Tutorial Introduction

This Tutorial guides the user through the complete processing of a survey using the 2015 CHaMP Topographic Processing Toolbar in GIS. The user should already be familiar with basic GIS concepts before working through the material presented in this Tutorial. If the user is unfamiliar with GIS basics, additional tutorials are available through the CHaMP Topo Toolbar website (http://champtools.northarrowresearch.com/). This Tutorial uses sample data, but describes all processing steps and tools that may be needed during normal CHaMP topographic survey data processing.

The CHaMP Topo Processing Toolbar is an **esriAddIn** developed for CHaMP crews to process topographic survey data, create, check and edit GIS products and prepare and publish the data for upload to champmonitoring.org, either through the Broker or directly on champmonitoring.org. Metrics based on the processed topographic and derived GIS datasets are generated on the server. It is important to be diligent in checking for and repairing any survey or processing errors throughout the workflow, as you, the survey crew, will have intimate knowledge of the site and survey data.

Table of Contents

System Requirements

The following software should be installed on your computer:

- Windows 7 or higher
- ArcGIS 10.1
  - ArcGIS for Desktop Advanced (*formerly ArcInfo*) License Level
  - Spatial Analyst Extension (Available and Enabled)
  - 3D Analyst Extension (Available and Enabled)
- CHaMP Topographic Processing Toolbar for ArcGIS 10.1 version 5.01 or higher.
  - Latest download is available at http://champtools.northarrowresearch.com/
- (Optional) Spectra Precision (*formerly TDS*) ForeSight Version 2.2.5 (for use with SurveyPro/Nikon Total Stations)

General GIS Tips:

- Always turn off the Editor (ArcMap Vector or TIN) when finished editing layers before running any tool.
- If an error appears when running a tool, double check all input/output file locations, feature class names, etc. to make sure the correct inputs and outputs are listed.
- Naming best practices for CHaMP:
  - Do **NOT** use spaces, parentheses "( )", or other special characters (*, #, -, @, $) when naming files, folders, site names, etc. Use underscores "_" in file names if a separator is needed
  - Do **NOT** start file or site names with a number.
  - Try to use a minimal number of characters.
- If you cannot find a layer in ArcMap, double check the Table of Contents. Rearrange layers (drag and drop the layer name) or change their visible status (with the checkbox) as needed as other layers may be blocking the view of your layer of interest.
- Save all of your work in "c:\champbroker\<your organization>\<your crew>\<the hitch you are working in>\<the site you surveyed>\Topo". If you must work outside of this folder, there **WILL** be issues with publishing the data and you may need additional assistance.
- *Survey Checks (QA Tools) and TIN checks (QA Tools) can be run at any time. We recommend running these tools after major editing sessions to record 'behind the scenes' information about your surveys.*
- *Validate Data (QA Tools) can be run at any time to review what products need to be created for your survey.*

Tutorial Data:

This Tutorial is based on the following CHaMP Survey:

Site Name: CBW05583-527786
Watershed: Upper Grande Ronde
Stream Name: Catherine Creek
Projection: UTM Zone 11N
Visit type: Initial Visit
Coordinate Type: Unprojected
Instrument Type: Total Station
Instrument Model: TopCon

Visit Dates: 7/21/2013 and 7/22/2013

Initial Setup

To setup or upgrade the CHaMP Topo Toolbar:

1. When Upgrading from a previous version of the CHaMP Topo Processing Toolbar that is already installed on your computer, first
   a. **Open** ArcGIS
   b. **Click** on the Customize Menu and select Add-In Manager…
   c. **Find and click** on the CHaMP Topo Processing Add-In.
   d. **Click** on the "Delete" button to uninstall this version of the Toolbar.
   e. **Close** ArcMap.
2. **Download** the latest version of the CHaMP Topo Processing Toolbar Add-In from:
   http://champtools.northarrowresearch.com/
3. Make sure ArcMap is closed.
4. **Double click** on Add-In file and **Click** OK to install the Add-In.
5. **Open** ArcMap. If the toolbar is not visible, make sure it is checked under the CUSTOMIZE/TOOLBARS… menu.

ArcMap Settings

Make sure the following settings and toolbars are enabled in ArcMap.

1. **Open** ArcMap.
2. **Turn** on following toolbars and organize them like the image below so you can easily find the tools you need (look under Customize menu >Toolbars). Toolbars displayed in next screenshot:
   a. CHaMP Topo Processing Toolbar
   b. 3D Analyst
   c. Editor
   d. Snapping
   e. Spatial Analyst
   f. TIN Editing

3. **Turn** on the 3D Analyst Extension.
4. The toolbar will now be available every time you use ArcGIS in the future.

Topo Processing Toolbar

The TOPO PROCESSING TOOLBAR is used to process data from a Total Station survey using CHaMP protocol standards and formats.
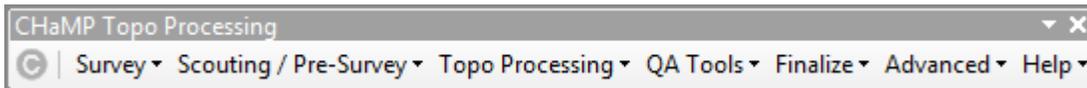
New for 2015, the Topo Toolbar now is *Project-Based* and uses a custom *Layer Manager* for organizing data inputs, outputs and map layers. Once the processing project is started, only a limited number of inputs are required by the tools.

The tools in this toolbar menu are listed in the order of the processing workflow. If you need to repeat a step in the process and use a tool a second time, *most tools will overwrite output datasets*.

Note
For each tool there is a help menu and tutorial video for each tool. Videos are available (both off and online) by clicking on the video icon in the lower left of each tool window.

 CHaMP Tool Help.

 CHaMP Help Video.

Survey Processing Workflow

To start processing a Survey,

1. **Start** ArcMap.
2. Save the Map Document to the same folder location as your data. For CHaMP surveys, this will be the "Topo" Folder for the Visit created by the CHaMP Data Broker.

Step 1: Create Survey GDB

This tool creates a new Survey Geodatabase (Survey GDB) and associated metadata files you will be using for the rest of the tools. Most of the GIS products of the CHaMP Toolbar processing steps will be saved to the Survey GDB. The rest of the data, including TINs, are saved in the same folder as the Survey GDB (i.e. "Topo" folder).

1. Open the SURVEY menu, **select** the CREATE SURVEY GDB" tool.
2. **Specify** the Output Folder:
   a. **Click** on the folder next to the Output folder box, and **navigate** to the folder where your geodatabase will be stored.
3. **Specify** the Site Information
   a. Site name or ID: This is the name of site from champmonitoring.org. Do not include the survey date.
      For this tutorial use "CBW05583-527786".
   b. Watershed: This is the name of watershed where site is located.
      For this tutorial use "Upper Grand Ronde".
   c. Stream name: This is the Stream name where site is located.
      For this tutorial use "Catherine Creek".
   d. Projection system:
      For this tutorial use "UTM Zone 11 N".
   e. VisitID: Specify the visit id for the survey
      For this tutorial use "2291".
   f. Field Season: Specify the year of the survey.
      For this tutorial, use "2014".
4. **Specify** the Survey Crew Information
   a. Organization: Name of organization that sampled the site.
      For this tutorial use the name of your organization.
   b. Survey Crew: Name of survey crew, as defined by the Crew Lead.
      For this tutorial use your name.
5. **Specify** the Visit Type

a. **Check** either "Initial visit" or "Repeat visit" depending on your survey data. An Initial Visit is used if the site has never been surveyed before, while repeat visit is used when a site has been surveyed at any point in the past.
For this tutorial, Check Initial Visit.

6. **Click** OK to run the tool. A success message will appear when the tool has completed successfully.

Survey Project Mode

Once the SurveyGDB is created, the Toolbar is in "Project-Mode". It will remember where the input data is stored, and it knows where the output data should be created. Only a few other inputs will be required, and these should be located in the same folder as the SurveyGDB.

At any point in the process, you may close the current Project SurveyGDB and open a different one using the CLOSE SURVEY and OPEN SURVEY tools.

If you close ArcMap, you will need to reopen the project you were working using the OPEN SURVEY tool. Most of the processing tools will remain locked until a new SurveyGDB Project is started, or a previous SurveyGDB project is opened.

Step 2: Process Total Station Instrument File

This tool processes total station instrument files, generating uncertainty values for every point, as well as assessing the quality of the total station survey, providing crews with feedback in the Validation window.

