Tutorial

MEASURE

Sketching & Measuring

with

TNTmips®

TNTedit™

TNTview®

Before Getting Started

TNTmips®, TNTview®, and TNTedit™ offer sketch tools for photointerpretation and annotation and a wide selection of measurement tools. The measurement tools provide measurements for any shape you can draw and for solid color areas in a displayed or reference raster. Sketch and measuring tools are integrated into a single GeoToolbox that lets you get measurements for any area you've sketched and turn areas sketched or drawn for measurements into regions if desired. You can also obtain measurements or add sketch elements from GPS input.

Prerequisite Skills This booklet assumes you have completed the exercises in the *Displaying Geospatial Data* and *Navigating* tutorial booklets Those exercises introduce essential skills and basic techniques that are not covered again here. Please consult these booklets for any review you need.

Sample Data The exercises presented in this booklet use sample data distributed with the TNT products. If you do not have access to a TNT products CD, you can download the data from MicroImages' web site. The first exercises in this booklet use the MEASURE Project File in the MEASURE directory of DATA. The objects in the CALIBRAT and SKETCH Project Files in this directory are also used. Additional objects are drawn from the BEREACROPS Project File and the July30 folder in the BEREAMSS Project File in the BEREA data collection. Make a read-write copy of the sample data on your hard drive so changes can be saved when you use these objects.

More Documentation This booklet is intended only as an introduction to the sketching and measuring functions in TNTmips, TNTedit, and TNTview. Consult the TNTmips Online Reference Manual for more information.

TNTmips and TNTlite™ TNTmips comes in two versions: the professional version and the free TNTlite version. This booklet refers to both versions as "TNTmips." If you did not purchase the professional version (which requires a software license key), TNTmips operates in TNTlite mode, which limits the size of your project materials. All exercises in this booklet can be completed in TNTlite using the sample geodata provided.

Merri P. Skrdla, Ph.D., 1 November 2002

It may be difficult to identify the important points in some illustrations without a color copy of this booklet. You can print or read this booklet in color from MicroImages' web site. The web site is also your source of the newest Getting Started booklets on other topics. You can download an installation guide, sample data, and the latest version of TNTlite.

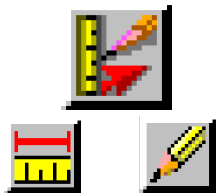
http://www.microimages.com

Welcome to Sketching and Measuring

TNTmips, TNTedit, and TNTview provide a variety of tools for sketching and measuring. These tools are part of the integrated GeoToolbox that lets you seamlessly switch between selection, measuring, sketching, and region creation. You can immediately get measurements for any sketch element you draw or add any element used for measuring to a sketch. Closed shapes initially drawn for measuring or as part of a sketch can also be converted to regions and used for selection by the GeoToolbox. Regions and element selection are described in other tutorial booklets.

The Sketch tool provides a quick and convenient means for interpretation and annotation directly in the Spatial Data Display process. You can use the Sketch tool as your field sketching tool or in the office as an alternative to the more robust Spatial Data Editor. The object created is in a simplified CAD format that can be opened again and added to using the Sketch tool or opened in the Spatial Data Editor and modified. Sketch objects modified in the Spatial Data Editor become full-featured CAD objects that can no longer be opened as simple sketches, but they can be added as CAD layers.

The Measure function provides tools that let you make various types of measurements, such as the distance between two points, the area and boundary length of a user-defined region, and the angle between two linear features. You also can perform cell size calibration to determine distance and area measurements in the absence of georeference information. These measurements are reported in the units you specify, which can be changed at any time. Measurements made with the available tools equate to actual distances only when the object is georeferenced or has cell size calibration (raster objects). Measurements can be saved to a text file that can be read by the TNTmips text editor or used in a database. We'll start with the measurement tools.



The Measure tools let you introduce cell size or scale calibration for objects that lack georeference information, as well as letting you make measurements.

The Sketch tools let you interpret and annotate in the office or in the field.

STEPS

☑ copy the files mentioned on page 2 to your local drive for faster access and the ability to save display parameters and calibration information

Pages 4 and 5 introduce the context-sensitive cursors, graphic tools options, and the Measure panel of the GeoToolbox. The exercises on pages 6–9 describe use of most of the measurement tools. Manual positioning and right mouse button options are discussed on pages 10–11. Histograms, profiles, cross-sections, recording, and calibration are described on pages 12–17. The basic sketch tools and techniques for photointerpretive sketching are discussed on pages 18–21. This booklet concludes with conversion of sketches to other formats and use of sketch layers to enhance layouts.

Preferences and Cursors

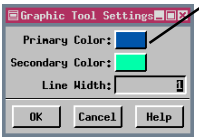
STEPS

- ☑ choose Display / Spatial Data
- ☑ click on the Setup icon on the Display Spatial Data toolbar, choose View options, and check that the Redraw after any change button is turned on in the View panel
- ☑ click on the New 2D Group icon if one is not already open
- ☑ click on the Add Layer(s) icon in the Group Controls window and choose CIR_COMP and ROADS (in that order) from the MEASURE Project File in the MEASURE data collection
- ☑ click on the GeoToolbox icon (View window)
- ☑ choose Options/Graphic Tools, click on the Primary Color button, and set the sliders on the RGB panel to 0% Red, 40% Green, and 60% Blue; click [OK]
- ☑ Set the Line Width to 1 and click [OK]

The GeoToolbox window does not open until you have added at least one layer. The tool color and width for the GeoToolbox tools are set from the Options menu in the GeoToolbox window. Wider tool lines are desirable in many applications, but for measuring, it makes it difficult to see exactly where the tool is positioned. The line width used for most illustrations in this booklet is 3 pixels, so that the tool position is obvious. You can try varying tool width and color to make the tool easiest for your use. Tool color and width changes take effect as soon as they are set.

The color specified here works well with the imagery selected in this exercise, but you may want to change colors as you work through the booklet. Just remember if you feel you can't quite see the tools, or if it seems like a tool is obliterating what you're trying to look at, you can change the color or width at any time.

TNTmips' elastic tools make use of context-sensitive cursor shapes to let you know what will happen if you click the mouse in its current position. The left arrow indicates you are going to draw the tool anew, either because you have just selected the tool and haven't yet used it or because you are too far from the previously drawn tool to move it or make adjustments in size. The four-point arrow indicates that you can move the tool to a new position if you click and drag. The right-hand cursor indicates that the tool will be resized if you click and drag. When either the four-point arrow or right-hand cursor are shown, the keyboard arrow keys as well as the mouse are available for cursor movement.




left arrow


four-point arrow


right hand

Measurement Tool Panel

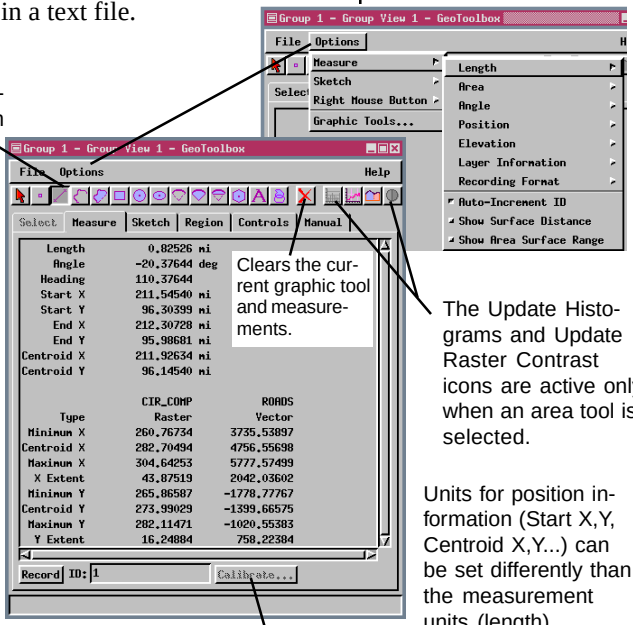
TNTmips' measurement tools can be used in all display modes: 2D Group, 3D Group, Display Layout, and Hardcopy Layout. (The GeoToolbox appears only in the 2D planimetric view for 3D groups.)

