MEASURE

Tutorial

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. An Annotate tool is provided on the View toolbar for simplified sketching.

Prerequisite Skills This booklet assumes you have completed the exercises in the *Displaying Geospatial Data* and *TNT Product Concepts* 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 DVD, 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 and files in the CB_DATA folder. 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 Technical Guides on MicroImages' web site for more information.

TNTmips Pro, TNTmips Basic, and TNTmips Free TNTmips comes in three versions: TNTmips Pro, TNTmips Basic, and TNTmips Free. If you did not purchase the professional version (which requires a software license key), you are using TNTmips Free or TNTmips Basic, which limit the size of your project materials. All exercises in this booklet can be completed in TNTmips Free using the sample geodata provided. MicroImages, Inc. publishes a complete line of professional software for advanced geospatial data visualization, analysis, and publishing. Contact us or visit our web site for detailed product information.

Merri P. Skrdla, Ph.D., 5 May 2013

You can print or read this booklet from MicroImages' web site or from the version you install. The web site is also your source of the newest tutorial booklets on other topics. You can also download an installation guide, sample data, and the latest version of TNTmips Free.

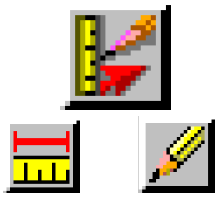
http://www.microimages.com

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. An Annotate tool is provided on the View toolbar for simplified sketching.

The Sketch and Annotate tools provide a quick and convenient means for interpretation and annotation directly in the Display process. You can use either tool as your field sketching tool or in the office as an alternative to the more robust Editor. The object created is in a simplified CAD format that can be opened again and added to using the Sketch or Annotate tool or can be opened in the Editor and modified. Sketch objects modified in the Editor become 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 *.csv (Comma Separated Value) file that can be used in a spreadsheet or 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.

Page 4 describes monitor calibration. Pages 5 and 6 introduce the context-sensitive cursors, graphic tools options, and the Measure panel of the GeoToolbox. The exercises on pages 7–11 describe use of most of the measurement tools. Right mouse button options are discussed on page 12. Histograms, surface measurements, profiles, cross-sections, recording, and calibration are described on pages 13–19. The basic sketch tools and techniques for photointerpretive sketching are discussed on pages 20–23. Standard Attributes and Editing sketches are described on pages 24 and 25. The Annotate tool on the View window is discussed on pages 26 and 27. This booklet concludes with use of sketch layers to enhance layouts.

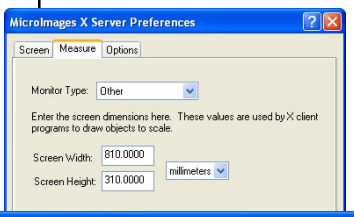
Calibrate Your Screen Size

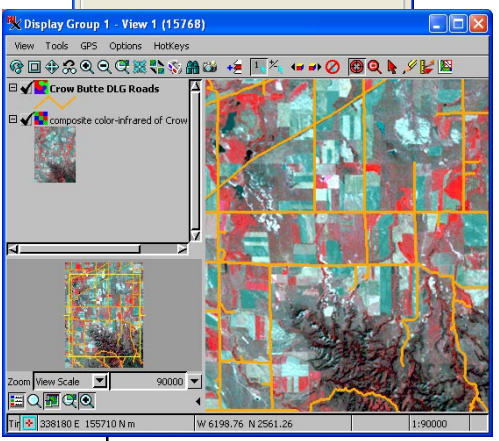
STEPS

- ☑ copy the files mentioned on page 2 to your local drive for faster access and the ability to save display parameters and calibration information
- ☑ launch TNTmips
- ☑ left-click on the MI/X icon in your system tray or right-click and choose Preferences
- ☑ click on the Measure tab, choose your monitor type, then measure your monitor and enter the results if the default measurement is not accurate (if you have multiple monitors, add their dimensions together)
- ☑ click [OK]
- ☑ exit the X server and launch TNTmips again if you made any changes

This exercise for Windows platforms only.

Your measurements will be correct whether or not you have established your monitor size because measurements are determined from the object's georeference or cell size calibration if georefernce is absent. Your screen dimensions do affect whether the map scale shown at the bottom of the View window is the actual map scale of the display. You want the map scale of the display to be correct so that vector styles will display as designed.





Map scale is the relationship between the distance on a map and the distance on the ground. Map scale is most commonly shown as a ratio, such as 1:24,000 or 1:1,000,000. The scale shown at the bottom of the View window is the number to the right of the colon. The larger the number, the smaller the map scale (things closer to actual size are at a larger scale)—1:24,000 is a larger scale than 1:1,000,000.

The table below translates map scales into real world distances.

at 1:12000, 1" = 1000 feet
at 1:120000, 1" = 10000 feet
at 1:1200, 1" = 100 feet
at 1:1000, 10mm = 10 meters
at 1:10000, 10mm = 100 meters

Preferences and Cursors

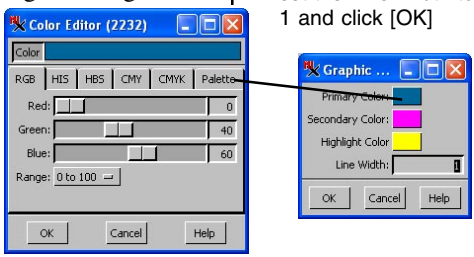
The GeoToolbox icon is not active until you have added at least one layer. The tool color and width for the GeoToolbox and Annotate tools are set from the Options menu in the GeoToolbox window. Wider tool lines are desirable in many applications, but for measuring, it makes it difficult to see exactly 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 when adding elements to a sketch. Lines and polygons use the crosshair tool for drawing. The right-hand cursor in conjunction with a diamond shape on the line indicates the insertion of a vertex in the line or polygon. The right-hand cursor and a plus sign indicate you will drag the vertex to a new position. The left arrow indicates that you are going to draw a new element other than a line or polygon. The double-headed arrow indicates that the geometrically-described shape being drawn will be resized or rotated depending on if you are closer to a side or the rotation line. You can select existing elements and view, add, or edit their attributes, but you cannot edit an element's shape.

STEPS

- ☑ choose Main / Display
- ☑ choose Options / View Options in the Display Manager window, check that the *Default to re-draw primary views after any change* button is turned on in the View panel, and click OK
- ☑ click on the New icon and select 2D Display
- ☑ 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 (Range 0 to 100); click [OK]
- ☑ set the Line Width to 1 and click [OK]




crosshair


left arrow


double-headed arrow


right hand

GeoToolbox Measure Panel

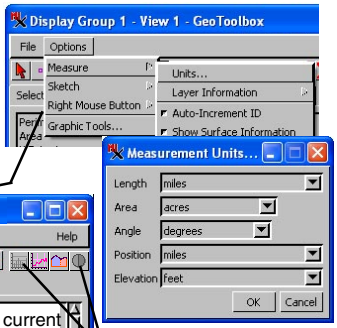
STEPS

- ☑ click on the Measure tab, then on the Ruler  icon and draw a line
- ☑ choose Options / Measure / Units 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

TNTmips' measurement tools can be used in all display modes: 2D Display, 3D Display, Display Layout, and Page Layout. (The GeoToolbox draws only in the 2D planimetric view for 3D displays, but drawn elements appear in the 3D view.)