1. Under the TOPO PROCESSING menu, **select** PROCESS TOTAL STATION INSTRUMENT FILE.
2. **Specify** the Inputs for Total Station Files
   a. Instrument model: Select the instrument model from which the raw file is from.
      For this tutorial, select "Topcon Magnet v2.5.1".
   b. Instrument and Auxiliary Instrument files**:** Select the Instrument and Auxiliary Instrument files for the survey. The file type changes depending on which instrument model you selected.
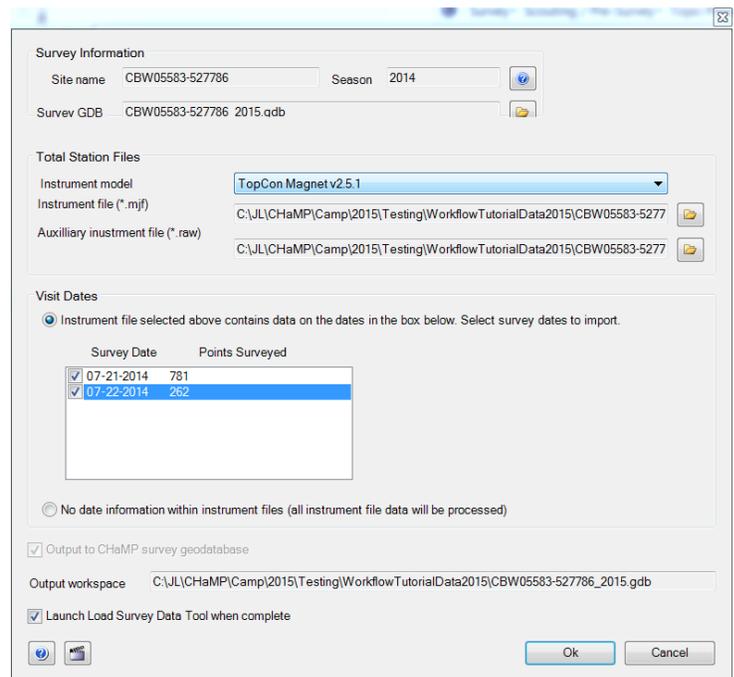
Instrument Model	Instrument File	Auxiliary Instrument File
Nikon/Survey Pro	*.raw	-none-
TopCon/Magnet	*.mjf	*.raw

For this tutorial, select ".mjf" *for the Instrument File and* ".raw" *for the Auxiliary Instrument File*

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2. **Specify** the Visit Date
   a. After the survey instrument file is specified, all of the survey dates in the file will populate, along with the number of points surveyed on each day.
   b. Check the box next to the relevant dates for the survey to be imported.
      i. *For this Tutorial use 7-21-2014 and 7-22-2014.*
      If no dates are found in the file, select "No date information within instrument files." The tool will process all of the survey points in the file.
3. **Click OK** to run the tool. A success message will appear when the tool has completed successfully.

Step 3: Load Survey Data to GDB

This tool loads the processed instrument point and line datasets into the survey geodatabase.

1. Under the TOPO PROCESSING menu, select the LOAD SURVEY DATA TO GEODATABASE tool.

2. **Specify** the Input Datasets:
   a. <u>Code field</u>: DESCRIPTION.
   b. <u>Point Number Field</u>: POINT_NUMBER.
   c. <u>Breaklines</u>: Add the polyline layer from the .dxf file in the topo folder.
   d. **LiDAR points**: Not needed for standard CHaMP survey--leave blank.
   e. <u>Instrument type</u>: Select *Total Station* for this tutorial.
   f. <u>Instrument model</u>: Select *TopCon Magnet* for this tutorial.
3. **Specify** the Imported Coordinate Type:
   a. Select the coordinate type of the raw file that was just imported. Choose one:
      i. "Assumed/Local (Unprojected)" for unprojected data (Initial Visit).
      ii. "Projected" for a repeat visit where the control network was successfully reoccupied.

      For This Tutorial, Use "Assumed/Local (Unprojected)"

4. **Click OK** to run the tool. This process may take several minutes. A success message will appear when the tool has completed successfully.
5. If the data is unprojected, the tool will remind you to proceed to the Transformation tool (Step 4). If the data is projected, you can start reviewing your survey data (Step 5).

Step 4: Coordinate Transformation Tool

If your data is unprojected, you will need to project it using the Coordinate Transformation tool. If the data is already projected, you can start reviewing your survey data (Step 6).

How do I know if my data is already Projected?

If these conditions are true, then your data is projected:
• The survey is a Repeat Survey
    o The Total Station must have successfully reoccupied the established control network
    o The Data is using UTM coordinates (i.e. x,xxx,xxx , xxx,xxx) instead of an Assumed coordinate system (i.e 1000, 2000)
• The survey is generated from RTK GPS or LiDAR (Initial or Repeat)

1. Add Base Imagery to your Map. The Coordinate Transformation tool is designed to work with aerial imagery as a base image on your map. There are two ways to do this:
   a. Strong Internet Connection: Click the small arrow next to this icon and select 'Add Basemap'. Select 'Imagery' and a background image should be added to your Map Window.
   b. No (or slow) Internet Connection: Use the "Add Data" button to add a base layer to the map. CHaMP Laptops have NAIP imagery preloaded in C:\\Base_Imagery\. The images are organized by county. For this tutorial, you may use C:\\Base_Imagery\Grant Count\vol1\ortho_1-2_1n_s_or023_2009_2.sid

Transformation Tool Window #1

The first page of the transformation tool sets up the projection and coordinate information for the benchmarks you will use to transform the data.

1. Output Coordinate System:
   a. Specify the Coordinate System (*UTM Zone 11 N* for the survey processed in this tutorial).
   b. The *Transformation* input should populate automatically. If not, choose the NAD_1983_To_WGS_1984_1.
2. Coordinate Entry:
   a. You can enter benchmark coordinates manually from field notes, or Load the Benchmarks from the provided *.csv file (*Benchmark.csv* in the *Topo* folder). We strongly recommend loading benchmarks from the .csv to avoid transcription errors. The Benchmarks.csv file is automatically generated by the CHaMP Data Broker application and should be available in your Topo folder after you have downloaded your data logger to the laptop.
   b. If you load from the .csv file the window below will appear after the file is selected.

      i.   Check the "Use Benchmark" box next to three of the benchmarks that you will use in the transformation.
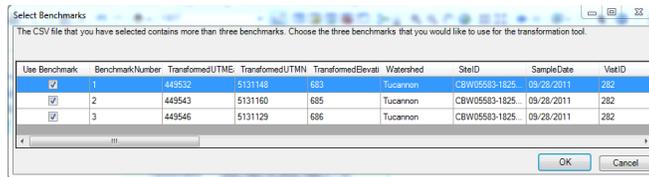
      ii.   Click OK

  c.   Choose the Projected radio button.

3. Output workspace:
     a.   Specify your <u>Survey GDB</u> as your Output Workspace (*Topo Folder*).
4. When all of the information is properly selected, the 'Select Inputs' button will become active. Select it to proceed to the next screen.

Transformation Tool Window #2

In this screen you will select the input data to be transformed with the benchmark information that was selected on the previous screen.

1. Input Data to be Transformed to UTM
     a.   Control Points: *Control_Point_Unprojected* should be automatically set.
     b.   The tool should find and list all of the Feature Classes in the Unprojected Dataset in the survey Geodatabase. If only one or two feature classes are listed, you may need to close out of the Transformation tool and select Coordinate Transformation from the Topo Processing menu and double check your input data and specifications.
2. Choose BMs From Control Point File:
     a.   **Attribute Field:** "DESCRIPTION".
     b.   **Select Hinge Point:** Choose the Benchmark you are most confident with. The tool will select the elevation and coordinates from this benchmark to project the survey data. You will get a chance to review all projections from benchmarks on the next screen. For this exercise, we are choosing the first benchmark in the list (3).
     c.   In the drop down menus next to each benchmark and <u>select the appropriate code</u> for each benchmark. The benchmark numbers loaded from the csv file appear in the parenthesis for each benchmark.
         i.   Benchmark (3): bm3
         ii.   Benchmark (2): bm2
         iii.   Benchmark (1): bm1
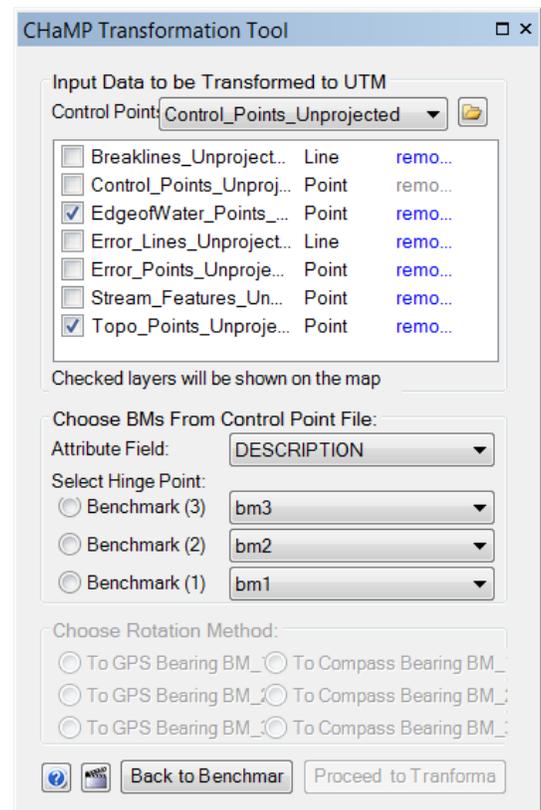
3. **Choose Rotation Method**: Once the benchmark hinge has been selected, the Rotation Method section should become active.
    a. Select one of the Rotation methods. It doesn't matter which one, as this will be reviewed on the next screen.
4. When all required information has been filled out for this screen, Proceed to Transformation will become active. Click on Proceed to Transformation to continue to the next screen.

Transformation Tool Window #3

In the final page of the Transformation Tool, you will visually inspect the different transformations and select the best one available.

1.
2. Review the Transformations:
    a. Cycle through the various Transformations by clicking through the different options. Watch what happens to the survey in the Map Window.
    b. Visually compare each survey to the base imagery and determine which transformation aligns the survey the best with the base imagery.
    c. Check the values listed in the Residual Error columns. Values closer to zero indicate a better fit and are more desirable. Try to pick a transformation with average/overall low values.
3. When you have found the best Transformation for the data with the best visual alignment with the imagery and best average/overall low residual error, click on the two confirmation checkboxes.
4. Click on the "**Save to File and Exit**" if you are finished.
5. The survey data is now projected and is added to the map.

