Chester, Delaware, and Montgomery Counties Regional Watershed Improvement Project Decision Support Tool

User Guide

Version 1.1

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Prepared for:
U.S. Army Corps of Engineers, Philadelphia District
Pennsylvania Department of Environment Protection

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Quick Start

- Architecture –The Decision Support Tool (DST) has been developed as an extension to Esri ArcGIS Version 10, “Standard” (ArcEditor) license. It also uses functionalities of the ArcGIS Spatial Analyst extension, which must be purchased and activated in order for the tool to perform properly.

  The DST uses an Esri file geodatabase that stores GIS datasets in a file system folder.

- Source Data – A dataset (geodatabase) is provided with the installation file that can be used to run evaluations. This dataset consists of a file geodatabase containing all layers required for the analysis. Selecting this geodatabase automatically selects a default analysis area feature layer based on watersheds for the three-county study area. Selecting the provided geodatabase also automatically correlates indicators with the appropriate layers.

  An alternate dataset (geodatabase) can be selected and used in the tool as long as it meets the requirements listed in Section 4. If an alternate dataset with layers that are named differently is selected, you need to manually select the analysis area and correlate individual indicators with feature layers.

- Customization –You can select and use different layers within the selected geodatabase for the analysis area feature layer or as the basis of individual indicators. You can also select and use layers that are stored externally from the selected geodatabase.

  You can adjust the weights assigned to categories and individual indicators by selecting one of five weighting approaches. You can also manually adjust category and individual weights (as long as the combined weights for a category total to 100). Weights that are set manually can be saved in the ArcMap project file (.mxd) with other current settings.

- Results –During each run, the DST creates a new results layer at the specified location (within the source geodatabase, in a different Esri geodatabase or as a shapefile). By default, results are stored in the selected source geodatabase.

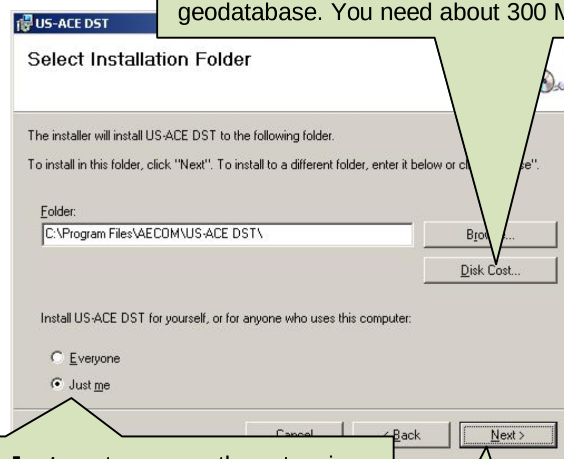
  Result values are stored as attributes of this layer. Refer to Table 6 for information about the contents of the results layer.

  The DST also loads the results layer to the map and renders the watersheds by total DST score from green (low need for watershed improvements) to red (high need for watershed improvements) with 5 natural breaks.

Install the Extension

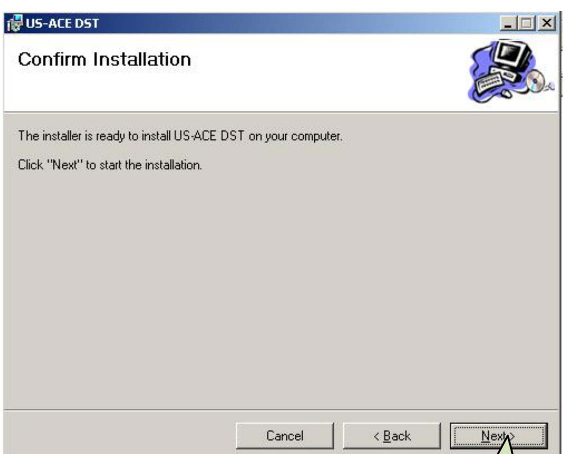
Open the installer file. When the wizard is displayed, click **Next**.

Click Disk Cost to check that you have sufficient storage for the application and geodatabase. You need about 300 MB.

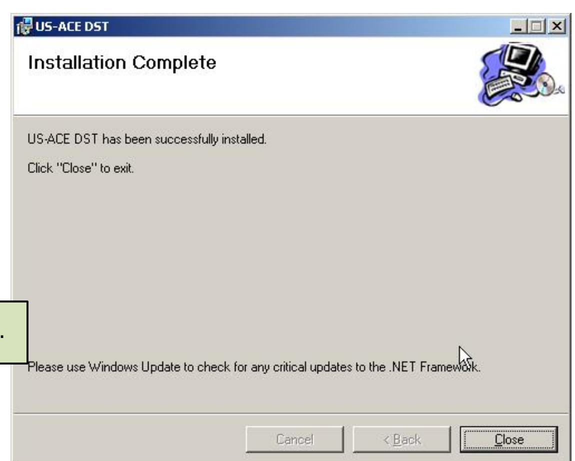


Click **Just me** to remove the extension and toolbar for others using ArcMap (they can enable it if needed), or click **Everyone** to display the extension to anyone after you've enabled it.

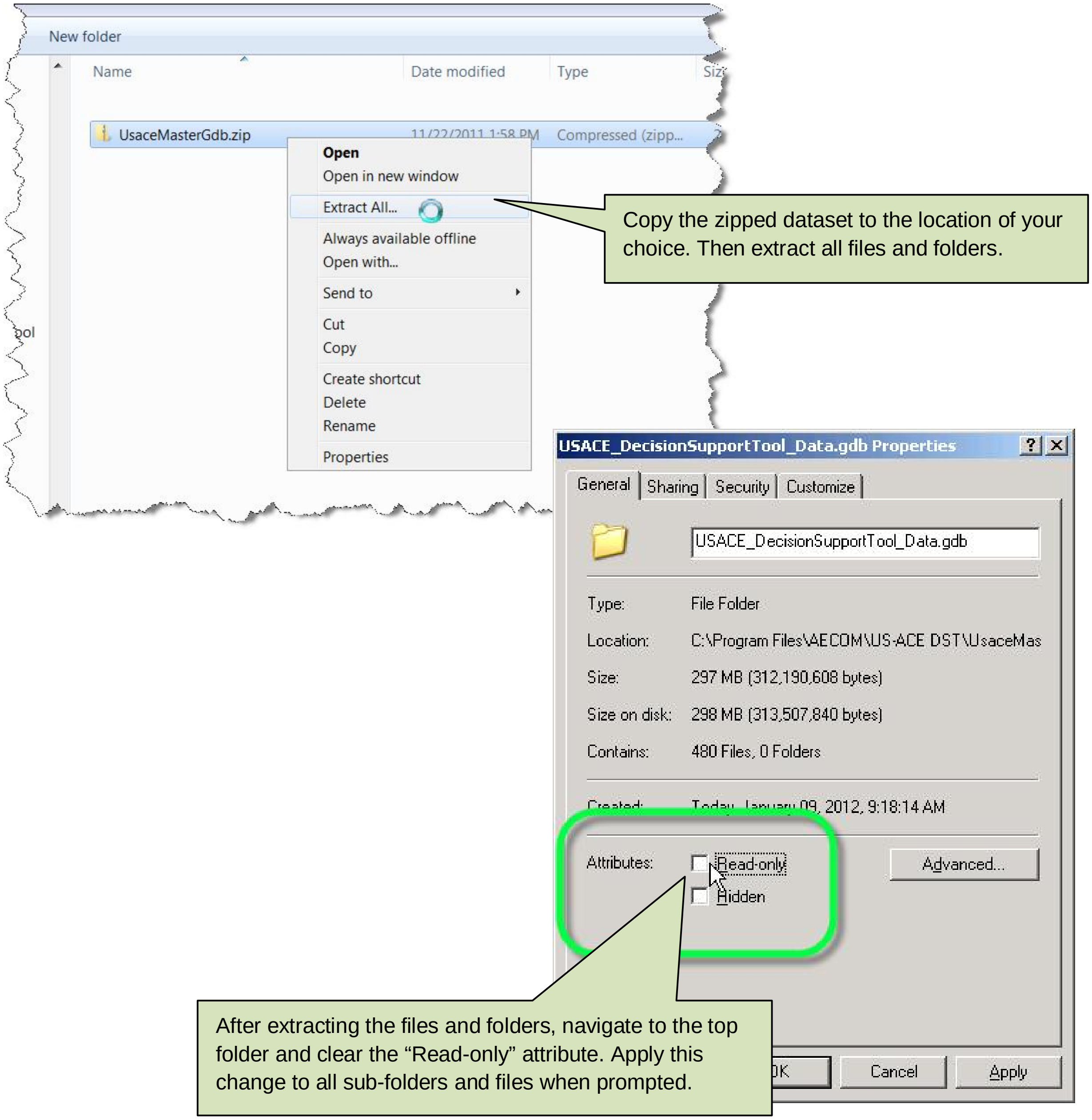
Click **Next**.



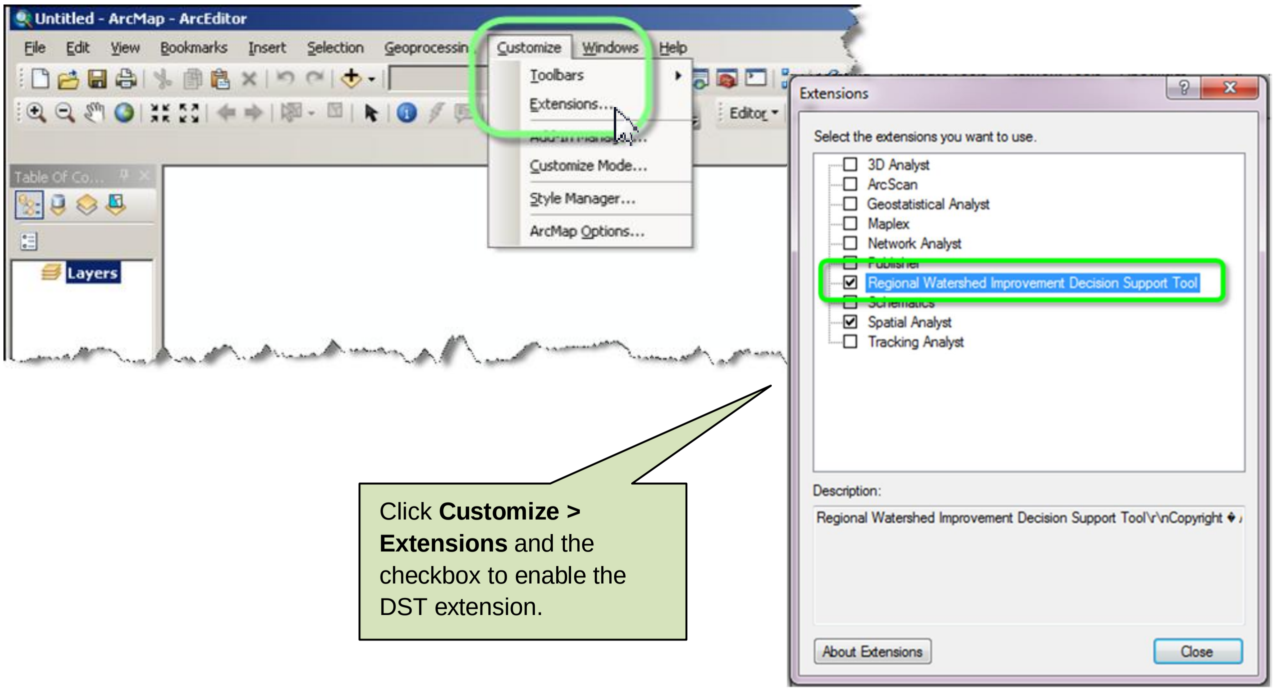
Click **Next**.

