

WHAT IS EDC CHANGE?

EDC CHANGE is a FHWA initiative that promotes the use of two-dimensional (2D) hydraulic modeling technologies, which include graphics and visualization software tools that enable hydraulic engineers to more effectively communicate results of complex hydraulic analysis to a broad audience.

WHAT MODELING TECHNOLOGIES AND SOFTWARE TOOLS ARE BEING PROMOTED?

SRH-2D is a two-dimensional hydraulic program that was developed by Dr. Yong Lai and the Bureau of Reclamation. The program has proven to be robust and stable and handles steady and unsteady flows as well as sub and supercritical flows. It supports varied boundary conditions, hydraulic structures, and includes sediment transport capabilities.

SMS (Surface-water Modeling System) is a graphical user interface that supports a wide range of riverine and coastal models including SRH-2D. The software includes many advanced tools used to create and refine SRH-2D models along with a 2D and 3D visualization environment for evaluating model solutions and preparing graphical presentations.

WHAT COMMUNITY (FREE) AND COMMERCIAL PRODUCTS ARE AVAILABLE?

SMS with SRH-2D is offered as a community (free) version as well as a full version that has no limitations and includes technical support. The full version of the software is available through sponsored licenses for State DOT's or as a commercial license. The full version also offers advanced mesh editing tools, allows for multiple simulations, and features a variety of other capabilities that make 2D modeling easier. SMS offers the most advanced and refined pre- and post-processing environment for SRH-2D models available.

RESOURCES:

SMS/SRH-2D Download:

www.aquaveo.com/downloads/sms

2D hydraulic modeling tutorials:

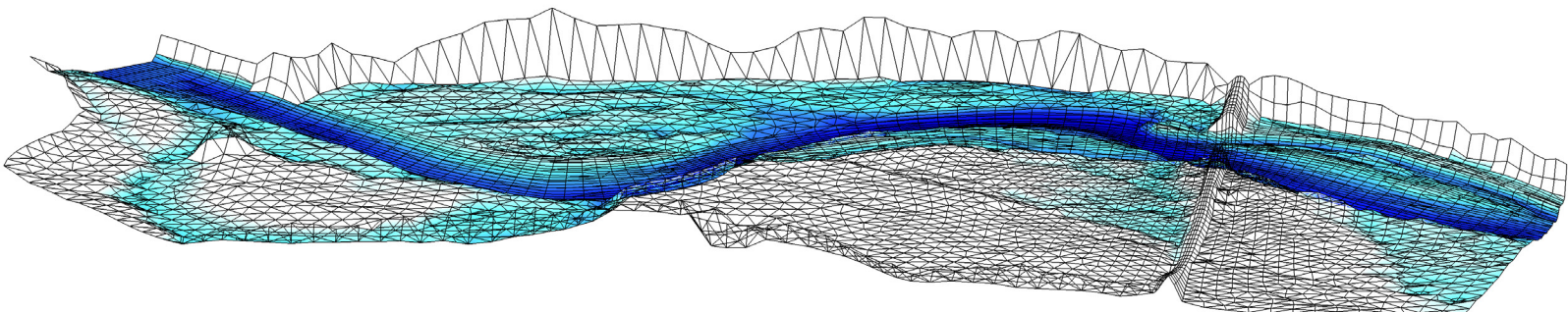
www.aquaveo.com/software/sms-learning

SMS/SRH-2D user's guide:

www.xmswiki.com/wiki/SMS:SMS

SMS/SRH-2D commercial licensing:

www.aquaveo.com/software/sms-pricing



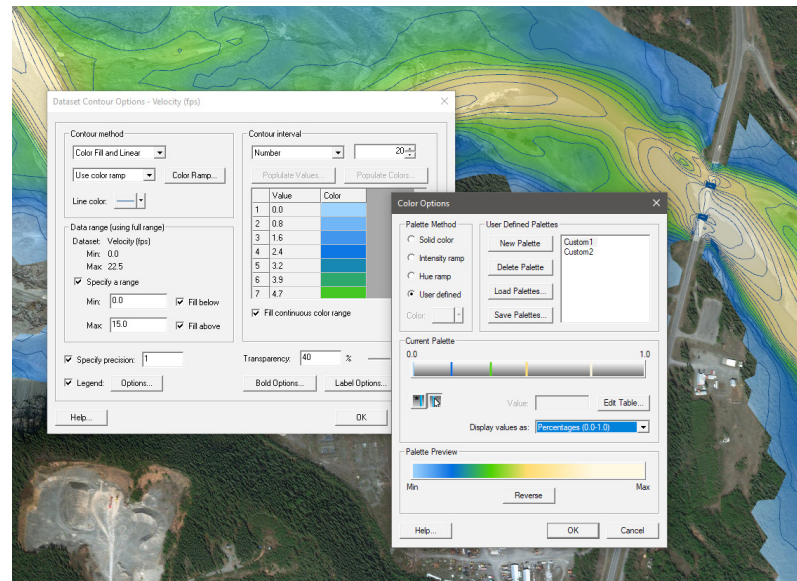
SMS & SRH-2D Graphical Visualization: Contour Scalar Data

QUICKLY CONVEY MODEL RESULTS USING CONTOURS

SMS can be used to visualize a variety of scalar datasets using contours. Contours are a graphical representation of data that can be displayed at a point in time or in series to show change over a period of time.