Measurements are determined by the georeference for the group you are measuring over. If the group is not georeferenced, cell size or scale is used. In the absence of either it is assumed that object coordinates are in meters. You can also use the tool to establish cell size or scale calibration if the group lacks georeference.

There are ten different tools you can use to draw paths or areas for measurement or you can obtain measurements for the active region or sketch element. These tools can take input from a GPS device as well as your mouse. You can also choose to record the measurements in a text file.

STEPS

- ☑ click on the Measure tab, then on the Ruler icon and draw a line 
- ☑ choose Options / Measure from the menu bar in the GeoToolbox window and set the Length and Position units to miles
- ☑ set Options / Measure / Layer Information to All Layers
- ☑ position the cursor near one end of the ruler and click and drag to resize the tool
- ☑ note changes in the measurement information reported



Choose your Measurement tool from the toolbar.

Measurement and position information are updated every time you move, resize, or change tools.

Clears the current graphic tool and measurements.

The Update Histograms and Update Raster Contrast icons are active only when an area tool is selected.

Units for position information (Start X,Y, Centroid X,Y...) can be set differently than the measurement units (length).

Choose another tool from the toolbar in the View window to close the GeoToolbox.

The Calibrate button is active if the group is not georeferenced.

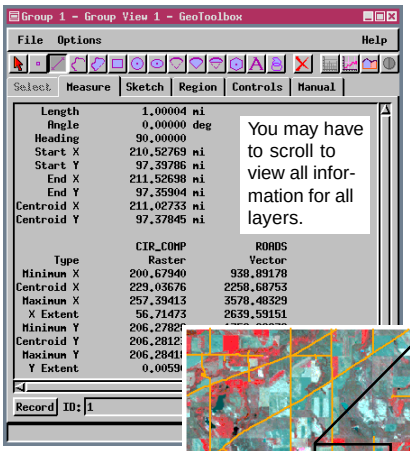
Measuring with the Ruler Tool

STEPS

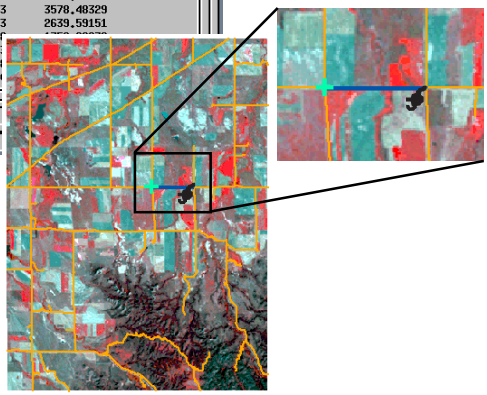
- ☑ place the cursor at the road intersection near the center of the raster
- ☑ click and hold the left mouse button while dragging to the road intersection to the east
- ☑ release the mouse button, position the cursor over the middle of the calipers (4-point arrow shape), and press the + key to zoom in centered on the calipers
- ☑ use the arrow keys when the cursor is the right-hand shape for fine adjustments of the caliper's end points, getting them as close to the road intersections as possible
- ☑ check that the length units are set to miles (Options / Measure / Length)
- ☑ look in the Measurement panel to see how close you were able to come to the distance between section roads (1.0 miles)

The ruler, or caliper, tool has a marker at the "start end" to distinguish it from the other end. The heading reported is clockwise from North (0 to 360 degrees) moving along the tool away from this marker. The Angle is measured from due East and expressed as up to plus (counterclockwise) or minus (clockwise) 180 degrees.

Like all elastic tools in TNTmips, the ruler tool uses context sensitive cursor shapes to let you know what the action of the left mouse button will be. When the cursor is the 4-point arrow shape, clicking the left mouse button and dragging, moves the whole caliper tool. Clicking when the cursor is the left pointing arrow resets the caliper tool to the new position with both ends at the same point. You then drag while holding the left mouse button down to extend the tool from the origin. Clicking when the cursor is the right hand shape moves just the closest endpoint to the position where you click.



If there is a surface layer in the group, you also get a surface distance measurement. For area tools you get a surface perimeter and surface area if there is a surface layer.



In addition to the overall length between the caliper endpoints, the Measure panel reports the X and Y extents, the angle of the tool, and the minimum and maximum X and Y values in object coordinates for each layer if you have Options / Measure / Layer Information / All Layers turned on.

Measuring with the Protractor Tool

The Protractor tool lets you measure the angle between linear features on the screen. There are three drawing tools that provide protractor-like information: the arc, arc wedge, and arc chord tools. The arc wedge and arc chord tools provide perimeter and area measurements, as well as angle, radius, and position information. The parts of the tool that are not part of the geometric shape are drawn in the secondary tool color.

Two additional context sensitive cursors are active with these tools. Dragging the mouse adjusts the top arm of the protractor when the cursor is the left double arrow and the lower arm when the cursor is the right double arrow. As with other tools, if the cursor is the left-arrow, clicking and dragging will start the position / size of the tool anew, and clicking and dragging with the four-point arrow will reposition the tool while maintaining current specifications. Clicking and dragging with the right hand cursor changes the radius of the protractor. A larger radius generally helps with the best fit of the protractor arms to the angle being measured. In this example, for instance, you will probably arrive at a different angular measurement between the roads if you only extend the protractor half the way from the road intersection to the raster edge because the upper line of the angle becomes slightly steeper with distance from the intersection.

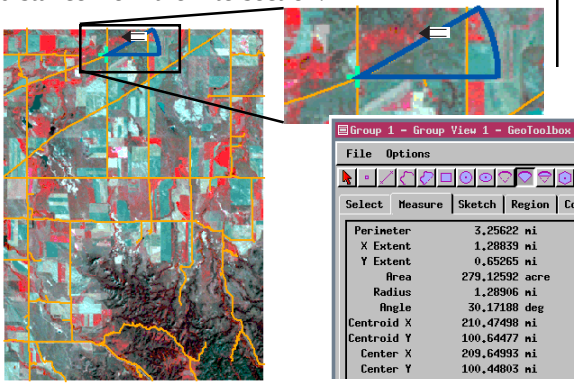
two more cursors for adjusting tool position

left double arrow ⇐

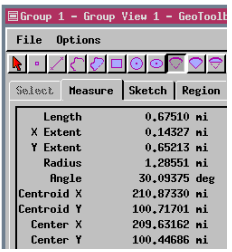
right double arrow ⇒

STEPS

- ☑ click on the Arc Wedge icon 
- ☑ click at the intersection of the angled road at the center top of the image and drag the mouse to the right to pull out the protractor tool
- ☑ reposition the origin, or centroid, of the protractor as necessary so it is at the intersection of the three roads using the arrow keys or the mouse when the cursor is the four-point arrow shape
- ☑ use the left and right double arrows to adjust the position of the upper and lower arms of the protractor so they match the angle between the road to the east and that to the northeast
- ☑ click on the Arc icon and repeat the procedure, comparing the measurements you obtain 