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 ruler 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 *.csv or *.txt file.



Choose your measurement tool from the toolbar.

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

Clear the current graphic tool and measurements.

The Update Histograms and Update Raster Contrast icons are active only when an area tool is selected. The latter button requires that a raster with contrast set be the active layer.

Choose another tool from the toolbar in the View window to close the GeoToolbox or choose File / Close and the View Position tool becomes active.

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

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

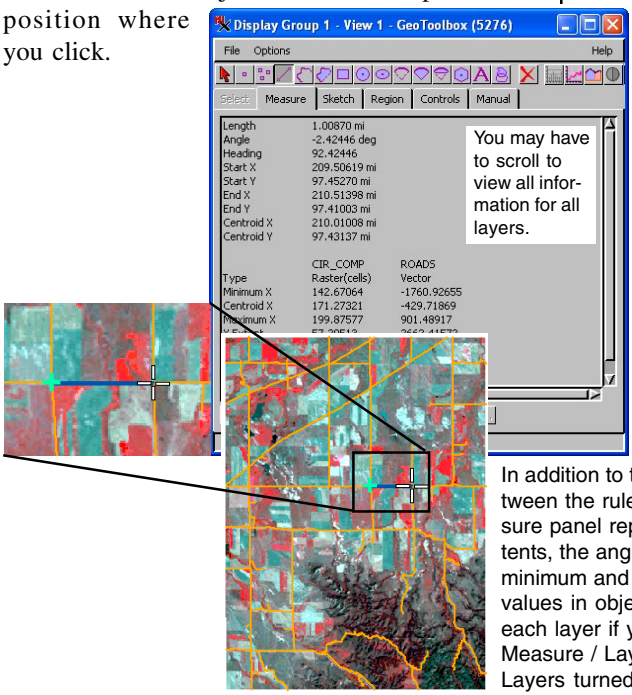
Measuring with the Ruler Tool

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 the start 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 right-hand shape, clicking the left mouse button and dragging, moves the whole ruler tool. Clicking when the cursor is the left pointing arrow resets the ruler 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 crosshair moves just the closest endpoint to the position where you click.

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 ruler (right-hand shape), and press the + key to zoom in centered on the ruler
- ☑ use the arrow keys when the cursor is the crosshair shape for fine adjustments of the ruler's end points, getting them as close to the road intersections as possible
- ☑ check that the length units are set to miles (Options / Measure / Units)
- ☑ look at the Measurement panel to see how close you were able to come to the distance between section roads (1.0 miles)



In addition to the overall length between the ruler 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

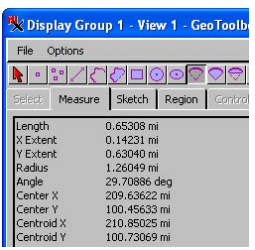
STEPS

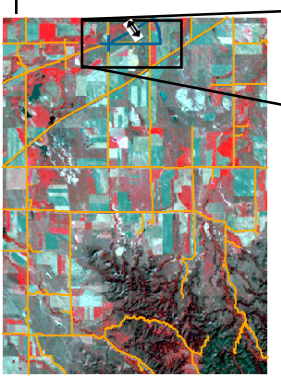
- ☑ click on the Arc Wedge icon 
- ☑ click at the intersection of the angled road at the center top of the image and drag the mouse to the right to pull out the protractor tool
- ☑ reposition the origin, or centroid, of the protractor as necessary so it is at the intersection of the three roads using the arrow keys or the mouse
- ☑ 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 compare the measurements you obtain 

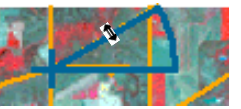
The Protractor tools let you measure the angle between linear features on the screen. There are three drawing tools that provide protractor-like information: the arc, arc wedge, and arc chord tools. The arc wedge and arc chord tools provide perimeter and area measurements, as well as the angle, radius, and position information provided by the arc tool.

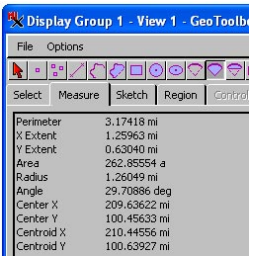
If the cursor is the left-arrow, clicking and dragging will start the position / size of the tool anew. The crosshair or left hand cursor drags the position of the origin and the double-headed arrow repositions the arms and changes the radius of the protractor. A larger radius helps obtain the best fit of the protractor arms to the angle being measured. In this example, 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. The protractor arms are represented by dashed lines for the arc and arc chord tools and by solid lines for the arc wedge tool, which is shown in the illustrations below. 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.

Arc measurements









Measuring with the Polygon Tool

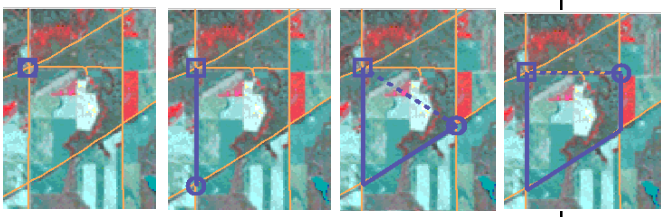
The Polygon tool functions as a planimeter to provide the area and perimeter for any polygon you draw. The X and Y extents and centroids and the minimum and maximum X and Y values are reported in object coordinates for each layer.

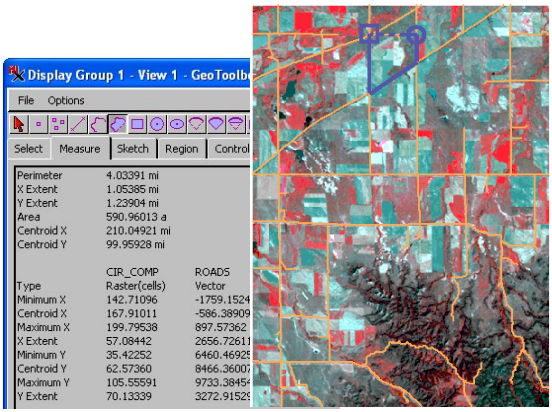
This measurement tool is the same tool used for drawing and editing lines and polygons throughout the TNT products. The start of the line is marked with a square and the end with a circle. The closing line of the polygon is always drawn as a dashed line between the start and end points. Polygons and lines are easily reshaped. The right-hand cursor indicates a vertex will be inserted along the current line while the crosshair indicates a new endpoint will be added. A plus sign (+) appears at an existing vertex to indicate it can be dragged.

STEPS

- ☑ click on the Polygon icon 
- ☑ click on the Controls tab then on the Stretch icon 
- ☑ 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

You can adjust the position of a vertex before a line is added to get the best fit to your reference.





You switch between drawing modes dynamically as you move the cursor.

Moves the drawn line or polygon.

