

TdhGIS

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Vector based Spatial Analysis

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Introduction

The purpose of TdhGIS is to perform spatial analysis of vector defined geometric data. This may include:

- [Allocate point data to polygons](#). (e.g. assign structures to hydrological basins).
- [Allocate polygon data to other polygons](#). (e.g. allocate population data by census block to political boundaries).
- [Allocate point data to buffers for points, polygons or multilines](#) (e.g. find all gas stations within 1 mile of a highway).
- [Create thiessen polygons](#) (e.g. for all hospitals within a state, define the areas where a particular hospital is closer than any other).
- [Create data contours](#) (e.g. create lines of equal ground elevation based on a set of elevation points).
- [Create contour polygons](#) (e.g. define the area where average rainfall exceeds a selected value based on weather station data).
- [Color polygons](#) based on user_data values using either Discrete intervals or Gradients.
- [Set multiline widths](#) based on user_data values

TdhGIS includes the ability to [graphically create and edit data](#), similar to the abilities in a Cad program. Combined with the ability to use a [raster image](#) as a background, vector data can be created and edited based on maps, photos, plans etc for manipulation using all the spatial analysis tools provided by TdhGIS.

Map making abilities are enhanced with a [Legend](#) editor and the ability to display a [TdhCad drawing](#) as an overlay (particularly useful for labeling and annotations).

Unlike some other GIS programs, TdhGIS does not provide user defined database management functionality (e.g. user defined tables and queries). Rather, TdhGIS provides spatial analysis functionality and the means to exchange data and results with third party database managers. This approach has the advantage of allowing the use of whichever database manager best suits the user's needs. TdhGIS is intended to be a spatial analysis tool, not a comprehensive data management solution. TdhGIS provides dialogs to perform some common database operations such as [importing user data](#) and [producing overlay data](#), using Sqlite databases.

TdhGIS is available in executable code for both the MS Windows and Linux operating systems. These TdhGIS programs may be used free of charge for non-commercial use. The executable code may not be used for other programs without the consent of the copyright owner. This software is provided without warranty and the author disavows any liability resulting from its use. The author and copyright

owner for TdhGIS is Tim Hirrel, who may be reached timhirrel@tdhgis.com.

Input Data

Coordinate Systems

Any coordinate system may be used to define geometric points, however, all points within a TdhGIS Project should use the same coordinate system. TdhGIS assumes the coordinates implicitly define the distance between points, in the desired units, unless the coordinate system is specified as longitude/latitude coordinates, using the Edit | Options – LonLat Coords field. In that case, the desired distance units must be defined using the Edit | Options - Distance Units field.

Information regarding the coordinate reference system for a data group can be viewed from the Coordinate Info dialog by clicking on the Coord Info button in the [Data Selection dialog](#). The Coordinate Info text can be edited after the Data Selection dialog is closed. (Be sure to click the Save button to save editing changes.) The first line of the Coordinate Info text should consist of a string usable as a [CRS within the OGR/Proj](#) library. This line will often be created automatically when importing data. Subsequent lines may be entered text the user finds helpful.

The coordinate system for any data group can be transformed to a different coordinate system using the supporting app [TdhOGR](#). Create a new project for a different coordinate reference system by selecting File | Projects from the Main menu.

When inputting coordinates as longitude/latitude, values can be specified as degree.decimal (e.g. 39.775), degree:minute:second (e.g. 39:46:30), or degree:minute.decimal (e.g. 39:46.5).

Pt Data

Point Data contains x,y coordinates and a user defined data value that applies to the particular point. Examples of user defined data are elevation data and rainfall data. Pt Data is always contained within a Pt Group. Each Pt Group must have an identifier unique among Pt Groups within the Project and each Pt Datum must have an identifier unique within the Pt Group. Pt Groups may be copied within the same project or to another project.

Polygons

Polygons contain a series of x,y coordinates (polygon points) that define an enclosed area. The points may be in either clockwise or counter-clockwise order and the last point does not need to be the same as the first point (the polygon will be automatically closed). Consecutive points define the line segments of the polygon. A line segment of a polygon must not cross any other line segment of the same polygon. A Polygon may also have a user defined data value, such as population within the polygon.

Each Polygon must have an identifier unique among polygons within the Polygon Group.

Shared Points

Points defining polygons may be shared by more than one polygon within a polygon group. A point may not be shared by polygons in different groups. Shared points are created by using either the [Edit Pts dialog](#) for a particular polygon or the [Reduce/Share](#) Points operation on a polygon group. If a

shared point is relocated while editing a polygon, the change will affect all other polygons sharing the point. The area and perimeter will automatically be recalculated for all affected polygons. Deleting a shared point from one polygon will have no effect on the other polygons.

Exclusion Polygons

An Exclusion Polygon defines an area that is to be excluded from its parent polygon. An exclusion polygon will be drawn with dashed lines. A parent polygon may have any number of exclusion polygons but the exclusion polygons should not overlap. Each Exclusion Polygon must have an identifier unique among exclusion polygons belonging to the parent polygon.

The area of an exclusion polygon will be subtracted from the area of the parent polygon and the perimeter of an exclusion polygon will be added to the perimeter of the parent polygon. An exclusion polygon should be contained entirely within the parent polygon.

An exclusion polygon may not have an exclusion polygon, i.e. an area within the exclusion that is not to be excluded. To address such a situation, a new polygon may be created and added to the Polygon Group. This is how TdhGIS addresses the situation when performing spatial operations that would result in an area to be excluded from an exclusion polygon.

Polygon Groups

All polygons are contained within a Polygon Group, even when a polygon group has only one polygon. A polygon group normally contains polygons that have some relationship (e.g. the states within a nation) and will be operated on together. Each Polygon Group must have an identifier unique among Polygon and MultiLine Groups within the Project.

A single polygon may be copied from one group to another, either within the same project or to another project. Entire polygon groups may be copied within the same project or to another project.

Many of the Spatial Operations performed by TdhGIS create new Polygon Groups. Many such operations require 2 input Polygon Groups and the IDs for the input groups are saved with the new group as Parent1 and Parent2. A string describing the operation is saved as Create_Op. These values are included, by default in the group description, viewable when selecting a polygon group from the Edit menu.

MultiLines and MultiLine Groups

MultiLines contain a series of x,y coordinates (multiline points) that define a series of connected line segments. Each MultiLine must have an identifier unique among multilines within the MultiLine Group. A MultiLine may also have a user defined data value, such as speed limit within the multiline.

All multilines are contained within a MultiLine Group, even when a multiline group has only one multiline. A multiline group normally contains multilines that have some relationship (e.g. the roads within a city) and will be operated on together. Each MultiLine Group must have an identifier unique among MultiLine and Polygon Groups within the Project.

A single multiline may be copied from one group to another, either within the same project or to another project. Entire multiline groups may be copied within the same project or to another project.

FYI => Identifiers may not contain apostrophes because they create problems with sql queries. Apostrophes will be automatically removed from any imported or edited identifier.

Color Values

User input of a color is accomplished with either a common color name (e.g. “red”, “blue”, etc) or a hexadecimal string for any color value (0xAARRGGBB). Alternatively, a color may be selected from a color dialog by entering “select”.