Arc measurements



Measuring with the Polygon Tool

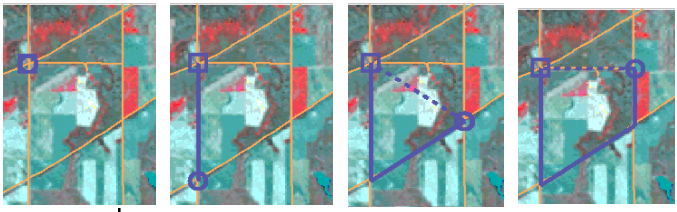
STEPS

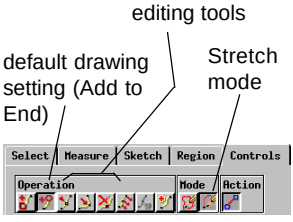
- ☑ click on the Polygon icon 
- ☑ click on the Controls tab then on the Stretch icon in the Mode panel 
- ☑ click at the three road intersection near the center top of the objects (used as the origin for the Protractor in the previous exercise)
- ☑ click at the next intersection to the south, holding the mouse button and dragging if needed until the tool aligns with the road; then release the mouse
- ☑ click at the next intersection to the northeast, again not releasing the mouse until satisfied with the tool's alignment
- ☑ click at the next intersection to the north and release the mouse when satisfied with the tool position
- ☑ click on the Measure tab, and compare your measurements to those in the sample shown

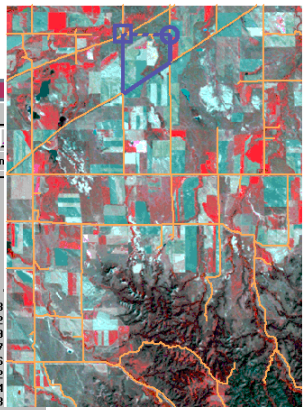
The Polygon tool functions as a planimeter to provide the area and perimeter for any polygon you draw. The X and Y extents and centroids and the minimum and maximum X and Y values are reported in object coordinates for each layer. The cursor shape for most drawing and editing functions with this tool is a pencil.

This measurement tool is the same tool used for drawing and editing lines and polygons throughout the TNT products. The start of the line is marked with a square and the end with a circle. The closing line of the polygon is always drawn between the start and end points. As with other tools that provide area measurements, the histogram of the measured area can also be viewed for a displayed raster or any coregistered raster, which is demonstrated in a later exercise.

When you draw your polygon in the Stretch mode you can continue to adjust the position of a vertex so the line from the last vertex has the best fit.







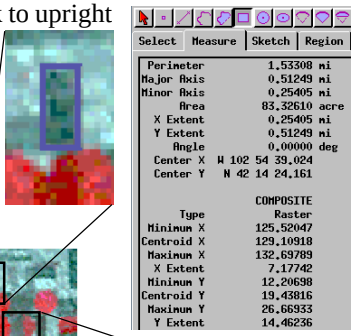
Measuring with Geometric Shapes

The geometric measuring tools include the rectangle, circle, ellipse, and regular polygon, as well as those described in the protractor exercise. The Rectangle tool uses corner and side resizing cursor shapes not used by other tools. The Circle, Ellipse, and Regular Polygon tools operate nearly identically except the ellipse uses the right hand cursor shape to resize the tool in either the X or Y dimension rather than in both dimensions simultaneously, as for the circle and regular polygon.

The measurements you make with these tools include area and perimeter, surface area and perimeter if you have a surface layer, centroid positions (X and Y), and the length of major and minor axes (Rectangle and Ellipse) or radius (Circle). Rectangles, ellipses, and regular polygons can be rotated by holding the shift key and dragging the mouse when the cursor is the corner resizing shape (rectangle) or the right hand shape (ellipse, regular polygon). You can pop the tool back to upright by holding the shift key and clicking the mouse when the cursor is the four-point arrow shape.

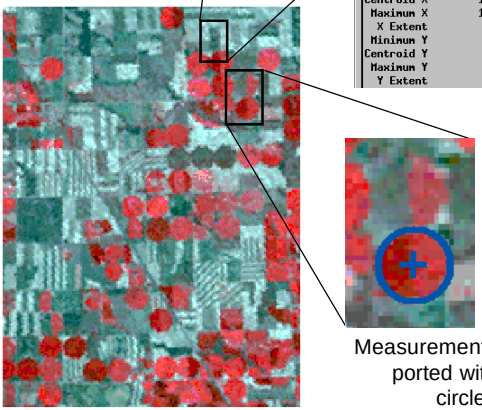
STEPS

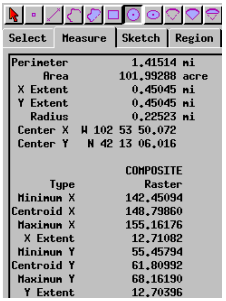
- ☑ choose Remove All from the Layer menu in the Group Controls window
- ☑ click on the Add Raster icon, choose Quick-Add Single, and select COMPOSITE from the JULY30 folder in the BEREAMSS Project File (from the BEREA data collection)
- ☑ click on the Rectangle icon in the GeoToolbox window
- ☑ use the tool to outline a rectangular feature in the image, such as that illustrated
- ☑ examine the measurements reported
- ☑ click on the Circle tool and use the tool to outline a circular feature, such as that illustrated, and again examine the measurements



Measurements reported with the rectangle tool.

corner (left) and side (right) resizing cursor shapes





Measurements reported with the circle tool.

Manual Positioning of Graphic Tools

STEPS

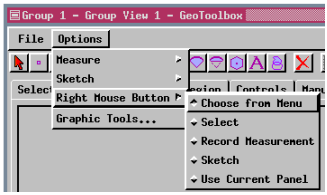
- ☑ with the BEREAMSS JULY30 COMPOSITE raster still displayed, click on the Polygon icon 
- ☑ left click at the intersection of the diagonal road with the road one-third up from the bottom
- ☑ next click at the intersection of the diagonal road and the road one-third down from the top
- ☑ then click directly east at the intersection just west of the mature (red) fields with center pivot irrigation (circular)
- ☑ next click at the intersection south of the third vertex that is directly east of the first vertex
- ☑ click on the Manual tab
- ☑ click on the Edit Vertex icon, then on the entry for the third vertex 
- ☑ change the Latitude entry in the text box below the vertex list to match that of the 2nd vertex, and click on the Update Vertex icon 
- ☑ click on the entry for vertex 4, change the Latitude to that of vertex 1 and the Longitude to that of vertex 3
- ☑ click on the Update Vertex icon 

You can be certain you've positioned the measurement tools exactly where you want if you know the geographic coordinates for the endpoints or vertices of the length or area to be measured. Knowing the coordinates is particularly useful when there are no obvious position indicators, such as road intersections, on the reference imagery.

