Author: Barbara Donnell (USACE ERDC-CHL)   Last Modified: 9-18-2011

How to Make a Mesh (AdH) from Scratch

Background and Data Gathering

Define the Purpose

Define a clear purpose of the modeling exercise. Understand the reason behind running the model. Understand the physical forcing(s) of the system. Do you foresee the purpose expanding to include other issues, such as salinity intrusion or sedimentation? Consider if the proposed changes to the system will affect boundary condition locations. Will the time/energy/effort/money used for modeling pay off?

Pre-Model Data Gathering

Go on a treasure hunt to find bathymetry data, learn about the system and determine the model domain and boundary condition locations. Data gathering has evolved away from "paper maps" to electronic downloads from the web or from GIS data base(s). A detailed bathymetry data set is essential to a successful model. Go visit the site and talk to the locals. Take the time to review previous studies, publications, and become familiar with NOAA station locations.

Bathymetry data can be found in many different formats: charts, GIS data bases, shape files with Z-values, digital survey data (ADCP), or "fly overs" (LIDAR). ADCP and/or LIDAR data sets are popular choices. These data sets can be enormous! Be prepared to address whether you have enough computer memory and processor speed to process the data.

Select the Appropriate Model

You must choose a numerical model that addresses the physics at the site. Consider if the system is vertically mixed or stratified? Will wetting and drying occur? Consider the dimensionality of the problem (1D, 2D, 3D). Examine historical field data records to determine if the system can be modeled by 2D type model, or if a 3D model is required. Determine if the water velocities are critical or sub-critical. Are there unusual features in the system (weirs, control structures, etc) or extreme test conditions (dam breaks, fish ladders, etc)?

Select the Computation Environment

When selecting what computer(s) to use, there are two categories to consider: where will the pre- and post- processing be done, and where will the numerical model be run.

A desktop computer is necessary.

SMS: Surface Water Modeling Graphical User Interface

Surface Water Modeling Interface (SMS) can pre-process, run the model, and post-process . . . "if the problem will fit on a PC". If (SMS) is to be used, then a Windows operating system is presently your only option.

Desktop PC Guidelines:
1. 64-bit Intel chip
   - Windows-XP or Windows-7 Operating System
   - Apple computer, I strongly suggest getting *BootCamp* software to allow dual boot. NOTE: *Parallels* software creates a virtual Windows, but SMS does <u>not</u> run efficiently in a virtual environment.
2. Fast CPU speed (example: 3.73 GHz or higher), with multi-core processing
3. As much RAM Memory as you can afford (24 Giga Bytes of Ram or more)
4. Deluxe Video Card (example: NVIDIA, Quadro FX 4500 with at least 512 Mega-Byte memory)
   - Video card driver needs to be up to date (supporting OpenGL version 2.1 or higher)
5. Flat screen dual monitors (the larger the better)
6. A VERY good precise / ergonomic / comfortable mouse.

CMB: Conceptual Model Builder and its Components

The Conceptual Model Builder (CMB) can do pre- and post-processing (only).   If the conceptual model builder interface is to be used, then there are many choices for the computer operating system: Windows, Apple, Linux, or Unix.   Users who wish to know more may contact Amanda Hines (ERDC-ITL) or Stacy Howington (ERDC-CHL).

HPC: High Performance Computational Center

As an employee of the USACE, you have 'free' access to the High Performance Super Computers (HPC) located at ERDC.   This capability permits the choice of run-time environments: Desktop or HPC.

The HPC is a Unix operating system. HPC usage does require a desktop computer running *Kerberos* software, which validates a ticket after reading your CAC card. At first it may seem overwhelming and intimidating, but most users become proficient within a couple of days. Users desiring a HPC account may call 601-634-4400 ext=1 for assistance getting an USERID and instructions.

Choose Horizontal Coordinate Reference

If you are going to be getting boundary condition from ADIRC, STWAVE, or some other model, it would save a lot of time if all models (including AdH) used the same horizontal coordinate's reference.   Many times the sponsor will mandate a particular coordinate reference.   Be aware that AdH cannot use Geographic (Lat/Long) coordinates.

For example, for the Columbia River Inlet demonstration:
1. ADCIRC: Horizontal: Geographic NAD27 (meters).
   Vertical Datum: Mean Tide Level, m. MTL very close to same as Mean Sea Level.
   - ✓ ADCIRC Z-Elevation reference: Positive Z means wet, Negative Z means dry.

2. STWAVE: Horizontal: State Plane Oregon North NAD27 (meters).
   Vertical Datum: ?
3. AdH: Horizontal: State Plane Oregon North NAD83 (meters)
   Vertical Datum: NAVD88, m.
   - ✓ AdH Z-Elevation reference: Negative Z means wet, Positive Z means dry.

Choose Vertical Datum Reference

If you are going to be getting boundary condition from ADIRC, STWAVE, or some other model, it would save a lot of time if all models (including AdH) used the same vertical coordinate reference.

Obtain Image(s)

Fly-over or satellite images come in several formats. SMS can support various types such as .jpg, .tif, .sid . . . There are several download web sites. However, if working with a district, always check with your sponsor to see if they have recent images. Get to know the GIS folks at that district. It's always best to obtain "registered" images.   A registered image will have an associated world file (world file extensions: .jpw, .tfw, or .sdw . . .)