Color values in TdhGIS are expressed with 4 byte integers comprised of 1 byte fields for alpha (opacity), red, green and blue, the color channels. Each of these fields may have values from 0 to 255 in decimal notation or 0 to ff in hexadecimal notation. A leading 0x signifies the string is a hexadecimal value and each of the following pairs of characters signifies the value of a color channel, the first being alpha (ff = full opacity, 0 = full transparency).

Projects

A project specifies the use of a particular directory containing a TdhGIS database file. All data used by and produced by TdhGIS for a particular project is contained in single SQLite3 database file, named TdhGIS_Data.sqlite. Any number of projects can be created.

The Projects dialog is accessed by selecting File | Projects from the Main menu. This dialog provides a list of the available Projects and the following options:

- Select - determines the Project to be used and directory where a TdhGIS_Data database can be accessed. (Double clicking on the list item also accomplishes this).
- Add - prompts for a new Project name and a directory to be used for the project database. If the specified directory does not already contain a TdhGIS_Data database, one will be created. If the Project name already exists, the directory will be changed as specified.
- Describe – provides a dialog for entering description text and for finding projects based on text contained within the project description.
- Delete - removes the Project from the TdhGIS_config database, does not delete the TdhGIS_Data database in the Project directory.
- Rename – allows renaming a project.
- Compress – reduces the file size after deletion of data and deletes any orphan records. Compression should be run after deletion of a large amount of data or the improper deletion of records by external operations.
- Below the Project list, the directory for the highlighted Project is displayed.
- Below the Project list, the Description for the highlighted Project is displayed.

Information about the available Projects is contained in the Projects database file TdhGIS_config.sqlite. By default, the program looks for this file in the sub-directory TdhGIS_Data, off the directory containing the executable file. A different directory can be specified as a command argument when starting the program.

A project named “Default” is automatically created in the same directory containing the Projects database. This project can not be deleted and the database file should not be removed. The Default directory can be changed by adding a project named Default.

Tip – to setup the program so that each user has a separate Projects database:

- Create a program Shortcut for each user. For the Shortcut Target, specify the directory to contain the user's Projects database as a command argument.

The TdhGIS_Data directory is not installed and will not be overwritten during the installation of TdhGIS. If the TdhGIS_Data directory doesn't already exist, it will be created when the program is started. The TdhGIS_Structure directory will be installed and overwritten (if it exists) during the installation of TdhGIS. The purpose of the TdhGIS_Structure directory is to contain the most recent database structure for TdhGIS. The files within the TdhGIS_Data directory and any other database files used will automatically be updated, if necessary, based on the files in the TdhGIS_Structure directory. User created data should NOT be stored in the TdhGIS_Structure directory.

Import/Export

Importing and exporting allows TdhGIS to communicate with the rest of the computing universe. In addition, TdhGIS uses an open [database structure](#) to store all data used by and produced by the program. Other programs may be employed to manipulate the data within the TdhGIS database (with the suggestion that backup copies of the database be regularly maintained).

Importing

The following methods for importing data are accessed by selecting File | Import from the main menu.

TdhCad Drawing:

A TdhCad drawing can be imported as an overlay or by converting drawing entities to GIS entities.

- Overlay: all visible layers in the Cad drawing, except a Legend layer, will be displayed in an overlay layer named "CadLayer". A Legend layer in the Cad drawing will be displayed as a Legend layer (editable with the Legend dialog). The Cad database directory and drawing name will be saved with the Options so that the drawing is automatically displayed when the GIS project is opened. This options can be disabled by setting the Cad Display option to "No". A compatible TdhCad database file is included when a new TdhGIS project is created.
- Convert Entities: TdhGIS will import all pts (circles), polygons and multilines contained in the visible layers of the Cad drawing into new user specified Pt, Polygon and MultiLine Groups.

Shapefile Info:

- Shapefile - a shapefile will be imported into a new user specified Pt, Polygon or MultiLine Group. This operation imports only the geometric and id data. The user will be prompted for a Shapefile, an ID field and a new group id.

If the Shapefile does not contain field appropriate for use as the ID field, the user may click the None button and IDs will be generated automatically.

A SHPT_POLYGON with multiple parts is handled as follows:

- If the menu item "Check for Exclusion Polys" is checked, a part that is contained entirely within the first part is an exclusion polygon.

- Otherwise, the part is a new polygon and the id is appended with _Part#, with # incremented sequentially. The id for the part with the largest area is not appended.
- Check for Exclusion Polys – determines whether polygons parts contained within a larger part are designated as exclusion polygons. Since checking for exclusion polygons can take considerable time, this option should be left unchecked unless the shapefile is believed to contain exclusion polygons.
- Shapefile Data – data for a specified field within a shapefile db will be imported into an existing user specified Pt, Polygon or MultiLine Group. The user will be prompted for a Shapefile, a data field and an ID field. If the user selects a dbf file rather than a shp file, the user will be prompted for the the group type. The user is then prompted for a Pt, Polygon or MultiLine Group to be updated. For records in the Shapefile with an ID that match an ID in the Group, the user_data values within the Group will be overwritten with the Shapfile data.

For polygons with multiple parts (not exclusions), the data will be allocated to the parts based on area (if the id for the parts is appended with _ShpPart#, as explained in Importing Shapefile).

OpenStreetMap Data:

To import OSM data, it is first necessary to obtain OSM data for a desired area. Visit the OSM web site (http://wiki.openstreetmap.org/wiki/Downloading_data) for instructions on how to accomplish this. (see also TdhGIS_tutorials.pdf in the TdhGIS library at tdhgis.com).

Tip => OSM files can be very large so when extracting data specify the smallest area that satisfies the intended use. It's also a good idea to start with a small test area.

- For all submenu options, the OSM Tag Criteria dialog will be displayed and provide the following options:
 - Included - a text control that allows the user to specify tags that indicate OSM data should be included in the imported data. The user provides comma separated text for the:
 - Tag Key
 - Tag Value (an asterisk may be used to accept any value and to set the user_data field to the value)
 - ID tag (optional), the tag key for which the tag value will be used as the data element (polygon, multiline, point) ID.
 - Excluded – a text control that allows the user to specify tags (key, value) that indicate data will not be included in the import, even if it has a tag specified in the Included text.
 - Require All Nodes – if checked, only ways and relations that include all referenced nodes within the OSM data will be imported. Referenced nodes may not be included based on the boundaries specified for the OSM data, which would result in clipped polygons and multilines.
 - Save – allows the user to save the values specified within the dialog box with a specified query id.
 - Retrieve – allows the user to fill the dialog box with previously saved values.
 - Continue – closes the dialog and allows the import process to proceed using the values specified within the dialog.

- Polygons from Ways – based on the Tag Criteria, polygons will be created from OSM ways.
- Polygons from Relations – based on the Tag Criteria, polygons will be created from OSM relations.
- MultiLines from Ways – based on the Tag Criteria, multilines will be created from OSM ways.
- MultiLines from Relations – based on the Tag Criteria, multilines will be created from OSM relations.
- Points from Nodes – based on the Tag Criteria, points will be created from OSM nodes.
- For all submenu options:
 - the user will be given the option to convert from longitude/latitude coordinates to any coordinate system support by the Proj4 library.
 - The user will be prompted for a group name for the imported data.