Stretch mode

Measuring with Geometric Shapes

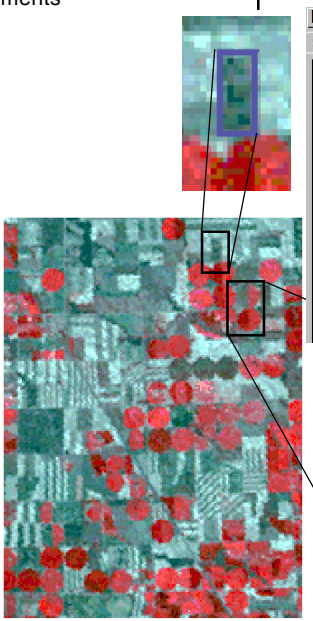
STEPS

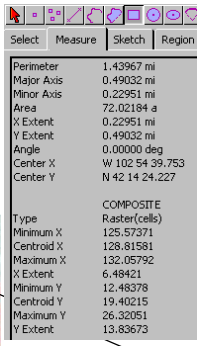
- ☑ choose Remove All Layers from the group's right mouse button menu
- ☑ click on the Add Objects icon, and select COMPOSITE from the JULY30 folder in the BEREAMSS Project File (from the BEREA data collection)
- ☑ click on the Rectangle icon in the GeoToolbox window
- ☑ use the tool to outline a rectangular feature in the image
- ☑ examine the measurements reported
- ☑ click on the Circle tool and use the tool to outline a circular feature, and again examine the measurements

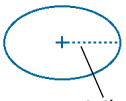
The geometric measuring tools include the rectangle, circle, ellipse, and regular polygon, as well as those described in the protractor exercise. The Rectangle, Ellipse, and Regular Polygon tools have a dotted line that serves as a rotation handle when the double-headed arrow is the active cursor shape.

You can change the number of sides (segments) in a regular polygon on the Manual panel of the GeoToolbox or by using the mouse scroll wheel when the View window has focus. Roll the wheel forward (away from you) to increase the number of sides and back to decrease the number of sides.

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).

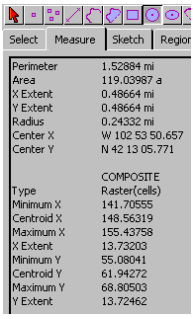






Measurements reported with the rectangle tool.

Measurements reported with the circle tool.



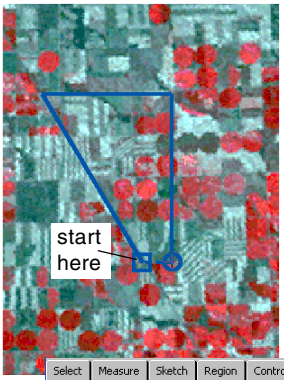
Manual Positioning of Graphic Tools

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.

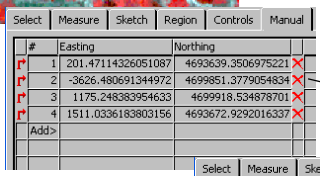
You can begin by approximately positioning the drawing tools then editing the coordinates, or you can directly enter all coordinates in the Manual panel after the appropriate tool is selected from the toolbar. Manual entry is also useful when you don't know the exact coordinates but know that one vertex 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. You can copy and paste from one text field to another.

STEPS

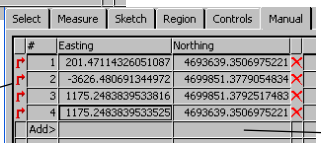
- ☑ with the BEREAMSS JULY30 COMPOSITE raster still displayed, click on the Polygon icon 
- ☑ left click at the intersection of the diagonal road with the road one-third up from the bottom
- ☑ next click at the intersection of the diagonal road and the road one-third down from the top
- ☑ then click 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
- ☑ change the entry in the text box for the third vertex in the Latitude/Northing field (Y) to match that of the 2nd vertex (you can copy and paste)
- ☑ click on the entry for vertex 4, change the Latitude or Northing to that of vertex 1 and the Longitude or Easting to that of vertex 3



A crosshair marker appears in the View window at the vertex selected for editing. There is a Coordinates button in the window so that you can change the coordinates for viewing and entering your vertex position information.



deletes the vertex



inserts a vertex above the line where you click

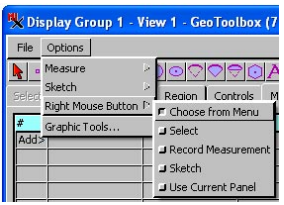
enter coordinates here to add a vertex to the end

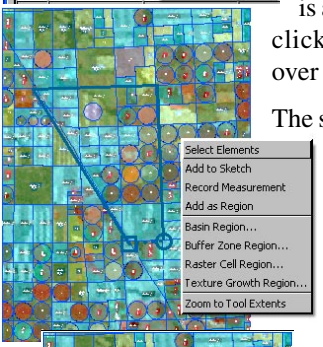
Right Mouse Button Options

STEPS

- ☑ starting where you left off in the last exercise, click on the Add Objects icon, 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
- ☑ right-click on the name of the vector object in the Display Manager window, and choose Extract Clipping Inside from the menu

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 View window canvas.

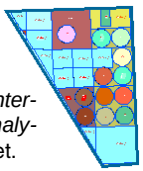




The settings in the Select panel, such as Completely Inside, are used when you select elements with an area tool. You can then choose to record the measurements and create a region from the polygon used for selecting. This region can be used to extract elements from the vector object or to generate or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

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

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.



temporary extracted vector layer

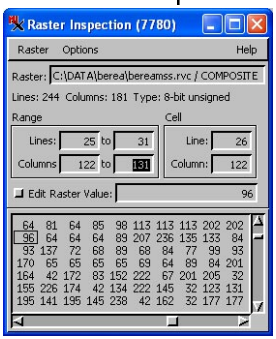
Viewing Raster Values and Histograms

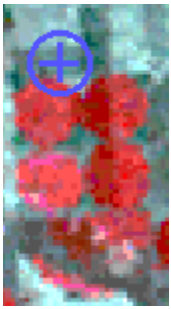
The GeoToolbox tools work for all object types displayed, but raster objects have additional features associated with these tools, namely profiles, local histograms, and contrast updating. Profiles work with all of the measurement tools, while the histogram update feature requires use of an area measurement 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.

STEPS

- ☑ with the BEREAMSS JULY30 COMPOSITE raster still displayed, right-click on the raster name in the Display Manager, and select Examine Cell Values
- ☑ click around in various spots of the raster displayed and notice how the Raster Inspection window updates



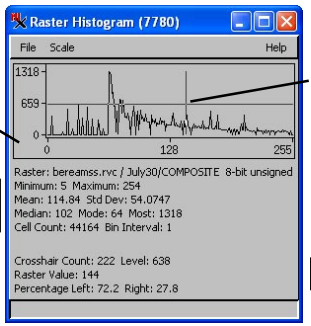


- ☑ right-click on each vector layer and choose Remove Layer from the menu
- ☑ right-click on the remaining layer and choose View Histogram from the menu
- ☑ click on the GeoToolbox icon*

* Continue to the exercise on the next page.

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. 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.