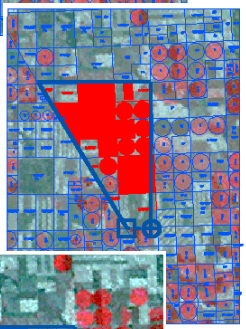
You can begin by approximately positioning the drawing tools then editing the coordinates (Edit Vertex mode), or you can directly enter all coordinates in the Manual panel (Add Vertex mode) after the appropriate tool is selected from the toolbar. Manual entry is also useful when you don't know the exact coordinates but know that one vertex should be directly north or west of another. In such a case, use the coordinates for the vertex you are surest of to replace the corresponding coordinate of the other vertex. Be sure to click on the Update Vertex icon after editing coordinates, or your changes will be lost when the next vertex is selected. A crosshair marker appears in the View window at the vertex selected for editing.

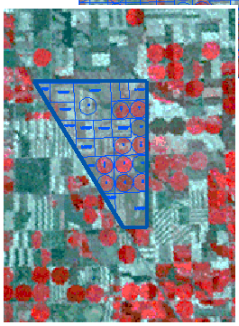
Right Mouse Button Options

The right mouse button can be configured for a variety of functions when using the GeoToolbox. You can choose for a right-click to do the same action each time (select, add an element to a sketch, or record a measurement). Another choice is to perform any of these three functions depending on which panel is currently showing. You can also elect to pick from a menu each time and choose from a variety of functions regardless of the current panel. You can change the option set at any time. Your new selection is available the next time you click the right mouse button over the image area of the View window.



The settings in the Select panel, such as Completely Inside, are used when you select elements with an area tool. You can then choose to record the measurements and create a region from the polygon used for selecting. This region can be used to extract elements from the vector object or to generate or combine with another region.





The full vector is automatically hidden when you extract by region so the extracted result is visible.

temporary extracted vector layer

STEPS

- ☑ starting where you left off in the last exercise, click on the Add Vector icon, choose Quick-Add Vector, and select BERCROPVEC in the BERCROPS Project File
- ☑ check that the Options / Right Mouse Button setting in the GeoToolbox window is *Choose from Menu*
- ☑ click the right mouse button over the View window canvas, choose Select Elements, and verify that the elements selected match the settings in the Select panel (the results shown are for the Completely Inside option)
- ☑ click the right mouse button over the canvas and choose Add as Region
- ☑ left-click on the Tools icon for the vector layer in the Group Controls window and choose Extract Clipping Inside from the menu

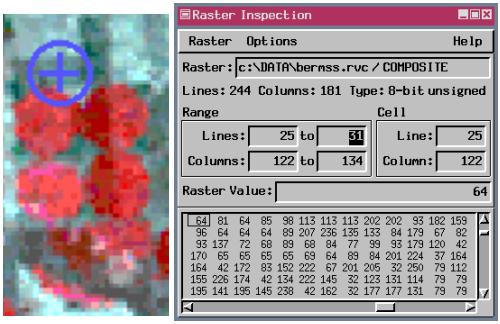
Extract by region is not a right mouse button function, but is provided as an example of how far you can readily go after using the GeoToolbox and its right mouse button functions. For more information on extracting by region, see the *Interactive Region Analysis* tutorial booklet.

Viewing Raster Values and Histograms

STEPS

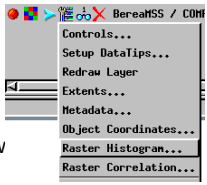
- ☑ with the BEREAMSS JULY30 COMPOSITE raster still displayed, click on the Examine Raster icon in the View window
- ☑ click around in various spots of the raster displayed and notice how the Raster Inspection window updates

The GeoToolbox tools work for all object types displayed, but raster objects have additional features associated with these tools, namely profiles, local histograms, and contrast updating. Profiles work with all of the measurement tools, while the histogram update feature requires use of an area measurement tool. You also must have a histogram view open before you can update the histogram to reflect just those values within the area defined by one of the drawing tools or a region.



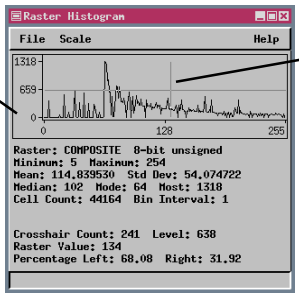
Before we look at the Histogram tool, which graphs the frequency of cell values for the raster as a whole, we'll take a diversion to the Examine Raster tool. Cell value presentation depends on the data type of the raster object. Each cell is represented by a single value for 8-bit and most other grayscale raster types (except complex data). Sixteen- and 24-bit composite color rasters have red, green, and blue values enclosed in brackets reported for each cell. You may want to try looking at values for a variety of rasters of different data types.

- ☑ click on the Remove icon for both vector layers
- ☑ click on the GeoToolbox icon
- ☑ choose Raster Histogram from the Tools icon menu (Group Controls window



The horizontal or vertical bar of the crosshair can be moved when the cursor is the four-point arrow shape. The right hand cursor drags both bars at the same time although they can be adjusted separately. The intersection of the bars is placed where you click when the cursor is a cross.

The X axis of the histogram provides the cell values while the Y axis is the number of occurrences.



These are summary statistics for the raster as a whole.

These values refer to the current position of the adjustable crosshair.

Viewing Local Histograms

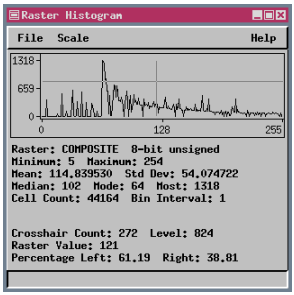
You can view histogram information for the raster(s) displayed or for other coregistered raster objects. Each time you select Raster Histogram from the Tools menu, you open a new Raster Histogram window. (It opens in the same location as the first window opened, so you need to move one to see them both.) The File / Raster choice in that window lets you choose a different raster object for histogram display in the open window.

The Update Histograms function updates the values in all histogram windows to reflect only those cells that are inscribed by the graphic tool or region. You can change the tool selected and / or its position as many times as you like or change the selected region and use the Update Histograms button to see the local cell distribution and statistics.

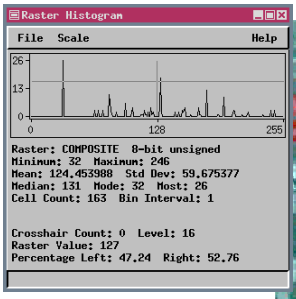
STEPS

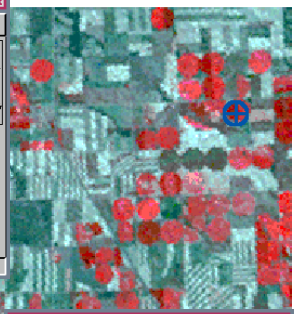
- ☑ click on the Circle icon and size it to measure one of the center pivot irrigated areas in the Berea MSS raster (or use your last circle if it still exists)
- ☑ in the open Raster Histogram window choose File / Raster and select the NIR_6 raster from BEREAMSS JULY30
- ☑ choose Raster Histogram from the Tools icon menu in the Group Controls window then choose File / Raster to select the RED raster (band 5)
- ☑ repeat the preceding step except select the GREEN raster (band 4)
- ☑ click on the Update Histograms icon

Histogram for full composite color raster.