CHaMP Transformation Tool

Residual Error Calculations

Transformation Hinge / Bearing	BM Rotated dH (m)	dZ (m)	Other BM dH (m)	dZ (m)
○ 1 / GPS 2	-0.13	-0.75	-0.06	-1.22
○ 1 / GPS 3	-0.60	-0.38	-0.93	-0.61
○ 1 / Compass 2				
○ 1 / Compass 3				
○ 2 / GPS 1	0.13	0.75	0.07	-0.47
◉ 2 / GPS 3	0.21	-0.08	0.57	0.68
○ 2 / Compass 1				
○ 2 / Compass 3				
○ 3 / GPS 1	0.60	0.38	-0.32	-0.23
○ 3 / GPS 2	-0.21	0.08	0.36	0.75
○ 3 / Compass 1				
○ 3 / Compass 2				

☑ Have you visually verified the transformation on the map

☑ Have you checked residual errors above?

Back to Inp | Cancel | Save to File and

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Step 5: Review and Edit Projected Survey Data

At this point, take a few minutes to quickly review all survey points and lines for any errors that were missed or overlooked. This is a good opportunity to repair any known errors as guided by your field notes.

More Information
The Vector Editing Tutorial describes how to perform the edits described in this section.

Review the Validation Panel

The Data Validation Panel provides warnings and errors in the survey data and GIS products for the user to review.
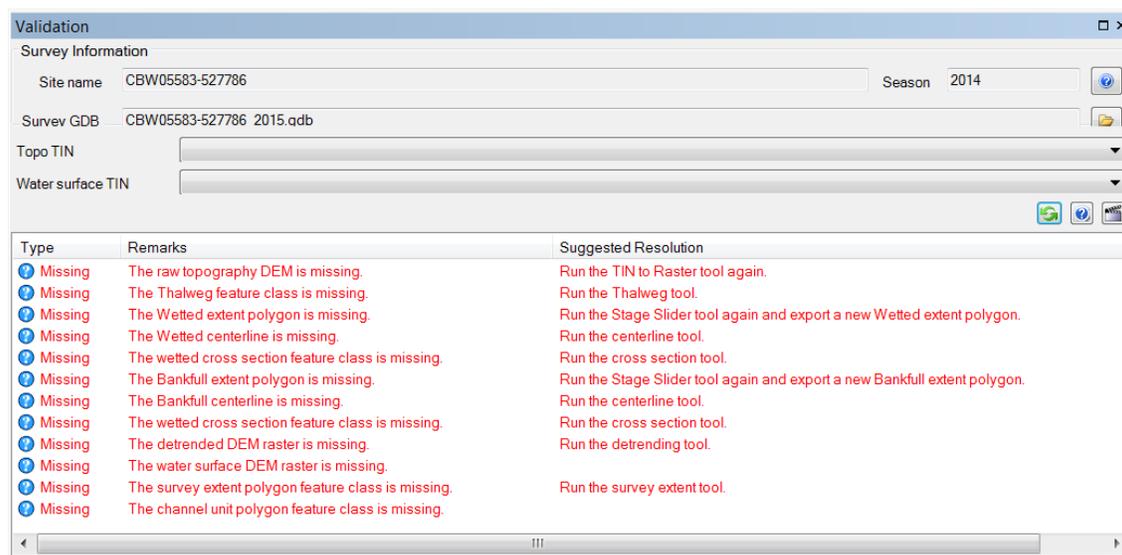
1. Under the QA TOOLS menu, **select** VALIDATE DATA.
    a. **Specify** the field "Season" for the survey data.
    b. **Specify** the Survey GDB for your survey data.
    c. **Click** the Green Arrow circle on the right side to run the validation.
2. When the tool completes running, **review** all validation checks.
    a. Yellow Messages indicate a warning (dataset should be examined for issues or problems).
    b. Red messages means error (dataset must be repaired).
    c. Blue messages means required data is missing or a tool has not yet been run. At this stage in the processing, you will see several of these messages. This is normal.
3. Focus on the following:
    a. Fix any Errors with Topo_Points, EdgeofWaterPoints, ControlPoints, StreamFeatures, ErrorPoints, or Breaklines.
    b. Review Warnings with "Process Total Station Instrument File" in the message. These are related to the raw survey information and cannot be fixed at this point. Use this information to help improve your surveying technique in future surveys.

Each error/warning message will also have a suggested repair method to help you determine your next course of action to resolve the issue.   If you are uncertain of the meaning of the message, contact your Crew Lead, kelly@southforkresearch.org, or champtools@northarrowresearch.org.

You can rerun the Validation Panel at any point in the processing workflow by clicking the green arrow circle.

Survey Data Check Tool

This tool makes sure that the description codes of the Survey Points are correct, the points are located in the correct feature class, and calculates QA metrics on the survey data and stores information in tables within the Survey Geodatabase.

This tool should be run anytime edits are made to the Survey Data (Topo Points, Edge of Water Points, Control Points, Error Points, Stream Features, or Breaklines).
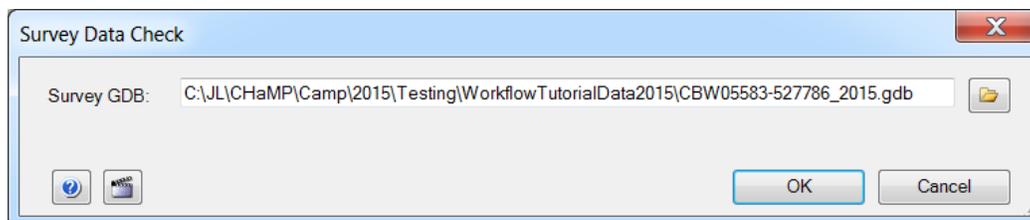
1. Under the QA TOOLS menu, **select** the SURVEY DATA CHECK tool.
2. **Click OK** to run the tool.
3. A "Success" message will appear when the tool has completed running.

Review the Error Points Layer

This layer contains points that have description codes that are inconsistent with the CHaMP Protocol. These points are "quarantined" and will not be used in any of the processing steps.

1. **Open** the Attribute Table of this layer to see if there are any records present.
2. If you want to move any point(s) back to their feature class, you will need to update their description code:
    a. **Open** the Attribute Table for the Error Points Layer and start an edit session.
    b. **Select** the Point(s) you want to update
    c. **Correct** the description code(s) for those points.
    d. **Save** your edits and stop the edit session.
    e. **Run** the Survey Data Check tool to move these points to the correct feature class.

Review Survey Points

Review the Topo Points, Edge of Water Points, Control Points and Stream Features Layers to make sure these points are coded properly (left/right banks, top/toe banks, etc.) and are in the correct location.

1. To Fix an error in one of these layers, first start an Edit Session
    a. Change the Description Code:
        i.   **Open** the Attribute Table for the Error Points Layer and start an edit session.
        ii.   **Select** the Point(s) you want to update
        iii. **Correct** the description code(s) for those points.

  b. Point in a bad location

    i. Do not move survey points. Since they represent a sampled location in the landscape, moving points reduces the survey data integrity.

    ii. Instead, spatially erroneous points should be deleted

2. When all changes have been made, **Save the edits** and **stop the edit session**.

3. **Run** the Survey Data Check tool

Review the Breaklines Layer

The Breaklines layer needs to adhere to a strict set of rules to maintain survey data integrity.

To make changes to the Breaklines layer:

1. Start an Edit Session.

2. **Check** the following in the Breaklines Layer:

  a. Make sure all lines are connected that need to be connected.

  b. Make sure each Breakline Vertex is snapped to a Survey Point (Topo or Edge of Water).

  c. Make sure each Breakline has a correct description code and LineType (HARD, SOFT or NONE).

  d. Uncross any Hard Breaklines

    i. Split the line along vertices and delete the segment in-between.

    ii. If a vertex is *slightly* (within a few centimeters) causing two lines to cross, move both the line vertex and coincident point to the other side of the line to uncross the pair. Make sure the line vertex and point are snapped together!

3. **Save your edits** and stop the edit session.

4. Under the QA TOOLS menu, **select** the ADD Z VALUES TO BREAKLINE tool.

  a. **Specify** the <u>Survey Geodatabase</u>.

  b. **Click OK** to run the tool. A "Success" message will appear when the tool has completed running.

5. **Re-Run** the validation panel, and look for any errors found in the Breaklines dataset. Fix these errors before proceeding.
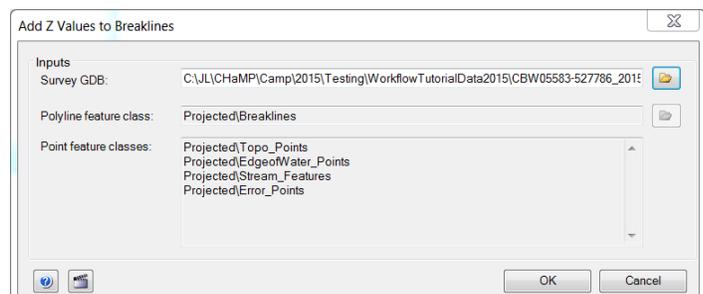
Step 6: Create Survey Extent Polygon

The survey extent polygon is used to define the area of interpolation for the TIN. The CREATE SURVEY EXTENT POLYGON tool generates an initial polygon with a "Concave Hull" that generally follows the shape of the survey points. You will need to make fine-scale edits to the polygon after it is generated.

