SOIL MAPPING

Introduction to

Digitizing Soil Maps

with

TNTmips®

Before You Start

This booklet takes you through the sequence of processes in TNTmips that are used to digitize soil maps: from a paper map sheet to a vector object with attached soil attribute tables. This booklet assumes that you are an experienced TNTmips user. At the minimum, you should have completed the exercises in the associated tutorials *Displaying Geospatial Data, Mosaicking Raster Geodata, Georeferencing,* and *Editing Vector Geodata*. The exercises in those tutorials introduce essential concepts and skills that should be second nature to you by the time you begin this sample project.

Sample Data The exercises in this booklet use sample data that is 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: www.microimages.com. In particular, this booklet uses objects in the SOIL51 Project File in the SOILMAP folder.

More Documentation The exercises in this booklet use several TNTmips processes with no attempt at comprehensive documentation. Consult the TNT Reference Manual for more information.

TNTmips® and TNTlite® TNTmips (The Map and Image Processing System) comes in two versions: The professional version of TNTmips, and the free TNTlite version. Both versions run exactly the same code from the TNT products CD-ROMs and have exactly the same features. If you did not purchase the professional version (which requires a software license key), then TNTmips operates in TNTlite mode, which limits the size of your project materials.

The exercises in Part One of this booklet can be completed in TNTlite. A larger project, suitable for the professional version of TNTmips is treated in Part Two. None of the exercises can be performed in TNTview. TNTedit offers only the editing tools for cleaning and repairing auto-trace conversion artifacts.

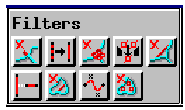
Keith Ghormley, 26 April 2005

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 for the newest tutorial booklets on other topics. You can download an installation guide, sample data, and the latest version of TNTlite:

http://www.microimages.com

Digitizing Soil Maps

The task of digitizing soil maps is accomplished in TNTmips by using a suite of separate processes. At the heart of the effort is the Auto-Trace process, which converts grayscale raster objects (in particular, scanned soil sheets) into vector objects by thinning and tracing line features. The Auto-Trace process (Process / Convert / Raster to Vector / Auto-Trace) provides a number of unique and powerful conversion filters which are designed to identify and delete unwanted line features during the conversion process. In particular, the filters can remove soil labels and drainage lines which, if not removed by filters, must be removed in tedious editing sessions after conversion.



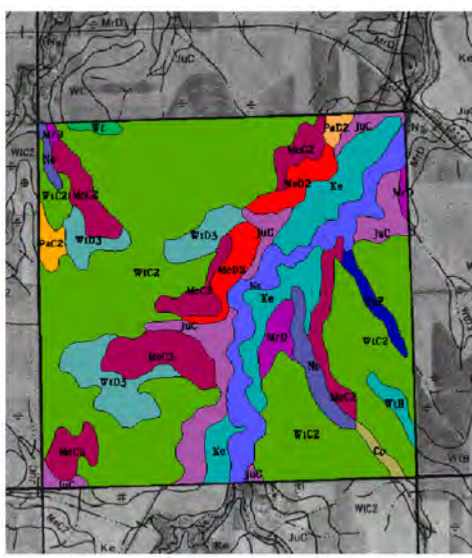
The main part of this booklet treats the use of the Auto-Trace process and the control settings for the line filters. Other processes, used to scan and prepare the soil sheets, and after conversion, to dress up the soil map vector object are touched on in later exercises.

If you are starting with a soil map that was vectorized by some other product, you may be faced with unwanted conversion artifacts that would have been removed by the Auto-Trace filters in TNTmips. You can apply vector editing filters in the TNT Spatial Data Editor (TNTedit, or TNTmips Edit / Spatial Data)

PART ONE of this booklet (pages 3 - 15) describes the simple process of digitizing a single section from one soil sheet.

PART TWO (pages 16-23) treats the other processes that would be used in a larger, multi-sheet digitization project.

A single section, bounded by county roads, has been scanned, georeferenced, auto-traced, edited, assigned attributes and styles, and displayed with automatic labels. The exercises in Part One of this book use Section 30 from Sheet 51 of the Lancaster County Soil Survey for Nebraska. This section offers a number of typical digitization problems: a crossing railroad, solid drainage lines, printed labels and annotations, some dark background image values, and complex line intersections. The following exercises emphasize the use of the filter tools in the TNTmips Auto-Trace process to minimize the number of unwanted artifacts that are converted to vector elements.



The Auto-Trace Process

SHEET51SECT30 is a raster object that was extracted from the scan of sheet 51 from the Lancaster County Soil Survey. The soil sheet was scanned at 300 dpi. The extracted 1024 x 1024 section was sampled to 512 x 512, which retains sufficient resolution for these sample exercises.

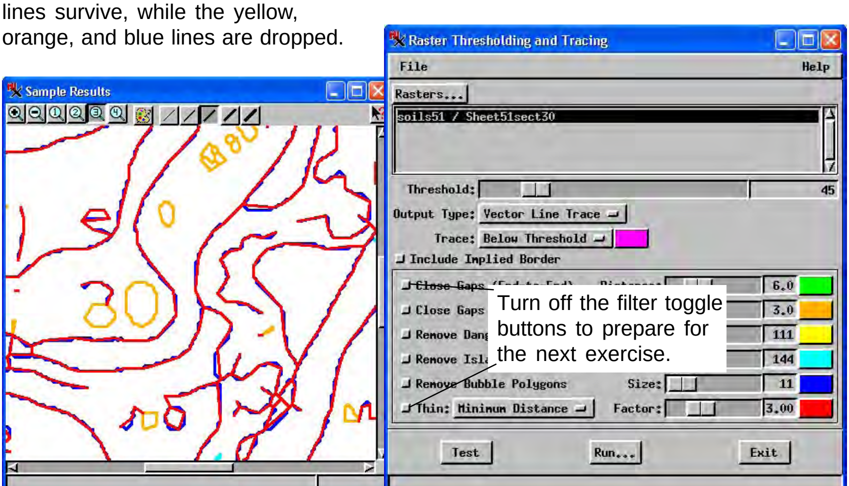
STEPS

☑ select Auto-Trace from Process / Convert / Raster to Vector
☑ select SOIL51 / SHEET51SECT30
☑ choose File / Restore Settings and select SECT30.INI
☑ turn off all the filter toggle buttons

The Auto-Trace process finds line features in a scanned map image and traces them into vector line elements. Soil maps are commonly distributed as grayscale airphotos with annotations and soil interpretations drawn in black lines. By thresholding and filtering the image, the soil units can be automatically converted into polygon elements in a vector object.

Launch the Auto-Trace process by selecting Auto-Trace from the Process / Convert / Raster to Vector menu. TNTmips opens the Raster Thresholding and Tracing window, a Sample Results view window, and a standard Select Object dialog. Select the SHEET51SECT30 object from the SOIL51 Project File. When you complete the selection, the process opens another view window that displays the raster object. Select Restore Settings from the File menu and then choose SECT30.INI (a prepared settings file that contains the control values illustrated here).