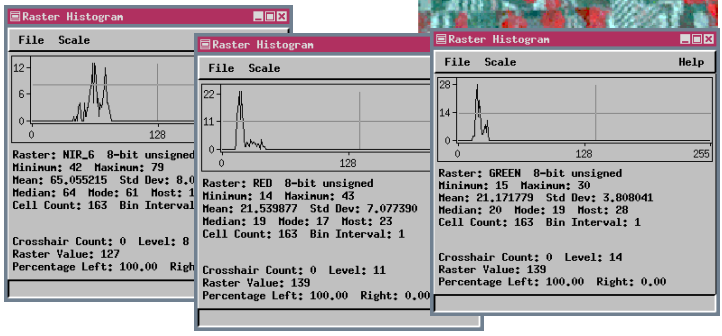


Updated histogram for area inscribed by circle tool.





Look at the separate red, green, and blue values used to create the composite color raster you're viewing.



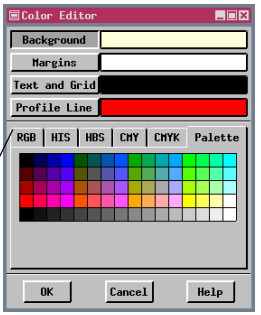
Profiles

STEPS

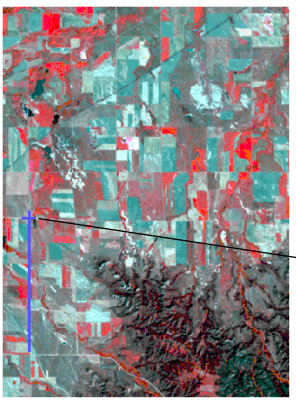
- ☑ click on the New Display Layout icon 
- ☑ click on the Add Raster icon,  choose Quick-Add Single, and select DEM_16BIT from the CB_ELEV Project File (CB_DATA folder) then CIR_COMP from the MEASURE Project File (MEASURE folder)
- ☑ click on the GeoToolbox icon 
- ☑ click on the Open Profile View icon and  check that the elevation object is listed and highlighted in the top panel of the Profile View window
- ☑ select the Calipers (Ruler icon) and pull  out the tool over a straight stretch of road as shown
- ☑ keep this layout open and add to it in the next exercise

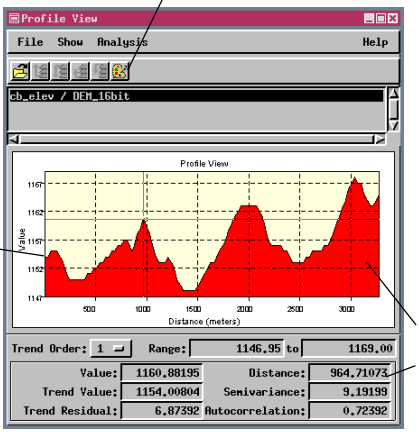
A profile graphs the cell values along the path of any of the graphic tools. You can, for example, look at the ups and downs in an elevation raster along a length of road in another raster used for reference. With the calipers (ruler), line, and polygon tools, the start of the profile (left edge) corresponds to the start of the line. With other tools, particularly the closed geometric shapes, it is less obvious where the profile begins.

A variety of display and analysis features are available when viewing profiles. Display options include display of the trend line for the profile, display of the grid, and whether to fill under the curve, among others. Analysis features include display of trend residuals, semivariograms, and first and second derivatives. The values shown in the fields at the bottom of the window are for the current cross-hair position in the profile.



This button opens a window to let you set the color of the graph area, margin, text and grid, and profile line.



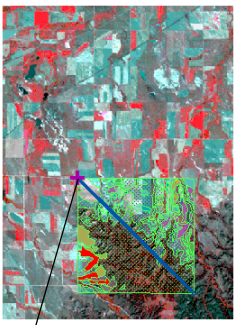


You need to click in the Profile View for these values to be filled in.

Cross-Sections

The Generate Cross-Section feature requires a surface layer in combination with a vector object and use of any of the graphic tools. The result is a new vector object that shows a cross section along the path of the tool with attributes assigned from the vector polygons in the original vector. The scale is from sea level to the surface cell value along the path of the tool so variations in elevation are not as apparent as for profiles, which are scaled to the minimum and maximum value along the path.

The resulting vector object is not georeferenced since the polygons do not represent areas on the surface—the polygons are in the Z dimension. Although not georeferenced, the vector is scale calibrated so you can determine the distance traversed across an individual polygon in the cross section. To get this distance, you can use the measuring tools or select the polygon and look at the active element information in the Group Controls window. The difference between the X extents is the distance traversed across the active polygon. The maximum value for the Y extents in the active element information is the maximum elevation traversed by the segment in that polygon.

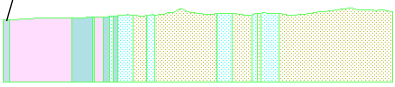


The cross-section includes only those stretches of the tool that cross both the surface and vector layers. With multiple vector layers, the active layer or the top vector layer if the active layer is not a vector, is used for the cross-section.

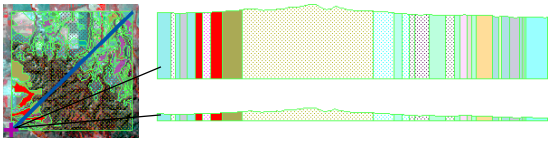
STEPS

- ☑ click on the Add Surface icon, choose Quick-Add Surface, and select the DEM_16BIT object in the CB_ELEV Project File
- ☑ click on Add Vector, choose Quick-Add Vector, and select CBSOILSEXTRACT from the MEASURE Project File
- ☑ use the Ruler tool to draw from the upper left to the lower right of the vector object
- ☑ click on the Generate Cross-Section icon, turn on the View results in new group toggle*, and save the new vector object in your MEASURE Project File
- ☑ use the Ruler to draw from the lower left to the upper right of the vector object, and generate a second cross-section

*The special toggle button near the bottom of the Select Object window when creating cross-sections automatically brings up the cross-section in a new group using the same drawing styles as the vector from which it is generated. View results in new group



The lower left to upper right diagonal (center and bottom) crosses many more polygons than the opposite diagonal (left).



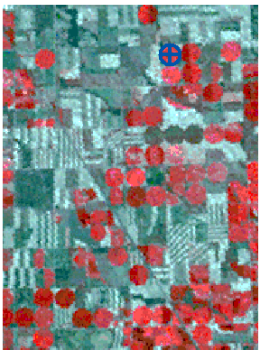
cross-section from lower left to upper right with DEM_8BIT as the surface

Recording Measurements

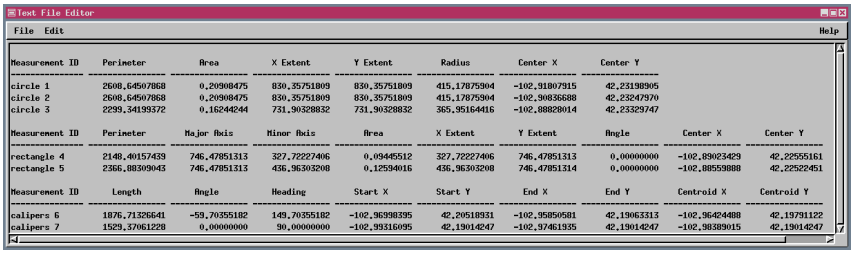
STEPS

- ☑ click on the Open icon, choose Open, and select BEREAMSS JULY30 COMPOSITE
- ☑ open the GeoToolbox and choose Options / Measure / Recording Format / Text Table then Options / Right Mouse Button / Record Measurement
- ☑ click on the Circle icon; position and size the tool to measure one of the center pivot irrigated fields
- ☑ click the right mouse button and create a new text file named MEASURE (note message at bottom of GeoToolbox window)
- ☑ move the circle tool to another field, resize if necessary, and click the right mouse button
- ☑ change to the Rectangle tool and measure and record three fields
- ☑ change to the Ruler tool and record two more measurements
- ☑ close the GeoToolbox, then choose Edit / Text Files from the main TNT menu and open the file created in step 4

Recording measurements writes all the information shown in the Measure panel (without layer information). You can include a measurement ID number, which is automatically incremented, or up to 15 characters of identifying text. If your identifying text is to the left of the ID number as shown across the bottom of the page, the number will continue to automatically increment with each measurement recorded. You indicate your choice of recording format (.txt or .csv) and whether to auto-increment the ID number on the Measure cascade of the GeoToolbox Options menu. The measurements are written to the file when you close the GeoToolbox. A line to identify each of the entries is added to the file when you switch from one measurement tool to another. If you want to review the measurements at a later time in a text editor, choose a text table as the recording format, as shown below. If you intend to create a database or use the information in a spreadsheet, .csv is a better choice.



