourceData folder, with the datasets organized by topic subfolders. The z_SourceData folder is primarily read-only and serves as the main reference and back-up of the source datasets. Prior to any geoprocessing or editing, datasets are copied from the z_SourceData to the SpatialData working folders which are organized by topic (Table 6).

Table 5. Folder structure and brief description for the GIS Program

Folder Name	Description
Applications	Esri mapping applications
Documentation	Reference materials, How To’s, Esri ArcGIS license, etc.
MapDocs	Export files of maps (.png, .tif)
Metadata	Export files of metadata and templates
mxds	ArcGIS map files; organized by purpose
SpatialData	Spatial data library
Standards	GIS program standards and guidance documents
Tables	Tables generated from geoprocessing (INFO files, .csv, .dbf)
Thumbnails	AGOL standardized and custom thumbnails
Tools	Custom toolboxes and geoprocessing tools
Training	Training materials and certifications

Table 6. Topic folders used to organized PSP spatial data library.

Folder Name	
Authoritative_PSP	ProjectAtlas
Boundaries_Admin	ProtectedAreas
Boundaries_CoordSys	PSNERP
Elevation	Shoreline
Hydrography	SpecialMapsData
Infrastructure	Species
LandCover	Stewardship
Mixed_NetMap	Vital Signs
Mixed_PSNERP	Z_SourceData

Topic categories are used to organize the spatial data downloads and operational data. The International Organization for Standards (ISO) metadata standard (ISO 19115) is the basis for the topic categories with a few additions and the exception of mixed category datasets, such as the PSNERP data stored in the Mixed_PSNERP folder. PSP’s authoritative data are managed in the Authoritative_PSP folder. The purpose of the standardized topic categories is to facilitate easy data discovery within the library for projects and cartography.

3.5.1.1. Naming Conventions

Non-secondary geodatabases, tables, map files (.mxd), map documents (.png) are named according to the subject of the data. Geodatabase feature datasets also include the coordinate system if the data are not projected in the state standard. Naming conventions do not apply to the original data download from secondary sources located in the z_SourceData folder; the original data names are retained for the original data. Operational data based on secondary data names may be modified once they are processed and relocated to PSP’s GIS data library.

3.5.2. Network Storage and Structure

The GIS program laptop is backed-up daily to PSP’s shared file server with a folder structure defined by the local structure.

3.5.3. ArcGIS Server Structure

PSP’s SDE datasets and published feature and map services reside on RCO’s ArcGIS and SQL servers (Table 7). Access to the RCO server as a user or publisher are provided by the IT manager. Server data are backed-up and managed by RCO.

Table 7. Server connections and URLs.

Connection address/URL	Purpose
dev.prism_gis_v.psp.sde	Development SQL server for feature classes <i>Primarily for operational datasets</i>
prod.prism_giv_v.psp.sde	Production SQL server for feature classes <i>Location of PSP’s authoritative datasets</i>
gismanagerweb.rco.wa.gov	Development ArcGIS server for services <i>Primarily for operational services</i>
gismanager.rco.wa.gov	Production ArcGIS server for services <i>Location for authoritative services</i>

PSP uses the following folder organization as established by the IT Manager for feature classes and services:

- SDE datasets reside at the root level of the server as feature classes
- Feature and map services reside in a folder named **PSP** at the root level

ArcGIS services are created using the following steps:

1. One or more feature classes are migrated to the RCO SQL Server to create an .sde file with the standard naming convention
2. An ArcGIS map file (.mxd) is generated locally using the .sde file
3. The ArcGIS map file is then shared as a published service to the RCO ArcGIS server.

All ArcGIS map files that support a service are stored locally in a *MapServices* folder within the *mxd* folder at the root level of the GIS program folders. Map files are organized by a naming convention that indicates if the data are authoritative, *A_maps*, or operational (temporary), *O_maps*.

Feature classes and services published to the RCO servers abide by the Washington State OCIO GIS program standards for metadata, keywords, thumbnails, and naming conventions. Standards are available upon request from the OCIO GIS Manager.

3.5.3.1. Naming Conventions

In keeping with the State standards, PSP's naming conventions for feature and map services are:

- Authoritative feature class on the SQL server:
 - **prism_gis_v.psp.XXX_XXXX_sp**, where
 - XXX = PSP
 - XXXXX is a unique but informative name for the dataset, no character limit
 - “_sp” is present only if the projection is State Plane South NAD 83 HARN for layer packages and data download link on the State Geospatial Portal GIS Data Catalog (<http://geography.wa.gov/GeospatialPortal/dataDownload.shtml>).
- Authoritative feature and map services (REST and SOAP) on the ArcGIS Server:
 - XXXXX_XXXXX, where
 - X = WAPSP
 - XXXXX is a unique but informative name for the dataset, no character limit
- Operational feature and map services (REST and SOAP) use the following naming convention:
 - O_XXXXXX
 - Where O denotes the operational (temporary) nature of the data
 - XXXXX is a unique but informative name for the dataset, no character limit