Scalar datasets include flood depths and extents, changes in water surface elevation, or variations in velocity magnitude. Separate contours may be specified for each dataset.

SMS includes a wide range of contour options that are highly customizable. Results are presented in a 3D environment where static and dynamic images may be created for print and digital presentations.



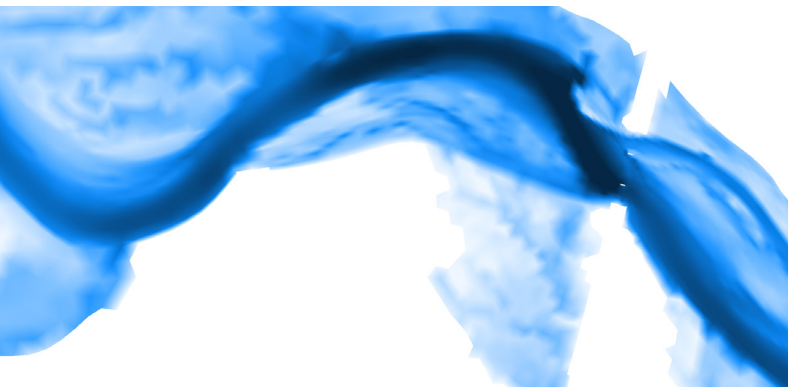
SMS Contour Options

CONTOUR OPTIONS:

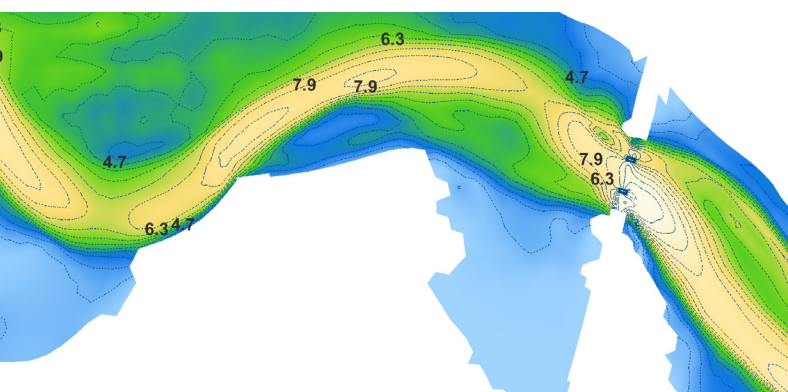
- Apply color-filled, linear, or combined contours to specific scalar datasets.
- Specify the transparency level of each contour from 0% to 100% revealing map data below.
- Efficiently convey model results through user-defined palettes with custom color ramps.
- Add contour labels with options to specify color, font, size, orientation, and spacing.
- Add contour specific legends with options to specify title, color, font, size, and location.

RESOURCES:

xmswiki.com/wiki/SMS:Contour_Options



Depth Contour - dataset specific contour with color fill

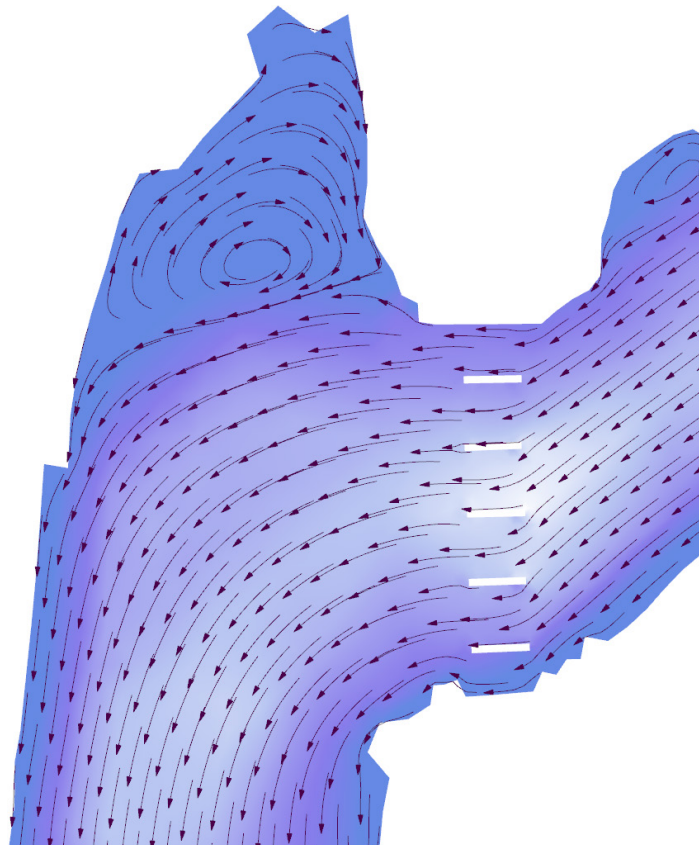


Velocity Contour - color fill and linear contour with labels

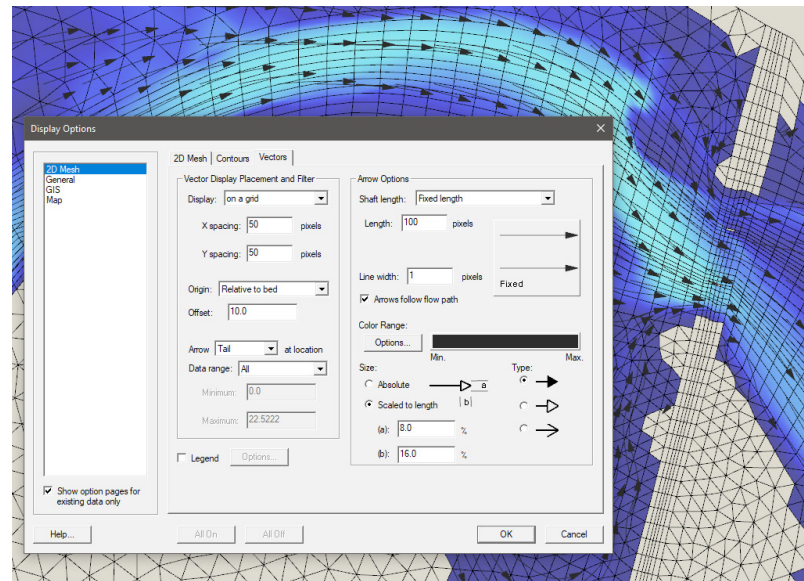
QUICKLY CONVEY MODEL RESULTS USING VECTORS

Just like contours, SMS can be used to visualize a variety of scalar datasets using vectors. In fact, SMS can generate contours from a vector dataset. Vectors are a graphical representation of data that can be displayed at a point in time or in series to show change over a period of time.

Vectors can help identify flow paths and patterns. This helps recognize recirculation zones, flow contraction & expansion and flow distributions for split flows. Vectors can also be used to determine flow approach angles at bridge piers for scour analysis.



Velocity Vector - color fill contour with vectors



SMS Vector Options

VECTOR OPTIONS:

- Apply vector datasets as arrows with constant size or vary the arrow size by magnitude.
- Specify a range of magnitudes or display all vector.
- Color the vector datasets by magnitude or display vectors as a solid color.
- Vary the density of vectors displayed to meet presentation needs based on the number of datapoints and the zoom level.
- Specify the origin of the vector relative to bed, max elevation, or absolute elevation.
- Optimize vector placement by modifying the z-offset moving arrows above the geometry.

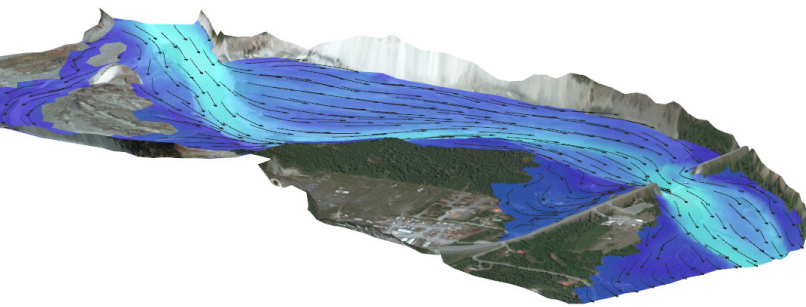
RESOURCES:

xmswiki.com/wiki/SMS:Vector_Display_Options

SMS & SRH-2D Graphical Visualization: Texture Mapping, Lighting, & Functional Surfaces

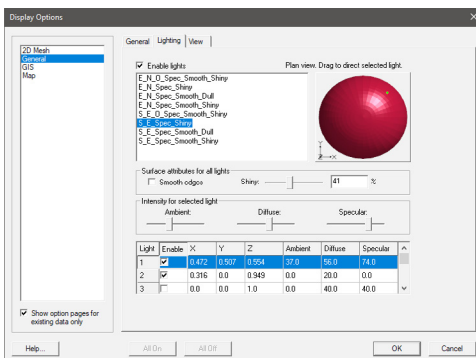
TEXTURE MAPPING

Texture mapping allows the map or photo to be referenced in relation to the topography or surface of the model domain offering visual references as to model location. Scanned maps or aerial photos can be texture mapped or draped over the top of a mesh, TIN, or grid. The first image listed in the project explorer may be used in jpg, tif, or png format.