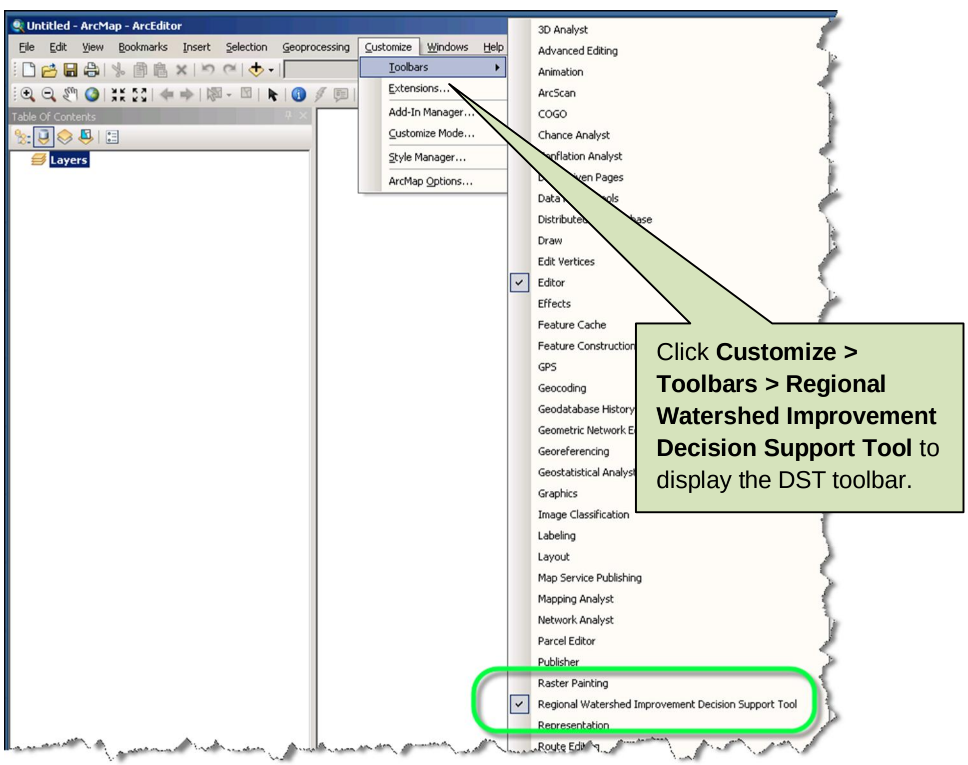


Extract the Provided Dataset

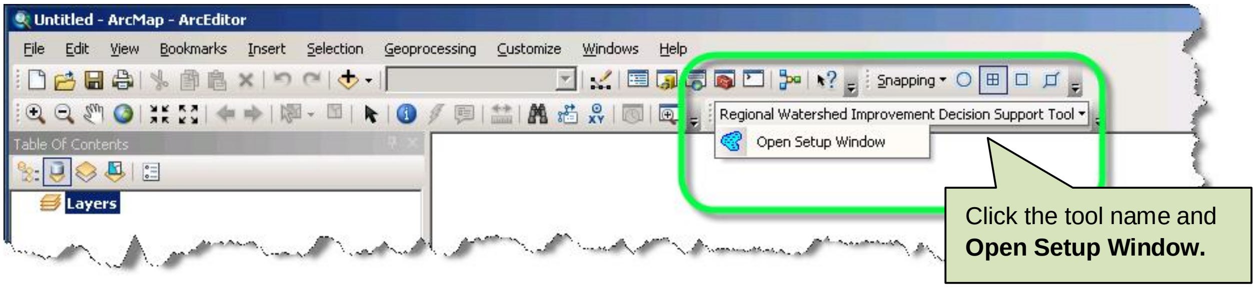


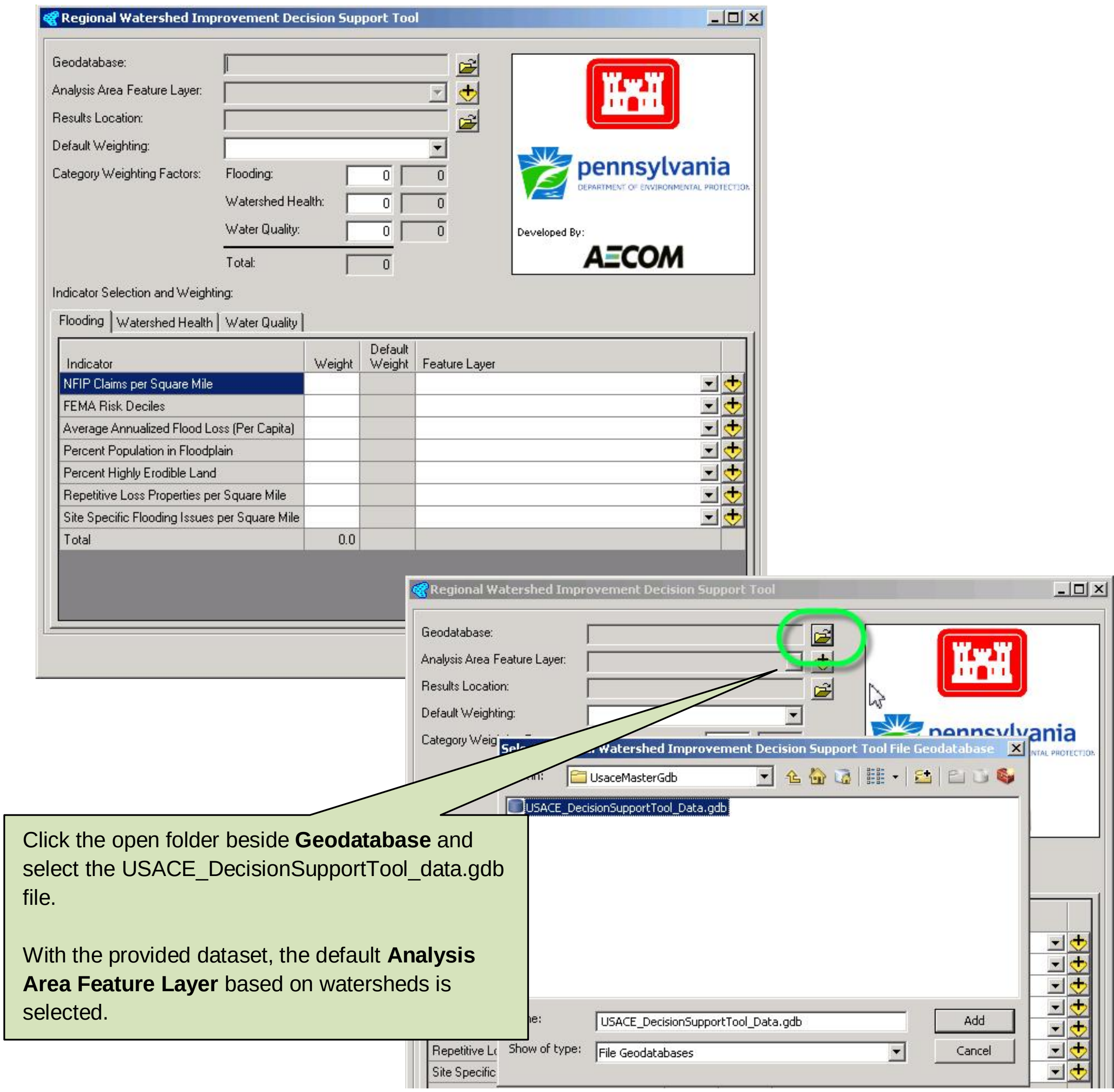
Enable the DST and Spatial Analyst Extensions in ArcMap



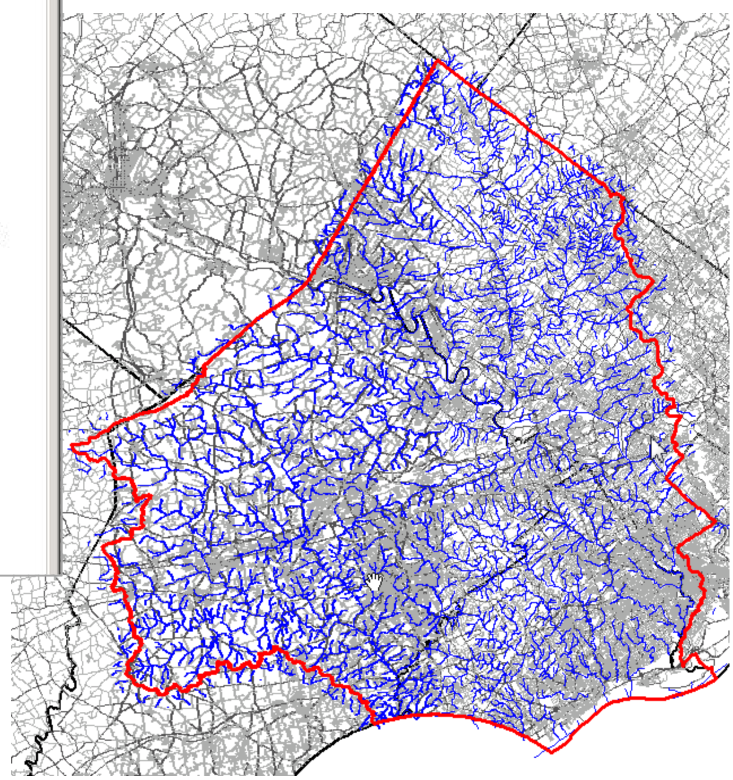


Select the Provided Dataset



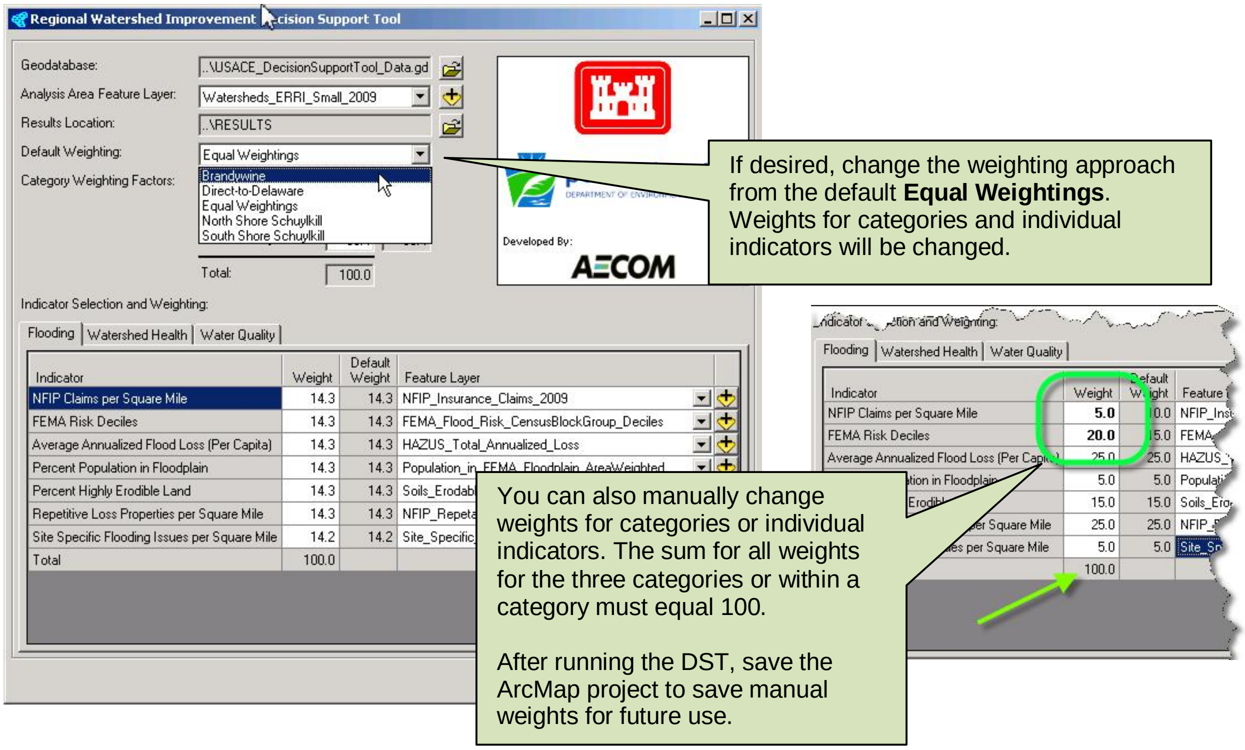


DST will automatically load these layers in the provided geodatabase to the map. Only layers in the General group will be visible (the other layers will be turned off initially).