3.5.4. ArcGIS Online Structure and Procedures

PSP's GIS manager is a member of the Washington State ArcGIS Online Organization. The AGOL account holdings are managed by PSP's GIS manager, and PSP's AGOL account is managed by the Washington State OCIO GIS Program. The online portal provides an organizational license for providing data, services, PDFs, and map applications in a central place for all state agencies. These data may be private for internal use or public. There are a variety of groups at the Washington State ArcGIS Online Portal to organize and elevate the visibility of the resources published by the agencies. Use of these groups are detailed in a document provided by the Washington State OCIO GIS Program Manager. All PSP services are provided in the Esri web map coordinate system of WGS84 Web Mercator, Auxiliary Sphere.

PSP uses the WA State AGOL portal to:

1. Publish REST/SOAP map services for the four authoritative datasets.
 - a. These services are a member of the WA Portal Services group.
 - b. All services are provided in the web map coordinate system (WGS 84 Web Mercator, Auxiliary Sphere).
2. Publish REST/SOAP map services for operation datasets used in mapping applications
 - a. These services are *not* a member of WA groups.
 - b. All services are provided in the web map coordinate system (WGS 84 Web Mercator, Auxiliary Sphere).
3. Create and publish web maps and mapping applications.
 - a. These services may be a member of the WA Portal Maps & Apps group if applicable.
4. Create and share layer package of authoritative data for public download.

5. Create and publish non-geographic PDFs of maps for public download.

Data and services are organized in a single-layer folder structure, i.e. subfolders are not permitted (Table 8).

Table 8. AGOL organization folder structure.

Folder	Description
A_DataServices	REST/SOAP Feature Services for authoritative datasets
A_LayerPackages	Layer packages for authoritative datasets download
A_MapServices	REST/SOAP Map Services for authoritative datasets
A_WebMaps	Maps and mapping applications for authoritative datasets
LIOs	Operational resources for PSP's LIOs
O_DataServices	REST/SOAP Feature Services for operational datasets
O_MapServices	REST/SOAP Map Services for operational datasets
O_WebMaps	Maps and mapping applications for operational datasets
PDFs	PDF files of maps
Thumbnails	Thumbnail images for AGOL metadata
VitalSigns	Vital Sign feature services and maps embedded in PSP website

The portal access is provided through an invitation from the Washington State OICO GIS Program manager using the GIS Manager's email address. All online resources are linked to this account and this account cannot be deleted, in the event that the individual separates from PSP, until all resources are relocated or deleted from the system. When there is a change in GIS Manager staff, the resource ownership will be transferred to the replacement GIS Manager.

3.6. Processing Data

3.6.1. Overall Standards

Spatial datasets are often manipulated for cartographic and analytical purposes through geoprocessing and data management processes. The output is typically multiple intermittent and final geospatial datasets that may be similar to the original or completely different. The following standards are applied for all geoprocessing tools.

- If a new vector or raster dataset is generated, the new dataset is tested for positional consistency with original dataset when applicable.
- All analyses are completed (input and output) in the file geodatabase environment for both vector and raster datasets.
- The use of shapefiles is strongly discouraged.
- Source data that originates from a shapefile is converted to a file geodatabase feature class, reviewed for positional accuracy in ArcMap with basemaps, and topology is validated for inappropriate overlaps and gaps (polygons).
- Geoprocessing of data should be limited and repeated procedures should be initiated on copies of the original source dataset.

The general steps for processing geospatial data are illustrated in Figure 3 and Figure 4.

3.6.2. Generating Authoritative Datasets

PSP creates and maintains four authoritative datasets as part of PSP's business needs. These data are constructed from existing data using the steps Figure 3.