LIGHTING OPTIONS:

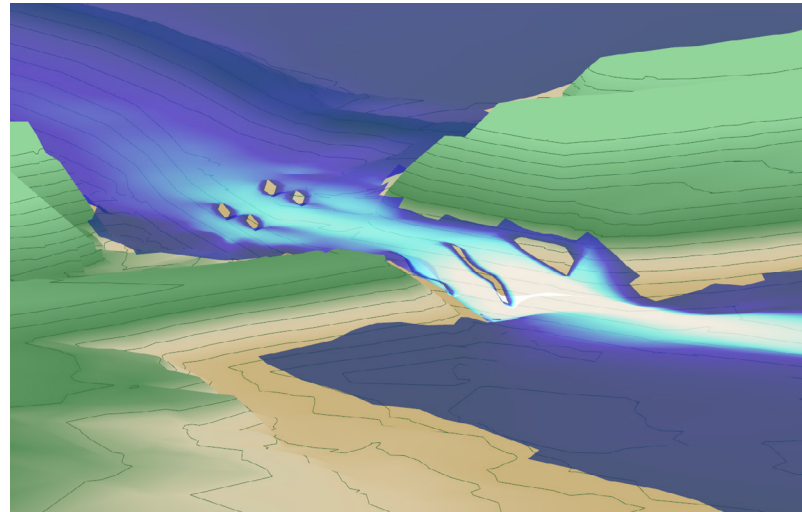
The lighting options dialog allows control over the lighting and shading of objects such as elements, cells, and triangles that cover a three dimensional entity. A light source is used allowing control over light direction. Intensity sliders offer adjustments over ambient light amount as well as diffuse and specular adjustments. Multiple lighting schemes may be created to refine the model presentation and more accurately convey model results.



FUNCTIONAL SURFACES:

Data from the surface of a mesh, grid, or TIN may be displayed as a functional surface. The surface may represent an actual physical surface such as the water surface over a model's bathymetry, but it can also represent the velocity magnitude, or concentration, or any other scalar quantity.

- A z-offset may be specified to place the functional surface at its real value, relative to the bathymetry, or another specified offset.
- Functional surfaces may also be scaled or magnified to more easily convey slight changes.
- Functional surfaces can be displayed as solid colors or color contoured with transparency adjustment.



Velocity contours mapped to the water surface elevation ("holes" in the surface represent bridge piers)

RESOURCES:

xmswiki.com/wiki/SMS:General_Display_Options

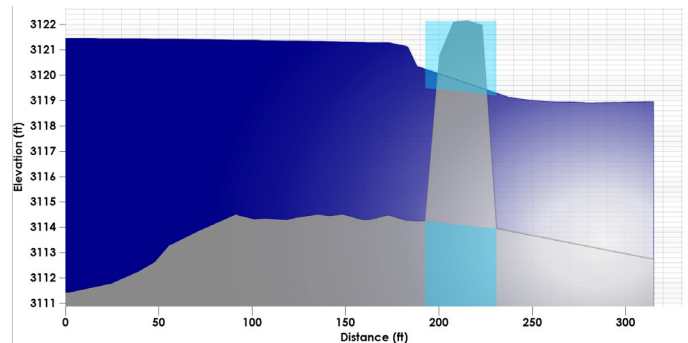
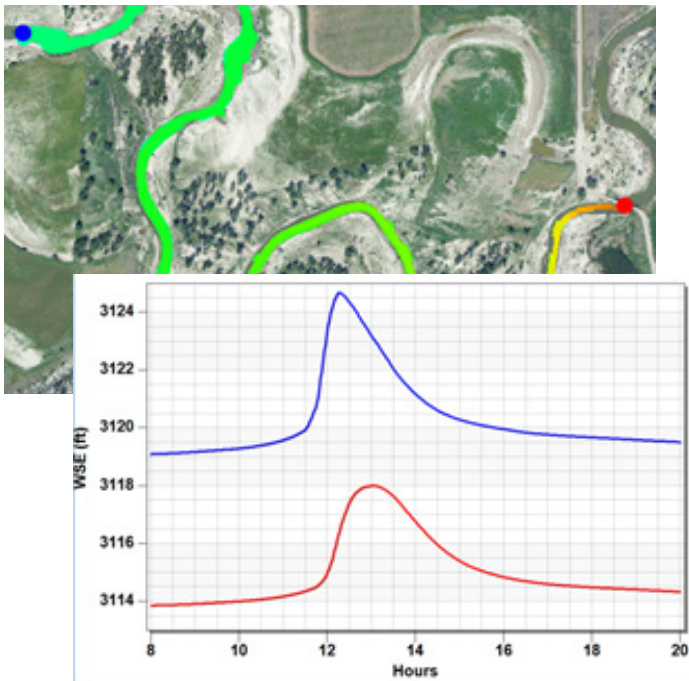
xmswiki.com/wiki/SMS:Functional_Surfaces

VISUALIZE DATA WITH PLOTS

In SMS, the Plot Window can be used to display various plots. Using the Plot Wizard, 2D plots can be created to aid in extracting and displaying model solution or other datasets, or creating plots to help visualize model calibration.