You can assign recording measurements as the sole function of the right mouse button when using the GeoToolbox if desired. There is also a Record button on the GeoToolbox's Measure panel if you want to mix recording measurements with adding elements to a sketch or creating a region.



Text File Editor

File Edit Help

Measurement ID	Perimeter	Area	X Extent	Y Extent	Radius	Center X	Center Y
circle 1	2608,64507868	0,20908475	830,35751809	830,35751809	415,17875904	-102,91807915	42,23198905
circle 2	2608,64507868	0,20908475	830,35751809	830,35751809	415,17875904	-102,90836688	42,23247970
circle 3	2293,34139372	0,16244244	731,90328832	731,90328832	365,95164416	-102,88828014	42,23329747

Measurement ID	Perimeter	Major Axis	Minor Axis	Area	X Extent	Y Extent	Angle	Center X	Center Y
rectangle 4	2148,40157439	746,47851313	327,72227406	0,09445512	327,72227406	746,47851313	0,00000000	-102,89023429	42,22555161
rectangle 5	2366,88309043	746,47851313	436,96303208	0,12594016	436,96303208	746,47851314	0,00000000	-102,88559888	42,22522451

Measurement ID	Length	Angle	Heading	Start X	Start Y	End X	End Y	Centroid X	Centroid Y
calipers 6	1876,71326641	-59,70355182	149,70355182	-102,96398395	42,20518931	-102,95050581	42,19063313	-102,96424488	42,19791122
calipers 7	1529,37061228	0,00000000	90,00000000	-102,99316095	42,19014247	-102,97461935	42,19014247	-102,98389015	42,19014247

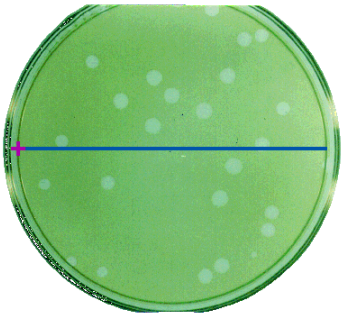
Calibrating Cell Size or Object Scale

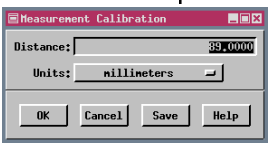
Cell size is derived directly from georeference information for geospatial data in the TNT products. You may, however, have objects for which georeferencing makes little sense, such as an architectural drawing or biological imagery. You can calibrate such objects using the Ruler tool stretched between two features a known distance apart. The Calibrate option is only active in the absence of georeference information.

Once accurately calibrated, you can make reliable measurements of components of the object if it has suitable geometry. Suitable geometry for an object without georeference is similar to that for an object with georeference—the angle of image capture or drawing cannot be oblique. In the scanned photograph of the virus-infected algal lawn provided as sample data, the camera angle was orthogonal to the plane of the petri dish, which makes it suitable for measurements once calibrated. The oblique drawing of the space shuttle shown is not suitable for measurements. If you calibrate to the 60 foot length of the payload bay, the overall measurement for the shuttle is about 20 feet too long.

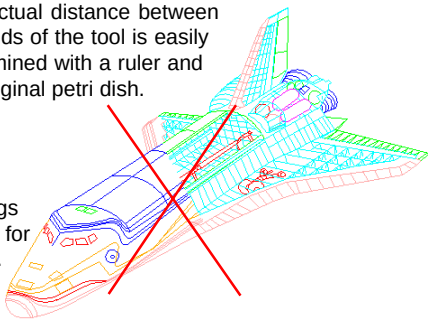
STEPS

- ☑ click on the Open icon, choose Open, and select the PBCV_1 object from the CALIBRAT Project File
- ☑ click on the Geo-Toolbox icon then on the Ruler icon, and pull out the tool so it stretches from one inside edge of the petri dish to the other
- ☑ click on [Calibrate]
- ☑ set the Units option menu to millimeters and enter 89 in the Distance field then click on [Save]
- ☑ now use the Ruler tool to measure other distances, such as the distance between plaques (clear areas); you will want to change units
- ☑ change to the Circle tool and obtain area measurements for some of the plaques





The actual distance between the ends of the tool is easily determined with a ruler and the original petri dish.



Oblique drawings are not suitable for measurements.

Sketch Objects and the Sketch Panel

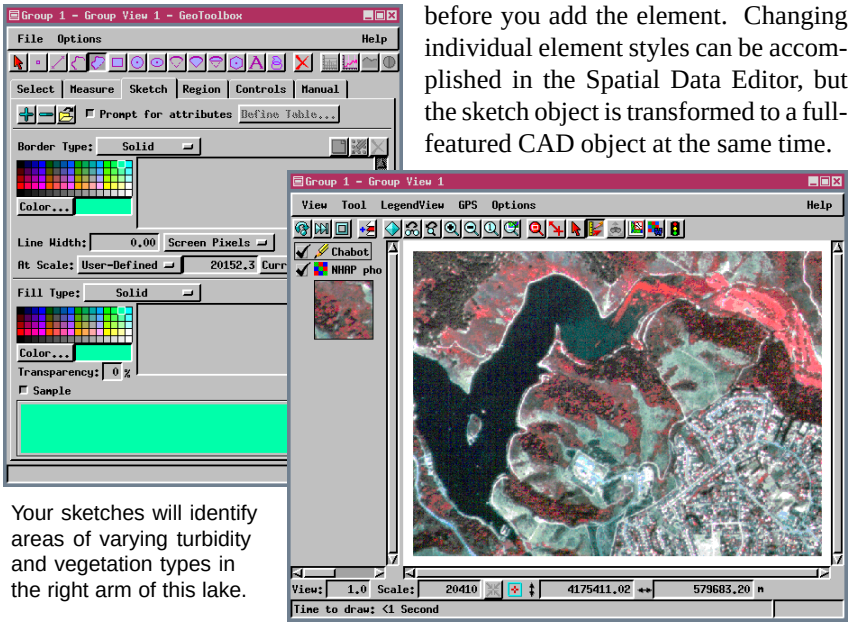
STEPS

- ☑ click on the New 2D Group icon 
- ☑ click on the Add Raster icon, choose Quick-Add Single, and select the HAYWARD object in the SKETCH Project File 
- ☑ click on the Geo-Toolbox icon 
- ☑ click on the Polygon icon then on the Sketch tab, and select CHABOT from the SKETCH Project File 
- ☑ choose Right mouse Button / Sketch from the Options menu in the GeoToolbox window

See page 8 and *Getting Started: Editing Vector Geodata* for more about the Line / Polygon tool.