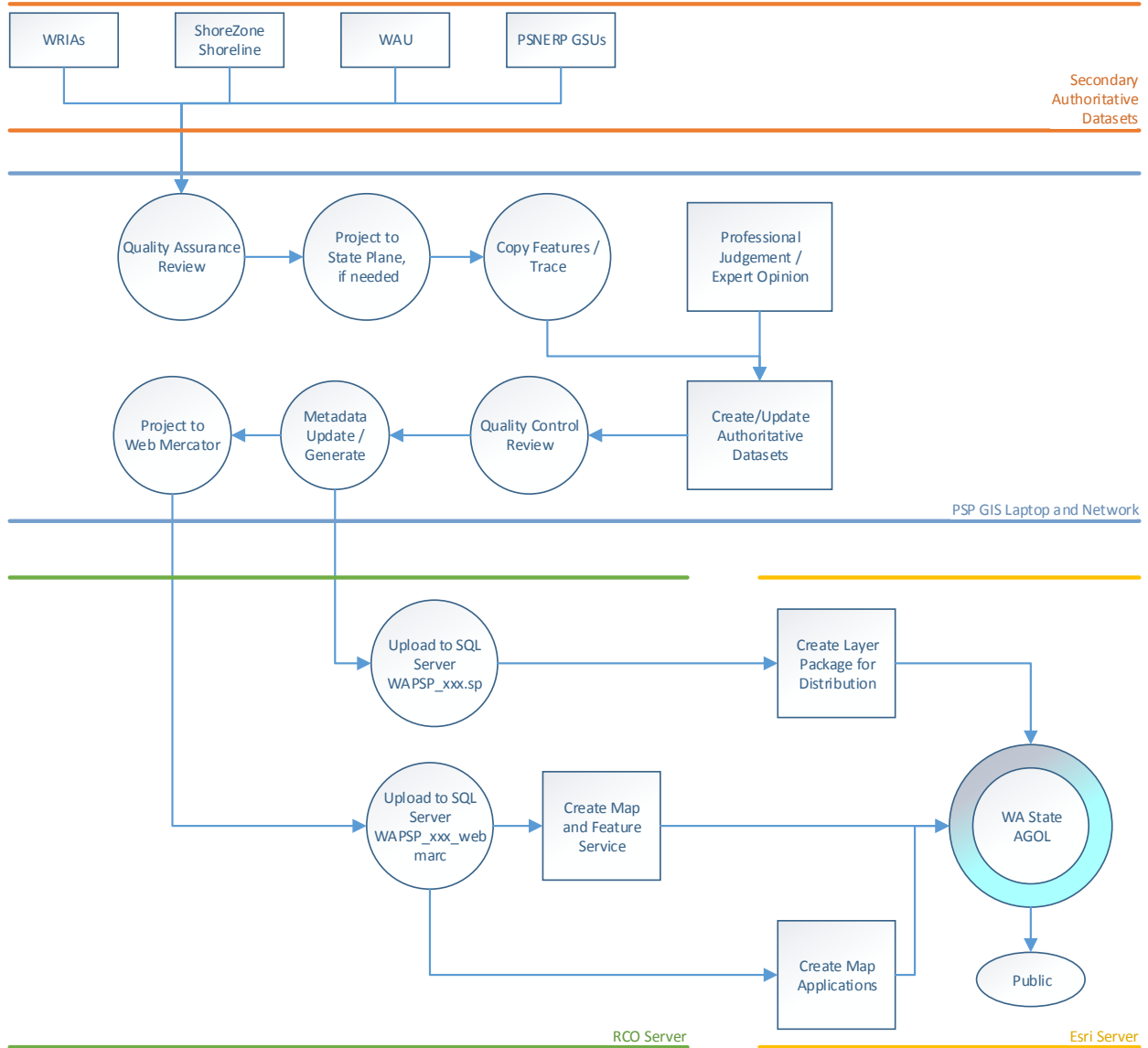


Figure 3. Geoprocessing, quality control, and dissemination steps for PSP's authoritative datasets.

