Flowmap TIPS & TRICKS

Version 1.04 - January 2024 - TdJ

Contents

Calculating base numbers for Catchment Profiles

Catchment profiles can be used to compare accessibility results for different population or target market groups, different locations of service providers or different transport networks. But results are always influenced by irregularities in study area shape that never is perfectly circular, transport networks that never are perfectly symmetrical in all directions, different shapes and sizes of zones and an uneven distribution of the weight variable. For instance, if all criteria were perfectly evenly distributed the score for the proximity coefficient would be 33.3% but this will never be realized in practice. To get comparative numbers that take some of these irregularities into account "base numbers" can be calculated by creating a catchment profile (Charts | Catchment Profile) in the usual fashion using 'SIZE' as the new weigth variable to represent a homogeneous distribution:
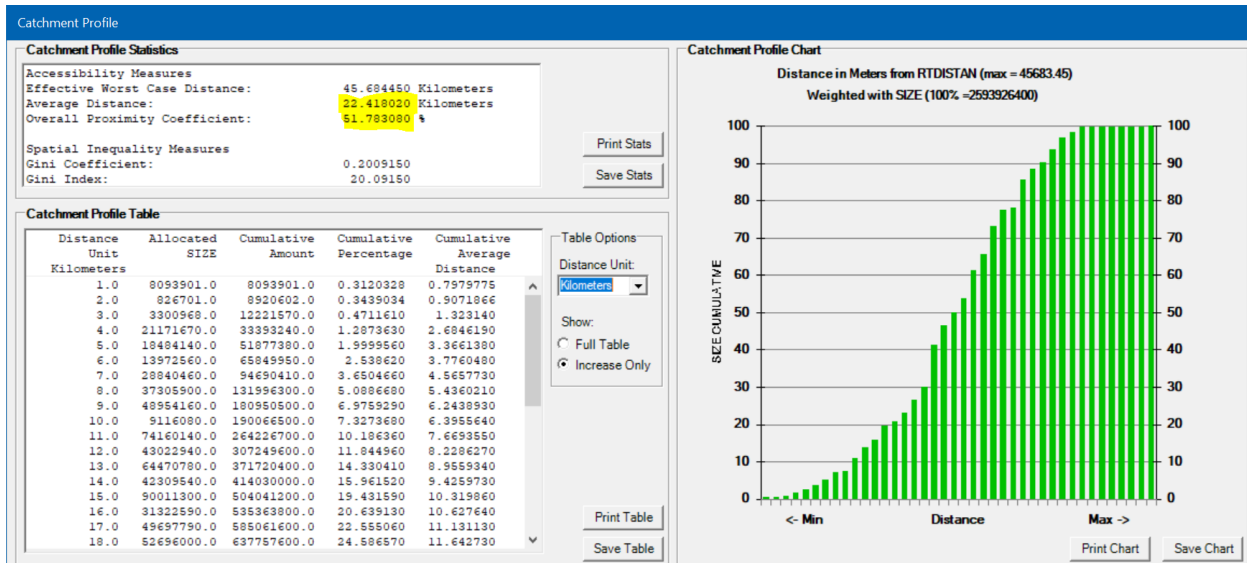
For this specific case base numbers amount to 22.42 km for the average distance and to 51.78% for the proximity coefficient. So for a set of facility locations to cater properly for the actual population / target market the average distance should be significantly lower and the proximity coefficient significantly higher than the comparable base numbers.

Creating Flow Files suitable for Trade Area Analysis without Competition

The principles underlying 'Trade Area Analysis without Competition' are virtually identical to those underlying the 'Threshold Distance Accessibility Measure'. In both cases the analysis identifies the shortest distance at which a fixed number (threshold) of clients/customers (threshold) can be reached from one or more points of interest. The 'Threshold Distance Accessibility Measure' just stores this threshold distance of all points of interest (origins or destination). The 'Trade Area Analysis without Competition' does the same (if so desired only for a limited number of points of interest) but also identifies all client /customer locations that cumulatively make up that fixed number or threshold. Based on this knowledge the 'Trade Area Analysis without Competition' can also calculate the average distance to these identified client /customer locations, draw an outer boundary (convex hull) around them and store their flows to the point of interest. All this functionality is already available in ordinary Trade Area Analysis; all is needed is special Flow File that contain links from each point of interest to the demand for service in all client /customer locations. A Flow File containing all relevant combinations of points of interest with client /customer locations can quickly be obtained by converting a distance table to flow file and the demand can be added using the copy fields across tables function.