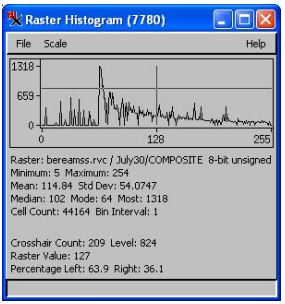
Viewing Local Histograms

STEPS

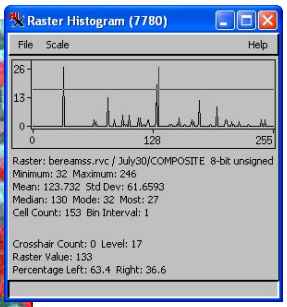
- ☑ click on the Circle icon and size it to measure one of the center pivot irrigated areas in the Berea MSS raster (or use your last circle if it still exists)
- ☑ in the open Raster Histogram window choose File / Raster and select the NIR_6 raster from BEREAMSS JULY30
- ☑ right-click on the raster name (Display Manager), choose View Histogram from the menu 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

You can view histogram information for the raster(s) displayed or for other coregistered raster objects. Each time you select View Histogram from the layer right mouse button menu, you open a new Raster Histogram window. (It opens over the Display Manager.) The File / Raster choice in that window lets you choose a different raster object for histogram display in the open window.

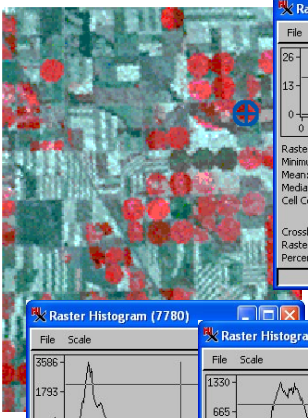
Histogram for full composite color raster.

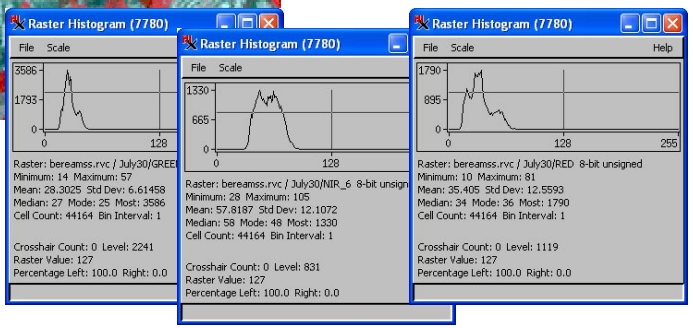


The Update Histograms function updates the values in all histogram windows to reflect only those cells that are inscribed by the graphic tool or region. You can change the tool selected and / or its position as many times as you like or change the selected region and use the Update Histograms button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



updated histogram for area of composite color raster inscribed by circle tool



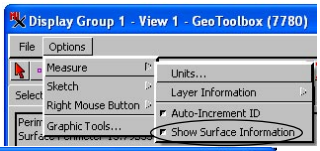


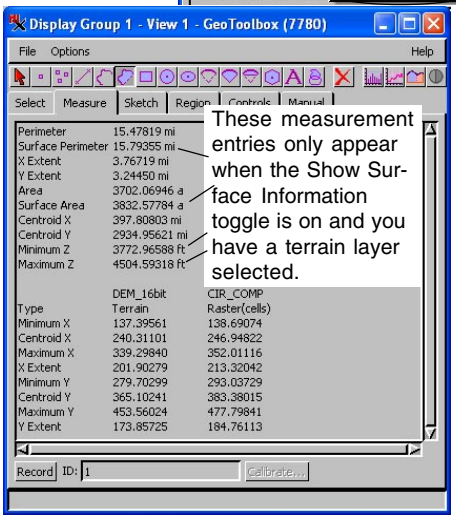
Look at the separate red, green, and blue values used to create the composite color raster you are viewing.

Surface Measurements

Additional measurement information is available if you are making measurements in a view with a terrain layer. The surface perimeter is longer than the simple perimeter unless the ground is flat because it traverses the ups and downs of the terrain as it follows the outer edge of the shape you have drawn. Similarly, the surface area will be greater than the two-dimensional area because the surface needed to cover hills and valleys is included. The difference between the area and surface area gives you an idea of how rugged the terrain is.

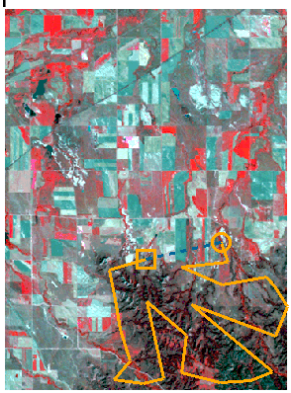
This exercise has you draw a convoluted polygon in a hilly region so you can see the difference in these values over an extended path and area. You can move this polygon to the upper left of the raster and see how the surface values are affected. To move a polygon drawn with the GeoToolbox, click on the Controls tab and choose the Move Line Operation. The cursor is active for dragging whether it is the crosshair or right-hand shape.





STEPS

- ☑ right-click on the group name and choose Close Group
- ☑ click on the Add Terrain icon (Display Manager), and select DEM_16BIT from the CB_ELEV Project File (CB_DATA folder)
- ☑ click on the Add Objects icon, and select CIR_COMP from the MEASURE Project File
- ☑ open the GeoToolbox and check that the Options / Measure / Show Surface Information toggle is on
- ☑ click on the polygon tool and draw a convoluted polygon at the lower right of the image
- ☑ examine your measurement results comparing perimeter and surface perimeter, area and surface area, and noting the minimum and maximum Z values



Profiles

STEPS

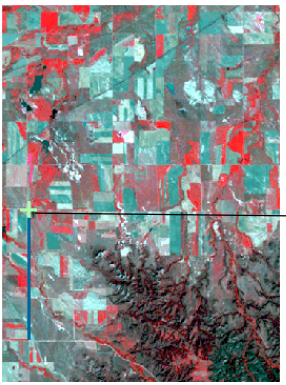
- ☑ starting with the group open from the last exercise, click on the GeoToolbox icon 
- ☑ click on the Open Profile View icon  and check that the elevation object is listed and highlighted in the top panel of the Profile View window
- ☑ select the Calipers (Ruler icon)  and pull out the tool over a straight stretch of road as shown
- ☑ keep this group open and add to it in the next exercise

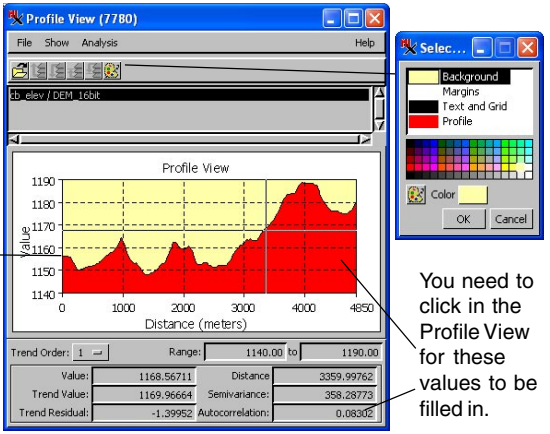
*You can select multiple rasters for profile viewing if desired. To add them to the same Profile View, use the Open icon in the Profile View. To add them to separate Profile Views, click on the Open Profile View icon again. New Profile Views may open on top of and obscure others.