Although SMS has the ability to register the image by using up to 3 known points, the district GIS expert will have an easier and more precise ability to register the image(s). Furthermore, if the district provides this information, then that reduces the potential of error. If you cannot get the images registered in the chosen horizontal coordinate system, SMS can change the registration from one reference to another.

Images may vary in resolution.   With enhanced satellite capabilities, you could request a high resolution image and not have enough computer memory or processor speed to use that image effectively. I suggest images between 10x10m to 30x30m pixel resolution.   Obviously there are circumstances that may require a more detailed image, such as a degrading jetty.

What Constitutes a Good AdH mesh?

REFERENCE: Donnell's PowerPoint: "How_to_Make_AdH_Mesh_using_SMS_9-16-2011.ppt"

A finite element, unstructured mesh is composed of nodes and elements. However a beautifully constructed mesh can still be faulty if the resolution or extent of the modeling domain is faulty.

The AdH numerical model accepts only linear triangle shaped elements.   Although SMS has many mesh creation guidelines, it is not fool proof. Human intervention may be necessary to achieve a well designed mesh. Guidelines for making a good mesh are listed below. The remainder of this document may mention slide numbers in the referenced Power Point Presentation.

Properties of a Good Element (slide 1-6 of power point)

Each element should have a good aspect ratio, shape, and angle criterion.
- Ratio: Desirable to have Elemental Length to width aspect ratio less than 1 x 10

- Shape: The best shapes are an ~equilateral-, ~right-, or ~isosceles- triangle. Avoid "pointy/needle" shaped triangles!
- Angle: Again, the goal is to avoid sharp points on a element. An element with an angle < 20-degrees can be trouble.

Properties of a Good Mesh (slide 7-14 of power point)
Given that the mesh is composed of good elements, the next step is to consider the properties of the mesh.   Fortunately, the SMS has the ability to graphically pin-point mesh quality issues such as items a) and b) below.   The user may alter the default element quality check criterion if desired. Within SMS Mesh Module | Display Options | toggle on Mesh Quality. Then choose the options button.

a. Gradual element-to-element area change (<50%)
b. Avoid "HUB nodes", where *8 or more elements connect to 1-node*
c. Smooth bathymetric contours following element edges
d. Smooth boundary and wet/dry edges
   - Fast Run Time considerations: Wet/Dry occurs in 1-Element
e. Adequate Resolution to capture the bathymetry
   - Emphasis on the major topographical features within the area of interest
   - Resolution should be a function of the distance from the study area
   - For AdH you are creating the "BASE" mesh, allowing AdH to adapt/ refine the BASE mesh as needed to ensure computational accuracy. If you "over resolve" the BASE mesh, then AdH will not need to adapt, and the simulation will "pay in run time" for unnecessary resolution for the entire simulation
   - Do not allow "choke" points. If a channel bifurcates around an island, maintain the flow path with at least two-elements wide around the island.
   - How to know if the BASE mesh has enough resolution? Test various resolutions until these changes no longer affect the answer.
f. Well placed boundary condition locations
   - Locate where field data is adequate
   - Locate far enough away from the study area
     1. Does the prescribed BC affect the answer @ study area?
     2. Does production model test (i.e. deepening the channel) affect the BC?
g. For Aesthetics it is desirable to have a smooth land/water boundary
h. Renumber the mesh
   - Create a nodestring, select the nodestring "handle", right-click | renumber.

Use SMS: Surface Water Modeling Graphical User Interface

Open SMS version 10.1.11 or version 11.x. I recommend using version 11.0.7 or higher because of the maturity of the SMS/AdH interface. SMS can be a start-to-finish interface for conducting a numerical model with less than 1-million elements. Although SMS-11 now has both 64-bit memory enhancements and faster file manipulations for large data sets, SMS will struggle for large mesh applications: slow file load, slow graphical refresh.   This fact inspired the 'monster mesh user' to seek other tools, such as CMB (see section: CMB: Conceptual Model Builder and its Components)

SMS is a widely used tool both within ERDC and across the USACE. Don't hesitate to call the SMS HOTLINE support at USACE ERDC-CHL for bug reports, guidance, or help when problems arise.

- USACE Help: 601-634-2433 (license), 601-634-2730 (hotline support)

- Online help web site (Aquaveo maintains): http://www.xmswiki.com

The following are the start-to-finish steps of creating a mesh within SMS version 11.0.7.

Open SMS
Double click the SMS icon located on your desktop or go to the START menu | All Programs | SMS 11 64-bit

Set the Current Projection
From within any module of SMS, issue the command Edit | Projection. Set both the horizontal and vertical projection.

Set Mesh Model Type
Activate the SMS Mesh Module, then Data | Switch Current Model. Click AdH.

Set Model Preferences to specify SMS start up instructions
- Edit | Preferences
- File Locations Tab. Browse to the path where model executables exist on your PC.
- Startup Tab. Default 2D Mesh Model.

