THEME MAPPING

Tutorial

Theme Mapping

with

TNTmips®

TNTedit™

TNTview®

Before Getting Started

A theme map is a screen display or print that portrays graphical elements using color, patterns, or symbolism to convey information about the relative value of a numeric attribute associated with the element, such as yield, population, or elevation. Generally, a range of styles, such as a color spread, is used to represent the range of values for the attribute. Through a series of exercises, this booklet familiarizes you with the powerful theme mapping functions that are part of the visualization process in TNTmips®, TNTedit™, and TNTview®. Theme maps can be incorporated in a TNTatlas®, but they can't be created while running one.

Prerequisite Skills This booklet assumes you have completed the exercises in the *Displaying Geospatial Data* and *TNT Product Concepts* tutorial booklets. The exercises in those booklets provide basic knowledge on how to use the TNT products including how to select and view raster, vector, CAD, TIN, and database objects stored in Project Files. Please be sure you remember how to add and remove layers from a multilayer view. You should also know how to set up and select your printer. This booklet does not present these basic skills again.

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. Many of the exercises use the COUNTY object in the NEBRASKA Project File in the THEMEMAP directory of DATA. The objects in the GS_THEME Project File in this directory are also used.

More Documentation This booklet is intended only as an introduction to the functions in Theme Mapping.

TNTmips® Pro and TNTmips Free TNTmips (the Map and Image Processing System) comes in three versions: the professional version of TNTmips (TNTmips Pro), the low cost TNTmips Basic version, and the TNTmips Free version. All versions run exactly the same code from the TNT products DVD. If you did not purchase the professional version (which requires a software license key) or TNTmips Basic, then TNTmips operates in TNTmips Free mode.

This booklet refers to TNTmips, TNTedit, TNTmips Free, and TNTview as "TNT." Since the display features in all four products are essentially the same, you will be able to follow these exercises no matter which product you have.

Merri P. Skrdla, Ph.D., 10 August 2012

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

http://www.microimages.com

Welcome to Theme Mapping

Geodata stored as vector, CAD, and TIN objects can make use of associated database information for drawing style assignment by attribute value. Database information can be quantitative or qualitative. The TNT products provide three methods for using associated attributes to assign display styles. These methods are referred to as style By Attribute, By Theme, and By Script.

Style By Attribute lets you assign a drawing style to each attribute value. Such displays are best suited for qualitative data, such as soil type or land use. Style By Theme requires quantitative attributes and is not available for CAD objects. Style By Script is suitable for quantitative or qualitative attributes, but requires specific knowledge for constructing scripts (database queries).

Quantitative data presents the possibility of conveying where in the range of values an element falls, as well as whether it is the same or different than other elements. Theme Mapping is a powerful means to look at trends and classes present in the database information associated with vector and shape objects without the need for you to design the scripts required to identify the classes and assign meaningful styles. Theme Mapping treats the values in a designated field statistically and assigns styles to the classes identified according to the parameters you specify. The approach used to assign drawing styles based on the distribution of values in a database field is essentially an interactive interface for a specialized database query.

Themes are maintained using style assignment tables and style objects just as when drawing style is assigned by attribute. Thus, in order to create or edit a theme, you have to be able to write to the file. Consult the *TNT Product Concepts* booklet for details on copying objects or use your operating system.

Vocabulary: A **theme map** is a color coded map with the coloration related to the relative amount of some variable, or attribute. An **attribute** is a distinguishing characteristic stored in a database and associated with an element in a geometric object (vector, CAD, shape, or TIN) or with cells in a raster object. Attributes can be qualitative (soil type, land use) or quantitative (yield, population).

STEPS

☑ launch TNT

☑ use the File Manager or your operating system to copy the Project Files in the THEMEMAP data collection to your local drive

Pages 4–11 provide instruction for creating a theme map, adding a legend, and printing the result. Pages 12–16 lead you through adding a computed field to get new information out of your existing database and creating and printing a theme map based on that information. Page 17–20 introduce theme mapping for points and lines, and pages 21–23 describe interactive theme mapping tools and options.

Selecting Your First Theme

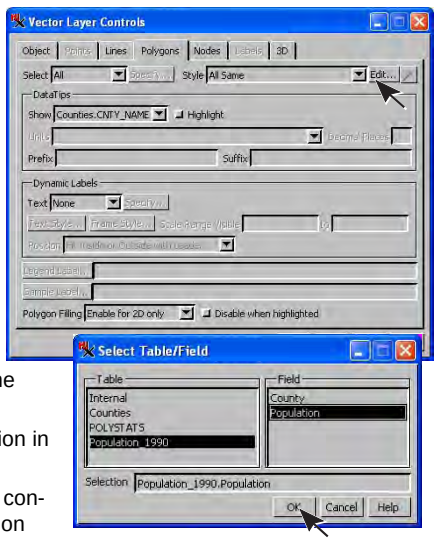
Vocabulary: A **drawing style** associates a name with element drawing specifications, such as point size, line weight, whether and how to fill polygons, and whether to use simple or symbolic representations for an element.

STEPS

- ☑ select Main / Display from the TNTmips menu
- ☑ choose Options / View Options in the Display Manager, click on the View tab; turn on the *Default to redraw primary views after any change* button on the View panel, and click [OK]
- ☑ click on the New icon, choose 2D Display, and select the COUNTY object from the NEBRASKA Project File
- ☑ click on the Layer Controls icon for the COUNTY layer in the Display Manager
- ☑ check that polygon Select is set to All
- ☑ set polygon Style to New - by Theme
- ☑ click on Population_1990 in the Table list
- ☑ click on Population in the Field list
- ☑ click on [OK] to confirm your selection and proceed to the design phase

Themes can be created for point, line, and polygon elements. First we'll design a vector polygon theme based on population. When a theme has already been created, you can set the element Style option to By Theme, and the last selected theme will be used. In order to create a theme, you need to click on the Edit button next to the Style option. The Select Table / Field window then opens if the object has never been used for theme mapping. If a theme has been created previously, you go directly to the Theme Mapping Controls window shown on the next page and see the Select Table / Field window again only when you choose New from the Theme menu or click on the Attribute button.

When the Select Table / Field window initially opens, all the tables in the database for the selected element type are shown in the list at the left of the window, and the Field list is blank until you select a table. You then select a field from those listed and your theme has been identified. Themes can be developed for quantitative data only. However, you are not prevented from selecting a string field because it may contain numeric values, such as data imported from a comma separated values (csv) file. If all minimum and maximum values are listed as zero when the Theme Mapping Controls window opens, you have picked a field that is inappropriate for theme mapping.



Theme Mapping Controls

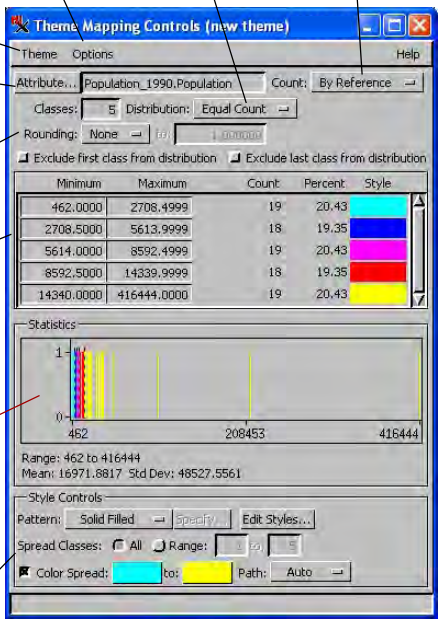
The Theme Mapping Controls window opens already customized to the range of values in the field you selected, but with default parameter settings, such as the number of classes and the methods for determining the count and the distribution. You can keep these defaults or make changes to better reflect your theme mapping needs. You can use Save As Default on the Theme menu at any time to alter the default settings used for subsequent new themes to your current settings.