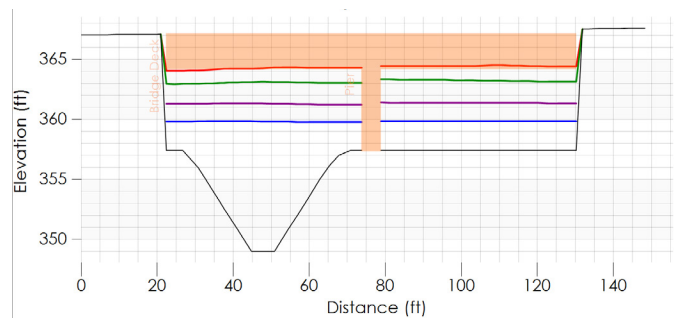
TIME-SERIES PLOTS:

For transient simulations, values for any scalar dataset can be plotted vs. time at a single point in the model. Points can be created anywhere and data is interpolated from the model results at that point. Time-series plots can include multiple points plotted for the same time interval. This can be useful for things such as showing the lag of a hydrograph from two points along a river reach, or plotting variations in coastal surges at various points.



PROFILE PLOTS:

Using an Observation coverage in SMS, arcs can be created to extract and plot data from the model. Observation Profile plots can be generated representing data along the arcs. Points on the arc are created at intersections of the arc with model element edges. For a single plot one or more datasets can be specified and multiple arcs can be plotted in the same plot window. A Plot Data coverage can be created to define the location and depth of features such as bridge decks or culverts which are then represented in the profile plot.



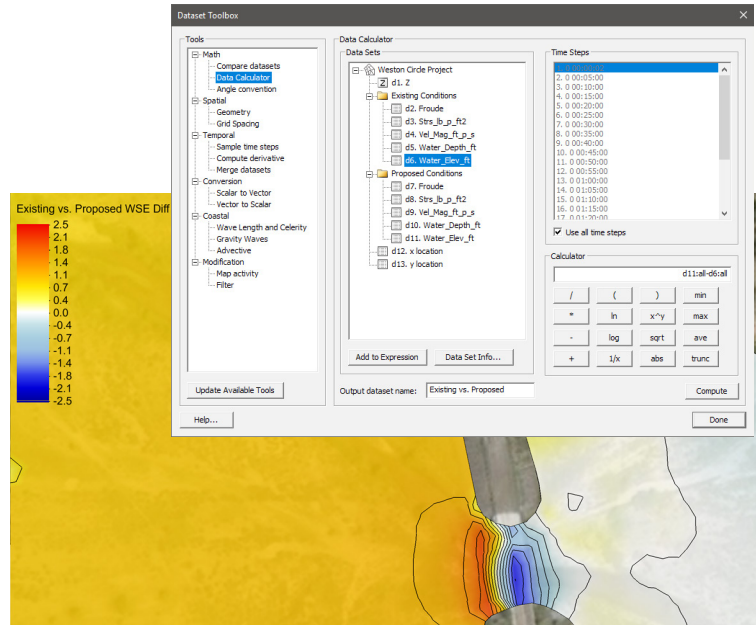
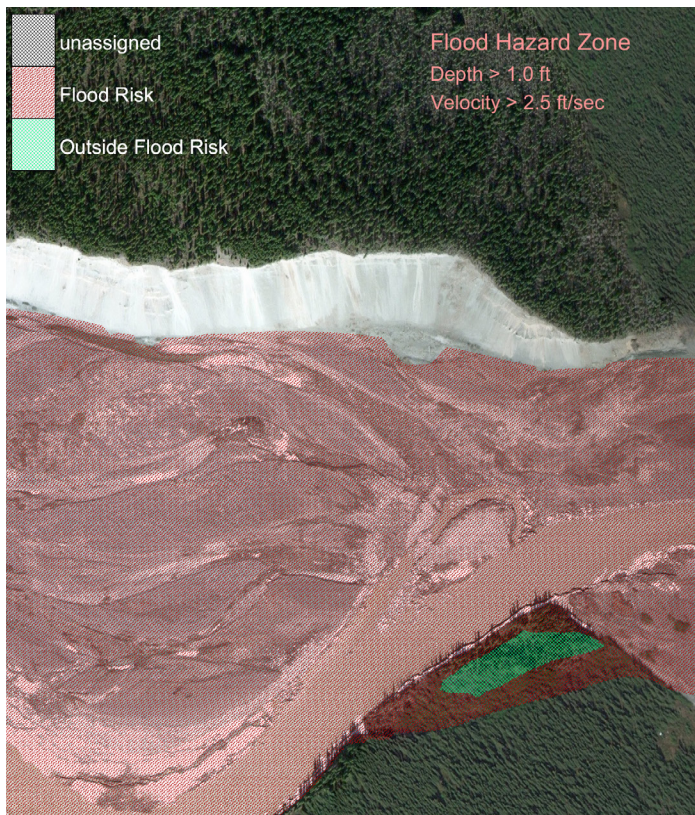
RESOURCES:

xmswiki.com/wiki/SMS:Plot_Window

SMS & SRH-2D Graphical Visualization: Zonal Classification & Dataset Toolbox

ZONAL CLASSIFICATION

Zonal classification is a tool that will identify polygonal areas that meet a set of criteria. The criteria can be based upon scalar dataset values and/or specific material id's in a coverage. A zone may contain one or more criteria such as a range of depths and also a range of velocities. SMS creates a coverage with polygons created enclosing all areas that meet the specified criteria. For example, zonal classification can be used to identify areas where water depths are above and velocities are below specified values corresponding to fish passage criteria, or perhaps identifying zones where water depths and velocities are below threshold amounts to help evaluate flood risk.