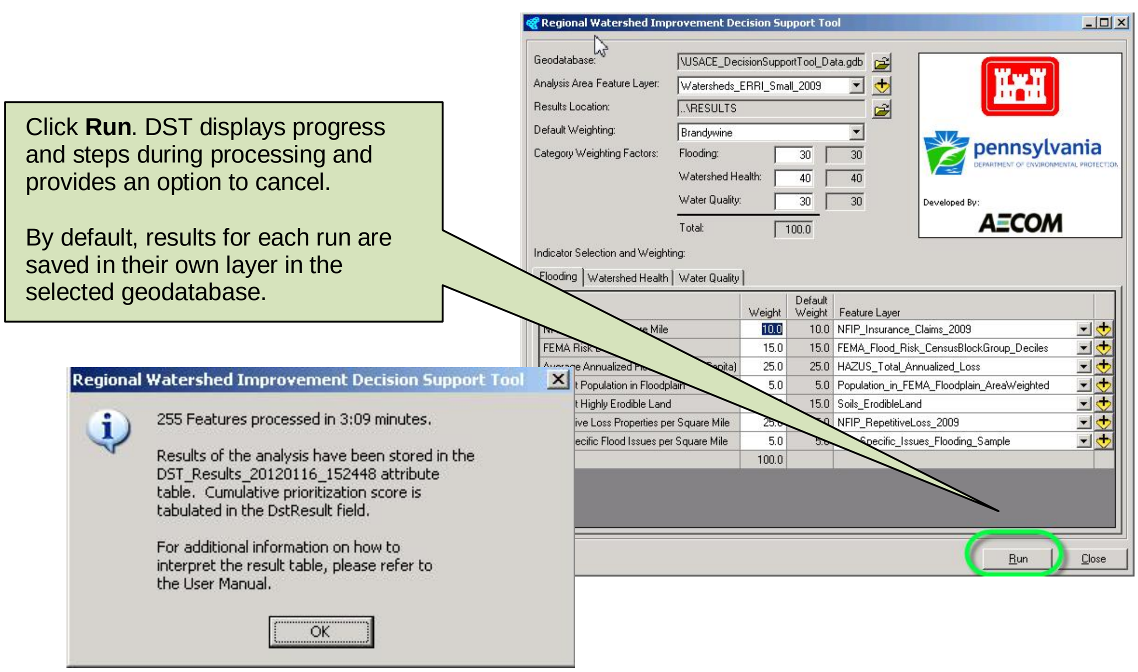


Layers by Drawing Order

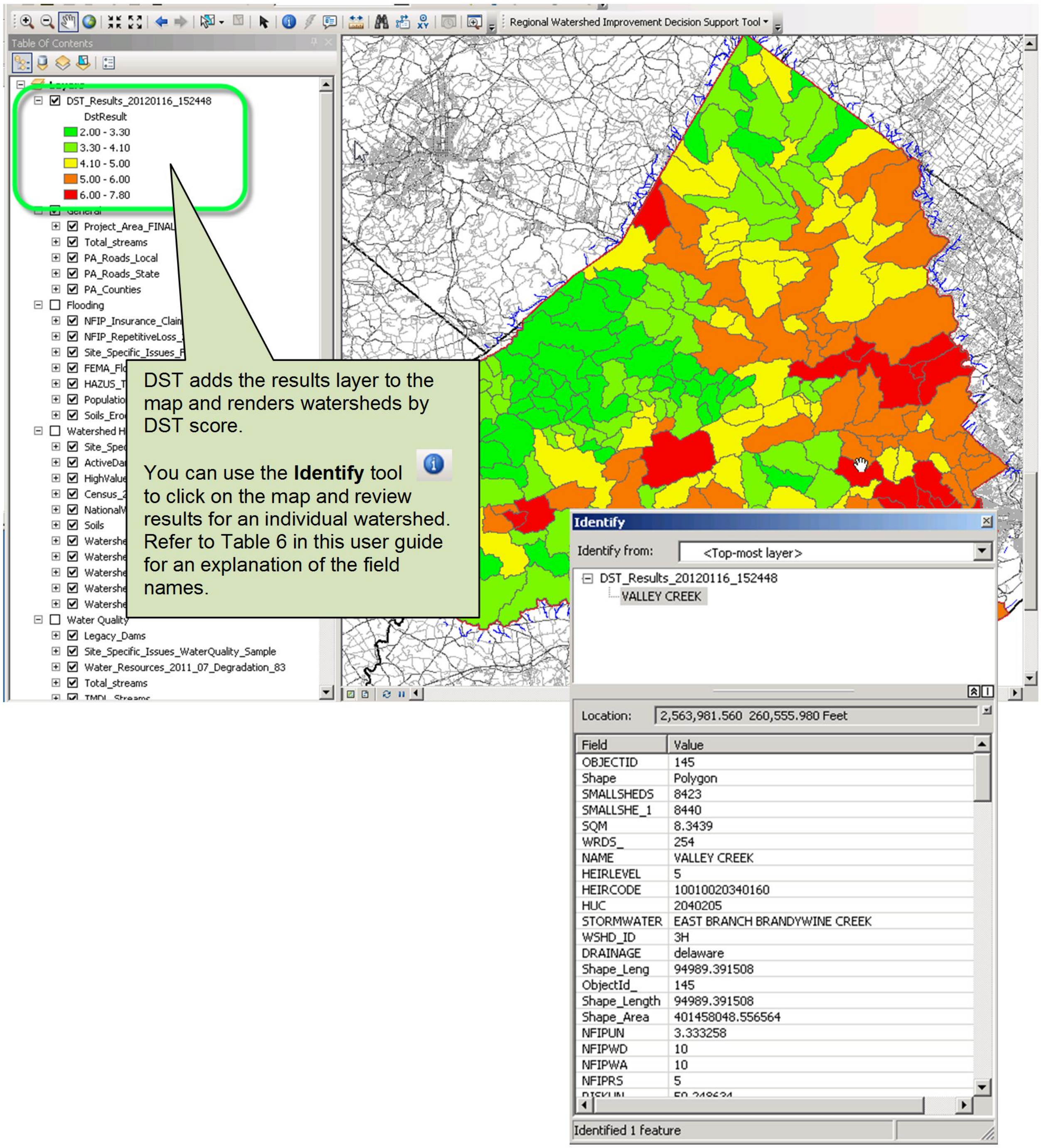
Select the Weighting Approach

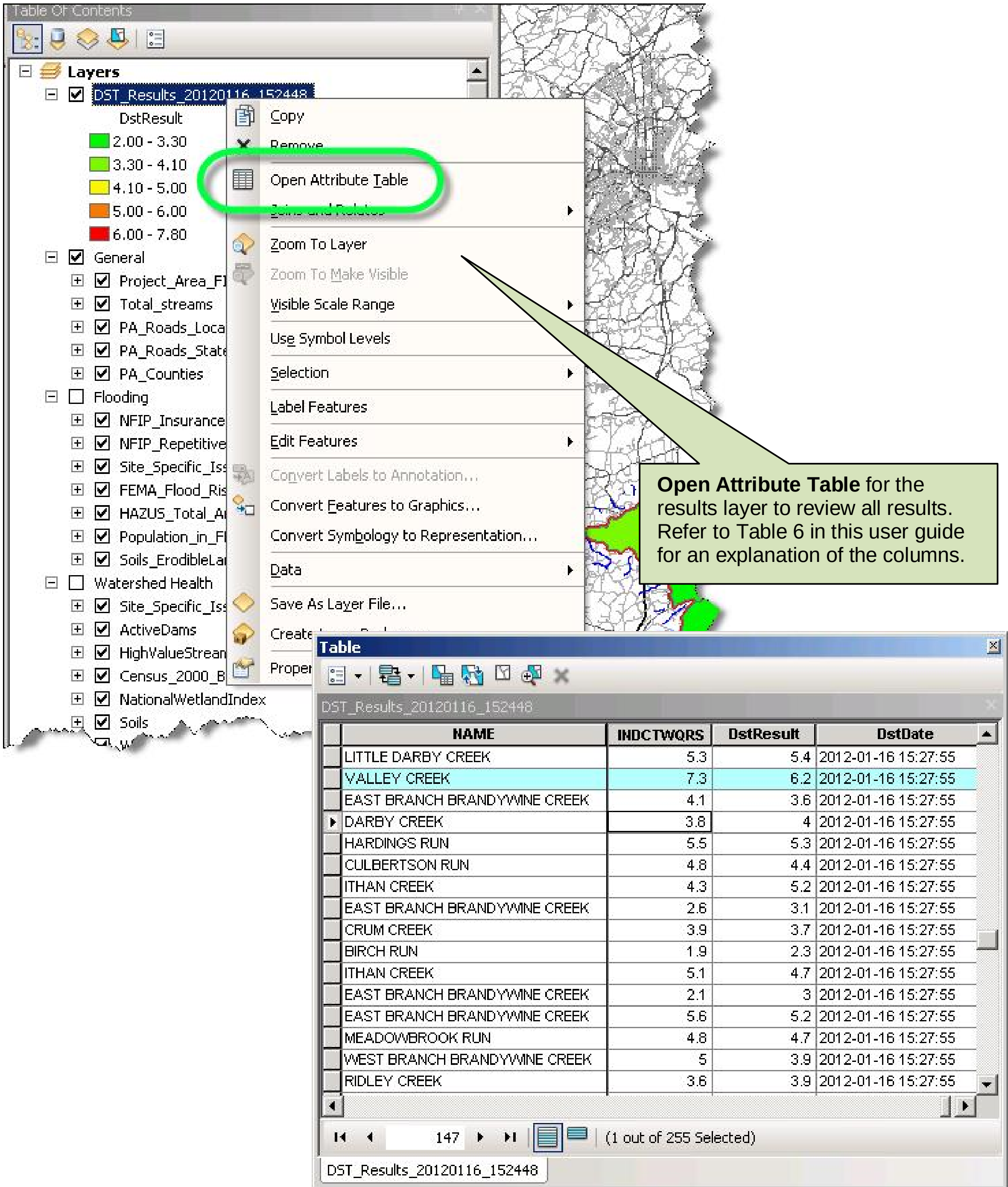


Run the DST



Review Results

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Layers
DST_Results_20120116_152448
DstResult
2.00 - 3.30
3.30 - 4.10
4.10 - 5.00
5.00 - 6.00
6.00 - 7.80
General
Total_streams
PA_Counties
Flooding
Watershed Health
ActiveDams
NationalWetlandIndex
Soils
Copy
Remove
Open Attribute Table
Zoom To Layer
Zoom To Make Visible
Visible Scale Range
Use Symbol Levels
Selection
Label Features
Edit Features
Convert Labels to Annotation...
Convert Features to Graphics...
Convert Symbology to Representation...
Data
Save As Layer File...
Open Attribute Table for the results layer to review all results. Refer to Table 6 in this user guide for an explanation of the columns.
Table
DST_Results_20120116_152448
NAME
INDCTWQRS
DstResult
DstDate
LITTLE DARBY CREEK 5.3 5.4 2012-01-16 15:27:55
VALLEY CREEK 7.3 6.2 2012-01-16 15:27:55
EAST BRANCH BRANDYWINE CREEK 4.1 3.6 2012-01-16 15:27:55
DARBY CREEK 3.8 4 2012-01-16 15:27:55
HARDINGS RUN 5.5 5.3 2012-01-16 15:27:55
CULBERTSON RUN 4.8 4.4 2012-01-16 15:27:55
ITHAN CREEK 4.3 5.2 2012-01-16 15:27:55
EAST BRANCH BRANDYWINE CREEK 2.6 3.1 2012-01-16 15:27:55
CRUM CREEK 3.9 3.7 2012-01-16 15:27:55
BIRCH RUN 1.9 2.3 2012-01-16 15:27:55
ITHAN CREEK 5.1 4.7 2012-01-16 15:27:55
EAST BRANCH BRANDYWINE CREEK 2.1 3 2012-01-16 15:27:55
EAST BRANCH BRANDYWINE CREEK 5.6 5.2 2012-01-16 15:27:55
MEADOWBROOK RUN 4.8 4.7 2012-01-16 15:27:55
WEST BRANCH BRANDYWINE CREEK 5 3.9 2012-01-16 15:27:55
RIDLEY CREEK 3.6 3.9 2012-01-16 15:27:55
147
(1 out of 255 Selected)
DST_Results_20120116_152448

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Revision History

Name	Date	Reason for Changes	Version
AECOM	March 21, 2012	Initial version	V 1.0
AECOM	August 1, 2012	Updates to DST	V 1.1

1. Overview

1.1 Project Background

The Chester, Delaware, and Montgomery Counties Regional Watershed Improvement Project is a collaboration of the U.S. Army Corps of Engineers (USACE) Philadelphia District and its local sponsor, the Pennsylvania Department of Environmental Protection (PA DEP). The goal of the project is to improve and protect surface water resources and environmental infrastructure in portions of Chester, Delaware, and Montgomery Counties through regional coordination and collaboration. This goal will be met through the prioritization and implementation of regional watershed improvement projects inside the three-county project area. The project area includes the portions of the Brandywine Creek, Direct-to-Delaware River tributaries, and the Schuylkill River watersheds that fall within Delaware, Chester, and Montgomery Counties.

1.2 Objectives for the Regional Watershed Development Decision Support Tool

The Regional Watershed Improvement Decision Support Tool (DST) is a GIS-based decision support tool used to identify priority areas for investment in watershed improvements. By using comprehensive data on existing conditions and input from stakeholders, the DST facilitates a thorough and objective assessment of issues facing the project area, while providing consistency in prioritizing watershed improvement efforts.

