Manual

Flowmap 7.2

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Contents

Introduction

The Flowmap Scope

Flowmap is a program for geographical analyses. It is specialized in displaying *interaction data*, like commuting and migration flows, *interaction analysis* like accessibility analysis, network analysis, and *interaction modeling*.

The Type of Data used by Flowmap

Flowmap uses several kinds of data, which can be grouped into three classes: maps, flow data and distance tables. These will be discussed further below.

A: Maps
For Flowmap analyses nearly always three maps are used:
1. A base map (i.e. map file). This is either an area map (e.g. countries, provinces or municipalities), or a network (e.g. a road map).
2. A point map containing flow starting points (i.e. origins).
3. A point map containing flow ending points (i.e. destinations).

The point locations in the point maps are usually centroids (center locations) of the base maps' areas. Flows between these centroids then actually represent flows between areas. This approach is related to the level of generalization of available flow data. For instance, it can be the case that migration flow data are available only at the provincial level. In that case nothing is known about the spread of origins and destinations of these flows *within* provinces. Thus, flows between the provinces are represented as if they were flows between the centroids of the provinces.

B: Flow data
Flow data provide actual (observed) interactions, for example, the size of commuter flows and migration flows from certain origins to certain destinations.

C: Distance tables
A distance table is a matrix that contains the distances for all possible combinations of interactions between origins and destinations, in meters, kilometers or minutes. Using a specific maximum distance, for example a maximum reach from a certain area of origin can be calculated. The reverse approach is also possible: calculating from which areas an area of destination is accessible, again limited by a certain maximum distance. Distance tables can be calculated and built within Flowmap. The matrix can be produced based on airline distances and on distances along a network, like a road map.

In Flowmap, maps are called Location Data. Data with regards to flows are called Flow Data and distance tables are called Distance Matrices.

Flowmap Filenames and Formats

In the Flowmap data directory several files are located with their own typical filename extensions.

A base map (map file) consists of a number of files. Each one contains part of the topological structure of the map, like area definitions (*.001 and *.002 files), the line data (*.003 and *.004 files) and the coordinates (*.005 and *.006 files).
A base map containing area features requires all of the above-mentioned files. A base map containing a network requires only the last four.
The Flowmap user does not need to set all these files; setting only one of them is sufficient. Because the *.006 file is part of both area maps and network maps, this file represents the available map.

The maps containing starting and ending locations of flows are called point maps. These points are often centroids of the area map that serves as a base map. These maps have a much simpler structure. Each point has a minimum of three variables. The first one is the name of that point. The other two are the X- and Y-coordinate to determine the location of that point in the map.

Zeeland1 : Table

	LABEL	XCOOR	YCOOR
▶	648	21182.3	367351.1
	649	36999.45	392544
	650	53000.92	363352.7
	654	45491.17	384772.4
	656	56336.77	413089.6
	657	64891.7	407129.1

For these points a DBF format is used. This is a format that can be read and edited in Flowmap 7. The naming of these point maps is as follows: ???????1.DBF.

To these ???????1.DBF files more variables can be added. These then become the so-called attributes. They provide more information on the points. If the points are area centroids, then the attributes contain characteristics of these areas. A widely used attribute, for instance, is the number of inhabitants of an area. Besides area centroids, point data in a map could, for example, represent schools. An attribute could then be the capacity, i.e. the maximum number of pupils a school can host. Always note that the first three fields of a ???????1.DBF file are always the label (name), the X- and the Y-coordinate.

The distance matrices, like the area and network maps, are stored in a set of files. The extensions of the files are *.010, *.011, *.012, *.013, *.014 and *.015. The kind of matrix determines which files are and which are not part of the set.

- In a *.011 file only airline distances are stored;
- In a *.012 file only network distances are stored;
- In a *.013 file calculated interaction data are stored in Flowmap format.

The *.010 file is a plain text (ASCII) file and thus always readable. In this file information is stored about the construction of the distance matrix. This information can be retrieved using any word processor. The *.014 and *.015 files contain indexes to the sorted values of all rows and columns of the matrix.

Like point data, flow data are also retrieved from a .DBF file. File naming for flow data is always ???????2.DBF.
The structure of this type of files is as follows: score, label1, label2. The score is the size of the flow, for example, the daily number of commuting trips from A to B. Label1 is the flow origin, label 2 its destination. Both labels must occur in the origin and destination files (???????1.DBF), because Flowmap searches these files for the location labels that the flow

data file contains.
The third and last type of .DBF file that Flowmap makes use of is the attribute file for a road map. In this file data are stored concerning, for instance, the length of a road, the speed limit of that road and its classification. These files are named ???????3.DBF.

Apart from .DBF files and Flowmap files, Flowmap makes use of so-called BNA files. These are base area maps stored in BNA format, which dates back to the days of Atlas Graphics but is still usefull. Flowmap can display these maps on the screen.

How to Use this Manual

Using Flowmap is in a sense quite simple. Just a few mouse clicks, typing a file name, a variable and a parameter makes the program draw maps or flows on the screen or perform the necessary calculations. However, it is vital that the *right* choices are made, and this is why this manual explains so comprehensively the features and options Flowmap has to offer. This applies especially to the chapters in Part III focusing on analysis, and Chapters 6 and 7 in Part II on the creation of tessellations and distance tables respectively. Actions to be executed are printed in bold and a sans serif font. This is accompanied by the necessary explanation. When some item requires special attention, the text is printed in italics, with the expression "**NOTE:**" placed to the left of it.

The manual consists of four parts. In Part I the general settings are discussed, as well as drawing maps and flow data. Making selections and exporting map displays and flow data are also demonstrated. Part II, creating specific Flowmap files is explained. In Part III the various analyses Flowmap can perform are elaborated on. And finally, in Part IV, a number of features from the professional edition of Flowmap, that are not available in the educational version, are discussed.
In this manual data based on the Zeeland province, located in The Netherlands, are used as examples. The various maps and entry windows in this manual were created using data based on the Zeeland province. The names of the files and variables used are printed between square brackets.

New in Flowmap 7.2

Compared to Flowmap 7 the following items are enhanced, extended or new:
- The map drawing ability has been upgraded and can contain more different legend entries
- Public transport network features have been added to the 'create' ability of Flowmap
- Dissolve function has been added
- Overall analysis function has been enhanced
- Minimum sum method analysis has been added
- Second best catchment area analysis has been added
- Alternate catchment location analysis has been added
- Multi modal accessibility analysis has been added
- Overall service location models have been enhanced and upgraded
- Expansion models have been enhanced
- Coverage models have been enhanced
- Relocation models have been enhanced
- Reduction models have been added
- Throughout Flowmap minor improvements have been made
- Comments from users have been processed and included in the manual

Summary

File types:	File naming:
• Area maps:	*.001,*.002,*.003,*.004,*.005,*.006
• Network maps:	*.003,*.004,*.005,*.006
• Distance tables:	*.010,*.011,*.012,*.013,*.014,*.015
• Point maps (or centroid maps for area maps):	???????1.DBF
• Actual flow data:	???????2.DBF
• Attribute file for network maps:	???????3.DBF
• Area maps (Atlas GIS):	*.BNA

Part I

General Settings and Display of Flow Data

This part consists of five chapters. In Chapter 1 starting up Flowmap and the general settings of the program are discussed. Chapter 2 deals with drawing maps and flow data. Chapters 3 and 4 are about making selections. The fifth chapter explains how to print maps and flow data, or how a display can be saved as a file.

CHAPTER 1

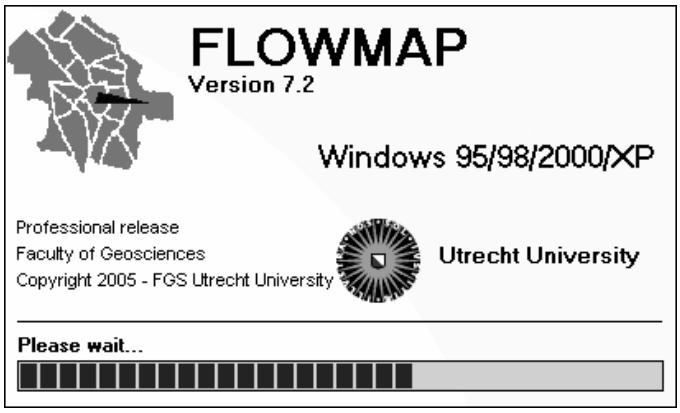
Starting Flowmap and General Settings

In this chapter starting up Flowmap is discussed first. Then its general settings are dealt with. Finally in the last section the "Window" option in the menu bar is explained. The menu options regarding symbology are discussed in section 2.11 after is explained how to draw a map. How to save and print a map is discussed in chapter 5.

1.1 Starting up Flowmap

- **Double-click the Flowmap icon**

While Flowmap initializes, the Splash Window to the right is shown. After the program has been loaded, the Flowmap window will be displayed.



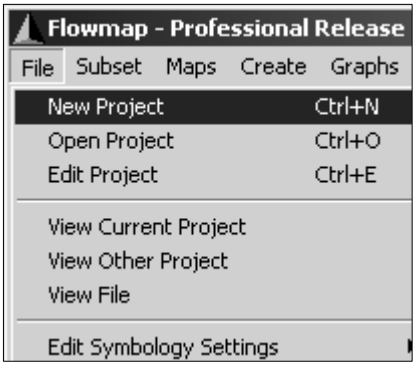
1.2 General Settings

Working with Flowmap 7 usually involves working with one or more projects. It is usually a good idea to make at least one new project for each dataset you are working with.

1.2.1 Defining a New Project

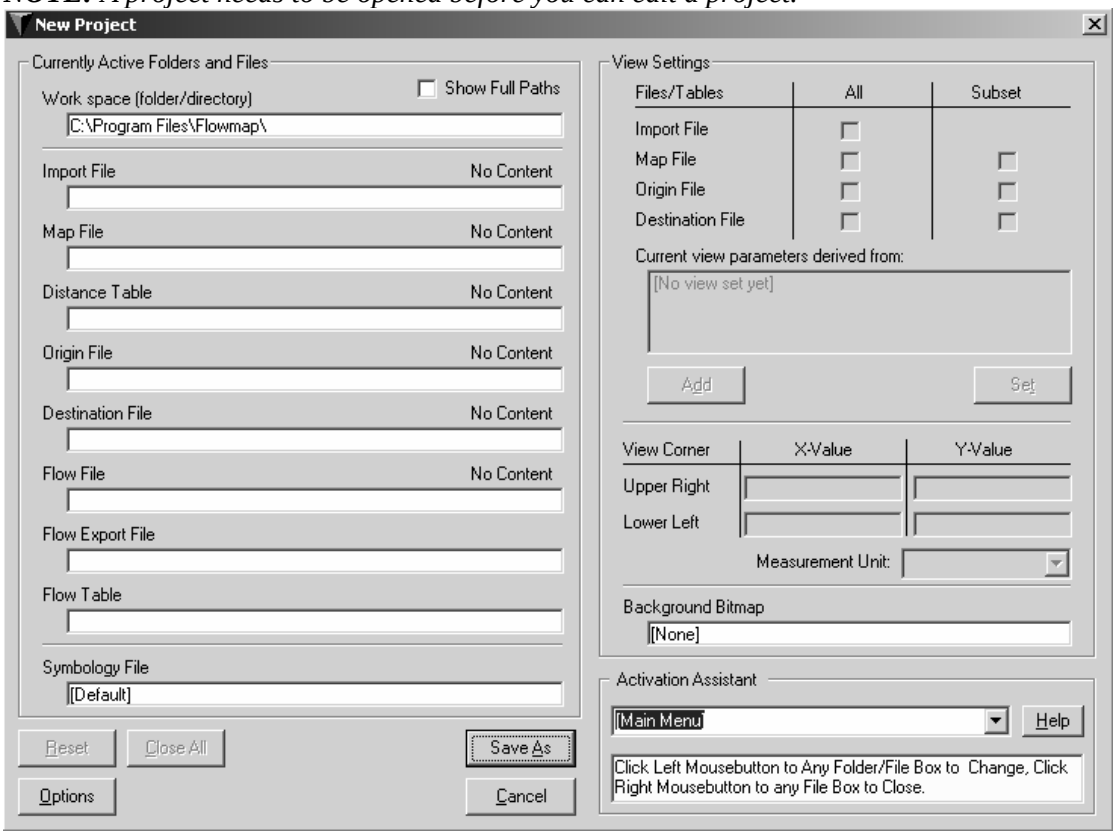
You can create a new project in the file menu.

- **Select "File" in the menu bar**
- **Click on "New Project"**



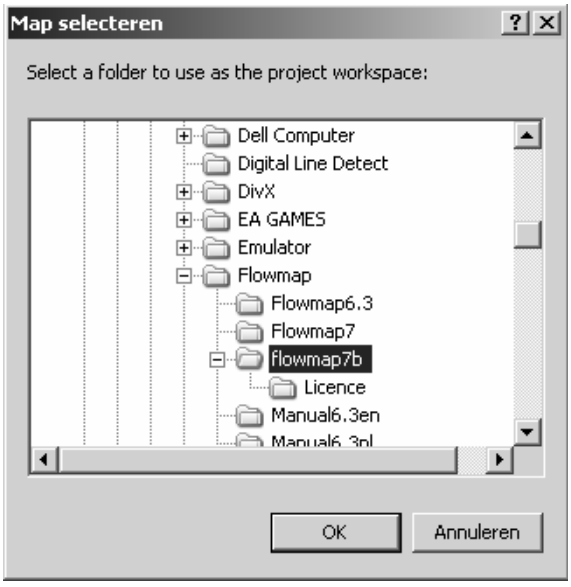
Now the "New Project" window pops up. The project window is designed to give an overview of all the current Flowmap settings and selections. Also all settings (not selections) can be changed through the project window.

NOTE: *A project needs to be opened before you can edit a project.*



First you can set the workspace, this will be the folder/directory in which all the files will be saved.

- **Click in the white entry box beneath "Work space (folder/directory)"**



A new window pops up in which you can browse to and set the workspace folder.

- **Browse to and select an existing folder**
- **Click on "OK"**

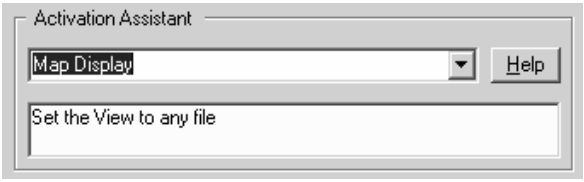
Now you return to the project window and the work space folder has been changed. Next some files need to be opened. The kind of files that need to be opened depend on the kind of activities that need to be carried out. You can open up a total of seven different file types and one import file by clicking in the appropriate white entry box.

To open an import file:	**Click beneath "Import File"**
For a map file (base map)	**Click beneath "Map file"**
For a distance table (matrix):	**Click beneath "Distance Table"**
For origin locations	**Click beneath "Origin File"**
For destination locations:	**Click beneath "Destination File"**
For flow data:	**Click beneath "Flow File"**
For a ".BNA" file	**Click beneath "Flow Export File"**
For a flow data matrix:	**Click beneath "Flow Table"**

The first five file types are discussed in Chapter 2. The distance table will be dealt with when

several kinds of analyses are explained in Part III. The purpose of a matrix with flow data will be explained in Chapter 10 on gravity modeling.

You can use the “Activation Assistant” in the lower right corner of the project window to help selecting the right files. In this example we want to display a map as will be done in the first part of chapter two.



- **Click on the small arrow in the “Activation Assistant” box**
- **Select “Map Display”**

Notice that only the required settings required for the Flowmap function are still in white. Now the required files need to be opened.

- **Click in the white entry box beneath “Map File”**
- **Select [Zeeland.006] in the new “Open Map File” window**
- **Click on “Open”**

- **Click in the white entry box beneath “Origin File”**
- **Select [Zeeland1.dbf] in the new “Open Origin” window**
- **Click on “Open”**

- **Click in the white entry box beneath “Destination File”**
- **Select [Zeeland1.dbf] in the new “Open Destination File” window**
- **Click on “Open”**

NOTE: *we don’t need to import a file so we leave this box blank*

NOTE: *you can unselect a file by right clicking the corresponding textbox.*

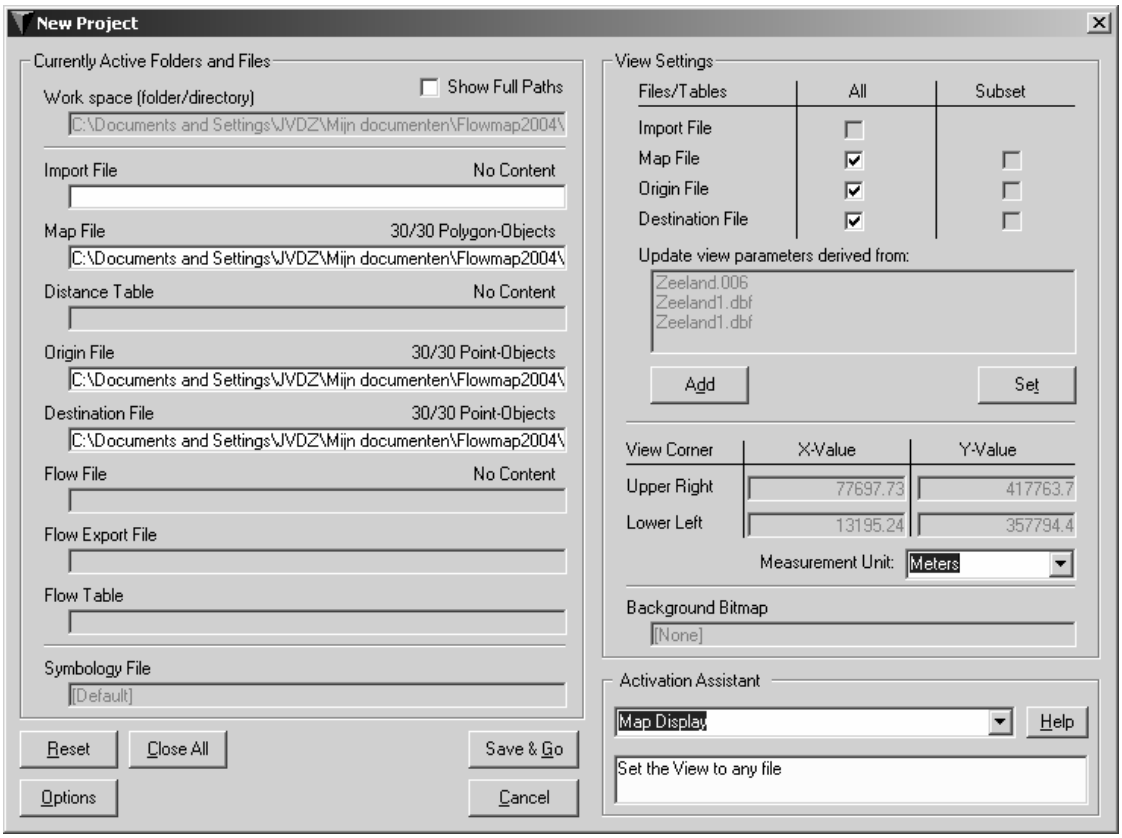
The next step is to set the view. Flowmap needs to know on which scale the maps should be displayed on the screen. Therefore, the preferred map scale must be entered. In Flowmap this is called the “view”.
Flowmap has a certain amount of screen space available for displaying maps. Flowmap can fit a map exactly into this space. However, in order to do this it has to know on *which* map the view should be based. A view can be set based on any of the different maps Flowmap uses in a certain analysis (that is, both on the map file/base map and on the origins or destinations). The view can also be set on a combination of all opened maps. All map features of all the maps opened at that stage can be displayed.
When you select an new "view", all of the opened maps and flow data are erased. Make sure to change the view before you start drawing.

- **Check the small boxes right of “Map File”, “Origin File” and “Destination File” in the “All” column in the “View Settings” box**
- **Click on the “Set” button**

Right of the “Measurement Unit:” box the measurement unit can be selected. When the unit is not known it can be left blank or guessed by looking at the corner values above the entry box. These numbers are too large to be “kilometers” so it is more likely that the measurement unit will be “meters”.

- **Select [Meters] in the “Measurement Unit” box**

Flowmap also enables you to zoom in on part of a map or to zoom out, making the scale twice as large. See section 2.19.
Now all the settings have been made to display the map. The final project window would now show like this:



The project can be reset by clicking the "Reset" button. The settings will return to the original parameters. To clear all the project parameters you can click on the "Close All" button. You can save or cancel the project settings by clicking the appropriate "Save", "Save As" or "Cancel" button. When the "Activation Assistant" has been used, a "Save & Go" button will be shown instead of a "Save As" button. By clicking "Save & Go" Flowmap doesn't only save the project, but also begin with the selected function (in this example displaying the map).

- **Click on "Save & Go"**
- **Use the suggested file name or type in an appropriate name in the new "Save Project" window**
- **Click on "Save"**

The new project has now been saved. How to view a map is explained in chapter two.

NOTE: *By clicking on the options button a new window will pop up in which the application directory and the database management system can be changed. This could come in handy when Flowmap is installed in a network and you don't have permission to write on the C:\ drive.*

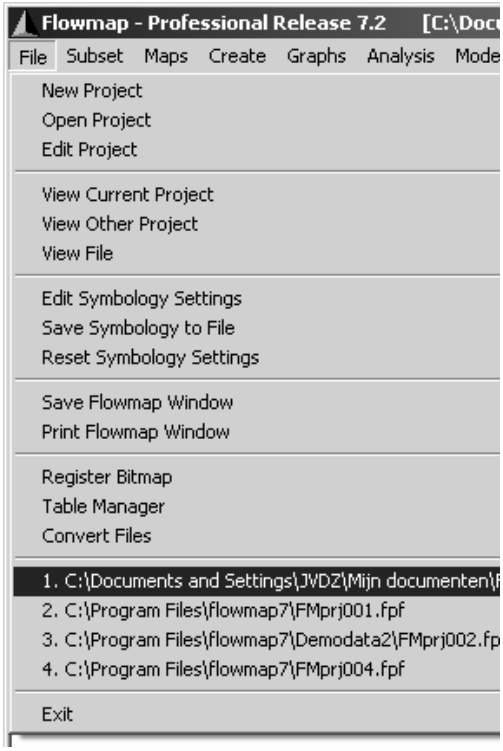
NOTE: *In Flowmap maps can only be drawn and analyses done using opened files. Hence it is important that files - the correct ones - are opened before starting off.*

NOTE: *Flow data files can only be opened if they correspond with opened origin and destination location maps. Before Flowmap opens a flow data file, it checks whether the origins and destinations to which the file refers are indeed present in the opened origin and destination location files. If origins and/or destinations are missing, the flow data file cannot be used*.

NOTE: *A distance table always refers to a specific map of origins and destinations. If origins and destinations have not been opened yet, Flowmap automatically opens them on opening a distance table. If origins and destinations are already opened, but they do not relate to a distance table that was just opened, Flowmap closes these files automatically and opens the files that do correspond to it.*

NOTE: *It is also possible to change the directory settings described in section 1.2.1 if files have already been opened. If this is done, Flowmap assumes that you cannot use previously opened files any longer, so it closes them down. Even if one directory for one type of data is changed, all files will be closed, including the ones in the other directory.*

1.2.2 Opening and Editing an Existing Project



You can open an existing project in the File menu.

- **Select "File" on the menu bar**
- **Click on "Open Project"**

A window pops up in which an existing Flowmap project can be selected. Flowmap projects have a ".fpf" (Flowmap Project File) extension.