The Count choices are: By Reference; By Element Size, which requires a standard attributes table in order to be active; and All Records, which counts each record only once regardless of the number of elements attached to it.

The Theme menu lets you start a new theme, open an existing theme, save changes with the same or a different name, set new defaults, and close the theme window.

The Options menu lets you set whether the histogram is displayed as a curve or with bars and whether its scale is linear or logarithmic.

The Distribution choices are: Equal Count, Equal Interval, and User Defined.



Click here to select a different table / field for the theme map.

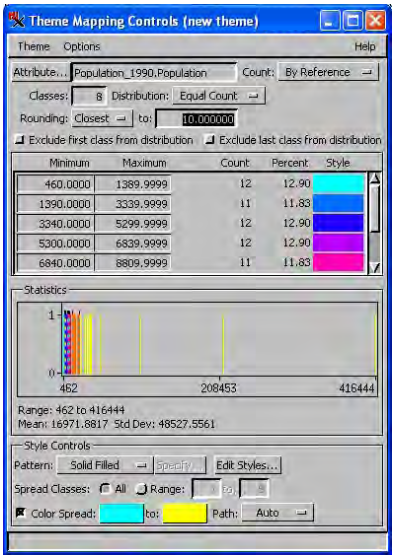
Rounding options are: None, Closest, Down, and Up.

This panel shows the breakdown of values for each class and the drawing style assigned. The panel scrolls when the theme is divided into more than five classes.

A graphic representation of the distribution with class boundaries indicated by dashed lines.

The bottom panel lets you set the drawing style for each class either automatically or manually. When theme mapping points or lines, there is an additional panel for size or width spread.

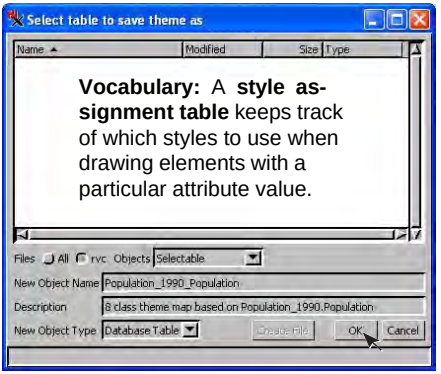
Modifying and Saving a Theme



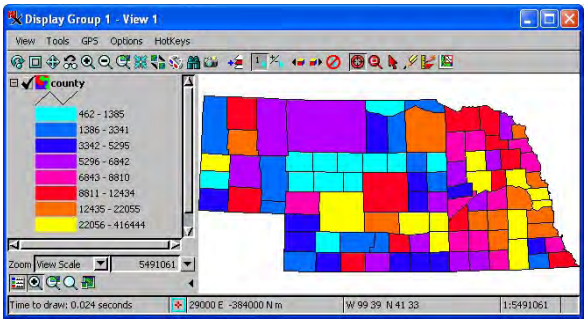
Let's make a couple of changes to the default settings for this theme map, which is designed to convey relative population. Because Nebraska has 93 counties, we can reasonably assign more than the default five population classes. We would have to go to 31 classes, which is a bit excessive, to get an equal number in each class; so let's just go with eight. You want to be able to distinguish the classes from one another, and it is difficult to readily distinguish more than 10 or 12 classes with the color spread method for assigning drawing styles. Let's also set the rounding function to round to the closest multiple of 10. Up and down are also offered as rounding options. The default sets rounding to none.

- ☑ change the value in the Classes field to 8
- ☑ choose Closest from the Rounding option menu and enter 10 in the field to its right
- ☑ choose Close from the Theme menu
- ☑ click on [Yes] when asked "Save changes before closing?"
- ☑ click on [OK] to accept the default name and description in the *Select table to save theme as* window that opens
- ☑ click on the Lines tab and check that the Select option for line elements is set to All
- ☑ click on [OK] in the Vector Layer Controls window

Database structure is important in theme mapping. For applications where a single entity, such as a state, may have multiple polygons with a single value that applies to all, you want to make sure that there is only a single record for each state and that all the polygons are associated with this one record. A state outline map of the USA with upper and lower Michigan or California and the islands off its coast provides examples of such situations. The adjustments that need to be made in theme mapping for these circumstances are discussed in a later exercise.

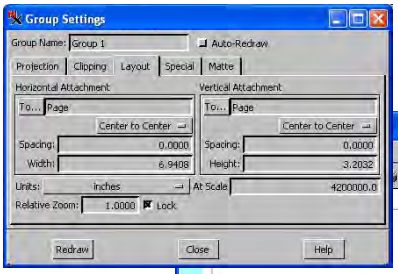


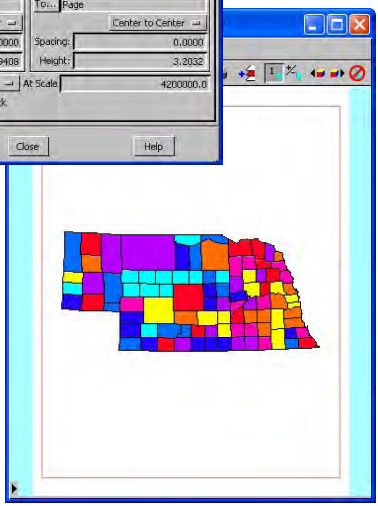
Making the Transition to a Layout



You have now created and saved a theme map. This theme map breaks the county populations for Nebraska into eight classes, which are displayed in an incremental color spread from cyan (lowest population) to yellow (highest population). It would be nice to see the actual population ranges associated with each color, which can be achieved onscreen in the View window legend or by adding a legend object, which is needed to provide values in a printed map. You need to be in either Page or Display layout mode to add a legend object in the View window.

There are five tabbed panels in the Group Settings window. We use only Layout-panel options in this exercise.





Keep the Spatial Data Display process and the current layout open until you have added a legend, printed the results, and saved the layout (through the top of page 12).

STEPS

- ☑ right-click on the group name in the Display Manager window and choose Close Group
- ☑ click on the New icon and choose Page Layout
- ☑ click on the Add Objects icon in the Display Manager, and select the COUNTY object for which you created the theme in the last exercise
- ☑ click on the Settings icon for Group 1, then on the Layout tab of the Group Settings window
- ☑ toggle off the Auto-Redraw button at the upper right of the window and enter 4200000 in the At Scale field (yes, that's 4.2 million)
- ☑ click on the Redraw icon if vector object has not drawn