Example:

Distance table STRAAIR.012 connects 699 customer locations to 12 different shopping Malls. Use (Conversions | Flowmap | Flowmap Distance Table to Dbase) to convert the distance table to a Flow File by following the Flowmap naming convention for Flow File (exactly seven characters followed by 2.dbf) so CustMal2.DBF is Ok. The resulting Flow File has three columns: Distance, Origin Label, Destination Label

In this case the origin location represents the customers so we can use (Table | Copy Fields across Tables) to copy any field representing demand (like POP2022) from the Origin File (key field LABEL) to the Flow File (key field ORIGIN). The final Flow File could then resemble:

Flowmap dBASE-file Browser

Number of fields: 4
Number of records: 8388

C:\Data\2023Johann\CustMal2.DBF |◄ ◄ 1

DISTANCE	ORIGIN	DESTIN	POP2022
27612.64	312073	350036	11113
16118.57	312073	321577	11113
43432.92	312073	380052	11113
37778.94	312073	362690	11113
24630.95	312073	351600	11113
25292.96	312073	342132	11113
21630.81	312073	335807	11113
15228.79	312073	334215	11113
30496.72	312073	331078	11113
12381.21	312073	329472	11113
10895.75	312073	329462	11113
32317.6	312073	354782	11113
26973.48	312075	350036	2014
24467.98	312075	342132	2014
43817.13	312075	380052	2014
37146.61	312075	362690	2014
24842.32	312075	351600	2014

Note that the new Flow File contains 8388 records which equals 12 mall locations * 699 customer locations. Moreover, 12 Malls means 12 flows from each customer location to all different Malls each time duplicating the full demand, so this Flow File should only be used for this specific purpose.

Now load this new Flow File in the project using POP2022 for Flow Size and all is set for Trade Area Analysis

Flow Size Field:	POP2022
Origin Label Field:	ORIGIN
Destination Label Field:	DESTIN

In case of Trade Area Analysis without Competition the Trade Volume Percentage can be used to define the Threshold number for instance in case a comparison is to be made if all 12 Mall would get an equal share of the market the number 8.33 (100% / 12) must be entered

By Trade Volume Percentage (Classic 60 or 80%)   8.33

Remember that the flow file allows each all mall access to the full market, so this would result in the same threshold number for each mall. Now the following results can be stored:

Trade Area Volume 008% Contours as BNA file   Convex Hull around identified client / customer locations

Trade Area Volume 008% Flows as new (dBASE) Flow file   Flows that make up the Trade Areas

Average Trade Area Distance per destination   Average customer distance per Mall

Maximum Trade Area Distance per destination   Threshold / Largest distance per Mall

The top result will contain the boundaries of the "Trade Area without Competition" in BNA format. Convert the BNA file to MIF format for use in regular GIS packages.

Creating Network Distance tables

< Content to be added>

Deactivating unconnected network segments

In Flowmap open or create any project containing at least a transport network, a single (selected) origin and a single (selected) destination location. Preferably the origin and destination location are close to the center of the transport network. From the main menu choose 'Analysis' and option 'Transport Network Analysis'

Leave all parameters at default values and directly click 'OK'.

Elect to only save the 'Distance to Centre' as field 'Connected'; this field will contain the shortest distance from every road segment to the one destination. In case the network is fully connected all values will be positive, but for eventual unconnected road segments the value of field 'Connected' will be set to '-1'. To exclude these unconnected roads when creating a network distance table simply select field 'Connected' as the "Access Exclusion Attribute", this will prevent all Origins/Destinations to start travel along any of these roads:

Note:

- In case the study area contains islands a single central origin/destination must also be selected for each island (and main land)
- In case the transport network contains road types like 'Motorways' where no stopping/parking is allowed this can be replicated by assigning a negative value to

'Connected' for these roads. These roads can then still figure in the middle of a shortest path and are only excluded from hosting the start of finish of a shortest path

- In case of directionality (one-way streets/lanes) is applied connectivity must be established in separate runs for both directions; same parameter settings only the 'Start Analysis from …' parameter must be changed from 'Destinations' to 'Origins'. Store the results in different fields that afterwards must be integrated into a single field with negative values in case either the destination 'connected' or the origin 'connected' is negative. In case the problem persists it is most likely caused by one-way dead end streets. Those roads are connected to the main network so reachable at one end, but not traversed in both directions hence create a kind of 'black hole'; you can get in but not out or vice versa. This may occur legitimately for instance at the entrance of an estate where these roads in practice connect to private roads that are not included in the dataset at hand. This only becomes a problem when trying to connect an Origin/Destination Location situated on that estate, so either add the necessary private roads, or move the location involved or deactivate all public dead end street involved.