1.3 Acronyms, Abbreviations, and Terminology

The following abbreviations, acronyms, and terms are used in this document:

- DST – (Regional Watershed Improvement Project) Decision Support Tool
- FEMA – (United States) Federal Emergency Management Agency
- HUC – Hydrologic Unit Code, a standardized watershed classification system developed by the U.S. Geological Survey in the mid-1970s. Hydrologic units are watersheds organized in a nested hierarchy by size; the more digits included in the HUC, the smaller the watershed area (as HUC12 includes smaller, more finely divided watersheds than HUC10, and so on).
- NHD – National Hydrography Dataset. The NHD is a database of the stream segments or reaches that comprise the surface water system of the United States, including lakes, ponds, streams, rivers, canals, dams, and stream gages. This digital vector dataset interconnects and uniquely identifies these reaches. It was developed and is maintained by the U.S. Geological Survey.
- NLCD – National Land Cover Dataset
- NLT – Natural Lands Trust
- NRCS- National Resources Conservation Service
- PA – Pennsylvania

- PA DEP – Pennsylvania Department of Environmental Protection
- TMDL – Total Maximum Daily Load. Under section 303(d) of the Clean Water Act, States, territories, and authorized tribes are required to develop lists of impaired waters that are too polluted or otherwise degraded to meet the water quality standards set by these jurisdictions. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards.
- PennDOT – Pennsylvania Department of Transportation
- USACE – United States Army Corps of Engineers
- US EPA – United States Environmental Protection Agency
- USGS – United States Geological Survey

2. Installation and Setup

The DST operates as an extension to ArcMap, a part of ArcGIS for Desktop, the comprehensive GIS software package developed by Esri. To use the DST, you will need the following software:

- Version 10 ArcMap, "Standard" (ArcEditor) license level
- ArcGIS Spatial Analyst, an extension to ArcMap available through Esri

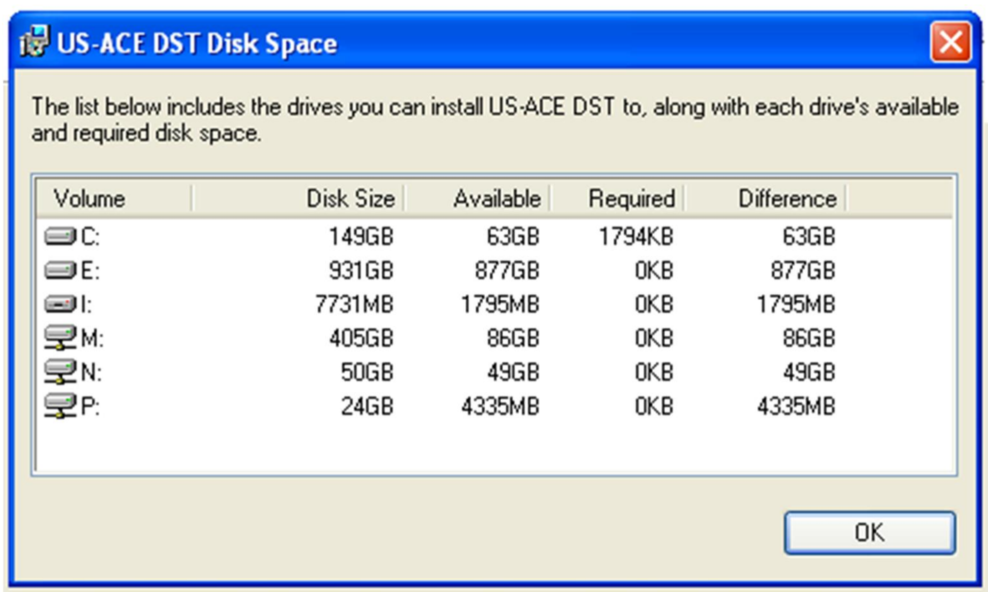
2.1 Installing the Software

Approximately 1.5 MB is required for the application. Installation is through a self-guided wizard that starts after opening the installer file.

2.1.1 Check for Sufficient Storage Space

To help you decide where to install the DST, click **Disk Cost** in the installation wizard. This displays a table of possible locations on your network where the DST could be installed. The table lists network volumes and available storage space, indicates which volumes have sufficient storage space for the DST, and calculates how much storage space would remain after installation of the DST.

Figure 1: Disk Cost Window



2.1.2 Determine if the DST will be Displayed to Everyone Using ArcMap on this Computer

If you select "just for me" when installing the DST, the DST will store the current username for the computer and compare it when opening ArcMap. If the name matches, the current ArcMap settings for the

DST will be displayed. So after you've enabled the DST and displayed its toolbar once, you will see it displayed each time you log in. However, the DST toolbar will not be displayed for anyone else logging in.

If you select "for everyone" and enable the DST, anyone logging into ArcMap on this computer will see the DST toolbar after you display it.

2.2 Saving the Dataset

After installing the software, you can copy the provided dataset to any location and extract the files for future use with the software. Approximately 300 MB is needed for this geodatabase.

2.3 Enabling and Displaying the Extension in ArcMap

After the software is installed, you will need to log into ArcMap and enable the extension in ArcMap. This process is illustrated in the Quick Start.

If you are using ArcMap over a shared server with a limited number of licenses and all of the available licenses are in use, you will not be able to open ArcGIS or use the DST. If Spatial Analyst has not been installed or if there are no licenses available for Spatial Analyst, an error will be displayed stating "A Spatial Analyst license is required."

After you enable the DST extension in ArcMap, remember to display the toolbar for the DST.

3. Using the DST

3.1 Using the Provided Dataset

A dataset that includes all data needed to determine prioritization scores is provided with the DST as an Esri file geodatabase. You can use the provided dataset by selecting the file named**:**

USACE_DecisionSupportTool_Data.gdb

If you select the provided geodatabase, the analysis extent is automatically limited to that of the Project_Area_FINAL feature class in the geodatabase. The default analysis extent has been defined as the entire area of Delaware County and portions of Chester and Montgomery Counties with additional minor areas of Lancaster, Bucks, and Philadelphia Counties. You can run the analysis on a different project area by developing and selecting an alternate Project_Area_FINAL feature class and accompanying input datasets.

The tool allows the user to select an analysis area feature layer that defines the extent, number, and size of analysis units for prioritization. Available default options include variations of the HUC watersheds and subsets of the Watersheds_ERRI_Small_2009 feature class. These subsets include feature classes for the Brandywine Creek, the Direct-to-Delaware Tributaries, the North Shore Schuylkill River, and the South Shore Schuylkill River. You can run the analysis with a different analysis area feature layer by selecting an alternate layer inside the DST. Due to the spatial resolution of the information in the geodatabase, analysis units less than 500 acres in area are not recommended.

When the provided geodatabase is selected, each indicator will be automatically correlated with the appropriate source feature layer. Table 1 presents details for the source feature layers. The DST will also automatically load all source feature layers correlated with indicators to the map.

Table 1: Summary of Provided Dataset

Feature Layer	Description	Source/ Provider	Data based on Year	Link	Type
GENERAL LAYERS					
Brandywine	Subset of the Watershed_ERRI_Small_2009 feature class representing the Brandywine Creek watershed.	Environmental Resources Research Institute, PA DEP/ Modified by AECOM[1]	2009	NA	Polygon feature class
Census_2000_Blocks Census_2010_Blocks	U.S. census blocks with population data	U.S. Census Bureau	2000/2010	www.census.gov	Polygon feature class
Direct_to_Delaware	Subset of the Watershed_ERRI_Small_2009 feature class representing the Direct-to-Delaware Tributaries' watershed.	Environmental Resources Research Institute, PA DEP/ Modified by AECOM[1]	2009	NA	Polygon feature class
NHD_PA_HUC8	Watershed boundaries for the 8-digit HUCs	USGS	2011	http://water.usgs.gov/GIS/huc.html	Polyline feature class
NHD_ PA_HUC10	Watershed boundaries for the 10-digit HUCs (subdivisions 8-digit HUCs)	USGS	2011	http://water.usgs.gov/GIS/huc.html	Polyline feature class
NHD_PA_HUC12	Watershed boundaries for the 12-digit HUCs (subdivisions of the 10-digit HUCs)	USGS	2011	http://water.usgs.gov/GIS/huc.html	Polyline feature class
NHD_Streams_PA	The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system.	USGS	2004	http://nhd.usgs.gov/	Polyline feature class
North_Shore_Schuylkill	Subset of the Watershed_ERRI_Small_2009 feature class representing the North Shore Schuylkill River watershed.	Environmental Resources Research Institute, PA DEP/ Modified by AECOM[1]	2009	NA	Polygon feature class
South_Shore_Schuylkill	Subset of the Watershed_ERRI_Small_2009 feature class representing the South Shore Schuylkill River watershed.	Environmental Resources Research Institute, PA DEP/ Modified by AECOM[1]	2009	NA	Polygon feature class

[1] EPCMR spatially joined PA DEP 104 Major Sheds, Act 167 Stormwater and PA River Basins layers and incorporated them into the attributes to show features as pieces of a bigger watershed. These boundaries enclose catchment areas for named streams officially recognized by the Board on Geographic Names and other officially named streams that flow through named hollows. Minor data cleanup procedures were performed in order to remove sliver polygons and resolve topological errors.

Table 1: Summary of Provided Dataset (continued)

Feature Layer	Description	Source/ Provider	Data based on Year	Link	Type
PA_Legislative	U.S. Congressional legislative boundaries within PA as set forth in Act 34 of 2002. This layer was digitized by PennDOT from maps generated by the Reapportionment Commission for the Bureau of Commissions, Elections and Legislation, PA Dept. of State. The current layers are district boundaries attributed with the current legislator's name, party affiliation, and home county.[2]	PennDOT	2011	http://www.pasda.psu.edu/	Polygon feature class
PA_Municipalities	Boundaries of municipalities within PA as delineated for the PennDOT Type 10 general highway maps. Additional information comes from the PA Bureau of Municipal Services.[3]	PennDOT	2011	http://www.pasda.psu.edu/	Polygon feature class
PA_Roads_Local	Public roads by county within PA. This field includes all identified public roads not maintained by PennDOT.	PennDOT	2011	http://www.pasda.psu.edu/	Polyline feature class
PA_Roads_State	State-owned and maintained roads within PA as extracted from the PennDOT Roadway Management System (RMS).	PennDOT	2011	http://www.pasda.psu.edu/	Polyline feature class
PA_Counties	County boundaries within PA as delineated for the PennDOT Type 10 general highway map.	PennDOT	2011	http://www.pasda.psu.edu/	Polygon feature class
Project_Area_FINAL	The limits of the study	USACE	2011	NA	Polygon feature class
Watershed_ERRI_Small_2009	ERRI Extracted, reprojected and edgematched datasets for major watersheds produced by the Water Resources Division of the USGS into this smallsheds coverage.[4] Modified by AECOM.	Environmental Resources Research Institute, PA DEP/ Modified by AECOM[4]	2009	NA	Polygon feature class

[2] These boundaries were used as the legislative district boundaries for the Nov. 2002 general election, but are currently being contested in the judicial system.
[3] This layer contains all classifications of municipality including first and second class townships, boroughs, cities, and towns.
[4] EPCMR spatially joined PA DEP 104 Major Sheds, Act 167 Stormwater and PA River Basins layers and incorporated them into the attributes to show features as pieces of a bigger watershed. These boundaries enclose catchment areas for named streams officially recognized by the Board on Geographic Names and other officially named streams that flow through named hollows. Minor data cleanup procedures were performed in order to remove sliver polygons and resolve topological errors.

