

Snohomish County

SnoScape: Landscape Imaging

METHODOLOGY FOR DATA COMPILATION

Introduction

The inception of the SnoScape Project came about to assist the citizens of Snohomish County in the development of their property. The location of landscape features on individual parcels is a desired component to save time and funds in the permitting and development process. The most accurate way to find the most precise location/classification of these features is to conduct detailed ground surveys. The original estimate for such a project was in the order of many millions of dollars and only possible with an extended timeframe. Consequently, alternatives were suggested utilizing remote sensing technology to develop a system of models to approximate reality.

Two important landscape features to the permitting function and land capacity analyses are streams, and slopes greater than or equal to 33 percent. It is decided at the beginning of this project that the quantity of work needed requires limiting the project scope to these features.

A primary component of the following methods is the use of high resolution satellite imagery and airborne based Light Detection and Ranging (LiDAR) imagery. These imaging techniques allow relatively accurate mapping of landscape features such as valleys, slopes, vegetation, and water. Similar data are currently available through existing mapped data sources but only at smaller scales from 1:24,000 to 1:250,000.

Computerized analysis of these data is used to model the location and extent of landscape features within a reasonable probability. It is to be remembered that the landscape models produced under these methods are still subject to evaluation and/or validation by field staff. However, this analysis can help citizens and permit staff to determine if any additional review may be needed to consider a permit for development. In the early evaluative stages of the permitting process, previously unmapped features may appear in this model thus alerting a citizen to increased complications for land development. If a citizen has knowledge early in the process he will be better equipped to make decisions and choose options. The County will be able to provide better service.

The models of data developed here are non-regulatory and are intended for information purposes only. Regulatory data for property development is generally only available from on site evaluations. The data created here will not replace on site review. Due to limited time constraints the first models will be created for these data sets only. As time permits additional models for other important landscape features will be constructed.

Project Study Area

The study area for this project is bounded by the Urban Growth Area (UGA) for Southwest Snohomish County derived from the Snohomish County GMA Comprehensive Plan, December 2005. The Little Bear Creek watershed lies to the East on the edge of this UGA boundary and is also included in the analysis. After evaluation of the Southwest County analyses the same techniques may be applied to the remainder of the County.

All new data are projected on State Plane Washington_North_FIPS_4602_Feet coordinates with a horizontal datum of NAD83 to be commensurate with all County data.

Satellite Imagery

The project uses the best available high resolution satellite imagery data from the Digitalglobe Quickbird2 satellite (provided and processed by Merrick & Company). The imagery area of

approximately 221 square miles of Southwest Snohomish County was collected in March and May 2005. The Quickbird2 scenes available at these times are the most cloud free. The imagery data consists of a panchromatic band with 60cm (2ft) ground resolution and the four multispectral bands with 2.4m (8.1ft) ground resolution, including a near infrared bandwidth (760-900nm). The imagery is provided in 11 bit formatted to 16 bit digitization allowing for up to 2048 levels of gray scale. All imagery is orthophotorectified using the digital elevation models derived from the two sets of LiDAR data.

Please follow this link for specifications, metadata, and product information about the Digitalglobe Quickbird2 Satellite Data

DigitalGlobe Satellite Imagery

http://www.digitalglobe.com/product/ortho_imagery.shtml

DigitalGlobe Inc. Quickbird Satellite Images of approximately 221 Square Miles of South/Central Snohomish County, panchromatic (1 band, 60 cm) and multispectral (4 bands, 2.4 m) imagery (not pan-sharpened), with second generation orthorectification

- Satellite Imagery: QuickBird imagery from the scenes and dates mentioned above.
- Bit Depth: 11-bit converted to 16-bit
- File Format: GeoTiff 1.0
- Spatial Resolution: 60cm for panchromatic band, 2.4m for multispectral bands (original sensor spatial resolutions).
- Projection: State Plane Washington_North_FIPS_4601_Feet
- Datum: NAD83
- License Type: Civil Government Products
- Resampling Kernel: 4x4 Cubic Convolution
- Contrast Enhancement: DRA off/ No Color Correction

Quickbird Image Catalog ID Numbers:

1010010004146F01
1010010004146F02
101001000434F202

These images were delivered orthorectified to Snohomish County Orthophotography.

Snohomish County Aerial Orthophotography

Specifications for Snohomish County 2002 and 2003 Digital Orthophotos:

Snohomish County 2002 Orthophotos

- 1-foot pixel resolution
- Color rectified aerial photos of Southwest Snohomish County
- Date Flown: June 11, 2002 – June 13, 2002
- Sun Angle: 35 to 50 degrees
- Nominal photo scale: 1:17,000
- Horizontal accuracy: +/- 5ft
- Camera focal length: 6in

Snohomish County 2003 Orthophotos

- 1-foot pixel resolution
- Color rectified aerial photos of North and Eastern Snohomish County
- Date Flown: Sept 13, 2003 (Westerly $\frac{3}{4}$ of County) and Sept 24, 2003 (Easterly $\frac{1}{4}$ of County)
- Sun Angle 38 to 40 degrees
- Nominal photo scale: 1:17,000
- Horizontal accuracy: +/- 5ft

- Camera focal length: 6in

LiDAR Imagery

The Light Detection and Ranging (LiDAR) data used for the project comes from two sources. The first source was acquired by King County for the Brightwater Project and covers a significant portion of Southwest Snohomish County. It was acquired in 2003 with a horizontal accuracy estimate RSME (Root Mean Square Error) of 1.8m (5.9ft) and a vertical accuracy estimate from 58.8cm to 117.9cm (2ft to 3ft). This data was originally used in analysis for the Brightwater Project.

The second LiDAR source was provided through contract by Snohomish County with David Evans and Associates and collected by Terrapoint USA Inc. (acquired in April 2006 with a horizontal accuracy of 30cm (1ft) and a vertical accuracy of 15cm (0.5ft). At this time additional LiDAR data to complete western Snohomish County was acquired for an area of approximately 249 square miles. This data was ordered by Snohomish County specifically for use in the Environmental Mapping Project and subsequent citizen application.