Load Background Image(s)
- File Open. Browse to the directory where the image file resides.
    - Create Pyramids? No
      NOTE: One image (100,800 Kbytes) loaded into SMS, used 176,760K memory.
- Register image if needed. (Right-Click image icon | Register)
- Change the projection of the image, if needed.

Load in Shape File(s)
- File Open. Browse to the directory where the shape file resides.
- Change the projection if needed

- If desired convert the shape file to feature objects (points, arcs, polygons)
    - GIS Module | Mapping | Shapes to Feature Objects
- If the shape files contain Z-values, convert them to scatter data

Load Bathymetry Data Set(s) as Scatter Data Set(s)

Although it is not mandatory that bathymetry be loaded at this point in time, doing so can help with the conceptualization of the study area.

- File Open. Browse to the directory where the data set resides.
    - Use the import wizard to define as scatter data with columns of (Z, Y, and Z)
    - The import wizard automatically starts if the data set has the extension   .xyz
- Merge scatter data sets together, defining a priority for overlap areas.
    - Scatter Module, populated with at least 2 sets. Scatter | Merge Sets.
- Example: Columbia River
    - Opened ADCIRC mesh dated 2005, projected to correct horizontal coordinates, deleted everything except the pertinent ocean area and inlet details, applied a datum conversion constant to get the Z-values into NAVD88 (m). Saved as Scatter-1.
    - Opened the latest bathymetry for the detailed AdH Columbia River project (dated 7-2011). Saved as Scatter-2
    - Merged Scatter-1 with Scatter-2 with a priority of 1 and 2 respectfully, requesting to eliminate any nodes in set2 that overlapped set 1.
    - Saved the merged scatter set as:
    XYZ_GOLD_Merge_Bathymetry_Horiz_SPCS_OR-N_NAD83_Vertical_NAVD88_m.txt

SMS Map Module "Game Plan" (slide 16)

First let me explain the SMS game plan. To use SMS in the most efficient, it is necessary to create a conceptualization of the domain with a "map", convert the map to a mesh, check for mesh quality issues (re-visiting the map module if needed), assign boundary conditions, and run the numerical model from within SMS. After post processing and analysis of the output, the user may decide to go back to the map module, make changes and repeat the process. However, in the world of ERDC-CHL, this ideal process is a rare event. The reason is that our assignments are always pushing the state-of-the-art and modeling typically "outgrows" the capacity of the desktop computer. If your PC is not sufficient, first try saving the ADH run files, exit out of SMS, and run ADH from a command prompt. If this "tip" does not eliminate resource issues, then the ASCII ADH run files (.3dm, .bc, .hot) must be moved to a better computational environment. Numerical models, such as AdH, were designed to run in either "Serial" or "Parallel" processing mode, so they can be used across computational platforms from the PC to the HPC.

If human intervention/mesh editing becomes necessary to achieve a well designed mesh, then you are no longer using the ideal "game plan". ANY editing done in the mesh module will have to be repeated EVERY time it becomes necessary to revisit the map module conceptualization (map-to-mesh).

Save Often
Save Often – Save Often – Save Often, especially when working with the map module! File | Save as.
Under save as type, select to save the SMS project. To save just the map module work, File | Save map.

Map Module Building Blocks (page 17 of power point)
The building blocks of the map module are called feature objects: feature points, feature arcs, and feature polygons.

- A feature point is a standalone point used to define field gage locations and/or use as a refinement location (refine around an obstruction in the water body).   By using a feature point to define field stations, it guarantees that a mesh node will be placed exactly at that location.

- A feature arc is composed of two "end nodes" and zero-to-many "vertices". Each "end node" may have z-value(s) attributes. The placement of vertices along the arc, will become mesh nodes, and thereby control mesh resolution.

- Feature Polygons area created by the "Feature Objects | Build Polygon" command. A polygon is successfully built if and only if, two or more feature arcs form an enclosed area. Feature polygons have attributes: a) mesh type, b) material type, and c) bathymetry.

Polygon Attribute: Mesh type
The polygon attribute mesh type choices, pertinent to AdH are: NONE, Paving, and Patch. A mesh type of NONE means that no mesh may be previewed nor will the mesh be created for the polygon when the map is converted to a mesh. A mesh type of Paving is the most common form used for AdH meshing. However, Patch is the most popular form of meshing for navigation channels, and structures. When the map coverage is set to AdH, patching takes a ~quadrilateral shaped polygon and systematically fills it with triangles. Requesting a patch insures control of resolution in critical areas.

Quote from SMS wiki: The paving method uses an advancing front technique to fill the polygon with elements. Based on the vertex distribution on the boundaries, equilateral triangles are created on the interior to define a smaller interior polygon. Overlapping regions are removed and the process is repeated until the region is filled. Interior nodal locations are relaxed to create better quality elements.

Polygon Attribute: Material Type
The material type is a user assigned numbering system, which allows for easier control of numerical run-time parameter assignments. For example, bottom roughness is assigned by material type. There is a special material type called "DISABLE". If the material type is labeled as disabled, then a mesh will be created with a special material type of "disable", and the AdH boundary condition file will have control cards which will "turn this section of the mesh off for purposes of computation".