1. Under the TOPO PROCESSING menu, **select** CREATE SURVEY EXTENT POLYGON.
2. **Specify** the <u>Tolerance</u> (in meters). This will determine how much edge extrapolation will happen in the auto generation of the survey extent. Think of this as the maximum edge length between points on the edge of the survey.
     i. Use larger values (15 to 20) for larger sites (more than 120 m to 600 m long).
     ii. Use smaller values (5 to 10) for smaller sites (120 m long).
3. **Click OK** to run the tool. A completion message will appear when the tool has finished running, and the Survey Extent Polygon will be added to the map.
4. **Review** the <u>Survey Extent</u> polygon to make sure all topo points and lines are within extent of survey extent polygon. All points should be within the Survey_Extent polygon except the Control Points, which may be located outside of the polygon. Do not edit the Survey_Extent polygon to include the control points.
     a. If the survey extent didn't follow the outside edges of the point cloud well, **rerun** the tool and change the edge tolerance, if needed:
         i. If holes appear in the polygon, or significant areas seem to be excluded, increase the tolerance.
         ii. If a significant amount of extra space appears between points (especially around meanders or bends), decrease the tolerance.
5. Once the overall shape of the <u>Survey Extent</u> polygon is correct:
     a. Review the sides of the survey (i.e. banks, floodplain) for any deviations in point density where the Survey Extent should be adjusted.
         i. **Edit** the <u>Survey Extent</u> polygon as needed using the "Editor" toolbar. Make sure point snapping is turned on and **always snap the Polygon vertices to survey points. Refer to the Vector Editing tutorial for additional details on how to do this process.**
     b. Review the cross-channel transects at top/bottom of site. The <u>Survey Extent</u> should be adjusted to exactly follow the each point along the transect. Refer to the vector editing tutorial for an example of survey extent editing.
         i. **Edit** the <u>Survey Extent</u> polygon as needed using the "Editor" toolbar. Make sure point snapping is turned on and **always snap the Polygon vertices to survey points.**
6. **Save** any edits made to the Survey Extent Polygon, and end the "Editing Session".
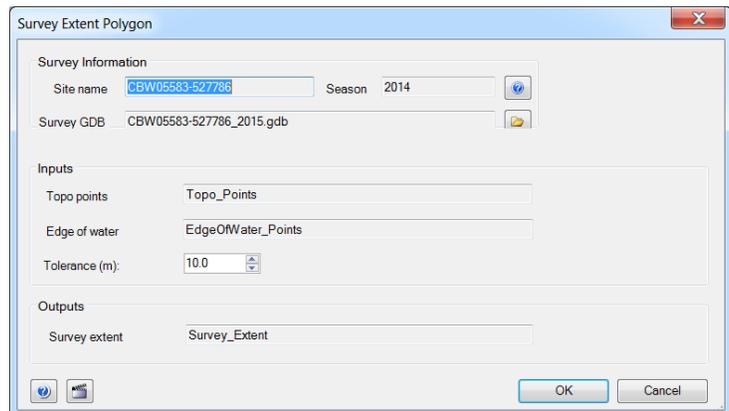
Step 7: Create a Topo TIN from Survey Points

The TIN (Triangulated Irregular Network) surface is a 3D representation of the survey points and lines collected in the field and is used to interpolate the surface between the points and lines. The TIN is confined to the area of the Survey Extent. Topo Points, Edge of Water Points, Breaklines, and the Survey Extent Polygon are used as inputs to generate TIN.
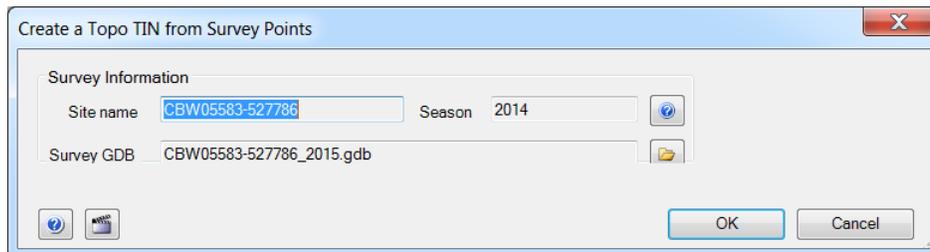
1. Under the TOPO PROCESSING menu, **select** CREATE A TOPO TIN FROM SURVEY POINTS**.**
2. **Click OK** to run the tool. When the tool has completed running, a new TIN will appear on the map.
3. **Review and Edit** the TIN for survey or interpolation errors (refer to the TIN Editing Tutorials):
   a. Bust and Sink points. These often show up as shadowed areas or colors unlike adjacent colors (aka anomalies).
   b. Artificial ridges and troughs.
   c. Artificial cross channel dams.
   d. Artificial dams at end of surveys.
   e. Notches or Prisms along stream edges
   f. Crossed hard breaklines.
   g. Any other abnormal looking areas in the TIN.
4. **Review** areas of the TIN that are prone to errors:
   a. Side channels, backwater areas, and other areas with low point densities.
   b. Steep banks, especially those that are near-vertical.
   c. Complex topography.
5. **Check areas** of notable features to make sure they were surveyed accurately:
   a. Large boulders, log jams, other features delineated with breaklines.
   b. Side channel confluences, large meanders, steep stream sections or other features that stand out.
6. **Final Review of TIN**: Once all of the issues have been repaired, scan the TIN for errors that may have been missed or that have become noticeable due to the repairs that have been made. Remember, when one part of a TIN is changed, the surrounding area will change too.
7. **Save the edits** to the TIN.

Step 8: Convert a Topo TIN to a DEM

A DEM (Digital Elevation Model) is a raster dataset created by sampling the TIN elevations at a 10x10 cm cell resolution. The DEM is easier to use for different types of spatial analysis and metric generation but is difficult to edit.

1. Under the TOPO PROCESSING menu, **select** CONVERT A TOPO TIN TO A DEM**.**
2. **Select** the name of the correct Topo TIN from the drop down, if more than one TIN is listed.
3. **Click OK** to run the tool. When the process has completed, click OK on the success message. A DEM and Hillshade layer will be added to the "Table of Contents".
4. **Review** the DEM and make sure the surface doesn't have any odd color banding, which would indicate an error.
    a. If any errors are discovered, return to the TIN editing step to make any necessary changes
    b. Then, **rerun** the CONVERT A TOPO TIN TO A DEM tool.
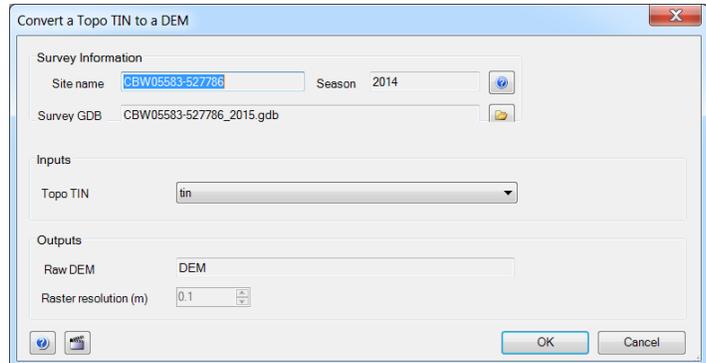
Step 9: Detrend a DEM to Remove Slope

1. Detrending is the process of removing the downhill slope (in this case, represented by the slope of the water surface) from the Topo DEM and making it 'level.' The stream bed topography is retained but there will be no elevational change between the top and bottom of the survey. This allows water stage height to be modeled on the DEM. Under the TOPO PROCESSING menu, **select** DETREND A DEM TO REMOVE VALLEY SLOPE.
2. **Click OK** to run the tool.
3. A Detrended DEM will be added to the map once this step is complete
4. **Briefly review** the Detrended DEM. In general, pools (channel features with low relief) should be blue, and banks should be green.
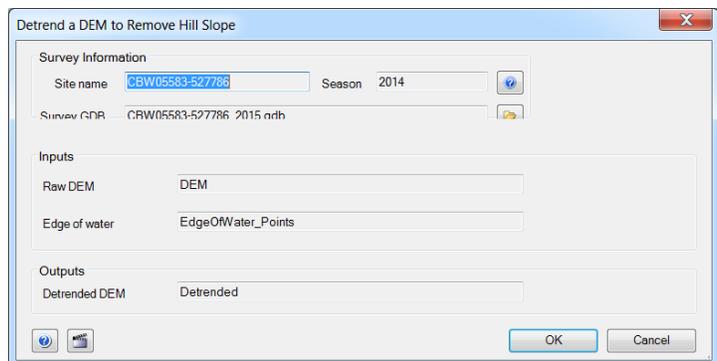
> **NOTE**
> The Detrending process may take up to 10-15 minutes for very large sites.

Step 10: Create Wetted and Bankfull Polygons

This step involves modeling the wetted and bankfull stage heights using the Detrended DEM. **This 'slider tool' will be run 2 times, once to create a wetted polygon and once to create a bankfull polygon.**

Create the Wetted Polygon

1. Under the TOPO PROCESSING menu, **select** the CREATE WETTED AND BANKFULL POLYGONS tool**.**
   a. The "Stage Slider" panel will appear next to the "Table of Contents".
   b. **Specify** the Detrended DEM**:** Select the Detrended DEM from your Survey GDB.
2. Click on "Add Reference Points"
   a. Reference Points Represent**:** Make sure to select "EdgeofWater_Points"
   b. Make sure the checkbox for "Move the stage slider to the average elevation of the chosen points" is selected.
   c. **Click OK**.
3. **Click** the REFRESH button.
4. Review the blue area in the Map Window--this represents the 'wetted' area of your survey.
   a. **Move** the "Slider Bar" (or the" Up and Down Arrows") to best fit the blue polygon to the "EdgeofWater_Points". This is changing the elevation at which the water stage is set.
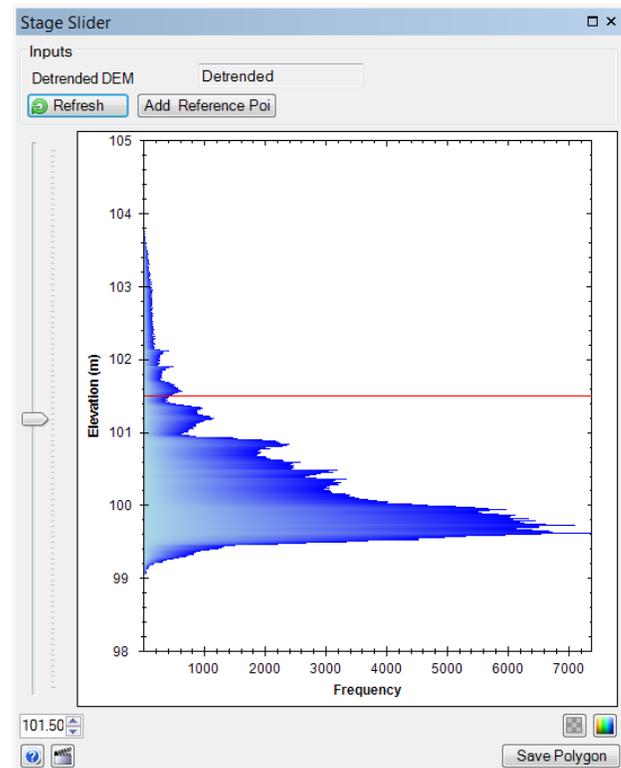
Note

Not all points may be on the edge of the polygon--this is ok. Focus on making the blue polygon fit most of the points, or areas that were surveyed well and are very important (e.g. the main channel edges are likely better represented than a backwater area). You will have the opportunity to edit the polygon to remove bad sections.