The geography acquired from the LiDAR imagery is visually compared to County 2002-2003 orthophotography with a 1-foot pixel resolution and a horizontal accuracy of +/- 5ft and the high resolution satellite imagery, with particular emphasis on the near infrared band (760-900nm).

Please follow these links for LiDAR data and/or metadata.

Brightwater Digital Ground Model – King County 2003

<http://www.metrokc.gov/gis>

http://www.metrokc.gov/gis/sdc/raster/elevation/LiDAR_Data.htm#DGM_Elevation

<http://duff.geology.washington.edu/data/raster/lidar>

Southwest County Bare Earth Topography - Terrapoint USA Inc. 2006

<http://pugetsoundlidar.ess.washington.edu/index.htm>

LiDAR Derived Digital Elevation Models (DEM)

The digital elevation model for the new data arrived as Arc export Grids and Hillshade files. Complete mosaics were then assembled from these files.

The LiDAR data is processed in two different batches, one each for the Brightwater LiDAR data and for the newly acquired LiDAR. Although the accuracy of the latter is considerably greater, the metadata for both data sets supports sufficient accuracy for the purposes of this model building project. Due to the extreme density of these files the derivative DEMs were constructed using a 6ft by 6ft pixel size.

1. Stream Model

Objectives

1. To improve the spatial accuracy of the existing Snohomish County Hydrography data set.
2. To provide for these new streams data to be compared at an increased level of detail (higher resolution) to other County geographic features and make these available to the citizens of the County.
3. To model potential locations of previously unknown streams.

Process

The hydrologic analysis developed using the digital elevation models from the two LiDAR data sets in combination with ArcGIS software. The geographic information system (GIS) called ArcGIS is produced and supported by Environmental Systems Research Institute, Inc (ESRI). An extension to

this software termed ArcHydro is used as the primary aid to analysis by the Public Works-Surface Water Management division.

The software extension called ArcHydro exists as a set of tools that work within the ESRI ArcGIS software environment and act as a data model for water resources. The ArcHydro Data Model consists of five main components, drainage, hydrography, network, channel, and time series, which describe different components of natural water systems. The focus, for this project, is on the drainage component of the model which delineates hydrology based on an analysis of land surface topography. The land surface topography is derived from the LiDAR datasets.

In order to generate the hydrology from any LiDAR dataset, a series of sequential steps, outlined by the ArcHydro toolset, are used. Each step contains functions that automate the process of delineating drainage areas and stream networks, and builds upon the output from the previous step. The key user input, defined by the intricate nature of the project area of interest, is the stream definition threshold.

The stream definition threshold defines the threshold drainage area that flows into a specific stream or watercourse. This determines the extent of the resulting stream network. A stream definition threshold that is too large does not adequately depict all possible watercourses. A stream definition threshold that is too small depicts many small tributaries that may be supported by the topography but are not realistic ground networks.

A literature review indicates there is no definitive rule for determining this stream definition threshold input. In part, this is due to the high level of variability that is encountered in topographic relief. To ensure that all potential watercourses are captured, a series of varying stream definition thresholds are employed within the model. Stream definition thresholds tested include; 0.005 km² (1.2 acres), 0.0075 km² (1.8 acres), 0.009 km² (2.22 acres), 0.034 km² (8.4 acres), 0.05 km² (12.4 acres), and 0.1 km² (24.7 acres). A visual comparison of the resulting hydrology datasets with varying stream definition thresholds and the existing county hydrology dataset is made to assess the new datasets. Based on this assessment 8.4 acres has been chosen as the stream definition threshold that captures existing county hydrology as well as any potentially realistic tributaries that have not been previously mapped.

It must be recognized, that the digital elevation model, the basis for this analysis, has limitations especially in areas that have become urbanized where there is a reduction in natural topography. In addition to the automatic generation of a hydrology layer by ArcHydro, there is a need to manually edit some stream networks in areas of low relief. Additional interpretation is also needed, as in some cases where a roadbed with a culvert may alter the natural topography and hence the natural drainage network.

Procedures – Stream Model

The project study area is located in urbanized Southwest Snohomish County. Urbanization results in altered topography through development. The reduced relief (i.e. raised roadbeds, graded areas, etc.) introduces error in the modeled hydrology. In order to realize an accurate dataset, all stream arcs generated are verified and edited according to the following guidelines.

1. A stream definition threshold is selected and ArcHydro generates new hydrologic features from the digital elevation model. In this case eight steps of the ArcHydro Model are incorporated to process for drainage lines.
2. All generated stream arcs are evaluated against pre-existing sources and datasets that could verify the existence of a stream. (see below) A hierarchy of evaluation is established for verifying these stream arcs.
3. To increase spatial accuracy, all verified stream arcs are aligned to corresponding survey quality Surface Water Management (SWM) Drainage Inventory points such as stream thalweg points or culvert locations.

4. Any stream arc that cannot be verified against the proxy data, but is deemed to be potentially significant based upon the LiDAR data, is flagged and marked to be field checked. It is also left un-typed.
5. Any stream arc that cannot be verified using the proxy data and is not deemed significant based upon the LiDAR dataset is then deleted.
6. All stream arcs are visually generalized and smoothed in ArcGIS to improve cartographic depiction and reduce pixel edge effects resulting from the original LiDAR raster dataset.
7. All significant stream arcs are typed according to the pre-existing County hydrology dataset, or County permit data from the Critical Area Site Plan database. Where previously unmapped streams are evident the typing occurs only when ground based data is available.

Several existing data sources, including ground based sources, are compared to the remotely sensed data and evaluated in turn. The above mentioned hierarchy of evaluation (guideline #2) is illustrated here in descending order of importance.