Applying filters helps remove unwanted artifacts. The color of the line elements in the Sample Results window shows which artifacts are deleted by each filter. As you adjust the filters, you will see the effect of the new values. In this illustration, the red lines survive, while the yellow, orange, and blue lines are dropped.



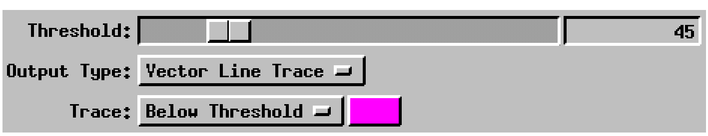
Adjust Threshold

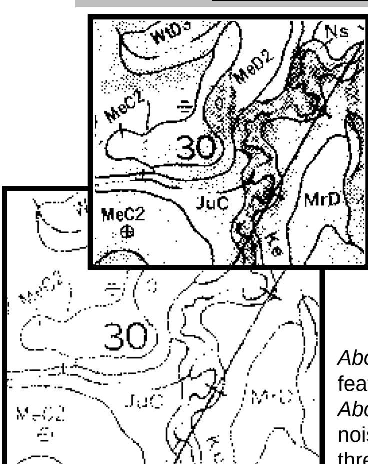
The initial threshold value provided from SECT30.INI is 45. That means that in the 8-bit grayscale SHEET51SECT30 raster object, all cell values from 0 to 45 would be traced as line features, while all cell values from 46 - 255 are discarded. In the Sample Results window illustrated here, the line features show as black, and all other image values show as white. (You can change the background / traced line colors by clicking the Colors icon button in the Sample Results window.)

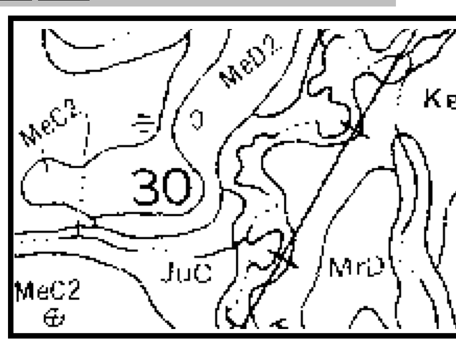
As with all the controls, you can change the threshold value either by typing in a new value, or by dragging the slider. Try dragging the slider all the way to the right end of the trough: the entire sample window turns black. If you drag the slider all the way to the left end, the entire sample window turns white. Select several values between 30 and 60. Your goal is to choose a value low enough to minimize background noise, and high enough to keep most line features connected.

A locator box in the Raster Thresholding and Tracing window shows which portion of the image is treated by the Sample Results window. Drag the box to a different location to see how the current threshold settings apply to a different part of the raster image.

STEPS
- ☑ observe the effect of the threshold value loaded from SECT30.INI
- ☑ change the threshold value to see the effect of other settings
- ☑ click [Test] to view a line trace of the thresholded line features
- ☑ type in the threshold value 45







Above: A threshold value of 45 retains most line features unbroken, and minimizes background noise. *Above Left:* The threshold value is too high, and noise from the background intrudes. *Left:* With a low threshold value, the line features lose their integrity.

Closing Gaps (End-to-End)

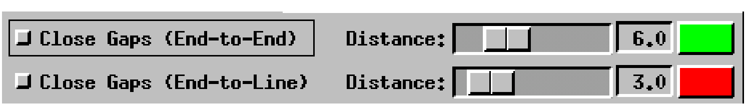
The filters are processed in an order that is designed to have a cumulative effect. Thus, you should adjust each filter in turn and be satisfied with its results before going on to the next filter. If you skip filters and, for example, Remove Dangling Lines without applying the earlier Close Gaps filter, you could see needed line elements drop out.

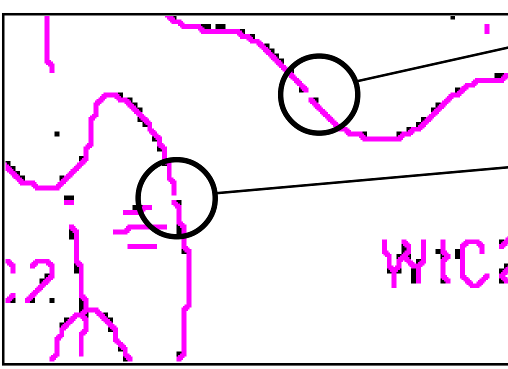
STEPS

- ☑ turn on the Close Gaps (End-to-End) toggle
- ☑ adjust the location and zoom so you can see line features with gaps in the Sample Results window
- ☑ click [Test] to see the results of the filter

If you set the threshold value low enough to suppress all the background image noise, you will usually have some small gaps in your line features. The Close Gaps (End-to-End) filter joins gapped line elements as they are traced. The control value specifies how many cells you want the filter to jump as it closes gaps. If you set the value too low, your line elements will not be continuous and you will not get closed, complete soil polygons. If you set the value too high, the filter will start joining all the dashed drainage lines and give you lines that you do not want.

Move the locator box to an area that shows gaps in line features. You may wish to press one of the zoom icon buttons at the top of the Sample Results window to get a closer look. Turn on the Close Gaps (End-to-End) toggle, and click the [Test] push button. The process traces the line features in magenta, showing the threshold results with line gaps, and then applies the gap filter, showing the resulting traces in green (gaps closed).





No matter how carefully you set the threshold value, some line features will probably break. The Close Gaps (End-to-End) filter jumps gaps of a width you specify. Set the value for how many cells you want the filter to jump. If you set the filter for too large a gap, you will see other features connected, such as drainage lines joined to their dashed line segments.

Closing Gaps (End-to-Line)

Mid-line gaps, such as those treated with the End-to-End gap filter are common. Occasionally you may also see a gap between the end of one line and the middle of another where they should join at a “T” junction. Use the Close Gaps (End-to-Line) filter to join such line features.

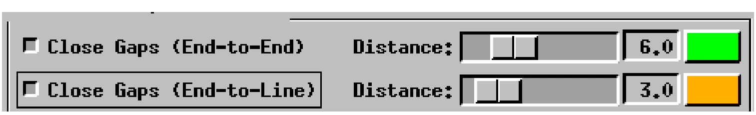
When you use a threshold value of 45, the SHEET51SECT30 sample data provided for these exercises does not have any end-to-line gaps that need to be closed. Nevertheless, you can see how the filter works with the crossing drainage lines in the MeC2 soil unit adjacent to the bounding section road at the top of the image. If the two drainage lines that cross the soil unit were supposed to be bisecting line features, you could close the gaps (illustrated below) by increasing the control value. One of the gaps closes at 4.0, and both gaps close at 5.0.

Turn on the Close Gaps (End-to-Line) toggle and experiment with a few different control values. Remember to set the value back to 3.0 before you go on to the next exercise.