The Sketch tool lets you interpret objects in underlying layers by drawing lines, polygons, circles, rectangles, and ellipses and adding text. Each element can have an individually assigned drawing style and an attached attribute. The sketch object created can be used in any process that accepts CAD objects. The drawing styles assigned when the sketch is created are always used when the sketch is opened in the Sketch tool and can be used when the object is selected elsewhere if you choose By Element for the drawing style.

The Select Object window opens when you click on the Sketch tab in the GeoToolbox window if the active group does not already have a sketch layer. The style controls for sketch elements are on the Sketch panel along with buttons to add an element, delete the last element added, open a previously saved sketch, and assign attributes. Because styles are assigned by element as your sketch is drawn, you need to set the drawing style to what you want before you add the element. Changing individual element styles can be accomplished in the Spatial Data Editor, but the sketch object is transformed to a full-featured CAD object at the same time.



Your sketches will identify areas of varying turbidity and vegetation types in the right arm of this lake.

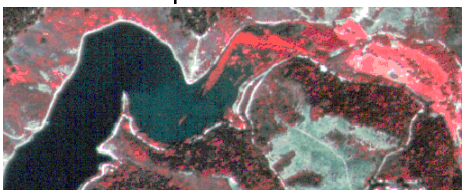
Photointerpretive Sketching

The level of detail you should put into a sketch depends on its intended use. If you're working with TNTview in the field and intend to convert a sketch to CAD or vector format to obtain feature statistics, you want to draw around the features carefully because it is generally easier to do it right the first time than to extensively edit the object at a later time. If all you want is ground truth information, you can just add text, with or without callout lines.

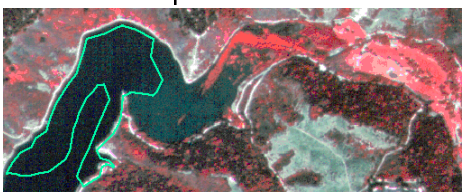
In this example, we're looking for a sketch accurate enough to evaluate whether areas of turbidity (cloudiness in the water) are increasing or decreasing over time. Such a goal requires a fair amount of care when drawing and a judgement call for the low / moderate and moderate / high turbidity boundaries. When the area of high turbidity is drawn as a filled polygon, the algal bloom locations (brightest red) are obscured. To also interpret these areas, hide the current sketch layer and draw around the algal bloom areas. You will be prompted to add the first polygon to a new sketch object. (It would be added to the original sketch if the layer wasn't hidden.)

STEPS

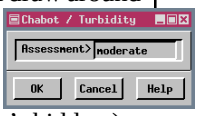
- ☑ set the border and fill types to solid with a light green for both
- ☑ zoom in (press the + key) so the area of moderate turbidity shown can be clearly seen



- ☑ draw around this area (the Stretch drawing mode is recommended)

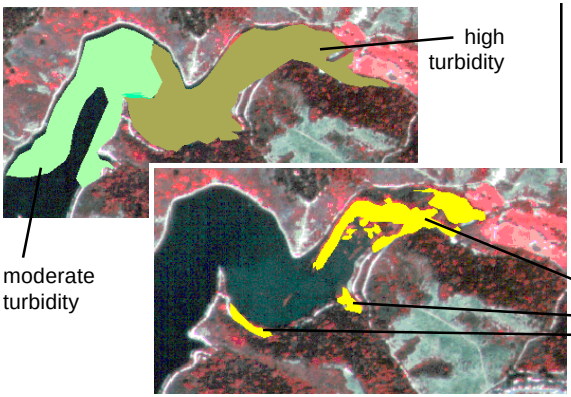


- ☑ click the right mouse button when you are done drawing around the moderate turbidity area, and enter "moderate" in the prompt window



- ☑ change the Line and Fill Colors to a darker green, click on the Clear icon to begin a new polygon, and draw around the area of higher turbidity shown

- ☑ click the right mouse button to add this new polygon to the sketch and enter "high" in the prompt window



Sketching with Geometric Tools

STEPS

- ☑ choose Layer / Remove All in the Group Controls window
- ☑ click on the Add Raster icon, choose Quick-Add Single and select the JULY30 COMPOSITE raster in the BEREAMSS Project File
- ☑ turn off the *Prompt for attributes* toggle
- ☑ click on the Circle icon, set the line and fill color to orange and use the tool to outline a circular feature, such as one of the three dark green fields just above and to the right of the center
- ☑ click the right mouse button to add the circle to the sketch when the tool is sized and positioned properly
- ☑ save the sketch to the same file as in the previous exercise, naming the sketch WHEATPIVOTS
- ☑ move the tool to the adjacent field and click the right mouse button again, repeat with the third dark field
- ☑ click on the Open Sketch icon, then click on the New Object icon, and name the object SOYBEANS
- ☑ change the line and fill color to blue, move the tool to the next center pivot (red), click the right mouse button, then continue adding circles

The geometric sketching tools are often ideal for making sketches to identify crops in agricultural areas since fields are often circular (center pivot irrigation) or rectangular. The tools persist at the same size in the same location after you add an element to a sketch unless you turn this feature off (Options / Sketch / Clear Tool After Add). When the tool is not cleared, it is very easy to delineate a number of areas with the same dimensions, such as the center pivots in the object used for reference in this exercise.

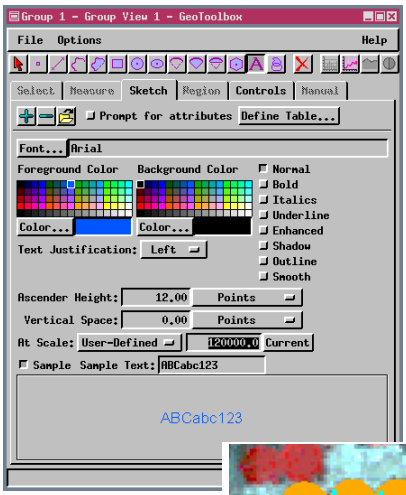
In the last exercise, you hid a sketch layer, which enabled you to see behind what you had already sketched, and initiated the creation of a new sketch layer. You can also start a new sketch layer by clicking on the Open Sketch icon and selecting a new object rather than a previously saved object. You can create as many different sketch objects as desired.

You can delete the last element added to a sketch if you are unhappy with its match to the feature being sketched. You can step back through the previously added elements by repeatedly clicking on the Delete Last Element icon if you decide you're unhappy with more than one element. You can delete the last element added even after a sketch is saved, closed, and opened again.

Adding Annotations to a Sketch

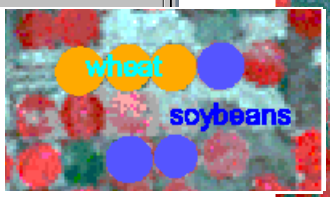
In most photointerpretive sketches, you want to add annotations to identify areas you've sketched around or even areas you haven't delineated. The sketches you made on the previous page provide a couple of different examples for annotation placement without callout lines.