For DETERMINATION OF STREAM EXISTENCE:

1. The LiDAR Derived Digital Elevation Model (DEM) plus ArcHydro software determines the location of the valley bottom and hence the existence of potential stream.
2. Any stream located from a georeferenced surveyed subdivision or plat plan is then compared and confirms existence of the LiDAR stream data.
3. Stream data obtained from SWM drainage needs reports of December 2002 is used next to verify streams.
4. Any additional information from the Washington Department of Transportation (WDOT), Adopt-A-Stream Foundation (AASF), or Snohomish County Stream and Wetlands Inventory next offers corroborating evidence, however, spatial accuracy is considered approximate. No cases were found where WDOT or AASF data indicated the presence of streams that were not found in 1-3 above.

Additional interpretation of stream channel locations from the digital satellite imagery (as data is being compiled) often corresponds with the determinations from 1-3 above.

For SPATIAL ACCURACY

1. The LiDAR Derived Digital Elevation Model (DEM) plus ArcHydro software determines the location of the valley bottom and hence the potentially correct stream channel location.
2. Global Positioning System (GPS) Points obtained from SWM drainage inventory are now used to modify the spatial accuracy .The accuracy of these points is +/- 2cm to 5cm (0.8in to 2.0in).

For STREAM TYPING:

1. Any stream typed from a georeferenced surveyed subdivision, plat plan, or residential critical area site plan determines the typing of that stream as derived from the LiDAR data.
2. Typing from the existing Snohomish County Hydrography typing, if not included in 1 above, is then applied to the LiDAR streams
3. SWM, WDOT, and AASF inventories then apply if not contradicted by the above datasets.

Snohomish County Stream and Wetland Inventory and/or personal communication with SWM or PDS staff may also offer corroborating evidence.

Stream types were compiled in both existing stream types and proposed stream types. Stream types were transferred from the Existing Snohomish County Water Courses Data Set in the following manner.

EXISTING STREAM TYPING	POSSIBLE NEW STREAM TYPING
Type 1 streams	= Type S - Shorelines of the State
Type 2 and 3 streams	= Type F - Fish Bearing
Type 4 streams	= Type Np - Perennial Non-fish

Type 5 streams = Type Ns - Seasonal Non-fish
Type 9 streams = Type U - Undefined

Reference Sources

The following sources are used by SWM and PDS GIS staff to evaluate whether a LiDAR/satellite image generated stream is incorporated into the new stream/water body layer. These reference sources are listed in order of their preference for use in the procedures above.

Subdivision and Plat Plans

The PDS Land Use Division Biologist verifies the location of all native growth protection areas (NGPAs), and insures that these areas designated for permanent protection are accurately identified on binding site development plans (subdivisions or plats).

Spatial Accuracy of Data – Although plats are surveyed and drawn in assumed or real world coordinates, they are submitted to the County in paper format. Making these plats accessible in GIS is a time consuming process that requires scanning of the plat and geo referencing to state plane coordinates. The original scanning is achieved by the County Auditor as part of recording process.

Drainage inventory information from plats is not available in digital form, however, the Assessor's parcel layer does have all subdivision lines, parcels, common areas, and native growth protection areas associated with plats.

Regulatory Steam Types – PDS Land Use Division Biologists verify the location of all native growth protection areas, wetlands, and streams. This verification is used to determine downstream stream type and wetland types that extend beyond an individual parcel boundary.

Critical Area Site Plans (CASP)

A Critical Area Site Plan is used to designate and record native growth protection areas and other environmental restrictions (e.g., wetlands and streams) for residential and commercial development. PDS Land Use Division Biologists verify the location of all native growth protection areas, wetlands, and streams.

Spatial Accuracy of Data –CASPs are a drawn portrayal of environmental site conditions that exist on a property. Using ARCGIS georeferencing software (Appendix 5) from ArcMap, analysts georeference each individual CASP to state plane coordinates.. The raster TIFF images of CASPs are available from the recorded Snohomish County auditor's files. The georeferencing typically uses four identifiable points from the CASP. These are then referenced to their corresponding points from the Assessor's Parcel Database. Once the data is converted to state plane coordinates the boundaries of any identified wetland or stream are digitized.. Attributes are added to the arcs and are converted to polygons by extracting additional arcs from or snapping arcs to the parcel database.

Regulatory Stream Types – PDS Land Use Division Biologists verify the location of all native growth protection areas, wetlands, and streams. This verification is used to determine downstream stream type and wetland types that extend beyond an individual parcel boundary.

SWM Drainage Inventory

As part of the County Drainage Needs Report Project (December 2002), Surface Water Management conducted a GPS inventory of constructed and natural drainage features within unincorporated urban areas of the County.

Spatial Accuracy of Data – As part of the Drainage Needs Report Project, SWM uses survey grade Trimble 4700 real time GPS units to locate and attribute catch basin and

drainage features in the field. These GPS units have a horizontal accuracy of ± 2 cm in .1ft) and a vertical accuracy of ± 2 cm-5cm (.8in to 2in). In some areas, Trimble Pathfinder GPS units with sub-sub-meter accuracy were used.

The spatial accuracy of the SWM drainage inventory data is high. GPS inventory staff follows set procedures for collecting inventory data and cross sections on naturally occurring defined stream channels. All DEM created hydrology is adjusted to route through drainage inventory culverts where a stream crosses a road.

Regulatory Steam Types – Although SWM staff inventoried and collected cross sections on a number of naturally occurring streams, staff did not type the streams.

WADOT Culvert Inventory

Spatial Accuracy of Data – WADOT uses Trimble Pathfinder GPS units to inventory culvert locations, culvert approaches, and catch basins throughout state. The Pathfinder GPS units are accurate to ± 2 meters. WADOT inventory provides information on culverts on state highway right-of-way that are inaccessible to SWM inventory staff. As a result, the WADOT Culvert Inventory is used to help supplement spatial location of streams when they cross state highways.

Adopt-a-Stream Foundation South County Culvert Inventory

Spatial Accuracy of Data – The Adopt-A-Stream Staff (AASF) uses Trimble Pathfinder GPS units to inventory culvert locations throughout their study area. The Pathfinder GPS units are accurate to ± 2 meters (6.5ft). AASF is able to access culverts on private property that the SWM inventory staff can not access. As a result, the AASF South County Culvert Inventory is used to supplement spatial location of streams in areas where there is no GPS inventory from Snohomish County.