Detour Analysis

Detour analysis entails the comparison of distances between either identical origin-destination combination in different networks or (when analyzing actual interaction data) the between origins (customers) and their actual destination (supplier) on the one hand or their closest destination (supplier) on the other hand. The detour factor is the quotient of largest of the two distances divided by the smallest distance, so the factor can never drop below the value of one (no detour).

An application of the first option is to test transport network connectivity by comparing the network distances with the matching airline distances as even in fully connected network there may be some intersections missing. Simply calculate the detour factor for all combinations and then sort in a descending order. The combinations coming out on top are the most suspicious and need to be checked and may lead to network repairs. Work down the list until all remaining detour factors are credible.

An application of the second option is to test the spatial rationality of customer behavior (as measured in spatial interaction data) and hence the validity of applying catchment area analysis or gravity modelling. The more frequent in time the more distance matters provided physical contact is required, so shopping at the mall and basic education should score a low average detour factor. On the other end of the spectrum is online shopping (provided the merchandise at hand is not perishable and delivery cost can be neglected or based on a flat tariff) which may score a high average detour factor in which case neither catchment area analysis nor gravity modelling should be applied

In Flowmap Detour Analysis is not a separate menu option, but can be achieved by (option 1) converting two Flowmap distance table to text (Conversions | Flowmap -> | Flowmap Distance Table to CSV) followed by matching and comparing the results in a database App or spreadsheet or (option 2) adding the actual distance to the interaction data (Analysis | Trip End Ranking) and by matching and comparing the actual interaction distance with closest distance resulting from a catchment area analysis (Analysis | Catchment Area Analysis | Regular Catchment Area Analysis) in a database App or spreadsheet.

Downsizing a transport network for training purposes

Identifying the projection point on the transport network for all origins and destinations can be a lengthy process that needs to be avoided during a training session. On the other hand, leaving out all local and residential roads might cost too much differentiation in the results. However, critical local and residential roads may be extracted and together with the main roads provide a downsized transport network that provides accurate results in combination with a relatively short processing time. The procedure to extract critical local and residential roads is:

1. Make sure origins & destinations are opened in your project.
2. Add a matching Map File preferably containing Thiessen Polygons for simple boundaries.
3. Make sure the transport network file is opened in your project.
4. Create a centroid connecting network (Preparations | Centroid Connecting Network (TIN)) as a CSV file. Save as a CSV file this network will effectively contain a list of map objects that share a common border.
5. Convert the CSV file to a Flowmap Flow File (Conversions | CSV | to Flowfile) and add the Flow File to the Project.
6. Assign the Flows (connecting direct neighbors) to the shortest path in the transport network. Make sure to include roads that are only partially used.
7. Select both main roads and the newly identified critical local roads and save the selection as your downsized network.

Note the assumption is that longer distance traffic will use main roads mostly and that local roads will be used either for nearby trips (to neighboring locations) and to get on and off the main roads which will be automatically intersected by the selected local roads. Make sure that your main road layer also includes all roads of the level(s) that feed directly into/from the motorways (etc) at multilevel crossings via on- and off- ramps.