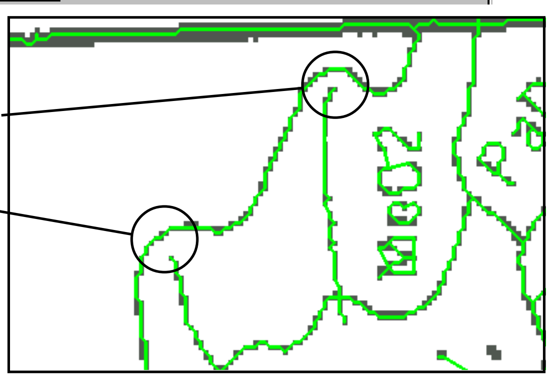
TIP: Apply the End-to-Line gap filter even if you don’t have obvious open “T” junctions. Part of the filter’s job is to tie up character gaps in the soil type labels, which makes them easy to delete with the subsequent Island Polygon filter (see page 9).

STEPS
- ☑ turn on the Close Gaps (End-to-Line) toggle
- ☑ adjust the location and zoom so you can see the MeC2 soil unit illustrated
- ☑ change the control value to 5.0
- ☑ click [Test] to see the results of the filter
- ☑ change the control value back to 3.0

You can also close gaps with the Undershoots filter in the Vector Tools of the Spatial Data Editor.



You may encounter places where there is a gap between two lines that should join at a “T” juncture. The Close Gaps (End-to-Line) filter jumps gaps of a width you specify. Set the value for how many cells you want the filter to jump. If you set the filter for too large a gap, you will see other features connected, such as drainage lines joined to polygon boundaries (as illustrated).



Removing Dangling Lines

Vocabulary: A **Dangling Line** intersects another line element on only one end. The unattached end terminates in a node element that is not shared by another line element. After unwanted gaps have been closed, any remaining dangling lines are probably “nuisance” features (such as drainage lines or railroad hash marks).

STEPS

☑ turn on the Remove Dangling Lines toggle

☑ adjust the location and zoom so you can see line features with short crossing lines in the Sample Results window

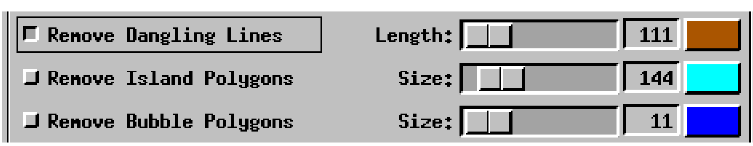
☑ click [Test] to see the results of the filter

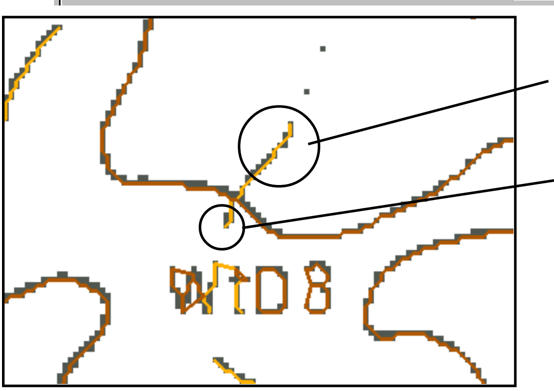
You can also remove dangling lines with the Dangling Lines filter in the Spatial Data Editor.

Crossing lines are common artifacts in soil maps and almost always need to be removed. Careful application of the Remove Dangling Lines filter can catch most crossing lines before the output vector line elements are created.

Turn on the Remove Dangling Lines toggle. The associated Length control value determines the maximum length of line features (measured in number of cells) that will be deleted. The longer a line is, the more likely it is part of a feature that you want to keep. The initial Length value from the settings in SECT30.INI is 111 cells. Experiment with longer and shorter values and inspect the results produced by clicking [Test].

IMPORTANT: If you are processing a section (unlike this sample data) that is not bounded by line features, then you will have many dangling line features where lines run off the edge without meeting a boundary line. With such material, this filter may be useful, only if you **turn on the Include Implied Border toggle** to create outside boundary lines.





Since the goal of the process as applied to soil maps is the extraction of closed polygons, any line that ends without joining another line can be assumed to be an unwanted artifact. Crossing drainage lines, as illustrated, count as “dangling lines” which, if shorter than the specified length, this filter will drop during the conversion processing.

Removing Island Polygons

Small island polygons should usually be treated as artifacts that need to be removed. Especially after gaps have been joined and dangling lines removed, label features may be little more than clusters of small adjacent polygons.

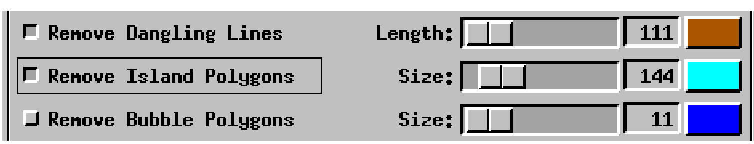
Turn on the Remove Island Polygons toggle. The associated Size control value determines the maximum size of polygon features (measured in number of cells) that will be deleted. The larger a polygon is, the more likely it is an actual soil polygon or other feature that you want to keep. The initial Size value from the settings in SECT30.INI is 144 cells. Experiment with larger and smaller values and inspect the results produced by clicking [Test].

Remember that an island polygon may be anything from a one-line solitary polygon to a complex of adjacent polygons that may themselves contain nested island polygons. Set the Size value with some care and inspect the sample results in several parts of the image.

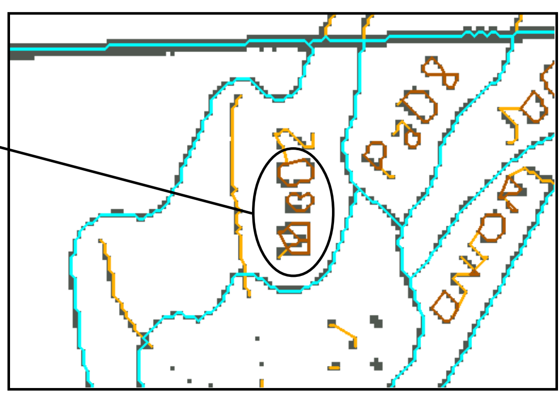
STEPS

- ☑ turn on the Remove Island Polygons toggle
- ☑ adjust the location and zoom so you can see characters in a soil type label
- ☑ click [Test] to see the results of the filter
- ☑ experiment with other Size values, but remember to change the value back to 144 before you go on to the next exercise

You can also remove island polygons with the Remove Islands filter in the Spatial Data Editor.



Extracting large polygons is the goal of the digitization process. But small, island polygons are probably label artifacts and the Remove Island Polygons filter eliminates them in the conversion. Set the filter size large enough to catch label artifacts, but not so large that the filter eliminates any legitimate island soil polygons.



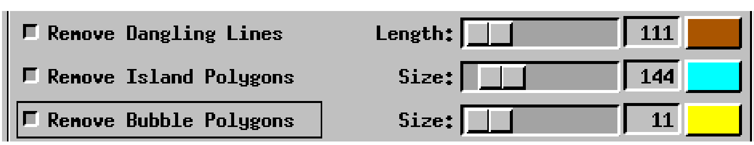
Removing Bubble Polygons

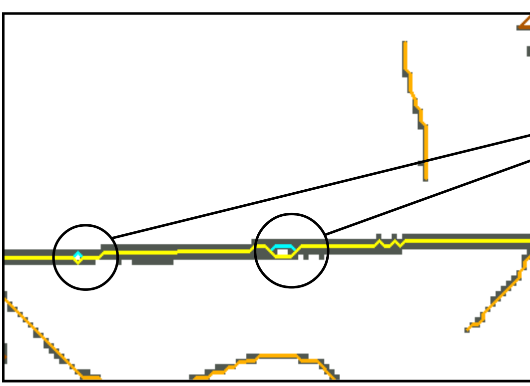
STEPS
- ☑ turn on the Remove Bubble Polygons toggle
- ☑ scroll along the boundary roads so you can see line features with bubbles in the Sample Results window
- ☑ click [Test] to see the results of the filter

You can also remove bubble polygons with the Remove Bubbles filter in the Spatial Data Editor.