Regulatory Steam Types – The AASF staff collects information of fish usage and fish passage information to help in support stream type.

Snohomish County Stream and Wetland Inventory

Beginning in 1985 and continuing through 1990, Snohomish County conducted a stream and wetland inventory in the western portion of the County. Aerial photography, National Wetland Inventory maps, Soil Conservation Service maps, and Washington Streams and Salmon Utilization data were used to identify stream corridors and probable wetlands. Field biologists walked streams and examined wetland vegetation to confirm that the wetlands were correctly identified on the maps.

Spatial Accuracy of Data – The Snohomish County Stream and Wetland Inventory was mapped using 1984 aerial photography of the County as a base. The scale of the annotated photography was 1:4800, although, it was never converted to orthophotography (i.e., not georeferenced or orthorectified).. Even though stream and wetland locations are considered approximate, the streams correlate well with DEM generated hydrology.

Regulatory Steam Types – The County used a different stream typing system at the time of preparing the Stream and Wetland Inventory maps. The original tabular field sheets often contain specific information on fish usage or other information that could be used to confirm stream typing under the current system.

Personal Communications with SWM or PDS Staff

Existing SWM and PDS staff (e.g., stewards, planners, biologists, and habitat specialists) have first hand knowledge of specific stream reaches and may have field knowledge of fish

usage, fish passage, and can corroborate existing stream type or help identify stream type on DEM generated streams.

Data Documentation

As the stream data layer is compiled attributes are added to the data that outline the source, types, and reliability. The sources mentioned above are outlined in the feature class metadata and data dictionary for this layer.

Stream Layer Attributes

Attribute Field	Description
SOURCE1	Primary Supporting Data Source.
SOURCE2	Secondary Supporting Data Source.
SOURCE3	Tertiary Supporting Data Source.
SOURCE4	Additional Supporting Data Source.
SOURCE5	Additional Supporting Data Source.
COMMENT	How the stream segment was modified.
TYPE	DNR Stream Typing.
W_TYPE	New Stream Typing.
PARCELID	ID of Parcel if a Casp or Plat was used as a data source.
NEEDSFLDCH	Marked yes, if the stream segment needs ground truthing.
NAME	Name of Stream.
LENGTH	Length of stream segment (ft).

Of note, is the inclusion of attributes for the current stream types and the new proposed stream types (yet to be adopted or not adopted).

2. Slopes Greater Than or Equal to 33 Percent Model

Objectives

1. To improve the spatial accuracy of the existing Snohomish County slopes data set.
2. To provide for more precise location of slopes greater than or equal to 33% in relation to other geographic features and make these available to the citizens of the County.
3. To model any potential slopes greater than or equal to 33% that may have been previously unknown.

Process

Slope data for Snohomish County currently exists for slopes greater than or equal to 33%. However, this slope data was generated from the USGS ten meter digital elevation model (DEM). This has served well but for relatively limited areas of slope or areas of relative low relief a higher resolution, denser DEM is needed. Also, there is little precision in the location of the slope boundary.

With the acquisition of LiDAR data and the subsequent development of digital elevation models that are at least an order of magnitude denser, the creation of slope data becomes more refined and more definitive.

ESRI software ArcInfo 9.1 workstation is used to analyze the LiDAR DEMs and develop the slope dataset. Slopes are generated from an Arc Macro Language (AML) program using the two sets of LiDAR imagery digital elevation models. (These two data sets are described in this document under LiDAR Imagery.) The two newly generated slope data sets are processed and stored separately because of the differences in accuracy of the original LiDAR. They are converted to polygons and

assembled into an intermediate data layer. They are processed to remove slopes within Rights of Way and slopes with less than ten foot vertical rise.

Procedures

The development of slope data using ArcInfo software is relatively straight forward. Using ArcGIS it becomes even more so. The ArcInfo method is chosen simply because a program had been developed previously and was ready. ArcGIS software will likely be used for additional iterations. The following steps outline this procedure:

Department of Information Services analyzes the LiDAR imagery and produces a derivative GIS digital elevation model (DEM) for the two sets of data. The data itself is much more data dense than the final layer which is based on a 6ft by 6ft pixel size. Once this GIS GRID is produced ArcInfo is able to carry out further analysis as follows:

1. This data is analyzed by Planning and Development Services (PDS) using the Grid module in ArcInfo 9.1 workstation. The slope percentage is calculated for each raster cell and only those with a slope of 33% or greater are used to generate the layer..
2. The raster cells that remain are then grouped by connectivity.
3. The height of the slopes is then calculated and slopes with a rise of less than 10ft are selected within the AML program and then removed. The 10ft rise is the minimum regulatory height for consideration in the permitting process.
4. The raster data are then converted to polygons
5. Next the rights of way (ROW) data from the County ILR parcel data set are used to remove the slopes within in the ROW area. The ArcInfo 'erase command' is incorporated within the AML. To achieve this.

The result is a polygon layer that appears jagged with edges that construct a stair step pattern. No attempt to remove this edge effect is made. Generalization of this boundary was considered, however, no improvement in accuracy can be achieved. This may be considered at a later date to improve cartographic depiction for the end application.

The initial derived DEM Grid for the new LiDAR data set did not abut or overlap the Brightwater data in a few places. Consequently, these places did not facilitate connectivity (2 above). An overlap of 200ft has been ordered from the vendor and will be incorporated into the model upon arrival.

Data Documentation

The opportunity for additional slope categories is now available. Several test data sets to produce a broad spectrum of slope data are being developed. It is expected that a variety of uses can take advantage of the data set. However, for this iteration only the classification of greater than or equal to 33 percent slope is created.

Slope Layer attributes

Attribute Name	Description
OBJECTID	Object identifier
GRID_CODE	field used in previous calculation
ZONE_	field used in previous calculation
SLPHT_FT	average slope height of polygon
Shape	type of data (polygon)
SHAPE.area	area of polygon in square feet
SHAPE.len	perimeter length of polygon

3. Future Sources

The scope and time frame for this project precludes the incorporation of additional data. There is a considerable library of historical information in existence that will be added to this data as time and resources allow. As unmapped sources are identified and corroborated the reliability for any previous individual piece of data builds in stature. Protocols will also be developed for the ongoing updates and additions from field staff as they conduct new field reviews.