Table 1: Summary of Provided Dataset (continued)

Feature Layer	Description	Source/ Provider	Data based on Year	Link	Type
LAYERS USED TO SCORE FLOODING INDICATORS					
NFIP_Insurance_Claims_2009	Point location of FEMA NFIP claims information up to and inclusive of the year 2009.	FEMA	2009	http://www.fema.gov	Point feature class
NFIP_RepetitiveLoss_2009	Point locations of FEMA NFIP repetitive loss properties up to and inclusive of the year 2009.	FEMA	2009	http://www.fema.gov	Point feature class
Site_Specific_Issues_Flooding	Stakeholder provided locations of site specific flood issues or recommendations for future projects.	AECOM	2011	NA	Point feature class
FEMA_Flood_Risk_CensusBlockGroup_Deciles	FEMA's Multi-Year Flood Hazard Identification Plan (MHIP) identifies flood risk on a block group level for the nation. Risk is indicated on a scale from 1-10 where 1 represents areas of highest risk.	FEMA	2008	http://www.fema.gov/plan/prevent/fhm/dl_mhip.shtm	Polygon feature class
HAZUS_Total_Annualized_Loss	Estimated potential average annual loss by census block. Data was generated by using the FEMA HAZUS-MH (Multi-Hazard) software, a standardized methodology that contains models for estimating potential losses from earthquakes, floods, and hurricanes.	FEMA	2012	http://www.fema.gov/plan/prevent/hazus/	Polygon feature class
Population_in_FEMA_Floodplain_AreaWeighted	US Census block data was intersected with FEMA floodplain data. The percentage value of each block that was spatially located within the floodplain area was multiplied by the total population value of the census block. This assumes an even distribution of people within the census block.	AECOM, using datasets from FEMA floodplain and Census data	2010	http://www.fema.gov and www.census.gov	Polygon feature class
Soils_ErodibleLand	Merged NRCS soil surveys detailing location of hydric soils and potential for erosion. The "hydricrating" field indicates which parts within the watershed area are hydric. The "muwathelcl" field indicates which parts within the watershed have high potential for erosion from water.	NRCS	Chester-2008; Delaware, Montgomery, Philadelphia- 2009; Bucks, Lancaster- 2008	http://soildatamart.nrcs.usda.gov	Polygon feature class

Table 1: Summary of Provided Dataset (continued)

Feature Layer	Description	Source/ Provider	Data based on Year	Link	Type
LAYERS USED TO SCORE WATERSHED HEALTH INDICATORS					
Site_Specific_Issues_Watershed_Health	Stakeholder provided locations of site specific watershed health issues or recommendations for future projects.	AECOM	2011	NA	Point feature class
ActiveDams	Dams that are under active maintenance.[5]	PA Fish and Boat Commission	2006	http://www.pasda.psu.edu/	Point feature class
HighValueStreams_DesignatedUse2010	Streams designated high quality or exceptional value which obtain or exceed their designated use as determined by PA DEP under Pennsylvania Code Chapter 93.	PA DEP	2010	http://www.pasda.psu.edu/	Polyline feature class
NationalWetlandIndex	The National Wetland Inventory (NWI) data clipped to the study area. The NWI dataset includes the extent, approximate location, and type of wetlands and surface waters as defined by Cowardin et al. (1979).[6]	U.S. Fish and Wildlife Service	2009	http://www.fws.gov/wetlands	Polygon feature class
Soils	Merged NRCS soil surveys detailing location of hydric soils and potential for erosion. The “hydricrating” field indicates which parts within the watershed area are hydric. The “muwathelcl” field indicated which parts within the watershed have high potential for erosion from water.	NRCS	Chester-2008; Delaware, Montgomery, Philadelphia-2009; Bucks, Lancaster-2008	http://soildatamart.nrcs.usda.gov	Polygon feature class
Watershed_Health_Impervious2006	Each pixel in the grid indicates the percentage of the 30m by 30m pixel that is impervious	NLCD	2006	http://www.mrlc.gov/finddata.php	Raster
Watershed_Health_RiparianBuffer_rblcrank	Rating of stream buffer quality on a scale from 0- 10, where 10 is the highest quality rating.	NLT	2006	http://www.pasda.psu.edu/	Raster
Watershed_Health_TreeCover	Each pixel in the grid indicates the percentage of the 30m by 30m pixel that is impervious	NLCD	2001	http://www.mrlc.gov/finddata.php	Raster

[5] Dams derived from point locations of the “Run-of-the-River” dams in PA, that is, dams that are regulated or permitted by the PA DEP pursuant to the act of Nov. 26, 1978 (PL 1375, No. 325), known as the Dam Safety and Encroachment Act. These are dams that: (1) are built across a river or stream for the purposes of impounding water where the impoundment at normal flow levels is completely within the banks and all flow passes directly over the entire dam structure within the banks, excluding abutments, to a natural channel downstream; and (2) PA DEP determines to have hydraulic characteristics such that at certain flows persons entering the area immediately below the dam may be caught in the backwash.

[6] Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the tidal and subtidal zones of estuaries and near shore coastal water. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery. By policy, the Service also excludes certain types of “farmed wetlands” as may be defined by the Food Security Act or that do not coincide with the Cowardin et al. definition.

Table 1: Summary of Provided Dataset (continued)

Feature Layer	Description	Source/ Provider	Data based on Year	Link	Type
Watershed_Health_Critical_Habitat_cressg	Rating of critical habitat quality on a scale from 0- 10, where 10 is the highest quality rating.	NLT	2006	http://www.pasda.psu.edu/	Raster
Watershed_Health_ImperviousChange2001_2006	Percentage of watershed converted to impervious from 2001 to 2006. Each pixel in the grid indicates the percentage of the pixel that is newly impervious	NLCD	2001, 2006	http://www.mrlc.gov/finddata.php	Raster
LAYERS USED TO SCORE WATER QUALITY INDICATORS					
Legacy_Dams	Point locations representing no longer active or legacy (removed) dams digitized from historical maps by the PA DEP.	PA DEP	2006	NA	Point feature class
Site_Specific_Issues_WaterQuality	Stakeholder provided locations of site specific water quality issues or recommendations for future projects.	AECOM	2011	NA	Point feature class
Water_Resources_2011_07_Degradation_83	Sources of water degradation. This dataset identifies point sources listed as DEP Water Resources Pollution Control Facilities (Active or Abandoned).	PA DEP	July 2011	http://www.pasda.psu.edu/	Point feature class
Total_streams	Streams meeting either attainment or nonattainment status	PA DEP	July 2011	http://www.pasda.psu.edu/	Polyline feature class
TMDL_Streams	Streams on the (PA) Streams Integrated List that have not attained its use(s) defined by the PA DEP (and therefore require TMDL limits). The layer is based on the NHD.[7] Pre-preprocessing of the original dataset was required to remove duplicate streams and overlapping TMDL status changes.	PA DEP Office of Water Management. Modified by AECOM to only include stormwater related TMDLs	July 2011	http://www.pasda.psu.edu/	Polyline feature class
SSOs_Municipality	Number of sanitary sewer overflows per municipality, a combination of data from the PA DEP and PennDOT. The original dataset was joined to the municipality layer.	PA DEP, PennDOT	2011	-	Polygon feature class
Agriculture_DVRPC_Lancast_LU	Land use dataset from the DVRPC.	Delaware Valley Regional Planning Commission	2005	-	Polygon feature class

[7] The Streams Integrated List compiles stream assessments in an integrated format for the Clean Water Act Section 305(b) reporting and Section 303(d) listing. PA DEP protects 4 stream water uses: aquatic life, fish consumption, potable water supply, and recreation.

Table 1: Summary of Provided Dataset (continued)

Feature Layer	Description	Source/ Provider	Data based on Year	Link	Type
WaterQuality_Sediment_tonsyr	Sediment load (in tons per year) was calculated using the Revised Universal Soil Loss Equation (RUSLE) equation and several input datasets, including land use, rainfall, topography, and soil characteristics [8].	AECOM, using datasets from PA DEP, USGS, NRCS, USEPA	July 2011	NA	Raster
WaterQuality_Annual_tn	Nitrogen load (in pounds per year) was calculated using the Simple Method developed by Schueler (1987) [9] and input datasets including runoff, land use, event mean concentration, and impervious land cover.	AECOM, using datasets from PA DEP, USGS	Various	NA	Raster
WaterQuality_Annual_tp	Nitrogen load (in pounds per year) was calculated using the Simple Method developed by Schueler (1987)[9] and input datasets including runoff, land use, event mean concentration, and impervious land cover.	AECOM, using datasets from PA DEP, USGS	Various	NA	Raster

[8] C and P factors for the RUSLE equation were retrieved from Integrated Land Management Inc., 1997. *Streamwatch Results and Landscape Factors*, White Clay Creek, Chester County Pennsylvania", Appendix A of the White Clay Creek River Management Plan. White Clay Watershed Association.
[9] Schueler, Thomas R., 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*. Washington Metropolitan Water Resources Planning Board, Washington D.C

3.2 Assigning Weights for Categories and Indicators

The weighted scores calculated by the DST are based on three categories of indicators: Flooding, Watershed Health, and Water Quality. The categories are weighted to assign different emphasis depending on your objectives. Within each category, there are various individual indicators that are also weighted.

You can control the weight assigned to each category and each individual indicator by selecting a default weighting approach before the run. The provided geodatabase includes five approaches to distributing weights, which are listed for comparison in Table 2. Watershed specific weighting factors are based on stakeholder feedback obtained during outreach meetings held by USACE and PADEP in 2011.

After you select a default weighting approach, you can adjust the weight for each category or the weight for individual indicators. The DST requires the sum of all weights for the three categories to be 100 and the sum of all indicator weights within each category to be 100.

If you edit the weights in the DST window and save the ArcMap project, the revised weights are saved with the .mxd file and will be the default setting when the ArcMap project is re-opened. However, weights that have been manually edited cannot be easily transferred to a different ArcMap project.

Table 2: Comparison of Default Weighting Approaches

Categories	Equal Approach	Direct-to-Delaware Approach	Brandywine Approach	North Shore Schuylkill Approach	South Shore Schuylkill Approach
Flooding	33.3	50	30	30	30
Watershed Health	33.3	25	35	30	35
Water Quality	33.4	25	35	40	35
Total for Category Weightings	**100**	**100**	**100**	**100**	**100**

Indicators	Equal Approach	Direct-to-Delaware Approach	Brandywine Approach	North Shore Schuylkill Approach	South Shore Schuylkill Approach
FLOODING					
NFIP Claims per Square Mile	14.3	10	10	10	10
FEMA Risk Decile	14.3	15	15	15	15
Average Annualized Flood Loss per Square Mile	14.3	20	20	20	20
Percent Population in Floodplain	14.3	10	10	10	10
Percent Highly Erodible Land	14.3	15	15	15	15
Repetitive Loss Properties per Square Mile	14.3	25	25	25	25

Indicators	Equal Approach	Direct-to-Delaware Approach	Brandywine Approach	North Shore Schuylkill Approach	South Shore Schuylkill Approach
Site Specific Flood Issues per Square Mile	14.2	5	5	5	5
Total for Flooding Indicators	**100**	**100**	**100**	**100**	**100**
WATERSHED HEALTH					
Percent Impervious	9.1	30	30	30	30
Population Density	9.1	10	10	10	10
Percent Wetlands	9.1	5	5	5	5
Percent Hydric Soils	9.1	5	5	5	5
Riparian Buffer Quality	9.1	15	15	15	15
Percent Tree Cover	9.1	10	10	10	10
Critical Habitat Quality	9.1	5	5	5	5
Percent of Stream Miles that are High Quality or Exceptional Value	9.1	5	5	5	5
Site Specific Watershed Health Issues per Square Mile	9.1	5	5	5	5
Percent Increase in Impervious Cover	9.1	5	5	5	5
Active Dams per Square Mile	9.0	5	5	5	5
Total for Watershed Health Indicators	100	100	100	100	100
WATER QUALITY					
Estimated Annual Sediment Loading per Square Mile	10	20	20	20	20
Estimated Annual Nitrogen Loading per Square Mile	10	10	10	10	10
Estimated Annual Phosphorus Loading per Square Mile	10	10	10	10	10
Percent of Stream Miles Impaired	10	25	25	25	25
Percent of Stream Miles with TMDL	10	5	5	5	5
Legacy Dams per Square Mile	10	7.5	7.5	7.5	7.5
Sanitary Sewer Overflows per Square Mile	10	7.5	7.5	7.5	7.5

Indicators	Equal Approach	Direct-to-Delaware Approach	Brandywine Approach	North Shore Schuylkill Approach	South Shore Schuylkill Approach
Site Specific Water Quality Issues per Square Mile	10	5	5	5	5
Percent Agricultural Land	10	0	0	0	0
Water Degradation Sources per Square Mile	10	10	10	10	10
Total for Water Quality Indicators	100	100	100	100	100

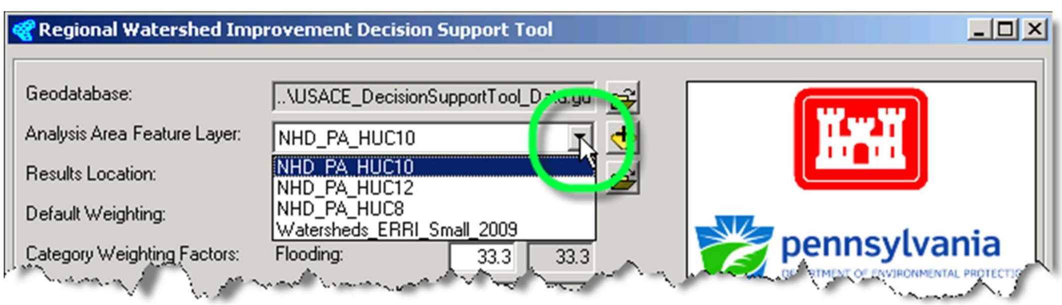
3.3 Using an Alternate Dataset or Alternate Layers

You can use an alternate dataset instead of using the provided dataset. The requirements for developing an alternate geodatabase are described in Section 4. To select an alternate geodatabase, click the open folder beside **Geodatabase** and select the alternate geodatabase in whichever folder it has been saved.

DST checks for the presence of required tables and layers in the geodatabase. If you attempt to select a geodatabase that does not include required tables or has become corrupted, DST will display an error message.