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5. When the blue area adequately represents the wetted area of the stream, **Click** the SAVE POLYGON button (located on the bottom of the Panel).
   a. **Specify** "Wetted Polygon" from the drop-down menu.
   b. **Specify** a filter to remove small artificial features from the final output (or leave to the default setting of $1m^2$).
   c. **Click OK** to save the WaterExtent ("Wetted") polygon.

Create the Bankfull Polygon

6. **Repeat** the previous steps to create the Bankfull Polygon:
7. **Click** on "Add Reference Points"
   a. Reference Points Represent**:** Bankfull

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b. Make sure the checkbox for "Move the stage slider to the average elevation of the chosen points" is selected.
c. **Click OK.**
8. **Click** the REFRESH button.
9. **Review** the blue area in the Map Window--this represents the 'bankfull' area of your survey.
    a. Use the "Slider Bar" or the" Up and Down Arrows" to best fit the blue polygon to the "Edge of Water" points. This is changing the elevation at which the water stage is set.

> **Note**
> Not all points may be on the edge of the polygon--this is ok. Focus on making the blue polygon fit most of the points, or areas that were surveyed well and are very important (e.g. the main channel edges are likely better represented than a backwater area). Since Bankfull points have more uncertainty than edge of water points, you will have to use more judgment when fitting the bankfull polygon.

10. When the blue area adequately represents the bankfull area, **Click** the SAVE POLYGON button (located on the bottom of the Panel).
    a. S**pecify** "Bankfull Polygon" from the drop-down menu.
    b. **Click ok** to save the Bankfull polygon.
11. **Close** the STAGE SLIDER panel.
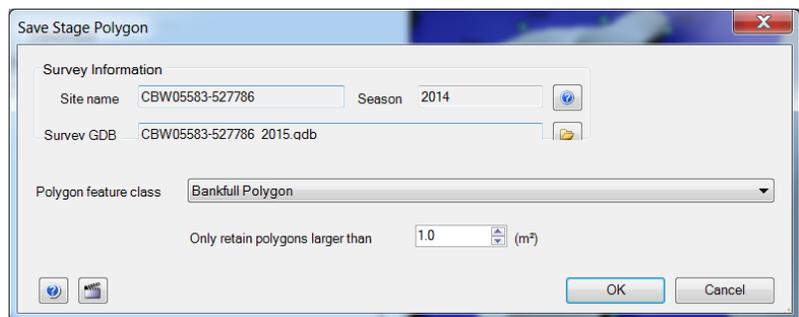
Review and Edit the Extent Polygons

1. Use the "Editor" toolbar to edit the two polygons.
    a. **Remove** tiny artificial holes within the polygons that you know are not accurate with the site water extent:
        i. Double Click on the polygon to show the vertices.
        ii. Zoom in to one end of the polygon.
        iii. **Pan** across the polygon and **Scan** it for tiny triangular or square holes using. You should be able to see the vertices inside the polygon.
        iv. Use the Delete Vertex tool to remove these small, artificial donuts.
    b. **Open** the attribute table of the WaterExtent and remove any polygons that have very small areas (delete them during an editing session). Do the same for the Bankfull_polygon.

> **Main Wetted and Bankfull Extent**
> There should only be one large, main polygon that represents the extent of the flowing channel and connected off channel areas, and one large polygon for the Bankfull Extent. These should have the attribute "Channel" in the "Extent" field.
>
> All other polygons should have no value for "Extent".

2. **Save** any edits and close the edit session.

3. Refresh and Review the Validation Tool Panel for Warnings and Errors. Make sure all available inputs are selected.

Step 11: Digitize Channel Unit Polygons

Channel Units are identified in the field and captured by using "Unit Boundary" points in the survey. Since crew judgment is needed in determining the arrangement of these polygons, they need to be created (digitized) manually.

1. Under the TOPO PROCESSING menu, **select** the DIGITIZE CHANNEL UNIT POLYGONS tool**.**
   a. Check the box next to "Create new channel unit feature class"
   b. Click OK to add a new *empty* Channel Units layer to the map. *There currently are no features from this layer, so none will show up in the Map Window!*
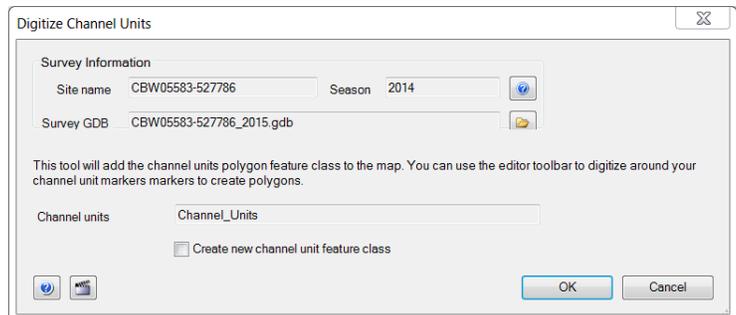

2. **Roughly digitize** the Channel Unit Polygons based on the channel unit markers that were collected in the field. On the "Editor" toolbar **Click** "Start Editing" to start an edit session and "Select the Create Features" tool:

   a. In the "Create Features menu" of the Editor tool, **select** "Channel Unit 01".
   b. In the bottom of the Create Features window under Construction Tools**, select** "Polygon".
   c. In the MAP WINDOW**, pan** to the u1 channel unit marker as a starting point for your polygon.
   d. **It is ok to digitize** the channel unit polygons **LARGER** than water surface extent polygon (in width across stream), but make sure they are DETAILED within the water surface polygon. Avoid creating overlapping or gaps between units. **Snap** them to Channel Unit flag u1. See Vector Editing tutorial for instructions on turning on Snapping. It's likely your computer is already set to these settings.
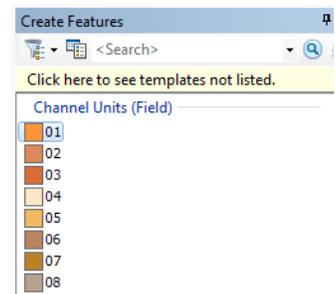
   e. **DO NOT** need to follow the exact boundaries of the channel units; you just need a rough outline. See image of example for channel units 6 and 7. See how boundaries follow flags IN the channel, but are sloppy outside of the wetted extent.
   f. Continue clicking to generate vertices and digitize the polygon until you reach u2 flags.
   g. **Double Click** OR Right Click/Finish Sketch to end a unit.

3. Repeat this digitizing process for all channel units in the site.
4. **Stop Editing** after all units complete and **Save Edits**.
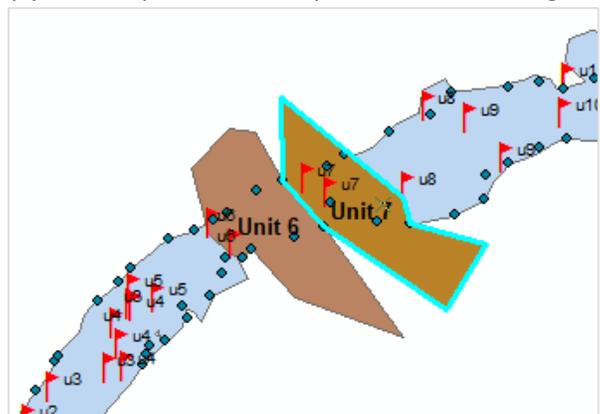
Step 12: Create Stream Surface TIN, DEM and Water Depth Raster ⬤

This tool generates a Water Surface TIN, water surface DEM, and Water Depth raster, and clips the Channel Units to the Wetted polygon.