Start a Legend for Your Theme Map

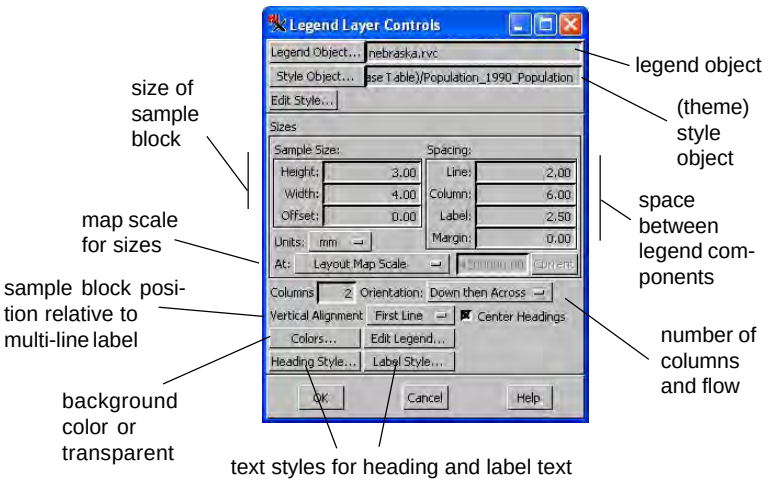
STEPS

- ☑ choose Add / Legend / Add Polygon Legend in the Display Manager
- ☑ navigate to the Project File that contains the county population theme map and enter COUNTY POPULATION in the New Object Name field in the "Select legend object to use" window
- ☑ click on [OK] in the Select legend object to use window
- ☑ navigate to the same file and click on your COUNTY object icon in the county "Select style object to use" window
- ☑ next click on the POLYDATA icon, then the PolyData POPULATION_1990_POPULATION table Population_1990_Population icon, and finally the POPULATION_1990_POPULATION style Population_1990_Population object icon

The Add Legend icon is on the toolbar in the Display Manager window, along with the icons for adding text and scale bars, because these icons add a new group that contains the specified layer type to the layout. These layer types require separate groups because they cannot be combined in georeferenced overlay with other layers and usually require independent positioning in a layout. The group will be named to match its legend object. The Add Legend icon adds multi-object legends; other legend types are selected from the Add menu.

The only tricky part about creating a legend for a theme map is locating the style object for the theme. It is maintained as a subobject of the theme style assignment table, which is in the database with the table used to provide the theme values. This is a logical place to store the style object so that the styles don't get separated from the theme, however, it's much deeper in the RVC file structure than you may have navigated before.

The Legend Layer Controls window opens after you have selected a legend object and, if it is a new legend object, the style object for the legend. The entries you make are retained as defaults.



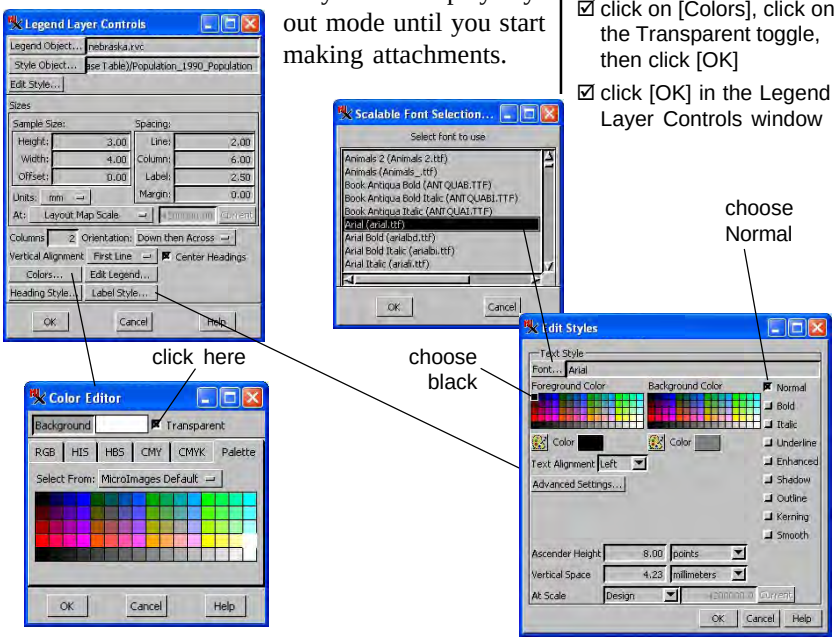
Setting Legend Parameters

You could click on the OK button at this point and see what you've got, because the legend labels and sample color blocks are determined by the theme style object, which means you have a complete legend at this point. However, unless you set some sizing parameters or at least confirm they are appropriate for this example, you may end up with a legend too small to be legible or so large that it obliterates the map. Also, we're going to print this theme map, so the size should be appropriate for letter size paper.

After you click OK in the Legend Layer Controls window, you'll find you have two groups listed in the Display Manager window. Legends are always placed in a group by themselves since they lack georeference information and also require independent positioning. The display process automatically places newly added groups centered on the page in Page Layout mode. Groups are automatically tiled in Display Layout mode until you start making attachments.

STEPS

- ☑ in the Sample Size panel set Units to mm, Height to 3.0, and Width to 4.0
- ☑ make the following settings for spacing: Line 2.0, Column 6.0, Label 2.5, and Margin 0
- ☑ choose Layout Map Scale on the At: option button
- ☑ set the number of columns to 2 and check that the orientation option is Down then Across
- ☑ click on [Label Style]
- ☑ click on [Font] and choose arial.ttf or a similar font you have, then click [OK]
- ☑ set the Foreground Color to black, the style to Normal, and the Ascender Height to 8.0 Points, then click [OK]
- ☑ click on [Colors], click on the Transparent toggle, then click [OK]
- ☑ click [OK] in the Legend Layer Controls window



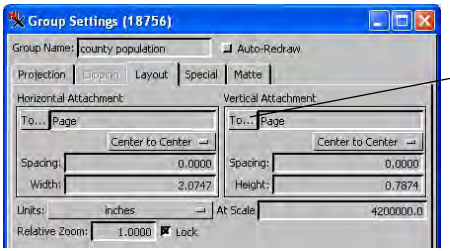
Positioning the Legend

STEPS

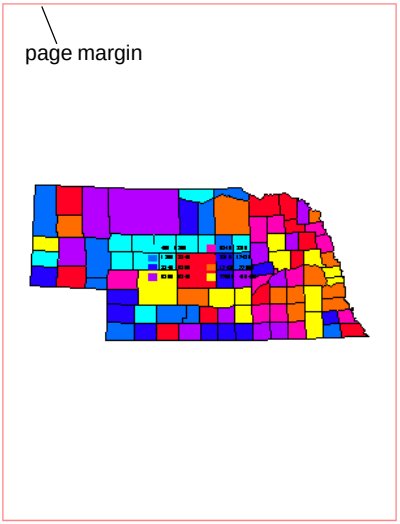
- ☑ click on [To…] in the Vertical Attachment panel
- ☑ double click on Group 1 in the window that opens
- ☑ set the option menu for Vertical Attachment to Top to Bottom
- ☑ set the Units option menu to millimeters and enter 5.0 in the Spacing field
- ☑ click on [Refresh] in the Group Settings window (or the Refresh icon on the View window toolbar)
- ☑ click on [Close] in the Group Settings window

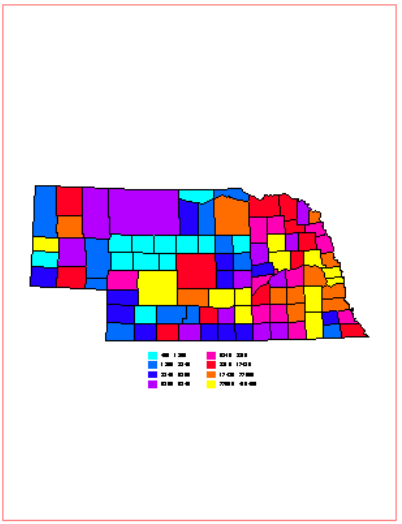
The Group Settings window should still be open from the exercise on page 7. The Group Name will automatically update in this window to that of the legend object because the group containing the legend became the active group when it was added.

The automatic tiled placement of groups you get in the Display Layout mode is replaced by automatic centering on the page in Page Layout mode. Your legend will, thus, initially appear centered over Nebraska. You just need to change the Vertical Attachment so it will appear below Nebraska but still centered on the page. Printer margins are often asymmetric so if you want a group centered, it is better to use page than margin attachment.