Polygon Attribute: Bathymetry Type
If one or more bathymetry scatter data set(s) are loaded within SMS, the user can request that the chosen polygon instantaneously receive nodal Z-values from one of the scatter sets when the map is converted to a mesh. Otherwise, the only choice is to provide a constant Z-value to mesh nodes.

Map Module Finished Examples (page 18-19 of power point)

Example 1: Idealized Inlet

This inlet was actually a physical model, created out of concrete and housed in a hanger at ERDC-CHL. It was built for the purpose of experimentation (William C. Seabergh, Lihwa Lin, and Zeki Demirbilek) and has been used for numerical model validation exercises. Physical modeling uses similitude principles, where physical model coordinates are a (1:50) of the real-world (prototype) coordinates. Both the horizontal coordinate projection and vertical datum within SMS is designated as "LOCAL, meters".

The Idealized Inlet, is a very simple/small map module conceptualization. There are only 55 arcs comprising 8 polygons. Resolution varies between 10- to 150-meters. After the map shown in Figure 1 is converted to an AdH mesh, there are 7915 Elements, and 4151 nodes.
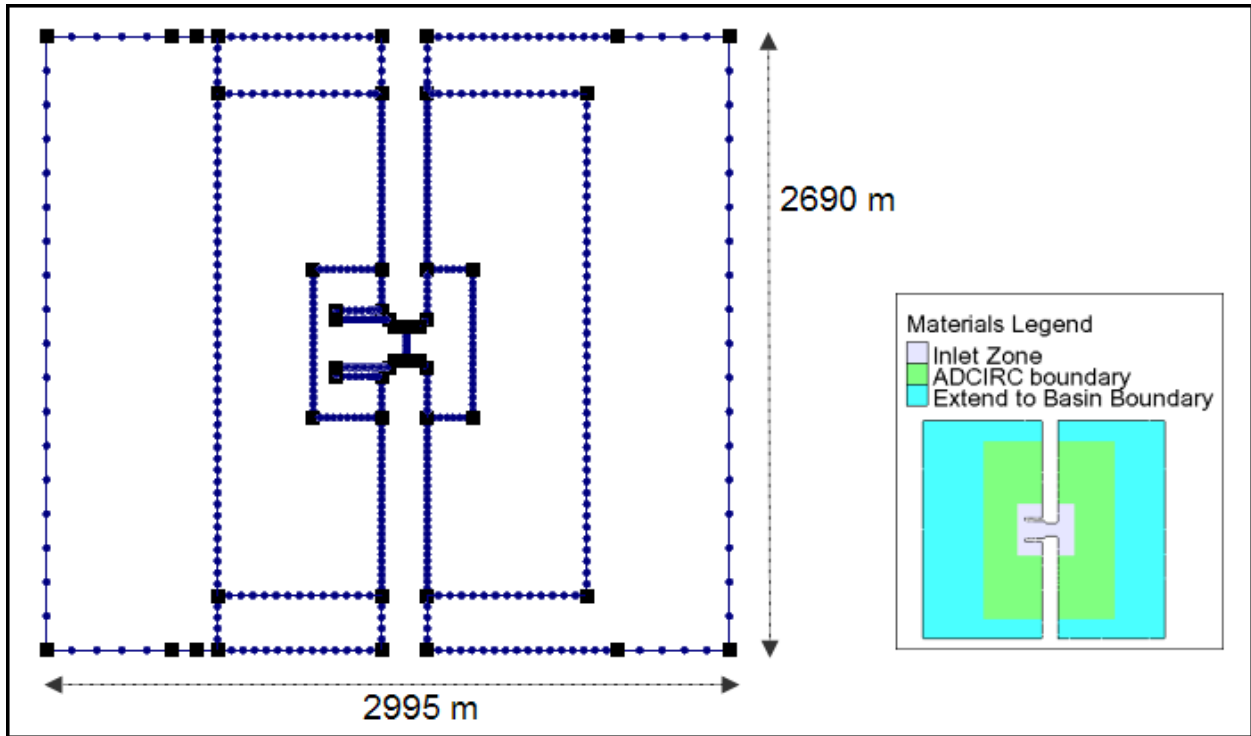