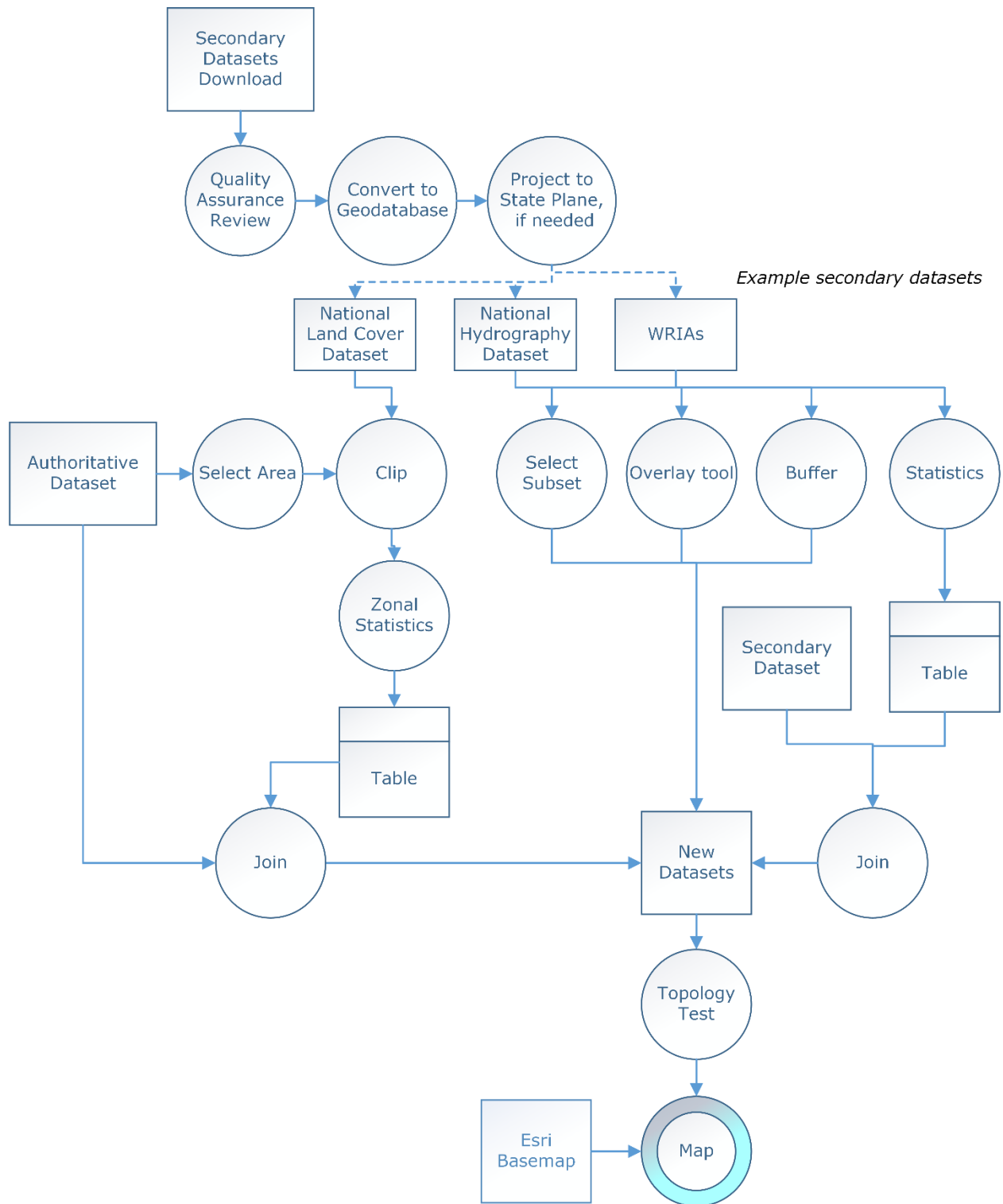


Figure 4. Example steps for geoprocessing authoritative and secondary datasets to developing a map.

3.6.3. Spatial Analyses Standards

PSP may conduct simple spatial analyses such as using ArcToolbox Tools to summarizing spatial data by geographic areas, calculating areas of polygons, etc. These analyses are often straightforward and

completed with one to two steps. The tool parameters may vary depending on the product desired; however, there are standards that will be enforced for these analyses. The following tools are the most commonly used.

3.6.3.1. Analysis Tools

The Analysis Toolbox is one of the most common toolsets used for both analyses and cartography purposes. Tools commonly used here are: Clip, Select, all the Overlay tools, and Buffer. Standards include:

- Datasets have the same coordinate system
- XY tolerance (cluster tolerance) is equal to zero or less than twice the output dataset's coordinate resolution.
 - Setting is ignore for feature datasets
- Topology has been validated for overlapping features and gaps

3.6.3.2. Analysis Tools, Statistics Toolbox

Within the Analysis Tools, the common statistics for vector attribute data are Frequency and Summary statistics. The standards for these tools include:

- Attributes of Input Table are complete and logistically consistent
- Selected Statistic Type is consistent and appropriate with the attribute value type
- Output Table is .csv or .dbf
- OutPut Table is reviewed for completeness and inconsistencies

3.6.3.3. Spatial Analyst Tools, Zonal toolbox

Zonal tools commonly used are Tabulate Area, Zonal Geometry, Zonal Histogram, and Zonal Statistics. Standards include:

- Datasets have the same coordinate system.
- Coordinate system is appropriate for zonal statistics, i.e. not geographic or web Mercator.
- If using a polygon dataset as feature zone data:
 - Polygon topology validated for non-overlapping and no gaps.
 - Attributes are complete and logistically consistent.
 - Zone field values are unique.
 - Feature class is free of empty geometry features
- Raster datasets cell size are significantly smaller than the minimum feature zone data area

3.6.3.4. Spatial Analyst Tools, Surface Toolbox

The Surface toolset is commonly used to process digital elevation models to create background hillshade datasets for cartography purposes. Standards for this geoprocess include:

- *Snap Raster* set to original raster dataset
- *Z Factor* is set to 1 unless exaggerated elevations are the intent

3.6.4. Reporting

Documentation of the geoprocessing steps as a report, memo, or metadata are stored with and provided with all distributed datasets that has been processed and distributed by PSP. If the data or the process encountered limitations or errors, these are also to be provided in the documentation.