Example from Parow, Cape Town shows 19 Uber (level 7) hexagons. The travel time between these hexagons must be established via shortest path analysis, to do so the 19 center points of must be projected on to the network.
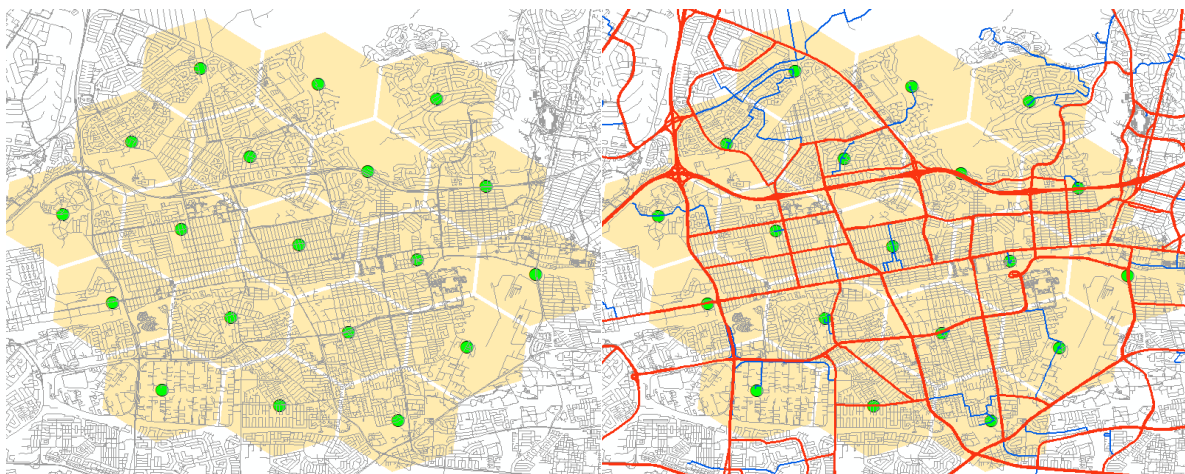
The map on the left shows that there are almost 16,000 roads (grey) to choose from in the original roadmap. The map on the right shows that when following the above described procedure, the number

of roads can be significantly reduced to some 3000 main roads (red) and 1000 local connecting roads (blue).

Handling directionality in Transport Networks

Flowmap functionalities like 'Transport Network Analysis', 'Network Distance Table Creation' and 'Flow Assignment to Network' can all handle network directionality (one way streets). A transport network consists of many network segments (road/street/rail) that each have an individual geometric direction; the direction in which the segment was digitized and recorded in the dataset. Irrespective of this geometric direction by default all network segments can be traversed in both directions; along or against the geometric direction.

> To show the actual geometric direction in Flowmap, click "Displays" in the main menu, choose options "Draw Topology from Network File" and "Geometric Direction". In ArcGIS show the geometric direction by using line symbol 'Arrow at End' or 'Arrow Right Middle' or use the 'Editor' tool to flip the current geometric direction in the opposite direction. Not strictly necessary but good practice is to make sure that, in case of one way streets, the geometric direction matches the allowed passage direction. OSM complies to this practice.

To allow Flowmap to handle directionality correctly two travel impedance variables must be prepared in advance. One variable containing the travel impedance along the geometric direction and another variable containing the travel impedance against the geometric direction. In most cases these variables will be identical for a particular network segment but may vary due to local conditions like uphill/downhill or different maximum speed settings. A negative value in either variable indicates no access in that direction. A negative value in both variables effectively deactivates the segment at hand. See also T&T "Deactivating unconnected network segments".

Typical parameter settings are:

Non-Directional Transport Network   Directional Transport Network

Parameter Setting		
Distinction between directions:	○ Yes ● No	
Two Way Impedance Attribute	LENGTH	▼
Currently redundant Return Impedance Attribute	LENGTH	▼

Parameter Setting		
Distinction between directions:	● Yes ○ No	
Road segment Start->End (Out/Along) Impedance Attribute:	BIKSECALNG	▼
Road segment End->Start (Home/Against) Impedance Attribute	BIKSECBACK	▼

Be aware that a single error in segment direction or attribute (-> -> -> <- -> ->) may block a whole network section or lead to unnecessary detours.

How to add the proper coordinate system information back in ArcGIS after import.

Most feedback of data from Flowmap to (Arc)GIS will concern attribute data that can simply be made available via a "Copy Fields Across" operation on the Flowmap end or a "Join" operation on the ArcGIS end. But there are also several occasions (like Export nodes/flows or Dissolve or Split or Create Thiessen/Feedlinks etc) where a new geometry layer is created in Flowmap, that needs to handled or post-processed in ArcGIS.