Figure 1. Idealized Inlet map conceptualization

Example 2: Columbia River Inlet

The Columbia River Inlet is a relatively complex/large map module conceptualization. This map is composed of over 950 arcs and over 300 polygons. The coordinate projection within SMS is designated as; Horizontal: State Plane Oregon North NAD83 (meters) and Vertical Datum: NAVD88, m.
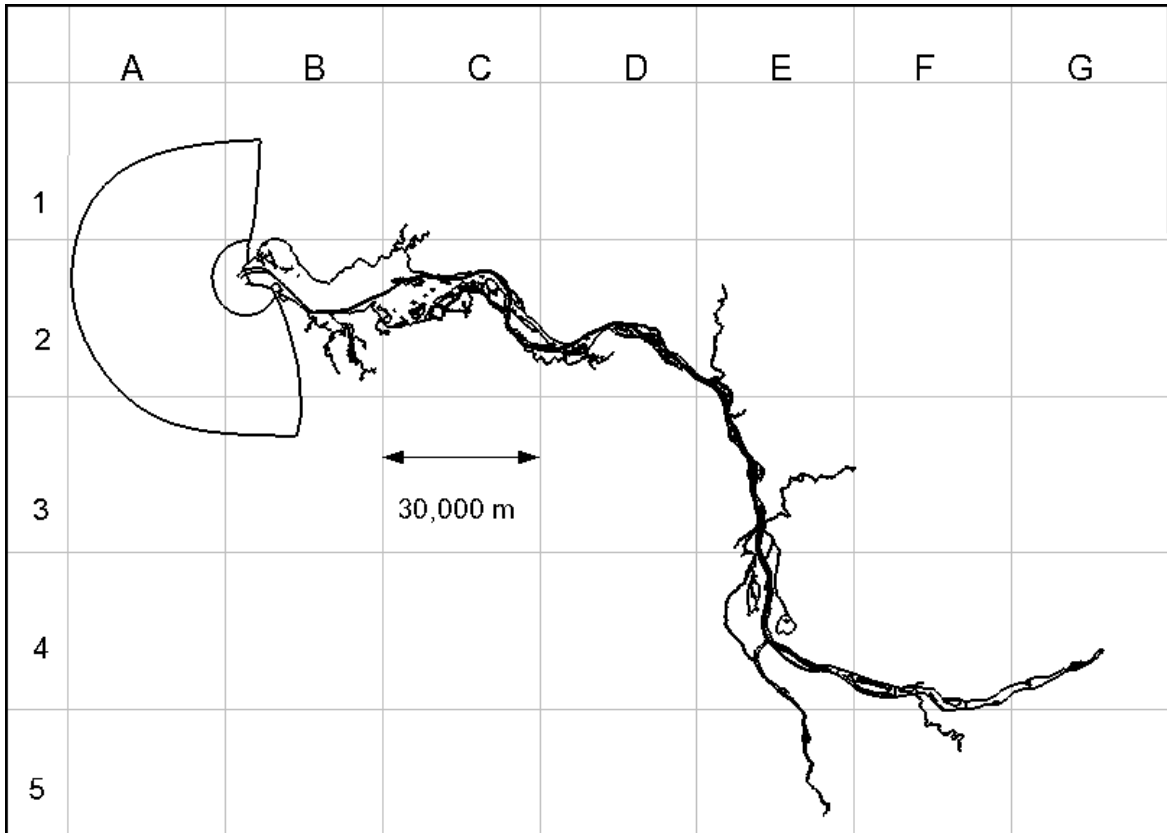The remainder of this document will discuss sections from the Columbia River map module.

Figure 2. Columbia River Map Module Conceptualization, designated by section.

SMS Map Module (Page 20-end of power point)

New Coverage / Set the Map Coverage (Page 20)

IMPORTANT! Before you do new work in the Map Module, create/define the map coverage. In the project explorer (data tree), right-click on "Map Data" and define a "New Coverage". In the new coverage

dialogue, scroll down until you locate "AdH" Model then rename the coverage to be "AdH Coverage". Make sure that the "AdH Coverage" is visible and highlighted. Failing to do this step will result in confusion and/or failure.

Set the Map Display

Components of the map module may be toggled on/off and the color of feature objects may be changed. It lessens eye strain to change the feature objects color to stand out against the background color. For example if working with a dark background image, it is helpful to make the feature points and nodes a vibrant aqua or lime green. When building a map, it is helpful to "Fill" the polygons with material type colors. Occasionally it is helpful to toggle on the ability to see the inactive coverage's as a light gray shade.

    Command: Display Options | Map. Then make your choices.

Start Building the Map Conceptualization

        For the Columbia River example, the primary study area is the ocean and inlet, as defined in

Figure 2, blocks A1 A2, A2, B1, and B2. First define the extent of the modeling domain which will necessitate defining the land/water interface. Then we will start simple with the ocean and build from there.

Domain Extent and Land / Water Outline (page 21 of power point)

There are several methods to define the extent of the modeling domain. This land/water outline can be obtained in at least 4 ways:

1. Inherit the outline of the boundary from a prior model
2. Get shape files and convert them to feature arcs
3. Click-click-click
4. Automatically get Feature Arcs from bathymetry scatter data contours (requesting the appropriate Z-value and spacing). (Scatter Module. Data | Scatter Contour to Feature). Depending on your (XYZ) data, you may or may not have a lot of cleaning up to do.

The Outer Ocean (page 22 of power point)

If the intent is to couple AdH with STWAVE, the first consideration is to <u>make sure</u> that the AdH mesh is larger than the STWAVE mesh. If the intent is to obtain ADH boundary conditions from ADCIRC, make sure that the AdH mesh fits within the ADCIRC mesh in all those locations. The last consideration is to include the "wave run-up" zone of the coast line, especially if storm events will be simulated.

In this example, a semi-circular shape was used to form the outer ocean polygon, with a total of 6 arcs for the ocean domain. Ocean elements will have a larger area than elements in the inlet. The distance between vertices dictates resolution control (Right-Click the arc and request to redistribute vertices). After building polygons ("Feature Objects | Build Polygon"), you can double click the polygon to assign mesh type as paving, bathymetry type as constant = 0, and material type as ocean. Hit the preview button in the 2D Mesh Polygon Properties dialogue to preview the mesh. (NOTE: The actual mesh does not exist yet, you are just getting a sneak peak). If the preview fails, you must adjust the arc vertices either by redistributing or by hand moving them, until the preview is successful.