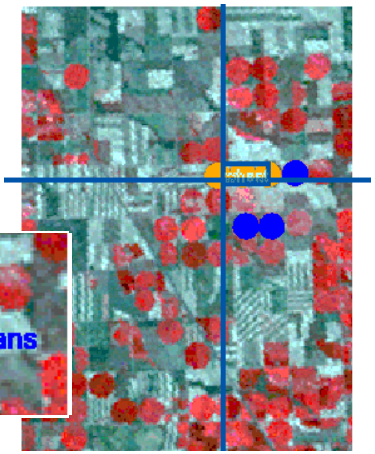
The text function of the sketch tool has three parts that act together—the text crosshair cursor, the settings on the Sketch panel, and entries on the Controls panel. The font and characteristics can only be set from the Sketch panel. The position can be set using the text crosshair or by GPS input from the Controls panel. The size can be set using either the Ascender Height field in the Sketch panel or by resizing the text crosshair. The text crosshair accepts keyboard input whenever the View window has focus. You can also enter the desired text on the Controls panel of the GeoToolbox.



The text Background Color is used only for the outline with Enhanced style text.

- ☑ click on the Select icon to make WHEATPIVOT the active layer → 
- ☑ click on the Text icon, position the mouse near the middle of the leftmost pivot sketched, and click 
- ☑ type *wheat* while the View window has focus
- ☑ click on the cyan tile in the Foreground Color palette
- ☑ set the Ascender Height to 12 Points at a User-Defined scale of 120000
- ☑ click on the Add Sketch Element icon or right-click over the image 
- ☑ now click on the Select icon in the Group Controls window to make SOYBEANS the active sketch layer
- ☑ reposition the text crosshair between the two rows with soybean pivots, type *soybeans*, and right-click



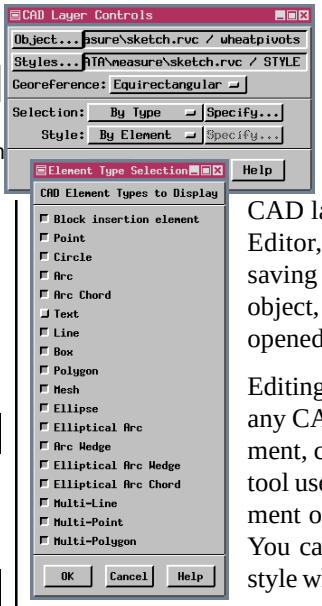


Converting Sketches to Other Formats

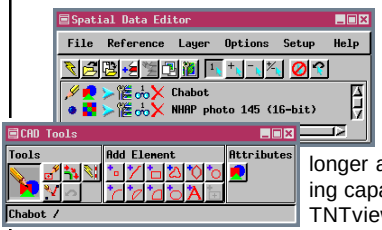
STEPS

- ☑ remove both sketch layers from the previous exercise
- ☑ click on the Add CAD icon, choose Quick-Add CAD, and select WHEATPIVOTS
- ☑ note the elements drawn
- ☑ choose Controls from the Tools menu
- ☑ set the Selection option menu to By Type, click on [Specify], turn off Text, and click [OK]
- ☑ set the Style option menu to All Same and click [OK], note the changes, then exit Spatial Data Display
- ☑ choose Edit / Spatial Data from the main menu
- ☑ click on the Add Reference Layer icon (Spatial Data Editor window) and select the HAYWARD object then the CHABOT sketch (p. 18)
- ☑ click on the Edit Reference Layer icon for the CHABOT layer
- ☑ click on the Edit Elements icon in the CAD Tools window
- ☑ click on the Edit Element icon in the Operation panel of the Edit Elements window
- ☑ click on the moderate turbidity polygon, then click the right mouse button
- ☑ click on the Drag Vertex icon and edit the polygon for a better fit as necessary
- ☑ save your edited object

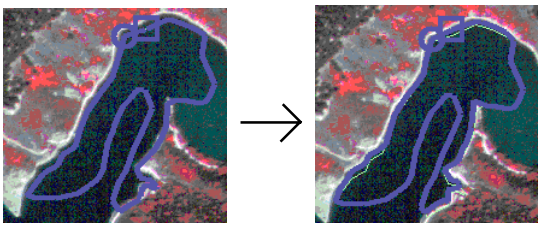
You can add a sketch as a CAD layer in the display process. When added as a CAD layer, you can selectively turn off element types for drawing and you can change the drawing style if you draw all elements of a particular type in the same style. You can also view the attributes assigned when creating the sketch. The object itself remains a sketch object when the changes introduced are simply display parameters. If added as a CAD layer in the Spatial Data Editor, the object created by saving is a full-featured CAD object, which can no longer be opened as a sketch.



Editing a sketch is like editing any CAD object; select an element, choose to edit it, and the tool used to add the sketch element opens so you can edit it. You can also edit the element style while editing the element.



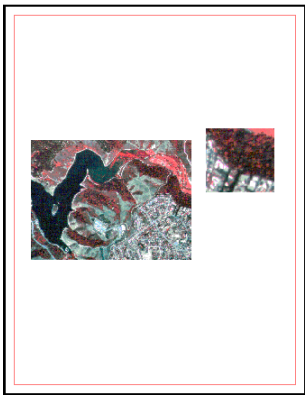
A sketch can be altered in the Spatial Data Editor like any other object type, but the result is no longer a sketch. This editing capability is absent in TNTview.



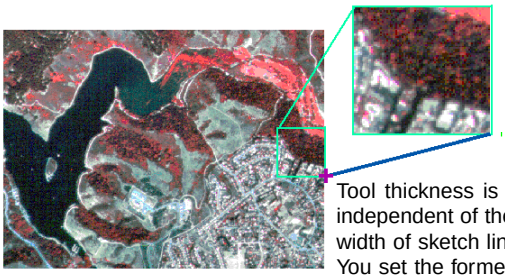
Using Sketches in Layout Design

Layouts may need sketch elements to tie different groups together, such as when one group is an enlargement of part of another group. When you use the Sketch tool to draw between groups, the sketch is added to the "active" group. Sketches that extend beyond the extents of the layers in a group change the extents of the group as a whole and may cause repositioning of groups on the page depending on how the group attachments are specified.

The layout used as the starting point for this exercise has its attachments specified so that the group positions on the page will not be affected by addition of the sketch elements.



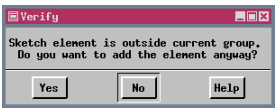
The margin (red) is shown in hardcopy layout mode. The edge of the page is also apparent when the View window background is a color other than white.



Tool thickness is independent of the width of sketch lines. You set the former under Options / Graphic Tools and the latter on the Sketch panel. If you want the sketch lines to be thicker or thinner after the sketch is completed, add the sketch as a CAD layer, set the drawing style to All Same and change the line width.

STEPS

- ☑ in Display Spatial Data, click on the Open icon, choose Open Layout, and select SKETCHINLAYOUT from the SKETCH Project File 
- ☑ click on the GeoToolbox, then on the Rectangle tool 
- ☑ make sure FullHayward is the active group, click on the Sketch tab and name the new sketch
- ☑ set the Fill Type to None and Line width to 1 screen pixel
- ☑ locate the area of FullHayward that is enlarged, inscribe it, and click the right mouse button to add the rectangle
- ☑ draw a rectangle around the enlarged area, right-click, and answer Yes to the prompt (may not be prompted until after the next step)



- ☑ click on the Ruler icon, draw a line between the upper left corners of the two rectangles, and right-click
- ☑ draw a line between the rectangles' lower right corners and right-click
- ☑ set the GeoToolbox Right Mouse Button options back to Choose from Menu

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