- **Select a "Flowmap Project File"**
- **Click on "Open"**

After Flowmap has loaded the project file, a "Project Overview" window pops up. This is the same project window as seen in the previous paragraph only this time you can't edit any of the files or settings.

- **Click on the upper right cross to close the "Overview project" window**

The project has now been loaded.
There is also a faster way to open a project in Flowmap. You can open up to a maximum of four previously opened project files by selecting them straight from the file menu.

- **Select "File" on the menu bar**
- **Click on a previously opened project file**

NOTE: *besides closing the window by clicking on the small cross, it is also possible to let the window float by clicking on the middle square button with the two small windows. The files information window can be minimized by clicking on the left square "underscore" button at the top right-hand side of the window. It will be placed at the left hand bottom of the screen as an iconized bar.*

To edit a project follow the next steps:

- **Select "File in the menu bar**
- **Click on "Edit Project"**

Now the "Edit Project" window will be opened and changes to the project can be made. The project can be edited the same way as discussed in section 1.2.1 "Defining a New Project".

1.2.3 Viewing a Project or File

To view the currently opened project:
- **Select "File" in the menu bar**
- **Click on "View Current Project"**

A project window pops up viewing the current project. This way the project can only by viewed and not be edited. It is also possible to view an other project:
- **Select "File" in the menu bar**
- **Click on "View Other Project"**
- **Select an other project file in the "View Other Project" window**
- **Click on "Open"**

To view some file information:
- **Select "File" in the menu bar**
- **Click on "View File"**
- **Select a file**
- **Click on "Open"**

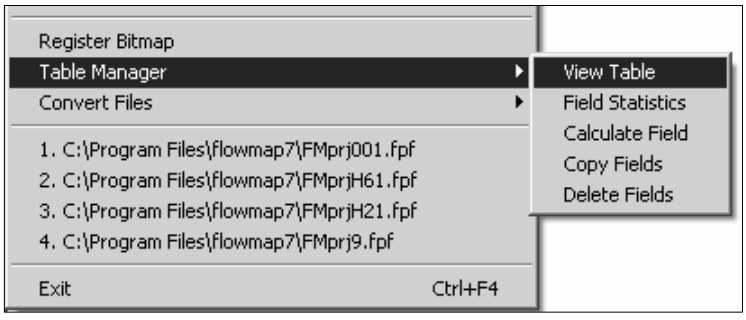
Depending on the selected file a new window will pop up showing information about the selected file. This could be a text window showing for example information about the file type and the object type or, in case of a '.dbf' file, a database window showing the relevant data.

1.3 The Table Manager

With the "Flowmap Table Manager" it is possible to edit tables and make calculations with table fields. You can also view a table or view some common field statistics. The "Table Manager" can be found in the "File menu".

1.3.1 Viewing a Table

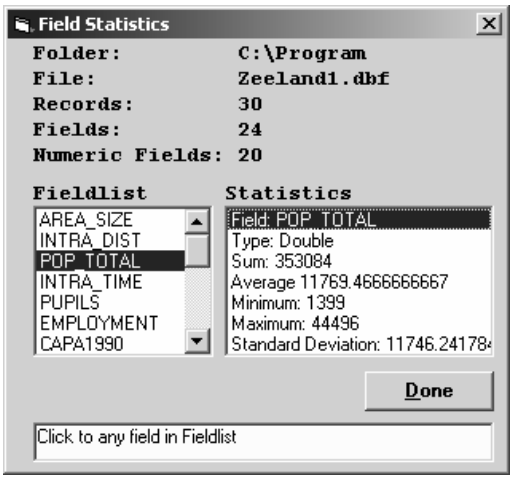
- **Select "File" in the menu bar**
- **Select "Table Manager"**
- **Click on "View Table"**



An "Open Table" window pops up. In this window you can browse and select a table file, a Dbase III file (.dbf).
- **Select the table file which you want to view**
- **Click on open**

Now the "Flowmap dBASEfile browser" will be opened. You can browse through the table be clicking the arrows or by using the sliders at the sides of the table. It is not possible to edit the table.
- **Click on the "Ok" button to close the "Flowmap dBASEfile browser"**

1.3.2 Field Statistics



- **Select "File" in the menu bar**
- **Select "Table Manager"**
- **Click on "Field Statistics"**
- **Select a dBase file (.dbf) in the new "field statistics" window, in this example [Zeeland1.dbf]**
- **Click on "Open"**

A "Field Statistics" window pops up. You can click on any field in the field list and get some common statistical information about the selected field.

- **Click in the "Fieldlist" box on [POP_TOTAL}**

Specific statistical information about the selected field will be displayed in the "Statistics" box. For example the sum of all the values in the selected field is 353084. This number is the total population of Zeeland.

- **Click on "Done" to close the "Field Statistics" window**

1.3.3 Calculating Fields

- **Select "File" in the menu bar**
- **Select "Table Manager"**
- **Click on "Calculate Field"**
- **Select a dBase file (.dbf) in the new "calculate field" window**
- **Click on "Open"**

The "Flowmap Variable Calculator" will be opened. The Flowmap calculator practically works the same as a normal calculator. By clicking on a variable and on a operator, constant or function it will be added to the formula box at the bottom.

- **Enter a formula**
- **Click on "Ok"**

In the "Store New Field" window an existing fieldname can be selected or a new fieldname can be entered instead of the default fieldname.

- **Enter a new fieldname or choose the default fieldname**
- **Click on "Ok"**
- **Click on "Ok" in the Flowmap Report window**

Flowmap has now calculated and stored the new values in the chosen field. In section 7.5 we use the table manager in an example to calculate a new field.

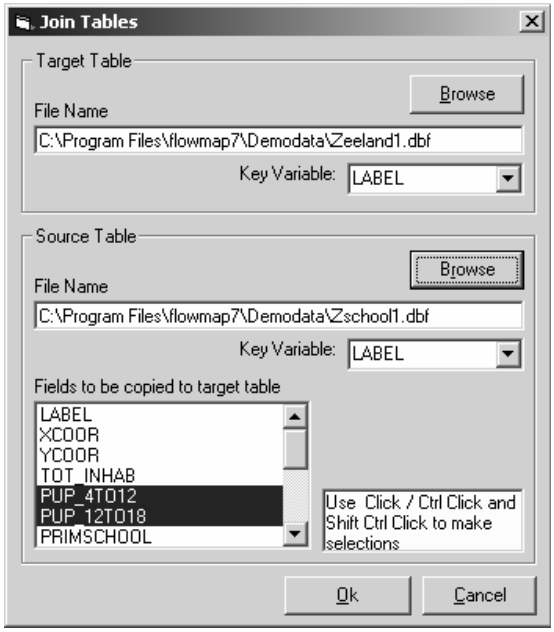
1.3.4 Copying Fields

With the “Table Manager” it is also possible to copy and delete fields.

- **Select “File” in the menu bar**
- **Select “Table Manager”**
- **Click on “Copy Fields”**

In the new “copy fields: Open Target file” window, the target file needs to be selected. The target file has to be the dBase file to which you want to copy the field(s).

- **Select the target file**
- **Click on “Open”**



In the next window you need to select the source table from which you want to copy the field(s) to the target table. This can be done by either typing directly the filename into the “Filename” box or by clicking the corresponding “Browse” button.

- **Click on the “Browse” button in the “Source Table” box**
- **Select the source file in the “copy fields: Open Source file” window**
- **Click on “Open”**

It is also important to select the right key variable so that the tables can be joined correctly, which is needed for the copying to succeed. A key variable consists of fields with a unique value which makes the corresponding cases unique.
The key variable of the target table and the source table need to correspond to each other so that both tables can be linked correctly to each other.

- **Select the key variable for the target table**
- **Select the key variable for the source table**

Once the source and target tables and their corresponding key variable have been selected, the fields that need to be copied to the target table have to be selected.

- **Select the fields that need to be copied**
- **Click on “Ok”**

When Flowmap has copied the field(s) a Flowmap 7 Report window appears.

- **Click on “Ok”**

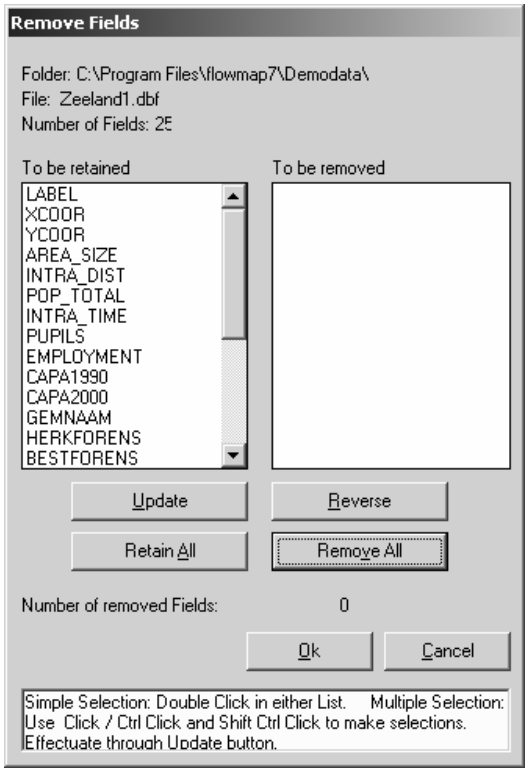
1.3.5 Deleting Fields

- **Select “File” in the menu bar**
- **Select “Table Manager”**
- **Click on “Delete Fields”**
- **Select a dBase file from which field(s) have to be deleted**
- **Click on “Open”**

The “Remove Fields” window as is shown on the next page pops up. Fields that need to be deleted have to be put in the “To be removed” box. This can be done be double click on a file name to place it to the other box. Multiple fields can be replaced by clicking and holding the Ctrl or Shift key.

It is also possible to use the buttons below the two boxes. By clicking the “Update” button a selected field will be placed in the other box. Clicking the “Reverse” button will replace all the fields from one box with the fields from the other box. Clicking the “Retain All” button will place all the fields in the “To be retained” box. Clicking the “Remove All” button will place all the fields in the “To be removed” box. Finally clicking on “Ok” will delete the fields in the “To be removed” box.

- **Place the fields that need to be removed in the “To be removed” box**
- **Click on “Ok”**
- **Click on “Ok” when the “Flowmap 7 Report” window appears,**



The selected fields have now successfully been deleted.

1.4 Flowmap Mode of Operations

In the options menu it is possible rescale the window and to change some operating settings for Flowmap. The options regarding the log file are only available in the professional edition and will therefore be discussed in part IV.
You can rescale the Flowmap window to 800x600 proportions in the options menu.

- **Select “Options” in the menu bar**
- **Click on “Scale Windows to 800x600 Proportions”**

NOTE: *You can only rescale the windows when you work in full screen mode (by clicking the “maximize” button in the right upper corner of the Flowmap window), once rescaled you can maximize the window again by un-checking “Scale Windows to 800x600 Proportions” in the options menu .*

It is also possible to change the interactive working mode to an interactive working mode without message stops. By default the interactive mode is selected, in which you receive message stops after you have run a process like the ‘Flowmap report’ windows and the ‘Flowmap at your convenience’ windows. By using the interactive working method these message stops are disabled.

- **Select “Options” in the menu bar**
- **Select “Mode of Operation”**
- **Click on “Interactive without Message Stops”**

Now the mode of operation has been changed.

CHAPTER 2
Drawing Maps and Flow data

This chapter discusses how to draw the various maps and flow data sets. Area maps can be drawn in several ways. Flow data can be drawn in two ways. All these possibilities are discussed in this chapter.

In this chapter data of the Zeeland province are used. The following files must be opened:

BNA file:	ZEELAND.BNA
Map file:	ZEELAND.006
Origins:	ZEELAND1.DBF
Destinations:	ZEELAND1.DBF
Flows (ExtDB):	FORE9502.DBF

Section 1.2.2 discusses how these files should be opened. The "View" is on "Combined View".

The BNA file ZEELAND.BNA and the map file ZEELAND.006 are both maps containing municipality boundaries of the Zeeland province. The origins and destinations are the municipality centroids. In this case the origins and destinations are read from the same file (ZEELAND1.DBF). This implies that every flow origin can be a destination and every destination an origin. The flows are read from the file FORE9502.DBF. This file contains data on the commuter flows between the various Zeeland municipalities.

NOTE: *Every time a new command is issued to draw a map, a new map is more or less imposed on the previous one(s). A window in which an area map, an origins map and a destinations map are drawn, looks like one map, but is in fact a combination of three maps placed exactly on top of each other.*

NOTE: *When many maps and flow data are drawn on top of each other, the display can become cluttered. You can start again by erasing the screen. All maps will then be erased. The way to erase the screen is discussed in section 2.17.Except the topmost layer, it is not possible to erase only one map layer.*

NOTE: *A total of 32 maps can be drawn in the display window (imposed on each other). A 33rd map can only be drawn if the screen is erased (see section 2.17).*

2.1 Drawing a Simple Map

You can quickly draw a simple map without using the advanced display options by selecting the "Display Outlines & Locations" option. By using this option it is also possible to draw .BNA files. This is an easy and quick way to orient yourself:

- **Select "Maps" in the menu bar**
- **Click on "Display Outlines & Locations"**
- **Select a file which you want to draw in the new pop up window**
- **Select a symbol**

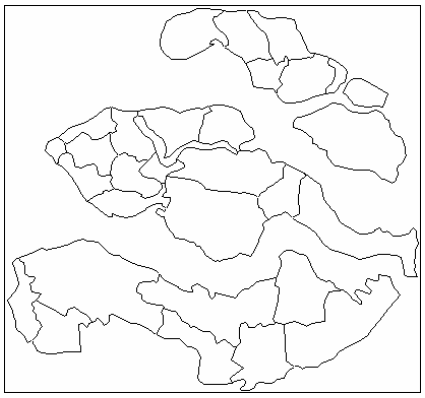
The map will now be drawn

NOTE: *You can't make selections or adjustments to a map using the "Display Outlines & Locations" method.*

2.2 Drawing Area Maps

- **Select "Maps" in the menu bar**
- **Select "Advanced Display"**
- **Select "Draw Map File"**
- **Select "Draw Edges/Lines"**
- **Select "Uniform Drawing"**
- **Select a line symbol**

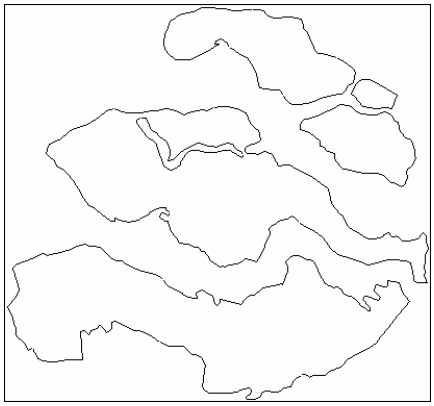
The municipal borders are drawn.



2.3 Drawing the Area Map's Hull

- **Select "Maps" in the menu bar**
- **Select "Erase Screen"**
- **Select "Maps"**
- **Select "Advanced Display"**
- **Select "Draw Map File"**
- **Select "Draw Hull"**
- **Select "Draw Topological Hull"**
- **Select a line symbol**

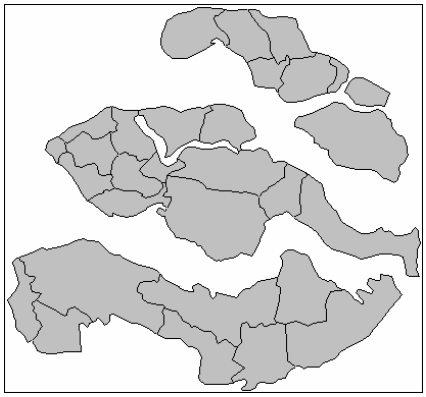
The outer borders of the entire area are drawn. When selecting "Draw Attribute Based Hull" instead of "Draw Topological Hull" the hull of the selected attribute will be drawn.



2.4 Shading Area Maps

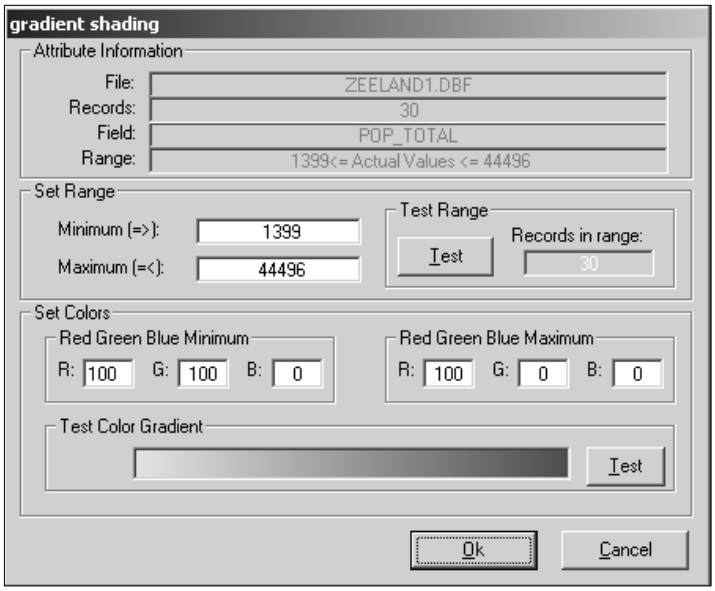
- **Select "Maps" in the menu bar**
- **Select "Erase Screen"**
- **Select "Maps"**
- **Select "Advanced Display"**
- **Select "Shade Map File"**
- **Select "Uniform shading"**
- **Select a shade symbol**

The shading of the Zeeland municipalities is now drawn on the screen. If you want to display the area border as well, see section 2.2.



Another option is gradient shading of an area map, based on an attribute of your choice. Furthermore, you can make a selection by setting the minimum and maximum values of the selected attribute. These values are then shaded. For the lowest and highest values, a color must be chosen. The color changes gradually from one value to another.

- **Select “Maps” in the menu bar**
- **Select “Advanced Display”**
- **Select “Shade Map File”**
- **Select “Gradient Shading”**



A window pops up in which a variable must be set.

- **Select an attribute name [POP_TOTAL]**
- **Click on “OK”**

A window appears, in which the upper and lower selection limits can be set. The limits can be set using either the sliders, or by typing the numbers.

- **Set the range limits by typing the numbers [1390, 44497]**
- **Click on the “Test” button**

The number of map features selected is indicated beneath the “Records in range” text in the window.

The box “Set Colors” enables you to set the colors for the highest and lowest values. You do this by setting the color intensities of red, green and blue on a 0-100% scale for both values.

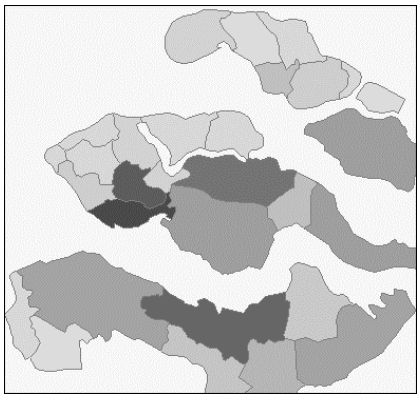
- **On the left, enter percentages for the lowest value [Red: 100, Green: 100, Blue: 0]**
- **On the right, enter percentages for the highest value [Red: 100, Green: 0, Blue: 0]**
- **Click on “Test” in the “Test Color Gradient” box**

The bar in the “Set Colors” box now displays the appearance of the colors when you have selected gradient shading.

NOTE: *The “Test” buttons do not make the selection; only when the OK button is pressed, the selection is activated.*

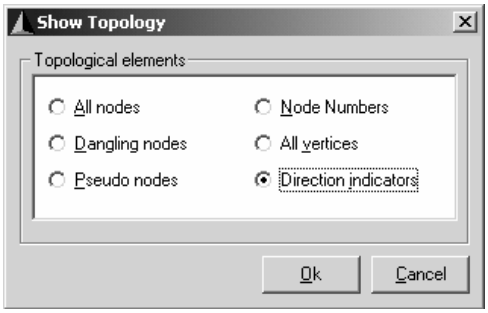
- **Click on “OK”**

The gradient shading of the municipalities is now drawn on the screen.



NOTE: *If you have first drawn the area borders and after that, you have shaded the area map, you will not be able to see the area borders any more, because the map you just drew was placed on top of them. If you want to display both shading and area borders, first shade the map and then draw the area borders, as described in section 2.2.*

2.5 Show Topology



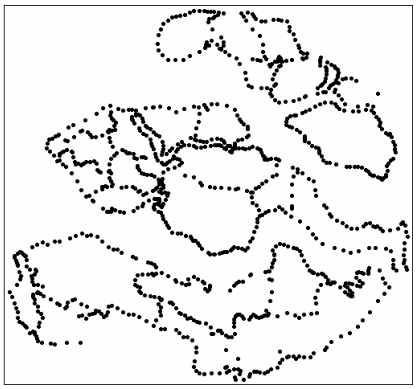
It is also possible to show the different topological elements from a map.

- **Select "Maps" in the menu bar**
- **Select "Advanced Display"**
- **Select "Show Topology"**

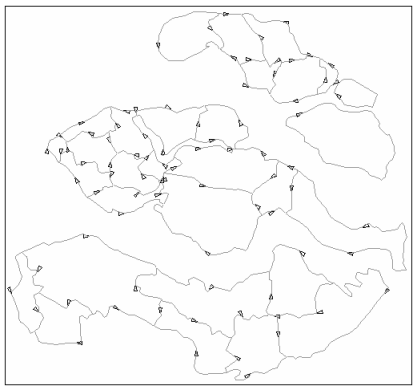
The "Show Topology" screen pops up in which different topological elements can be selected. Dangling nodes are nodes which correspond with the origin of only one line, edge or arc. Pseudo nodes are nodes which correspond with the origin of two lines, edges or arcs and are, from a topological perspective, unnecessary and cause a delay when using the network. There are exceptions when pseudo nodes are correct, for example when halfway a road the speed class changes. So the usefulness of pseudo nodes is related to a change in the attribute value. In both cases the data can be correct or can be the result of a mistake during the digitalization process. Direction indicators represent in which direction the line, edge or arc has been digitally stored. This directionality is useful for network analyses relating to for example the difference between one and two way traffic or the difference between uphill and downhill.

- **Check the topological elements which needs to be drawn, for example "Direction indicators" or "All vertices"**
- **Click on "Ok"**

Bellow an example of all vertices:



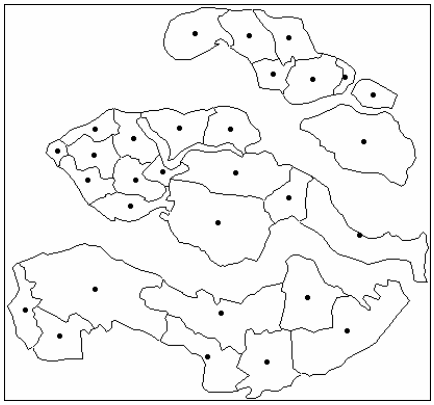
Bellow an example of direction indicators:



2.6 Drawing Origin Locations

- **Select "Maps" in the menu bar**
- **Select "Advanced Display"**
- **Select "Draw Origin File"**
- **Select a point symbol**

All flow origin locations are drawn.