If you don't like something, simply continue to redistribute vertices, . . . until you like the preview. The outer ocean map polygon (page 20) has vertices' resolution between 500- and 3900 meters.

The Inner Ocean/ Entrance to the Inlet (page 23 of power point)

Finer mesh resolution is required as you enter the inlet. This polygon has to be designed to coordinate with the navigation channel markers and tips of the jetties. In this instance, channel buoy markers were not provided, the navigation channel boundaries were inherited from a previous study. However often times, the bathymetry data set will suffice to define the channel turning points.

The procedure is the same as described above: draw arcs, redistribute vertices, build polygons, assign polygon attributes, review the mesh, and repeat as necessary.

The Jetties / Navigation Channel (page 24 of power point)

This is an important section of the mesh. If the intent of the study is to evaluate jetty stability, then it is important to provide sufficient resolution to define the present jetty condition. Good element shapes are important in this region because this is a high stress point. As a general guideline, most AdH modelers prefer to use Mesh Type = PATCH, for jetties and navigation channels.

Islands and Wet/Dry Zones (page 25-26 of power point)

The navigation channel tracks through this area. But what about all of those islands? Are they significant enough to spend wet and dry computational time? For areas that look like "mud flats" or wet/dry zones, I suggest allowing the model to decide what to do. Within the map module, the user has the ability to do what I call: "design for change-of-mind". By looking at the background image, I decided to set the material type = disable for all island polygons that appeared to have dark green vegetation. Another choice would be to assign a unique material number to represent them and activate/de-activate the elements within this material number inside of the AdH model control. Using this technique gives the user the flexibility to change the mesh type from disabled to an active material type if needed.

As you might ascertain, it requires a lot of mouse clicking to outline all of these islands. See section Domain Extent and Land / Water Outline (page 21 of power point).

Section C2 and D2 show that element edge size increases for both the land/water outline and the navigation channel as we move further upstream from the primary study area. Obviously if the element edges get larger, the resolution becomes coarser.

Upstream Wet/Dry Zones (page 27 of power point)

The navigation channel continues to wind its way through the upper estuary. The navigation channel resolution changes from 3-elements wide to 2-elements wide (square rectangle in Figure 3) within this section [X= 2267101 Y= 293018. (m)].

This particular graphic also illustrates a New Map Capability within SMS-11. The modeler may incorporate "Stand Alone" arc(s) within a polygon to help guide resolution (red arrow). Warning – The arc must be stand alone – if it touches another arc, it can cause failure! This new feature is helpful when

trying to guarantee that all side channels have a resolution of at least two elements wide across the channel.
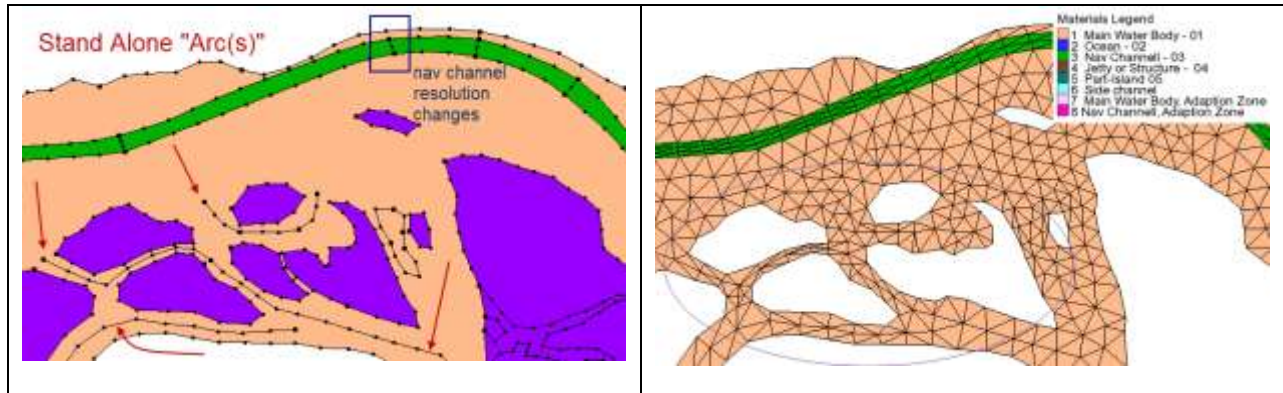

Figure 3. Illustration of controlling resolution with "stand alone arcs", a new capability within SMS v 11.

Upstream Wet/Dry Zone, Section E3 (page 28 of power point)
The number of elements across the navigation channel decreases from 2-elements wide to 1-element wide.

Upstream Wet/Dry Zone, Section E4, F4, G4 (page 29 of power point)
The navigation channel stops in this section. Again the "stand alone" internal arcs are used within the polygons to insure that there is always at least two elements wide channel around the islands.