CSV Files:

- Points CSV - a comma separated file containing Pt Data will be imported into a new Pt Group. The file may contain any number of records in the format: ID, x, y, user_data. After selecting a file to import, the user will be prompted for a group color.
- Pt, Polygon and MultiLine Data CSV - a comma separated file containing user_data values for Pt, Polygon or MultiLine Data. The user_data values will be used to overwrite the existing user_data values in a user specified Pt, Polygon or MultiLine Group. The file may contain any number of records in the format: ID, user_data. Existing user_data values will be overwritten only when the ID matches a record in the CSV file.

Tip – Create CSV files using a simple text editor such as Notepad or Gedit, not a word processor such as MS Word. Word processors use file formats that contain extraneous data.

Data Dialog:

Data from an Sqlite database can be imported into the user_data fields for a Pt, Polygon, or Multiline group using the Data Dialog. which provides the following functions:

- Select the group type, Pt, Polygon or Multiline.
- Select the group for which the user_data field will be populated.
- Select the input data which will be used to populate the user_data field by selecting the Sqlite database file, the table and the fields to be used.
- Select the key field, i.e. the field within the input data corresponding to the ID's in the group data. The key field must be one of the selected fields.
- Specify any conditions which must be satisfied within the input data for the subsequent “Set User Data” operation to apply to a particular entity.
- Specify a “Set User_Data” operation. User_data will be modified according the expression in the text box next to the “Set user_data =” button. The expression may or may not include one or more input data fields with mathematical operations. To set all user_data to an initial value, specify the value in the text box and click on the “Set user_data” button, with no

preceding conditions. Any number of “Set user_data” operations may be specified before an execution.

- Execute all the specified “Set user_data” operations.
- Clear all previously specified “Set user_data” operations.
- Save the specified parameters and “Set user_data” operations to a named query.
- Retrieve a named query specifying the parameters and “Set user_data” operations.

SVG Files:

An SVG file can be indirectly imported by using TdhCad to import the file and then importing the TdhCad drawing.

Exporting

The following methods for exporting data are accessed by selecting File | Export from the main menu.

Polygon Group Report:

Creates a comma separated (CSV) file providing data for a Polygon Group. CSV files may be imported into many types of software, including spreadsheets and database managers, which can then be used to further analyze the data. The first record contains: Group ID, Parent1 Group ID, Parent2 Group ID, Create_Op. Successive records, one for each Polygon within the group, contain: Polygon ID, Area, Perimeter, User_Data, Allocate_Factor, Parent1, Parent2, Allocate_Factor2. (the last 4 fields are explained in [Intersect Polygons](#)).

Pt Group Report:

Creates a comma separated file providing data for Pt Group. The first record contains: Pt Group ID, Allocated To (polygon group ID). Successive records, one for each Pt within the group, contain: Pt ID, User_Data, Allocated_To (polygon ID), x, y.

TdhCad Drawing:

All visible layers, except a Legend layer, currently drawn within TdhGIS will be copied to a layer named “GisLayer” within the TdhCad drawing. A Legend layer will be copied to a Legend layer in the Cad drawing.

Shapefile:

Creates a shapefile containing the data for a selected Polygon Group, Pt Group or MultiLine Group.

SVG, PNG, PDF:

The current drawing view can be written to file formats SVG, PNG or PDF. The user will be prompted for the output x,y dimensions. The dimension units can be specified by appending the

dimensions with a code as follows:

- 0 – inches (default)
- 1 – centimeters
- 2 – pixels

so, to specify a 60x40 pixel output, the user would enter 60,40,2.

If File | Export | White To Black is checked, any layers with a default color of white will be drawn as black.

To make the aspect ratio of the current view match the desired aspect ratio for the output, select Zoom | Display Size from the Main menu.

Editing

Editing allows input data to be created or modified. From the Edit menu, Data Selection dialogs for Pt groups, Polygon groups and Multiline groups all have the following options:

- New – create a new group and open the Edit dialog for the group. Group entities can be created using the Insert button and providing an entity id.
- Select – Select an existing group for editing. The Select dialog also allows groups to be deleted, renamed or copied (to the same or a different project).
- Information - Opens a dialog allowing information about the group to be viewed and modified. This dialog has 2 button:
 - Describe – opens a dialog allowing description text for the group to be created or modified. Searches may be performed to find all groups with descriptions containing a specified text.
 - Coordinate Info – text providing information on the [coordinate system](#) used by the group may be viewed (and modified, after the Data Selection dialog is closed).

Edit Dialogs

Edit dialogs can be accessed from the Main menu by selecting Edit | <data type> | Select or by right clicking on a displayed entity and selecting “data”. A number of features are common to all edit dialogs.

- Navigation buttons allow access to the First, Previous, Next and Last records.
- The Goto button allows access to any record by specifying an id most similar to the record id.
- The Insert button allows the creation of a new record.
- The Delete button deletes the current record.
- The Show button will update the display with the latest editing changes.
- Right clicking on the data grid displays a pop up menu that provides options for the the current entity, including the option to zoom on the graphical display of the entity and, for polygons, the option to recalculate area and perimeter.
- The bottom buttons determine whether the data is written to the database as follow:
 - Close - the edit dialog is closed and changes since the previous save are discarded (user

will be prompted to save if data has been changed).

- Save - the data for the group is written to the database and the edit dialog remains open.

The entity being edited will be highlighted in yellow on the display. This entity can be zoomed to by right clicking on the edit grid and selecting “Goto Map”.

Important=> Editing changes that have not been written to the database will have no effect on Spatial Operations.

Pt Data

The following Editing options are specific for Pt Data:

Pt Radius – within the Edit menu, the radius, in pixels, at which Pt's are drawn can be specified. (Pt's will appear the same size regardless of zoom factor.) Pt's are always drawn with a width of 2 pixels.

Set Point – within the Edit dialog, this button allows the coordinates for the Pt to be specified by clicking and dragging on the graphical display.

Polygons & MultLine

The following edit fields are specific for Polygons and Multlines:

- Color Flag: If no, the entity color will be the group color, as specified in the Layer dialog. If yes, the entity color will be determined by the value in the color field. For polygons, if no, an outline will be drawn, if yes, the polygon will be filled.
- Color: the [color](#) to be used if the Color Flag is yes.

Polygons & MultLine Points

In the Polygon and MultLine Edit dialogs, the Edit Pts button allows modification of the points defining the polygon or multiline. [Shared points](#) are displayed with a cyan background, non shared points are displayed with a white background.