All the Groups in the View (with the exception of the active group), as well as Page and Margin appear in the window for attachment selection.





Printing a Theme Map

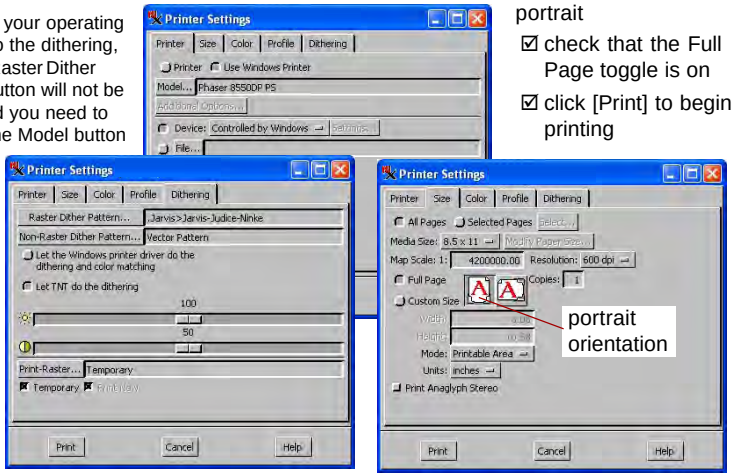
The default printer is always the last selected printer, so you should be set to go from your printing exercise in the *Displaying Spatial Data* booklet. It is a good idea to check your Page Setup the first time you print in each display session, because someone may have used your computer and changed the settings.

Your printed product should be high quality with crisp lines and text. The text, in fact, should be more readable than it is on-screen at the same map scale. If you need to be convinced, type 4200000 into the Zoom/ViewScale field in the sidebar of the View window (turn on the Show Sidebar and Show Status toggles on the Options menu in the View window if the Scale field isn't showing). For your display scale to be the map scale entered, you need to enter your screen dimensions on the Measure tabbed panel of the MicroImages X Server Preferences window.

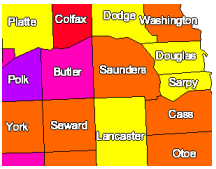
STEPS

- ☑ choose Print from the Display menu in the Display Manager window
- ☑ make sure that your desired printer and destination are selected on the Printer panel
- ☑ click on the Dithering tab, check that the Non-Raster Dither Pattern is set to Vector Pattern*, and set the Print-Raster to Temporary if not set that way already
- ☑ click on the Size tab and check that the Map Scale is 4200000
- ☑ set the media size to A, A4, 8.5 x 11, or letter size depending on your printer and check that the orientation is set to portrait
- ☑ check that the Full Page toggle is on
- ☑ click [Print] to begin printing

*If you let your operating system do the dithering, the Non-Raster Dither Pattern button will not be active and you need to click on the Model button on the printer panel to check most settings.



If you want labels for your counties, set the Dynamic Labels Text option button in the Polygons panel of the Vector Layer Controls window to By Attribute, click on [Specify] and select the CNTY_NAME field in the Counties table. Labels with a 5 point ascender height at the design map scale work well for this object. Enhanced type is also a good idea for labels so they can be read over both dark and light polygon fill colors.



Setting Up a New Theme Layout

STEPS

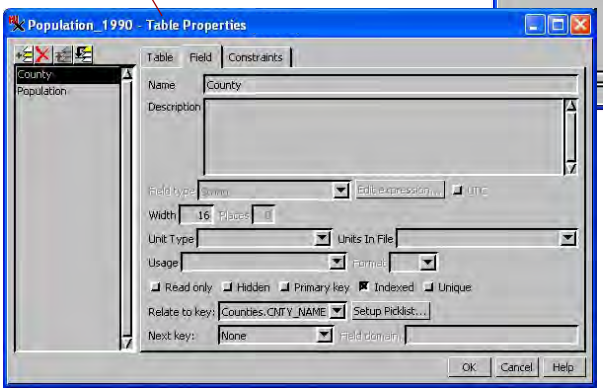
- ☑ click on the Save Display icon on the Display Manager toolbar and create a new object in the Project File with the other Nebraska objects
- ☑ click on the expand icon (+) for the COUNTY layer (you will have to first expand Group 1 if you exited the Display process)
- ☑ click on the expand icon for polygons
- ☑ hold the right mouse button down anywhere over the name or description of the Population_1990 table and select Properties from the menu that pops up
- ☑ click on the Field tab in the window that opens

We are not going to use the layout you just printed again in this booklet, but you may as well have a layout that associates the population theme and its legend. In this exercise, we are going to create a second theme for the same object. You could exit the Display process after Step 1 and restart on Step 2 on this page by opening the layout when you are ready to continue. To open a layout, click on the Open icon on the Display Manager toolbar and select the layout.

Although you will be creating a new theme map, which means you'll also need a new legend, don't delete the legend group. This group can be used to add a new legend that has the same position relative to the theme map as the original legend. If the group is deleted, this positioning information is lost.

You don't need to turn on polygon selection to edit a table in the database and we are not going to select any elements. For future reference, opening a table automatically turns on selection for the corresponding element type.

The Table Properties window lets you add and delete fields and set other table parameters.



All tables have a right mouse button menu.

New Information from Existing Tables

We are going to add a computed field to the Population_1990 table that calculates population density for each of the counties using the Population field in that table and the area from the standard attributes table (POLYSTATS). Highlighting the Population field before clicking on Add serves two purposes—the new field is then the last field instead of being inserted between the two existing fields, and it picks up its defaults, such as field width, from the Population field. The factor of a million in the equation is necessary to get population density expressed in people per square kilometer. If you'd rather have population density expressed per square mile, replace this factor with 386100.

STEPS

- ☑ click on Population in the list at the left of the window, then on the Add Field icon above the list 
- ☑ change the field name to PopDensity by editing directly in the list
- ☑ set the Field Type to Computed
- ☑ set the number of Places to 4 (leave Width at 11)
- ☑ click on [Edit Expression]
- ☑ in the Query window type

*Population_1990.Population * 1000000 / POLYSTATS.Area*

(you can also enter the field names using Insert / Field in the Query window and selecting the fields as shown below to insure that spelling is correct)

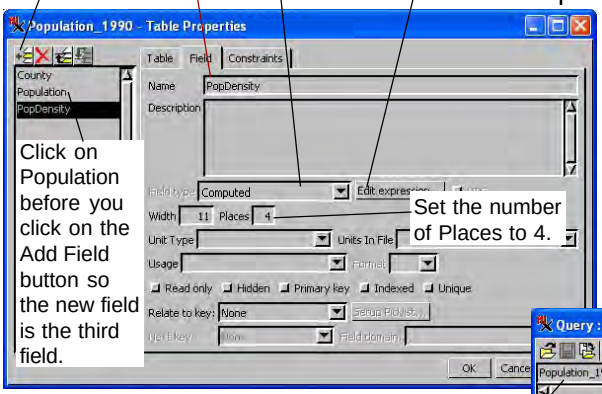
- ☑ click [OK] in the Query window
- ☑ click [OK] in the Table Properties window

Click on the Add Field button after highlighting Population in the list.

You can also edit the field name here.

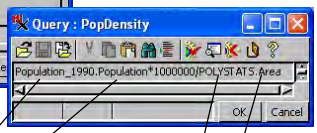
Click on this button to edit the expression for the computed field.