An example limitation may be the use of watershed to summarize the National Land Cover Database (NLCD) and a subset of the watersheds are not sufficient in area to accurately summarize the 30 m NLCD data. The metadata and the summary table *must* note this limitation.

3.7. Projecting Data

One of the more common and critical geoprocessing techniques is the projecting of data from one coordinate system to another, or defining the projection of geospatial data that lacks a projection file.

Regardless of the format of the data, all newly projected data will be compared in ArcMap with the original data to ensure the projection was successful and features are aligned within an acceptable tolerance.

3.7.1. Defining a Projection

Data lacking a defined spatial coordinate system are projected but steps must be taken to decipher what coordinate system the data is using. This may occur if the projection file is lost or not provided by the source. Step to determine the projection are:

1. Identify the number of digits to the right of the decimal of the coordinates to isolate the system as UTM, State Plane, or Geographic.
2. Systematically display the data with unknown coordinate system in ArcMap with datasets of known coordinates to find a coordinate system match.
 - a. Clear the display coordinate system to disable Projection-on-the-fly in ArcMap.
3. Once the projection has been identified, use the Define Projection tool in the Data Management Toolset, Project and Transformations tools to define the projection.

3.7.2. Vector Data

- Projecting vector data will use the appropriate transformation (section 3.4.4 Transformations), if required.
- Distance tolerance of geometry when comparing the new and the original datasets: 0 feature units

3.7.3. Categorical Raster Data, e.g. Land Use Land Cover

Projection of categorical raster data will have the following settings:

- *Resampling Technique* set to NEAREST neighbor
- *Output Cell Size* equal or proportional to source data
- *Snap Raster* set to original raster dataset
- Distance tolerance of grid cells when comparing the new and the original datasets: vary with the coordinate systems

3.7.4. Continuous Raster Data, e.g. Digital Elevation Models

Projection of digital elevation models (continuous raster data) will have the following settings:

- *Resampling Technique* set to BILINEAR interpolation
- *Output Cell Size* equal or proportional to source data
- *Snap Raster* set to original raster dataset
- Distance tolerance of grid cells when comparing the new and the original datasets: vary with the coordinate systems

3.8. Cartography

Where reasonable, PSP will follow National Map Accuracy Standards (NMAS) (U.S. Bureau of Budget 1947) for hard-copy, published, and publication maps.

3.8.1. Map Elements

PSP developed map element requirements based on the State of Oregon’s guidelines (Table 9). This will be reviewed when Washington State has developed similar standards.

http://www.oregon.gov/DAS/CIO/GEO/standards/docs/OGIC_Map_Elements_Standard-DRAFT-20130605.pdf

Table 9. Map elements.

Item	Required	Notes and Examples
Title	Yes	<i>Example:</i> WA Land Cover
Legend or Key	Yes	Explanation of the symbology of the map data
Date of Data	Yes	Maps intended to show status or progress of ecosystem recovery must include a date associated with the data.
Map author’s initials and date	Yes	The agency’s URL may also be used. <i>Example:</i> Puget Sound Partnership (jlb), www.psp.wa.gov , May 23, 2015
Originating program	No	<i>Example:</i> Software: ESRI ArcMap ver. 10.1
Source files	No	<i>Example:</i> Source file(s): M:\gisdata\dev\maps\landcover.mxd, or \\dataserver\gisdata\dev\maps\landcover.mxd
Data source citation	No; except when using external data.	<i>Example:</i> Aerial photography from the U.S. Geological Survey, 2007.
Additional descriptive text	No	Dependent on map status, use, or content. <i>Example:</i> DRAFT, File request #1234567
Graphical Scale	Yes	Include at least one scale bar (usually in miles).
Numeric Scale	No	An optional representative ratio (1:24,000).
Originating agency and/or state logo	Yes	Follow agency guidelines. Use logos from other agencies, as appropriate, when they are contributors to the development of the map.
Geographic reference or locator map	Yes	Use depends on the scale of the map and the size of the area depicted. This may include latitude/longitude graticule or a “common” theme (e.g., counties) as a backdrop, and highlight the area being mapped.
North arrow	Yes	
Coordinate system including projection and datum	No	

3.8.2. Source Citations

All maps will include appropriate citations to external data sources when those sources appear in hard-copy or digital static maps. Citations must identify the source and year of the data, and may identify the data, e.g. Aerial photography from the U.S. Geological Survey, 2007; or U.S.G.S. Aerial Imagery 2007.

3.8.3. AGOL Resources

ArcGIS Online services offers interactive maps, story maps, and applications through the State of Washington organizational account. PSP uses these resources for short-term and long-term projects. Short-term projects include interactive maps to support meetings and discussions and have a life cycle of less than one month. Longer-term projects include interaction maps, story maps, and applications that reside on the Washington State Geospatial Portal and may be embedded in the agency's website. These resources are developed and maintained on an as-needed basis with the exception of PSP's boundary map and application.