DATASET TOOLBOX

The dataset toolbox is a suite of tools for analyzing, comparing, and creating datasets. Among the tools is a data calculator for performing mathematical operations using entire datasets as arguments. Additional features include tools for filtering data, mapping activity, computing derivatives, and sampling time steps. One common application of the data calculator is to create datasets showing the difference between existing and proposed conditions or between different boundary condition events.

RESOURCES:

xmswiki.com/wiki/SMS:Zonal_Classification

xmswiki.com/wiki/SMS:Dataset_Toolbox

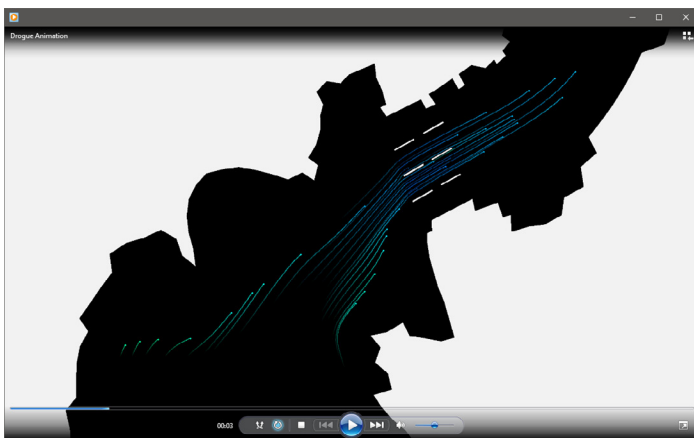
xmswiki.com/wiki/SMS:Data_Calculator

SHOW CHANGES IN TIME WITH ANIMATIONS

Several types of animations or film loops can be generated from model solutions in SMS. Transient data shows changes in time with the use of contour and vector data. Multiple view animations show change over time from a variety of perspectives by changing the bearing and dip of the animation. Additionally, plot window animations can show plots changing through time as well.

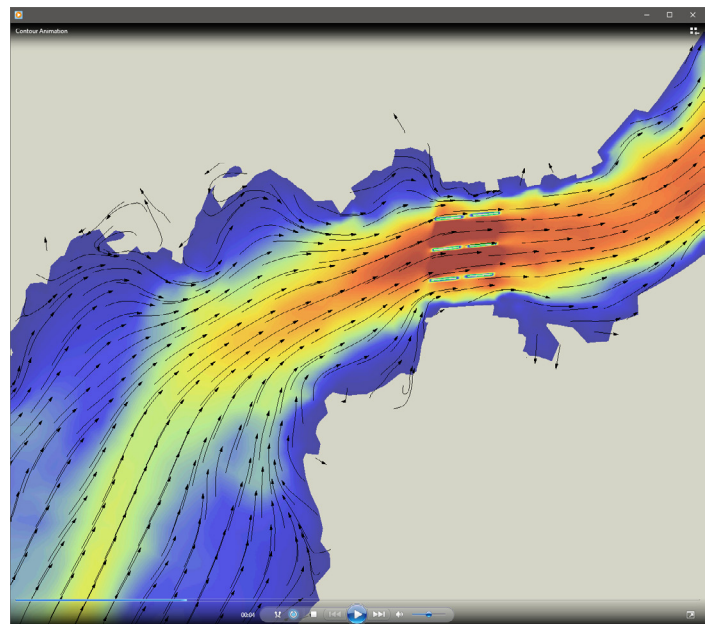
FLOW TRACE ANIMATIONS:

Flow trace and drogue plot animations are techniques used to visualize vector fields in SMS. Settings in the film loop setup dialog allow control of the flow trace that is displayed. Flow trace can be thought of as introducing tiny drops of dye into a fluid field and watching the flow patterns that are created. Drogue plots use user specified starting locations and show how the particles would flow through a vector field. Looping the animation assists in identifying patterns. Adjustments may be made to low or high magnitude fields in order to optimize visibility.



TRANSIENT DATA ANIMATIONS:

As animations represent changes over a period of time, an animation clock can be displayed as a digital or analog face. Define a beginning and ending time for the animation sequence and specify whether scaler or vector data will remain constant. The total number of frames presented in an animation can either match the time steps or use a constant interval. If time steps are matched, extra frames can be created between each step using linear interpolation of the data values at specified time steps.



RESOURCES:

xmswiki.com/wiki/SMS:Animations

xmswiki.com/wiki/SMS:Film_Loop_Drogue_Plot_Options

SMS & SRH-2D Graphical Visualization: Export Options

EXPORT OPTIONS IN SMS

In addition to the many import options available in SMS, there are a number of file formats supported that allow for easy export from SMS for use in other software applications:

IMAGES

A variety of image files may be exported from SMS including vector (.EMF & .WMF) and raster (.BMP, .JPG, & .PNG) files. World files may be exported which contain registration data. Georeferenced images can also be exported which contain embedded coordinate information for locating the image to the real world.