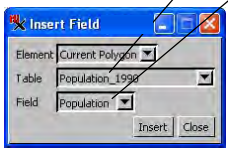
Set the Field Type to Computed.

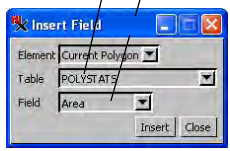


Click on Population before you click on the Add Field button so the new field is the third field.

Set the number of Places to 4.







The expression for this computed field is constructed from table/field names and an operator.

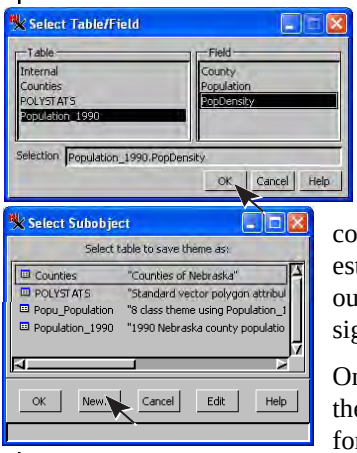
Theme Map from Computed Field

STEPS

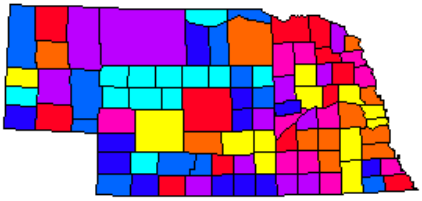
- ☑ click on the Vector icon in the layer row for the COUNTY object
- ☑ on the Polygons panel, select New - by Theme from the Style menu
- ☑ click on Population_1990 in the Table list then PopDensity in the Field list of the Select Table / Field window
- ☑ click on [OK] to confirm your selection and open the Theme Mapping Controls window
- ☑ set the number of classes to 8
- ☑ choose Save As from the Theme menu
- ☑ click on [OK] in the *Select table to save theme as* window that opens to accept the default name and description
- ☑ choose Close from the Theme menu
- ☑ click on [OK] in the Vector Layer Controls window

You can now use the computed field you created (PopDensity) to provide a new theme and generate a new theme map. To create a new theme, you first need to open the Vector Layer Controls window for the County layer, which you can do by clicking on the vector icon at the left of the layer row in the Display Manager window or by right-clicking on the vector's name and selecting Controls from the menu.

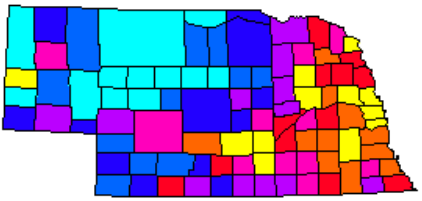
You can use Save or Save As to create a new theme style object after choosing New - by Theme from the Style option menu in the Vector Layer Controls. For the population density theme, we will again set the number of classes to eight, but this time we won't use rounding (although you could round to the nearest 0.01 or 0.001 without changing class assignment).



Once you've saved a theme, you can select it for use again from the style option menu in the Vector Layer Controls for that vector object. If you want to use another previously saved theme after opening the Theme Mapping Controls, choose Open from the Theme menu in that window.



Population



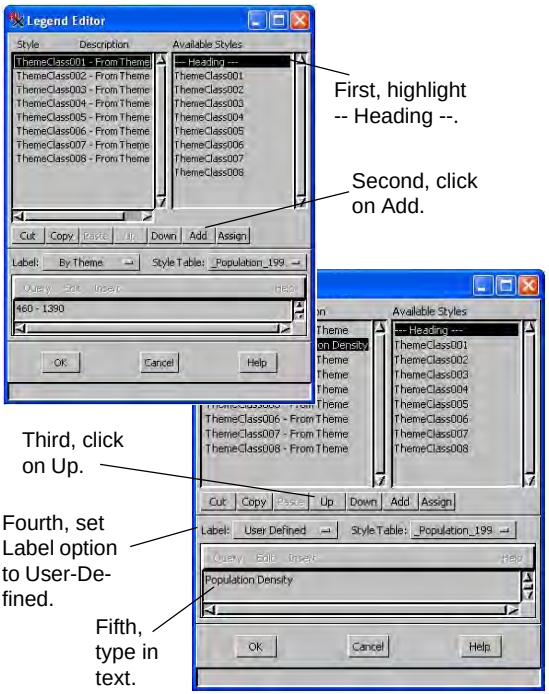
Population Density

A New Legend for Your New Theme

All parameters from the last legend you set up should be the defaults for this legend. You could, thus, just name the new legend, select the desired theme style object, and click on [OK] in the Legend Layer Controls window. But let's expand your knowledge of legends a little and add a heading to this one.

Theme legends change dynamically with the theme style object. So any changes you make and save in the number of classes in a theme, the method of determining the distribution, or assigned colors, for example, will automatically be updated the next time the legend is drawn.

Because you created a new legend without deleting the original legend group, the group positioning information is retained, and the new legend will come up centered under Nebraska when drawn.



STEPS

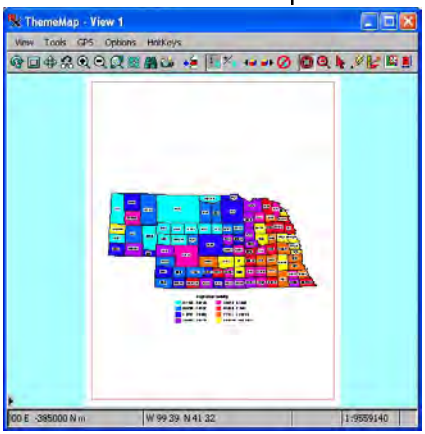
- ☑ click on the Legend icon at the left of the COUNTYPOPULATON group row
- ☑ click on [Legend Object], enter Population Density in the New Object Name field, and click [OK] in the *Select legend object to use* window
- ☑ click on [Style Object]
- ☑ navigate up one level, then click on the POPULATION_1990_POPDENSITY table icon, and finally the POPULATION_1990_POPDENSITY style object icon
- ☑ confirm or adjust the settings in the Legend Layer Controls window to match those on page 9
- ☑ click on [Edit Legend]
- ☑ click on --- Heading --- (top of righthand column)
- ☑ click on [Add] then [Up]
- ☑ set the Label option menu to User-Defined
- ☑ type *Population Density* into the text field, and click on [OK]
- ☑ click on [Heading Style] in the Legend Layer Controls window
- ☑ set the font to Arial, the Ascender Height to 14 points, and the Vertical space to 20 points
- ☑ click on [OK] in the Text Style Editor window
- ☑ turn on the Center Headings toggle and click [OK] in the Legend Layer Controls window

Print Your Second Theme Map

STEPS

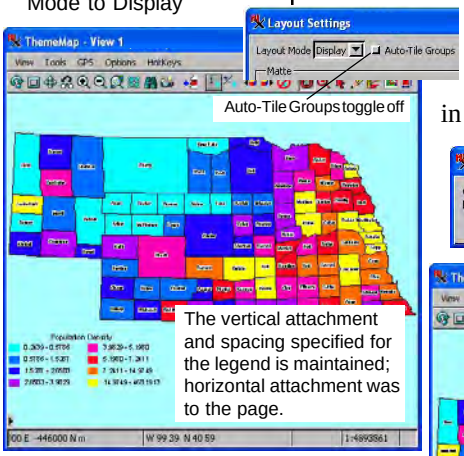
☑ choose Display / Print in the Display Manager

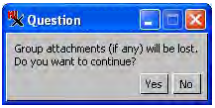
When creating a new layout, your last used Page Setup is the default for the new layout. These values are reset to those saved when you open a layout. The last layout printed from this booklet was for the exercise on page 11. No changes have been made to map scale or page orientation, so the print you make in this exercise should show Nebraska at the same size, position and orientation as that previous print, but with different theme styles and the corresponding legend. It is, however, always a good idea to double check your settings when you go to print to insure they have not changed inadvertently.