3.8.4. Operational maps

For decision-making maps, which typically have a lifespan of a single meeting or day, the procedure is:

1. Data source and original format of the data received are preserved in a project folder file on the server
2. Latitude and longitude coordinate may require conversion to decimal degrees (5 digit precision)
3. Geospatial data are developed in a file geodatabase as points, polylines, or polygons
 - Polyline and polygons may be generated from points or heads-up digitizing
 - Head's up digitizing - National mapping standards with highest level of horizontal accuracy possible or acceptable
4. Data are displayed and reviewed for accuracy

Coordinates and datum will vary with the map medium. PSP will generally defaults to the Washington State Plane coordinate system and a horizontal datum of NAD 83 HARN, a state standard set forth by the WA RCW 58.20 (available at <http://apps.leg.wa.gov/rcw/default.aspx?cite=58.20>). The exceptions to the standard are when another coordinate system may benefit the user, e.g. cartography, spatial analyses, and web maps, and provide improved visual display and accuracy of products.

Feature services and map services are distributed to the public for online consumption in ArcGIS Online and ArcMap Desktop. Because the established projection for ArcGIS Online is Web Mercator Auxiliary Sphere, PSP's feature and map services are distributed in Web Mercator Auxiliary Sphere (Table 3).

Datasets provided as layer packages for download through AGOL and the WA State Geospatial Portal are in the State standard coordinate system.

3.8.5. PSP Publications

The GIS Manager provides multiple standardized map for three routine publications: Action Agenda and State of the Sound by PSP, and Salmon Recovery Plans by the Salmon Recovery Watersheds. The GIS Manager is responsible for designing the standardized map template used within each publication. The primary purpose of the Action Agenda and Salmon Recovery Plan maps are to display the boundaries for the Action Areas and LIOs in the Action Agenda, and the Salmon Recovery Watersheds in the Salmon Recovery Plans. The template is sent for review to the publication managers at least one month prior to publication or public comment period.

For the State of the Sound, PSP’s partner agencies provide the spatial data for each Vital Sign/Indicator and coordinate the development of the map symbology and legend with the GIS Manager. Each map is sent to the Vital Sign/Indicator lead at the partner agency for final approval prior to publication.

3.9. Quality Control and Assessment

Quality control is the “overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated performance criteria established by the customer, operational techniques, and activities that are used to fulfill performance criteria for quality” (EPA, 2001b).

3.9.1. Data Development

Geospatial data and non-geospatial data are reviewed according to the specifications detailed in 1.5 *Quality Objective and Criteria*. Additional data quality control measures include:

- Data are created in a file geodatabase
- Topology rules are enforced, if applicable

3.9.2. Digitizing

Where possible, polygons and polylines should share identical geometry and accuracy with existing PSP or other agency authoritative data, such that:

- Threshold is 0 meters or feet from the authoritative data sets.
- Heads-up digitizing (data capture) of authoritative datasets is used to generate the feature geometry.

When geospatial data are generated using head’s up digitizing techniques, the follow is a quality control checklist:

- Source data are authoritative and appropriate in scale, accuracy, resolution, time period, format, and content
- Source data was generated according to National Map Accuracy Standards (US Bureau of the Budget 1947)
- Source data is projected in the same coordinate system and datum as the dataset being generated
- ArcMap coordinate system is consistent with the source material and the dataset to be generated
- Map scale is appropriate for digitizing effort accuracy and precision
- The follow methods are used to existing features from another dataset:
 - Copy and paste
 - Trace tool on the Feature Construction toolbar
 - Replace Sketch
- Feature templates are used, if applicable
- Save often
- Review dataset according to specifications in this Section and Section 1.5 Quality Objective and Criteria

If data fail to meet criteria, the data are either edited to correct the error or archived and the process of generating the data repeated according to a modified methodology to ensure meeting quality assessment criteria.

3.9.3. Imagery Geoprocessing

In many cases, the default parameters and environment of the ArcToolBox tools are sufficient for PSP's geoprocessing. However, processing of imagery requires the following standards:

- All raster and vector datasets involved in a process must be in the same coordinate system.
- Snap Raster (Processing Extent in Environment Settings) is set to match original raster dataset if a new raster dataset or subset of the data is being generated.
- Output coordinate system is same as input.
- Raster resampling of cell size is equivalent or proportional to the original raster dataset
- Raster resampling uses BILINEAR interpolation for digital elevation data

3.9.4. Latitude and Longitude Coordinates

Partners may provide secondary data to PSP as latitude and longitude coordinates of projects for mapping purposes. PSP depends upon the source agency or project manager to guarantee the accuracy of the data provided. In this case, the following standards are required:

- Five digit precision
- PSP will assess:
 - If possible, relative positional accuracy through comparative visual inspection using base data/maps or ancillary data
 - Data completeness
 - Number of features
 - Attribute table content

3.10. Maintenance and Retirement

3.10.1. Authoritative Datasets

PSP's authoritative datasets are updated as needed by the GIS Manager at the request of the responsible program (Table 10). Updates include boundary adjustments using the standards mentioned in the section Quality Control and Assessment, and attribute updates.