The point values are displayed in a grid and individual points may be selected by left clicking on the row label. A range of rows may be selected with a click on a second row while pressing a shift key. Values may be modified by typing new values or using the buttons as follows:

- Drag Pt - the value in the selected row will be modified by mouse dragging.
- Insert - a new point will be inserted prior to the current row by clicking and dragging on the display.. If the Insert button is clicked while pressing a shift key, multiple points will be inserted until a double left click or a single right click. Select the empty row after the last point to add points after the last point.
- Delete - deletes the points at the selected rows.
- Copy Pts - the value(s) in the selected row(s) will be saved for pasting to other entities. The user will be asked if the copied points should be shared. If the points are not shared, identical points will be created.
- Paste Pt - the copied values will be added prior to the current row. The values will be added in reverse order if the shift key is pressed. If the row past the the last row is selected, the vales will be added after the last point.

- Find Click - selects the row containing the point closest to the last left click on the drawing. A range of rows can be selected with a subsequent Find Click while pressing a shift key.

Changing the polygon points will trigger an automatic recalculation of a polygon area and perimeter (these values are displayed as read only in the Polygon edit dialog).

Right clicking on the Edit Pt grid will present a pop up menu with the following options:

- Pan to Pt – the point will be centered within the display.
- Move – move the point by a user specified x,y distance.
- Unshare Pt – if the the point is shared, it will be replaced with an unshared point with the same value.
- Calc Pt From Angle/Distance – calculate coordinates for the point based on a user specified angle and distance from the previous point.
- Show Angle/Distance – show the angle and distance from the previous point to the current point. If the current point is the first point, angle and distance is calculated from the last point.

Exclusion Polygons

In the Polygon edit dialog, the Exclude button allows the creation and modification of [exclusion](#) polygons for the current polygon. The Exclusion Polygon edit dialog will be automatically updated for the current parent polygon when the record in the Polygon edit dialog is changed.

Parts

In the Polygon edit dialog, the Parts button allows data for polygons with a common base ID, but appended with “_Part#”, to be manipulated as a group. Such polygons might be created automatically when importing a Shape file (e.g. separate land masses composing a state) but may also be created manually.

The Parts dialog allows the entry of the base ID, shows the number of parts associated with the base ID and provides the following options (each of which uses the text box to the right of the options for either input or output):

- Set Color: a color may be specified as in the Polygon edit dialog and will be applied to all parts. The ColorFlag for all parts will be set to “yes”. To set the ColorFlag for all parts to “no”, enter “none”.
- Set User Data: a user data value may be specified that will be applied to all parts.
- Aggregate Data: the aggregate value of user data for all parts will be shown.
- Aggregate Area: the aggregate area for all parts will be show.

Legend

The Legend dialog allows the automatic creation and editing of a map legend. Legends are created on a Legend layer, The dialog provides the following options:

- Title: the text used for the legend title.
- Items Box: each line in the Items box creates a Legend Item. Each line consists of 2 comma separated fields:

- Color: can be specified as [color](#) value. The color field can be automatically entered by clicking on the Color button and using the standard color dialog.
- Description Field: the description text to be associated with the color.
- Position: when creating a new legend, the position information is set to approximate the current window but may be modified as follows:
 - Left, Lower: specifies the x,y coordinates for the left lower corner of the bounding parallelogram.
 - Height: specifies the height of the bounding parallelogram (the width will be determined by the text).
- Create: creates a legend as specified within the dialog. if an existing legend is being edited, the previous version will be deleted and the new version created.

A Legend can be saved to a TdhCad drawing by selecting either Edit | Legend | Save or File | Export | TdhCad Drawing from the Main menu. The TdhCad drawing used to save a Legend will be automatically displayed upon project startup. The entities created by the Legend dialog may also be manipulated by any of the applicable tools available in TdhCad.

Options

The following options apply to Projects and may be set by selecting Edit | Options from the Main menu:

- SnapOn and SnapValue - determines whether mouse selected points will be rounded to the specified integral value of map units.
- Background Color – sets the background [color](#) for the drawing.
- Highlight Color – sets the [color](#) for items selected during editing. Enter 0 to disable highlighting or 1 to select the default color.
- FlipY - if true, the vertical coordinate increases as it goes up; otherwise it increases as it goes down. The default is true.
- Long/Lat Coordinates – determines whether coordinates are treated as long/lat when calculating distances and areas.
- Distance Tolerance – points with distances less than this value will be considered equal.
- Distance Units – for polygons and multilines using longitude/latitude coordinates, distance units must be specified to calculate area, perimeter and length. If this option is changed, the calculated parameters for existing groups can be updated using the Recalculate operation.
- Cad DB – the directory containing a TdhCad database to be used for exporting and importing Cad drawings.
- Cad Drawing – the TdhCad drawing to be displayed and to be used for saving a Legend. If these 2 values don't reference a valid TdhCad drawing, no drawing will be displayed.
- Display Cad – toggles whether the Cad Drawing is displayed.

Angle Options

By default, when an angle is specified, the angle is in radians counter clockwise from an East origin. This default can be changed by selecting Edit | Angle Options from the Main menu and using the Angle Options dialog as follows:

- Direction – select Counter CW, Clockwise or Bearing. For Bearing, angles are given as a deviation of no more than 90 degrees from either East or West (i.e. NE, SE, SW or NW).
- Origin – specifies the orientation of the 0 angle, East, North, West, South or Other. For Other, an angle is specified Counter CW from an East origin.
- Radians, Degrees, DegreeMS, DegreeDM – specified the units for input and output angles. For DegreeMS (degrees, minute, seconds) the format is dd:mm:ss, for DegreeDM (degrees, decimal minutes) the format is dd:mm.x.

The angle specifications will apply to both the angle input by the user and for the angles reported by program. It is permissible to input an angle with one specification and then use the Angle Options dialog to have the angle reported in a different specification.

Drawing

A Pt Group, Polygon Group or MultiLine Group may be displayed by selecting Edit | <group type> from the Main menu and then clicking on the Select button in the group selection dialog. A Pt Group will be displayed as a set of circles with the radius specified in the Pt Radius option. A Polygon Group created as a result of a Spatial Operation will be displayed upon successful completion of the operation.

Zooming and Panning

Panning can be accomplished by:

- A double click of the left mouse button, which places the click point in the middle of the window. This is useful for zooming in on a particular point.
- Left clicking and dragging the mouse by the desired pan distance.
- Selecting Pan from the Main menu and
 - Up, Down, Left, Right to pan by $\frac{1}{2}$ the displayed distance.
 - By Drag to pan by dragging the mouse.
 - Pan To specified coordinates which default to the most recently clicked point.
 - Overview to open an [overview window](#).

Zooming can be accomplished by:

- Rotating the mouse wheel, forward to zoom in, backward to zoom out (this can be reversed with a Wheel Factor less than 1).
- Selecting Zoom from the Main menu and
 - Extents to display all entities in shown layers.
 - Window to display the rectangle defined by a mouse drag.
 - In, Out to change zoom by a factor of 2.
 - Previous to return to the previous display.
 - Redo to undo a “previous” action.
 - Wheel Factor to change the amount of zooming accomplished by a mouse wheel rotation.

Overview Window

An Overview window will be displayed after selecting Pan | Overview from the Main menu. The overview window floats over the main window and initially has $\frac{1}{4}$ dimension of the main window,

but can be resized and placed anywhere. The overview window will have a duplicate of the drawing in the main window plus a pan ring.