A profile graphs the cell values for visible raster layers 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 crosshair position in the profile.

A Profile View for the bottom visible raster layer is opened by default the first time you click on the Open Profile View button*. The next time you click on this button, another raster layer is opened in a new window until all raster layers have separate Profile Views at which point you are prompted to select an object to profile.





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

Cross-Sections

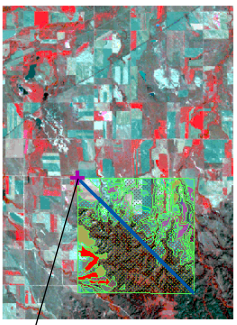
The Generate Cross-Section feature requires a surface layer in combination with a vector object and use of any of the graphic tools. The result is a new vector object that shows a cross section along the path of the tool with attributes assigned from the vector polygons in the top vector layer. The default scale is from sea level to the surface cell value along the path of the tool. To emphasize differences in elevation, this value can be changed to the minimum elevation in the terrain or some other value.

The resulting vector object can have manifold georeference or be ungeoreferenced since the polygons do not represent areas on the surface—the polygons are in the Z dimension. If not georeferenced, the vector is scale calibrated so you can determine the 2D 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 internal element details in the Display Manager 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 from the base Z value traversed by the segment in that polygon.

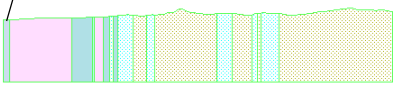
STEPS

- ☑ click on the Add Objects icon (Display Manager), 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 off the Generate Manifold Georeference toggle, then click OK
- ☑ 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

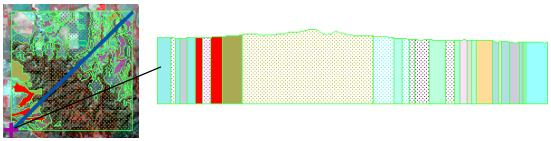
* To be able to measure or select these polygons, you need to generate your cross sections in a layout and turn on the *View results in new group* toggle. The *Show results in new window* toggle, opens a new view to display the results.



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 attributes. The cross-sections shown do not have manifold georeference.



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



Recording Measurements

STEPS

- ☑ click on the New icon, choose 2D Display, and select BEREAMSS JULY30 COMPOSITE
- ☑ open the GeoToolbox and choose 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, create a new file named MEASURE (File Type .csv), click OK, and note message at bottom of GeoToolbox
- ☑ move the circle tool to another field, resize if necessary, and click the right mouse button
- ☑ change to the Rectangle tool; measure and record three fields
- ☑ change to the Ruler tool and record two more measurements
- ☑ close the GeoToolbox, then choose Tools / Miscellaneous / Edit Text Files from the main TNT menu and open the file created in step 4 (be sure to set Files to All, txt is the default)

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 by typing into the ID field at the bottom of the Measure panel. If identifying text is to the left of the ID number, the number will continue to increment with each measurement recorded. You indicate whether to auto-increment the ID number on the Measure cascade of the GeoToolbox Options menu. A line to identify each of the entries is added to the file when you switch from one measurement tool to another. The default file type for recorded measurements is *.csv. You can also save the recorded measurements to a file with a .txt extension, but that does not change the contents of the file. TNT's text editor will open files with either extension to review the contents.

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. You can choose to start a new file for recorded measurements using File / Measurement Record in the GeoToolbox.

Recorded measurements (*.csv file) opened in Microsoft Excel.

Microsoft Excel - measure.csv

File Edit View Insert Format Tools Data Window Help

A1 = Measurement ID

	A	B	C	D	E	F	G	H	I	J
1	Measurement ID	Perimeter	Area	X Extent	Y Extent	Radius	Center X	Center Y		
2	1	1.735937	153.4745	0.552566	0.552566	0.276283	-102.919	42.23237		
3	Measurement ID	Perimeter	Major Axis	Minor Axis	Area	X Extent	Y Extent	Angle	Center X	Center Y
4	2	2.860745	0.919525	0.510847	300.6304	0.510847	0.919525	0	-102.978	42.16886
5	3	1.736881	0.510847	0.357593	116.9118	0.510847	0.357593	0	-102.99	42.15852
6	4	2.452067	0.715186	0.510847	233.8237	0.715186	0.510847	0	-102.99	42.15113
7	Measurement ID	Length	Angle	Heading	Start X	Start Y	End X	End Y	Centroid X	Centroid Y
8	5	1.022014	1.432095	88.5679	-102.922	42.21243	-102.902	42.2128	-102.912	42.21261
9	6	2.273845	-88.7127	178.7127	-102.9	42.18215	-102.899	42.14928	-102.899	42.16572

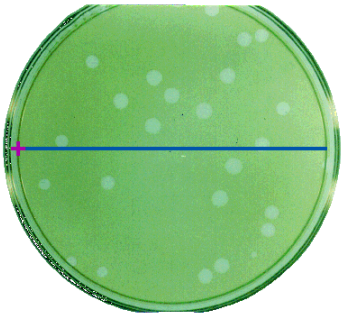
Calibrating Cell Size or Object Scale

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.

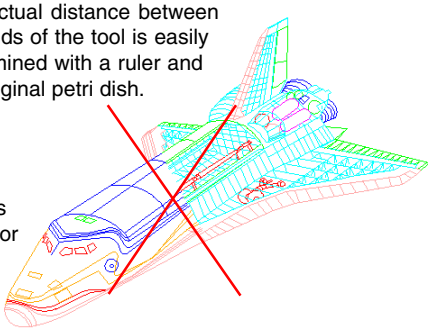
Once accurately calibrated, you can make reliable measurements of components of the object if it has suitable geometry. Suitable geometry for an object without georeference is similar to that for an object with georeference—the angle of image capture or drawing cannot be oblique. In the scanned photograph 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 New icon, choose 2D Display, 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 [OK]
- ☑ now use the Ruler tool to measure other distances, such as the distance between plaques (clear areas); you may 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

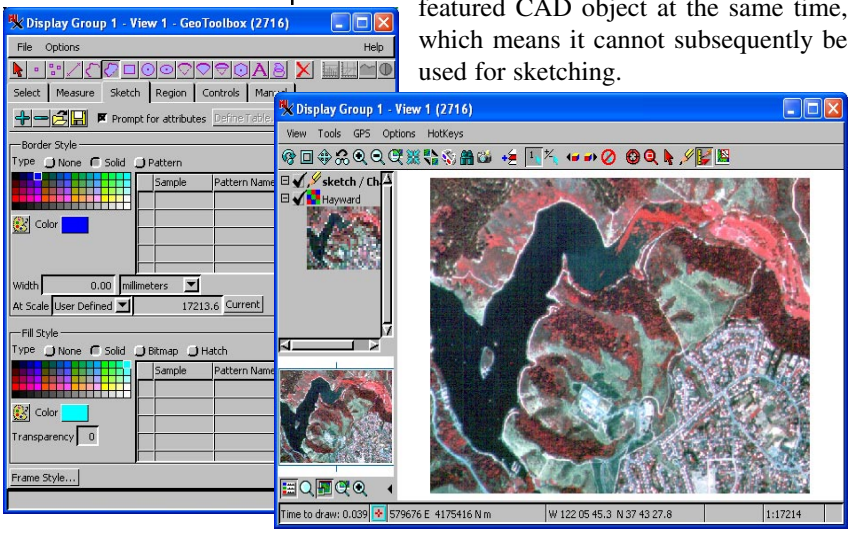
STEPS

- ☑ click on the New 2D icon, choose 2D Display, 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 the Open Sketch icon, then select CHABOT from the SKETCH Project File (contains no elements but has the attribute table set up)
- ☑ turn on the Clear Tool After Add toggle from the Sketch menu opened from the Options menu in the GeoToolbox
- ☑ set the border and fill styles to solid with a light green for both

See *Editing Vector Geodata* tutorial 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. Your sketches in this and the following exercise will identify areas of varying turbidity and vegetation types in the right arm of this lake.