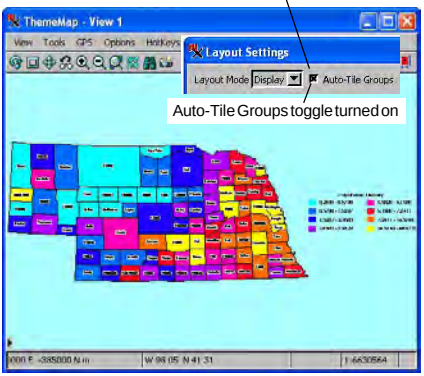
☑ click on the Settings icon for the layout in the Display Manager and change the Layout Mode to Display

Saved layouts can be viewed in either Page or Display Layout Mode. However, unless each group is attached to another group in the layout, the two displays will not be interchangeable. Horizontal, as well as vertical, attachment of the legend to the vector object instead of the page will prevent the shift of the legend between layout modes in this exercise.





When this toggle is turned on, you are asked if you want to proceed.

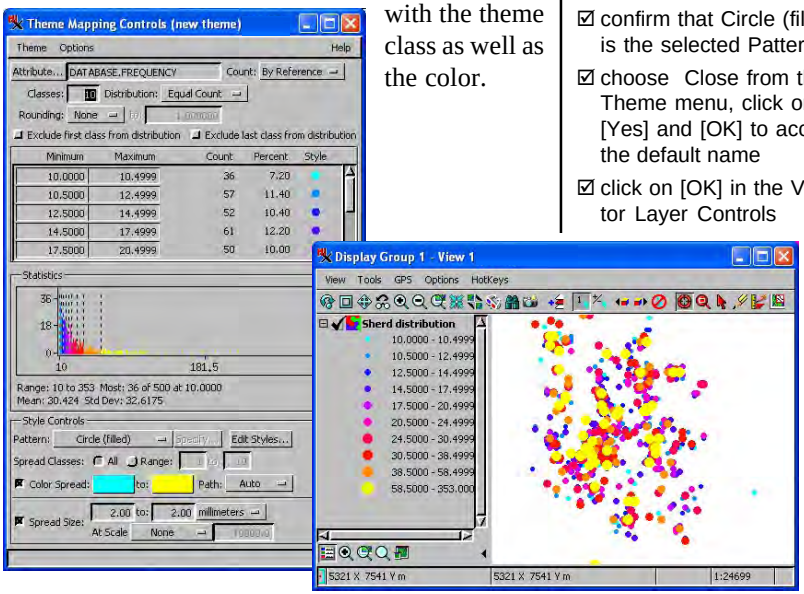


If you had set the legend background to white rather than transparent on page 9, there would be a white block evident behind the legend in Display layout mode.

Theme Mapping Point Observations

Your options for point styles include display as a box (outline or filled), circle (outline or filled), crosshair (simple or enhanced), symbol, or by style assigned individually to each theme class. For Box, Circle, Crosshair, and Symbol, all points are represented by the same symbol, and the symbol size and/or color can vary. If Symbol is chosen on the Pattern option menu, the symbol color can change by theme class if you are using a symbol design that incorporates variable color using the selected color spread. Nearly all of the symbols provided with the TNT products make use of this variable color feature.

As mentioned, theme mapped points can incorporate a size spread as well as a color spread (or other color / symbol assignment). When you use this feature, as theme class values increase, so does the size of the points. The spatial distribution of points in the object should help you determine a size range in which the number of smaller points obscured by later drawn, larger points is acceptable. If you are theme mapping lines, you can vary the line width with the theme class as well as the color.



STEPS

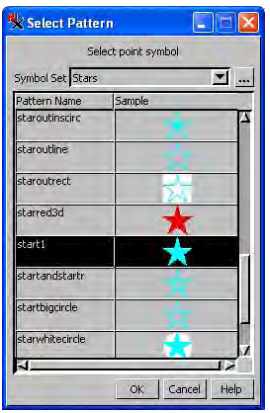
- ☑ right-click on the layout name in the Display Manager and choose Close Layout
- ☑ click on the New icon, choose 2D Display, and select the ARTIFACTS object from the GS_THEME Project File
- ☑ click on the vector's Layer Controls icon, set the style on the Points panel to New - By Theme
- ☑ click on DATABASE in the Table list, FREQUENCY in the Field list, then [OK] in the Select Table / Field window
- ☑ change Classes to 10
- ☑ set the Spread Size at 1 to 3 millimeters
- ☑ select None from the At Scale option menu
- ☑ confirm that Circle (filled) is the selected Pattern
- ☑ choose Close from the Theme menu, click on [Yes] and [OK] to accept the default name
- ☑ click on [OK] in the Vector Layer Controls

Points as Variable Color Symbols

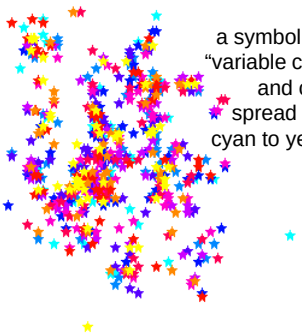
STEPS

- ☑ click on the vector icon in the layer row 
- ☑ click on [Edit] for point Style By Theme (DATABASE_FREQUENCY)
- ☑ select Symbol from the Pattern option menu
- ☑ choose Stars from the Symbol Set option menu
- ☑ scroll down, select the symbol named start1, and click [OK]
- ☑ set the Spread Size to 2.0 to 2.0 millimeters with the Spread Size toggle on (this returns you to constant sized symbols)
- ☑ choose Save As from the Theme menu, add *stars* to the end of the default name in the New Object Name field, and click [OK]
- ☑ choose Close from the Theme menu and click [OK] in the Vector Layer Controls window

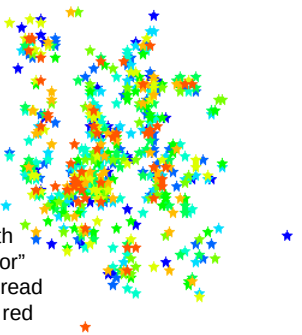
Tools to create point symbols, line patterns, and fill patterns are provided in TNTmips, TNTedit, and TNTview. Any of these symbolic element representations can incorporate multiple specified colors. Of particular interest for this exercise is the color referred to as "variable color," which can be included in point symbols and line and fill patterns. Variable color components get their actual colors from another source, such as a drawing style assigned by attribute or, in this case, by theme. Many of the symbols, line patterns, and fill patterns provided as samples with the TNT products incorporate a variable color portion, and some are designed entirely in variable color.