- Dragging the pan ring results in panning within the main window such the center coordinate in the man window corresponds to the center coordinate of the pan ring.
- When Zoom | Extents is selected from the main menu of the overview window, the entire drawing is displayed within the overview window and the pan ring is placed corresponding to the current center coordinates of the main window.
- If a new drawing is selected for the main window, Zoom | Extents should be selected in the overview window to refresh the overview drawing.
- The user may zoom and pan within the overview window to suit a given purpose.

Layers

A Pt Group, Polygon Group or MultiLine Group is drawn to a layer with the same ID as the group. Unlike a Cad drawing, the layers and the drawing are not the data, they are representations of the data. If a layer is deleted, the data is not deleted, but if the data is deleted, the layer is also deleted.

The Layer dialog may be accessed by selecting Layers | Select from the Main menu. The Layer dialog provides a list of the current layers and the following options:

- Hide – when checked, the selected layer will not be drawn, but will remain in the layer list. Since only polygons on drawn layers can be selected, Hide is useful if overlapping layers make polygon selection difficult.
- Delete – deletes the selected layer (but not the underlying data).
- Color – the default color for the selected layer may be modified.

The currently drawn layers are saved when a project is closed and re-established when the project is re-opened. The color assigned to a layer is saved with the group, so the same color will be used if the group is drawn again.

Raster Images

Any number of raster images can be displayed as a background for a project by selecting File | Raster Image | Edit Images from the Main menu. The following file types can read:

BMP, PNG, JPEG, GIF, PCX, PNM, TIFF, TGA, IFF, XPM, ICO, CUR, ANI.

From the Edit Image dialog, the user may select:

- Insert: the user will be prompted for an image file and new image will be created.
- Delete: delete the image.
- Write World file, savings the extents and rotation information to a World File, which can be use by many other graphics software.
- Crop the image while saving a World file along with the cropped image such that the cropped image will maintain the same position within the coordinate system.

After an image is read, 2 coordinates defining the extents of the image are needed. These extents will be read from a World file, if available, or they may be entered by the user directly or through the image [calibration](#) process. Note that the extents coordinates (i.e. the minimum x, minimum

y and the maximum x, maximum y) will not lie within the raster image if the image does not align with drawing coordinate system.

For each image, the user may:

- Specify an image ID.
- Specify a transparency value for the image, from 0 (no transparency) to 255 (full transparent).
- Set the Maximum Scale, beyond which the image will automatically be suppressed.
- Rotate the image (used when the image does not align with drawing coordinate system).
- Change the image extents.
- Toggle between showing and suppressing the image.
- Enter a description for the image.

If zooming would require scaling the image beyond the Maximum Scale, the image will not be displayed. Scaling beyond 1 may start to result in display delays.

The image parameters current when a project is deactivated will be saved and used when the project is activated again.

Once an image file is read, the bitmap will be saved in the database, so the file will no longer be needed. If an image is deleted and another image is to be used with the same imageId, the project should be saved (by exiting or switching projects) after deleting the old image and before reading the new image, or the new image bitmap won't be saved.

When an individual image is suppressed, it doesn't use ram. This allows many images to be kept in the database and ready for display by unsuppressing them, without adversely affecting ram.

Tip => for tips on how to obtain and align background maps, see the TdhGIS_tutorials.pdf in the [TdhGIS Library](#) at TdhGIS.com.

Image Calibration

When an Image file is read, if a corresponding World file is not found, the user will be given the option to Calibrate the image. Calibration requires the user to right click on 3 points on the image and specify the coordinates in the desired units. The program will then calculate the image extents and rotation. The points selected by the user should be well separated, particularly along the x axis.

Prior to entering points, the user will be given the opportunity to specify an assumed aspect ratio (width to height). This aspect ratio is important only in displaying the image during the calibration process, it has no effect on the calibration results.

Tip => After obtaining extents and rotation from calibration, the user may save this information to a World file for future use by selecting File | Image | Write World File.

TdhCad Drawing

TdhCad is a free vector graphics program, A TdhCad Drawing can be displayed as an overlay by selecting Edit | Options from the Main menu and specifying a directory containing a TdhCad database and drawing within that database. The drawing will be displayed when the network is subsequently opened. A TdhCad drawing can be useful for displaying labels and annotations and is

used to save a [Legend](#). A drawing and legend are placed on separate Layers that can be hidden using the Layer dialog.

Grids

Grids can be automatically displayed by selecting Grid | Draw Grid from the Main menu. Each Grid Cell can be uniquely identified by defining a Cell Label and cells can be located based on the label by selecting Grid | Find from the Main menu. The following Options defining the grid can be set by selecting Grid | Options from the Main menu:

- Cell Width – the grid spacing along the x axis, in distance units.
- Cell Height – the grid spacing along the y axis, in distance units.
- Show Labels – display the labels within the Cells.
- Cell Label – a string defining the cell labels as described below. If blank, no labels will be applied.
- X Label, Y Label – a string defining labels along the x and y axis, just beyond the limits of the grid. If blank, no labels will be applied along the axis.
- Grid XOrigin, Grid YOrigin – the zero point for cell labeling.
- Min X, Min Y, Max X, Max Y – defines the extents for the grid. If no grid extent values are provided, the grid will be drawn to the extents of the drawing.
- OverLay – if true, the grid will displayed as an overlay layer, otherwise the grid will be displayed a background layer. (note: the grid color can be changed using the Layers dialog.)
- Angle – a grid can be rotated up to 45 degrees in either direction.

The Cell Label specifications may contain the following fields, in any order, separated by commas:

1. A String Literal enclosed in quotes.
2. x<number>. The number of digits to be used for the grid position along the x-axis.
3. y<number>. The number of digits to be used for the grid position along the y-axis.
4. E. A single character with a value of E or W is used to signify whether the x coordinates are positive or negative, respectively.
5. N. A single character with a value of N or S is used to signify whether the y coordinates are positive or negative, respectively.

For example, given the following cell label specification:

Cell Label = "2",y2,N,E,x2

the label 237NW09 would be translated as follows:

The leading 2 is a string literal and has no meaning with regard to cell position.

The next two digits indicate the cell is in the 37th position from the origin along the y-axis.

The next character indicates the cell is above the origin.

The next character indicates the cell is to the left of the origin.

The next two digits indicate the cell is in the 9th position from the origin along the x-axis.

Note that leading zeros must be used to maintain the correct number of digits for the x and y positions. If the label specification does not contain an E/W or N/S field, a minus sign will be used to indicate cells below or to the left of the origin.

The grid positions in any direction begin with 1. There is no 0 grid position. The Cell Origin fields may be used to specify the coordinates at which cell counting begins.

Spatial Operations

AutoBoundary

A polygon defined by the outer Pts of a Pt Group can be generated automatically by selecting Operations | Polygons from Pts | AutoBoundary from the Main menu. The polygon will be saved to a user specified Polygon Group and can then be modified through editing.