As data is acquired and analyzed, it is anticipated that these same methods may be used to extend the model to the remainder of Snohomish County.

Appendix 1 – Metadata for SnoScape Data Layer- Stream Model

Southwest County Watercourses

Data format: Shapefile

Coordinate system: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

Theme keywords: Watercourses, Streams, Rivers,

Location: file://\apsrv27\gis_data\moerdata\snoscape_data\wtrcrs_snsmps.shp

Abstract: This GIS shapefile is a model depicting surface water features including streams, rivers and water body centerlines for the Southwest Corner of Snohomish County.

ISO and ESRI Metadata:

- [Metadata Information](#)
- [Resource Identification Information](#)
- [Spatial Representation Information](#)
- [Reference System Information](#)
- [Data Quality Information](#)
- [Distribution Information](#)
- [Geoprocessing History](#)

Metadata elements shown with blue text are defined in the International Organization for Standardization's (ISO) document 19115 *Geographic Information - Metadata*. Elements shown with green text are defined by ESRI and will be documented as extensions to the ISO 19115. Elements shown with a green asterisk (*) will be automatically updated by ArcCatalog.

Metadata Information

***Metadata language:** English

***Metadata character set:** utf8 - 8 bit UCS Transfer Format

***Last update:** 20070322

Metadata contact:

Organization's name: Snohomish County
Contact's position: Senior GIS Analyst
Contact's role: originator

Contact information:

Address:
Delivery point:
3000 Rockefeller Ave
City: Everett
Administrative area: WA
Postal code: 98201
Country: United States

***Scope of the data described by the metadata:** dataset

***Scope name:** dataset

***Name of the metadata standard used:** ISO 19115 Geographic Information - Metadata

***Version of the metadata standard:** DIS_ESRI1.0

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Resource Identification Information:

Citation:

Title: Southwest County Watercourses

Reference date:

Date: 20061201

Type of date: creation

Reference date:

Date: 20061201

Type of date: revision

Edition date: 20061201

***Presentation format:** digital map

Party responsible for the resource:

Organization's name: Snohomish County
Contact's role:

Party responsible for the resource:

Organization's name: Snohomish County
Contact's position: Senior GIS Analyst
Contact's role: originator

Contact information:

Address:
Delivery point:
3000 Rockefeller Ave
City: Everett

Administrative area: WA
Postal code: 98201
Country: United States

Themes or categories of the resource: inland waters

Theme keywords:

Keywords: Watercourses, Streams, Rivers,

Place keywords:

Keywords: Snohomish County Southwest

Abstract:

This GIS shapefile is a model depicting surface water features including streams, rivers and water body centerlines for the Southwest Corner of Snohomish County.

***Dataset language:** English

***Spatial representation type:** vector

***Processing environment:** Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 1; ESRI ArcCatalog 9.1.0.722

Resource's bounding rectangle:

***Extent type:** Full extent in decimal degrees

***Extent contains the resource:** Yes

***West longitude:** -122.399384

***East longitude:** -122.108241

***North latitude:** 47.978223

***South latitude:** 47.763821

Other extent information:

Geographic extent:

Bounding rectangle:

***Extent type:** Full extent in the data's coordinate system

***Extent contains the resource:** Yes

***West longitude:** 1256855.053022

***East longitude:** 1326902.636159

***North latitude:** 359433.340778

***South latitude:** 282504.990689

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Spatial Representation - Vector:

***Level of topology for this dataset:** geometry only

Geometric objects:

***Name:** wtrcrs_snsdp

***Object type:** complexes

***Object count:** 1249

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Reference System Information:

Reference system identifier:

***Value:** NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

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Data Quality Information:

Scope of quality information:

Level of the data: dataset

Lineage:

Lineage statement:

The wtrcrs_snsdp.shp was generated using LiDAR datasets and the ArcHydro extension to ArcGIS. All stream segments generated by our model were assessed in regards to multiple proxy data sources in order to determine the feasibility of existence.

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Distribution Information:

Distributor:

Available format:

***Format name:** Shapefile

Transfer options:

***Transfer size:** 0.836

Online source:

***Online location (URL):** file://\apsrv63\emp\Hydro\swcounty_wtrcrs.shp

***Connection protocol:** Local Area Network

Description: Downloadable Data

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Geoprocessing History:

Process:

***Process name:** Merge_1

***Date:** 20061201

***Time:** 120149

***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Merge

***Command issued:** Merge

U:\Hydro\lb_wtrcrs.shp;U:\Hydro\mrsInd_wtrcrs.shp;U:\Hydro\nc_wtrcrs.shp;U:\Hydro\PS_EV_wtrcrs.shp;U:\Hydro\swcrk_wtrcrs.shp

U:\Hydro\swcounty_wtrcrs.shp "SOURCE1 SOURCE1 true false false 50 Text 0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,SOURCE1,-1,-