The Auto-Trace process works on selected line features by thinning each line until it is one cell wide and then tracing the thinned result. If a thick line feature has dropout cells inside, then the thinning process creates small bubble polygons around the holes in the line. Bubble polygons are a nuisance, not only because of their appearance, but also because they provide misleading polygon statistics in the resulting vector object: when you look at the polygons statistics, you see more polygons than you expect, and you have a number of polygons that have no soil type attributes. The bubble polygon filter breaks a bubble polygon by removing one if its sides.

Turn on the Remove Bubble Polygons toggle. The associated Size control value determines the maximum size of polygon features (measured in number of cells) that will be deleted. The initial Size value from the settings in SECT30.INI is 11 cells. Experiment with larger and smaller values and click [Test] to inspect the results.





Small “bubble” polygons are created by the line thinning process when thick line features have interior dropout cells. Set the Remove Bubble Polygons filter to remove such polygons from line elements. If you set the filter value too high, you might remove wanted polygon features.

Thinning and Processing

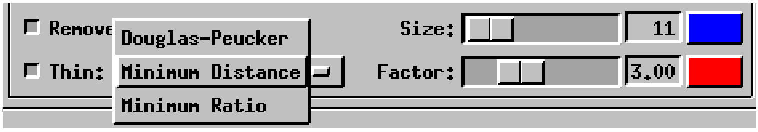
The Auto-Trace process traces the thinned raster lines by placing a vertex at every point where the path of the line changes direction. In most cases the resulting line elements have a denser set of vertices than is necessary, and can be thinned.

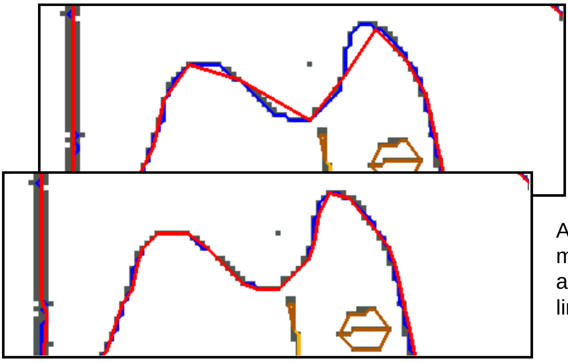
Turn on the Thin toggle. The associated Factor value determines how many vertices will be discarded in the line traces. The initial Factor value from the settings in SECT30.INI is 3 for the Minimum Distance method. Experiment with larger and smaller values and click [Test] to inspect the results.

The thinning filter is the last control value to set. You can apply the current thresholding and filtering values to the input raster object by clicking the [Run] push button. TNTmips opens the standard Select Object window; name the new vector object SECT30TRACE. Since the Auto-Trace process converts some features that you don't want, the next exercises show how to clean the output vector object in the TNTmips Spatial Data Editor.

STEPS
- ☑ turn on the Thin toggle
- ☑ click [Test] to see the results of the filter
- ☑ change the Factor value and method option button, and inspect the difference in the results
- ☑ change the method and Factor back to Minimum Distance and 3.0
- ☑ click [Run] and specify SECT30TRACE for the output vector object
- ☑ when the process finishes, select Exit from the File menu to quit the Auto-Trace process

You can also thin lines with the Line Simplification filter in the Spatial Data Editor.





The value for the thinning factor is too high, and the trace line cuts corners instead of following the curve smoothly.

A lower thinning factor minimizes the zig-zag effect and lets the trace follow the line feature closely.

Clean Artifacts

If any of the editing techniques mentioned here are unfamiliar, review the tutorial *Editing Vector Geodata*.

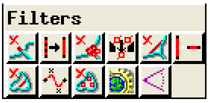
STEPS
- ☑ select Spatial Data from the Edit menu
- ☑ add the SHEET51SECT30 raster object as a reference layer
- ☑ open SECT30TRACE for editing
- ☑ change the line style to red, 2 pixels wide.
- ☑ move to the top left corner and zoom in

After you create a vector object in the Auto-Trace process, you need to open it in the Spatial Data Editor to clean and repair its elements. Some line elements need to be deleted and some need to be reshaped.

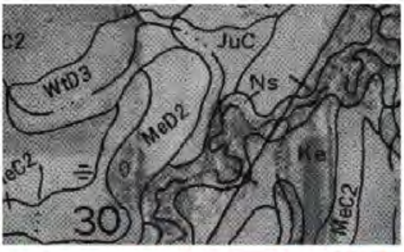
Open the Spatial Data Editor (Edit / Spatial Data). Add the SHEET51SECT30 raster object as a reference layer. Open SECT30TRACE for editing, and change the line and node colors and thickness to something that will be easy to see over the reference layer (the illustrations on the following pages use red lines, two pixels wide with white nodes).

It is best to traverse the vector object systematically, editing as you go. For these exercises, start in the top left corner zoom in, and scroll the view back and forth across the objects.

The vector filters in the Spatial Data Editor can be used to catch any artifacts that you missed in the Auto-Trace process.

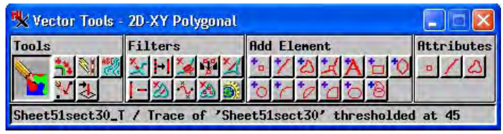


A particularly tangled intersection of railroads, labels, drainage annotations, and soil polygons comes out of the Auto-Trace process with several artifacts that need to be removed. Watch for the incorrect boundaries between polygons that are sometimes created along the line where a drainage or road passes through a polygon.



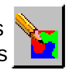
Remove Lines

Traverse the vector object in the Spatial View window, moving the view so you can edit each part in turn. Your primary task is to identify and delete line elements that are not part of soil polygon boundaries. In a typical conversion, some drainage lines, roads, label artifacts, and railroad features must be selected and deleted.



Select the SECT30TRACE layer and click the Edit Elements icon button in the Vector Tools window. In the Spatial Data Editor window, turn off the selection icon for each element type except lines and click the Select icon button. In the Element Selection window, select the Delete Operation icon. Then go to the Spatial View window and select several unwanted line elements. Click the [Selected] push button to delete them.