Upstream River Inflow, Section E4-5, F4-5, G4-5 (page 30 of power point)
This section of the map module will define the river inflow resolution. Willamette River is a relatively small, two element wide 100-meter cross section. Bonneville Dam, which is actually two separate inflows, was schematized as one inflow with 5-element wide resolution defining the 320-meter cross section.

Convert the Map to a Mesh
The procedure described above is the same for each section of the map: draw arcs, redistribute vertices, build polygons, assign polygon attributes, review the mesh, and repeat as necessary. It is advisable to convert the map to a mesh (Feature Objects | Map-to-Mesh) after building each major polygon section.

For the Columbia River Inlet example, the "map-to-mesh" conversion takes about 30-seconds using a desktop PC as described earlier in the section entitled "Desktop PC Guidelines:".

Human error or a slip of the mouse can cause SMS to fail the map-to-mesh conversion. See last few pages, section SMS Tricks and Tips.

Assign Mesh Bathymetry
As mentioned previously (Polygon Attribute: Bathymetry Type, page 7) , if the polygon attributes were defined to automatically interpolate the bathymetry when the map was converted into a mesh, this step

is not necessary. The advantage of assigning bathymetry polygon-by-polygon is that you can dictate a unique scatter set for each polygon. The disadvantage is you dictate a unique scatter set for each polygon. No, I did not miss-type, I'm emphasizing that this method can get confusing and tedious.

Most users prefer to assign bathymetry all at once because they may want to use additional interpolation options.   Another reason is that this method requires that all scatter set(s) be merged into one scatter set. Furthermore, if there are overlapping scatter sets, then a priority must be specified. So when it's time to archive the project, there is only one "GOLD" bathymetry XYZ data set.

In the Scatter Module, Scatter | Interpolate to Mesh. An interpolation dialogue appears (Figure 4) where you can specify the interpolation method, choose the scatter data set that will be used to interpolate from, assign a new file name for the new data set that will be created, decide if you wish to truncate Z-values min/max, and choose whether or not to Map the Z-values.

NOTE: The archived scatter data set that was used for the Columbia River Inlet AdH mesh (workshop 19-23 Sept 2011):
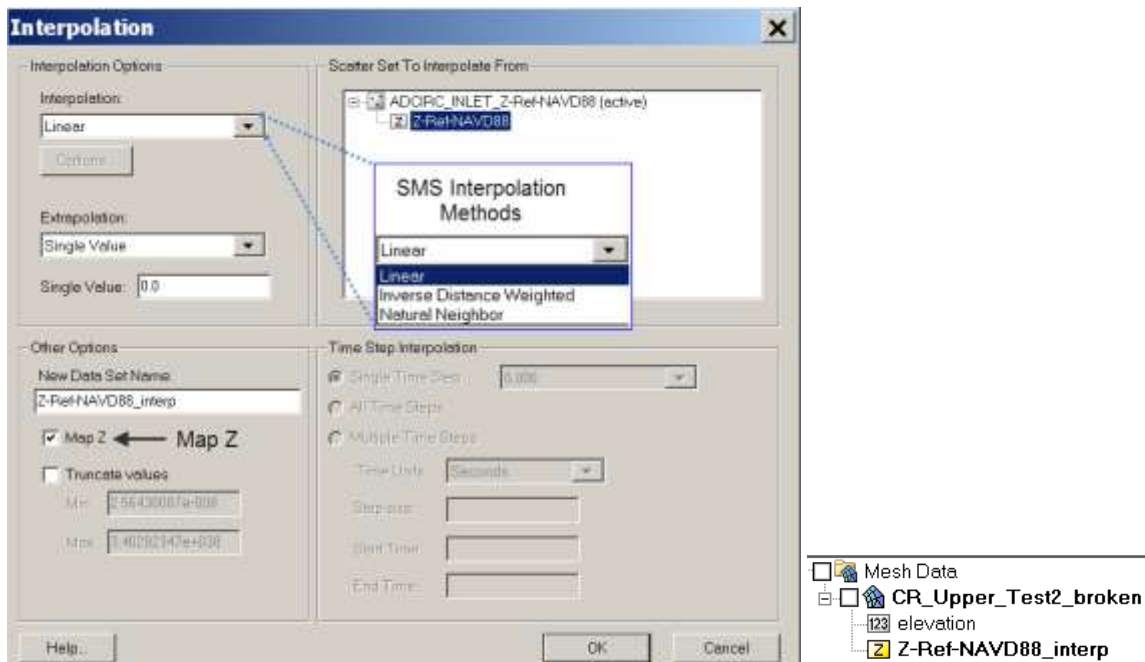XYZ_GOLD_Merge_Bathymetry_Horiz_SPCS_OR-N_NAD83_Vertical_NAVD88_m.xyz

Figure 4. Interpolate Scatter Z-Values into the Mesh.

Choose an interpolation method
Each interpolation option has pros/cons. If the bathymetry data set is rich in data and evenly distributed, then linear is a good choice. If the mesh slightly falls outside of the bathymetry data, then linear is a poor choice because it has no extrapolation ability. Both Inverse Distance Weighted and Natural Neighbor provide extrapolation, but will require a bit more computer power than linear.

Choose an extrapolation method

This part of the dialogue allows you to provide a user define constant value to be assigned to areas outside of the boundary of the scatter data.