2.7 Drawing Destination Locations

- **Select "Maps" in the menu bar**
- **Select "Advanced Display"**
- **Select "Draw Destination File"**
- **Select a point symbol**

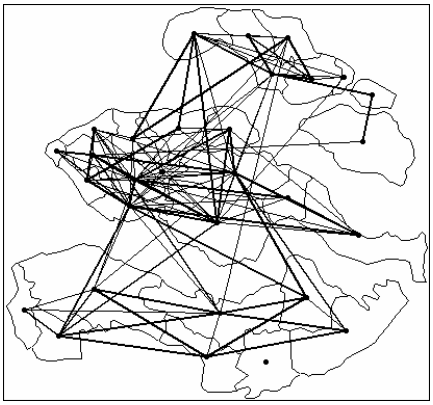
All flow destination locations are drawn.

NOTE: *The resulting map should look the same as the Origin Locations map.*

2.8 Drawing Flow Data Using Straight Lines

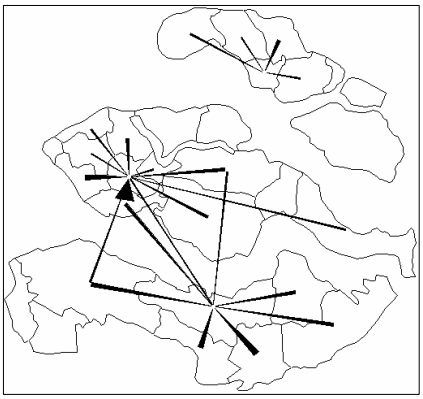
- **Select "Maps" in the menu bar**
- **Select "Advanced Display"**
- **Select "Draw Desire Lines from Flow File"**
- **Select a straight line symbol**

The (inter-municipal) flows are drawn. The result is a jumble of lines, as shown by the figure to the right. Chapter 4 will discuss how to select flow data in order to display only specific flows to keep the map easy to read.



2.9 Drawing Flow Data Using Wedges

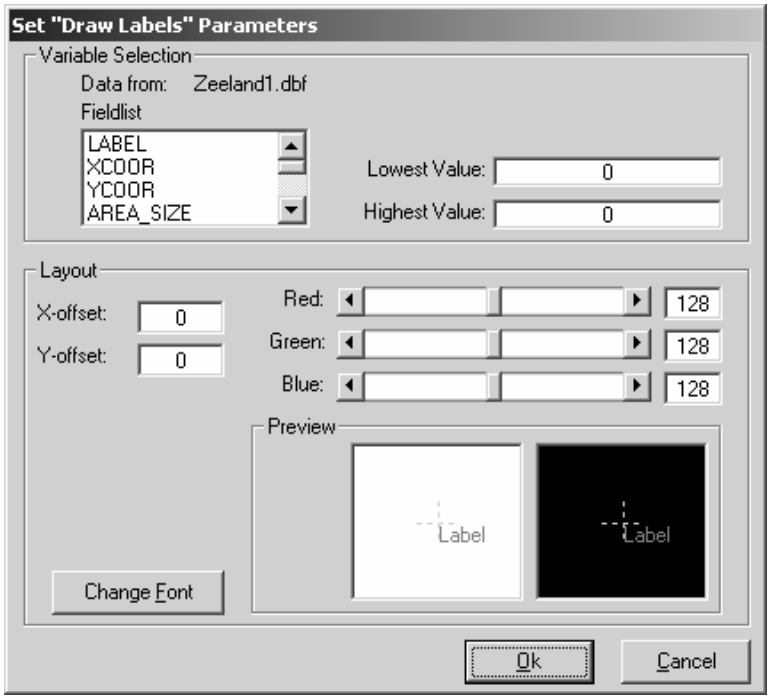
In Flowmap it is possible to have larger flows (i.e. consisting of many trips) drawn more widely. The flows then are represented by wedges. Apart from distinguishing between larger and smaller flows, direction is also indicated. The wedge is wide near the origin, but its width decreases in the direction of the destinations.



- **Select "Maps" in the menu bar**
- **Select "Advanced Display"**
- **Select "Draw Desire Lines from Flow File"**
- **Select a wedge**

NOTE: *The resulting map should be very messy, later on in this manual we will discuss how to make selections and how to assign flows to a network so that the result will become more viewable.*

2.10 Drawing Labels

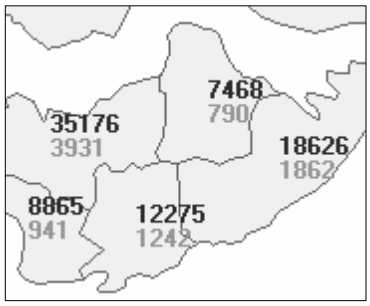


Four types of labels can be displayed: data on maps (Map File-related data), data on origins (Origin-related data), data on destinations (Destination-related data) and the number of intrazonal trips (Intrazonal interaction). Labels on origins or destinations can be displayed using different variables.

- **Select "Maps" in the menu bar**
- **Select "Advanced Display"**
- **Select "Show Labels from Origin File"**

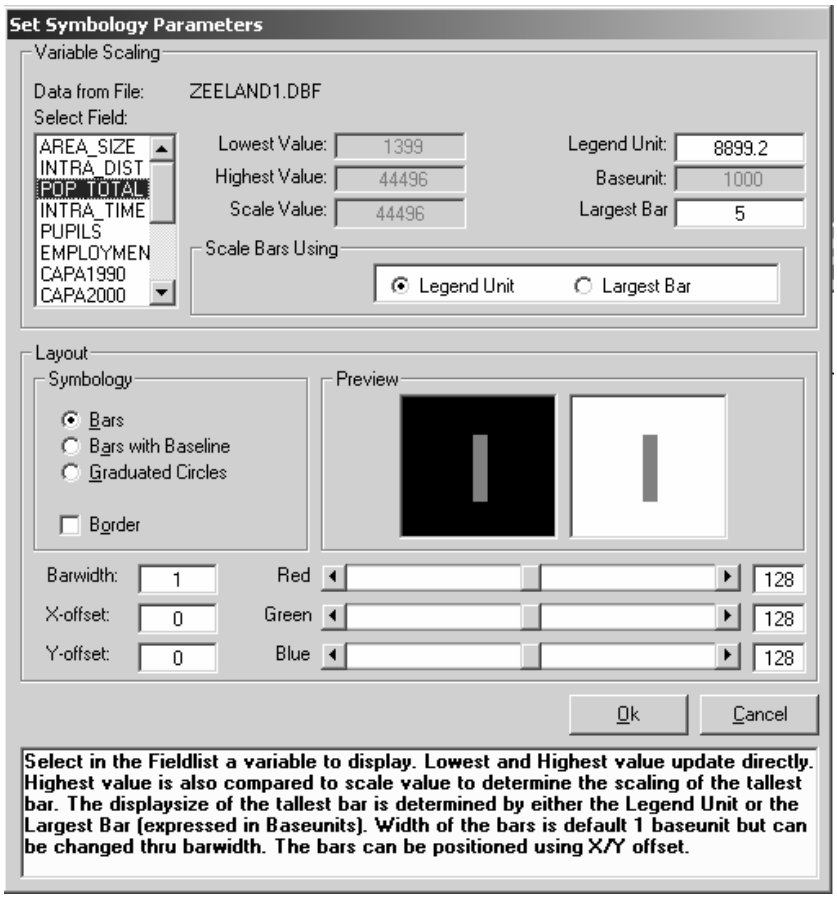
A window pops up in which you can choose which column's values should be displayed, and in which manner. For instance, in the ZLAND001.DBF map, you may choose PUPILS in the Fieldlist box. In that case the number of pupils represented by that centroid will be drawn on the map. Of course, any column of the DBF file can be displayed. There are three ways to manipulate the appearance of the label. You can change the label's

1. *Font*, by clicking the "Change Font" button and selecting the font you prefer;
2. *Position* in relation to the map feature (such as a centroid) it is connected to, by changing the X (horizontal) and Y (vertical) offset (for instance, changing the Y-offset will allow you to draw a new variable above or below the previous one);
3. *Color*, by dragging the slider handles to the position that displays the color of your choice.



Apart from origin-related data, destination-related data can also be displayed by means of a label. Data related to intrazonal interaction can only be displayed if origin and destination files are identical.
Of course values stored in new columns resulting from your own analyses, like those to be performed in the chapters to come, can also be displayed as labels. If you want to show more than one centroid characteristic, use the (X/)Y-offset, font and color options to distinguish more easily between the various groups of labels.

2.11 Drawing Symbols



Sometimes just drawing labels does not give a clear enough view of numeric data. In that case drawing bars to represent numbers is the solution. This is how to draw bars:

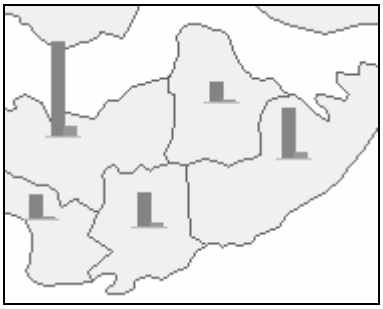
- **Select "Maps" in the menu bar**
- **Select "Advanced Display"**
- **Select "Show Symbols from Origin File"**

A window pops up in which you can choose which column's values should be displayed, and in which manner. For instance, in the ZLAND001.DBF map, you could choose PUPILS in the Fieldlist box. In that case the number of pupils represented by that centroid will be drawn on the map. Of course only numeric columns of the DBF file can be displayed. There are several ways to manipulate the appearance of the symbols. In the "Layout" box you can choose which symbol you want to use. In this example we choose for "Bars". You can change the bars'

1. *Scale value.* By choosing "Largest bar" in the "Scale bars using" box, the bars are scaled to the largest bar. Usually one would scale a bar to the highest value in the attribute column, which is also the default value in this window. However, if it is your intention to compare several bars side by side, they should be scaled to the same scale value. This value should then be the highest value of the columns you want to display as bars. To accommodate this, Flowmap allows you to click on several columns and remembers the highest value found in any of these columns for scaling purposes. Make sure that the column you want to display is the last one that was clicked on. You can also choose the value to which the bars should be scaled yourself, for instance if you would like it to be a "round" number. Enter this value in the "Legend Unit" box, and then choose "Legend Unit" in the "Scale bars using" box.
2. *Size.* You can change the height of the largest bar, to which all the other bars will be scaled (Largest bar). Apart from that, you can also change the width of the bar (Barwidth).
3. *Position* in relation to the map feature (centroid) it is connected to, by changing the X (horizontal) and Y (vertical) offset.
4. *Color,* by dragging the slider handles to the position that displays the color of your choice;

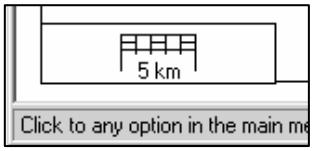
Apart from origin-related data, destination-related data can also be displayed by means of a bar. Data related to intrazonal interaction can only be displayed if origin and destination files

are identical.
Of course values stored in new columns resulting from your own analyses, like those to be performed in the chapters to come, can also be displayed as bars. If you want to show more than one centroid characteristic, use the X(/Y)-offset, and color options to distinguish more easily between the various groups of bars.
The value shown in the legend is the quotient of "Scale Value" and "Largest Bar Size". You can make the legend show round numbers by adjusting either value.



2.12 Displaying a Scale Bar

In order to get a better sense of distance when looking at your maps, you can have a scale bar displayed permanently.
A scale bar can be displayed with or without a border. This is how to display a scale bar:



- **Select "Maps" in the menu bar**
- **Select "Map cosmetics"**
- **Select "Scalebar with Border" or "Scalebar without Border"**

Now the scale bar will be shown. The number below the scale bar corresponds with its length, expressed in "map units". You can drag the scale bar to any place you like in the drawing area. If you want to remove the scale bar, you will have to go through the same procedure as outlined above and select in the final step "Remove Scalebar".

You can also change the text below the scale bar:

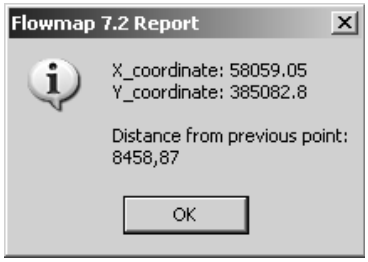
- **Select "Maps" in the menu bar**
- **Select "Map cosmetics"**
- **Select "Edit Scalebar Text"**

You can type your new text directly in the window that appears next.

- **Type a new text**
- **Click on "Font" to select the font you prefer**
- **Click on "OK"**

2.13 Location and Distance

Apart from a scale bar Flowmap provides two more features to assist you in the field of map orientation. If you move the mouse arrow to the map display area, it turns into a cross. If you



- **click on a location on your map**

a window will pop up telling you the X- and Y-coordinates of that location. If you

- **press OK, move the cross, and click again somewhere else on the map**

the window that pops up will now not only display the location, but also the distance between the latest click and the one before that. Both distance and coordinates are displayed in map units.

NOTE: *The distance will be shown in the map unit which has been chosen in the project.*

2.14 Displaying a Title

To keep your screen dumps apart, you can give each map a unique title:

- **Select "Maps" in the menu bar**
- **Select "Map cosmetics"**
- **Select "Map Title"**

Now at the top right of the display window, the text "?? Map Title ??" appears. Click on this to display a cursor with which you can edit the text, and thus give your map a name. You can use more than one line, but the number of lines that can be used is automatically reduced as the legend grows. By clicking on the "Font" button you can choose the font you prefer. The title aligns to the left. If you want to remove the title, you will have to go through the same procedure as outlined above.

2.15 Changing the Legend Text

The legend text of a map drawn on the screen can be modified.

- **Click on the legend text you want to change**

A small window appears, in which you can edit the text.

- **Type a new text**
- **Click on "Font" to select the font you prefer**
- **Click on "OK"**

2.16 Displaying the North Arrow

In order to show the direction of a map, the north arrow can be displayed.

- **Select "Maps" in the menu bar**
- **Select "Map cosmetics"**
- **Select "North Arrow"**

The window that appears next allows you to select the arrow style.

- **Select an arrow style**
- **Click on "Done"**

The arrow now appears on the map. You can move it around by dragging it.

2.17 Erasing the Screen

The screen can be completely erased (removing all the drawn map layers and the legend entries)

- **Select "Maps" in the menu bar**
- **Select "Erase Screen"**

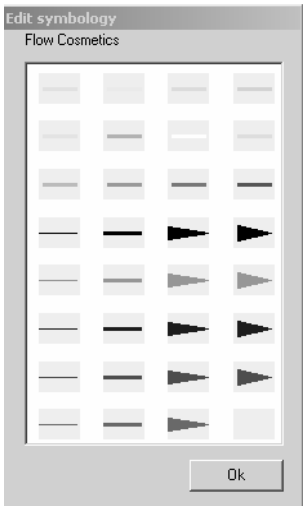
The display window is cleared, except for the title, the scale bar or the north arrow (if displayed). You can also remove the map cosmetics:

- **Select "Maps" in the menu bar**
- **Click on "Map Cosmetics"**
- **Click on "Remove All Cosmetics"**

You can also choose to remove only the last drawn entry:

- **Select "Maps" in the menu bar**
- **Click on "Remove Top Legend Entry"**

2.18 Changing the Symbology Settings of Area, Line, Point and Flow Features



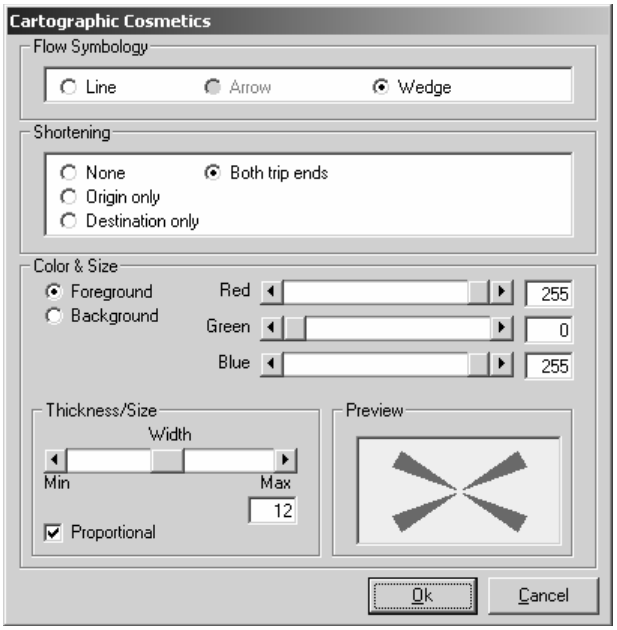
In the above sections (2.1 through 2.5 and 2.8) thirty-two different feature symbols for drawing maps or flows could be chosen. However, these symbols can be customized. Four feature types can be customized: Line (border lines of area maps or transport lines of road maps), Area (shade area features), Point (draw origins and destinations), and Flow (draw flow data).
This section discusses briefly how to customize a symbol.

- **Select "File" in the menu bar**
- **Select "Edit Symbology Settings"**
- **Select one of the symbol types to be customized (Point, Line, Flow or Area)**

The window "Edit Symbology" appears

- **Click on the symbol that needs to be customized**

The window "Cartographic Cosmetics" appears.



By moving the sliders and selecting a line style, the appearance of the line symbol can be changed. In the lower right-hand boxes the resulting appearance is visible.

- **Click on "OK" if the appearance of that feature is acceptable**
- **Click on "OK" once more if no further customizing needs to be done**

From now on, if you want to draw a map or flows, a customized appearance can be selected. In the previous diagram the "Cartographic Cosmetics" window for outlines is displayed. Similar windows are available for points and areas. However, in the "Cartographic Cosmetics" window for flows the options are somewhat different.
In the "Shortening" box the extent to which the flow lines or arrows overlap the origin and/or destination locations can be set. If the flows must overlap the origins and locations, the "None" option should be selected. If both origins and destinations must remain visible, then the option "Both trip ends" must be selected. If only origins should remain visible, and the destinations should not, then select the "Origin only" option. If on the other hand the destinations should remain visible and the origins should not, then the option "Destination only" should be set.
"Proportional" is also an option in this window. If this is not selected, the wedges or lines all have the same width. On the other hand, if "Proportional" is selected, the width of the wedge or line is related to the magnitude of that specific flow.

2.19 Zooming in and zooming out

Flowmap lets you zoom in on part of a map. To do this, you must first install a "view" (see section 1.2.1) and draw an area map (see chapter 2).

- **Select "Maps" in the menu bar**
- **Select "Zoom In and Erase"**

Using the cursor, you can set the area on which you want to zoom in. Place the cursor in one of the corners of the area, press and hold down the left mouse button while you move the cursor to the opposite corner of the selected area.

- **Select the area you want to zoom in on**

The map is now empty and the view is set. New maps and flow data can be entered.

You can make the displayed area twice as big by selecting "Zoom out":

- **Select "Maps" in the menu bar**
- **Select "Zoom Out (+100%)"**

The map can now be redrawn again. By selecting "Undo Zoom" after you have zoomed out, you can return to the original map size.

- **Select "Maps" in the menu bar**
- **Select "Undo Zoom"**
- **Redraw the map again**

NOTE: *It is also possible to directly zoom into selected points and/or areas by using the "set view to selected objects" in the subset menu. See section 3.5 for more details.*

CHAPTER 3

Selecting Map Features

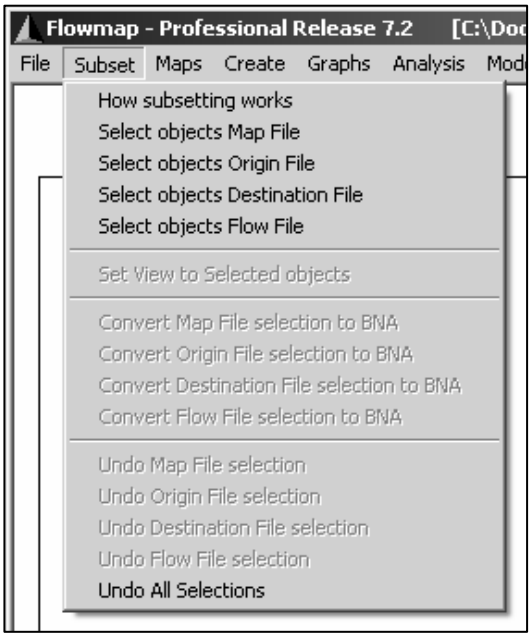
Apart from drawing all flows or the entire map on the display window, you can also make a selection in order to display only specific flows or features. Selections can only be made on map files, origins, destinations and/or flows. This chapter discusses the selection of map features (i.e. of map files, origins maps and destinations maps). The next chapter discusses how to select flows.

Selecting map features can be done in two ways:
1. By choosing individual items from a list containing all features of that map
2. By choosing a range of items that contains all features to be selected.

Section 3.1 discusses selecting individual items from a list; Section 3.2 explains how to select items within a range. Making multiple selections is explained in section 3.3. Section 3.4 discusses unselecting previously made selections and section 3.5 explains how previously made selections affect the view (for "view" see also section 1.2.1).

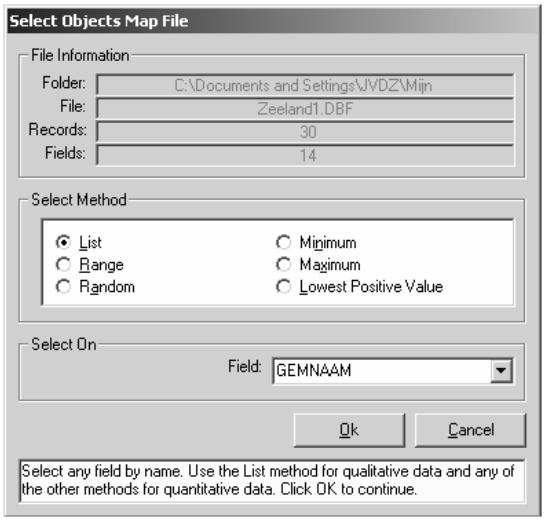
3.1 Selecting Individual Items from a List

- **Select "Subset" in the menu bar**
- **Select "Select objects Map File" for selecting map features. You can also select:**
  - **"Origin File" for selecting origins**
  - **"Destination File" for selecting destinations**



The example applies to map feature selections. For all three items, the procedure is exactly the same. This is why "Origins" and "Destinations" are not discussed separately. (The item "Flows" is discussed in Chapter 4).

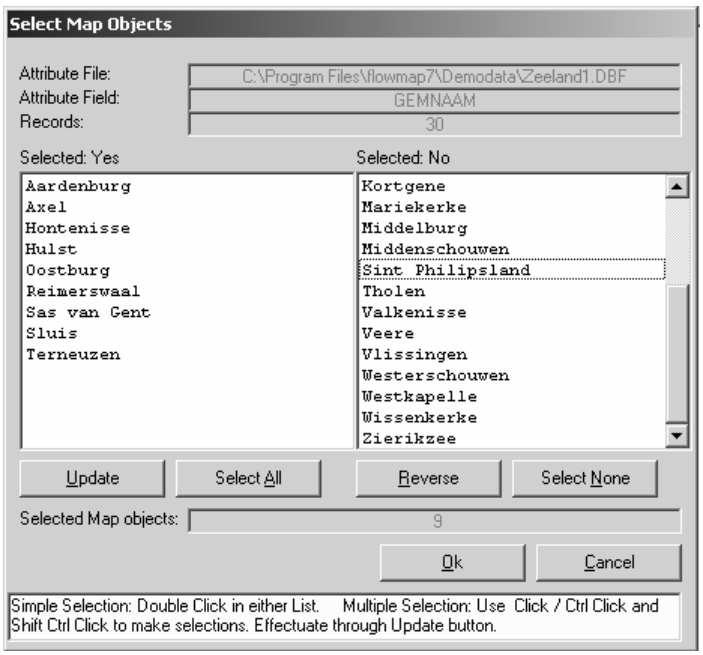
A window pops up in which the attribute to select and the type of selection (i.e. list or range) can be chosen. Firstly this section discusses how to select individual items from a list of map features.