Create Thiessens

Based on a set of points, thiessen polygons define the areas that are closest to each point. Some of these polygons will not be closed. To obtain a set of closed polygons, a boundary polygon must be specified. A polygon group containing thiessen polygons may be created as follows:

- Select Operations | Polygons from/to Pts | Create Thiessens from the Main menu.
- Select a Pt Group.
- Select a Boundary Polygon. The user will first be given the opportunity to use an automatic boundary. Alternatively, a polygon group may be selected and the first polygon in the group will be used as the boundary.

A thiessen polygon will be given the same ID as the Pt Data contained within the polygon.

Create Pt Polygons

Pt Polygons are regular polygons concentric around the Pts in a Pt Group and can be created as follows:

- Select Operations | Polygons from/to Pts | Pt Polygons from the Main menu.

With the Pt Polygon Dialog:

- Choose a Pt Group from which the Polygons will be created.

- Specify a radius for the polygons.
- Specify the number of sides for the polygons. (The more sides, the more the polygons will approximate a circle, but the more processing will be required when using the polygons. The default of 20 should provide a sufficient approximation for many applications).
- Choose whether the polygons will:
 1. Be entirely inside the defined circle.
 2. Have an area equal to the defined circle.
 3. Be entirely outside the defined circle.
- Click on the Execute button and specify an ID for the new Polygon Group.

Polygons form Grid

A polygon group will be created based on the Cells defined by the [Grid](#) options. The polygons will be given ids based on the cell labels.

Polygon Centroids

A PtGroup containing the centroids of the polygons in a Polygon Group can be created by selecting Operations | Polygons from/to Pts | Polygon Centroids. Select an existing Polygon Group and specify the name of a new PtGroup to contain the centroids.

Contour Lines

A Contour line defines where interpolated user_data values are equal to the contour value. Data values are interpolated from a Pt Group. A set of contour lines can be generated for any selected interval with any selected maximum and minimum values. Right clicking on a displayed contour line will display the contour value in a message box.

The generation of contour lines is controlled with the Contour Line dialog, which is access from the Main menu by selection Operations | Contours | Contour Lines. The input data and results destination are controlled as follows:

- Point Data – a drop down list allowing selection of a Pt Group.
- Boundary Polygon, Auto Boundary – a polygon defining the limits of the contour lines must be applied. The first polygon in the Polygon group selected from the drop down list will be used as the boundary. Alternatively, a boundary polygon will be automatically generated from the Pt Data if the AutoBoundary box is checked.
- Layer – the contour lines will be drawn to the specified layer, if Save Contours is not checked.
- Save Contours – if checked, the contour lines will be saved to a specified MultiLine Group and displayed.

The appearance of the contour lines are controlled as follows:

- Interval – specify the interval between contour lines.
- Majors – specifies the number of contour lines between major lines, which have double thickness.

- Min, Max – specifies the minimum and maximum values for contour lines.
- Color – specifies the color of the contour lines

After the Lines parameters have been specified, the Apply Lines button should be clicked so the selections appear in the Script text box. Multiple sets of line parameters can be specified, for example, applying different colors to different min/max values. When all desired parameters appear in the Script box, the buttons to the right of the Script box can be used as follow:

- Execute – contour lines are generated based on text in the Script box.
- Clear – the Script box is cleared, new line parameters must added to the Script box before contours can be generated again.
- Save – the text in the Script box is saved in the database.
- Retrieve – saved Script text can be retrieved.
- Label Size – determines the size of value labels for major lines.
 - A value greater than 0 specifies the text height in distance units (text size will change with zoom factor).
 - A value less than 0 specifies the text height in pixels (text size won't change with zoom factor).
 - A value of 0 results in no label text.

Contour Polygons

A contour polygon defines the area above or below a selected contour value. The Contour Polygon dialog is accessed from the Main menu by selecting Operations | Contour | Contour Polygons. The generation of contour polygons is controlled with the Contour Polygon dialog, as follow:

- Point Data – a drop down list allowing selection of a Pt Group.
- Boundary Polygon, Auto Boundary – a polygon defining the limits of the contour lines must be applied. The first polygon in the Polygon group selected from the drop down list will be used as the boundary. Alternatively, a boundary polygon will be automatically generated from the Pt Data if the AutoBoundary box is checked. A contour line that does not close on itself and does not intersect the boundary will not generate a contour polygon. The boundary polygon should be within the limits of the Pt Data.
- Target Value – the contour value used for contour polygon generation.
- < > - determines whether the contour polygons will be generated below or above the target value.
- Create - the contour polygons will be generated and saved to a user specified Polygon Group.

Intersect Polygons

A set of polygons will be generated based on the intersection of 2 selected Polygon Groups and saved to a user specified Polygon Group by selecting Operations | Intersect | Intersect Polygons from the Main menu. The new polygons will have IDs based on sequential numbering.

The 2 input Polygon Groups are designated Parent1 and Parent2. Each new polygon is formed as the result of an intersection between a polygon from Parent1 and a polygon from Parent2. For each

new polygon, an Allocate_Factor will be calculated by dividing the area of the new polygon by the area of the polygon from Parent1 . Allocate_Factor2 will be calculated by dividing the area of the new polygon by the area of the polygon from Parent2. The Allocate_Factors can be used to allocate data from Parent1 to Parent2 polygons or Parent2 to Parent1 polygons, respectively. The validity of this allocation method depends on the the correctness of either of the following statements (i.e. if either statement is entirely true, the method is entirely valid):

- The data is homogeneous across the Parent1 polygons.
- Each Parnet1 polygon is contained entirely within a Parent2 polygon.

Overlay Data

An Overlay operation allows data for 2 polygons groups to be combined into a single Sqlite table based on an intersection of the polygon groups. Before an Overlay operation can be performed, an [Intersect operation](#) must be performed for the parent polygon groups, thus forming a new polygon group. The Overlay dialog provides the following functions:

- Select the Polygon group containing the intersect polygons,
- Select the data related to the Parent1 polygon group by specifying the Sqlite database file, the table and the fields to be used for the results. Likewise, select the data related to the Parent2 polygon group. It is permissible to select no data for either parent group.
- For the sets of fields for the Parent1 and Parent2 data it is necessary to specify a key field, i.e. a field with data corresponding to the ID's within the parent polygon data. The key field is specified by selecting "key" within the Method column of of the fields grid.
- For each field in a fields grid other than the key field, one of 4 methods must be specified:
 - attrib – data for this field is included as is in the results for each intersect polygon formed from the parent polygon.
 - count – data for this field is allocated to each intersect polygon based on the result of the area of the intersect polygon divided by the area of the parent polygon. Thus, the count from the parent polygon will equal the sum of the counts from the intersect polygons formed from the parent polygon.
 - Filter = - data for this field will be used to filter other data. Other data will be used only if the value for this field equals the value specified in the Value column of the fields grid.
 - Filter other – data for this field will be used to filter other data. Other data will be used only if the value for this field satisfies the operational expression with the value specified in the Value column of the fields grid. The value in the Value column must be preceded by a valid operational expression (<>, <, >, <= or >=). Text values in the Values column must enclosed in single quotes.
- Select the Sqlite database file to contain the results.
- Specify the table to contain the results. A new table will be created. If the specified table already exists, the option will be provided to replace it.
- Execute the overlay operation based on the parameters specified within the dialog.
- Save the parameters within the dialog to a named query.
- Retrieve parameters for the dialog from a named query.