1,U:\Hydro\mrsInd_wtrcrs.shp,Source1,-1,-1,U:\Hydro\nc_wtrcrs.shp,SOURCE1,-

1,-1,U:\Hydro\PS_EV_wtrcrs.shp,SOURCE1,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,SOURCE1,-1,-1;SOURCE2 SOURCE2 true false false
50 Text 0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,SOURCE2,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,Source2,-1,-1,U:\Hydro\nc_wtrcrs.shp,SOURCE2,-
1,-1,U:\Hydro\PS_EV_wtrcrs.shp,SOURCE2,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,SOURCE2,-1,-1;SOURCE3 SOURCE3 true false false
50 Text 0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,SOURCE3,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,Source3,-1,-1,U:\Hydro\nc_wtrcrs.shp,SOURCE3,-
1,-1,U:\Hydro\PS_EV_wtrcrs.shp,SOURCE3,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,SOURCE3,-1,-1;SOURCE4 SOURCE4 true false false
50 Text 0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,SOURCE4,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,Source4,-1,-1,U:\Hydro\nc_wtrcrs.shp,SOURCE4,-
1,-1,U:\Hydro\PS_EV_wtrcrs.shp,SOURCE4,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,SOURCE4,-1,-1;SOURCE5 SOURCE5 true false false
50 Text 0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,SOURCE5,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,Source5,-1,-1,U:\Hydro\nc_wtrcrs.shp,SOURCE5,-
1,-1,U:\Hydro\PS_EV_wtrcrs.shp,SOURCE5,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,SOURCE5,-1,-1;COMMENT COMMENT true false
false 100 Text 0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,COMMENT,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,Comment,-1,-
1,U:\Hydro\nc_wtrcrs.shp,COMMENT,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,COMMENT,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,COMMENT,-1,-1;TYPE TYPE true false false 10 Text
0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,TYPE,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,TYPE,-1,-1,U:\Hydro\nc_wtrcrs.shp,TYPE,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,TYPE,-1,-1,U:\Hydro\swcrk_wtrcrs.shp,TYPE,-1,-
1;W_TYPE W_TYPE true false false 10 Text 0 0
,First,#,U:\Hydro\lb_wtrcrs.shp,W_TYPE,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,W_TYPE,-1,-1,U:\Hydro\nc_wtrcrs.shp,W_TYPE,-
1,-1,U:\Hydro\PS_EV_wtrcrs.shp,W_TYPE,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,W_TYPE,-1,-1;REVSTATUS REVSTATUS true false
false 2 Text 0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,REVSTATUS,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,RevStatus,-1,-
1,U:\Hydro\nc_wtrcrs.shp,REVSTATUS,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,REVSTATUS,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,REVSTATUS,-1,-1;PARCELID PARCELID true false
false 25 Text 0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,PARCELID,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,ParcelID,-1,-
1,U:\Hydro\nc_wtrcrs.shp,PARCELID,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,PARCELID,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,PARCELID,-1,-1;NEEDSFLDCH NEEDSFLDCH true
false false 4 Text 0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,NEEDSFLDCH,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,NeedsFldCh,-1,-
1,U:\Hydro\nc_wtrcrs.shp,NEEDSFLDCH,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,NEEDSFLDCH,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,NEEDSFLDCH,-1,-1;Name Name true false false 40
Text 0 0 ,First,#,U:\Hydro\lb_wtrcrs.shp,Name,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,NAME,-1,-1,U:\Hydro\nc_wtrcrs.shp,NAME,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,NAME,-1,-1,U:\Hydro\swcrk_wtrcrs.shp,NAME,-1,-
1;Length Length true false false 19 Double 11 18
,First,#,U:\Hydro\lb_wtrcrs.shp,Length,-1,-
1,U:\Hydro\mrsInd_wtrcrs.shp,Length,-1,-1,U:\Hydro\nc_wtrcrs.shp,Length,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,LENGTH,-1,-

1,U:\Hydro\swcrk_wtrcrs.shp,LENGTH,-1,-1;GridID GridID true false false 9 Long 0 9 ,First,#,U:\Hydro\mrsInd_wtrcrs.shp,GridID,-1,-
1,U:\Hydro\nc_wtrcrs.shp,GRIDID,-1,-1,U:\Hydro\PS_EV_wtrcrs.shp,GRIDID,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,GRIDID,-1,-1;FROM_NODE FROM_NODE true false false 9 Long 0 9 ,First,#,U:\Hydro\mrsInd_wtrcrs.shp,FROM_NODE,-1,-
1,U:\Hydro\nc_wtrcrs.shp,FROM_NODE,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,FROM_NODE,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,FROM_NODE,-1,-1;TO_NODE TO_NODE true false false 9 Long 0 9 ,First,#,U:\Hydro\mrsInd_wtrcrs.shp,TO_NODE,-1,-
1,U:\Hydro\nc_wtrcrs.shp,TO_NODE,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,TO_NODE,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,TO_NODE,-1,-1;HydroID HydroID true false false 9 Long 0 9 ,First,#,U:\Hydro\mrsInd_wtrcrs.shp,HydroID,-1,-
1,U:\Hydro\nc_wtrcrs.shp,HYDROID,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,HYDROID,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,HYDROID,-1,-1;NextDownID NextDownID true false false 9 Long 0 9 ,First,#,U:\Hydro\mrsInd_wtrcrs.shp,NextDownID,-1,-
1,U:\Hydro\nc_wtrcrs.shp,NEXTDOWNID,-1,-
1,U:\Hydro\PS_EV_wtrcrs.shp,NEXTDOWNID,-1,-
1,U:\Hydro\swcrk_wtrcrs.shp,NEXTDOWNID,-

Appendix 2 - Additional Information - Stream Modeling

ArcHydro Software from Earth Systems Research Institute, Inc.

<http://esri.com>

http://www.esri.com/industries/water_resources/business/literature.html

http://www.esri.com/industries/water_resources/business/terrain_modeling.html

<http://support.esri.com/index.cfm?fa=downloads.dataModels.filteredGateway&dmid=15>

ArcHydro Additional References

<http://www.crrw.utexas.edu/giswr/hydro/ArcHOSS/index.cfm>

Garbrecht, J., and L.W. Martz (1999), "Digital Elevation Model Issues in Water Resources Modeling," 19th ESRI International Users Conference, San Diego, California.

Guy D.D., S.W. Kienzle, D.L. Johnson, and J.M. Byrne, (2003) "Improving overland flow routing by incorporating ancillary road data into Digital Elevation Models," Journal of Spatial Hydrology, 3 (2): 1-27.

Maidment, D. R. (2002), "ArcHydro: GIS for Water Resources," ESRI Press.

Montgomery, D.R., and E. Foufoula-Georgiou, (1993), "Channel Network Source Representation Using Digital Elevation Models," Water Resources Research 29(12): 3925-3934.

Tarboton, D.G., (2003), "Terrain Analysis Using Digital Elevation Models in Hydrology," 23rd ESRI International Users Conference, San Diego, California, July 7-11.