- **Select "List" in the "Select Method" box**
- **Select an attribute name [GEMNAAM] in the "Field" box**
- **Click on "OK"**

A new window pops up, displaying two columns: the left-hand one containing selected, and the right hand one containing unselected map features [municipality names]

NOTE: *By default <u>all</u> map features are selected and thus shown in the column on the left. Double-click on the features in this column that are not to be selected, in order to move them to the column on the right, the "Selected: No" list. If you want to select only a few items, simply unselect all items by clicking on "Select None" and then move the items you do want to select to the "Selected: Yes" list. To select more than one item, hold down the Shift key. Press "Update" to make your selection change columns.*



If you want to select *most* map features, then:

- **Double-click on the features you do not want to select**

Every feature that was clicked on moves from the list containing selected features (Selected: Yes) to the list containing non- selected features. (Selected: No).

- **Click on "OK"**

Flowmap indicates the number of selected features.

- **Again click on "OK"**

The selection is made.

If you want to select *only a few* map features, you have two options.

Either:

- **Click on the "Select None" button**

All features move from the "Selected: Yes" columns to the "Selected: No" column

- **Double-click on the features you *do* want to select**

The clicked on features now move back to the "Selected: Yes" column

Or:

- **Click on the features you *do* want to select in the column on the left**

The features move from the "Selected: Yes" columns to the "Selected: No" column

- **Press the "Reverse" button for all the features on the right to move to the left and the other way around.**

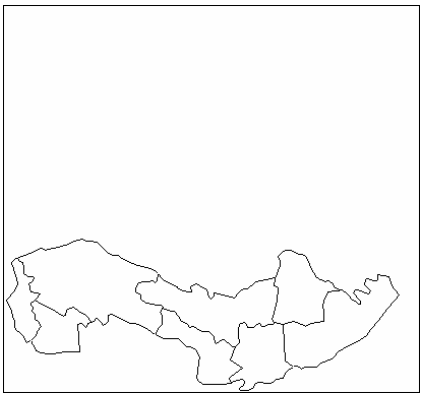
The features you clicked on move back to the "Selected: Yes" column

- **Click on OK**

In either case, Flowmap indicates the number of selected features. After that:

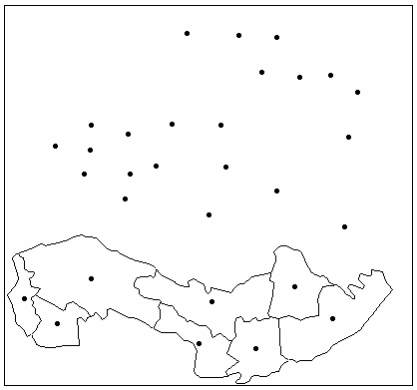
- **Click on "OK"**

Now the selection is made.



If the map on which the selections were made is drawn on the screen (see also the description in the sections 2.2 and further), only selected elements are drawn. The figure to the left shows only the southern municipalities that were selected (the Zeeuws Vlaanderen region) *and* drawn.

NOTE: *A selection as described above applies to only one map type; the other opened maps are unaffected. So, if you made a selection on the area map, no selection has been made on the origins or destinations. The figure to the right displays this. Both the area map, on which a selection was made, and the centroids of the municipalities (the origins) are drawn. The selection on the municipalities thus does not affect the origins and destinations!*



3.2 Select Features within a Range

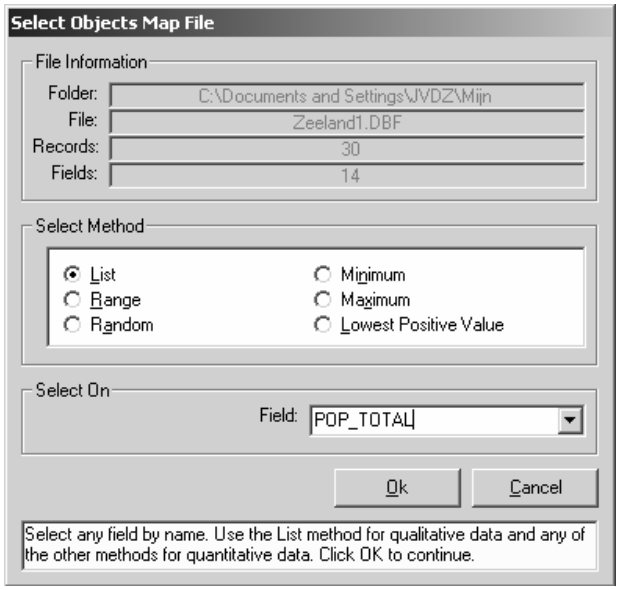
Selecting features within a range means one has to set an upper and lower limit between which the features to be selected should be situated. This way, for instance, municipalities having the least or most residents can be selected.
Of course this method can only be used if the attribute to be selected consists of numbers only.

- **Select "Subset" in the menu bar**
- **Choose one of the following items:**
  - **"Select objects Map File" for selecting map features**
  - **"Origin File" for selecting origins**
  - **"Destination File" for selecting destinations**

Choose one of these items. As in section 3.1, the remaining part of this description is applicable equally to all three of the above-mentioned items. This is why they are now discussed together.

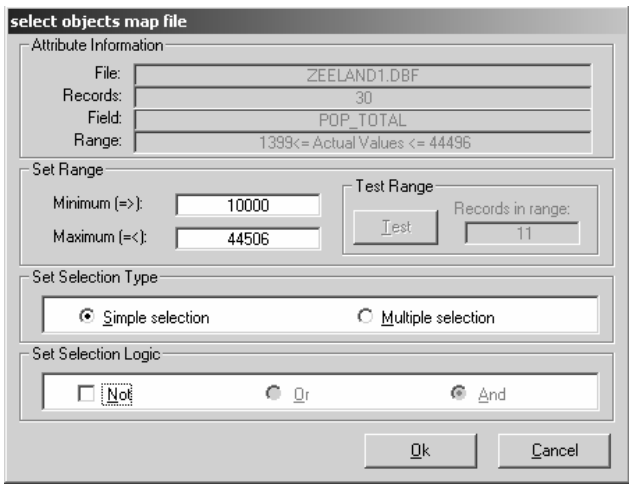
A window pops up in which the attribute to be selected can be set, as well as the selection method (list or range). This section discusses the range method.

- **Select the "Range" option in the "Select Method" box**
- **Select a field name in the "Select On" box on which the selection is to be carried out [POP_TOTAL]**
- **Click on "OK"**



A window like the one to the right pops up in which the upper and lower selection limits can be set. The limits can be set by typing the numbers.

- **Set the range limits by typing them in the "Set Range" box**
- **Click on the "Test" button in the "Test Range" box**



The number of map features selected is indicated beneath the "Records in range" text in the window.

NOTE: *The "Test" button does not <u>make</u> the selection; it only <u>checks</u> the number of selected features within that range. Only when the OK button is pressed, does the selection become active.*

In the lower part of the window the "Set Selection Type" and the "Set Selection Logic" boxes are displayed. The last box contains three so-called logic operators "Not", "Or" and "And". If you tick the "Not" operator, this means only map features that are *not* within the range that was set must be selected. The "Or" and "And" operators cannot be set the first time a selection is made. The use of these operators and the multiple selection type are explained in section 3.3.

NOTE: *If you click on the "Test" button, the result is always a check of how many map features are <u>within</u> the currently set lower and upper limits. The "Test Range" button is <u>not</u> affected by the logical operators.*

- **Click on "OK"**

Flowmap displays the number of selected features. However, this number *is* affected by the logical operators.

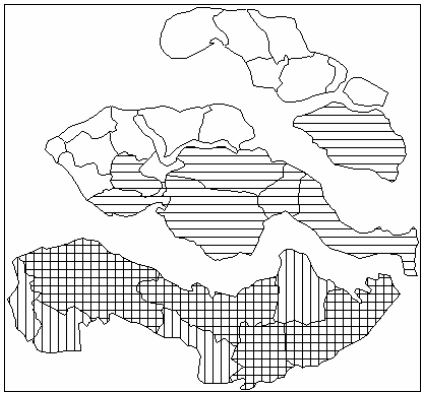
- **Again click on "OK"**

The selection is made.

3.3 Multiple Selections

Sections 3.1 and 3.2 discussed the way to make a selection. When selections in Flowmap are made sequentially on the same map, selections are more or less imposed on each other. In other words, the program remembers previous selections and combines them with the new one that has been made on that same map. In order to do this, when making a selection using a range, one of the logical operators, “Or” or “And” must be chosen. Flowmap then combines the selections that were made.

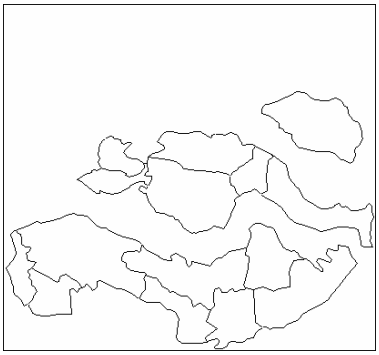
The following example will clarify this. For this we make use of the map of the Zeeland province.
First of all select all municipalities in the southern part of Zeeland (Zeeuws Vlaanderen) using the GEM-NAAM attribute. The way to do this is discussed in section 3.1. The municipalities are Aardenburg, Axel, Hontenisse, Hulst, Oostburg, Sas van Gent, Sluis en Terneuzen. These are vertically shaded in the figure to the right.



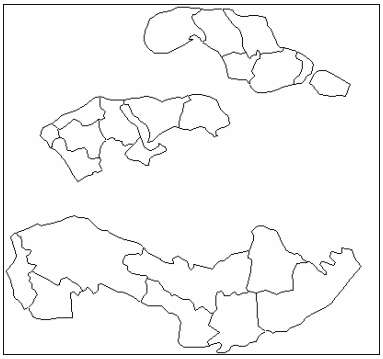
After that, select a range from the (POP_TOTAL) attribute, which contains the number of inhabitants in each municipality. The way to do this is discussed in section 3.2. All municipalities with a minimum of 10,000 inhabitants should be selected. These are shaded horizontally in the above figure.

Because a selection has previously been made on this same map, it is now possible to make a multiple selection by selecting “Multiple selection” in the “Set Selection Type” box and use one of the logical operators “Or” or “And”. Either of these operators can be combined with the “Not” operator. Thus, there are four:

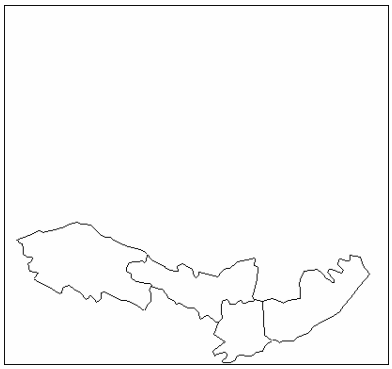
1) If “Or” is chosen, 15 municipalities are selected. If the municipality is located within Zeeuws Vlaanderen or if it has at least 10,000 inhabitants, the municipality falls within the selection criteria. These are the horizontal, vertical and crosshatched municipalities combined of the above figure, resulting in the figure to the right.



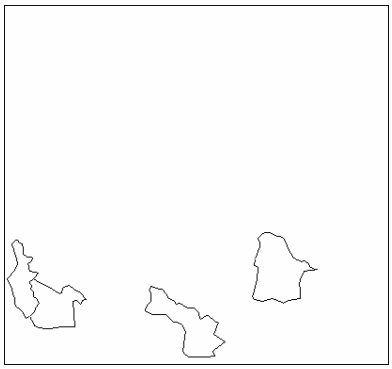
2) If “Or” is chosen combined with selecting “Not”, 23 municipalities are selected. In this case, a municipality is selected if it is a part of Zeeuws Vlaanderen or it has not 10,000 or more inhabitants. These are the vertically, the cross-, and the non-hatched municipalities combined in the first map of this section.



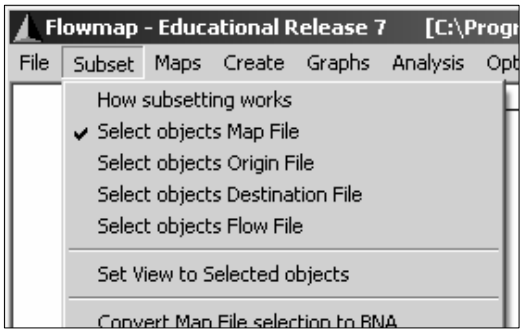
3) If “And” is chosen, only 4 municipalities will be selected. A municipality is selected if it is a part of Zeeuws Vlaanderen, and if it has at least 10,000 inhabitants. These are the cross-hatched municipalities of the first map of this section.



4) If “And” is chosen, and “Not” *is* ticked, then also just 4 municipalities are selected; however, these are not the same ones, but the vertically hatched ones: those within Zeeuws Vlaanderen, having less than 10,000 inhabitants.



NOTE: *If "Subset" in the menu bar is chosen, a menu appears in which the maps are displayed on which it is possible to make a selection. If a menu item is checked, this means that a selection has already been made on it.*



NOTE: *In Flowmap the criteria for a selection (or combination of selections) cannot be retrieved once the selection is made. Therefore, write these criteria down. Also, do not make too many combinations of selections. Otherwise you risk losing track of what you did.*

NOTE: *When Flowmap is closed, selections are lost. If Flowmap is restarted, and previous selections need to be reused, they will have to be made over again.*

3.4 Undoing Previous Selections

A selection remains active either until it is undone, or Flowmap is closed. Undo a selection as follows:

- **Select "Subset" in the menu bar**
- **Click on the map type for which the selection needs to be undone (Map Object, Origin, Destination or Flow files) or click on "Undo All Selections"**

All selections can now be undone. It is not possible to undo only a part of a combined selection.

3.5 How Selections Affect the View

In section 1.2.1 setting the view was discussed. While setting the view, Flowmap calculates how all map features can be drawn on the display area as large as possible. If a selection was made, not all map features need to be drawn. Reset the view in order to display only the selected map features. Flowmap again calculates the maximum map size; however, this time it is based on the selected map features. This way the selected features can be displayed on the screen somewhat bigger.

- **Click on "Subset" in the menu bar**
- **Click on "Set View to Selected objects"**

Selections can be made on any of the three maps, so you can set the view on the map you made a selection on. The figure on the right shows an example of a changed view setting. A selection was made on the municipalities in Zeeuws Vlaanderen and after that the view was set to the "Map".

NOTE: *Every time the view is reset, Flowmap erases the display area.*

NOTE: *If a selection was made on, for instance, Map Objects (however, not on origins or destinations) and a "Combined View" is chosen (as described in section 1.2.1), then*

Flowmap sets the view in such a way that the map features of all maps, including those of the origins and destinations, can be drawn in the display area. If you only want to have the selected map features drawn on the screen, set the view to "View to Map". As far as the view is concerned, Flowmap then does not take the origins and destinations into account.
If a selection was made on origins, set the view to "View to Origins". Similarly, for destinations: "View to Destinations".

3.6 Converting Selection to a BNA File

Once a selection has been made, it is also possible to convert the selection to a BNA file. First a selection has to be made as described in the previous paragraphs. Then the conversion can be carried out:

- **Select "Subset" in the menu bar**
- **Click on the relevant "Convert … File selection to BNA"**
- **Select a file or enter a new file name in the new "Save Converted File As" window**
- **Click on "Save"**

The file will now be converted and saved as a BNA file. The Flowmap 7 report window will pop up stating that the conversion has been completed successfully.

- **Click on "OK"**

The BNA file can be converted to a MID/MIF file, which can be used in ArcGIS. This way geometrical data in Flowmap can be transformed to data in ArcGIS. See section 8.6 for more details.

***NOTE:** Attribute data from both packages (Flowmap/ArcMap) use the .dbf format and can directly use each others data by using copy fields in Flowmap and join in ArcGIS.*

CHAPTER 4
Selecting Flow Data

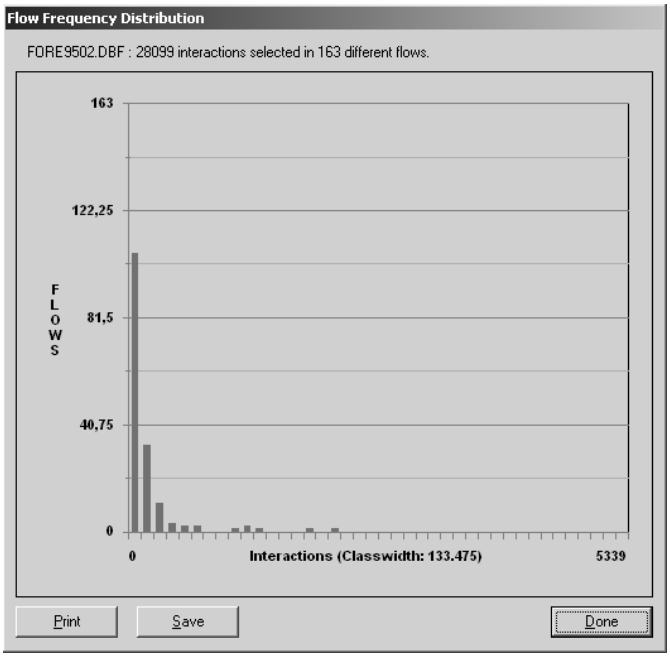
This section discusses how selections can be made on flow data. If there are many flows in a map between origins and destinations, drawing the flows can result in a “spaghetti” pattern; all kinds of flows are drawn across each other, blurring the general pattern. To still be able to produce a clear map, for instance, only the main flows can be drawn.
Selecting flow data always applies to the size of the flow. Flowmap provides a tool (a frequency distribution) that makes it easier to focus on (or selecting) a certain range of flow sizes. This tool will be discussed first. After that, selecting the flows will be discussed.

4.1 The Frequency Distribution of Flows

Flowmap can display a graph showing the frequency distribution of the different flow sizes - in other words; the number of flows in each size class.

- **Select “Graphs” in the menu bar**
- **Select “Frequency Distribution Flowsizes”**

A window pops up showing a frequency distribution of the various flow sizes. The figure to the right shows an example of a frequency distribution. This graph is based on data concerning daily commuting trips between all Zeeland municipalities. Various properties of the frequency distribution are shown. In total, there are 163 individual flows (i.e. trips or bundles of trips) between the thirty different municipalities. The total number of commuters per day in the Zeeland province is 28,099. From this you can derive that the average number of commuters per flow is a little below 175 (=28,099/163). The average in- and outflow per municipality is just below 950 (=28,099/30) commuters.
The largest municipal in- or outflow is also displayed: 5,339 commuters. This number is used to determine the width of the classes on the X-axis of the frequency distribution. A division is made into 40 classes, each with a width of about 133 (=5,339/40) commuters.



The graph shows the classes on the X-axis. On the Y-axis, the number of flows in each class is displayed. For example, the first bar indicates that more than 100 (of the 163) flows contain less than 133 commuters a day. The last bar in the histogram (column 17) indicates that there is at least one connection between two municipalities that is daily used by about 17 * 133 = 2,261 commuters.

It is also possible to print the picture or to save the picture as a bitmap file or as a jpeg file by clicking the corresponding button.

NOTE: *Selecting map features does not affect the frequency distribution graph. In the graph all flows are represented, irrespective of whether or not origins or destinations have been selected.*

NOTE: *The frequency distribution is always based on the largest in- or outflow of a municipality. This is also the case if a selection has been made. This way graphs based on different selections can always be compared.*

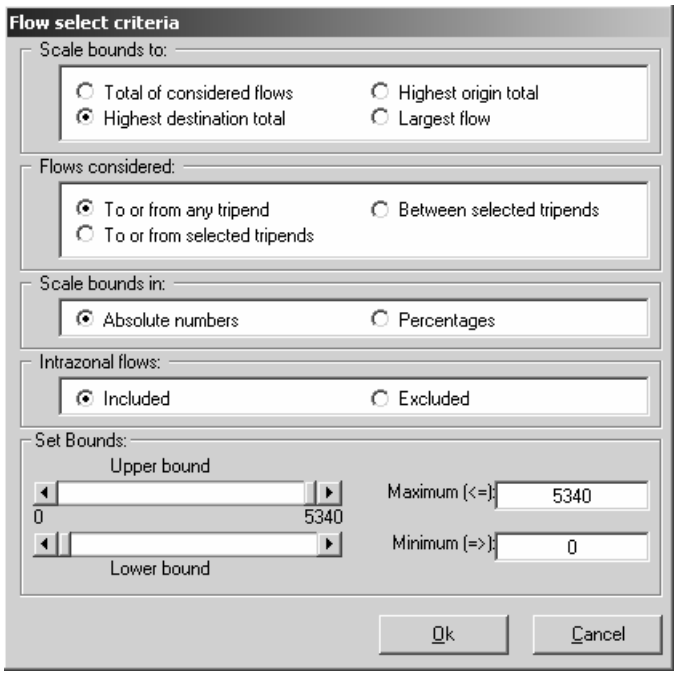
In this example most flows are small. For a more meaningful flow data display, which was the purpose of using this graph in the first place, it could be decided not to show flows that are part of the first column (that is, flows smaller than 134 trips, or in other words, less than 2,5% of a municipality's maximum in- or outflow)

- **Click on "OK"**

4.2 Selecting Flow Data

The frequency distribution, as discussed in section 4.1, shows which flows are bigger and which ones are smaller. Using this information, flows can be selected.
Selecting flow data can only be done within a range. To set the range, both absolute numbers and percentages can be used.

- **Select "Subset" in the menu bar**
- **Click on "Select objects Flow File"**



A window pops up, in which the flow selection criteria can be set. The upper part of the window contains four boxes ("Scale bounds to:", "Flows considered:", "Scale bounds in:" and "Intrazonal Flows:") in which options can be set that affect the selection range.

- **Click in the box "Flows considered:" on the "To or from any tripend" option**

Choosing one of the remaining two options in this box will cause any selection of origins and/or destinations to affect *which flows* can be selected. This may in turn change the maximum upper and minimum lower bounds of possible selections. These options offer many possibilities. However, discussing them all is beyond the scope of this manual.
In explaining the frequency distribution in section 4.1, it was mentioned that the X-axis of the displayed graph is always scaled to the largest in- or outflow of a municipality. Now the bounds on the flows to be selected can be set. Choosing the *maximum* upper boundary value of the range to be the largest in- or outflow of a municipality will cause the bounds previously determined by interpreting the graph to match the actual bounds that are to be set now.
Between the two sliders in the lower left of this window, the minimum (always 0) and the maximum value are displayed.