STEPS

☑ click Edit Elements in the Vector Tools window 

☑ select the Mode, Element Selection, and Operation tools as illustrated  

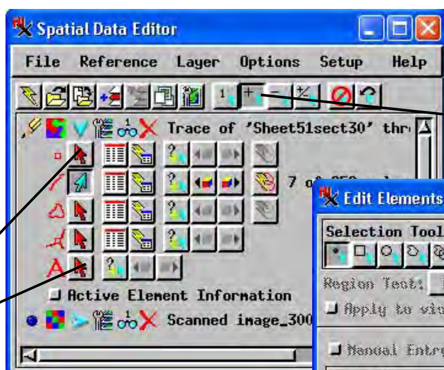
☑ click on several unwanted line elements in the Spatial View window 

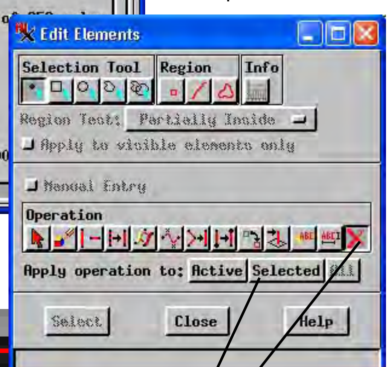
☑ click [Selected] to delete them

Use the editing controls in the Spatial Data Editor and Element Selection windows.

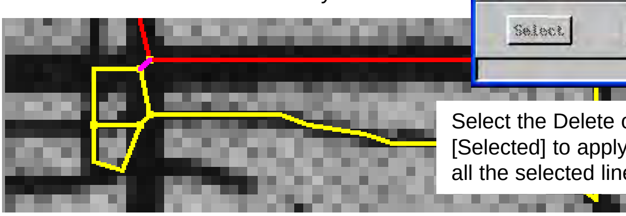
Turn off selection for all element types except lines.

Add several unwanted line elements to the selected set with the multiple select mode.





Line elements outside the southwest corner of section 30 are selected and ready to delete.



Select the Delete operation and click [Selected] to apply the Delete operation to all the selected line elements at once.

Remove Excess Nodes

STEPS

☑ click Remove Excess Nodes in the Vector Tools palette 

☑ select Save from the File menu

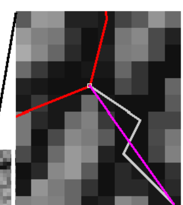
Vocabulary: An "excess node" is a node element shared by exactly two line elements of the same type. For some applications, you might want to keep the two lines divided, if for example, the lines were to be assigned different attributes. For soil map digitization, remove the excess node to create one line element from the two.

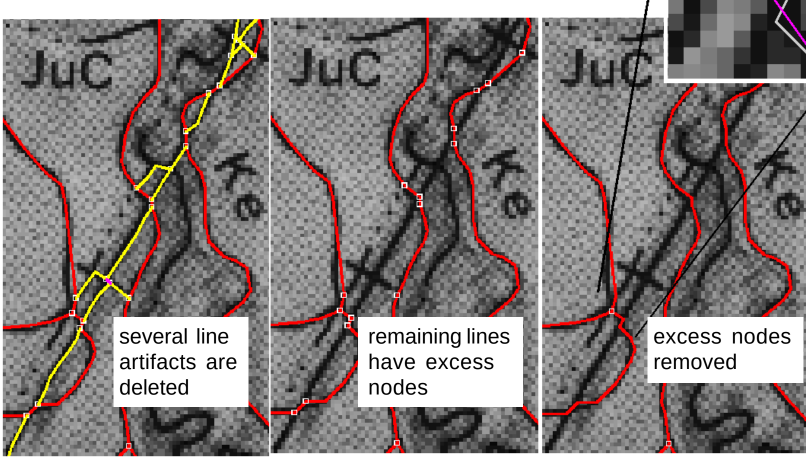
The topology of a vector object specifies that a node element always marks the end of each line element. Thus there is always a node element at every intersection of line elements. When you delete an intersecting line element, you leave behind an "excess node" in the remaining line element at the former intersections.

To update the object topology and remove the excess nodes, click the Remove Excess Nodes button in the filters panel of the Vector Tools palette. Then select Save from the File menu to update your changes. (It is good practice to save your edits each time you remove excess nodes or scroll to a new part of the vector object.)

After the excess nodes have been removed, you can drag, delete, and insert vertices to correct the shape of the polygon boundaries, especially where former intersections have a zig-zag appearance.

As you delete line elements, excess nodes remain at former intersections. Click Remove Excess Nodes in the Vector Tools palette. **Right**: after excess nodes have been removed, you can edit zig-zag lines.

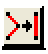




Other Editing Operations

To finish this digitization exercise, you will use the Spatial Data Editor to make final corrections to the SECT30TRACE vector object. You have removed unwanted line elements; now check to be sure that no required line elements are missing.

Use the editing tools on line elements to insert, delete, and move vertices to correct places where traced line elements do not conform to soil boundaries in the reference layer.



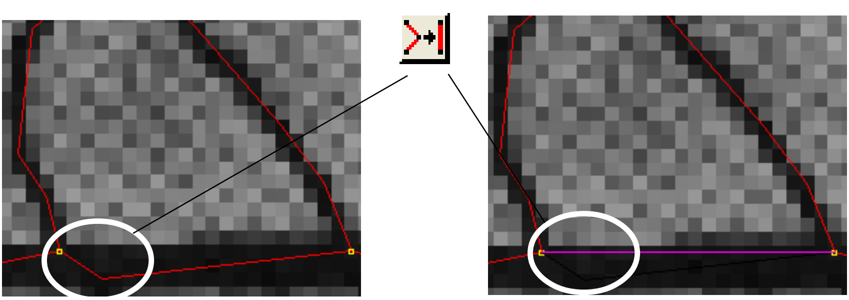
Use the straighten tool on line elements that should be straight, such as the roads along the boundaries of the section. The straighten tool removes all vertices between the end nodes.

You might use the spline tool to enforce a curved appearance on line elements that have especially visible corners. However, the spline operation adds many new vertices to a line element. Weigh the benefits of what may be a small cosmetic gain against the increased storage and processing demands of denser line elements.

This concludes the basic digitization exercise for Part One of this booklet. You probably will want to enhance the soil map by attaching databases and assigning styles. These steps are treated in Part Two of this booklet and in other tutorials in this series.

Take A Final Look. This is the last exercise in this booklet that treats the simple one-section digitization project. When you finish editing, you should have a complete vector object with clean soil polygon elements that match those on the input raster object. Before you save your final result and exit the Spatial Data Editor, take an overall look at the vector object to catch any missing or incorrect elements.

STEPS
- ☑ inspect the vector object for remaining problems
- ☑ apply appropriate editing tools
- ☑ save the vector object and exit the Spatial Data Editor



The jagged boundary line elements around the boundaries of the map can be selected and straightened with the straighten tool.