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 TNT's Editor, but the sketch object is transformed to a full-featured CAD object at the same time, which means it cannot subsequently be used for sketching.



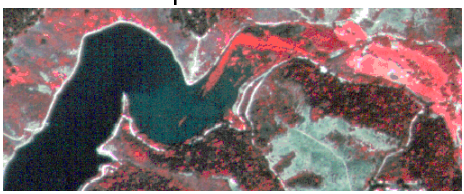
Photointerpretive Sketching

The level of detail you should put into a sketch depends on the conditions and its intended use. If you're sketching in the field and intend to convert a sketch to CAD or vector format, you may want to draw around the features carefully to avoid later editing or you may want just an approximate sketch to be edited further in an office setting. If all you want is ground truth information, you can just add text, with or without callout lines.

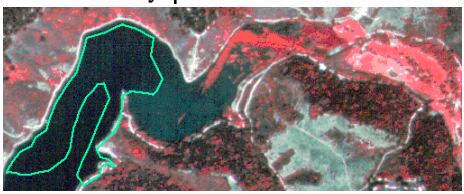
In this example, we're looking for a sketch accurate enough to evaluate whether areas of turbidity (cloudiness in the water) are increasing or decreasing over time. Such a goal requires a fair amount of care when drawing and a judgement call for the low / moderate and moderate / high turbidity boundaries. 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 them. A new sketch layer is created in the default sketch location* because your first sketch is hidden.

STEPS

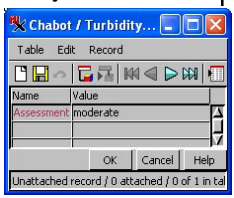
☑ zoom in (press the + key) so the area of moderate turbidity shown can be clearly seen



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

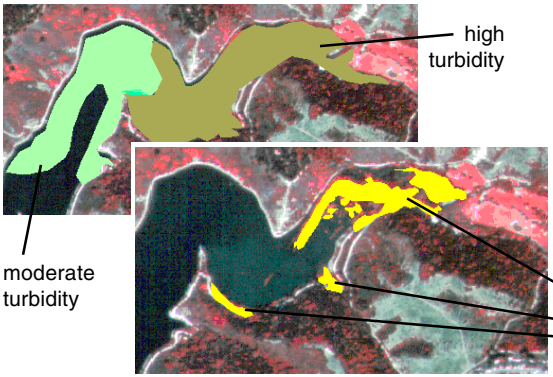


☑ click the right mouse button when you are done drawing around the moderate turbidity area, and enter "moderate" in the prompt window



☑ change the Line and Fill Colors to a darker green, 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



* Hover the mouse over the new sketch layer name to see the complete default path.

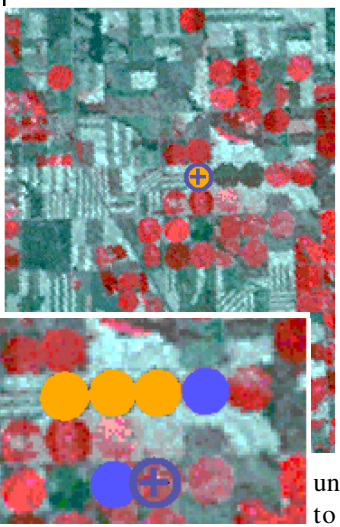
Sketching with Geometric Tools

STEPS

- ☑ right click on the group name and choose Remove All Layers
- ☑ click on the Add Objects icon, and select the JULY30 COMPOSITE raster in the BEREAMSS Project File
- ☑ open the GeoToolbox click on the Open Sketch icon, create a new file and name the object WHEATPIVOTS
- ☑ turn off the Options/ Sketch/Clear Tool After Add toggle
- ☑ click on the Circle icon, set the line and fill color to orange and use the tool to outline the leftmost 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
- ☑ move the tool to the adjacent field and click the right mouse button again, repeat with the third dark green field
- ☑ click on the Open Sketch icon, then enter SOYBEANS in the New Object Name field
- ☑ 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 as shown

The geometric sketching tools are often ideal for sketches that identify agricultural crops 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, which you did in the excersize on page 20 (when Options / Sketch / Clear Tool After Add is toggled on, tools do not persist). 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 naming a new object rather than selecting a previously saved object. You can create as many sketch objects as desired.



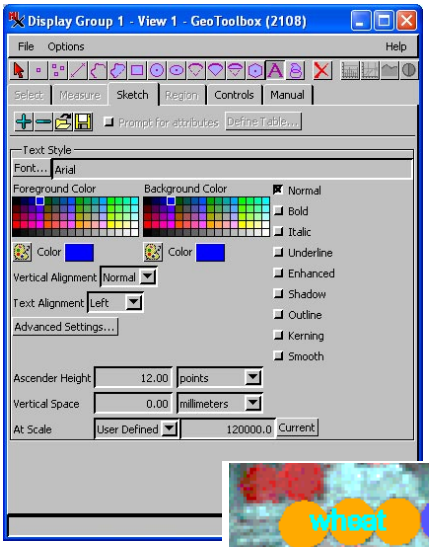
You can delete the last element added to a sketch if you are unhappy with its match to the feature being sketched. You can step back through the previously added elements by repeatedly clicking on the Delete Last Element icon if you decide you're unhappy with more than one element. You can delete the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

Note a standard attributes table is created for the sketch layer and added to as each element is drawn.

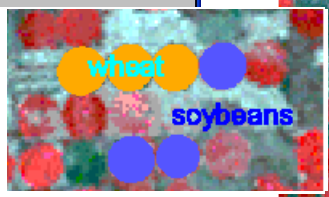
Adding Text to a Sketch

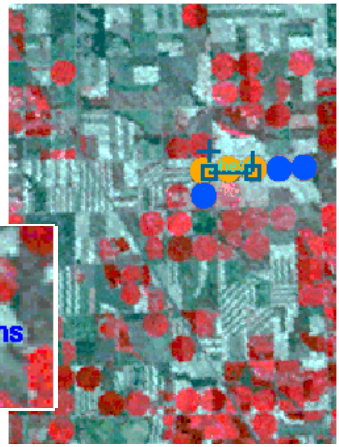
In most photointerpretive sketches, you may want to add annotations to identify areas you have sketched around or even areas you have not delineated. The sketches you made on the previous page provide a couple of different examples for annotation placement without callout lines.