- **In the "Scale bounds to:" box, click on either "Highest destination total" or "Highest origin total"**

Now the options that have been set in this window (Flow Select Criteria) are identical to the ones we used for the frequency distribution in section 4.1. Either by moving the sliders or by entering the values, the previously determined bounds, that correspond with the values that were determined by the frequency distribution, can be set. The "Scale bounds in:" box is to set the bounds either in absolute numbers or percentages. The method that is chosen does not really matter, provided you set the right bounds. In the example discussed in section 4.1, we decided not to select the smallest flows, that is, those that fall in the class to the extreme left of the graph, representing flows smaller than 134 commuting trips. In percentage terms: flows smaller than 2,5 percent of the maximum in- or outflow of a municipality.
Using absolute values:

- **Set the lower bound [133]**
- **Set the upper bound [5339]**
- **Click on "OK"**

Using percentages:

- **Set the lower bound [2.5%]**
- **Set the upper bound [100.1%]**
- **Click on "OK"**

One box in the "Flow Select Criteria" has not been discussed yet: "Intrazonal flows:". The options in this box are "Included" and "Excluded". Flows that have the same origin and destination might occur. These are called intrazonal flows. Compared to the "regular" in*ter*zonal flows, these are usually quite big. If these intrazonal flows are taken into account while setting the scale, the size of the other flows can be reduced too much compared to the intrazonal flows. The option "Excluded" prevents the intrazonal flows from interfering when the scale is set.

NOTE: *Intrazonal flows cannot be drawn if the origins and destinations are the same. These flows then would have to be drawn from one point and then back to that same point. Flowmap cannot do this.*

If the selected flows are now drawn on the screen (Maps, Advanced Display, Draw Desire Lines from Flow File), you will notice that the number of displayed flows has decreased substantially compared to the total number of flows (see the figure in section 2.9). This is no surprise, because of all the 163 flows, more than 100 are not drawn, because they are smaller than 134 commuting trips.

NOTE: *As opposed to selecting map features, selecting flows does not take any previous selections into account. The last selection made is the active one.*

NOTE: *Apart from the fact that the flows that are to be drawn are dependent on the applied selection criteria, they are also dependent on selected origins and destinations. If you have only selected one destination, only the flows to that destination are drawn. If you have only selected one origin, only the flows originating from that location are drawn. (As stated earlier, the frequency distribution discussed in section 4.1 does not take selections on origins or destinations into account.)*

CHAPTER 5

Exporting Flowmap Results: Maps, Graphs and Flows

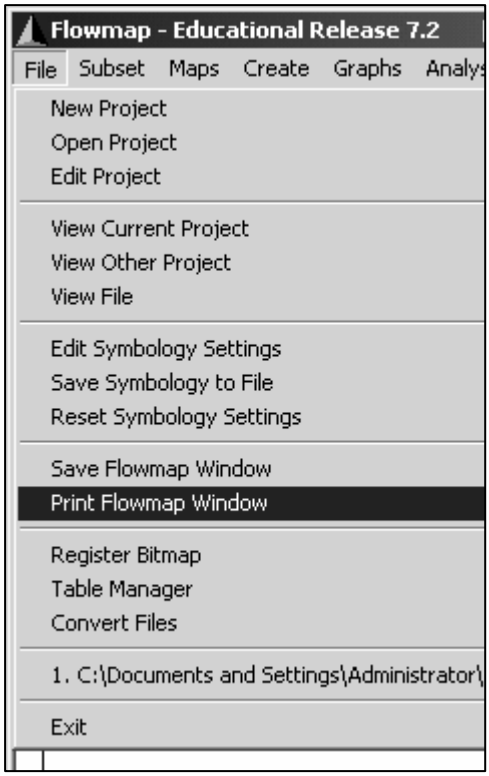
Maps that were made in Flowmap can be printed and saved as Bitmap files (.bmp) or as Jpeg files (.jpg). Both printing and saving will be discussed in this chapter. The way to print and save Flowmap graphs will also be explained, as well as using graphic files in some widely used word processing programs.

5.1 Printing Maps and Graphs

If you want to print a map you drew on the screen, first make sure the display window is active. You can make it active just by clicking on it. Besides maps, Flowmap displays graphs. The frequency distribution of flows (see Chapter 4) is such a graph. Printing graphs is done in exactly the same way as printing maps; just make sure that either the graph window or the map window is active by clicking on it.

- **Click on "File" in the menu bar**
- **Click on "Print Flowmap Window"**

Of course a printer must be connected to the computer.

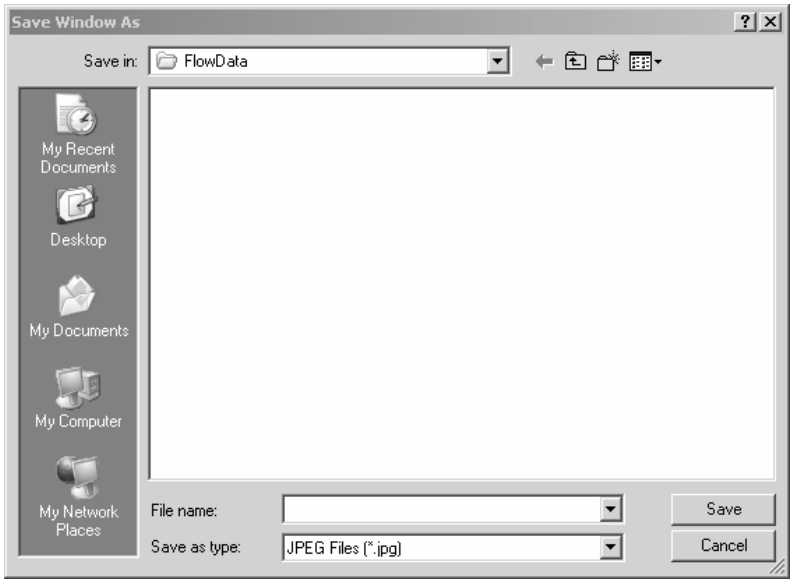


5.2 Saving Maps as Bitmaps or Jpegs

- **Click on "File" in the menu bar**
- **Click on "Save Flowmap Window"**

A window appears, allowing you to choose the folder in which you want to save the picture.

- **Browse to the folder in which you want to save the picture**
- **Type a file name and choose a file format (Jpeg or Bitmap)**
- **Click on "Save"**



5.3 Using Bitmaps and Jpeg in MS Word

Bitmaps and Jpeg, like the ones Flowmap produces (see previous section), can be handled by most of the widely used word processing programs. This section discusses importing or inserting Bitmaps into MS Word for Windows.
Only basic instructions will be provided in this manual. For instance, programs allow for settings like picture size to be changed, but for those options please check your program's own manual.

Open MS Word.

- **Move the cursor to the position in the text where the figure should be located**
- **Click on "Insert" in the menu bar**
- **Click on "Picture"**
- **Select "From File…"**

Now you can select the file using this familiar windows screen:

- **Browse to the correct folder (for example C:\Program Files\Flowmap7)**
- **Select the picture file (for example zeeland.bmp)**
- **Click on "OK"**

The Bitmap appears on the screen. Follow the same procedure for importing Jpeg files.

Part II
Making Flowmap Files

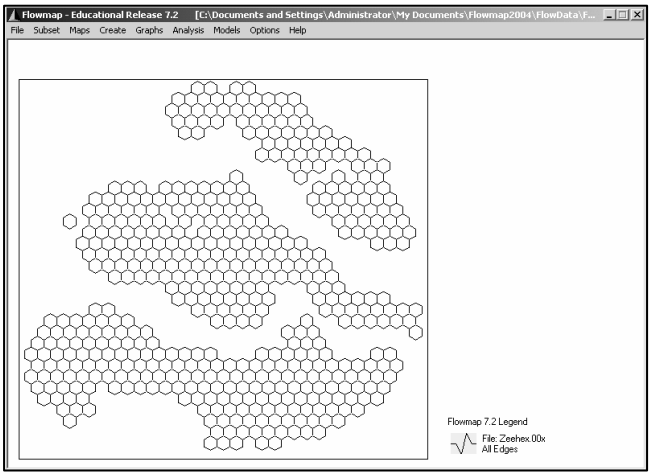
Flowmap offers various possibilities for producing input files that the program itself needs for analyses. These possibilities will be discussed in this third part of the manual.
First it will be explained how to make tessellations, which is basically a polygon map. You can make two different kinds of tessellations; regular polygons and Thiessen or Voronoi polygons. Making BNA files containing a network that links centroids of areas and calculating (weighted) gravity points will also be discussed in Chapter 6.

Furthermore, Flowmap can make two kinds of distance matrices: matrices based on airline distances, and matrices based on distances over a network. The distance matrices are used in the analyses that were discussed in Part II. All possible ways to make a distance matrix will be discussed in Chapter 7.

Finally Flowmap's import and export features will be dealt with. Flowmap can import four different map formats. These are Moss files (export files of Arc/Info and Genamap among other GIS packages), MapInfo files, ArcView files and BNA files. In Flowmap, you can convert BNA-maps to MapInfo- and Moss-maps. Also you can convert a map with origins and destinations into a BNA file, or a BNA-map with degrees of longitude and degrees of latitude as coordinates into a BNA-map with planar coordinates. Chapter 8 will discuss the procedures for importing files into Flowmap from several GIS packages.

CHAPTER 6

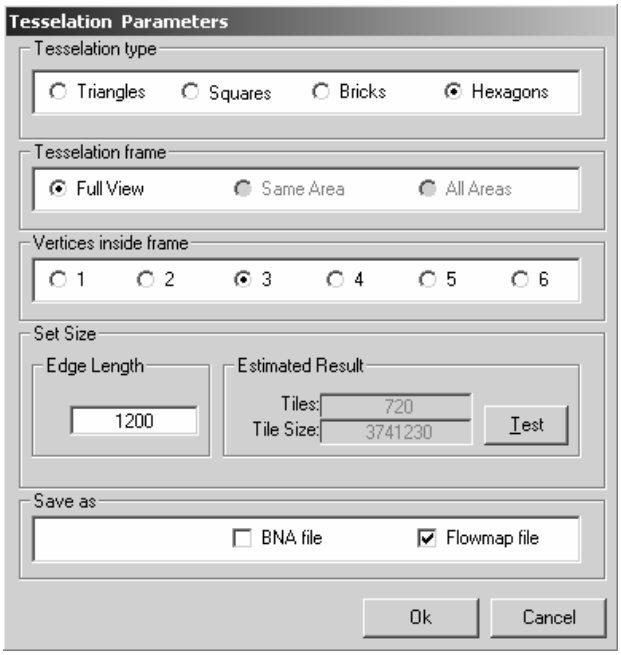
Making tessellations, networks and weighted gravity points



Using Flowmap you can make tessellations, a specific kind of polygon maps. This means the map area will be divided into either regular or irregular polygons, based on selected settings. The irregular polygons are also called Thiessen or Voronoi polygons.
The purpose of these kinds of maps will be discussed in the sections below. First the way to make regular tessellations will be shown. Following that, the way to create irregular tessellations will be discussed.
The third section deals with making network maps by connecting centroids. Calculating (weighted) gravity points will be discussed in the fourth section.

6.1 Making Regular Tessellations

Spatial data often are irregularly spaced and thus unsuitable for a more or less continuous image. The purpose of making tessellations is to divide up large sub-areas into smaller ones. This way it is still possible to display geographic differences within a sub-area.
Besides that, the sizes of sub-areas often varies widely. By making a regular polygon map, all sub-areas in the map will be equal in size. This might be convenient for certain analyses.
In the figure to the right an example is displayed in which Zeeland is divided into regular polygons.



NOTE: *In order to make tessellations a "view" must be set. If this has not been done, Flowmap does not know on which map the tessellations should be based.*

This is how to make such a map (the options in the square brackets were used to make the tessellations as used in the example):

- **Click on the "Create" option in the menu bar**
- **Select the "Tessellations" option**
- **Click on "Regular Tessellation"**

The next window pops up. In this window a number of settings can be made.

In the “Tessellation type” box the shape of the regular polygons can be set. You can choose between triangles, squares (forming a raster), bricks (=squares that do not form a raster) and hexagons.

- **Select a tessellation type [Hexagons]**

The criterion for tessellations to be included in the result map is the minimum number of polygon corners that would fall inside the area to be tessellated. You can set that number in the “Vertices inside frame” box. Triangles have a maximum of three, hexagons a maximum of six. In short this setting determines how widely the tessellations overlap the borders of the area map.

- **Select the minimum number of polygon corners that should fall within the map area (Vertices inside frame) [3]**

In the “Tessellation frame” box, you can set on which part of the map tessellations should be made. The first option, “Full View”, is for having the tessellations made on the “view” (see section 1.2.3), which is on the entire area that is visible in the display area. The “Same Area” option is for tessellations to be made on the map’s sub-areas. With this option, in order to determine the amount of overlap of the tessellations at the edges, the number of polygon corners *in each sub-area* is taken into account. The third option, on the other hand, is for tessellations to be made *on the entire area* of the combined sub-areas. The number of polygon corners in this *combined* area is taken into account.

- **Select an option in the “Tessellation frame” [All Areas]**

NOTE: *The second and third options can only be selected if an area map is opened. If a road map is opened or no base map was opened at all, a tessellation can only be made of the entire “view”.*

In the “Save as” box you can choose to save the map as either a polygon Flowmap-file, a BNA-file or both formats. The BNA-format has the advantage that it can also be used for other programs than Flowmap.

- **Tick the “Flowmap file” box if you want to make a Flowmap file**
- **Tick the “BNA file” box if you want to make an export file**

Then a window appears asking you to enter a name for the Flowmap file/export file. A Flowmap file will get the extension “.006” and a BNA file will automatically get the extension “.BNA”.

- **Enter a name of the file you want to create in the “Filename” box [ZEEHEX]**
- **Click on “Save”**

Finally you must set the size of the polygons that are to be created by setting the length of a single polygon’s side. This must be set in the “Edge length” entry box. This setting also determines the number of polygons that will be covering the map. When you click on the “Test” button in the “Estimated Result” box, you will be shown how many polygons will be created, and what the surface size of each individual polygon will be. All these figures depend on the set polygon’s edge length and the “Tessellation frame”.
If you make too few polygons, the whole purpose of making tessellations is lost. Every original sub-area would be represented by only a few or not even one polygon, which is pointless.
Making too many polygons also has its disadvantages. Using the map will slow Flowmap down and uses too much computer memory. Besides that, it does not provide a better insight into the distribution of phenomena within the map area.

- **Enter the length of the side of the polygons in the “Edge length” entry box [1,200]**
- **Click on the “Test” button to let Flowmap estimate the results**
- **Click on “Ok”**

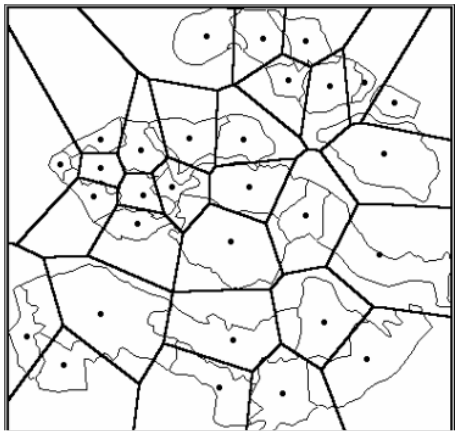
Using the options, Flowmap now executes the tessellation procedure in a number of steps.

- **Click on "Ok" in the Flowmap 7 Report window**

Once this has been completed, open the map first if you want to use it. (See section 1.2.2.)

6.2 Making Thiessen or Voronoi Polygons

In order to make Thiessen polygons you need point locations. Thiessen polygons can also be made on the basis of a network map. In that case, the nodes (intersections and ending points) are used as input. An origin or destination point map can also be used for making Thiessen polygons.
Thiessen or Voronoi diagrams basically represent delimitations of the map area between the input points, based on the proximity of every point in the map area to the input points. This results in convex polygons, also known as Thiessen or Voronoi polygons.



The example to the right will make this all more clear. A Thiessen polygon map shows which areas are closest to each input point. A map like this might come in handy in determining service areas.

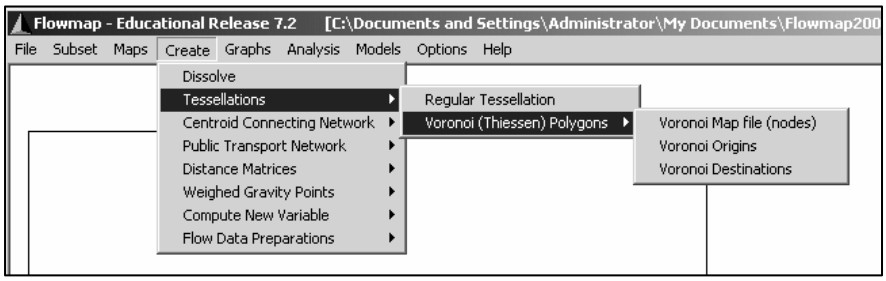
NOTE: *A "view" must be set before you start making tessellations. If no view is set, Flowmap does not know for which area it should make a tessellation.*

- **Click on "Create" in the menu bar**
- **Select the "Tessellations" option**
- **Select "Voronoi (Thiessen) Polygons"**

A menu appears in which, depending on which files have been opened, you can choose between three maps: Thiessen polygons can be created based on network nodes, an origin map, or a destination map.

NOTE: *In the menu shown to the right only opened maps can be selected. Section 1.2.2 discusses opening maps.*

- **Choose a map from the menu, based on which the Thiessen polygons should be created [Origins]**



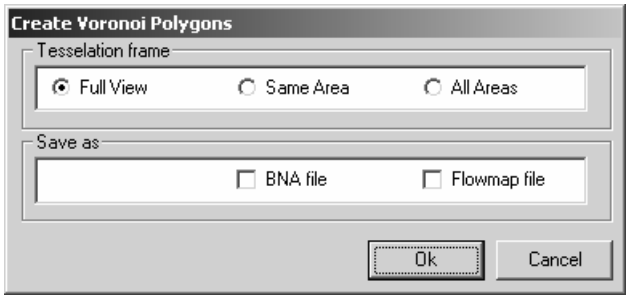
A new "Create Voronoi Polygons" window pops up. In this window some settings must be entered. In the upper box, Tessellation frame, the area for which the tessellations should be made must be set. If you choose "Full View", all points in the entire "view" area are allocated to the selected map points. If you choose "Same Area", the sub-areas' borders will be maintained, and the area (or imaginary points) in the sub-areas

will be allocated to the input points that are located *within* that area. The “All Areas” option in the “Tessellation frame” box is not yet supported in version 7.0 of Flowmap.

- **Select an option in the “Tessellation frame” box**

In the “Save as” box you can set whether you want the map to be saved as a polygon Flowmap file, as a BNA file or both. If you (also) save the map as a BNA file, the map can be used in other programs.

- **Tick the “Flowmap file” box if you want to save it as a Flowmap file**
- **Tick the “BNA file” box if you want to save it as an export file**



NOTE: *If you choose the “Same Area” option in the “Tessellation frame” box, you can only save it as a BNA file. If you still want to use this Thiessen polygon map in Flowmap, it has to be converted first. Section 8.5 discusses the conversion from BNA to Flowmap format.*

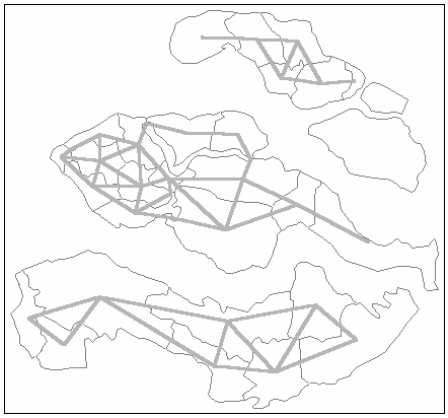
Then a window appears asking you to enter a name for the Flowmap file/export file. A Flowmap file will get the extension “.006” and a BNA file will automatically get the extension “.BNA”.

- **Enter a name for the file you want to create in the “Filename” box (a maximum of eight characters)**
- **Click on “Save”**
- **Click on “Ok” in the previous window**
- **Click on “Ok” in the “Flowmap 7 Report” window**

Now, based on the settings that were entered, the tessellation is performed in a number of steps. After that, if you want to use the map, you will first have to open it. See section 1.2.2. for opening files.

6.3.1 Centroid connecting network

To make a distance matrix based on distances over a network (see section 7.2) you need a network map. If no network map is available, but only a map with barriers Flowmap can create a network map. To do this, make sure a map file [ZEELAND.006] is opened. Flowmap then connects the centroids of the areas in the map, taking into account barriers (for example a body of water). The network map is saved as a BNA file.



- **Select “Create”**
- **Select “Centroid Connecting network”**
- **Click on “Construct Network”**

A window appears, in which the new file must be saved.

- **Type a name to the right of “Filename”, the file is saved automatically as a BNA file**
- **Click on “Save”**

Then Flowmap informs you the file was saved successfully.

- **Click on “OK”**

You can draw the network by opening the BNA file and then drawing the BNA-map (see sections 1.2.2 and 2.8).

Before you can perform an analysis based on the network, it must be converted into Flowmap-format (see section 8.5).

6.3.2 Centroid connecting network with origin locations or destination locations

Another option is to connect the origins or destinations on a map by means of a network. This procedure can be used when you have made a Thiessen polygon map (see section 6.2) and you want to make a network between the points (origins or locations) on which the Thiessen polygon map is based. The number of origins and destinations, however, must be equal to the number of centroids that will be replaced. Furthermore, a map file and a map of origins or destinations must be opened.

- **Click on "Create"**
- **Select "Centroid Connecting Network"**
- **Select "Replace Map Label Location"**
- **Click on "Replace with Origin locations" or "Replace with Destination locations"**

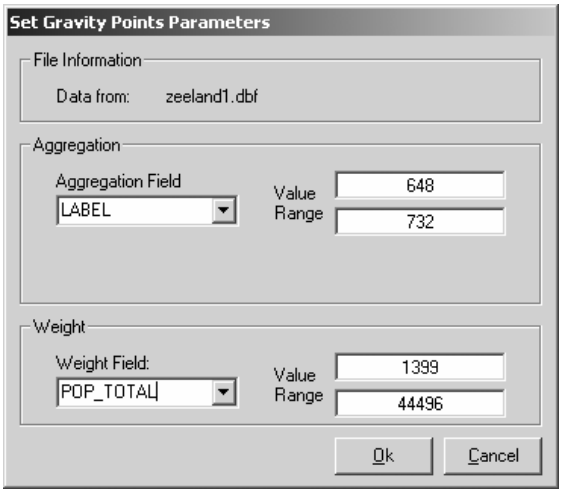
A window appears stating that the label locations have been replaced.

- **Click on "OK"**

Now, you can create a network (see previous section).

6.4 Weighted Gravity points

In Flowmap, you can calculate a gravity point or a weighted gravity point of all origins or all destinations per area (for instance per municipality). The sum of all squared distances to a gravity point must be minimal. When calculating a weighted gravity point, the value of the origins (or destinations) is also taken into account. The newly calculated gravity points are stored in a new attribute file. The first field of this new file contains the label of each area, the second and third fields contain the X- and Y- coordinates. The fourth field displays (in case of an unweighed, weighted gravity point) the number of origins and destinations per area and (in the case of a weighted gravity point) the total value of all origins or destinations of the area.



This is how to calculate a gravity point:

- **Select "Create" in the menu bar**
- **Select "Weighed Gravity Points"**
- **Click on "Gravity Points from Origin Locations" or "Gravity Points from Destination locations"**

A window pops up, in which several settings can be made. In the box "weight" you can choose between an unweighted or a weighted gravity point. The "Aggregation Field" box lets you choose a variable, indicating for each origin or destination the label of the area to which it belongs (for example municipality name) per origin or destination. If you have chosen a weighted gravity point, you must choose a variable in the "Weight Field" box reflecting the value of the

origins (or destinations).

- **Select a variable in the box "Aggregation Field"**
- **Select a variable in the box "Weight", if you have chosen a weighted gravity point**
- **Click on "OK"**

A window appears, in which the new file can be saved.