Updates occur when the managing program requests an update or there is a change in managing personnel resulting in a change in the boundary file's attributes. Datasets and metadata are updated using the follow steps:

1. A new file geodatabase is created.
2. The previous version is copied to the new geodatabase.
3. Geometry or attributes are updated in the new geodatabase.
4. Metadata are updated in the new geodatabase.
5. Previous version is retired to an Archive folder within the same folder.
6. Map created to review the dataset by the appropriate program lead, if needed.
7. RCO server and services are updated by overwriting the existing service.

Table 10. PSP's authoritative datasets.

Authoritative Dataset	Program Responsible
Action Areas	Planning Program, Science Program
Salmon Recovery Watersheds Local Integrating Organization	Ecosystem Recovery Coordinators
ECO Net	Stewardship Program

3.10.2. Secondary Datasets

Secondary datasets require the most maintenance for the GIS Manager. All downloaded secondary data must include metadata so that the GIS manager can verify currentness with the source data download website. In addition, when the data is downloaded to the appropriate z_SourceData folder, the download file name will include the date of the download, e.g. NHD_V2_11_23_2013.zip for easy reference.

Secondary data are retired if a more current version exists from the source. Retirement of secondary data follows the same standards for Operational Datasets (see section below) except for legacy/historic data. Legacy/historic data such as land use land cover from previous years are NOT retired since these data are of use for specific analyses. Determination of legacy/historic data is at the discretion of the GIS Manager or PSP staff.

3.10.3. Operational Datasets

Operational datasets are data that have been manipulated, edited, or projected for a limited purpose, typically a specific cartographic request. These data usually have a short life cycle predominantly spanning one day and less frequently one year, e.g. streams for the State of the Sound reference map. To clarify the purpose of the data, the names of the spatial feature classes and rasters should include, if appropriate, the purpose of the manipulated data.

If the data are no longer relevant to PSP or its partners as determined by the GIS Manager, these data and associated documents (tables, maps) will be retired in one of the following two ways:

- Relocated to an Archive folder in the topic folder if there is a potential future need
- Deleted if:
 - Data are erroneous or not what was requested/needed for a map
 - More up-to-date data or analyses would replace the data (*predominately the case*)
 - Redundant with existing data
 - No future use is identified

3.10.4. Analytical Datasets

Analytical datasets are managed and maintained using the same procedures as operational datasets.

3.11. Dissemination of Spatial Data and Maps

3.11.1. Authoritative Datasets

PSP distributes the four authoritative datasets using ArcGIS server and ArcGIS Online through the Washington State ArcGIS Online Portal [<http://wa-geoservices.maps.arcgis.com/home/index.html>] and organizational ArcGIS Online license. PSP follows the ArcGIS Online best practices and guidelines provided by the State of Washington OCIO GIS Program. These data are available as feature and map services and available for download by the public.

3.11.2. Operational Datasets

PSP hosts operational datasets using the same methods as the authoritative datasets with the exception that these data are often limited in use and audience, e.g. a specific meeting that required an interactive map for one day. Therefore, operational data are not available for public download.

3.11.3. Analytical Datasets

Datasets derived from spatial analyses or specific projects may be disseminated using the same methods and maintenance as the authoritative datasets. This will include data from high level spatial analyses projects that are not addressed in this QAPP; these datasets will have their own QAPP.

3.11.4. Basemaps

PSP does not download, manage, or disseminate basemaps. These are provided by the authoritative source as a service for consumption by PSP in maps.

4. Project Management

GIS project ideas or needs are initiated with a discussion with the GIS Manager. The GIS Manager will first ascertain if the project meets the business needs of the agency during the initial discussion, if the project is feasible within the existing time line provided, and if data are available to accomplish the project. If the project is feasible and within PSP's business needs, the project is scheduled according to the GIS Manager's work load and existing priorities.

The following information is obtained from the GIS map requestor:

- Schedule for the project?
- Who is the audience for the map?
- What is the purpose of the map?
- What data will be provided for the map?
- What documentation needs to accompany the map?
- What contextual information (state and county boundaries, labels, hydrography, etc.) should be included on the map?
- Who will review the map for accuracy?
- Output format of the map?