Tarboton, D.G. and D.P. Ames, (2001), "Advances in the mapping of flow networks from digital elevation data," in World Water and Environmental Resources Congress, Orlando, Florida, May 20-24, ASCE.

Tarboton, D.G., R.L. Bras and I. Rodriguez-Iturbe, (1991), "On the Extraction of Channel Networks from Digital Elevation Data," Hydrologic Processes, 5(1): 81-100.

Appendix 3 – SnoScape Data Layer – Brightwater Slopes Model

bw33slope_scsnp

Data format: Shapefile

Coordinate system: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

Location: file://\apsrv27\gis_data\moerdata\snoescape_data\bw33slope_snsmps.shp

Abstract: This GIS shapefile is a model depicting slopes greater than or equal to 33 percent and with a rise of 10 feet or more for the Southwest Corner of Snohomish County. These data use the King County Brightwater LiDAR to determine the subsequent slopes.

ISO and ESRI Metadata:

- [Metadata Information](#)
- [Resource Identification Information](#)
- [Spatial Representation Information](#)
- [Reference System Information](#)
- [Distribution Information](#)
- [Geoprocessing History](#)

Metadata elements shown with blue text are defined in the International Organization for Standardization's (ISO) document 19115 *Geographic Information - Metadata*. Elements shown with green text are defined by ESRI and will be documented as extensions to the ISO 19115. Elements shown with a green asterisk (*) will be automatically updated by ArcCatalog.

Metadata Information

***Metadata language:** English

***Metadata character set:** utf8 - 8 bit UCS Transfer Format

***Last update:** 20070322

***Scope of the data described by the metadata:** dataset

***Scope name:** dataset

***Name of the metadata standard used:** ISO 19115 Geographic Information - Metadata

***Version of the metadata standard:** DIS_ESRI1.0

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Resource Identification Information:

Citation:

***Title:** bw33slope_snsdp

***Presentation format:** digital map

***Dataset language:** English

***Spatial representation type:** vector

***Processing environment:** Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 1; ESRI ArcCatalog 9.1.0.722

Resource's bounding rectangle:

***Extent type:** Full extent in decimal degrees

***Extent contains the resource:** Yes

***West longitude:** -122.292868

***East longitude:** -122.119969

***North latitude:** 47.894842

***South latitude:** 47.774295

Other extent information:

Geographic extent:

Bounding rectangle:

***Extent type:** Full extent in the data's coordinate system

***Extent contains the resource:** Yes

***West longitude:** 1282373.625032

***East longitude:** 1324073.624804

***North latitude:** 329061.124985

***South latitude:** 285826.142607

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Spatial Representation - Vector:

***Level of topology for this dataset:** geometry only

Geometric objects:

***Name:** bw33slope_snsdp

***Object type:** complexes

***Object count:** 2084

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Reference System Information:

Reference system identifier:

***Value:** NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

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Distribution Information:

Distributor:

Available format:

***Format name:** Shapefile

Transfer options:

***Transfer size:** 6.519

Online source:

***Online location (URL):** file://\apsrv63\emp\Slope\bw33slope_study.shp

***Connection protocol:** Local Area Network

Description: Downloadable Data

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Geoprocessing History:

Process:

***Process name:** Create Feature Class

***Date:** 20060814

***Time:** 155530

***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\CreateFeatureclass

***Command issued:** CreateFeatureclass "I:\commons\PDS Environmental Mapping Project\LB_Boundary # lb_Watershed_Layer SAME_AS_TEMPLATE SAME_AS_TEMPLATE

"PROJCS['NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet',GEOGCS['GCS_North_American_1983',DATUM['D_North_American_1983',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Lambert_Conformal_Conic'],PARAMETER['False_Easting',1640416.666666667],PARAMETER['False_Northing',0.0],PARAMETER['Central_Meridian',-120.83333333333333],PARAMETER['Standard_Parallel_1',47.5],PARAMETER['Standard_Parallel_2',48.73333333333333],PARAMETER['Latitude_Of_Origin',47.0],UNIT['Foot_US',0.3048006096012192]];1269627.23607478 239679.128958069 18036.3808120003;0 100000;0 100000" # 0 0 0 "I:\commons\PDS Environmental Mapping Project\LB_Boundary.shp"

Process:

***Process name:** Append

***Date:** 20060814

***Time:** 155532

***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Append

***Command issued:** Append lb_Watershed_Layer "I:\commons\PDS Environmental Mapping Project\LB_Boundary.shp" TEST "I:\commons\PDS Environmental Mapping Project\LB_Boundary.shp"

Process:

***Process name:** FeatureClassToFeatureClass_1

***Date:** 20060814

***Time:** 155532

***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Conversion Tools.tbx\FeatureClassToFeatureClass

***Command issued:** FeatureClassToFeatureClass
I:\pw\swm\spwlca\PDSEnviroMapping\little_bear\watershed\watershed_delin.mdb\Layers\lb_Watershed "I:\commons\PDS Environmental Mapping Project" LB_Boundary # "Shape_Length Shape_Leng VISIBLE; Shape_Area Shape_Area VISIBLE; HydroID HydroID VISIBLE; Name Name VISIBLE" SAME_AS_TEMPLATE SAME_AS_TEMPLATE # 0 "I:\commons\PDS Environmental Mapping Project\LB_Boundary.shp"

Process:

***Process name:** Union_1
***Date:** 20060926
***Time:** 124313
***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Analysis Tools.tbx\Union
***Command issued:** Union "SWugaStudy "; LBstudy "" "S:\Planning\Cartography\PDS Environmental Mapping Project\Shapes\SWugaLBstudy.shp" ALL # GAPS

Process:

***Process name:** Intersect_1
***Date:** 20070222
***Time:** 113912
***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Analysis Tools.tbx\Intersect
***Command issued:** Intersect "EMP_study_area "; emp.SCDNDQ.bw33slope "" T:\Statistics\GIS\bwslope_study.shp ALL # INPUT

Appendix 3 – SnoScape Data Layer – Southwest Slopes Model

sw33slope_snsdp

Data format: Shapefile

Coordinate system: NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

Location: file://\apsrv27\gis_data\moerdata\snoescape_data\sw33slope_snsdps.shp

Abstract: This GIS shapefile is a model depicting slopes greater than or equal to 33 percent and with a rise of 10 feet or more for the Southwest Corner of Snohomish County. These data use the Snohomish County West LiDAR to determine the subsequent slopes.