Feeding back of geometry datasets from Flowmap to GIS involves a two to four steps:

1. If necessary, convert your Flowmap dataset to BNA-Format
2. Convert the BNA dataset to MapInfo Interchange Format (MIF)
3. Import the MIF file in GIS

4. If necessary, add coordinate system information in GIS after import

In case you did not project any datasets during import all the new datasets will be in the original projection:

- If known and available, you can choose to declare that projection during in step 2. If so step 4 won't be necessary.
- Otherwise select 'Unknown Projection' in step 2 and in step 4 use 'Define Projection' to simply copy the coordinate system from the original shape file to the newly imported dataset

In case you did use the Flowmap Project(ion) Function go to Help in ArcGIS and search for "Define a new Coordinate System" as each Flowmap Project is likely to have been projected with unique parameters. Follow the Help Instructions. A few steps need additional information:

5. Any name you like, for instance "Flowmap Mamelodi", where Mamelodi is the name of the study area
6. Projection name must be set to "Lamberts Azimuthal Equal Area"
7. The appropriate parameter values were set during the projection for BNA to Planar:

The 'Central Meridian' parameter must be set to the centre longitude value and the 'Latitude of Origin' parameter must be set to centre latitude value. In case you forgot but elected to press the Save button at the time as recommended these values can still be found by opening the CentreLonLat.BNA file in any plain text editor. False Easting and False Northing can be left at zero value, unless you elected to use the 'Translate' option during a Clean operation. If so the effect of all 'Translate' operation must be entered as False Easting for the net X-coordinate shift and False Northing for the net Y-coordinate shift.
8. The Linear Unit was also set during projection as Target Map Units and can also be found in the CentreLonLat.BNA file if necessary

Once defined this projection can be used for all geometric datasets created in the same Flowmap project

Pressure Maps; adding the element of competition to accessibility measures

One of the most straight forward accessibility measures is the 'Proximity Count' also known as the 'Cumulative Opportunity Index' that simply counts the amounts of potential clients or services within a given reach. Examples are the number of hospital beds within half an hour car travel time or the number of schoolchildren within three km walking distance. What this measure does not take into account is the competition for these clients or services.

The Pressure Map principle entails involving competition by preceding the 'Proximity Count' with another 'Proximity Count' that counts the competition and correcting the client/service size for the

amount of competition before applying the original 'Proximity Count'. Going back to the hospitals beds this could involve residential areas with a general population count as origins and hospitals with a bed count as destinations. Instead of simply counting for each residential area the number of beds in reach, the Pressure Map principle would first count for each hospital the population total in reach, then divide the number of beds by the population total in reach of that hospital and finally count the corrected number of hospital beds for each residential area.

With a slight adjustment the Pressure Map principle can also be used to identify top locations when running a (brownfields) service location expansion scenario. Assuming that the origins contain (a proxy for) the target market and that the destinations are for instance existing fast food restaurants (QSR) of a particular chain and its direct competitors. First for each origin the number of restaurants within acceptable reach are counted and the number 1 (one) is added to allow for the new restaurant. Then the target market can be divided by the number of restaurants in reach. Running a second proximity count counting the corrected target market for potential new restaurant sites will reveal the top location(s).

See also: Location profile-based measures as an improvement on accessibility modeling in GIS. de Jong, T & Ritsema van Eck, JR. May 1996, Computers Environment and Urban Systems 20(3):181-190

Replacing Polygon Center Points for the display of Desire Lines or Creation of a TIN network

There are many occasions where a polygon/area needs to be represented by a single point. For instance, to place a label or a proportional symbol near the center of the polygon, but also a starting or ending point for all spatial interaction (flows, desire lines) from or towards these polygons. So when objects of type polygon are imported into Flowmap, for each polygon the gravity point is automatically added as a proxy for a center point. In most cases the gravity point is perfect for all purposes mentioned, but with more irregular polygons the gravity point may end up close to the border or even outside the parent polygon. An (almost) outside center point maybe undesirable and when one wants to create a TIN (Delaunay) network, that connects only neighboring polygons, it is even mandatory that the center point lies within the polygon.

The simplest way to correct the default center point is the manual approach, select a single polygon and overwrite the current XCOORD and YCOORD fields with improved (inside) values.

However, for most purposes mentioned above the optimal center point would be the inside point that is furthest removed from the polygon border. This point is known as the center point of the largest inscribed Circle and can be identified in Flowmap (Preparations | Points in Polygon Analysis | Center and Radius Largest Inscribed Circle). Once Flowmap has created a new attribute table with radius and center points of these circles for each polygon in the Map File, the new center points can be copied to the Map File (Tables | Copy Fields across Tables) and all existing XCOORD, YCOORD fields can be overwritten with the new values.