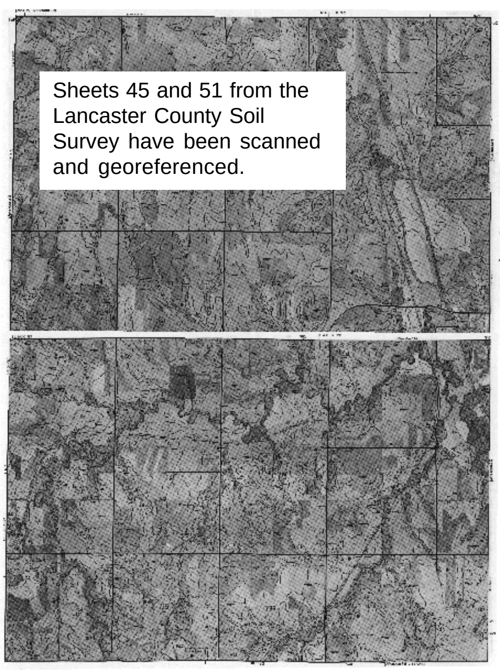
Scanning Soil Sheets

STEPS
- ☑ scan your soil sheets with Process / Raster / Utilities / Capture TWAIN or with an external scanning utility
- ☑ try a few test scans to find the best resolution, contrast, and brightness
- ☑ if you used an external scanning utility, import the rasters with Process / Import-Export (Refer to the tutorial *Importing Geodata*)

This is the first exercise in Part Two of this booklet. From here on, the exercises are not strictly sequenced and they treat general issues to consider if you plan a larger digitization project.

If you plan a large digitization project, such as creating one digital soil map of an entire county, begin with good scans of all the soil sheets involved.

Choose a high enough scanning resolution so that the line features are several cells wide. For example, the soil map used in Part One (pages 3-15) was scanned at 300 dpi and then sampled to an effective 150 dpi, which provided a usable map. A 600 dpi scan would be no better: tracing, thinning, and processing times would increase, not to mention the increased size and disk storage requirements of the raster objects. Do some test scans at different resolutions and compare the results.



Sheets 45 and 51 from the Lancaster County Soil Survey have been scanned and georeferenced.

Scan in grayscale mode, not color mode. Adjust your scanning software controls for contrast and brightness. Choose settings that give solid, black line features that are distinct from the gray photo image in the background.

Position the soil sheets on the scanner carefully to minimize the amount of angular skewing.

Adding Georeference

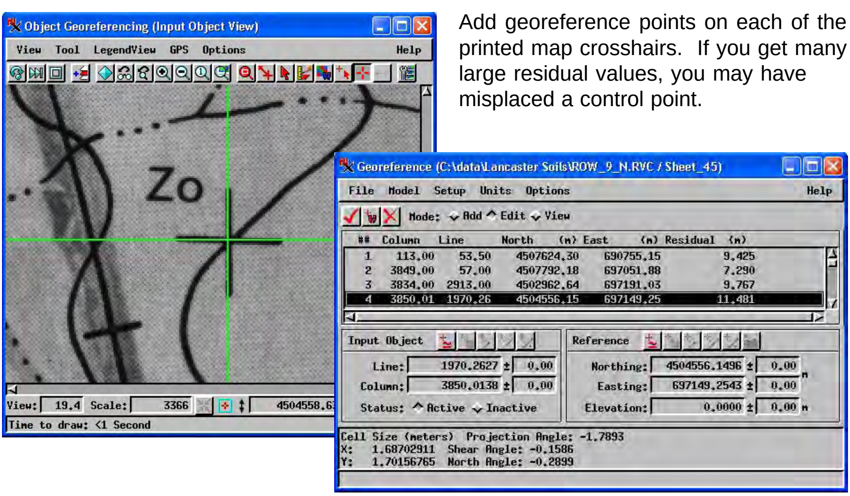
Georeference is the key to creating a mosaic of all the soil sheets in your project. Since soil surveys are created and published on uncorrected airphotos, the non-orthogonal geometry of the soil sheets prevents them from being simply tiled together. Good georeference control lets the mosaic process warp all the soil sheets to a common reference grid, ensuring a good fit.

Use the TNTmips georeference process (Edit / Georeference). Refer to the TNT Reference Manual and the tutorial booklet *Georeferencing* for review if you need it. The soil sheets are printed with map tick marks, so put your control points on those marks. You can also enter control points for road intersections or other features if you know their map coordinates from surveys, GPS readings, or other map materials.

Pay some attention to the Residual values. Since the soil sheets are based on uncorrected airphotos, large residuals for some points can be expected, but consistently large residuals for many points may indicate an incorrectly placed control point.

Since the soil maps use an uncorrected airphoto base, you can expect larger residuals than you would see with orthogonal map materials. Enter the points as accurately as you can, and let your subsequent warping or rectification steps reconcile the internal geometry.

STEPS
☑ add georeference control to each soil sheet with Edit / Georeference



Add georeference points on each of the printed map crosshairs. If you get many large residual values, you may have misplaced a control point.

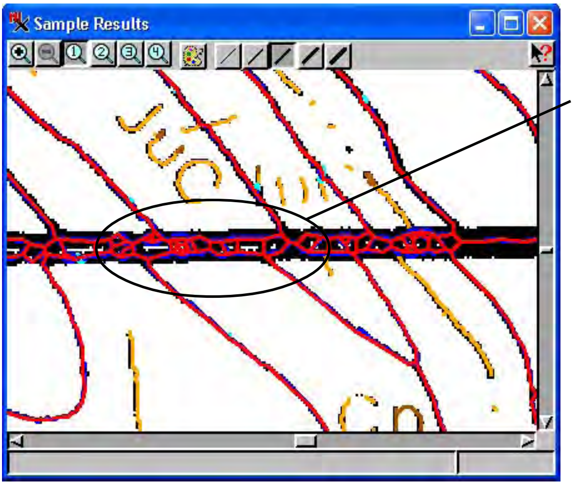
Mosaic Before Auto-Trace

If you have an elevation raster object that includes the extents of the soil maps, you can produce "orthoimage" soil sheets with improved geometry before coming to the Mosaic process. (Process / Raster / Photogrammetric Modeling.) Refer to the TNT Reference Manual and to the tutorial *Making DEMs and Orthophotos*.

The TNTmips Mosaic process (Process / Raster / Mosaic) can use georeference control to assemble any number of raster objects into one. As the process makes the mosaic, it automatically adjusts the orientation and scale of each object.

It is possible to autotrace each separate soil sheet and then combine the resulting vector objects. However, it is slightly harder to reconcile line elements at the map seams when merging multiple vector objects than to edit the seam artifacts in single vector object that was auto-traced from a mosaicked raster object. When a soil polygon straddles a seam, its line elements need to meet end-to-end. You may see overlapping, mismatched, and double boundary lines when you merge vector objects. By contrast, a raster mosaic usually yields a single boundary line, and it is easier to handle lines at the seam as you edit the auto-traced vector object.

The Mosaic process automatically warps each component raster object before it combines them. If you get seaming problems in the result (as illustrated below) choose a different warping method or correct your georeference control.



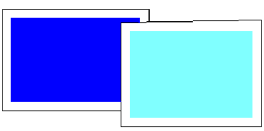
Poor georeference control and uncorrected airphoto geometry can cause problems along the seams in the mosaic process. The illustration shows how two sheets join along a line that does not overlap itself and creates unwanted seam artifacts. If you get such complex line results, correct your georeference control and consider using a different warping method in the mosaic process.

Mosaic Seams

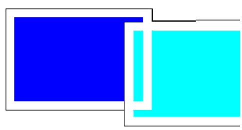
The Mosaic process has several ways of treating the overlap area between adjacent raster objects. Since each soil sheet has a white margin that conflicts with the image area in adjacent sheets, you need a seaming method that always chooses image cells over margin cells in overlap areas.