When the Select Symbol window opens, you should notice that the majority of the symbols are entirely cyan or include cyan as one of the colors. Cyan, as the color assigned to the first theme class, is the color currently used for variable color display for these symbols. If you change the first color in the color spread, the color of the variable color portion of the symbol in the Select Pattern window will also change.



a symbol with "variable color" and color spread from cyan to yellow



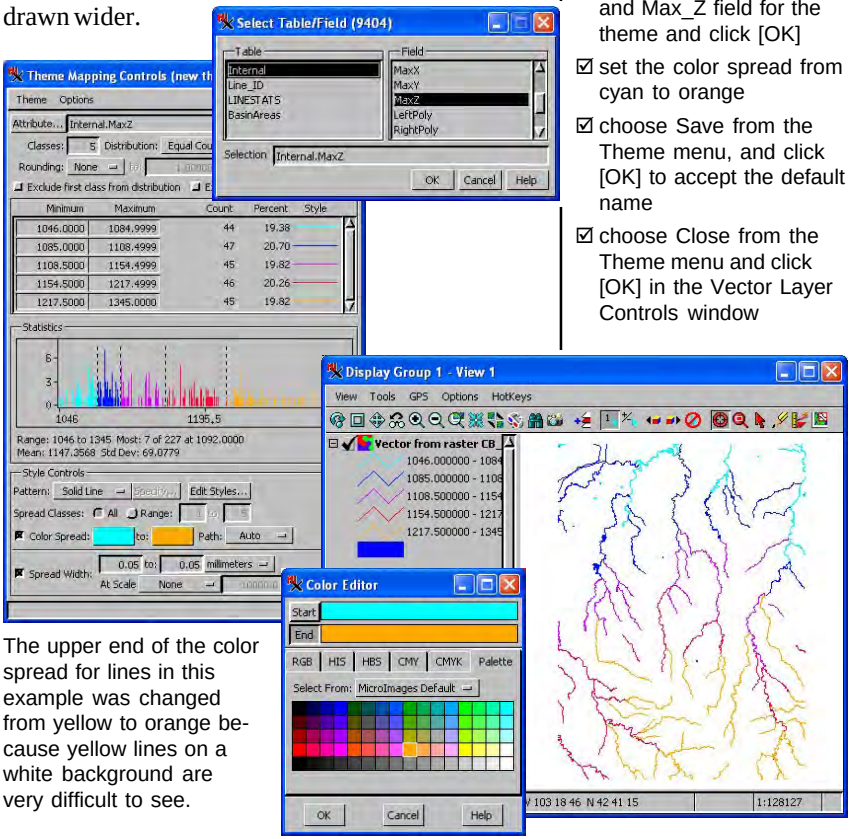
a symbol with "variable color" and color spread from blue to red

Hydrology with Elevation Theme

Theme maps aren't limited to points and polygons; you can also create themes for lines as we do in this exercise and the one that follows. Lines are not as frequently used for theme maps because their attributes are more likely to be categorical (such as state highway or county road or intermittent or perennial stream). Additionally, perhaps the most important quantitative line attribute, namely length, is generally evident without applying a theme. Just as points have a spread size that can be incorporated as part of the theme drawing style, lines have a spread width that can be applied. Assigning a spread width to lines makes sense for an attribute such as traffic volume so that roads / lines that carry more traffic are drawn wider.

STEPS

- ☑ right-click on the ARTIFACTS layer in the Display Manager and choose Remove Layer
- ☑ click on the Add Objects icon and select _3D_HYDROLOGY from the GS_THEME Project File
- ☑ click on the vector's Layer Controls icon, and on the Lines panel, check that Select is set to All, then set Style to New - by Theme
- ☑ choose the Internal table and Max_Z field for the theme and click [OK]
- ☑ set the color spread from cyan to orange
- ☑ choose Save from the Theme menu, and click [OK] to accept the default name
- ☑ choose Close from the Theme menu and click [OK] in the Vector Layer Controls window



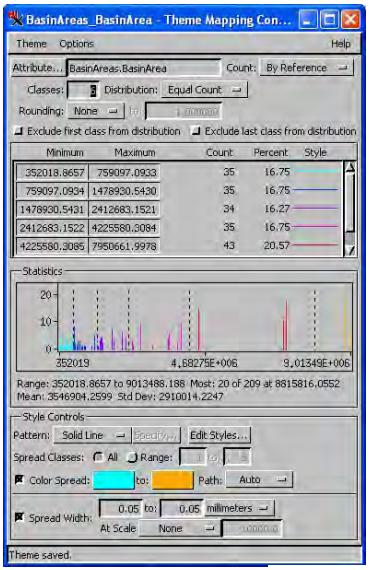
The upper end of the color spread for lines in this example was changed from yellow to orange because yellow lines on a white background are very difficult to see.

Hydrology with Basin Area Theme

STEPS

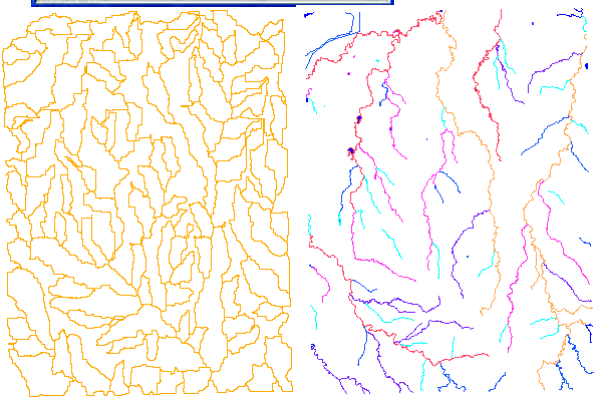
- ☑ click on the Layer Controls icon for the _3D_HYDROLOGY object
- ☑ click on [Edit] for line Style Internal_MaxZ
- ☑ choose New from the Theme menu in the Theme Mapping Controls window
- ☑ click on BasinAreas in the Table list then BasinArea in the Field list of the Select Table / Field window
- ☑ click [OK] to confirm your selection and return to the Theme Mapping Controls window
- ☑ change the number of classes to 6
- ☑ set the Count to By Reference and check that the Color Spread range is the same as in the previous exercise (cyan to orange)
- ☑ choose Save As from the Theme menu and click [OK] to accept the default name
- ☑ choose Close from the Theme menu and click [OK] in the Vector Layer Controls window

You can base linear themes on the attributes of surrounding polygons by first using the Transfer Attributes process (Geometric / Attributes / Transfer Attributes). The theme in this exercise is based on the watershed standard basin areas for the streams and tributaries in the vector object. Standard basin polygons were generated in TNTmips' Watershed process (Terrain / Watershed), and the areas of these polygons were transferred to the hydrology lines to prepare the vector object for your use in this exercise.



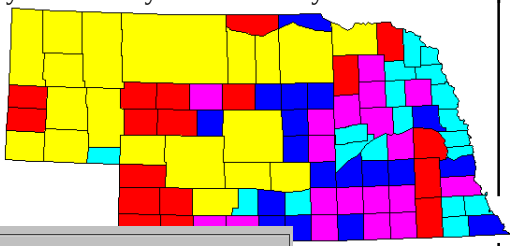
Any quantitative polygon attribute, such as soil permeability or average slope, can be transferred to points, lines, or polygons in another vector object and used for theme mapping or more sophisticated vector analysis.

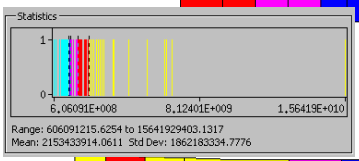
The standard basin polygons from the watershed process are shown at the near right with the theme map of the basin areas associated with each stream at the far right.



