



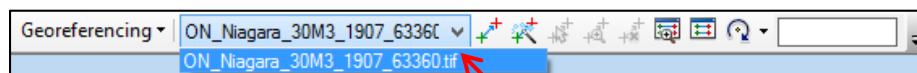
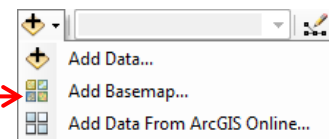
## Georeferencing Scanned Map Images (Topo maps)




### Section 1 – Preparing the map image

1. Open the scanned map in Photoshop or another image editor.
2. If necessary, crop the image to remove extraneous parts such as blank space or encapsulation film.
3. Use File > Save as... and save the image to a new folder thereby maintaining the original scan. If saving in Photoshop, do NOT use compression.

### Section 2 – Setting up ArcMap


1. Run ArcMap.
2. Add a suitable basemap to use as a reference (HINT: From the **Add Data** dropdown, select **Add Basemap...**
3. Select **Topographic** and click **Add**. If prompted to apply 'Hardware Acceleration', click **No**. The *esri* basemap uses the 'WGS 1984 Web Mercator (auxiliary sphere)' coordinate system. If possible, identify the original projection of the map you are georeferencing and project the data frame to match it (i.e. NAD27 UTM Zone 17N). If you can't identify the original projection, simply use that of the basemap.
4. **Zoom** to the approximate area you will need to georeference the map.
5. Add the scanned map image using the **Add Data** button . If necessary, click the **Connect to Folder** icon  and navigate to the **folder** holding the map image and click **OK**. Select the map image and click **Add**.
6. When prompted to 'Create Pyramids for...'. Click **Yes**.
7. Click OK to the message about "Unknown Spatial Reference".
8. To display the **Georeferencing** toolbar, click the **Customize** menu, and click **Toolbars > Georeferencing**.

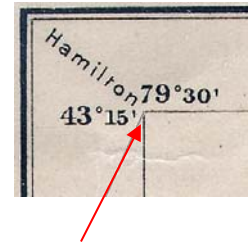


9. From the **Georeferencing** toolbar, click the **Layer** drop-down and select the map to be georeferenced.
10. Click the **Viewer** button  on the **Georeferencing** toolbar. This will open the **Image Viewer** window. If it appears blank, click the **Full Extent** button .
11. In the **Image Viewer** window, click the **Reposition** button  to view both the map and image viewer windows simultaneously.
12. In the *Table of Contents*, turn off the map image to be georeferenced.
13. From the Georeferencing dropdown, uncheck **Auto Adjust**.

### Section 3 – Georeferencing using known coordinates

Historical topographic maps provide precise coordinates for the 4 corners of the map sheet. We will use these to establish the first 4 control points (aka. links).

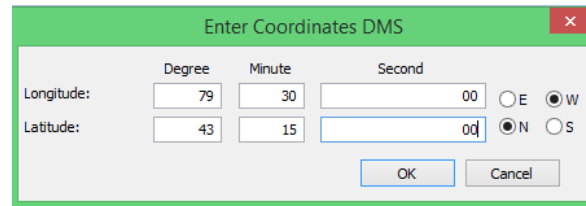
1. From the **Georeferencing** toolbar, click the **Add Control Points** button .
2. Zoom to top left corner of the scanned map image in the viewer window.
3. Click the corner to add a control point. Move the mouse away to see the line attached to the control point.




**TIP: hit ESC to cancel a link while you're in the middle of creating it.**

4. To assign the precise coordinates, right click the corner point and select **Input DMS of Lon and Lat...**

NOTE: Do not include the negative sign for Longitude but make sure W is selected on the right.





5. Click OK to accept the coordinates.
6. Zoom to the next corner and repeat the above step to assign precise geographic coordinates.
7. From the Image Viewer, click the Zoom to full extent button  between each control point.

### Section 4 – Georeferencing by matching points on the scanned map with points on the georeferenced basemap with known coordinates

The best control points are features that do not change over time such as intersections and railroads.