The illustration below shows how four seaming methods treat white margins in the overlap area. In the *Last Raster* method, the margin of the sheet on top blots out the image in its neighbor. In the *Maximum* method, margin cells from both sheets are selected. In the *Average* method, margin values are averaged with image values. In the *Minimum* method, the darker image cells are always preferred over the white margin values.

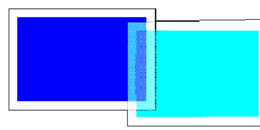
The Mosaic process in TNTmips offers many powerful features for creating good mosaics — even from images that have poorly matched color, contrast, brightness, and other conflicting characteristics. Refer to the TNT Reference Manual and to the tutorial *Mosaicking Raster Geodata*.



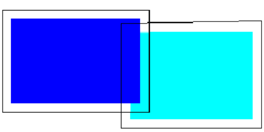
last raster



maximum

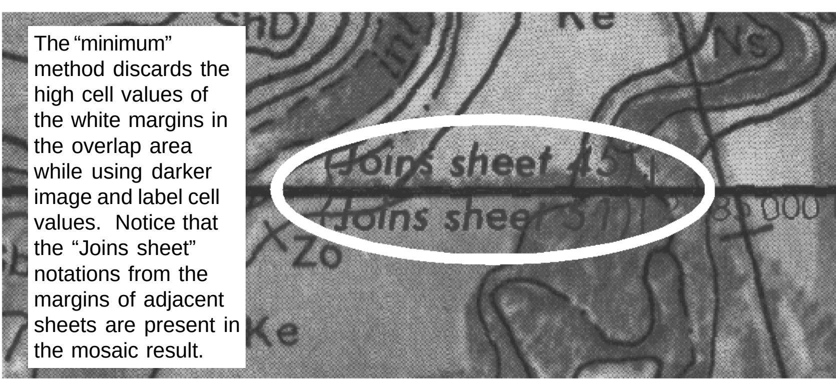


average



minimum

Set the overlap method to “minimum” so that the white margin around each soil sheet (high cell values) will be discarded while the lower image cell values survive. Other seaming methods are appropriate for other kinds of mosaic materials.



The “minimum” method discards the high cell values of the white margins in the overlap area while using darker image and label cell values. Notice that the “Joins sheet” notations from the margins of adjacent sheets are present in the mosaic result.

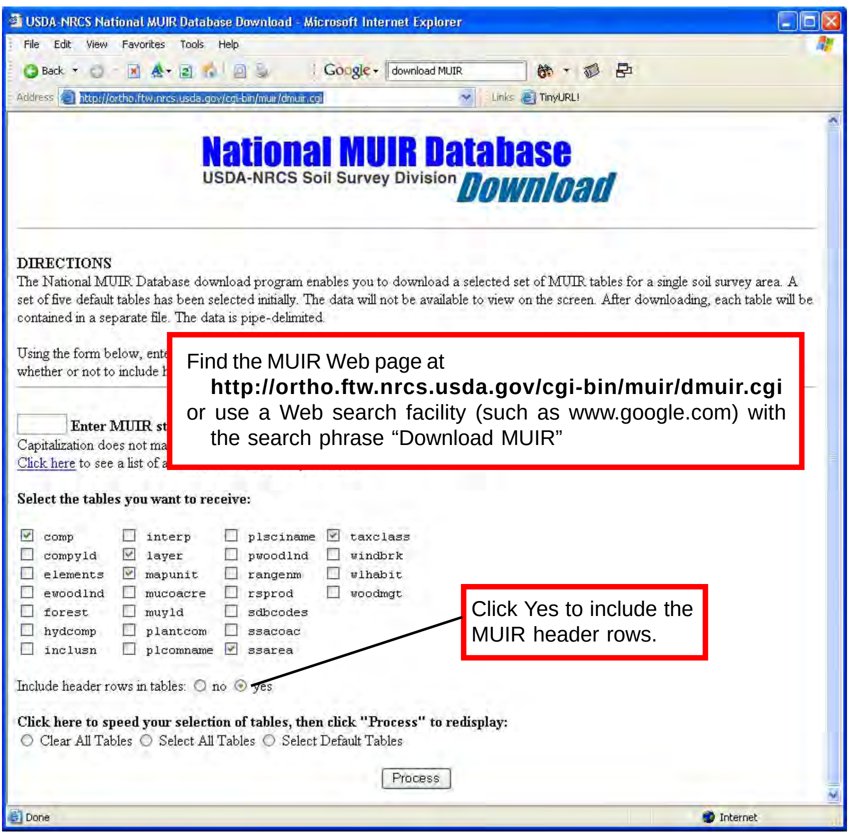
Import Attribute Tables (MUIR)

The soil attribute tables that are printed in the county soil survey books are available in electronic form as the Map Unit Interpretation Record (MUIR) database. You can buy a complete MUIR on CD from USDA Natural Resources Conservation Service, or download individual tables from the Web. If you use the Web page for download, check the boxes for every type of table, and check the Yes box to include the MUIR header rows (which are used by the TNT import process).

Use the TNTmips import process (Process / Import-Export) to import the tables to your vector objects (polygon elements).

You can order national data on CD-ROM from:

USDA - Natural Resources Conservation Service
National Cartography and Geospatial Center
501 Felix Street, Building 23 (P.O. Mail 6567)
Fort Worth, TX 76115
Telephone: (800)672-5559



Attach Attributes

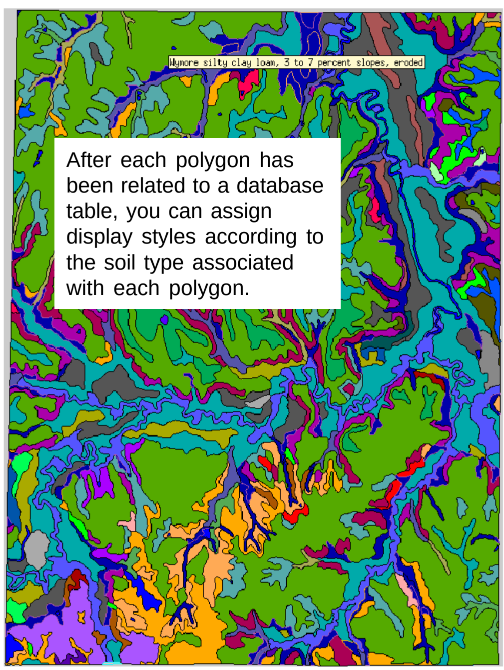
To attach database records to polygon elements, at least one of your database tables must have a key field defined. Select Edit / Attribute Databases, select the polygon elements from the vector soil map object, and open one of the MUIR tables. Select Table / Edit Definition, choose a field, and click its Primary Key toggle. (Review this procedure in more detail in the TNT Reference Manual and in the tutorial *Editing Vector Geodata*.) You can use the tools in the Polydata window to establish relations to other tables. (Refer to the tutorial *Managing Relational Databases*.)