1. Under the TOPO PROCESSING menu, **select** the CREATE STREAM SURFACE TIN, DEM AND WATER DEPTH tool.
2. **Specify** the Channel unit CSV file: **Select** the ChannelUnit.csv file in the Topo Folder (like the Benchmarks.csv file, this is automatically created by the data broker after you download the visit from the data logger to your laptop).
3. **Click OK** to run the tool. Layers will be added to the map when the tool has completed successfully.
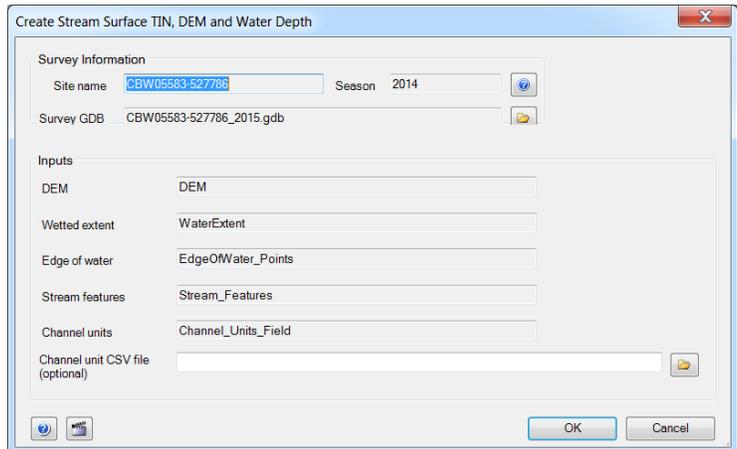
4. **Review** the <u>Water Depth</u> layer with the <u>Channel Units</u> layer to make sure they are generally in agreement (i.e. pools should have a deep blue color compared to riffles, etc.). If you can't see the new layers, make sure they are visible in the "Table of Contents" and are the topmost layers.
5. **Review** the Water Surface TIN (WSETIN). The review of the WSETIN is more straightforward than the review of the Topo TIN:
   a. **Review** color banding in WSETIN. The WSETIN should be a continuous 'rainbow' of color from one end of the site to the other.
   b. **Review** the WSETIN for bust or sink points. These will show up as colored pyramids in the WSETIN.
      i. If any error is found in the WSETIN, Go back and edit the <u>Edge of Water Points then,</u> <u>resume processing from Step 8: Create a topo TIN from Survey Points.</u>

Step 13: Generate Error and Associated Surfaces

The Derive Associated and Error Surfaces tool generates surfaces used for analyzing Geomorphic Change Detection.

1. Under the TOPO PROCESSING menu, **select** the DERIVE ASSOCIATED AND ERROR SURFACES tool.
2. Make sure that the correct TIN and Channel Unit CSV files are specified.
3. Click OK to Run the tool

There are no outputs that need to be reviewed.
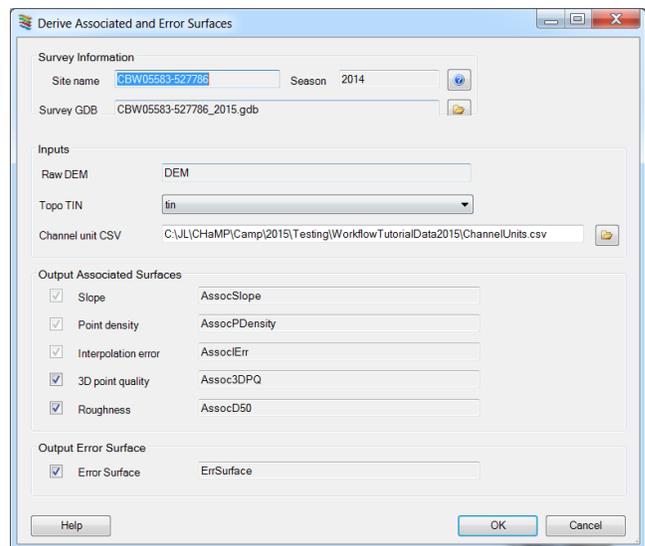
Note

⏰ This tool may take several minutes to run, especially for very large surveys.

Step 14: Create a Thalweg

The Thalweg represents the deepest part of the channel where the stream generally flows the fastest. The create Thalweg tool generates a topographically derived Thalweg line through the survey data. It does NOT use crew collected thalweg points (wg). These are used to visually validate the tool-generated thalweg.

1. Under the TOPO PROCESSING menu, **select** the CREATE A THALWEG tool.
2. **Set** the initial parameters:
    a. Inflow code: point description code used for the inflow point ("in").
    b. Outflow code: point description code used for the Outflow point ("out").
    c. Pool weight: 10.0. A pool weight will skew how much a pool will influence the thalweg. If you need a thalweg to be closer/change location in a pool, increase the weight.
    d. Smoothing Tolerance: 5.0
3. **Click OK** to generate the thalweg. A "Success" message will appear when the tool has completed running and the thalweg will appear in the map window.
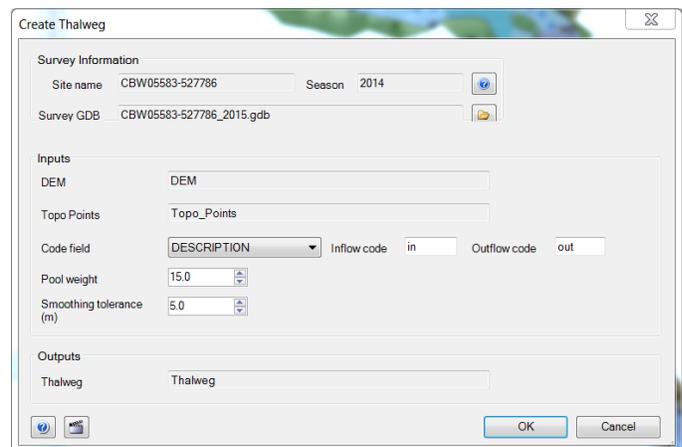
4. **Review** the "Thalweg" line in the map window. If needed, you can change the symbology for the "Thalweg" line to make it more visible. Refer to Intro to GIS tutorial for instructions on how to do this.
   a. Check to make sure "Thalweg" line generally follows the field-specified Thalweg points (wg). The "Thalweg" line does not have to 'pass through' every 'wg' point collected by the crews, but should at least pass nearby.
    b. Make sure the "Thalweg" line stays inside of the "Water Extent" polygon and remains on the "DEM".
    c. Review top/bottom of survey to make sure the "Thalweg" line begins/ends near the *in* and *out* points.
5. If there are problems with the "Thalweg" line:
    a. **Re-run** the CREATE A THALWEG tool using different pool weight and smoothing tolerances.
        i. Increase the pool weight by increments of 10 or so if the Thalweg Line appears to 'cut off' meanders or avoids some of the deep pools.
        ii. Increase or decrease the smoothing tolerance by 1-2m increments to adjust how 'rough' or jagged the line looks.
    b. If the pool weight has been increased to a value of 50-100 and the "Thalweg" line is still not following the main channel, then **Manually Edit** the Thalweg using the EDITOR Toolbar. Follow the general path of where the thalweg should be, but *do not snap* to the surveyed thalweg ('wg') points. Make sure to Save your Edits to the Thalweg.

Step 15: Create a Centerline (Wetted and Bankfull Centerlines)

The Centerlines represent the geometric centers of the Water Extent and Bankfull polygons. You need to run the tool twice, once to generate the Wetted Centerline and a second time to generate the Bankfull Centerline.

1. Under the TOPO PROCESSING menu, **select** the CREATE A CENTERLINE tool.
    a. Step 1: Generate Island Polygons
        i. Select the Wetted radio button. Click on 'Generate Island Polygons'
        ii. Review the Channel Outline that appears in the map window. The Channel outline should follow the water extent.
    b. Step 2: Classify Qualifying Islands. CHaMP surveys have specific definitions of a qualifying and non-qualifying island. Review these definitions in your CHaMP Protocol.
        i. Review each island in the Wetted Extent Island Layer. You can do this by opening the attribute table of the Wetted Extent Islands (right click on wetted extent islands and select Attribute table) or by viewing these in the map window. Islands are determined by what codes were used in the field. If a code mistake was made, you can decide which polygons in the channel are qualifying vs. non-qualifying islands. **Note that islands should be identified properly if the correct codes were made in the field, and the qualifying/non-qualifying status of an island should be done sparingly and with care.**
        ii. If a Qualifying island is identified as a Non-Qualifying, select the polygon and then click on the "Classify Current Selection as Island" button in the Centerline window.
        iii. Conversely, if a Non-Qualifying island is identified as Qualifying, select the polygon and click on the "Classify Current Selection As Non-Island" button in the Centerline window.
        iv. Once all qualifying and non-qualifying islands have been reviewed, move on to Step 3.
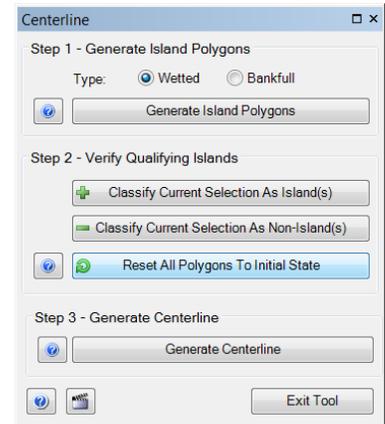
    c.   Step 3: Generate Centerline.
        i.   Click on the Generate Centerline button to create a wetted centerline.

2. **Review** the Wetted Centerline:
    a.   The Centerline should generally run down the center of the Water Extent
    b.   The Centerline should go around Qualifying Islands and should NOT go around Non-Qualifying Islands. If this is not generated properly, review the island qualifying status and rerun the Generate Centerline step.
    c.   Check to make sure the ends of the centerline do not bend. If they do, manually move the vertices of the line to the center of the wetted channel (using the "Editor" toolbar). See Vector Editing tutorial for example of bent ends of centerlines.
    d.   If the centerline was edited, remember to save your edits.

3. **Repeat** these same steps to create Bankfull Extent Islands and a Bankfull Centerline. Once again, under the TOPO PROCESSING menu, **select** the CREATE A CENTERLINE tool.
    a.   Step 1: Generate Island Polygons
        i.   Survey GDB: Select the Bankfull Extent Feature Class from the Projected Feature Dataset of your Survey GDB.
        ii.   Select the Bankfull radio button. Click on 'Generate Island Polygons'
        iii.   Review the Channel Outline that appears in the map window. The Channel outline should represent the Bankfull Polygon.
    b.   Step 2: Classify Qualifying Islands, using the definitions specified in the CHaMP protocol.
        i.   Review each item in the Bankfull Extent Island Layer. You can do this by opening the attribute table of the Bankfull Extent Islands (right click on wetted extent islands and select Attribute table) or by viewing these in the map window.
        ii.   If a Qualifying island is identified as Non-Qualifying, select the polygon and then click on the "Classify Current Selection as Island" button in the Centerline window.
        iii.   Conversely, if a Non-Qualifying island is identified as Qualifying, select the polygon and click on the "Classify Current Selection As Non-Island" button in the Centerline window.
   iv.   Once all qualifying and non-qualifying islands have been reviewed, move on to Step 3.
    c.   Step 3: Generate Centerline.
        i.   Click on the Generate Centerline button to create a centerline.