Tip - After an Overlay operation, the results can be easily imported into the user_data field for the intersect group by using the [Data dialog](#). This will allow the data to be used for various other operations such as [Coloring Polygons](#) and [Data Allocation](#).

Trim MultiLines

A set of multilines will be trimmed based on the border of a polygon and saved to a new multiline group by selecting Operations | Intersect | Trim MultiLines from the main menu. An input MultiLine group is designated Parent1 and an input Polygon group is designated Parent2. The first polygon in the Polygon group is used to trim the MultiLines. The new multilines will have the same id as the original multilines and will be saved to a new MultiLine group with a user specified id.

This operation could be used to trim a set of multilines representing roads based on a polygon representing a city, for example.

Split Polygon

A polygon can be split into multiple polygons based on a multiline that traverses the polygon by selecting Operations | Intersect | Split Polygon from the main menu. An input MultiLine group is designated Parent1 and an input Polygon group is designated Parent2. The first polygon in the Polygon group is split based on the first multiline in the multiline group. The new polygons will be numbered sequentially and saved to a polygon group with a user specified id.

The operation could be used to split a state based on an interstate that traverses it, for example.

Tip – to make a polygon or multiline the first in a group, copy it to a new group by right clicking on it and selecting “Copy to a Different Group”.

Merge Polygons

A set of polygons will be generated based on the merging of 2 selected Polygon Groups and saved to a user specified Polygon Group by selecting Operations | Merge Polygons from the Main menu. The 2 input Polygon Groups are designated Parent1 and Parent2. The merging of 2 polygons that intersect will result in 1 new polygon that may or may not have exclusion polygons. The merging of 2 polygons that do not intersect will result in 2 new polygons identical to the input polygons. If the Parent2 Polygon group contains multiple polygons, the operation will be cumulative, i.e. all Parent2 polygons after the first polygon will be merged with the results of the previous merge.

Subtract Polygons

A set of polygons will be generated based on subtraction using 2 selected Polygon Groups and saved to a user specified Polygon Group by selecting Operations | Subtract Polygons from the Main menu. The 2 input Polygon Groups are designated Parent1 and Parent2. Parent2 polygons will be subtracted from Parent1 polygons. If the Parent2 polygon is contained entirely within the Parent1 polygon, subtraction will result in a new polygon with an exclusion polygon. In this case, if the Parent2 polygon has an exclusion polygon, the subtraction operation will result in a 2nd new polygon identical to the exclusion polygon for the Parent2 polygon. If the Parent2 Polygon group contains multiple polygons, the operation will be cumulative, i.e. all Parent2 polygons after the first polygon will be subtracted from the results of the previous subtraction.

Reduce/Share Polygons/Multiline Points

Polygon or Multiline points within a specified distance of an adjacent point can be removed by selecting Operations | Reduce | [Polygons, Multilines] from the Main menu. The reduction operation will be performed on all polygons or multilines within the selected Group and the results will be saved in a new user specified Group. Polygon / Multiline reduction can result in performance improvements for Spatial Operations, at the expense of some loss in accuracy.

For Polygons, this operation also allows points to be [shared](#) by polygons within a polygon group. A dialog provides the options to perform point reduction and/or point sharing and a tolerance value for each. For all points remaining after any point reduction, all other polygons within the group are searched for the closest point within the share tolerance. If such a point is found, it becomes a shared point for the polygons, using the point value from the earlier (in sort order) polygon.

Reduce Pts

Pts within a Pt Group that are within a specified distance can be combined by selecting Operations | Reduce | Pts from the Main menu. The results will be saved in a new user specified Pt Group. This operation can be useful prior to the generation of Thiessen polygons, for example, to prevent unnecessarily small polygons.

Allocate Pts to Polygons

The user_data values in a Pt Group can be allocated to a selected Polygon Group by selecting Operations | Allocate Data | Pts to Polygons from the Main menu. The user_data values in the selected Polygon Group will be changed during this process. The polygon user_data values will initially be set to zero, then, for any Pt in the Pt Group that lies within a polygon, the Pt Data user_data value will be added to the polygon user_data value. A Pt Data value will not be allocated to more than one polygon, so if a Pt lies on a boundary between polygons, it's user_data value will be allocated only to the first polygon evaluated. The AllocatedTo field of the Pt Data will initially be set to null, then updated to the Polygon ID if the Pt is allocated.

Tip – to get a count of the Pts within a Polygon, set all Pt user_data values to 1 (use the [Data Dialog](#)).

Allocate Pts to Buffers

The user_data values in a Pt Group can be allocated to buffers surrounding Points or the line segments of the polygons or multilines in a group by selecting Operations | Allocate Data | Pts to Buffer from the Main menu. The Buffer Dialog provides the following options:

- Select a Pt Group to be allocated.
- Select a Pt Group, Polygon Group or a MultiLine Group for buffer creation.
- Select whether a buffer will be created on both sides of the line segments, the inside/right side only or the outside/left side only.
- Specify the distance for the buffer.
- Select whether the line segment end caps of the buffer should be square, rounded or none.
- Select whether the user_data values for the polygons or multilines should be initially set to 0.

Upon execution, Pt user_data values will be allocated to the pts, polygons or multilines, similar to the Allocate Pts to Polygons operation. However, in this operation a Pt may be allocated to more than one pt, polygon or multiline; the AllocatedTo field of the Pt will list all entities to which the Pt has been allocated (separated by semicolons).

Tip – to get a count of the Pts within a buffer, set all Pt user_data values to 1 (use the [Data Dialog](#)).

Cautionary Note: When using Inside only or Outside only buffering on a polygon, it is possible, depending on the angles within the polygon, that Pts outside or inside the polygon will be allocated, regardless of the EndStyle used. If it is imperative that only Pts outside or inside the polygon be allocated, these Pts can be identified using a Pts to Polygon allocation, then copied to a new Pt Group using a database manager, then allocated to a buffer.

Allocate Polygons to Polygons

The user_data values in a Polygon Group (group1) can be allocated to a different Polygon Group (group2) by selecting Operations | Allocate Data | Polygons to Polygons from the Main menu. The method used to allocate the data is discussed in [Intersect Polygons](#). The user_data values in the group2 polygons will be changed during this process. The group2 user_data values will initially be set to zero, then, for any portion of a polygon from group1 contained within a polygon from group2, the proportional user_data value from the group1 polygon will be added to the group2 polygon.

Polygon Colors

The polygons in a polygon group can be filled with [colors](#) based on the values in the User_Data field by selecting Operations | Display Parameters | Polygon Colors from the Main menu. A polygon group is selected and the Polygon Colors dialog is displayed.

The Polygon Colors dialog contains 4 vertical sections, typically accessed left to right.