- **Type a name to the right of "Filename" (the extension must be "1.DBF")**
- **Click on "Save"**

Then Flowmap informs you the results were saved successfully.

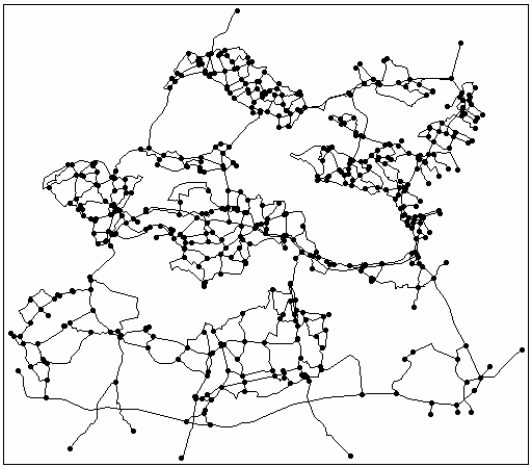
- **Click on "OK"**

See section 1.2.2. on how to open an attribute file.

6.5 Public Transport Network

In this section we will first look at how to create a station/stop file and second how to create a public transport import file. Before a station/stop file can be created an import file containing the right data (in this example [Zroad.bna]) needs to be opened in the project. See section 1.2.2 on how to edit an existing project.

- **Select "Create" from the menu bar**
- **Select "Public Transport Network"**
- **Click on "Create Station/Stop file"**



A new window pops up in which the new station/stop file can be saved.

- **Click on "Save"**

The file will now be created.

- **Click on "Ok"**

The result of the transformation can be viewed by drawing the map file (see chapter 2 for more information on drawing maps). In this example we have first drawn the import file [Zroad.bna] and second the newly created station/stop file [ZROASTP1.DBF]. Notice that the road network has been transformed to a station/stop file, with a station/stop on at each spot where two road sections are connected.

This is how to create a public transport file.

- **Select "Create" from the menu bar**
- **Select "Public Transport Network"**
- **Click on "Create Public Transport Import File"**

A new window pops up in which the new public transport import file can be saved.

- **Click on "Save"**

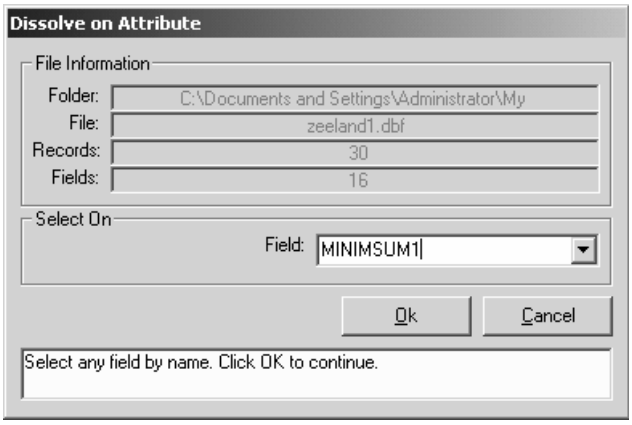
The file will now be created.

- **Click on "Ok"**

The resulting network can now be used for calculations regarding travel time in the public transport. These calculation take into account that getting on and of the public transport can only be done at public transport stations/stops. The resulting map is not mend for viewing purposes.

6.6 Dissolve

With the ‘Dissolve’ function it is possible to dissolve the inner borders between different areas if they have on both sides the same value based on a common attribute. For example, after an area consisting of 30 regions has been redefined to an area consisting of 10 regions the inner borders of the 10 new regions can be dissolved using this function (This example follows section 9.2).



- **Select “Create” from the menu bar**
- **Click on “Dissolve”**

The “Dissolve on Attribute” window pops up. In the “Field” box an attribute needs to be selected on which the file needs to be dissolved.

- **Select [MINIMSUM1] in the “Field” box**
- **Click on “Ok”**

Now the dissolving has been carried out. The result can be checked by drawing the map.

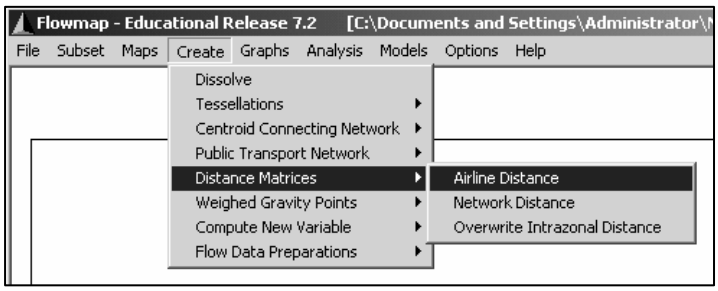
CHAPTER 7

Making Distance Matrices

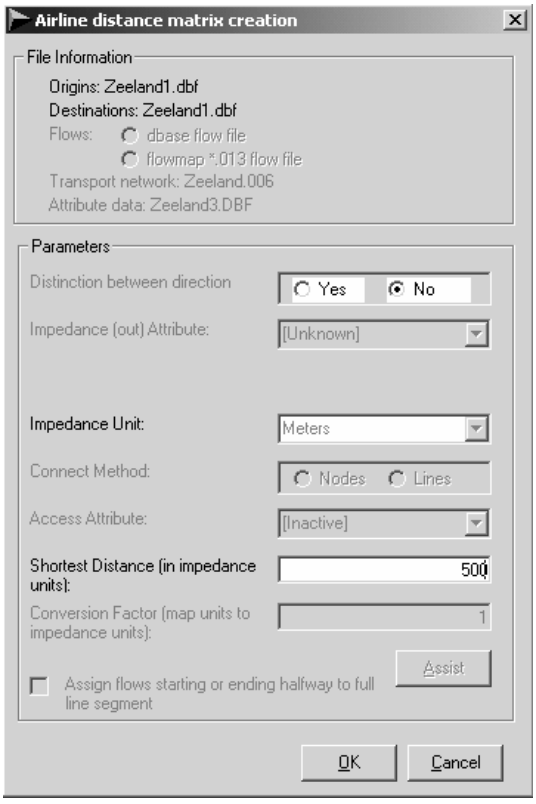
Flowmap makes use of distance matrices, for certain kinds of analyses to be discussed in Part III. You can use Flowmap to create these matrices. Based on a map of origin locations and one of destination locations, Flowmap calculates the shortest distance between each origin and destination.
Flowmap can calculate two kinds of distance tables. One kind is based on airline distances between origins and destinations. The other kind is based on the shortest distances between origins and destinations over a network. In order to create this kind of matrix, not only origins and destinations maps must be opened, but a network map as well.
This chapter first discusses how to make a distance matrix based on airline distances. After that, making a distance matrix based on a network map will be explained.

7.1 Making a Distance Table Using Airline Distances

In order to make a distance matrix using airline distances you must open both a map containing origins and one containing destinations; these maps serve as input for building the distance matrix.
Section 1.2.2. discusses how to open the correct maps.



- **Take care the right maps are opened**
- **Click on the "Create" option in the menu bar**
- **Select the "Distance Matrices" option in the menu**
- **Click on the "Airline Distance" option**



The "Airline distance matrix creation" window pops up. Two things must be entered here.
The first thing to enter is the shortest distance. If a calculated distance from an origin to a destination is shorter than this shortest distance, that calculated distance is overruled and replaced by the shortest distance as set by you.
There are two reasons to set a shortest distance bigger than zero. The first is a technical reason. When running gravity models, formulas are used in which the distances are put in a fraction's denominator. If this is 0 (or more or less 0), the computer gives a "Division by zero" error.
The second is a conceptual reason. If the origin and destination location are located very close together, the distance is never 0, or close to absolute 0. Factors like walking to the car, parking it, or waiting for the bus then become important. These factors do not play much of a role when long distances are concerned.

However, when short distances are concerned they cannot be neglected.

- **Enter the shortest distance in the "Shortest Distance" box [500 (meters)]**
- **Click on "OK"**

NOTE: *The unit you use here for the shortest distance depends on the distance units on which the maps are based. Often these will be meters, but maps can also be stored in other distance units, like kilometers, yards, miles or degrees.*
In Flowmap you cannot find out the map unit that was used. What you can do is combine the numbers in the "View" and your own knowledge of the size of the area.

A window pops up in which the distance matrix can be saved.

- **Enter a name for the distance matrix that you want to make in the "File name" entry box [ZAIRLINE]**
- **Click on "Save"**

Now Flowmap creates the distance matrix on the basis of airline distances. Flowmap indicates when this is finished.

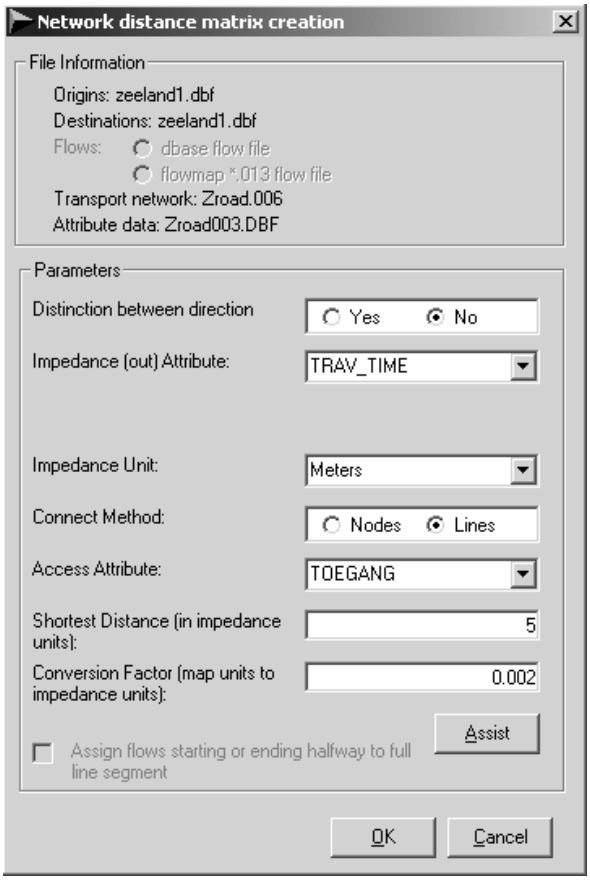
- **Click on "OK"**

The matrix is saved in the same directory in which the flow data reside.
If you want to use the distance matrix you have just made, you will have to open it first. Section 1.2.2. discusses opening files.

7.2 Making a Distance Matrix Using Network Distances

In order to make a distance table based on network distances not only must an origins map and a destinations map be opened, but a network map must be opened as well. This is because the roads in this network map are used for calculating the shortest distances between origins and destinations.
Section 1.2.2. discusses how to open maps.

- **Take care that the right maps are opened**
- **Click on the "Create" option in the menu bar**
- **Click on the "Distance Matrices" option in the menu**
- **Click on the "Network Distance" option**



Now the "Network distance matrix creation" window pops up. Certain settings must be entered in this window.
Data on specific elements (e.g. road segments) are stored in a separate ???????3.DBF file. This is the attribute file that belongs to the network map.

- **Select the right attribute field in the "Database" box [ZROAD003.DBF]**

In the "Impedance" box the selected attribute file's variables show up. These contain properties of roads. The first usually is always the label, a unique road number identifying that road. The other variables can differ per attribute file. They may concern the length of road segments, the maximum speed limit of that road

segment, or the amount of time needed to travel that road. The road length or travel time of a road segment can be set as an impedance variable.

- **Select an impedance attribute variable [TRAV_TIME]**
- **Select an impedance unit variable [minutes]**

Whit the right data it is also possible to distinguish between directions. This way it is possible to tell which direction the traffic will go. For example to tell the direction of a one-way road, to distinguish between height differences and the increase in travel time in a certain direction.
The settings window also displays an entry box for the “Multiplication factor”.
Origins and destinations are usually centroids of sub-areas. These centroids represent the sub-area. However, it would be quite a coincidence if such a centroid is located exactly on the spot where a road goes. But if the locations were not connected to the network, this would mean that origins and destinations are inaccessible for calculating a distance matrix. Therefore, Flowmap joins the origins and destinations to the nearest road. The program calculates the length of the stretch that is off the network in map units. So if the map units are meters, then the length of the stretch from centroid to road is also calculated in meters. If the impedance was set in minutes, meters would be added to minutes resulting in outputs that make no sense. This is why map units must be converted to impedance units.

For this conversion, let us assume that for a trip the impedance was set in minutes and the map units in meters. An estimate of the speed at which one can travel the remaining part of the network would have to be made. Let us say the speed is estimated at 30 kms/hour. The multiplication factor could be calculated as follows: (1/30 kms/hour) * 60 minutes = 0.002.

- **Enter the multiplication factor [0.002]**

NOTE**:** *Flowmap finds the shortest airline distance between origin or destination and the network. In reality, it is not always possible to travel in a straight line. This is why a curve or route factor is sometimes used. This indicates approximately how much longer the road is compared to airline distances. In The Netherlands this factor is somewhere between 1.2 and 1.3 (there is regional variation). By multiplying the calculated multiplication factor with the curve factor, this difference between airline travel and the real route is also taken into account.*

NOTE: *It might occur that the map units are unknown. If that is the case, it is safest to take 0 as a multiplication factor. This way it is as if the origins and destinations are located directly on the network.*

Next you have to enter the shortest distance. This must be expressed in the same map units as the impedance. So if the impedance variable is “traveling time in minutes”, the shortest distance must also be expressed in minutes.

- **Enter the shortest distance text area box [5 (minutes)]**

In the “Connect to:” box you can choose between “Nodes” and “Lines”. This has to do with the kind of network to which the origins and destinations are joined. An origin or destination cannot just be connected to the network halfway along a public transport line segment. If you want to make use of public transport, you will first have to go to a bus stop or railway station. In other words: you will first have to go to a node. In that case you will have to select Nodes. You can select the Lines option if one can get easy access to the roads that are represented by the network. You do not necessarily have to travel to a node first, to be able to use it (e.g. a car or cyclist’s network).
However, intermediate situations may also occur. This means that you can connect origins/destinations to a line segment halfway on most types of roads, like streets and

avenues, but to some you cannot, like highways. Only an access road will allow you to enter the highway system. Therefore, if you choose lines instead of nodes, Flowmap offers you to select an extra variable in the “Access” box. You can add a new variable to the attribute file of the road map. In this variable you can put a negative number (e.g. -1) for every road that cannot be accessed halfway. “Negative attribute roads” can only be accessed via the nodes (accesses). Again, you can select the newly made variable in the “Access” box.
If you do not select a variable in the “Access” box, Flowmap automatically selects the same variable that was chosen in the “Impedance” box.

- **Click on “Nodes” or “Lines” in the “connect to:” box [Lines]**
- **If you select Lines, you can choose a variable in the opened “Access Attribute” box; a variable that indicates whether a road segment may be connected to halfway [Toegang]**
- **Click on “OK”**

NOTE: See section 9.6 for more information on the assist function.

A window pops up in which you can save the new distance matrix.

- **Enter a name to the right of the “File name” entry box [ZNETWERK]**
- **Click on “Save”**

Now Flowmap will calculate the distance matrix based on the distances across/over the network. In the meantime Flowmap displays some results on the number of road segments and related attributes.

- **Click on “OK” when Flowmap displays intermediate results**

Finally Flowmap shows the longest distance between origin/destination to the network and the longest distance that was calculated between origin and destination. Always check whether these results make sense. If this is not the case, something went wrong in the calculation. It is possible that the wrong parameters were set. In that case, check the parameters that were set and recalculate the distances.
The table is saved under the name that was entered in the flow data directory.

If you want to use the distance matrix you have just made right away, you will first have to open the matrix. See section 1.2.2 for opening files.

7.3 Recalculating and Overwriting Intrazonal Distances

Origins and destinations usually are centroids of an area map. In a distance matrix that was calculated based on such origins and destinations, the distances between the area’s centroids are stored. If the origins and the destinations are the same set, then the distance is 0. For instance, this would be the case if one were to travel from one location within a municipality to another location in that same municipality.
Flowmap offers you the option to replace these zero distances in the distance matrix by intrazonal distances. This is the average distance that is traveled within an area. That intrazonal distance will be read from an attribute file (???????1.DBF) related to the areas. The intrazonal distances in the attribute file must be calculated beforehand and saved as a ???????1.DBF file. That can, for example, be done on the basis of the areas’ surface, which is stored in the attribute file.

The intrazonal distance is calculated on the basis of the following formula:

$C_i = 0.667 * \sqrt{(S_i / \pi)}$

where:
C_i = the intrazonal distance of area I
S_i = The surface of area I

In Flowmap creating a variable with intrazonal distances is done as follows:

- **Select "File" in the menu bar**
- **Select "Table Manager"**
- **Click on "Calculate Field"**
- **Select [ZEELAND.DBF] in the new "calculate field" window**
- **Click on "Open"**

The "Flowmap Variable Calculator" will be opened. By clicking on a variable and on a operator, constant or function it will be added to the formula box at the bottom.

- **Enter the formula "0.667*((AREA_SIZE/#pi)^0.5)" (without quotes!)**
- **Click on "Ok"**

In the "Store New Field" window an existing fieldname can be selected or a new fieldname can be entered instead of the default fieldname.

- **Enter the fieldname "INTRA_AFST"**
- **Click on "Ok"**
- **Click on "Ok" in the Flowmap Report window**

Flowmap has now calculated and stored the new values in the new field. This formula stores the distances in this example measured in meters in the INTRA_AFST variable (because AREA_SIZE is in meters), and the distances still represent *airline* distances. If intrazonal distances still have to be multiplied by a route factor (for example, 1.2), change the formula in:

- **"0.667*((AREA_SIZE/#pi)^0.5)*1.2" (without quotes!)**

It is also possible to transform meters to minutes. In that case, a different multiplication factor must be used. See section 7.2 on how to determine the correct multiplication factor.

When a distance matrix based on one point/attribute map for both origins and destinations was opened, the 0 distances in this distance matrix can be overwritten by the intrazonal distances. This is how to do it:

- **Select "Create" in the menu bar**
- **Click on "Distance Matrices"**
- **Click on "Overwrite Intrazonal"**

A window pops up in which you can select a variable that contains intrazonal distances.

- **Select the variable containing the intrazonal distances [INTRA_AFST]**
- **Click on "OK"**

Next Flowmap overwrites the 0 distances in the distance matrix by the intrazonal distance retrieved in the attribute file.

CHAPTER 8
Importing and Exporting

Importing maps in Flowmap is always done via the BNA file format. Thus, if a non-BNA map has to be imported into Flowmap, the map should first be converted to BNA format, and then converted again to Flowmap format.
You can use Flowmap itself for the conversion of three map formats to BNA format. These are the so-called Moss files, files that are used by the MapInfo GIS package and files used by ArcView. The way to transform these files to BNA format will be discussed in this chapter's first three sections. Then, converting a point map with origins or destinations to a BNA-map will be dealt with. In section 8.5, converting BNA files to Flowmap format will be discussed. When Flowmap converts BNA files to Flowmap files, topology is built. Besides that, an attribute file (???????1.DBF) is created in which the sub-areas' centroids (gravity points) are located.
In the following sections, converting BNA files to MapInfo-files and to Moss files will be discussed. You can also convert a BNA map with degrees of longitude and latitude to a BNA-map with Cartesian coordinates, in order to be able to use the map in Flowmap. This will be discussed in section 8.

NOTE: *converting options regarding dBASE files are only available in the professional edition and are therefore discussed in part IV.*

8.1 Converting Moss Files to BNA Format

A Moss file is a file format used by the Moss GIS package (Map Overlay & Statistical Systems). The Moss GIS package is now outdated, but it was used frequently so the Moss file format is still being used. GIS packages like ArcInfo and Genamap can convert their own file formats to a Moss file. In turn Flowmap can convert that Moss file to a BNA file in order for it to be used in Flowmap.

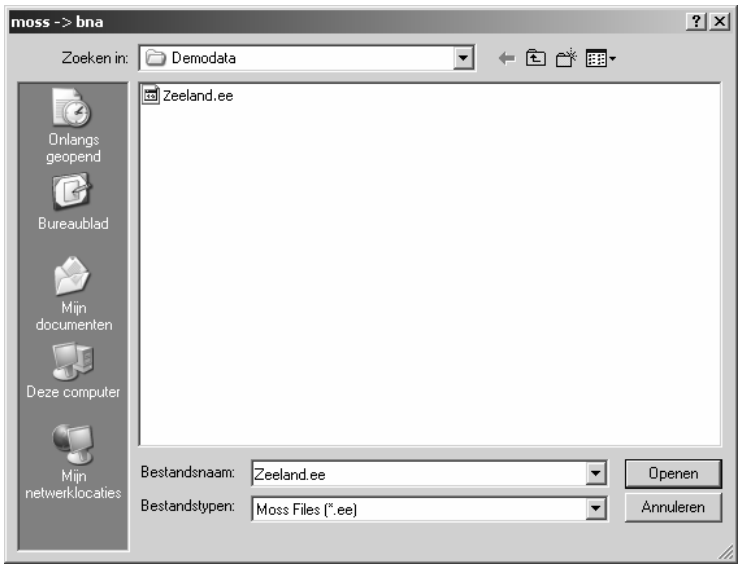
NOTE: *A Moss file does not have a standard extension, so you cannot see by its name whether it is a Moss file or not. However, Flowmap only recognizes a Moss file when it has an .EE extension.*
The Genamap conversion module for exporting to Moss format always gives an .EE extension to the output Moss file. If you export to Moss format in another program, then give the file an .EE extension manually (for example in the Windows Explorer).

This is how to convert a Moss file to BNA format:
- **Select "File" in the menu bar**
- **Select "Convert Files"**
- **Select "Moss->"**
- **Select "Moss -> BNA"**

A window pops up in which you can select an .EE file that has to be converted.

NOTE: *If you want to convert a file, it must be located in the "Location data directory". This is the same directory in which the various standard Flowmap maps are located.*

- **Select the file that is to be converted**
- **Click on "Open"**



A window pops up in which you can save the Moss file as a BNA file.

- **Type a name behind "File Name" (or leave the existing name, saving the BNA file under the same name as the Moss file)**
- **Click on "Save"**

The conversion now takes place. When is it completed, a "Flowmap 7 Report" window pops up.

- **Click on "OK"**

Moss and BNA files are quite similar, so the conversion process is relatively simple and quick. However, in a BNA file lines and polygons (closed areas) can be distinguished. This is impossible in a Moss file. Therefore it might occur that in the conversion process Flowmap will ask the following question:
In a Moss file no distinction is made between a closed polygon boundary and a line (road) that begins and ends in the same point.
Do you wish to treat polygons as circular lines?
If you want to make a network map, click the "Yes" button. If you want to make a polygon map, click the "No" button.

After a while Flowmap informs you that the conversion was carried out successfully.

- **Click on "OK"**

The conversion to BNA format has been completed. See section 8.5 for conversion from BNA to Flowmap format.

8.2 Converting MapInfo Files to BNA Format

MapInfo is a PC GIS package. This is why different conversion procedures are needed to convert both file formats to BNA format. Only the conversion procedure from MapInfo/Win format to BNA is a standard Flowmap 7 feature.

- **Select "File" in the menu bar**
- **Select the "Convert Files" option**
- **Select "MapInfo ->"**
- **Click on "MapInfo (MIF) -> BNA"**

A window pops up in which you can select the .MIF file that you want to convert.