Georeferenced image from SMS

TEXT:

SMS includes the ability to export tabular data files in text (.TXT) or Shoal (.PTS) format. Scattered data vertices or mesh nodes may be exported as tabular data with comma, tab, or space delimited text.

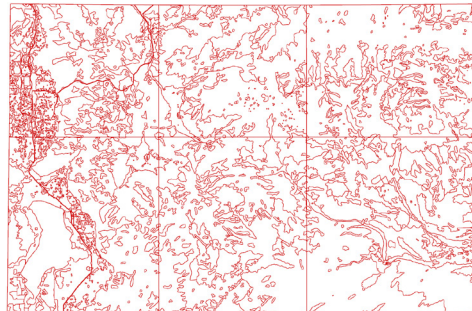
EXPORT FOR GOOGLE EARTH™:

SMS can export .KMZ files which may be imported into Google Earth for visualization and creating animations. The KMZ file supports both vector (lines, points, polygons, triangles etc.) and raster (images) data.

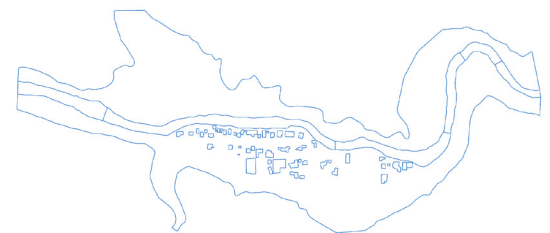
GIS & CAD DATA:

Data in SMS may be exported to .DWG or .DXF format that can be read into a CAD package.

Data created in SMS can be exported as a shapefile (.SHP) or MapInfo file (.MIF) for use in a GIS application.



GIS file from SMS



CAD file from SMS

RESOURCES:

- xmswiki.com/wiki/SMS:Images
- [xmswiki.com/wiki/SMS:Exporting Tabular Data](http://xmswiki.com/wiki/SMS:Exporting_Tabular_Data)
- xmswiki.com/wiki/KMZ_files
- [xmswiki.com/wiki/SMS:MapInfo MID/MIF](http://xmswiki.com/wiki/SMS:MapInfo_MID/MIF)
- xmswiki.com/wiki/SMS:Shapefiles
- [xmswiki.com/wiki/SMS:CAD Data](http://xmswiki.com/wiki/SMS:CAD_Data)

SMS & SRH-2D Graphical Visualization: Images, Maps, Online Maps (FEMA vector service maps)

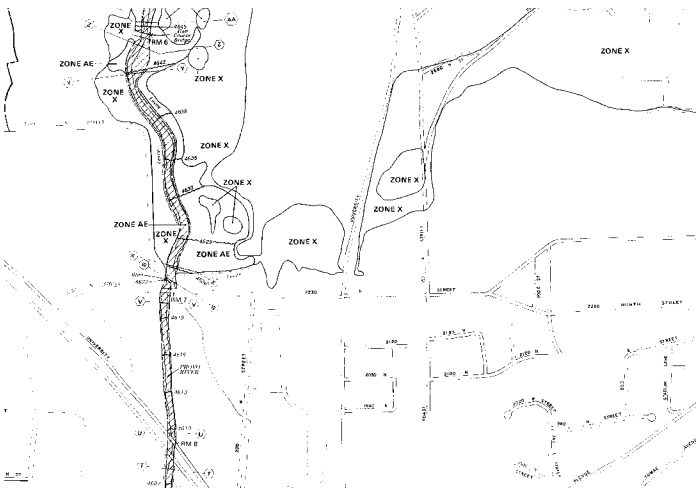
IMAGES & MAPS:

Images from a variety of sources and formats may be displayed in SMS detailing topography and land use attributes at an area of interest. Maps or aerial photos are useful in locating and defining boundaries of the study area and the extents and features in the project domain. Images may be registered to real world coordinates when imported or may use embedded georeferenced data.

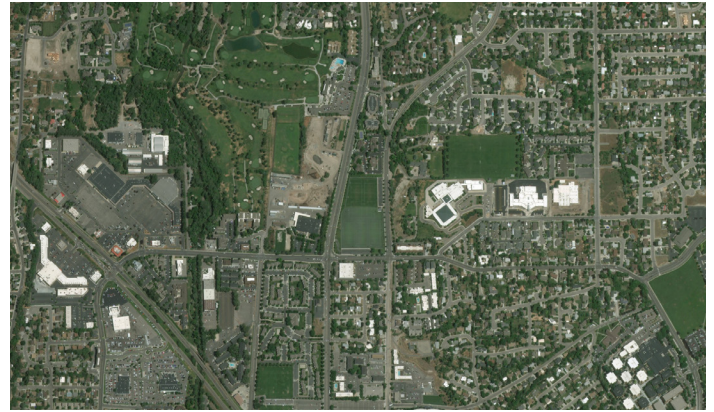
- Joint Photographic Exports Group (.jpg/.jpeg)
- Graphics Interchange Format (.gif)
- Portable Network Graphic (.png)
- Tagged Image File Format (.tiff)
- Multiresolution Seamless Image Database (.MrSID)
- Enhanced Compression Wavelet (.ecw)

FEMA FLOOD MAP SERVICE CENTER:

Flood hazard maps sourced from the FEMA Flood Map Service Center (MSC) are available for free as .tif or .png image files and can be imported into SMS.