Always review the interpolation results.
- File | Get Info on the mesh to check the Z-value min/max
- Choose several contour (min/max) limits.
- Scan the entire mesh domain in <u>both</u> plan view and oblique view looking for abnormal bottom elevation.
- If your scatter data is in the form of ADCP "strips", none of the interpolation methods may be satisfactory in the channels. You may have to add "Scatter break lines" to guide the interpolation. There is a teaching video on this subject, available from the link below:
  - SMS Download : http://chl.erdc.usace.army.mil/smsdownload
  - Video: Scatter Module Demonstration, Featuring Scatter Break Lines

Map Z
If "Map Z" is checked, then the interpolated data set will receive a special icon (yellow box with Z inside). The data set with this "Z" icon will be assigned to the mesh nodes and saved with the mesh.

Examine Mesh Quality

After the mesh is populated with bathymetry it's advisable to switch to the mesh module and set the display to examine mesh quality. Determine if you need to loop back to the map module to rectify problems or if you want to edit the mesh in the mesh module.

Renumber the Mesh
Create a node string, select and right-click the string to request renumber.

Save the SMS Mesh as an AdH Mesh.
When you issue a File | Save New Project or File | Save existing project, all loaded data will be saved such that there is one common ROOTNAME with various extensions. A basic example of a SMS project save (for an AdH application) is shown below:

```
ROOTNAME.sms                Master SMS file name which will reference the files below
      ROOTNAME.map                Map Module, all coverages
      ROOTNAME.materials          Material Numbers, Descriptions, Color, Fill pattern
      ROOTNAME.Scatter_set1.h5    Scatter set1 with all associated datasets (BINARY)
      ROOTNAME.Scatter_setx.h5    Scatter setx with all associated datasets (BINARY)
      ROOTNAME.sim                AdH simulation file (how SMS runs AdH from within)
      ROOTNAME.3dm                AdH two dimension mesh
      ROOTNAME.bc                 AdH boundary condition file
      ROOTNAME.hot                AdH hotstart file
```
Important: Do NOT exit SMS until you have verified that the appropriate files were saved. Examine both the file names, modification date, and the file length before you exit.

SMS Tricks and Tips

General: Zoom to Selection

Version 11 has a new capability, zoom to selection. Suppose you conduct a search for a particular mesh node number (Mesh Module, Nodes Find. Type in the node number. SMS puts a very small highlight mark on the node. The problem is that your mesh is so huge that you cannot find the highlighted node. Simply right-click in the graphics window, and request "Zoom to Selection".

Map: How to Find the Cause of Map-to-Mesh Failure

When building a map, mistakes can cause the SMS to fail to build polygons. In some instances, when SMS can diagnose a particular feature object as the culprit, you can set the map display to show "ID" numbers, then issue the command Feature Objects | Find (enter ID #), then right-click zoom-to-selection.

Map: How to Eliminate Duplicates / Dangle Arcs

What if you inadvertently double-clicked, or you mistakenly dragged a feature object on top of another; don't panic, just clean.   Issue the command "Feature Object | Clean" and adjust the parameters to snap nodes and vertices, remove intersecting arcs, and remove dangling arcs.
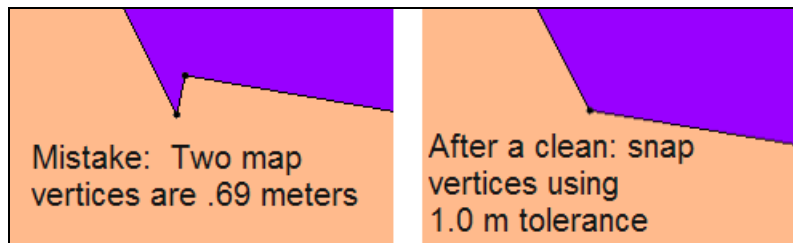

Figure 5.   Clean example.

Map: Automatic Arc Offset

With SMS version 10 and 11, there is the ability to create new arcs which are offset from an existing arc. This is a very helpful tool to precisely create arcs for a structure or channel.
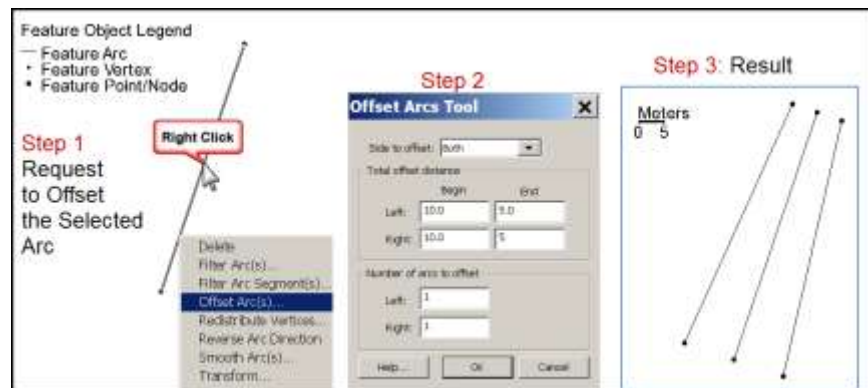

Figure 6. using the map module to creating offset arc(s).