NOTE: *If you want to convert a file, it must be located in the "Location data directory". This is the same directory in which the various standard Flowmap maps are located.*

NOTE: *The maps used by MapInfo are stored in two related files. These always have the same name, but different extensions. These extensions are .MIF and .MID. Make sure that both files are located in the "Location data directory".*

- **Select the file you want to convert**
- **Click on "Open"**

A window pops up in which you can save the MapInfo file as a BNA file.
- **Type a name behind "File Name" (or leave the existing name, saving the BNA file under the same name as the MapInfo file)**
- **Click on "Save"**

A window appears, in which a key variable must be set, that is unique for each object. Thus, the data in the two files (.MIF and .MID) will be linked correctly. Since the same name can be used for different areas (Label), usually the Identifier Code (ID) is chosen, because it is always unique.
- **Select "ID" or "Label"**
- **Click on "OK"**

After a while a notification pops up stating that the conversion has been successful.
- **Click on "OK"**

The conversion to BNA has been accomplished. See section 8.5 for converting a BNA file to Flowmap format.

8.3 Converting ArcView Files to BNA Format

ArcView and ArcInfo use different file formats. See section 8.1 for converting ArcInfo files. This section discusses converting ArcView files to BNA.

- **Select "File" in the menu bar**
- **Select "Convert Files"**
- **Select "ArcView ->"**
- **Click on "ArcView (Shape) -> BNA"**

A window pops up in which you can select the .SHP file you want to convert.

NOTE: *If you want to convert a file, it must be located in the "Location data directory". This is the same directory in which the various standard Flowmap maps are located.*

NOTE: *The maps used by ArcView are stored in three related files. These always have the same name, but different extensions. The extensions are .SHP, .SHX and .DBF. Make sure that these three files are located in the "Location data directory".*

- **Select the file that is to be converted**
- **Click on "Open"**

A window pops up in which you can save the Arcview file as a BNA file.
- **Type a name behind "File Name" (or leave the existing name, saving the BNA file under the same name as the Arcview file)**
- **Click on "Save"**

The conversion now takes place. When is it completed, a window pops up.
- **Click on "OK"**

The conversion to BNA has been accomplished. See section 8.5 for converting a BNA file to Flowmap format.

8.4 Converting origins and destinations to BNA Files

A map of origins and destination can be converted to a BNA file.

- **Select "File" in the menu bar**
- **Select "Convert Files"**
- **Select "Flowmap ->"**
- **Select "Flowmap Origins/Destinations -> BNA"**

A window pops up in which the origins or destinations file must be selected.

- **Select the file that is to be converted**
- **Click on "Open"**

A window pops up in which you can save the Arcview file as a BNA file.

- **Type a name behind "File Name" (or leave the existing name, saving the BNA file under the same name as the Origins/Destinations file)**
- **Click on "Save"**

The conversion now takes place. When is it completed, a window pops up.

- **Click on "OK"**

Before you can use a converted file, you will first have to open it. See section 1.2.2 on opening files.

8.5 Converting BNA Files to Flowmap Format

If you want to convert a BNA map to Flowmap format, you will have to open it first. Subsequently, the BNA map can be converted to Flowmap format.

This is how to open a BNA file:

- **Select "File" in the menu bar**
- **Select "Convert Files"**
- **Select "BNA ->"**
- **Click on "BNA -> Flowmap"**

A window pops up in which the Flowmap file can be saved.

- **Type a name behind "File Name" (or leave the existing name, saving the Flowmap map under the same name as the BNA map)**
- **Click on "Save"**

Now the BNA data will be converted.

NOTE: *It may occur that a BNA file is "corrupt". This means there is something wrong with the file structure. In that case conversion is impossible.*

A new window pops up. In one BNA file a combination of point, line and polygon data can be stored. This is not possible in Flowmap files. In Flowmap, point, network and area maps must be three separate files.
If Flowmap discovers more than one kind of map feature in the BNA file, Flowmap asks which kind of Flowmap map must be created: point, network or polygon.

- **Select the file type in the "Select object type" box**

NOTE: *If one BNA file contains two kinds of map features and if you want both kinds converted to separate Flowmap files, then the conversion must be executed twice. A problem that arises is that Flowmap overwrites the file with the same name every time a conversion is executed. To make two different Flowmap files out of one BNA file, you must convert the BNA file under two different names (e.g. one for points, one for lines). The same principle applies to converting three different kinds of map features from BNA to Flowmap.*

It may occur that the conversion window offers two additional options. This has something to do with the way data are stored in the BNA file. These additional options only appear if the "points" option was selected.
The first option is "Include degenerated lines". If this option appears, this means that lines do occur in the BNA file, however, the nodes the lines are based on have the same coordinates. In fact, the line is a point.

- **Tick the "Include degenerated lines" box when so-called "point lines" must be interpreted as points**

The second option that may appear is "Include single point curves". This means that in the BNA file lines were defined, but that these lines consisted of one single point each.

- **Tick the "Include single point curves" box when lines consisting of one point must be interpreted as points**
- **Click on "OK"**

Now the conversion will be executed. As soon as that has been completed, the next window pops up.

- **Click on "OK"**

If you want to use the converted file, you will have to open it first. See section 1.2.2. for opening files.

8.6 Converting BNA files to MapInfo files

If you want to convert a BNA map to a MapInfo map, you will have to open it first. Subsequently, the BNA map can be converted to a MapInfo file.

- **Select "File" in the menu bar**
- **Select "Convert Files"**
- **Select "BNA ->"**
- **Click on "BNA -> MapInfo (MIF)"**

A window pops up in which the BNA file must be selected.

- **Select the file that is to be converted**
- **Click on "Open"**

A window pops up in which the MapInfo map can be saved.

- **Type a name behind "File Name" (or leave the existing name, saving the MapInfo map under the same name as the BNA map)**
- **Click on "Save"**

Now the conversion will be executed. As soon as it is completed, the "At your service" window pops up.

- **Click on "OK"**

8.7 Converting BNA files to Moss files

If you want to convert a BNA map to a Moss file, you will have to open it first. Subsequently, the BNA map can be converted to a Moss file.

- **Select "File" in the menu bar**
- **Select "Convert Files"**
- **Select "BNA ->"**
- **Click on "BNA -> Moss"**

A window pops up in which the BNA file must be selected.

- **Select the file that is to be converted**
- **Click on "Open"**

A window pops up in which the Moss map can be saved. The file automatically gets the extension .EE

- **Type a name behind "File Name" (or leave the existing name, saving the Moss map under the same name as the BNA map)**
- **Click on "Save"**

Now the conversion will be executed. As soon as that has been completed, the next window pops up.

- **Click on "OK"**

8.8 Converting BNA Lat/Lon maps to BNA Planar

Since degrees of longitude do not have a fixed length (contrary to degrees of latitude) maps with degrees of longitude and latitude cannot be used in Flowmap. Deformed maps and mistakes in calculating distances would be the result. It is possible, however, to convert a BNA map with degrees of longitude and latitude to a BNA map with Cartesian (planar) coordinates (using Lamberts Equivalent Azimuthal Projection). This map can then be used in Flowmap.

- **Select "File" in the menu bar**
- **Select "Convert Files"**
- **Select "BNA ->"**
- **Select "BNA Lat/Lon ->BNA Planar"**

A new window pops up in which you can select and open a BNA file.

- **Select the file that is to be converted**
- **Click on "Open"**

A window pops up in which the BNA map can be saved. It automatically gets the extension .BNA. The new file must therefore have a different name than the existing map with degrees of latitude/longitude, otherwise the old file will be overwritten.

- **Type a name behind "File name"**
- **Click on "Save"**

The window shown to the right appears.
In the "Projection Parameters" box you can enter the center of the projection. In the exact center of the projection there is no distortion in relation to the original map. Deformation increases as the projection is further away from the center. The coordinates entered by Flowmap represent the exact center of the map.

- **Enter the coordinates of the center of the projection, or leave the existing values unaltered**

NOTE: *If you convert different maps that are to be used together, the same center should be chosen for all maps.*

In the "Target map units" box, the map units for the new map can be selected.

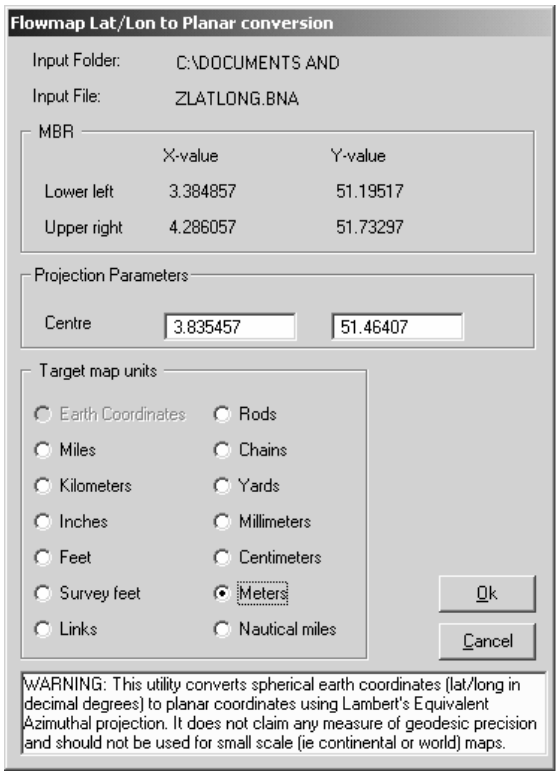
- **Select the map units that must be used**
- **Click on "OK"**

The next window contains the amount of distortion in terms of relative and absolute distance errors.

- **Click on "OK"**

The conversion now takes place. When is it completed, a window pops up.

- **Click on "OK"**



Part III

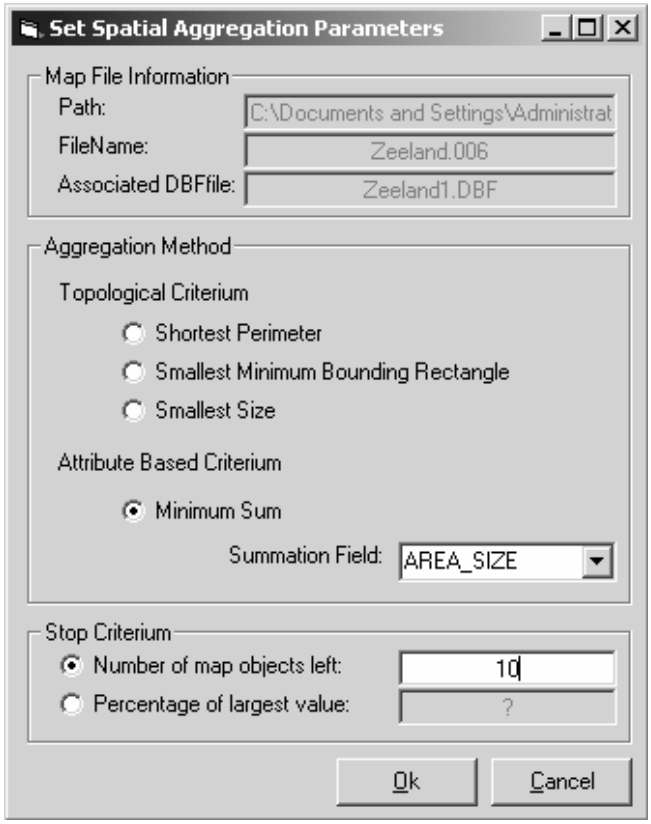
Analyses

Part III discusses the various analysis capabilities that Flowmap has to offer.
In Chapter 9 general analysis functions will be discussed. First the minimum sum method will be discussed, followed by the continuous intramax analysis, third the trip end ranking function and finally the transport network analysis and flow assignment to network function.
The catchment area analysis functions will be discussed in chapter 10. First we will look at the regular catchment area analysis, second the catchment area analysis with linear optimization will be discussed and finally the second best analysis.
In Chapter 11, different types of accessibility analyses will be discussed. First, catchment area profiles and location profiles will be discussed, followed by proximity counts, threshold distances and proximity coefficients based on the above-mentioned profiles. Next, catchment area analyses (analysis of service areas) will be discussed. Here, origins are assigned to the nearest destinations. Next, potential models will be dealt with. Potential models involve calculating potential values for locations, serving as a measure for the proximity of the "users" of the locations concerned (customers, employers, shoppers, etc.). At the end of the chapter, "Gravity Surface Analysis" will be discussed. By means of a "Gravity Surface Analysis", the location of several potential new destinations is compared to the existing services.
Chapter 12 discusses gravity modeling. Gravity modeling is a tool for analyzing actual (recently) observed interaction flows. Also, it can serve as a tool for the prognosis of future interaction flows.
Finally, chapter 13 will discuss the second part of the Flowmap model section, regarding service location modeling. It consists of four models: coverage, expansion, relocation and reduction models.

CHAPTER 9
General Analysis

In this chapter the first few analysis options in Flowmap will be discussed. Only the catchment area analysis, the accessibility measures or analysis and the gravity modeling are discussed in separate chapters. First we will look at spatial aggregation. The Continuous Intramax will be discussed in the next section. After that section Trip End Ranking, Transport Network Analysis and the Flow Assignment to Network analysis will be discussed.

9.1 Minimum Sum Method



This aggregation method is useful to redefine the number of regions in an area based on certain criteria. For example it's possible to redefine an area consisting of 30 regions to a more balanced area of 10 regions based on the area size.

- **Select "Analysis" from the menu bar**
- **Select "Spatial Aggregation"**
- **Click on "Minimum Sum Method"**

The "Set Spatial Aggregation Parameters" window pops up in which certain settings can be made. The "Map File Information" box contains information about the file which will be used in the spatial aggregation. In the "Aggregation Method" box either a topological or an attribute based criterium can be selected. In case an attribute based criterium is selected one also needs to select the summation field. Finally a stop criterium needs to be defined.

- **Select "Minimum Sum" and choose [AREA_SIZE] as summation field**
- **Select "Number of map objects left:" as stop criterium**
- **Enter [10] in the "Number of map objects left:" box**
- **Click on "Ok"**

A new window pops up in which the results can be stored.

- **Either accept the default name or enter a new one**
- **Click on "Ok"**
- **Click again on "Ok" in the "Flowmap 7.2 Report" window**

Now the analysis has been carried out. The results can be checked by drawing the appropriate map .

9.2 Continuous Intramax Analysis

Interaction between different locations in space can be seen as a measure for functional distance. The more interaction, the shorter the "distance". Clustering areas that are close in terms of this functional distance leads to the creation of functional regions. These kind of regions are the geographers alternative for the usual administrative divisions of space. There are several methods for arriving at functional regions. Flowmap uses Intramax analyses, that carries out a regionalization of an interaction matrix. "The objective of the Intramax procedure is to maximize the proportion within the group interaction at each stage of the grouping process, while taking account of the variations in the row and column totals of the matrix". This implies that in this particular case the two areas are grouped together for which the objective function:

$T_{ij} / (O_i * D_j) + T_{ji} / (O_j * D_i)$ is maximized

where:
T_{ij} = the interaction between origin location i and destination location j
O_i = $\Sigma_j T_{ij}$
D_j = $\Sigma_i T_{ij}$

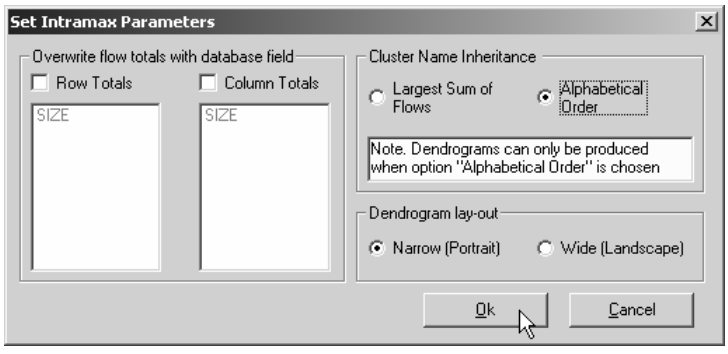
The objective function can only be calculated for all $D_j > 0$ and for all $O_i > 0$

The Intramax analyses is a stepwise analyses. In each step two areas are grouped together and the interaction between the two areas become internal (or intrazonal) interaction for the new resulting area. This new area now takes the place of the two parent areas at the next step of the analyses. So with N areas after N - 1 steps all areas are grouped together into one area and all interaction is intrazonal.

The outcome of an Intramax analysis is a report in table form and a dendogram.

The Intramax analysis can be found in the analysis menu:
- **Select "Analysis" from the menu bar**
- **Select "Spatial Aggregation"**
- **Click on "Continuous Intramax Analysis"**

The "Set Intramax Parameters" window pops up. Here you can choose to overwrite flowdata totals with an other field, determine the cluster name inheritance and choose the layout for the dendogram (either landscape or portrait). Option "Largest sum of flows" produces the best interpretable fusion report can't be used to create a dendrogam. So select the other option and:



- **Click on "Ok"**

The "Store.." window appears. By checking "store" you can determine which file(s) should be stored. It is also possible to change the filenames by clicking the appropriate filename box and entering a new filename.
- **Click on "Ok"**

NOTE: *the fusion report and the dendogram are both saved as text files (.txt) and can be viewed in a text editor like notepad or wordpad.*

In the next Now the "preprocessing data" window pops up showing information regarding the Intramax analysis like the number of steps in the analysis and a total interaction number.

- **Click on "Continue"**
- **Click on "OK" in the Flowmap 7 Report window**
- **Click again on "OK"**

Flowmap has now written the fusion report and the dendogram to the text files and the Intramax analysis has been carried out successfully.

The example at the next page represents the degree of clustering. The degree of clustering is visualized through a dendogram. The shorter the distance, the greater the degree of clustering. The longer the distance, the lesser the degree of clustering.

9.3 Importing Dendogram in MS-Word 2002

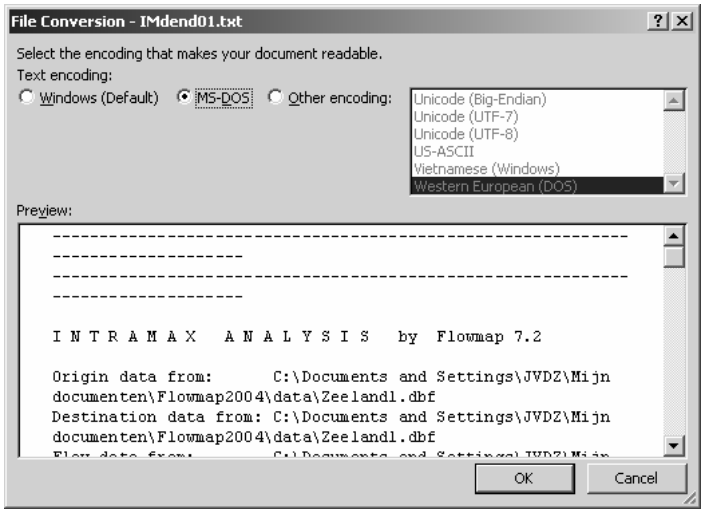
To insert the dendogram in a Word document it is necessary to convert the file and select the right settings. To select the right conversion the 'confirm conversion' option should be made available (sometimes this option is by default available). Follow the next steps to activate this option and insert the dendogram.

- **Select "Tools" in the menu bar**
- **Click on "Options"**
- **Click on the "General" tab**
- **Check the option "Confirm Conversion at Open"**

- **Select "Insert" in MS-Word**
- **Click on "File…"**
- **Select the [.txt] file which contains the dendogram (default name is [IMdend01.txt])**
- **Click on "Insert"**

Depending on the settings made in Word a 'Convert File' window will pop up. If this is the case follow the next step, else proceed to the next paragraph.

- **Select "Encoded Text" in the newly opened "Convert File" window**
- **Click on "OK"**



The window to the right pops up in which the encoding needs to be selected.

- **Select "MS-DOS"**
- **Click on "OK"**

The dendogram will now be inserted into the document.

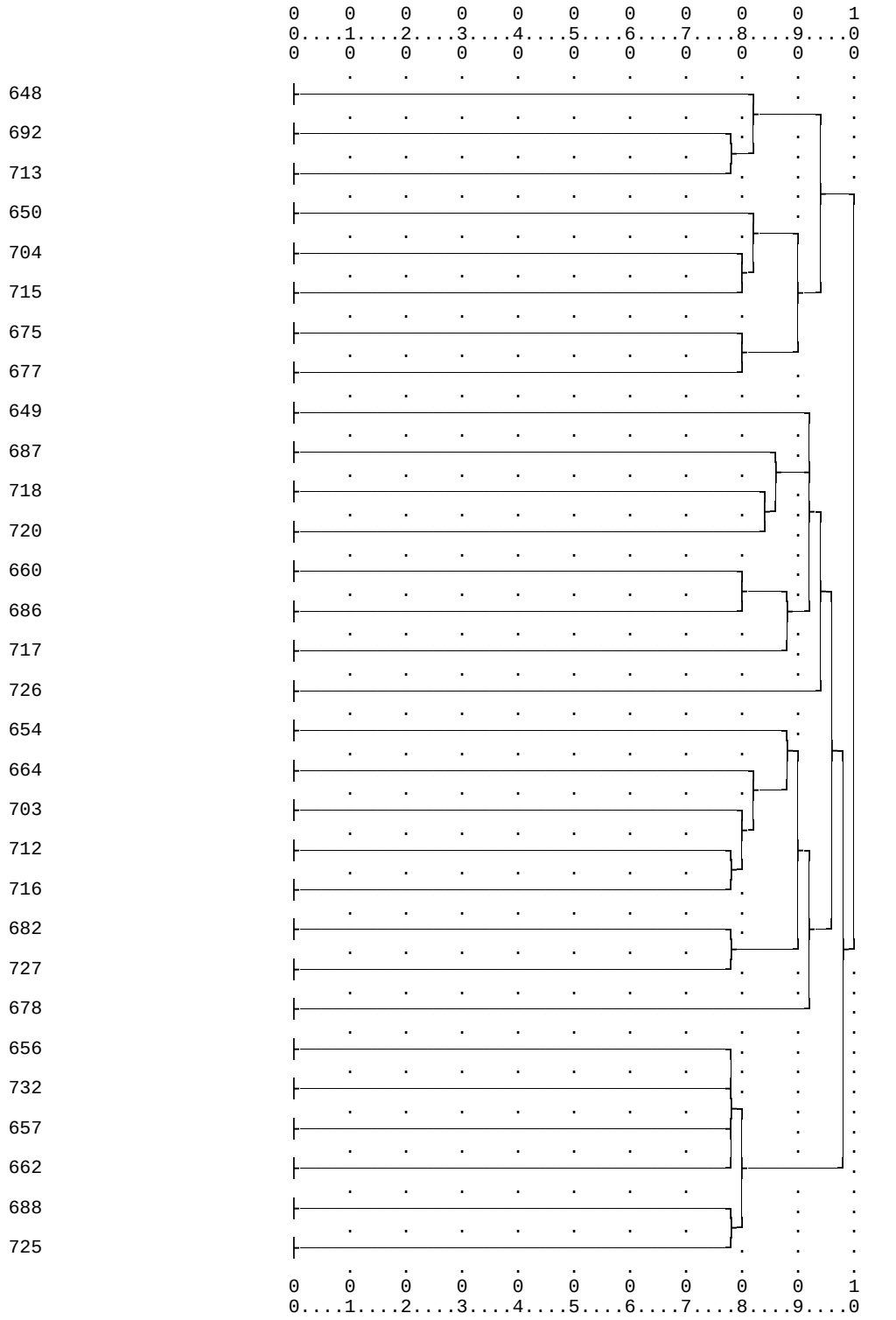
- **Select the new inserted dendogram**
- **Change the Font into "Courier New" and change the Font size into "8"**

The dendogram should now be readable.