Note that center points are for various purposes stored both in the geometry section of the Map File and in its matching Attribute Table. Both above described approaches have only updated the attribute table. To also update the geometry section, add the updated map file attribute table as Origin (or

Destination) File to the current project and choose (Preparations | Centroid Connecting Network | Replace Map Label Locations | Replace with Origin (or Destination) Locations).

Replacing Polygon Gravity Points for all transport network based analysis

< Content to be added>

Shading Overlapping Polygons

Flowmap automatically organizes polygon (and point) data in alphabetical order by primary label on import from BNA. This alphabetical order is also maintained when shading polygons. The shading order normally does not affect the visual result in any way as the usual Flowmap polygons in the same Map File do not overlap. However, in case a Map File contains overlapping polygons (as may result from Trade Area Analysis), it is preferable to shade these polygons in descending order by size. Thereby the odds are minimized that larger polygons totally obscure smaller polygons.

Before:
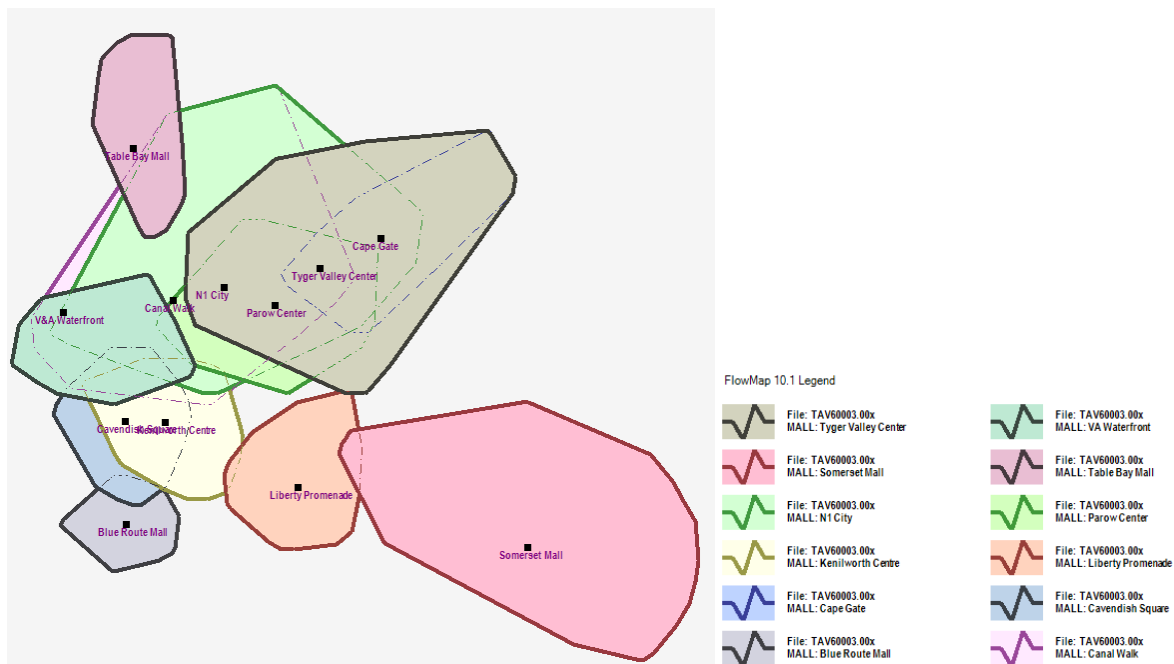
Note that the Gape Gate Trade Area is totally obscured by the larger Tyger Valley Center Trade Area. Typically, this situation of a single larger area obscuring one or more smaller areas can be prevented by changing the display order.

Follow these steps to change the automatic Flowmap alphabetical sort order to descending by size assuming a BNA file produced by Trade Area Analysis (or similar) is available

1) Import the BNA file with overlapping areas in Flowmap in the usual manner
2) Make the newly imported BNA file the Map File in the current project

3) Convert the Map File back to BNA file electing to add a size order indicator as secondary label
4) Clean the converted BNA file electing to swap primary and secondary labels.
5) Reimport the cleaned BNA file.

Effectively the primary label field (LABEL) now contains the size order indicator and was used for alphabetical sort on import ensuring the correct descending size order and the secondary label field (LABEL2) contains the original label and can now be used for copying any relevant data fields across tables from the original datasets.