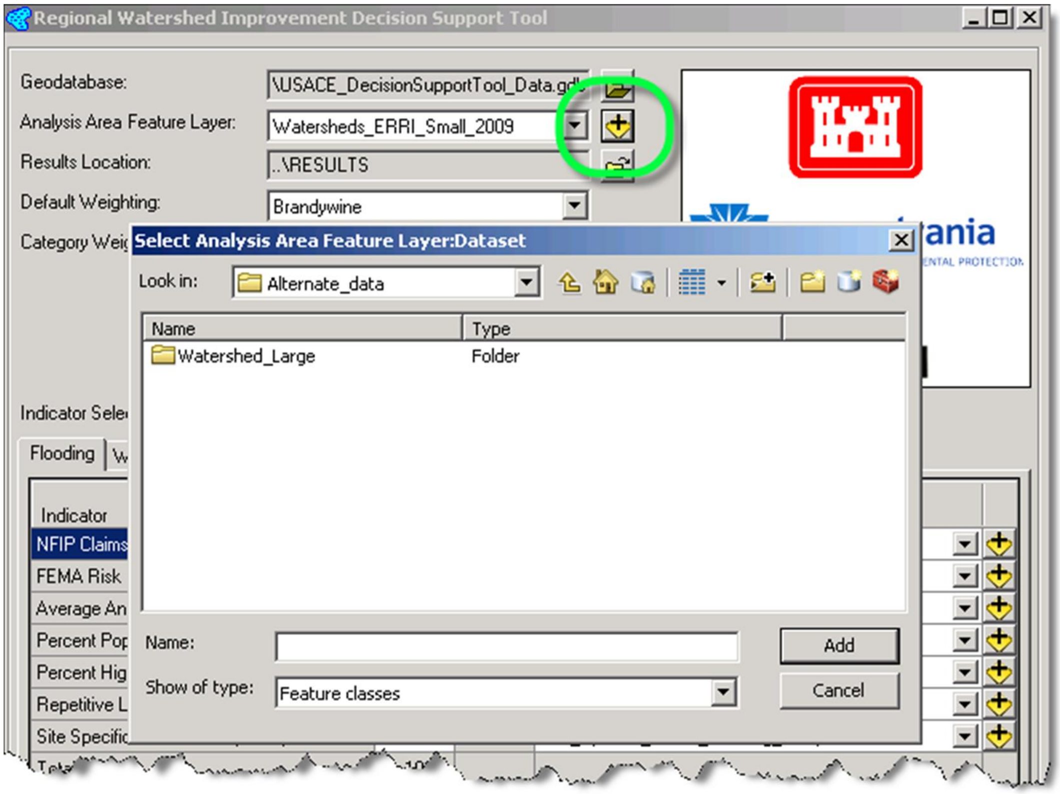
After selecting a geodatabase, you can change the default analysis area feature layer if needed. The drop-down arrow displays a list of provided alternative analysis area feature layers included in the geodatabase.

Figure 2: Selecting a Feature Layer within the Selected Source Geodatabase



You can also use a layer that has not been imported to the selected geodatabase. The **Add** button (shown in Figure 3) allows you to browse to a different geodatabase or individual layer.

Figure 3: Selecting a Feature Layer not in the Selected Source Geodatabase



If you select an alternate geodatabase, you may also need to select the appropriate feature layers, as described in Section 3.4, for individual indicators. Refer to Section 4 for details on how to develop an alternate geodatabase so that feature layers will automatically load and associate with indicators.

3.4 Correlating Indicators with Feature Layers

If you select the provided geodatabase, DST automatically correlates individual indicators with the appropriate feature layers in the geodatabase and loads these to the map. Feature layers in an alternate geodatabase may be named differently than those in the provided geodatabase and these will not be automatically correlated with indicators. (You can also change the default feature layers that are used to determine indicators.)

You can manually correlate an individual indicator to any feature layer in the geodatabase. Click the down arrow next the feature layer for the indicator to display a list of feature classes of the correct type (point, polyline, polygon. etc.) as shown in Figure 4.

Feature layers must include the fields used in DST as indicated in Table 5 in order to be correlated with indicators. DST will check for the presence of required fields by field name and data type.

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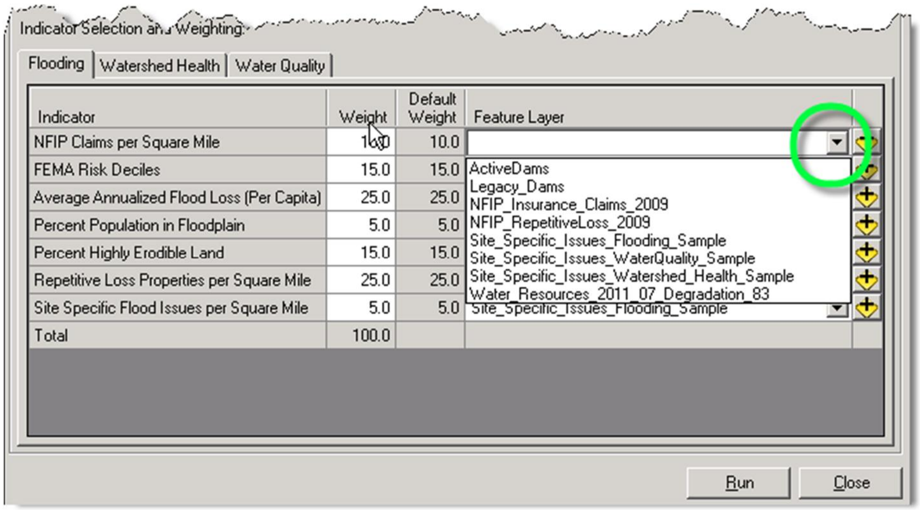
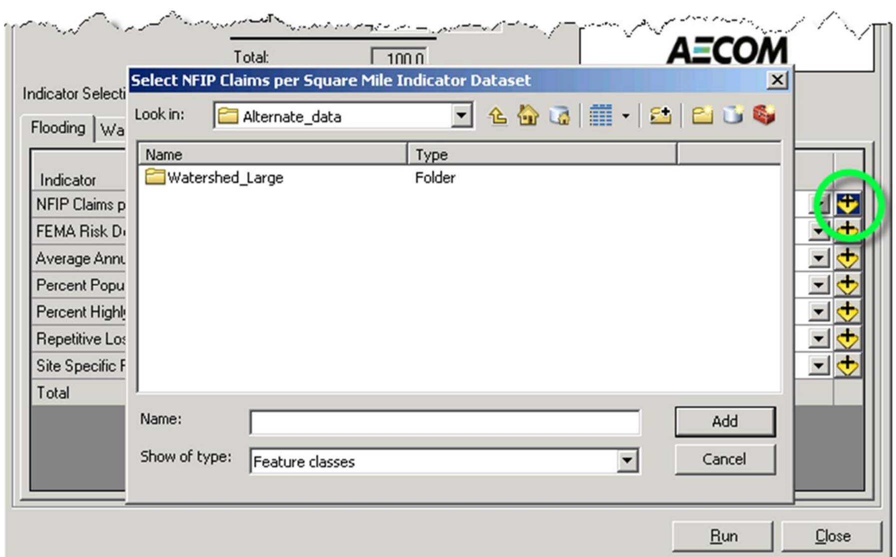
Figure 4: Correlating an Indicator with a Feature Layer in the Selected Geodatabase



You can also manually correlate individual indicators to feature layers that are not included in the selected geodatabase. For example, if you have different data on NFIP claims, you could prepare a feature layer with this information and select it for the indicator "NFIP Claims per Square Mile" by clicking the **Add** button, as shown in Figure 5.

Figure 5: Correlating an Indicator with a Feature Layer not in the Selected Geodatabase



3.5 Generating Results

After you initialize a DST run, the tool will display progress and which indicator is being processed, as well as the option to cancel the run. The DST calculates scores for each indicator, indicator category (flooding, watershed health, water quality), and total score for the selected geographical units. Individual indicators and how they are calculated are shown in Table 3. Normalization values are presented in Table 4. The overall process and codes for intermediate and final results are shown in Table 5.

Table 3: How the DST Determines Unnormalized Values for Individual Indicators

Name/Description	DST Approach	Provided Data Source(s)
GENERAL DATA		
Geographic units to be used in the analysis	1. Intersect the analysis area feature layer with the ‘Project_Area_FINAL’ feature class. 2. Analysis area feature layer is clipped to only include areas within ‘Project_Area_FINAL’ feature class.	Project_Area_FINAL
Unit population	1. Intersect the analysis area feature layer with the census blocks layer. 2. Add the populations for each census block that falls in an analysis unit.	Census_2010_Blocks Census_2000_Blocks (optional)
FLOODING INDICATORS		
NFIP Claims per Square Mile	1. Intersect the analysis area feature layer with the insurance claim layer. 2. Count the number of claim points within each analysis unit. 3. Divide the sum by the analysis unit area.	NFIP_Insurance_Claims_2009
FEMA Risk Decile	1. Intersect the analysis area feature layer with the FEMA Flood Risk layer. 2. Add the risk values (DENRISKDEC) within each analysis unit.	FEMA_Flood_Risk_Census BlockGroup_Deciles
Average Annualized Flood Loss per Square Mile	1. Intersect the analysis area feature layer with the HAZUS annualized loss layer. 2. Add the values for total loss (TotalLoss) within each analysis unit. 3. Divide the sum by the analysis unit area.	HAZUS_Total_Annualized_Loss
Percent Population in Floodplain	1. Intersect the analysis area feature layer with the FEMA floodplain population. 2. Add the values for area weighted population (AREA_POP) within each analysis unit. 3. Divide the sum by the analysis unit population. 4. Multiply by 100.	Population_in_FEMA_Floodplain _AreaWeighted
Percent Highly Erodible Land	1. Intersect the analysis unit feature layer with the soils layer. 2. Determine the area where muwathelcl = 'Highly erodible land' OR muwathelcl = 'Potentially highly erodible land' within each analysis unit. 3. Divide the area by the total area of the analysis unit. 4. Multiply by 100.	Soils_ErodibleLand

Table 3: How the DST Determines Unnormalized Values for Individual Indicators (continued)

Name/Description	DST Approach	Provided Data Source(s)
Repetitive Loss Properties per Square Mile	1. Intersect the analysis area feature layer with the 2009 NFIP repetitive loss layer. 2. Count the number of repetitive loss points within each analysis unit. 3. Divide the count by the total area of the analysis unit.	NFIP_RepetitiveLoss_2009
Site Specific Flood Issues per Square Mile	1. Intersect the analysis area feature layer with the site specific flood issues layer. 2. Add the importance values for all issues that fall within each analysis area. 3. Divide the sum by the total area of the analysis unit.	Site_Specific_Issues_Flooding
WATERSHED HEALTH INDICATORS		
Percent Impervious	1. Intersect the analysis area feature layer with the impervious raster data. 2. Calculate the mean value of the raster pixels within each analysis unit.	Watershed_Health_Impervious 2006
Population Density	1. Intersect the analysis area feature layer with the census blocks. 2. Add the population values within each analysis unit. 3. Divide by the total area of the analysis unit.	Census_2010_Blocks Census_2000_Blocks (optional)
Percent Wetlands	1. Intersect the analysis area feature layer with the National Wetland layer. 2. Add the areas of all wetlands within each analysis unit. 3. Divide by the total area of the analysis unit. 4. Multiply by 100.	NationalWetlandIndex
Percent Hydric Soils	1. Intersect the analysis area feature layer with the soils layer. 2. Determine the area where hydricrating = 'Yes' within each analysis unit. 3. Divide the hydricrating = ‘Yes’ areas by the total area of the analysis unit. 4. Multiply by 100.	Soils

Table 3: How the DST Determines Unnormalized Values for Individual Indicators (continued)

Name/Description	DST Approach	Provided Data Source(s)
Riparian Buffer Quality	1. Intersect the analysis area feature layer with the stream layer. Determine the total length of each stream that falls in each analysis unit. 2. Intersect each stream in the analysis unit with the riparian buffer layer. Determine the riparian value (0-10) and length by section. 3. Add the stream lengths for each riparian value (1-10). Divide each by the total stream length in the analysis unit. Multiply by the riparian value. 4. Add all the results.	Total_streams Watershed_Health_Riparian Buffer_rblcrank
Percent Tree Cover	1. Intersect the analysis area feature layer with the tree cover layer. 2. Calculate the mean value of raster pixels within each analysis unit.	Watershed_Health_TreeCover
Critical Habitat Quality	1. Intersect the analysis area feature layer with the critical habitat layer. 2. Calculate the mean value of raster pixels within each analysis unit.	Watershed_Health_Critical_ Habitat_cressg
Percent of Stream Miles that are High Quality or Exceptional Value	1. Intersect the analysis area feature layer with the streams layer. Determine the total length of all streams that fall in each analysis unit. 2. Intersect the analysis unit with the high value streams layer. Determine the total length of streams with MAP_SYMBOL not null. 3. Divide the sum from step 2 by the total length of all streams determined in step 1. 4. Multiply by 100.	Total_streams HighValueStreams_Designated Use2010
Site Specific Watershed Health Issues per Square Mile	1. Intersect the analysis area feature layer with the site specific watershed health issues layer. 2. Add the importance values for all issues that fall within each analysis unit. 3. Divide the sum by the total area of the analysis unit.	Site_Specific_Issues_Watershed _Health
Percent Increase in Impervious Cover	1. Intersect the analysis area feature layer with the layer for change in impervious cover. 2. Calculate the mean value of raster pixels within each analysis unit.	Watershed_Health_Impervious Change2001_2006
Active Dams per Square Mile	1. Intersect the analysis area feature layer with the active dams layer. 2. Count the number of active dam points within each analysis unit. 3. Divide by the analysis unit area.	ActiveDams