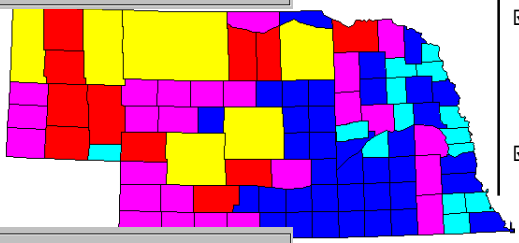
Altering Theme Class Boundaries

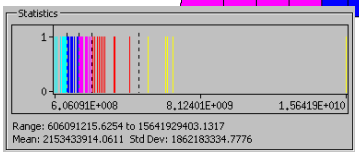
Some data distributions have natural groupings that are disrupted by the standard options provided. It's time to show you how to manipulate the position of the automatically generated class boundaries so natural groupings can be maintained. The Statistics panel in the Theme Mapping Controls window provides a histogram in bar graph form of values for the selected field. The bars are drawn in the assigned color for the class, and the positions of class boundaries are shown as dashed lines. These dashed lines can be dragged with the mouse. The range of values for any class affected is automatically updated. You can also type values directly into the minimum and maximum fields to achieve the same effect as dragging the class boundary lines. The Distribution option menu is automatically reset to User-Defined when you move any class boundary.





default Equal Count distribution for 5 classes





user defined distribution for 5 classes

STEPS

- ☑ right-click on the _3D_HYDROLOGY layer name and choose Remove Layer
- ☑ click on the Add Objects icon and select COUNTY from the NEBRASKA Project File
- ☑ click on the vector's Layer Controls icon, and on the Polygon panel, set Style to New - by Theme
- ☑ choose POLYSTATS and AREA as the table and field, respectively
- ☑ set the end for the color spread back to yellow
- ☑ position the mouse over the boundary line between the two highest classes, then click and hold the left mouse button as you drag the boundary to the right
- ☑ release the mouse when the boundary is at about 5 x 10^9 square meters (minimum value for highest class)
- ☑ repeat for the next boundary line to the left, and release when the minimum value for the fourth class is about 2.5 x 10^9
- ☑ move the other two boundary lines until the minimum value for the third and second class are 1.7 x 10^9 and 1.2 x 10^9, respectively
- ☑ choose Theme / Close, click on [Yes] when prompted

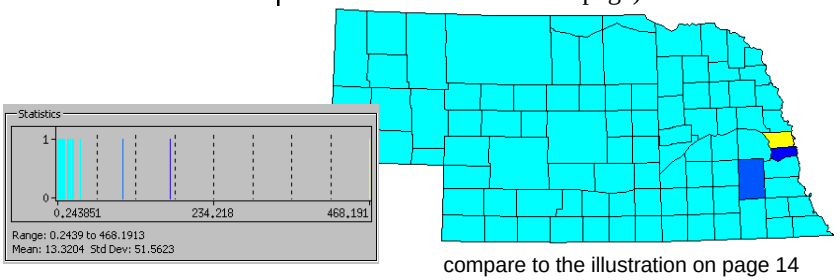
Other Distribution Options

STEPS

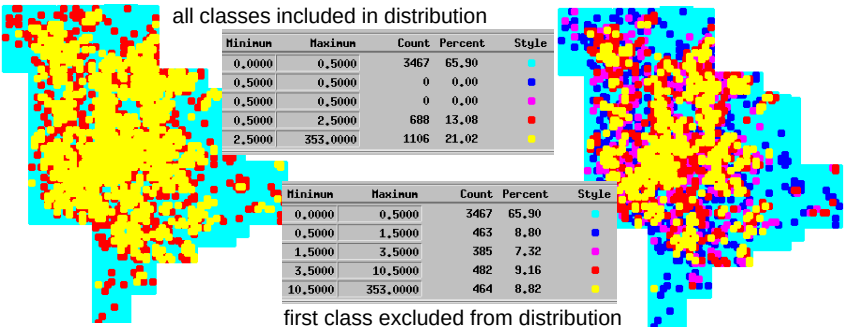
- ☑ return to the Vector Layer Controls window and click on [Edit] for Polystats_Area style
- ☑ choose Theme / Open and select POPULATION_1990_POPDENSITY
- ☑ click on [OK] in the Select Theme Table window
- ☑ select Equal Interval on the Distribution option menu
- ☑ choose Theme / Save As, add EQINT to the default name in the *Select table to save theme as* window, and click [OK]
- ☑ choose Theme / Close
- ☑ click on [OK] or [Apply] in the Vector Layer Controls window

We have used the Equal Count distribution for all exercises in this booklet except the one on the previous page. Let's take a look at how the results differ for an Equal Interval distribution. When you change to this option with the Nebraska Population Density data, you'll see that four of the eight classes have no members, and three have only one member, which means that 90 of the 93 counties are in the same class using an Equal Interval distribution for this theme. This theme provides a clear example of when you do not want to use an equal interval distribution.

Two check buttons are provided near the top of the window so that you can eliminate the highest and/or lowest values from consideration when the distribution is determined. This feature is generally used when one or both of these classes are far removed from the rest of the distribution or the first or last class contains the majority of observations (as illustrated at the bottom of this page).



compare to the illustration on page 14



all classes included in distribution

Minimum	Maximum	Count	Percent	Style
0.0000	0.5000	3467	65.90	
0.5000	0.5000	0	0.00	
0.5000	0.5000	0	0.00	
0.5000	2.5000	688	13.08	
2.5000	353.0000	1106	21.02	

Minimum	Maximum	Count	Percent	Style
0.0000	0.5000	3467	65.90	
0.5000	1.5000	463	8.80	
1.5000	3.5000	385	7.32	
3.5000	10.5000	482	9.16	
10.5000	353.0000	464	8.82	

first class excluded from distribution

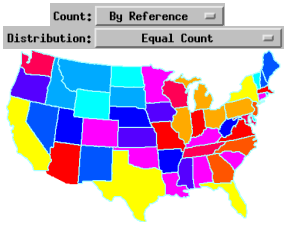
Where Next?

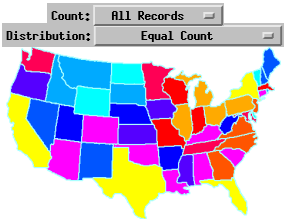
This tutorial booklet has introduced the basic techniques for creating theme maps and has also shown you how to add a legend and print the resulting layout. There are many additional features for use in creating theme maps that are not presented here. Be sure to look at the reference materials available from TNTmips' Help menu and using the Search feature on MicroImages' web site to find out about these additional features.

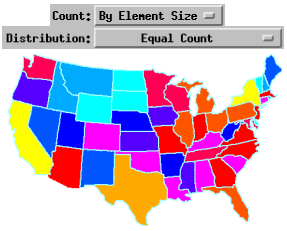
You should be familiar enough with your data to decide which theme mapping options are appropriate for it. You can, of course, become familiar with your data quite quickly using the Statistics panel in the Theme Mapping Controls window. The illustrations at the right show how results may differ for the same field values by changing the Count and Distribution modes; the differences between some methods are subtle, while differences between other methods are pronounced. All examples shown use state population as the basis for the theme map.

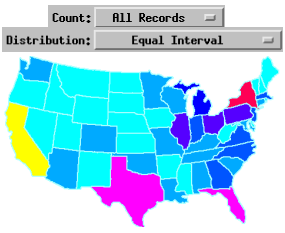
A new record counting mode not previously discussed is shown in the third theme map at the right (Count: By Element Size). The ability to count by element size is available only if standard attributes have been calculated for the element type being theme mapped. This choice makes it possible to assign the classes so that each covers as close to the same geographic area as possible based on the attribute value distribution in the selected field.

As mentioned earlier in this booklet, you may want your theme map to have labels. You can generate dynamic labels in the Display process or permanent labels in the Editor. Label text can be generated by attribute, such as county name in the Nebraska map you worked with, or using a more complex script. You can also design fill patterns, line patterns, and symbols for use in your theme maps directly in the Display process. This topic is covered in the tutorial booklet on *Creating and Using Styles*.









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