ISO and ESRI Metadata:

- [Metadata Information](#)
- [Resource Identification Information](#)
- [Spatial Representation Information](#)
- [Reference System Information](#)
- [Distribution Information](#)
- [Geoprocessing History](#)

Metadata elements shown with blue text are defined in the International Organization for Standardization's (ISO) document 19115 *Geographic Information - Metadata*. Elements shown with green text are defined by ESRI and will be documented as extensions to the ISO 19115. Elements shown with a green asterisk (*) will be automatically updated by ArcCatalog.

Metadata Information

- ***Metadata language:** English
- ***Metadata character set:** utf8 - 8 bit UCS Transfer Format

- ***Last update:** 20070322

- ***Scope of the data described by the metadata:** dataset
- ***Scope name:** dataset

- ***Name of the metadata standard used:** ISO 19115 Geographic Information - Metadata
- ***Version of the metadata standard:** DIS_ESRI1.0

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Resource Identification Information:

Citation:

- ***Title:** sw33slope_snsdp

- ***Presentation format:** digital map

- ***Dataset language:** English

- ***Spatial representation type:** vector

- ***Processing environment:** Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 1; ESRI ArcCatalog 9.1.0.722

Resource's bounding rectangle:

- ***Extent type:** Full extent in decimal degrees
- ***Extent contains the resource:** Yes
- ***West longitude:** -122.401379
- ***East longitude:** -122.113819
- ***North latitude:** 48.036218
- ***South latitude:** 47.77292

Other extent information:

Geographic extent:

Bounding rectangle:

- ***Extent type:** Full extent in the data's coordinate system
- ***Extent contains the resource:** Yes
- ***West longitude:** 1256797.851715
- ***East longitude:** 1325586.00024
- ***North latitude:** 380613.717912
- ***South latitude:** 285826.142607

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Spatial Representation - Vector:

***Level of topology for this dataset:** geometry only

Geometric objects:

- ***Name:** sw33slope_snsdp
- ***Object type:** complexes
- ***Object count:** 5156

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Reference System Information:

Reference system identifier:

- ***Value:** NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

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Distribution Information:

Distributor:

Available format:

- ***Format name:** Shapefile

Transfer options:

- ***Transfer size:** 23.845

Online source:

- ***Online location (URL):** file://\apsrv63\emp\Slope\sw33slope_study.shp
- ***Connection protocol:** Local Area Network

Description: Downloadable Data

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Geoprocessing History:

Process:

- ***Process name:** Create Feature Class
- ***Date:** 20060814
- ***Time:** 155530
- ***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\CreateFeatureclass

***Command issued:** CreateFeatureclass "I:\commons\PDS Environmental Mapping Project" LB_Boundary # lb_Watershed_Layer SAME_AS_TEMPLATE SAME_AS_TEMPLATE
"PROJCS['NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet',GEOGCS['GCS_North_American_1983',DATUM['D_North_American_1983',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich',0.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Lambert_Conformal_Conic'],PARAMETER['False_Easting',1640416.666666667],PARAMETER['False_Northing',0.0],PARAMETER['Central_Meridian',-120.8333333333333],PARAMETER['Standard_Parallel_1',47.5],PARAMETER['Standard_Parallel_2',48.7333333333333],PARAMETER['Latitude_Of_Origin',47.0],UNIT['Foot_US',0.3048006096012192]];1269627.23607478 239679.128958069 18036.3808120003;0 100000;0 100000" # 0 0 0 "I:\commons\PDS Environmental Mapping Project\LB_Boundary.shp"

Process:

***Process name:** Append
***Date:** 20060814
***Time:** 155532
***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Data Management Tools.tbx\Append
***Command issued:** Append lb_Watershed_Layer "I:\commons\PDS Environmental Mapping Project\LB_Boundary.shp" TEST "I:\commons\PDS Environmental Mapping Project\LB_Boundary.shp"

Process:

***Process name:** FeatureClassToFeatureClass_1
***Date:** 20060814
***Time:** 155532
***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Conversion Tools.tbx\FeatureClassToFeatureClass
***Command issued:** FeatureClassToFeatureClass
I:\pw\swm\spwlca\PDSEnviroMapping\little_bear\watershed\watershed_delin.mdb\Layers\lb_Watershed "I:\commons\PDS Environmental Mapping Project" LB_Boundary # "Shape_Length Shape_Leng VISIBLE;Shape_Area Shape_Area VISIBLE;HydroID HydroID VISIBLE;Name Name VISIBLE" SAME_AS_TEMPLATE SAME_AS_TEMPLATE # 0 "I:\commons\PDS Environmental Mapping Project\LB_Boundary.shp"

Process:

***Process name:** Union_1
***Date:** 20060926
***Time:** 124313
***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Analysis Tools.tbx\Union
***Command issued:** Union "SWugaStudy ";LBstudy ""
"S:\Planning\Cartography\PDS Environmental Mapping Project\Shapes\SWugaLBstudy.shp" ALL # GAPS

Process:

***Process name:** Intersect_1
***Date:** 20070222
***Time:** 113912

***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Analysis Tools.tbx\Intersect
***Command issued:** Intersect "EMP_study_area ";emp.SCDNDQ.bw33slope "" T:\Statistics\GIS\bwslope_study.shp ALL # INPUT

Process:

***Process name:** Union_3
***Date:** 20070222
***Time:** 114250
***Tool location:** C:\Program Files\ArcGIS\ArcToolbox\Toolboxes\Analysis Tools.tbx\Union
***Command issued:** Union "swslope_study ";bwslope_study "" T:\Statistics\GIS\new_slope_study.shp ALL # GAPS