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 on 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.



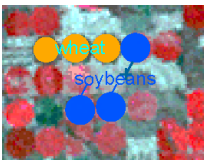


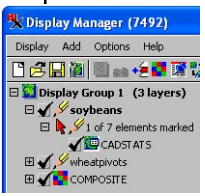
- ☑ click on the WHEATPIVOT layer name to make it the active layer
- ☑ click on the Text icon, position the mouse near the middle of the leftmost pivot sketched, and click
- ☑ type *wheat* while the View window has focus
- ☑ click on the cyan tile in the Foreground Color palette
- ☑ set the Ascender 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 SOYBEANS layer name to make it the active sketch layer
- ☑ reposition the text crosshair between the two rows with soybean pivots, type *soybeans*, and right-click
- ☑ keep open for next exercise

Standard Attributes with Sketch Layers

STEPS

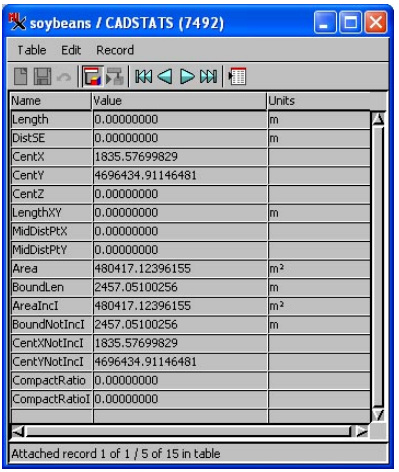
- ☑ click on the Ruler tool, and set the color to be the same as for the soybeans text
- ☑ draw lines from the soybeans text to the three soybean fields
- ☑ expand the Soybeans layer (click on the +) in the Display Manager window
- ☑ expand the database in the Display Manager to show the table
- ☑ click in the check box to open the table
- ☑ choose Table / Switch to Single Record view
- ☑ choose the select tool in the GeoToolbox
- ☑ click on line and circle elements and view associated statistics
- ☑ close the GeoToolbox



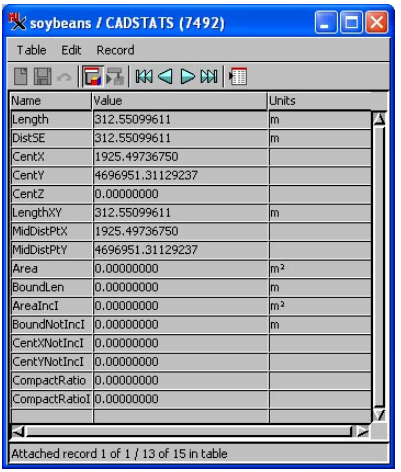


Because annotations are not directly associated with other elements in a sketch, leader line editing is not an integral part of generating the annotation as it is when editing vector labels. If you want leader lines, simply add line elements to your sketch. They are added in this exercise so you can see that different fields are filled out in the CAD standard statistics table that is automatically generated by the process for different element types. Annotations can have colored frames with transparency if desired like dynamic labels and label elements.

Unlike vector objects, which have separate point, line, and polygon databases, CAD objects have a single database for all element types. As a result in the standard statistics table, not all fields apply to each element type. The fields that do not apply to the marked elements have zeroes for the value in the standard statistics table. When you select a text element, all field values are zero.



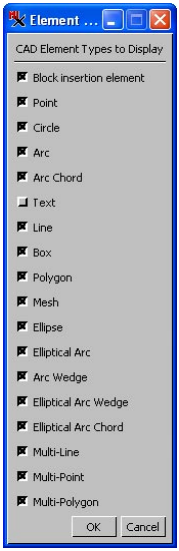
statistics for circle



statistics for line

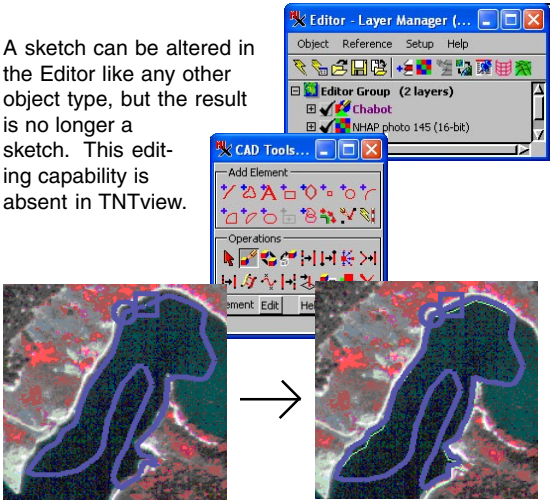
Editing Sketches

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. The object itself remains a sketch object when the changes introduced are simply display parameters or database changes. You can view and edit database parameters whether the object is opened as a sketch or added as a CAD layer. If added as an editable CAD layer in TNT's 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; choose to edit a selected element, and the tool used to add the sketch element opens so you can edit it. You can also edit the assigned element style while editing the element.

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



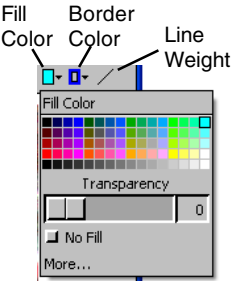
STEPS

- ☑ remove both sketch layers from the previous exercise
- ☑ choose Add/Layer/CAD in the Display Manager, and select WHEATPIVOTS
- ☑ note the elements drawn
- ☑ click on the Layer Controls icon for the WHEATPIVOTS layer 
- ☑ set Select to By Type (Elements panel), 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 Display
- ☑ choose Main / Edit from the TNT menu
- ☑ click on the Add Objects icon (Editor Layer Manager window) and select the HAYWARD object then the CHABOT sketch (p. 18) 
- ☑ click on the Edit Reference Layer icon for the CHABOT layer (Chabot should be in bold, click on name if not) 
- ☑ click on the Edit Element icon in the Operations panel of the CAD Tools window 
- ☑ click on the moderate turbidity polygon, then right-click
- ☑ drag and insert vertices to edit the polygon for a better fit as necessary
- ☑ save your edited object

Annotate Tool Settings

STEPS

- ☑ open the Display process and add the Hayward object used in the last exercise
- ☑ click on the Annotate tool in the View window 
- ☑ click on the Action/Settings icon that appeared in the View window toolbar and set your preferred line drawing mode (Draw or Stretch)



The Fill Color icon is used to set the color of points and lines, as well as polygons.

You cannot add attributes to elements when using the Annotation tool.

The default location for saving annotaions is C:\\Documents and Settins\yourname\My Documents\Sketches. The file in this location is named YYYMMDD_hhmmss. To change this location use Save to.

The Annotate tool lets you do simple sketching operations without having to open the GeoToolbox. When you click on the Annotate tool, seven icons  are added to the View window toolbar. Your View window must be wide enough to accommodate at least three of these icons or none of the Annotation tools will appear.