- Discrete – for setting colors based on discrete user_data values or intervals.
- Gradient – for setting colors based on continuum between specified low and high user_data values.
- Script – the text which controls the coloring process. This text can be set automatically using the Discrete and Gradient options or edited manually. The text can also be saved and retrieved using the Commands options.
- Commands – provides buttons for executing, clearing, saving and retrieving the Script text.

The Discrete section provides the following options:

- Value – allows selection of a boolean operator and a specified user_data value.
- Color – using a standard color selection dialog, the selected color is displayed next to the button.
- Channel Selector:
 - Alpha– allows selection of the opacity, 0 = transparent, 255 = opaque, to be set in addition to the color.
 - Alpha Only – sets only the alpha value, not the color.
 - Red Only – sets only the red value.
 - Green Only – sets only the green value;
 - Blue Only – sets only the blue value.
 - No Alpha – sets RGB values but not Alpha.

- None – sets no values, but allows for filtering, as before setting Color Flags (see below).
- Apply Discrete – Script text is written based on the specified values. Successive Discrete values can be specified to produce a “stair step” of colors.

The Gradient section provides the following options:

- Set Point – determines whether the Low or High point is being specified. The Low point must be specified first and must be followed by a High point.
- Value – the Low or High user_data value for the gradient. Alternatively, the text Min or Max may be entered and the min or max user_data value within polygon group will be used.
- Color – using a standard color selection dialog, the selected color is displayed next to the button.
- Channel Selector– same as for the Discrete Section but without None.
- Apply Gradient – Script text is written based on the specified values. Within the range between the Low and High user_data values, colors are assigned by interpolating between the Red, Green, Blue and Alpha values for the Low and High colors.

The Script section contains the text for controlling the coloring process and has the following attributes:

- The text “Clear Polygons Fills” resets the color to none for all polygons in the group. This text is automatically included after the Script is cleared. If this action is not wanted, the text may be deleted.
- Colors are written in hexadecimal, starting with a #. The remaining text is a series of 2 digit fields for Alpha, Red, Green and Blue, respectively. (Believe it or not, this makes it easier to manipulate the color as compared to using decimal numbers).
- Consecutive Discrete or Gradient values can be included in the Script. For example, Discrete values can be specified for user_data values beyond the range of a Gradient. A later color will overwrite any earlier colors for the same polygon.
- Text can be copied and pasted from within the Script box.

The Commands section provides the following options:

- Execute – implements the coloring process as specified by the Script text.
- Clear – clears the Script text. The text “Clear Polygon Fills” is then added. If resetting the polygon colors is not wanted, this text may be deleted.
- Save – the Script text is saved to the Queries table. The Saved Query dialog is displayed so that a description of the query may be entered.
- Retrieve – the Saved Query dialog is displayed. Saved queries may be searched by partial matching of the description. The text for the selected Query will be displayed in the Script box.

Color Flags – Each polygon has a fill color and color flag. The fill color for a polygon is displayed only if the color flag is set to 1. Both the color and color flag can be manipulated from the polygon editor or from the Polygon Color dialog as follows.

- The color flag for all polygons in the group will be set to 0 if the the text “Clear Color Flags” begins the script in the Polygon Color dialog.
- The color flag for all polygons in the group will be set to 1 if the the text “Set Color Flags” begins the script in the Polygon Color dialog.
- The color flag for a selected set of polygons within the group can be set by placing the above texts after a Discrete filter text, which would typically be generated with the Channel Selector set to None within the Discrete options.
- The color flag for polygon is set to 1 whenever the color is changed within a Discrete or

Gradient operation.

MultiLine Widths

The widths in a multiline group can be change based on the values in the User_Data field by selecting Operations | Display Parameters | MultiLine Widths from the Main menu. A multiline group is selected and the MultiLine Width dialog is displayed.

The MultiLine Width dialog contains 3 vertical sections, typically accessed left to right.

- User_Data – for setting widths based on user_data values.
- Script – the text which controls the widths process. This text can be set automatically using the User_Data options or edited manually. The text can also be saved and retrieved using the Commands options.
- Commands – provides buttons for executing, clearing, saving and retrieving the Script text.

The User_Data section provides the following options:

- Value – allows selection of a boolean operator and a specified user_data value.
- Width– allows the specification of a width. A value greater than zero specifies a width in geometric units; a value less than zero specifies a width in pixels, regardless of zoom factor.
- Apply Width– Script text is written based on the specified values. Successive Width values can be specified to produce a “stair step” of widths.

The Script section contains the text for controlling the width process and has the following attributes:

- The text “Clear MultiLine Widths” resets the widths to default for all multilines in the group. This text is automatically included after the Script is cleared. If this action is not wanted, the text may be deleted.
- Consecutive Width values can be included in the Script. A later width will overwrite any earlier widths for the same multiline.
- Text can be copied and pasted from within the Script box.

The Commands section provides the following options:

- Execute – implements the widths process as specified by the Script text.
- Clear – clears the Script text. The text “Clear MultiLine Widths” is then added. If resetting the widths is not wanted, this text may be deleted.
- Save – the Script text is saved to the Queries table. The Saved Query dialog is displayed so that a description of the query may be entered.
- Retrieve – the Saved Query dialog is displayed. Saved queries may be searched by partial matching of the description. The text for the selected Query will be displayed in the Script box.

Labels

The ID’s for a polygon group, a multiline group or a pt group can be displayed as labels by selecting Operations | Display Parameter | <group type> from the Main menu. The labels will be displayed as follows:

- The user may specify a maximum height for the labels by selecting Max Height from the Labels menu. A value of zero indicates that no maximum height is applied. A value less than zero indicates the height in pixels, regardless of the zoom factor.
- For polygons and multilines, labels will be displayed centered and within the extents of the

entity, but with a height no greater than the max height.

- For pts, labels will be displayed slightly above the center of the pt using the max height.
- All labels are written to a layer called LabelLayer. To edit the labels, this layer can be [exported to a TdhCad drawing](#). The TdhCad drawing can then be [displayed as a background image](#).

Transform Coordinates

Coordinate transformation is now handled by the supporting app [TdhOGR](#).

Recalculate

For Polygons groups, the area and perimeter for each polygon will be recalculated. For Multiline groups, the length for each multiline will be recalculated. These parameters are normally calculated automatically when data is edited and saved with the data. However, there may be circumstances when recalculation for an entire group is desired.

Triangulation

Several spatial operations, including area calculation, require polygon triangulation, where the polygon is divided into triangles. If a polygon is not successfully triangulated, the operations cannot be completed (e.g. the area will be show as zero). This may be the result of lines within the polygon crossing each other. If the problem cannot be determined with simple inspection of the polygon, displaying the triangulation process may be helpful. The triangulation process will be displayed if the id for the polygon is set to “ShowTriangulation”. The triangulation process will be undertaken by using the Recalculate operation for the polygon group.

Tutorials

(see TdhGIS_Tutorials.pdf in the TdhGIS_Library at tdhgis.com)

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GNU, compiler and debugger
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Cairo, vector graphics library
Pango, text rendering library
SQLite, database management
InstallJammer, multi-platform installer
Open Office
FireFox SQLite Manager
Shapefile C Library

OpenStreetMap