Flood Map sourced from FEMA Flood MSC



Aerial photo sourced from Online Maps

ONLINE MAPS:

Display free online maps from within SMS that automatically adjust resolution based on the zoom parameters in plan view. The map locator tool simplifies finding sites and sourcing the right map. Convert online maps to static images that can be saved locally.

- NED data - USGS
- ASTER and SRTM data - USGS & NASA
- NLCD and CORINE (European) Land Cover Data
- World Imagery
- World Street Maps and World Topo Maps
- MapQuest OpenStreetMap Worldwide Street Maps
- USA Topo Maps
- Other data sources - Geologic data, land cover, etc. (use the advanced button)

RESOURCES:

xmswiki.com/wiki/Get_Online_Maps

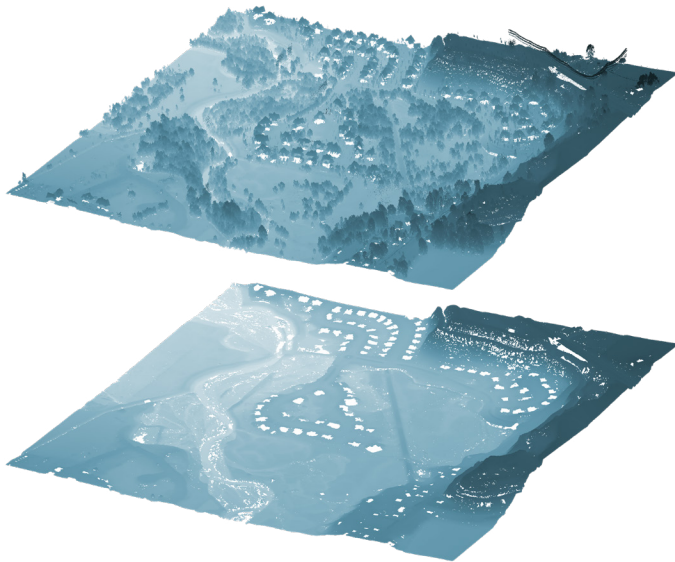
xmswiki.com/wiki/SMS:Images

msc.fema.gov/portal

SMS & SRH-2D Graphical Visualization: Processing Elevation Data

LIDAR DATA:

LiDAR data files (*.las/.laz) can be visualized in SMS as point clouds and used to assign elevations to the SRH-2D mesh. SMS LiDAR processing tools allow for the exclusion of undesirable surface points such as vegetation and bridge decks. Use tools to filter the points by point classification or return type. Use SMS to efficiently view large LiDAR point clouds or trim them to a smaller sub-set of points.

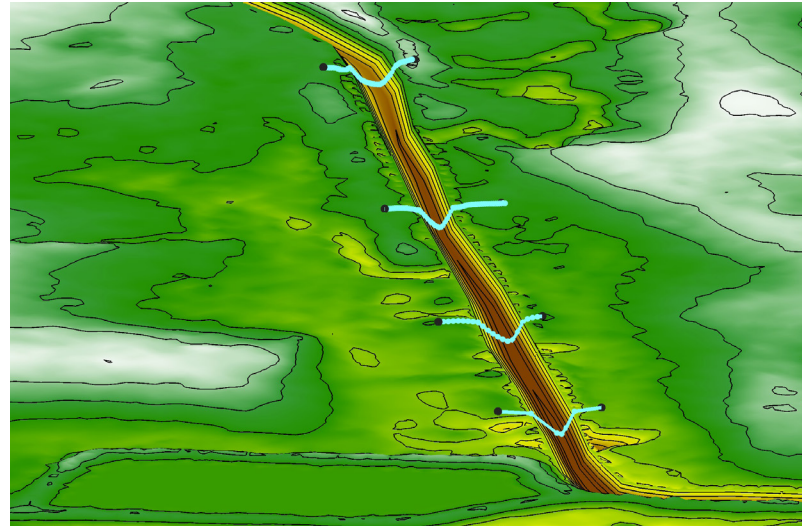


RASTER DATA:

SMS includes raster data file support for a large number of raster file formats, including all common industry standard formats. Import raster data and use it to assign elevation values to the SRH-2D mesh. Smooth, resample, and trim raster data using processing tools in SMS.

SURVEY POINTS:

Survey data points can be imported from various data types including text/csv and CAD files. Import bathymetric survey data and use processing tools to supplement other elevation data such as LiDAR.



FEATURE STAMPING:

Use the SMS feature stamping tool to create manmade features such as embankments, guidebooks, and geometric channels. Use the SMS elevation data processing tools to merge the feature stamps with other elevation data.

RESOURCES:

xmswiki.com/wiki/Lidar_Support

xmswiki.com/wiki/SMS:Raster_Module

xmswiki.com/wiki/SMS:Feature_Stamping

For more information, contact:

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