1. Set the view of the map window so that most of the geographic coverage of the scanned map is displayed.

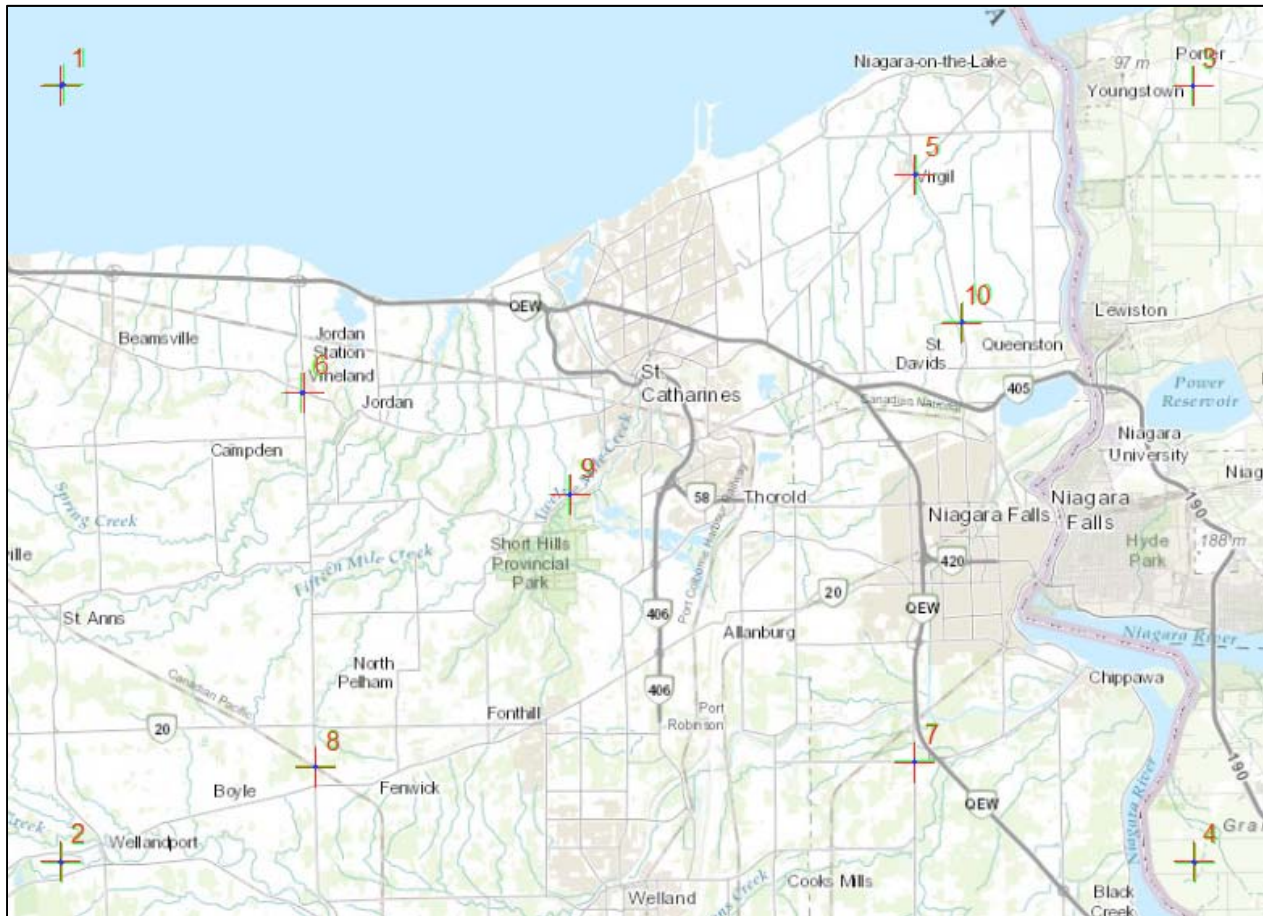
You should see the 4 control points  identifying the four corners of the map.





2. Select **Bookmarks > Create Bookmark** and assign a name (i.e. "Zoom Full").
3. From the **Image Viewer** window, click the **Link to Main Display**  button. When you zoom and pan in the Map Window, both views will change simultaneously.
4. In the **Map Window**, zoom in on the map and identify a good location for a control point. Notice the **Image Viewer** window zooms to the same location.

NOTE: Keep in mind that roads on topo maps are often represented by wide lines. When using a road be sure to place the control point at the centre of the road/intersection.

5. On the **Georeferencing** toolbar, click **Add Control Points**.
6. Click on the scanned map image first, then click the matching point on the reference data (in this case, the **Topographic** basemap).

7. Click **Bookmarks > Zoom Full** to return to a full view of the map extent. Repeat the above steps until at least 10 points have been established. Make sure the control points are widely distributed across the map.

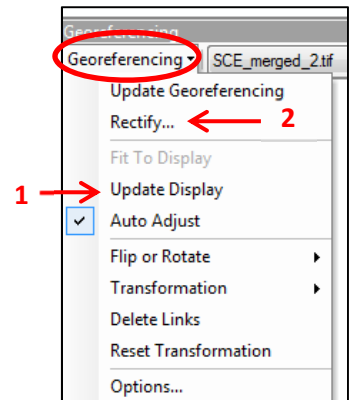



8. To see a table of all links click the **View Link Table** button . This is where you can examine the residual error of each link, as well as delete links that appear to be warping the image.
9. Uncheck a control point and observe how the map display changes. Turn it back on and observe again. If the georeferencing is better without the point, select it and click delete link button . Be sure to maintain the minimum number of control points.
10. To save the links, click the **Save** button . In the 'Save As' window, navigate to the project file directory, name the file according to the raster name and click **Save**. Your **Control Points** are saved. If you need to recover your saved **Control Points** at a later time, add the raster to ArcMap, view the link table and click the **Open** button , select your file (Text Document) and click **Open**.
11. When satisfied with the quality and quantity of control points, change the transformation from the default "Affine" to "Spline" (from the View Link Table window). This is the recommended transformation for scanned NTS maps and scanned imagery, but can only be applied with 10 or more control points.