4. **Review** the Bankfull Centerline.
    a.   The Bankfull Centerline should generally run down the center of the Bankfull Extent
    b.   The Bankfull Centerline should go around Qualifying Islands and should NOT go around Non-Qualifying Islands. If this is not generated properly, review the island qualifying status and rerun the Generate Centerline step.
    c.   **Check** to make sure the ends of the centerline do not bend. If they do, manually move the vertices of the line to the center of the wetted channel (using the "Editor" toolbar). See Vector Editing tutorial for example of bent ends of centerlines.
    d.   If the centerline was edited, remember to save your edits.

5. Refresh and Review the Validation Tool Panel for Warnings and Errors. Make sure all available inputs are selected.

Step 16: Create Cross Sections

This tool will generate Cross Sections that are perpendicular to the centerlines at 0.5 m intervals for the entire site. **This tool will be run twice:** once to generate cross sections for the wetted centerline and once to generate cross sections for the bankfull centerline.

1. Under the TOPO PROCESSING menu, select CREATE CROSS SECTIONS.

2. **Generate Cross Sections**

    a. **Type:** Select "Wetted".

    b. Click the "Generate Cross Sections" button.

    c. When the tool has completed processing, the Cross Sections will be added to the Map Window.

3. Review the Wetted Cross Sections

    a. Since the geometry of every site is different, the cross section tool sometimes generates cross sections that are not perpendicular to the stream channel and should be flagged as invalid. Invalid cross sections will not be used to generate CHaMP metrics and will appear in gray. Review the Cross Sections in the Map Window.

    b. If an invalid cross section is identified that is not already gray, select (highlight) this cross section using the Select Features tool by clicking on it and then hit the 'Classify Current Selection as Invalid" in the Step 2 window of the Create Cross Section panel. This will flag the cross section as invalid.

    c. Conversely, if an invalid cross section is identified and needs to be flagged as valid, select the gray cross section and then hit the 'Classify Current Selection as Valid" button in Step 2 of the Create Cross Section panel.

    d. Continue reviewing all cross sections until all invalid cross sections are flagged and you're satisfied with the valid cross sections.

4. Run the tool again to generate the Bankfull Cross Sections.

    a. **Survey GDB:** Select the name of your Survey GDB.

    b. **Type:** Select "Bankfull".

    c. Click the "Generate Cross Sections" button.

    d. When the tool has completed processing, the Cross Sections will be added to the Map Window.

5. Review the Bankfull Cross Sections

    a. Since the geometry of every site is different, the cross section tool sometimes generates cross sections that are not perpendicular to the stream channel and should be flagged as invalid. Invalid cross sections will not be used to generate CHaMP metrics and will appear in gray. Review the Cross Sections in the Map Window.

    b. If an invalid cross section is identified that is not already gray, select (highlight) this cross section using the Select Features tool by clicking on it and then hit the 'Classify Current Selection as Invalid" in the Step 2 window of the Create Cross Section panel. This will flag the cross section as invalid.

    c.   Conversely, if an invalid cross section is identified and needs to be flagged as valid, select the gray cross section and then hit the 'Classify Current Selection as Valid" button in Step 2 of the Create Cross Section panel.

    d.   Continue reviewing all cross sections until all invalid cross sections are flagged and you're satisfied with the valid cross sections.

This is the LAST step in processing your survey data. We will now validate the Survey GDB and TIN again and then finish by packaging and publishing the data for champmonitoring.org.

Step 17: Validate Data Tool (QA Tools Menu)

Run a final validation check on your data before publishing. Remember, this tool can be accessed from the QA Tools menu and run at any time during processing, and can help you find errors in your data early.
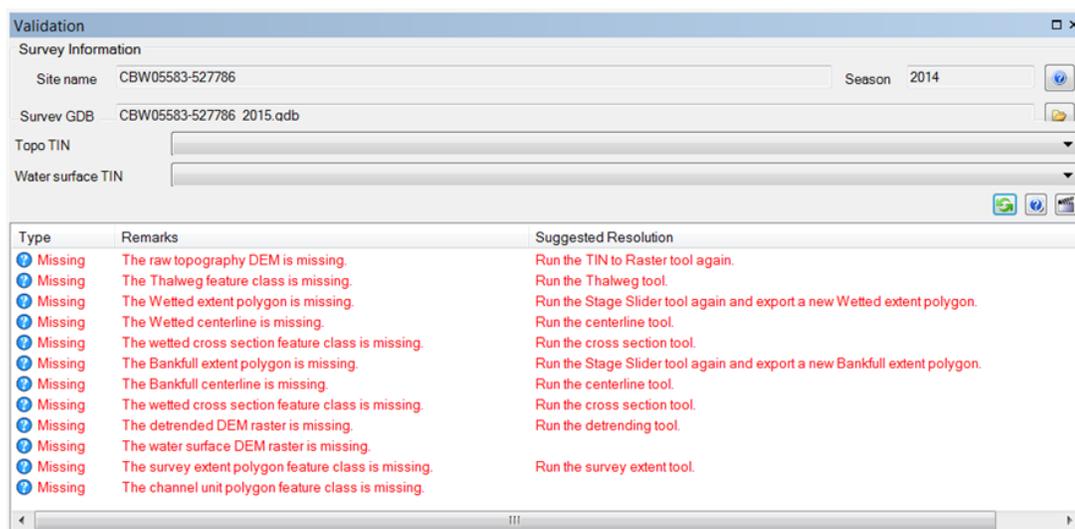

1.   Under the QA TOOLS menu, **select** VALIDATE DATA.

    a.   Specify the Topo TIN, if needed.

    b.   Specify the Water Surface TIN, if needed.

    c.   **Click** the green "Refresh Button" (circled in red) to activate the validation tool.

2.   When the tool completes running, review all validation checks.

    a.   Green means good (all clear--nice job!)

    b.   Yellow Messages indicate a warning (processing/publishing still possible).

    c.   Red messages means error or review (processing/publishing not possible until error is resolved).

    d.   Blue messages means required data is missing or a tool has not yet been run.

3.   Each error/warning message will also have a suggested repair method to help you determine your next course of action to resolve the issue.   If you are uncertain of the meaning of the message, contact your Crew Lead, kelly@southforkresearch.org, or champtools@northarrowresearch.org

4.   The Validation can be run and refreshed at any time during the process. This may be useful if you can't remember where you left off in the workflow.

Step 18: Add a Note to Survey Geodatabase Tool (QA Tools Menu)

If a survey has required intensive editing of any kind, we strongly suggest adding a note to the survey geodatabase to record this. Other reasons to add a note may include special processing, such as survey merging, instrument issues, protocol issues, or site-specific notes, such as improvements that should be made in next year's survey. This is an OPTIONAL TOOL and it is possible to publish without utilizing this tool. It may be useful if there is something outstanding or special about a survey that you want to record.

1. Under the QA TOOLS menu, **select** ADD A NOTE TO THE GEODATABASE.
    a. Specify the Survey GDB for your site.
    b. Enter a short note (1000 characters or less) to document an error or concern about the Survey data.
    c. **Click OK** to run the tool. A "Success" message will appear when the tool has completed running.
2. This tool can add as many notes as needed for the survey. They will remain inside of the Survey GDB and will be displayed on champmonitoring.org.
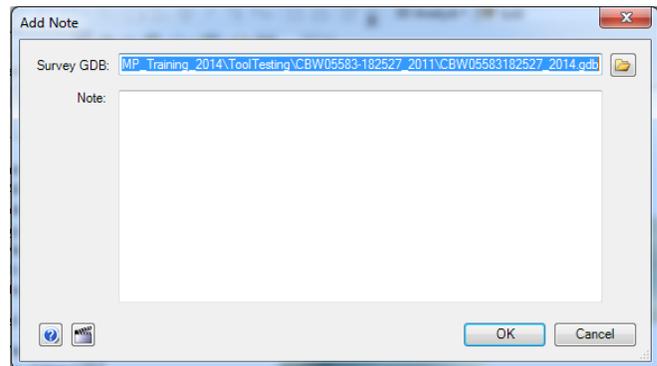
Step 19: Generate Map Images Tool (Finalize Menu)

Map images are 'quick' maps of topographic products that may be useful for later data review or sifting through sites and will be available on champmonitoring.org.

1. Under the FINALIZE menu, **select** the GENERATE MAP IMAGES tool.
    a. Leave the "Zoom" input at "120%".
    b. The output folder should be the *Topo Folder* for your survey data.
    c. **Click OK** to run the tool.
2. You can review the images after the tool has completed running by leaving the box 'Open folder on successful completion' checked.
3. If the images look ok, continue. If there is something wrong with data on the image, review the data within your Survey GDB that is on the map and pick up in the processing steps to remake an item.
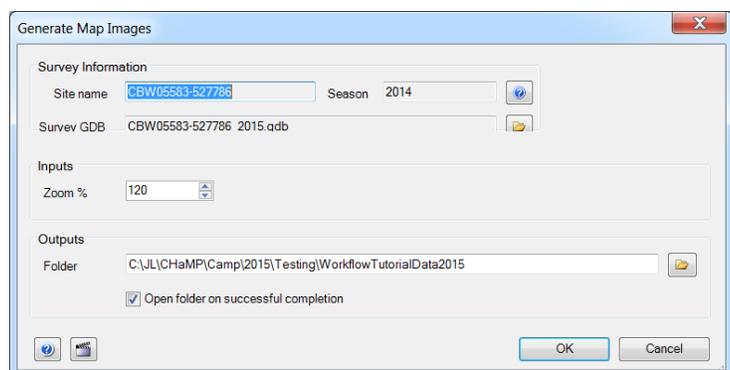
Step 20: Publish Final Geodatabase Tool (Finalize Menu)

Use the Publish tool when you have completed processing your site. This tool makes the Topo data available to the CHaMP data broker on your laptop, which in turn will upload the data to CHaMPmonitoring.org. **If your survey geodatabase has any issues, the publish tool can submit the data to the cloud for review by a Crew Supervisor or the Program GIS Analyst (kelly@southforkresearch.org).** The Publish tool **WILL NOT** publish your geodatabase as "Final" until the survey has cleared all of the data validation checks.