Table 3: How the DST Determines Unnormalized Values for Individual Indicators (continued)

Name/Description	DST Approach	Provided Data Source(s)
WATER QUALITY INDICATORS		
Estimated Annual Sediment Loading per Square Mile	1. Intersect the analysis area feature layer with the layer for estimated sediment loading. 2. Add the values within the analysis unit. 3. Divide by the analysis unit area in square miles.	WaterQuality_Sediment_tonsyr
Estimated Annual Nitrogen Loading per Square Mile	1. Intersect the analysis area feature layer with the layer for estimated nitrogen loading. 2. Add the values within the analysis unit. 3. Divide by the analysis unit area in square miles.	WaterQuality_Annual_tn
Estimated Annual Phosphorous Loading per Square Mile	1. Intersect the analysis area feature layer with the layer for estimated phosphorus loading. 2. Add the values within the analysis unit. 3. Divide by the analysis unit area in square miles.	WaterQuality_Annual_tp
Percent of Stream Miles Impaired	1. Intersect the analysis area feature layer with the stream layer. 2. Determine the length of non-attainment streams (‘Nonatt_mi’) within each analysis unit. 3. Determine the length of attainment streams (‘Attain_mi’) in each analysis unit. 4. Calculate non-attainment streams in each analysis unit (‘Nonatt_mi’ / ‘Nonatt_mi’ + ‘Att_mi’). 5. Multiply by 100.	Total_streams
Percent of Stream Miles with TMDL	1. Intersect the analysis area feature layer with the streams layer and determine the length of streams within each analysis unit. 2. Intersect the analysis area feature layer with the TMDL stream layer. Determine the length of TMDL streams within each analysis unit. 3. Calculate TMDL streams in each analysis unit (TMDL / total streams). 4. Multiply by 100.	Total_streams TMDL_Streams
Legacy Dams per Square Mile	1. Intersect the analysis area feature layer with the legacy dams layer. 2. Count the number of legacy dams that fall within each analysis unit. 3. Divide by the total area of the analysis unit.	Legacy_Dams

Table 3: How the DST Determines Unnormalized Values for Individual Indicators (continued)

Name/Description	DST Approach	Provided Data Source(s)
Sanitary Sewer Overflows per Square Mile	1. Intersect the analysis area feature layer with sanitary sewer overflows by municipality layer. 2. For each overlap, multiply the value in the SUM_COUNT field by the area of overlap with the analysis unit. 3. For each overlap, divide by the area of the sanitary sewer overflows polygon. 4. Sum the results for all overlaps.	SSOs_Municipality
Site Specific Water Quality Issues per Square Mile	1. Intersect the analysis area feature layer with the site specific water quality issues layer. 2. Add the importance values for all issues that fall within each analysis unit. 3. Divide the sum by the total area of the analysis unit.	Site_Specific_Issues_Watershed_Health
Percent Agricultural Land	1. Intersect the analysis area feature layer with the agricultural considerations layer. 2. Determine the area where LU_type = '10000' within each analysis unit. 3. Divide the area by the total area of the analysis unit. 4. Multiply by 100.	Agriculture_DVRPC_Lancast_LU
Water Degradation Sources per Square Mile	1. Intersect the analysis area feature layer with the layer for water degradation sources. 2. Count the number of points that fall within each analysis unit. 3. Divide result by the total analysis unit area.	Water_Resources_2011_07_Degradation_83

Table 4: Normalization Values for Indicators

Indicator	Normalization Values (Lower Limit)									
	1	2	3	4	5	6	7	8	9	10
FLOODING										
NFIP Claims per Square Mile	0	0.10	0.30	0.75	1.69	3.71	8.02	17.24	36.93	79.04
FEMA Risk Decile	0	1.45	1.96	3.03	5.26	9.95	19.78	40.36	83.47	173.80
Average Annualized Flood Loss per Square Mile	0	6.74	19.01	41.36	82.07	156.23	291.29	537.31	985.43	1,801.64
Percent Population in Floodplain	0	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	33.66
Percent Highly Erodible Land	0	25.00	50.00	75.00	80.00	81.50	83.00	84.50	86.50	90.01
Repetitive Loss Properties per Square Mile	0	0.07	0.19	0.41	0.82	1.56	2.91	5.37	9.84	17.99
Site Specific Flood Issues per Square Mile	0	0.05	0.10	0.17	0.26	0.37	0.51	0.68	0.89	1.15
WATERSHED HEALTH										
Percent Impervious	0	2.00	6.00	10.00	14.00	18.00	22.00	26.00	30.00	48.16
Population Density	0	169.56	251.28	391.47	631.96	1,044.49	1,752.17	2,966.15	5,048.66	8,621.08
Percent Wetlands	45.47	10.00	2.00	1.00	0.75	0.60	0.45	0.30	0.15	0
Percent Hydric Soils	29.19	12.00	9.00	5.50	3.50	3.25	2.25	1.25	0.75	0
Riparian Buffer Quality	9.01	8.01	7.01	6.01	5.01	4.01	3.01	2.01	1.01	0
Percent Tree Cover	66.02	45.00	40.00	35.00	30.00	14.00	9.00	5.00	3.00	0

Table 4: Normalization Values for Indicators (continued)

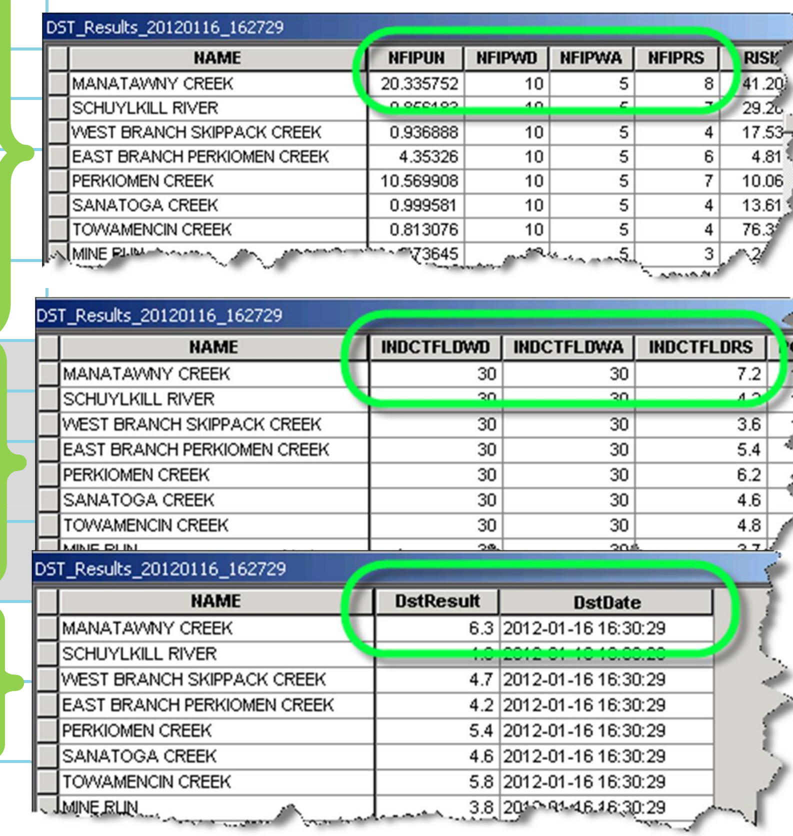
Indicator	Normalization Values (Lower Limit)									
	1	2	3	4	5	6	7	8	9	10
Critical Habitat Quality	9.01	8.01	7.01	6.01	5.01	4.01	3.01	2.01	1.01	0
Percent of Stream Miles that are High Quality or Exceptional Value	90.01	80.01	70.01	60.01	50.01	40.01	30.01	20.01	10.01	0.00
Site Specific Watershed Health Issues per Square Mile	0	0.06	0.13	0.21	0.31	0.43	0.57	0.74	0.94	1.19
Percent Increase in Impervious Cover	0	0.10	0.20	0.30	0.50	0.70	1.00	1.50	2.00	3.13
Active Dams per Square Mile	0	0.04	0.07	0.08	0.10	0.14	0.22	0.36	0.61	1.08
WATER QUALITY										
Estimated Annual Sediment Loading per Square Mile	0	573.53	872.07	1039.29	1337.83	1870.84	2822.49	4521.57	7555.11	12971.19
Estimated Annual Nitrogen Loading per Square Mile	0	630.66	681.68	762.47	890.42	1,093.05	1,413.93	1,922.08	2,726.81	4,001.19
Estimated Annual Phosphorus Loading per Square Mile	0	82.26	88.91	99.45	116.14	142.57	184.43	250.71	355.67	521.89
Percent of Stream Miles Impaired	0	10.01	20.01	30.01	40.01	50.01	60.01	70.01	80.01	90.01
Percent of Stream Miles with TMDL	0	10.01	20.01	30.01	40.01	50.01	60.01	70.01	80.01	90.01

Table 4: Normalization Values for Indicators (continued)

Indicator	Normalization Values (Lower Limit)									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Legacy Dams per Square Mile	0	0.13	0.21	0.27	0.36	0.49	0.67	0.92	1.29	1.82
Sanitary Sewer Overflows per Square Mile	0	0.0008	0.0027	0.01	0.02	0.05	0.13	0.31	0.79	1.98
Site Specific Water Quality Issues per Square Mile	0	0.06	0.13	0.21	0.31	0.43	0.57	0.74	0.94	1.19
Percent Agricultural Land	0	8.49	16.99	25.48	33.98	42.47	50.97	59.46	67.96	76.45
Water Degradation Sources per Square Mile	0	0.07	0.19	0.41	0.78	1.44	2.60	4.61	8.14	14.32

Table 5: How the DST Calculates and Stores Results

Step	Suffix for Results Table	Example	Example Column in Results Table
Perform all calculations to determine a value for an indicator (unnormalized value).	_UN	NFIP claims/square mile = 20.33	NFIPUN
Store default indicator weighting recommendation.	_WD	Default NFIP claims indicator weighting = 10	NFIPWD
Store user specified actual indicator weighting.	_WA	User specified NFIP claims indicator weighting = 5	NFIPWA
Assign a score (normalized value) between 1 and 10 to the unnormalized value based on the normalization distribution for that indicator.	_RS	Score for NFIP claims/square mile = 8	NFIPRS
Multiply the normalized score for the indicator by the user specified actual weighting as a percent.	---	Weighted score for NFIP claims/square mile = 8 x 5% = 0.4	Not displayed
Store default category weighting recommendation.	_WD	Default Flooding category weighting = 30	INDCTFLDWD
Store user specified actual category weighting.	_WA	User specified Flooding category weighting = 30	INDCTFLDWA
Add the weighted normalized indicator scores for all indicators in the category.	_RS	Total score for all Flooding indicators= 7.2	INDCTFLDRS
Multiply the category score by the user specified actual weighting for the category as a percent.	---	Weighted score for Flooding category = 7.2 x 30% = 2.16	Not displayed
Add the weighted scores for all categories.	---	Weighted Total Score for Manatawny Creek watershed = 6.3	DstResult
Record the date and time the analysis was performed.	---	Date and time run = 4:30 p.m. (16:30), Jan. 16, 2012 (2012-01-16)	DstDate


DST_Results_20120116_162729

NAME	NFIPUN	NFIPWD	NFIPWA	NFIPRS	RISK
MANATAWNY CREEK	20.335752	10	5	8	41.20
SCHUYLKILL RIVER	[illegible]	[illegible]	[illegible]	[illegible]	29.2
WEST BRANCH SKIPPACK CREEK	0.936888	10	5	4	17.53
EAST BRANCH PERKIOMEN CREEK	4.35326	10	5	6	4.81
PERKIOMEN CREEK	10.569908	10	5	7	10.06
SANATOGA CREEK	0.999581	10	5	4	13.61
TOWAMENCIN CREEK	0.813076	10	5	4	76.3
MINE RUN	[illegible]	[illegible]	5	3	[illegible]

DST_Results_20120116_162729

NAME	INDCTFLDWD	INDCTFLDWA	INDCTFLDRS
MANATAWNY CREEK	30	30	7.2
SCHUYLKILL RIVER	[illegible]	[illegible]	[illegible]
WEST BRANCH SKIPPACK CREEK	30	30	3.6
EAST BRANCH PERKIOMEN CREEK	30	30	5.4
PERKIOMEN CREEK	30	30	6.2
SANATOGA CREEK	30	30	4.6
TOWAMENCIN CREEK	30	30	4.8

DST_Results_20120116_162729

NAME	DstResult	DstDate
MANATAWNY CREEK	6.3	2012-01-16 16:30:29
SCHUYLKILL RIVER	[illegible]	[illegible]
WEST BRANCH SKIPPACK CREEK	4.7	2012-01-16 16:30:29
EAST BRANCH PERKIOMEN CREEK	4.2	2012-01-16 16:30:29
PERKIOMEN CREEK	5.4	2012-01-16 16:30:29
SANATOGA CREEK	4.6	2012-01-16 16:30:29
TOWAMENCIN CREEK	5.8	2012-01-16 16:30:29
MINE RUN	3.8	[illegible]

3.6 Viewing Results

Results are stored in their own layer in the selected geodatabase by default. However, you can specify that results will be stored in another geodatabase or as a separate shapefile. A dated results layer with a unique identity code is generated each time DST is run.