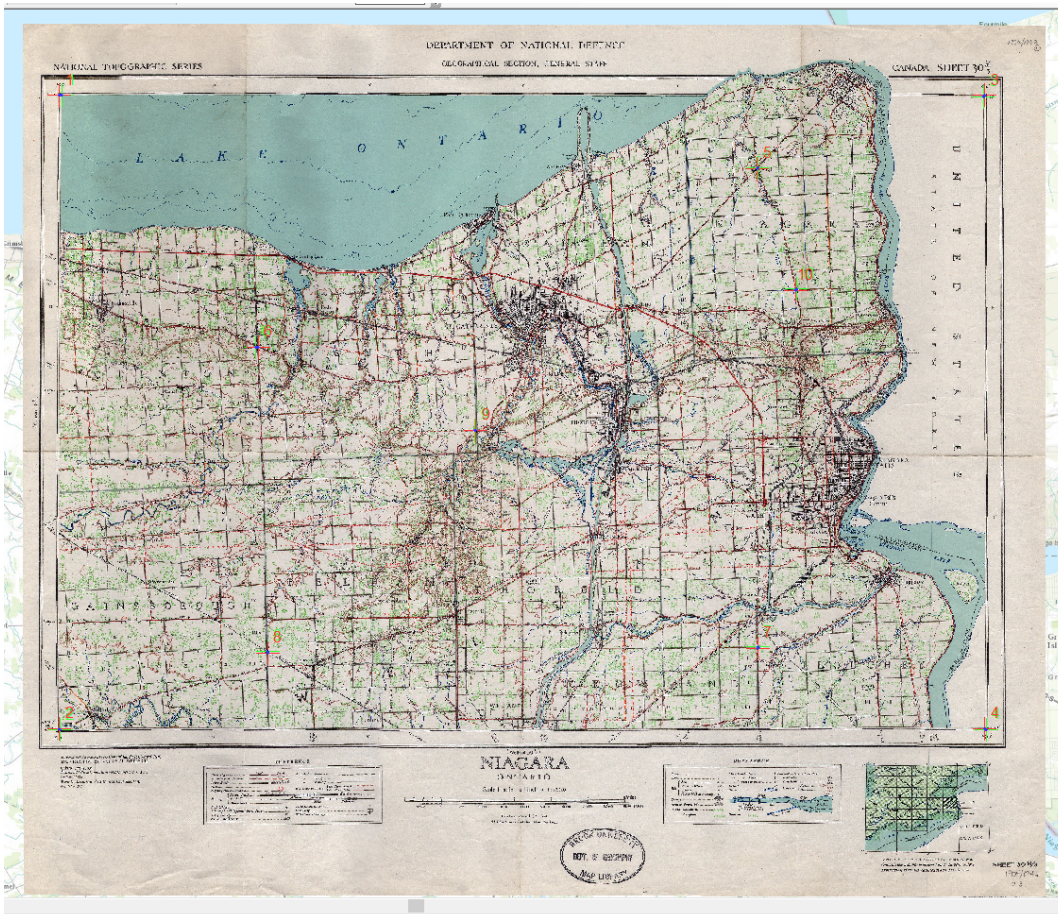
**NOTE: Spline transforms the source control points exactly to the target control points, ensuring local accuracy essentially 'pinning' the map to its reference links. (Not appropriate for early historical maps, ie.NMC)**



12. When satisfied with the control points, click the **Georeferencing** drop-down arrow on the **Georeferencing** toolbar and click **Update Display**. This shows you what the image will look like once it is saved with geographic coordinates. If necessary, turn the map image back on in the map view.



13. Use the Swipe tool  from the Effects toolbar to assess the georeferencing accuracy.



14. To save the results of your georeferenced image, click **Georeferencing** > **Rectify**. This saves the image with the map coordinates to a “new dataset”, or file, without altering the original scanned image.

15. In the **Save As** window...

- Accept the default for Cell Size and NoData.
- From the **Resample Type** dropdown, select **Bilinear Interpolation (for scanned maps)** or **Cubic Convolution (for scanned imagery)**.
- Click the **Browse** button and identify **only the folder** where the image will be saved.
- Provide an appropriate **Name** including the .tif extension. See “Naming conventions” below. (**TIFF** is the suggested file format with no Compression Type).
- Click **Save**.

16. Remove the original scanned map image before proceeding with another one.