1. Under the "Finalize" menu, **Select** "Publish Final Geodatabase"**. For this tutorial, we will practice publishing a FINAL version of the data.**
   a. Select your "Publish Action":
      i. Publish Final Version: Publish a final version of the data that will be uploaded to champmonitoring.org and used for metric generation.
      ii. Submit draft for review: Publish a DRAFT version of the data that can be reviewed by Crew Leads, Supervisors, or the Program GIS Analyst (**Note: if data fails validation rules, this will be the only option available**).
   b. Specify the "Site Name" for your survey data.
   c. Specify the "Date" of your survey.
   d. Specify the Survey Geodatabase.
   e. Specify the Topo TIN.
   f. Specify the Water Surface TIN (WSETIN).
   g. Select the Survey Instrument Files for your survey (i.e. .job and .raw).
   h. Specify the Converted Survey Files for your survey (i.e. .dxf file).
   i. **Click OK** to run the tool.
2. You nave now completed processing the survey data!
3. **Close** ArcMap and **Save** changes to your map document if prompted.
4. At this point, you would use the CHaMP Data Broker to complete the Data Upload process.
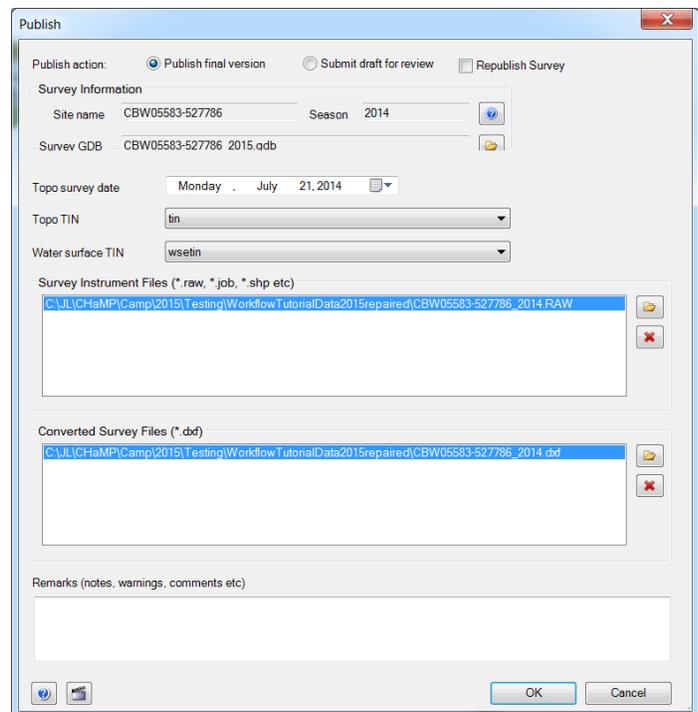
Additional Toolbar Functionality

QA Tools and Finalize Menus
The tools in the "QA Tools" menu can generally be run at any time during the workflow processing. They are intended to provide feedback either to the crew processing the data or to the CHaMP GIS analysis team.
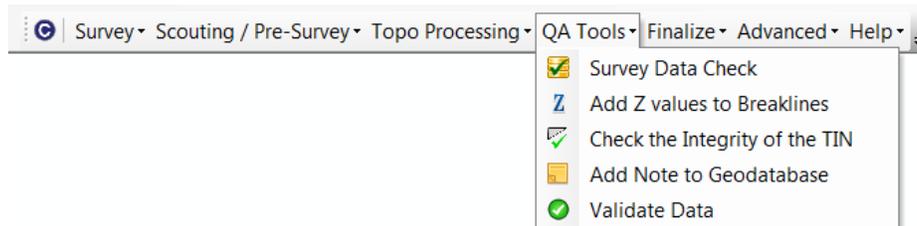
Survey Data Check Tool (Required when Survey Data is edited)
This is an OPTIONAL TOOL – This tool calculates QA metrics on the survey data and stores information in tables within the survey Geodatabase. If you are new to Toolbar processing, it's good to press this a few times during the survey to record information on your processing. There is no output information for the user.

1. Under the "QA Tools" menu, **Select** "Survey Data Check".
   a. Specify the Survey GDB for your site.
   b. **Click OK** to run the tool.
2. A "Success" message will appear when the tool has completed running.
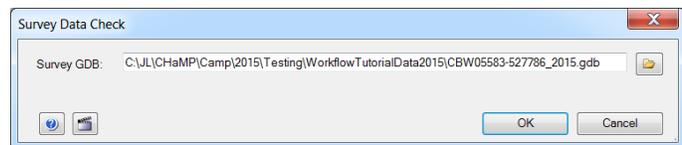

Add Z values to Breaklines (REQUIRED WHEN BREAKLINES EDITED)
The Add Z values to Breaklines tool adds z values to the vertexes of the Breaklines feature class from the underlying Topo or Edge of Water points that they are snapped to. This tool should be run

- If the initial breaklines do not have z values associated with them, or
- Edits are made to the Breaklines Feature Class that modifies the vertices of the line features.

Line Vertices *must* be snapped to either a Topo or Edge of Water point (depending on the line type) when editing in order to extract a z value. Also this tool should be run *Before creating a new TIN* in order to use the updated z values of the lines.

1. Under the "QA Tools" menu, **Select** "Add Z Values to Breakline" Tool.
   a. Specify the Survey Geodatabase for your site.
   b. **Click OK** to run the tool.
2. A "Success" message will appear when the tool has completed running.
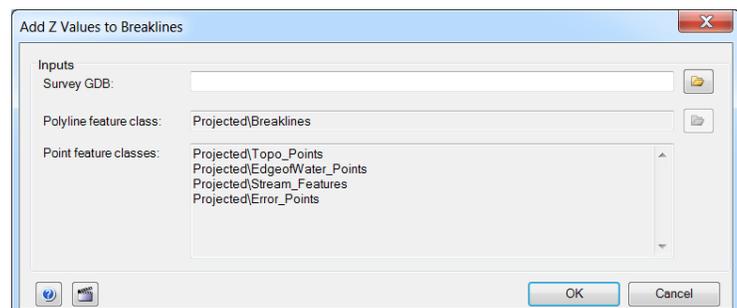
Tin Check Tool (Optional)

This is an OPTIONAL TOOL – This tool calculates QA metrics on the TIN and stores information in tables within the Survey GDB. There is no output information for the user.

1. Under the "QA Tools" menu, **Select** "Check the Integrity of the TIN".
    a. Specify the TIN.
    b. Specify the Survey Geodatabase for your site.
    c. **Check** the confirmation boxes.
    d. **Click OK** to run the tool.
2. A "Success" message will appear when the tool has competed running.
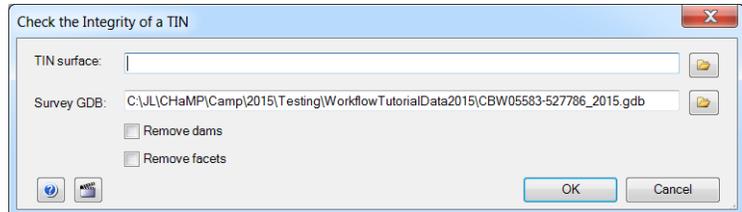
Advanced Menu

You will only regularly use the "Clear Temporary Workspace" tool in the Advanced Menu. The other two tools are for specialized workflows that are outside of the scope of this training.
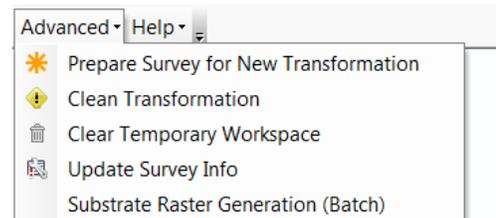
Clear Temporary Workspace

This tool clears your temporary workspace. It is important to run this tool regularly to keep your computer running well or if the Topo Tools return errors while processing.

Update Survey Info Table

The Update Survey Info Table Tool can be used to update or change the contents of the Survey Info Table. This Tool should only be used by advanced users.

Resources

- Web Help for each tool is available at http://champtools.northarrowresearch.com
- Tutorials and GIS processing information available on the Crew Resources page of champmonitoring.org. https://www.champmonitoring.org/Metadata/DescriptiveTextGroup/1/1/-1/-1#gisprocessing
- General Help for ArcGIS 10.1 is available at http://resources.arcgis.com/en/help/main/10.1
- Video tutorials for each CHaMP GIS Tool are available by clicking on the 'video' icon in the lower right of most tools. These videos are available on and offline. If your version does not have a full set of offline videos, we recommend installing the latest update and additional videos will be added to your library.
- Tool issues. If you run across an issue with the tools, please email champtools@northarrowresearch.org
- Kelly Whitehead is the lead GIS analyst for assisting you with survey issues. He will direct your questions to others as applicable. Kelly@southforkresearch.org, ph: 206-302-1779. If Kelly cannot be reached, contact Carol Volk (carol@southforkresearch.org, ph: 206-240-0301) or champemergencies@gmail.com.