The Action/Settings icon lets you control drawing and saving of elements in your annotation sketch, The Delete Last Annotation choice lets you sequentially delete the last annotations made. Clear Drawing Tool lets you clear a drawing tool before the element is added. All drawing tools are automatically cleared after an element is added. Open lets you select either a sketch object created with the GeoToolbox or one created with the Annotation tool. If the object was initially created in the GeoToolbox, the Delete Last Annotation choice is initially inactive. Save to lets you save somewhere other than the default location. Save as KML does not have a default location for the KML file and prompts you to save initially in the directly from which you opened your sketch or your last used directory.

Additional icons appear depending on the drawing tool you select. For example, an icon to set color appears for all annotation tools. The downward arrow to the right of this icon drops down the color palette. For points and lines there is only one color icon. For polygons there are two: fill color and border color. For lines and polygons there is also a line weight icon. This line weight remains constant as you zoom in and out (the same as if you had set the scale for a line style to None). For text there are Fill Color, Outline Color, and Font icons. You can set the outline color to be No Outline.

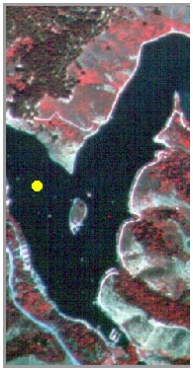
Drawing with the Annotate Tool

Point elements in annotations are always added as filled circles. Their size is not adjustable and they remain a constant size as you zoom in and out. If you want control over size when zooming or want to assign attributes, you need to use the GeoToolbox. You can, however, use text to identify your points in lieu of assigning attributes.

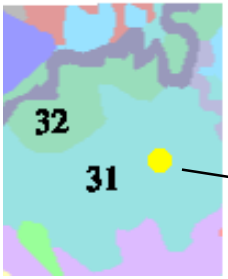
You can control the size and positioning of text using the text tool itself. Drag the + at the upper left of the tool to increase or decrease the text size when the cursor is the double arrow shape. You can reposition the text when the cursor is the right hand shape. Choosing a contrasting outline color makes the text visible over light and dark backgrounds.

STEPS

- ☑ click on the Point icon and position a point in the lake above and to the left of the island
- ☑ click on the Text icon
- ☑ click on the Text Color icon and choose a dark but bright color, such as blue
- ☑ click on the Outline Color icon, turn off the No Outline toggle, then choose white as the outline color
- ☑ note that the currently selected font is shown in the ToolTip, click on the Font icon if you would like to select a different font
- ☑ enter Lake Chabot as the text
- ☑ switch to the Line tool, pick white as the color, and connect the text to the point

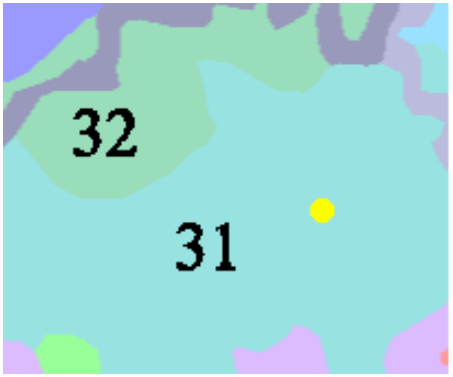


Annotation point added (top). Identifying text and leader line added (bottom)



annotation point

Polygons and polygon labels get larger as you zoom in. Annotation point remains the same size.

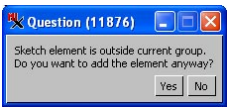


zoomed in once from above

Using Sketches in Layout Design

STEPS

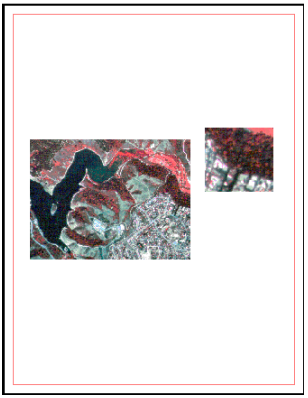
- ☑ in the Display process, click on the Open Display icon, and select SKETCHINLAYOUT from the SKETCH Project File
- ☑ click on the GeoToolbox, then on the Rectangle tool
- ☑ check that Options/Right Mouse button is set to Sketch (GeoToolbox)
- ☑ make sure FullHayward is the active group, click on the Sketch tab
- ☑ set the Fill Style 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 group, right-click, and answer Yes to the prompt



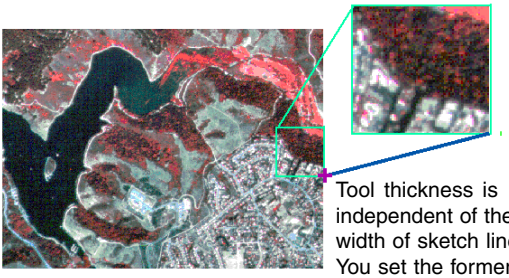
- ☑ click on the Ruler icon, change the color to match your box color, draw a line between the upper left corners of the two rectangles, and right-click
- ☑ draw a line between the rectangles' lower right corners and right-click
- ☑ keep this layout and the GeoToolbox open for the next exercise

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.



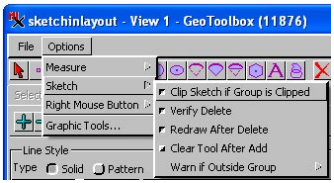
The margin (red) is shown in page layout mode. The edge of the page is also apparent when the View window background is a color other than white.



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.

Sketches and Group Clipping

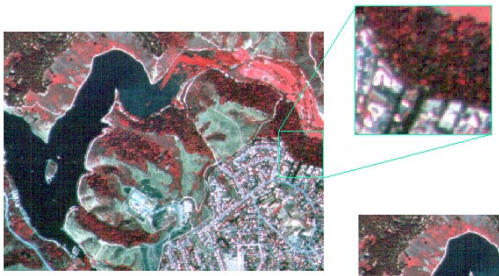
Sketches are often outside the group they refer to and you may not want the clipping that is applied to the geospatial layers in the group applied to the sketch. The example in this exercise is not particularly meaningful, but you have just made a sketch that could be clipped so it may as well be used for this purpose. Typically the sort of sketch you would not want to clip with the group would contain annotations for features that are present in the group after clipping. You could also have a special effect in mind that includes imagery in the central portion of the layout and sketch elements extending out from the imagery.



The sketch tool is useful both in the office and in the field and is available with the free TNTatlas. Sketching and measuring are only two aspects of the powerful, integrated GeoToolbox. For additional information on this powerful tool see the *Interactive Region Analysis* and *Operating with a GPS Unit* tutorials.

STEPS

- ☑ click on the Hayward layer name in the Display Manager to make it the active layer
- ☑ click on the Settings icon for the FullHayward group
- ☑ click on the Match Layer button on the Clipping panel and turn on the Clip toggle button
- ☑ check that the Options/Sketch/Clip Sketch if Group is Clipped toggle is off in the GeoToolbox, and redraw
- ☑ choose Options/Sketch in the GeoToolbox and turn the Clip Sketch if Group is Clipped toggle on, then redraw and note the change
- ☑ set the GeoToolbox Right Mouse Button options back to Choose from Menu



The lefthand group in this layout has been clipped to match the raster extents. The sketch layer is not clipped above (toggle off). The Clip Sketch if Group is Clipped Toggle is on at the right.

Notes:

Notes:

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