After a primary key has been defined, you can use a selection query in the display process (Display / Spatial Data) to visit each polygon element in turn and attach its primary database record. Add the soil sheet mosaic of raster objects for background reference, and overlay your edited vector object. For a key field named “Class,” the selection query would have the form

```
SetNum(Class[*])<1
```

Enter your polygon query, and click the Next icon button. This query pans to the next polygon that does not have an attached attribute in the Class field. Zoom in on the polygon element and read the soil type from the soil sheet reference object. Assign the soil type attribute from the table and click the Next icon button to advance to the next polygon element that needs an attribute.

Select a primary table that has fields common to many tables. After you have linked each polygon to its soil type, in the primary table, you can quickly relate several other tables to the soil polygons by relating other tables to fields in the primary table. Thereafter, database information from all the related tables can be accessed from the polygon elements.



After each polygon has been related to a database table, you can assign display styles according to the soil type associated with each polygon.

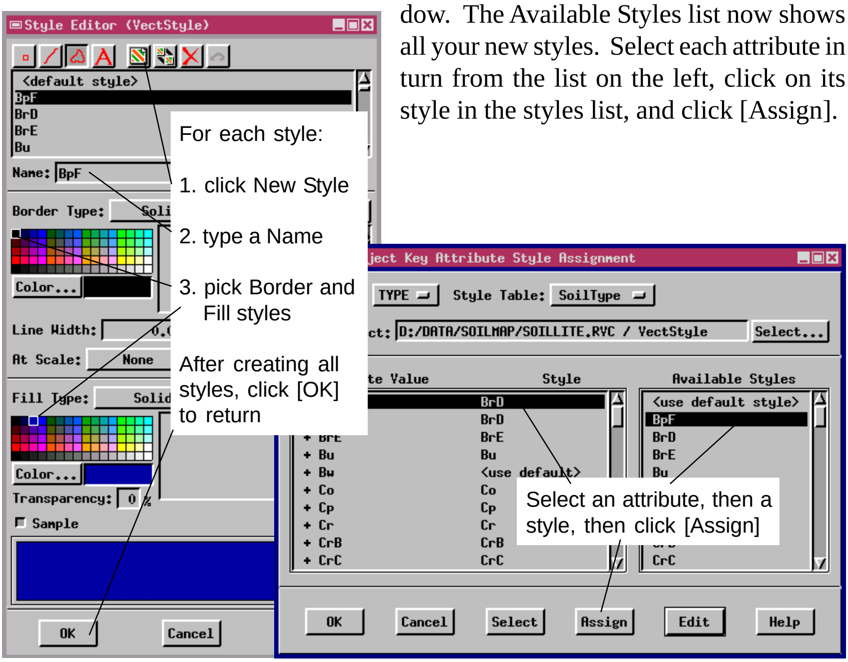
Create and Assign Styles

The illustrations and examples in this booklet use simple black borders and solid fills for polygon styles. Refer to the TNT Reference Manual and the tutorial *Creating and Using Styles* for details on creating and using fill patterns and transparency effects.

TIP: Choose similar colors for all the soil varieties in a series. For example, in the sample data, all the types in the Mayberry series have polygon fill colors selected in the red and maroon hues.

After you have attached database tables to polygon elements through a key field, you can create drawing and display styles for each attribute value. Open the Vector Object Display Controls window in the display process, and click the Polygons tab. Set the Style option button to By Attribute and click [Specify] to open the Vector Object Key Attribute Style Assignment window (illustrated below). The left half of the window lists the key field values from the database table. The right panel lists available styles. (To begin with, the Available Styles list contains a single item: <use default style>.)

Click [Edit] to open the Style Editor window for each attribute value, click the New Style icon button, type in a Name, and select Border and Fill styles. (Refer to the TNT Reference Manual for more detail on the Style Editor.) When you have a style for each attribute type, click [OK] to close the Style Editor window. The Available Styles list now shows all your new styles. Select each attribute in turn from the list on the left, click on its style in the styles list, and click [Assign].

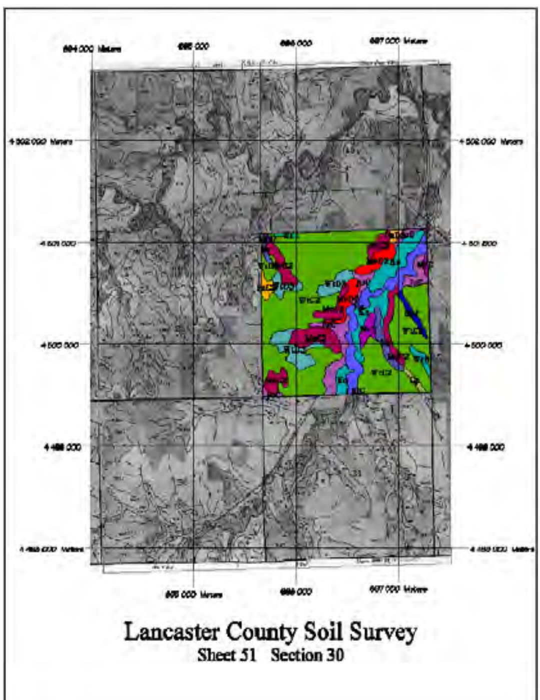


Soil Map Applications

The soils layer is one of the most important in any advanced system for spatial data analysis. Soil attributes are important for engineering, construction, planning, agriculture, natural resource management ... almost every discipline that uses geospatial information needs to have access to soils data. Query soil type attributes with other GIS layers that contain data for crop yield, proximity to development proposals, erosion data, watershed analysis, engineering studies, and any number of other spatial measurements and conditions.

The final use you make of your digitized soil map depends on the needs of your organization. You can use the soil polygons and their attributes in many complex GIS analyses in the TNT products. You can create map displays and large-format prints. You can export the vector object to a wide assortment of popular formats (including AutoCAD, Arc/Info, and MapInfo) for use in other systems.

Keep up with the latest version of TNTmips. Processes such as those used in this booklet are updated in regular upgrades. Download the latest version of TNTlite from the MicroImages Web site: www.microimages.com.



The vector object digitized from SHEET51SECT30 is displayed on soil sheet 51. The Hardcopy Layout process in the TNT display process trimmed the soil sheet to chosen extents, added a map grid, and added the map title lines. Vector polygon labels were generated automatically from attached attribute tables.

SOIL MAPPING

Advanced Software for Geospatial Analysis

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.

TNTmips TNTmips is a professional system for fully integrated GIS, image analysis, CAD, TIN, desktop cartography, and geospatial database management.

TNTedit TNTedit provides interactive tools to create, georeference, and edit vector, image, CAD, TIN, and relational database project materials in a wide variety of formats.

TNTview TNTview has the same powerful display features as TNTmips and is perfect for those who do not need the technical processing and preparation features of TNTmips.

TNTatlas TNTatlas lets you publish and distribute your spatial project materials on CD-ROM at low cost. TNTatlas CDs can be used on any popular computing platform.

TNTserver TNTserver lets you publish TNTatlases on the Internet or on your intranet. Navigate through geodata atlases with your web browser and the TNTclient Java applet.

TNTlite TNTlite is a free version of TNTmips for students and professionals with small projects. You can download TNTlite from MicroImages' web site, or you can order TNTlite on CD-ROM.

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