The results can be reviewed by using the Identify tool or opening the attribute table in ArcMap, as described in the Quick Start. These results can be exported to Microsoft Excel by choosing 'Export…" under the table options of the attribute table. Codes for intermediate and final results are shown in Table 6.

Table 6: Key to the Results Table

Code in Results Table	Description
SUFFIXES	
'indicator code'_UN	Unnormalized value for indicator
'indicator code'_WD	Default recommended weight for indicator
'indicator code'_WA	User specified weight for indicator
'indicator code'_RS	Normalized result for indicator
'category code'_WD	Default recommended weight for category
'category code'_WA	User specified weight for category
'category code'_RS	Sum of all weighted scores of indicators within this category
FLOODING CODES	
NFIP	NFIP Claims per Square Mile
RISK	FEMA Risk Decile
ALL	Average Annualized Flood Loss per Square Mile
POPFP	Percent Population in Floodplain
EROSION	Percent Highly Erodible Land
REPLOSS	Repetitive Loss Properties per Square Mile
FLDISSUE	Site Specific Flood Issues per Square Mile
INDCTFLD	Flooding Category
WATERSHED HEALTH CODES	
PCTIMP	Percent Impervious
POPDENS	Population Density

Code in Results Table	Description
PCTWTLND	Percent Wetlands
PCTHYDC	Percent Hydric Soils
RIPBUF	Riparian Buffer Quality
TREECVR	Percent Tree Cover
CRITHBT	Critical Habitat Quality
HGHVAL	Percent of Stream Miles that are High Quality or Exceptional Value
HLTHISS	Site Specific Watershed Health Issues per Square Mile
IMPCHGE	Percent Increase in Impervious Cover
ACTVDAM	Active Dams per Square Mile
INDCTWH	Watershed Health Category
WATER QUALITY CODES	
SDMENT	Estimated Annual Sediment Loading per Square Mile
NITRGN	Estimated Annual Nitrogen Loading per Square Mile
PHOSPH	Estimated Annual Phosphorous Loading per Square Mile
IMPRED	Percent of Stream Miles Impaired
TMDL	Percent of Stream Miles with TMDL
LEGADAM	Legacy Dams per Square Mile
PCT_SSO	Sanitary Sewer Overflows per Square Mile
WQISSUE	Site Specific Water Quality Issues per Square Mile
AGRCONS1	Percent Agricultural Land
WTRDGRD	Water Degradation Sources per Square Mile
INDCTWQ	Water Quality Category
OVERALL CODES	
DSTRESULT	Total score for that analysis unit
DSTDATE	Date and time that the results were calculated

4. Requirements for an Alternate Dataset (For Advanced Users)

An alternate dataset can be developed to analyze a different project area, assuming input datasets for that area are also provided. To set up an alternate geodatabase, you will need to add tables to store settings that the DST uses to process data, as well as feature classes or layers with the actual data. Since the DST validates the geodatabase before loading data, your geodatabase will need to meet certain standards.

1. The alternate geodatabase must be an Esri personal or file geodatabase.
2. The tables and domain listed in Table 7 must be included in the geodatabase. These tables should be copied from the provided database prior to customization.
3. Feature classes for Flooding, Watershed Health, and Water Quality Indicators – The feature classes used by indicators are not required to be imported to the geodatabase, as these can be selected from the DST window. However, if they are included in the geodatabase, you may want to populate the DefaultFeatureClassIndicator table so that each layer is automatically selected for the appropriate indicator. Whether or not these feature classes are included in the geodatabase, the feature layers must include the fields used in DST as indicated in Table 8 in order to be correlated with indicators. DST will check for the presence of required fields by field name and data type.

In addition to Table 7, you can use the form provided in Table 8 to record details of an alternate dataset and check that it meets the requirements for use in DST.

Table 7: Geodatabase Table/Domain Requirements

Name	Description	Required Fields	Required Field Type	Required Entries (feature must exist in geodatabase)
TABLES				
AnalysisFeatureClass	Stores the name of the layer(s) selected to provide geographic units for analysis (such as watersheds). Features listed here will be added to the ‘analysis area feature layer’ drop down menu.	FeatureClass	String	May be null initially as this can be selected in the DST browser window
CategoryWeighting	Stores one or more weighting approaches for categories. You can create and populate this table by copying this table from the provided geodatabase.	CategoryID WeightingID WeightingValue	Integer Integer Double	Similar structure to provided dataset required

Name	Description	Required Fields	Required Field Type	Required Entries (feature must exist in geodatabase)
DefaultFeatureClassGeneral	Stores the names of general layers that must exist in the geodatabase and corresponding dataset feature class name.	GeneralDataID FeatureClass	Integer String	Project Area → Corresponding feature class Population → Corresponding feature class Streams → Corresponding feature class
DefaultFeatureClassIndicator	Stores the names of layers that are correlated with indicators by default.	Category ID IndicatorID FeatureClass	Integer Integer String	May be null or match layer names
IndicatorWeighting	Stores one or more weighting approaches for indicators. You can create and populate this by copying the table from the provided geodatabase.	CategoryID IndicatorID WeightingID WeightingValue	Integer Integer Integer Double	Similar structure to provided dataset required
Normalization	Stores ranges of normalization factors to be applied to raw values for indicators.	CategoryID IndicatorID LowerLimit Score	Integer Integer Double Double	Similar structure to provided dataset required
DOMAIN				
D_Category	Stores the names of the each category.	ID Value	Integer Text	Similar structure to provided dataset
D_GeneralData	Stores the names of general datasets to be loaded into the Table of Contents.	ID Value	Integer Text	Similar structure to provided dataset
D_Indicator	Stores the names of indicator datasets to be loaded into the Table of Contents.	ID Value	Integer Text	Similar structure to provided dataset
D_IndicatorCategory	Stores the name of each category.	ID Value	Integer Text	Similar structure to provided dataset

Name	Description	Required Fields	Required Field Type	Required Entries (feature must exist in geodatabase)
D_Weighting	Stores the names of the weighting approaches in the CategoryWeighting and IndicatorWeighting tables so that an approach can be selected in the DST drop down window.	ID Value	Integer Text	Similar structure to provided dataset

Table 8: Description of Data Requirements for an Alternate Dataset

Input Data	Feature Layer Name	Description	Type	Required Fields	Field Value/Units
GENERAL DATA					
Analysis Area Extent	Name must match the name in table DefaultFeatureClassGeneral	Single polygon describing the limits of the analysis area	Polygon feature class	N/A	NA
Complete Streams Data (used in various indicators)	Name must match the name in table DefaultFeatureClassGeneral	Stream sections with information on impaired stream status (can be same as streams data used in Water Quality)	Polyline feature class	Nonatt_mi Attain_mi	Miles of non attaining stream Miles of attaining stream
Unit Population (used in various indicators)	Name must match the name in table DefaultFeatureClassGeneral	Population data by census block	Polygon feature class	POPULATION	Number of people
Geographic Analysis Units Feature Class	NA	Geographic units to be used in the analysis	Polygon feature class	N/A	NA
FLOODING					
NFIP Claims	NA	NFIP insurance claims	Point feature class	NA	NA
FEMA Risk Decile	NA	FEMA risk class by area	Polygon feature class	DENRISKDEC	Decile Value (1-10)
Average Annualized Flood Loss per Square Mile	NA	Estimated average potential annual loss by area	Polygon feature class	TotalLoss	Total Loss (dollars) determined by HAZUS divided by 1000
Percent Population in Floodplain	NA	Population in floodplain	Polygon feature class	AREA_POP	Population in floodplain

Table 8: Description of Data in Alternate Dataset (continued)

Input Data	Feature Layer Name	Description	Type	Required Fields	Field Value/Units
Percent Highly Erodible Land	NA	Highly erodible or potentially highly erodible soils (can be same soils layer used in Watershed Health)	Polygon feature class	muwathelcl ='highly erodible land' OR 'Potentially highly erodible land'	NA
Repetitive Loss Properties per Square Mile	NA	Cumulative repetitive loss reports	Point feature class	NA	NA
Site Specific Flood Issues per Square Mile	NA	Site specific issues related to flooding	Point feature class	Importance	Typically 1. Can use higher numbers to increase weight.
WATERSHED HEALTH					
Percent Impervious	NA	Percent impervious cover	Raster	NA	Percent impervious per raster cell
Population Density	NA	Population data by census block	Polygon feature class	POPULATION	Number of people
Percent Wetlands	NA	Wetlands	Polygon feature class	NA	NA
Percent Hydric Soils	NA	Hydric soils (can be same soils layer used in Flooding)	Polygon feature class	hydricrating = 'yes'	NA
Riparian Buffer Quality	NA	Riparian stream buffer quality assessment	Raster	NA	1-10 as determined by the Natural Lands Trust
Percent Tree Cover	NA	Percent tree cover	Raster	NA	Percent tree cover per raster cell
Critical Habitat Quality	NA	Critical habitat quality assessment	Raster	NA	1-10 as determined by the Natural Lands Trust

Table 8: Description of Data in Alternate Dataset (continued)

Input Data	Feature Layer Name	Description	Type	Required Fields	Field Value/Units
Percent of Stream Miles that are High Quality or Exceptional Value	NA	Designated uses per stream segment	Polyline feature class	MAP_SYMBOL not null	NA
Site Specific Water Quality Issues per Square Mile	NA	Site specific issues related to watershed health	Point feature class	Importance	Typically 1. Can use higher numbers to increase weight.
Percent Increase in Impervious Cover	NA	Percentage converted to impervious over a specified period of time	Raster	NA	Percent impervious per raster cell
Active Dams per Square Mile	NA	Active dams	Point feature class	NA	NA
WATER QUALITY					
Estimated Annual Sediment Loading per Square Mile	NA	Tons of sediment per year per square mile	Raster	NA	Tons/yr per raster cell
Estimated Annual Nitrogen Loading per Square Mile	NA	Pounds of nitrogen per year per square mile	Raster	NA	Lbs/yr per raster cell
Estimated Annual Phosphorus Loading per Square Mile	NA	Pounds of phosphorus per year per square mile	Raster	NA	Lbs/yr per raster cell

Table 8: Description of Data in Alternate Dataset (continued)

Input Data	Feature Layer Name	Description	Type	Required Fields	Field Value/Units
Percent of Stream Miles Impaired	NA	Stream sections with information on impaired stream status (can be same as streams data used in General Data)	Polyline feature class	Nonatt_mi Attain_mi	Miles of non-attaining stream Miles of attaining stream
Percent of Stream Miles with TMDL	NA	Stream sections with established stormwater related TMDLs	Polyline feature class	NA	NA
Legacy Dams per Square Mile	NA	Inactive or legacy (removed) dams	Point feature class	NA	NA
Sanitary Sewer Overflows per Square Mile	NA	Number of sanitary sewer overflows per square mile	Polygon feature class	SSO_Count	Number of Sanitary Sewer Overflows
Site Specific Water Quality Issues per Square Mile	NA	Site specific issues related to water quality	Point feature class	Importance	Typically 1. Can use higher numbers to increase weight.
Percent Agricultural Land	NA	Landuse polygon data with attribute indicating agricultural land use	Polygon feature class	LU_type =’10000’	NA
Water Degradation Sources per Square Mile	NA	Sources of water degradation	Point feature class	TYPE = ‘DEGRATION’ or ‘PROTECTION’	NA