After:
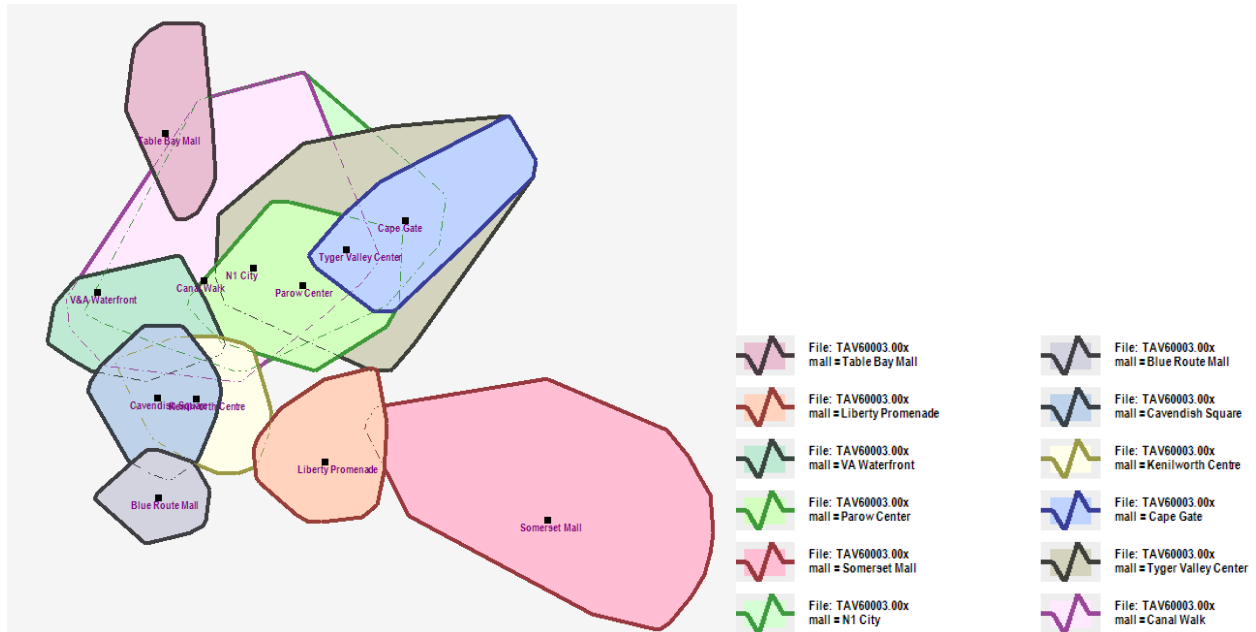
Using different colors for shading polygons or drawing edges

The "Discrete Shade" and "Discrete Draw" functionalities offer options to apply different colors depending on an attribute value. For instance, in case all polygons have been divided over twelve different catchment areas the above mentioned functions will assign a different color to each area or boundary. By default, working its way from the top, the first area encountered is assigned the first slot in the symbology table and the next area encountered is assigned the next slot. Using the default symbology tables, this may not always lead to the most informative map. There are several options to avoid adapting the twelve slots involved manually:

- Downloading a relevant GIMP "glp" file from https://colorbrewer2.org, converting the "glp" file to a Flowmap log file and running the log file in batch mode to temporarely adapt the current symbology table.
- Use the "Set Discrete Shade / Draw Symbology" Function to select 32 different grey-tones, soft colors or hard colors and put them in random, 'light to dark' or 'dark to light' order. When applying the "Discrete Shade / Draw" Function by default the top symbology slots will

be assigned. Checking the 'Stretch' Box however, ensures the use of the full depth of the symbology table as the assignment interval is maximized.

Overview[1]

Keyword	See Tips & Tricks Topic
accessibility statistics	Calculating base numbers for catchment profiles, Pressure maps
catchment area analysis	Calculating base numbers for catchment profiles
catchment profile	Calculating base numbers for catchment profiles
directional networks	
network connectivity	Deactivating unconnected network segments
network distance table	Creating a network distance table
network distance table	Deactivating unconnected network segments
network distance table	Replacing gravity points
transport network analysis	Deactivating unconnected network segments
transport network analysis	Replacing gravity points

---

[1] Under construction