4.1. Map and Project Workflow

1. Identify project objectives and requirements
2. Identify feasible time line
3. Identify data sets and spatial analyses needed
4. Specify spatial representation (point, polyline, polygon, raster)
5. Specify medium of product and intended audience
 - a. Publication
 - b. Hard copy map
 - c. Interaction online map
 - d. Presentation
6. Establish necessary folders with a standardized naming convention for all products
7. Inventory existing data

8. Determine data collection needs and potential sources
9. Acquire available data
10. Project spatial data to necessary coordinate system
11. Geoprocess spatial data if necessary
12. Identify or design Attribute fields
13. Specify Valid Attribute Values And Relationships
14. Validate and QA checks
 - a. Completeness of data
 - b. Attribute accuracy
 - c. Logical consistency
 - d. Physical consistency
 - e. Positional accuracy
 - f. Precision of data
15. Generate product, e.g. map, spatial data set, reporting data
16. Generate metadata and tags; validate metadata
17. Identify if a QAPP is required or needed?
18. Publish product, i.e. online, if applicable
19. Generate and Publish QAPP with data
20. Maintain or archive product
21. Review and optimize procedure used to generate product

4.2. Publishing feature and map services

1. Project datasets to Web Mercator Auxiliary (ArcGIS Online standard), if needed
2. Migrate required datasets to the SDE server if needed
3. Ensure datasets have minimum metadata if it is an operational dataset, full metadata if authoritative dataset
4. Develop .mxd file with appropriate feature datasets from SDE server
5. Publish using Share as Service
6. Check Publish as Service
7. Select the existing folder on the development or production server at RCO
 - a. Development is gismanagerweb.rco.wa.gov
 - b. Production is gismanager.rco.wa.gov
8. Service name should be proceeded with **WAPSP_XXXX**, where xxxx is a unique meaningful name
9. Using the Service Editor, use the following settings:
 - a. **Capabilities** set to features and mapping
 - b. **Feature Access** set to:
 - i. Create NO
 - ii. Delete NO
 - iii. Query YES
 - iv. Update NO
 - v. Do NOT check the Allow Geometry Updates
 - c. Complete the **Item Description**

10. Analyze the data and address errors and warnings
11. Publish
12. Review data or map online for errors or issues

5. Performance Management

PSP established measures of success for the GIS Manager and the program to gauge the progress of the program and the services provided Table 11.

Table 11. GIS Program performance measures.

Objective	Measure	Annual Target	Risk
Establish data standards	Documentation of PSP geospatial data standards	Annual update of this document at the end of the calendar year	
Establish and maintain data file structure	Update document file structure in this document	Yearly re-organization	
Successful maps	Follow up and obtain level of satisfaction; recorded with map request	100% satisfied	Insufficient time
Elevate visibility of services	Number of views online (provided by Esri)	40 or more views	Relevance of data
Data Storage and recovery	Daily back-up	Quarter testing of back-up	
PSP Boundary datasets published on WA Geospatial Catalog	Four datasets up-to-date and publicly available	Updated as needed	Boundaries are not finalized by partners
Provide online web maps and applications	Ongoing	Ongoing	Time
Analyses in Workplan, e.g. Stewardship, NTAs, etc.	Complete Work plan tasks	Same as measure	Time
30% FTE	Track time per request	$2850 * 0.30 = 855$ hours	Reprioritization of work plan
Update PSP Vital Sign web maps	Annual update of those with new data available	100% up to date at end of calendar year	Partner providing usable data
Training – Staying current	Conference attendance	Annual attendance at Esri, WA State GIS or NW Users annual conference	Travel budget
Training – Update skills	Class completion	One or more classes	Budget
Certification	Esri certificate	Current certificate	Budget and time

6. References

- Chesapeake Bay Program. 2007. *Geospatial Data Quality Assurance Project Plan*.
[http://www.chesapeakebay.net/content/publications/cbp_33365.pdf]
- Environmental Protection Agency. 2003. *Guidance for Geospatial Data Quality Assurance Project Plans*.
Office of Environmental Information, Washington, DC 20460. EPA/240/R-03/003.
- FGDC (Federal Geographic Data Committee). *Geospatial Positioning Accuracy Standards, Part 1: Reporting Methodology*. 1998. Reston, Virginia. FGDC-STD-007.1-1998.
[<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/>].
- FGDC (Federal Geographic Data Committee). *Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy*. 1998. Reston, Virginia. FGDC-STD-007.3-1998.
[<http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/>].
- National Park Service. 2008. *Data management guidelines for inventory and monitoring networks*.
Natural Resource Report NPS/NRPC/NRR—2008/035. National Park Service, Fort Collins, Colorado.
- OCIO Technology Services Board (TSB). 2013. Geographic Information Systems (GIS) Geospatial Metadata POLICY NO. 602-S1.
- U.S. Bureau of the Budget. 1947. *United States National Map Accuracy Standards*.
[<http://nationalmap.gov/standards/nmas.html>]. 1p, 6KB, PDF.