I N T R A M A X A N A L Y S I S by Flowmap 7.1

Origin data from: D:\DATA\zeedata\zeeland1.dbf
Destination data from: D:\DATA\zeedata\zeeland1.dbf
Flow data from: D:\DATA\zeedata\Migr9502.dbf

Total interaction: 36238
Intrazonal interaction: 28099
Percentage intrazonal: 77.54%



9.4 Proces Intramax Fusion Report

With the 'Proces Intramax Fusion Report' function a report can be processed for a given amount of steps. Before a specific fusion report can be created a regular intramax analysis needs to be carried out (section 9.2). Finally it will save the fusion results in a new column.

- **Select "Analysis" from the menu bar**
- **Select "Spatial Aggregation"**
- **Click on "Proces Intramax Fusion Report"**

A window pops up in which the fusion report which needs to be processed must be selected. The fusion report will be in a .txt file format.

- **Select the fusion report, default is [IMFus001]**
- **Click on "Open"**

A new window pops up in which the number of intramax fusion steps that needs to be processed can be entered.

- **Enter the number of steps, for example [20]**
- **Click on "Ok"**

In the next window the fusion results can be stored in a new column and the aggregated flows can be stored as a new dBASE file. The last number of the default name of the fusion results column indicates the number of fusion steps.

- **Check the file/field needs to be stored and change or accept the default names**
- **Click on "Ok"**
- **Click again on "Ok" in the confirmation window**

Finally the fields corresponding with the trip end labels and the flow size can be selected.

- **Click on "Ok"**

The results can be checked by using the view table function.

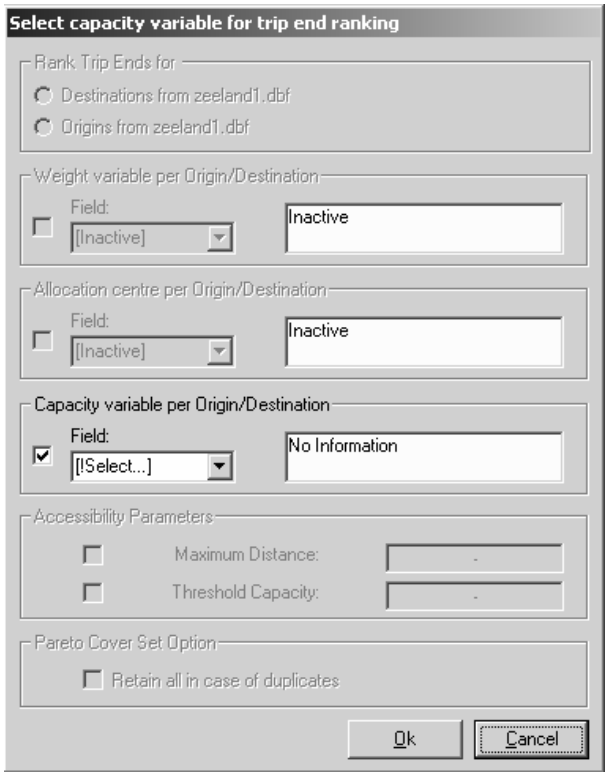
9.5 Trip End Ranking

The 'Trip End Ranking' analysis is useful to determine the importance of travel distance to the end destinations. For example: most people won't travel for their daily shopping to a shopping centre far away, but will travel to a shop close at home. This is less obvious for trips to a dentist or hospital. With help of the Trip End Ranking analysis you can determine the importance of distance to the destinations.

- **Select "Analysis" from the menu bar**
- **Click on "Trip End Ranking"**

A new window pops up in which you can select the origin and destination field of the Flow File. In the file information box pathnames are repeated for the different files needed to carry out the analysis.

- **Select the origin and destination labels and click on "Ok"**



In the next window some selections can be made. If the origins and destinations are not in the same file they can be changed in the “Rank Trip Ends for” box. If available, a field can be selected for the weight variable in the “Weight variable per Origin/Destination” box and/or a allocation centre in the “Allocation centre per Origin/Destination” box. In the “Capacity variable per Origin/Destination” box a field can be selected containing a capacity variable. If a value is not zero, it contains an end destination (for example a store).

- **Make the appropriate selections**
- **Click on “Ok”**

In the “Store Trip End ranking Results” window files can be selected which need to be stored and the fieldnames can be changed.

- **Leave the topics which need to be stored checked**
- **Change the fieldnames or use the default names**
- **Click on “Ok”**
- **Click again on “Ok” in the Flowmap report window**

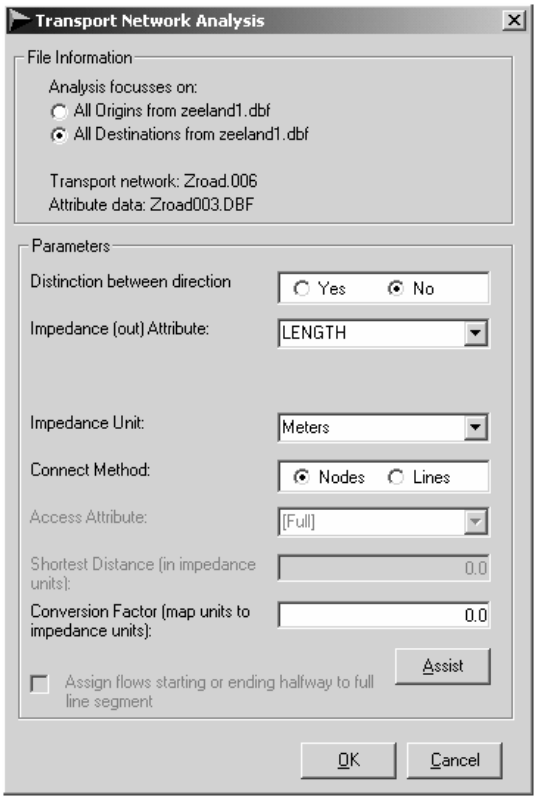
Flowmap will now carry out the analysis and store the results in the selected fields. To view the results you can view the table with the table manager as is explained in section 1 of this manual.
If the value in the new column for a case is 1 it means that the trip ends in the closest destination they travel to the nearest , if the value is 2 it is the second closest destination etcetera (so for example if the value is 1 that person travels to the nearest store, if the value is 2 they travel to the second nearest store). If the column contains a lot of high values it means that distance does not plays any role of importance.

9.6 Transport Network Analysis

The three main functions in Transport Network Analysis are “Zoning”, “Districting” and “Shortest Path”. *Zoning* shows all roads within a certain distance range from a predefined set of origins and destinations; it is the network equivalent of the GIS ‘Buffer’ operation. *Districting* shows all roadstr that are nearest to the same origin or destination in a predefined set of origins or destinations; it creates the network equivalent of ‘Thiessen Polygons’ or ‘Catchment Areas’ as they are called in Accessibility Analysis. *Shortest Paths* are calculated between all combinations of (selected) origins on the one hand and (selected) destinations on the other hand. Flowmap allows us to perform all three functions in one go.

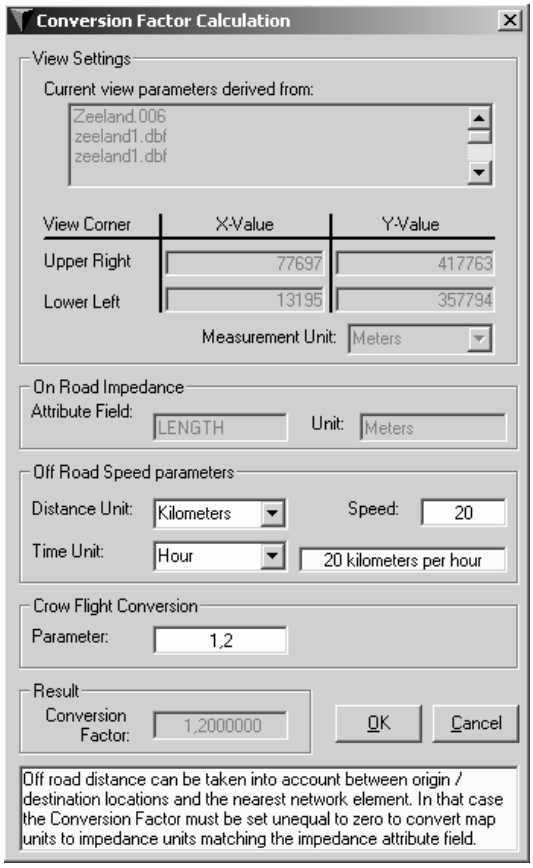
- **Select “Analysis” in the menu bar**
- **Click on “Transport Network Analysis”**

The “Transport Network Analysis” window appears.



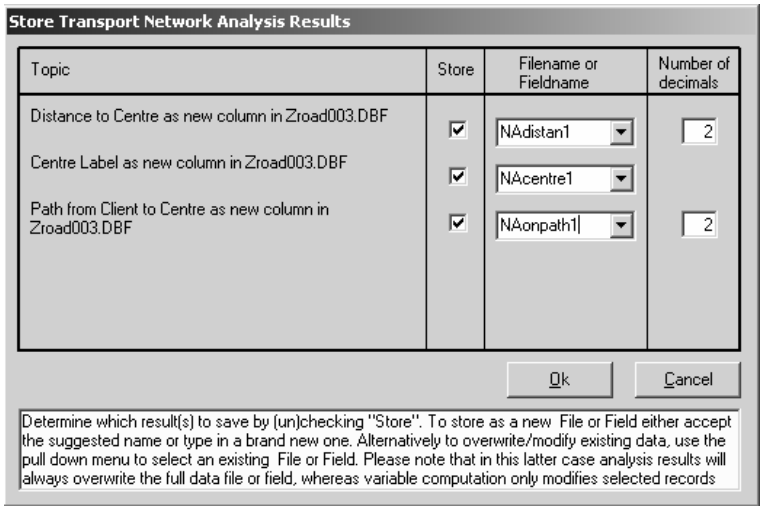
NOTE: *The option Transport Network Analysis can only be carried out when a map file containing ‘lines’ and an origin and a destination file are opened in the project.*

By default the ‘zoning’ and ‘districting’ options focus on destinations. You can change this to origins by clicking the appropriate button in the “File Information” box. In the “Parameter” box selections can be made regarding impendency, the connection method and the conversion factor. When the connection method “Lines” has been selected it becomes also possible to select an “Access Attribute”. With the “Access Attribute” box you can select a variable that indicates whether or not the mode of transport selected has access to a particular road segment; any non positive number indicates no access or no starting and stopping. When the right dataset is available it is also possible to distinguish between directions. This way it is possible to tell which direction the traffic will go. For example to tell the direction of a one-way road, to distinguish between height differences and the increase in travel time in a certain direction.



With the “Conversion Factor” you can either snap origin and destination location to the network, or to take the distance for that location to the nearest network node or line into account. If you want to snap, then use the default zero. If not, you must enter a positive multiplication factor based on the map units and the speed you assume vehicles/users will fetch outside the major network. By clicking the “Assist” button the “Conversion Factor Calculation” window appears.

First of all the map measure units and the unit of the impedance variable are repeated for your convenience. The measurement unit is the same as was set in the project.
In the “Off Road Speed parameters” box settings can be changed. For example we assume that the off-road speed for private cars is 20 kmph. And further assume that further off the road you can’t travel in a straight line but have to swerve around obstacles, so the “Airline Distance” (also called “Crow Flight Conversion Parameter”) is set at 1.2.



When all parameters are set correctly you can click on “Ok” twice and the “Store Transport Network Analysis Results” window pops up.
In this window you can change the filenames and select which file you want to be stored. If you leave the topic “Distance to Centre” checked, the results of the ‘zoning’ operation will be stored. If the topic “Centre Label” stays checked, the results of the ‘district’ operation will be stored and if the topic “Path from Client to Centre” the results of the

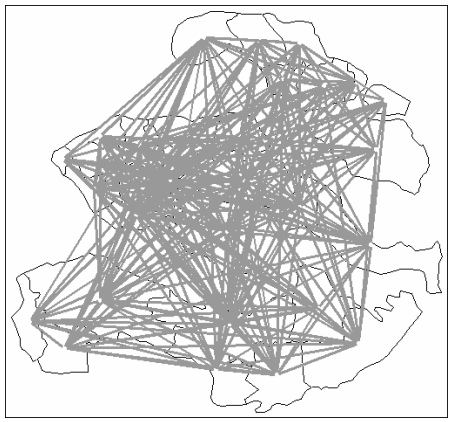
'shortest path analysis' will be stored. Click "Ok" to let Flowmap save the files and carry out the analysis.

After the analysis has been carried out the results can be drawn in a map as explained in section 2 of this manual. You get the best result by using the gradient drawing option.

9.7 Flow Assignment to Network

With the help of the 'Flow Assignment to Network' analysis it becomes possible to assign a flow file to a map file containing lines (a network). If you draw an ordinary flow file it connects everything with everything, it doesn't consider for example the road network. Once the flow file has been assigned to a network it does consider that network.

In this example we will need the following map files: Zeeland.006 (to draw the first map), Zroad.006, zeeland1.dbf as origin and destination file, and Migr9002.dbf as a flow file. How to edit a project and open the files is explained in section 1 of this manual.

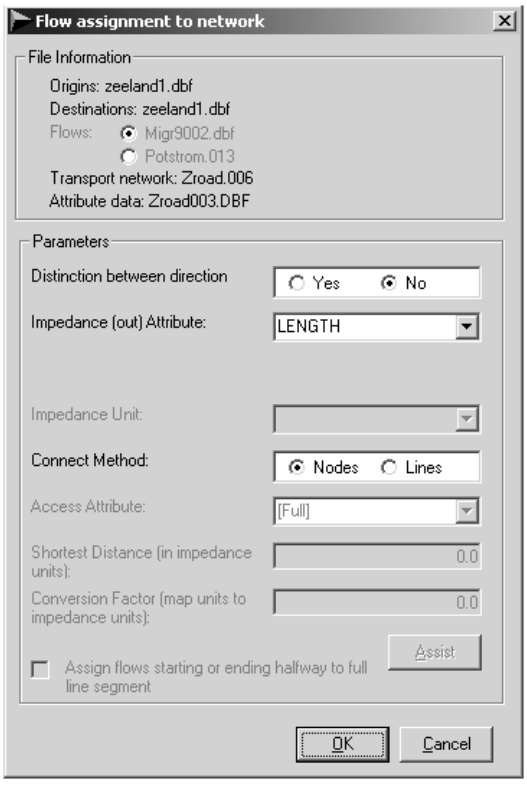


Once the project has been edited we will first draw the map file (Zeeland.006) and the flow file.

- **Draw the map file [Zeeland.006]**
- **Draw the desire lines from the flow file**

Now the map will look like the map on the right. Notice that the drawn flow file connects everything with everything.

- **Select "Maps" from the menu bar**
- **Click on "Remove Top Legend Entry"**
- **Edit the project and open [Zroad.006] instead of [Zeeland.006]**
- **Select "Analysis" from the menu bar**
- **Click on "Flow Assignment to Network"**



In the next window the fields containing the origin labels, destination labels and flow size can be selected.

- **Click on " Ok"**

Now the Flow assignment to network window pops up. Notice that this window is practically the same as the 'Transport Network Analysis' window as is discussed in the previous section. See the previous section for an explanation of the different options.

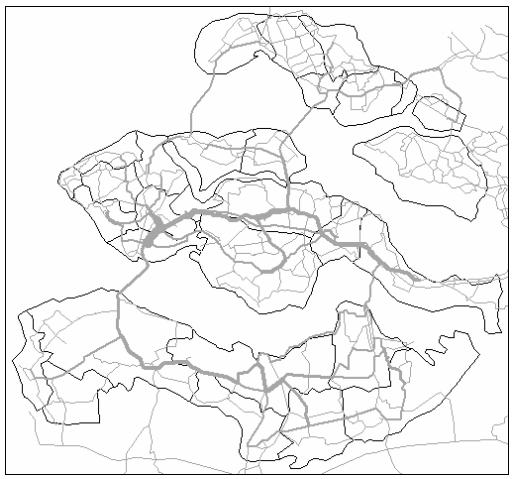
- **Click on "Ok"**

In the 'Store Flow Assignment Results' window you can check the topics which need to be stored. It is possible to store flows from both directions, flows from positive directions and/or flows from negative directions. For example, in case of traffic flows you can store traffic flows coming from both directions, traffic flows coming from

the left or traffic flows coming from the right. It is also possible to change the new fieldname or select an existing fieldname to be overwritten.

- **Leave the topic 'Flows in any direction' checked**
- **Change the fieldname or use the default field name [FAANYDIR]**
- **Click on "Ok"**
- **Click again on "Ok" in the Flowmap Report window**
- **Draw the map file using the "Gradient Drawing" option (Maps > Advanced Display > Draw Map File > Draw Edges/Lines > Gradient Drawing)**
- **Select the [FAANYDIR1] field in the "Select On" box in the 'gradient drawing' window**
- **Click on "Ok"**
- **Adjust the settings and click on "Ok"**

The map should now look like the picture on the right. Notice that the flows now follow more or less the road map. The flow file has successfully been assigned to the map file.



CHAPTER 10

Catchment Area Analysis

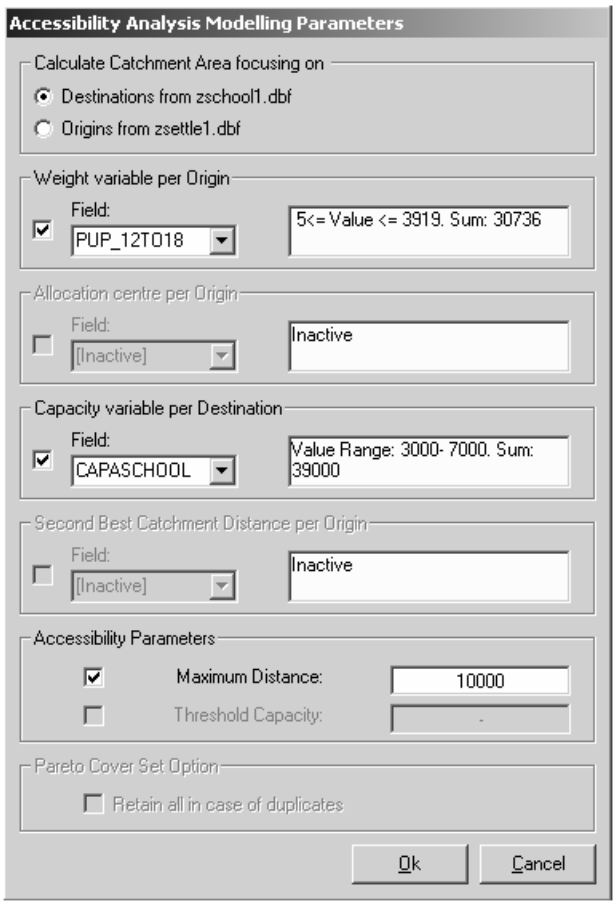
This chapter will discuss the catchment area analysis related functions. First we will look at the general catchment area analysis function. The second section we will look the catchment area analysis with linear optimization. The third section will look at alternate catchment locations. Finally we will discuss the second best analysis. The Pareto function is not yet available in Flowmap 7.

10.1 Catchment Area Analysis

A catchment area analysis allocates origins to the nearest destination. Contrary to proximity counts (section 11.4), in a catchment area analysis an origin can be allocated only to one single destination. Flowmap allows two bounds to be set:

A. A destination can have a maximum capacity. If this capacity is reached, the destination is not taken into account any longer in the remainder of the allocation procedure. The maximum capacity of a destination has to be retrieved from a variable (i.e. column) in the attribute file (???????1.DBF).
B. A destination can have a maximum reach. Origins that fall outside this reach cannot be allocated to this destination. The maximum reach must be set by the user and is equal for all destinations.

- **Click on "Analyses" in the menu bar**
- **Select "Catchment Areas Analyses"**
- **Click on "Regular Catchment Areas"**



A window pops up, shown on the next page, in which various settings can be made.

In the "Calculate Catchment Area focusing on" box the origins (ZSETTLE1.DBF) or the destinations (ZSCHOOL1.DBF) can be selected. If you select the destinations, the origins will be allocated to the destinations. If you select the origins, the destinations will be allocated to the origins.

NOTE: *The origins and destinations on which a distance matrix is based can be the exact same file. If that is the case, then it is not possible to choose either origins or destinations in the "Calculate Catchment Area focusing on".*

If the origins and destinations are not the same set:

- **Select either origins or destinations [ZSCHOOL1.DBF]**

This measure of accessibility also offers a choice between only counting origins or using a variable as a weighing factor.

- **Select either [Count] or a weight variable in the "Weight variable per Origin" box**
- **If you choose a weight variable, you must select the [PUP_12TO18] variable of which the values will be added up**

If you want to set maximum capacities to destinations, the box to the left of "Capacity Constraint" should be ticked. Then you can choose from variables stored in the attribute columns of the destinations file.

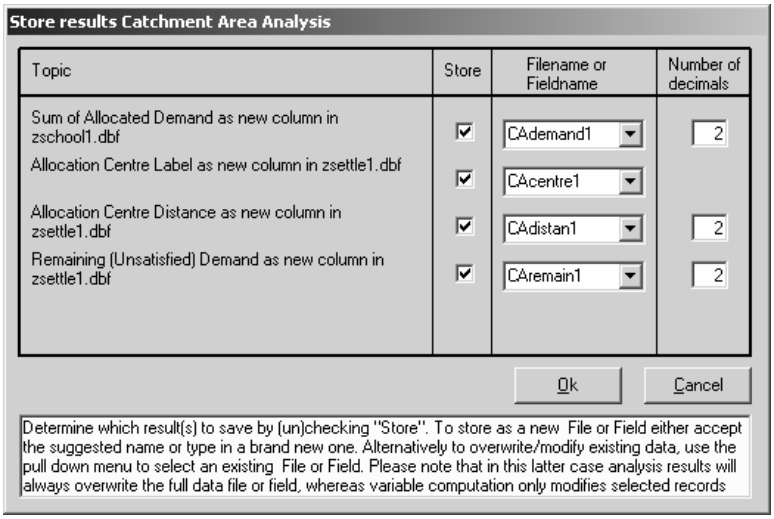
- **Tick the "Capacity variable per Destination" box or select a variable [CAPASCHOOL]**

In the "Accessibility Parameters" box, the maximum distance (distance constraint) can be entered. If you choose not to (because there is no constraint), then make sure the box "Distance Constraint" is not ticked.

- **Click on the tick to the left of "Maximum Distance" or enter a distance [10,000 (meters)]**
- **Click on "OK"**

NOTE: *The unit to be used for determining the value to be entered is the same that was used for building the distance matrix. Often these are meters (as in this example). If a different unit was used for building the distance matrix (kilometers, miles, yards, hours, minutes, etc.), the maximum distance value to be entered should be expressed in that same unit.*

A window pops up allowing you to save the results in an attribute file. You can choose between four options:



The first option (Sum of Allocated Demand) causes a variable to be added as an attribute column to the destination file (ZSCHOOL1.DBF). The numbers in this column will represent each destination location's <u>amount of *allocated* capacity</u>.

The second option (Allocation Center Label) causes a variable to be added as an attribute column to the origin file (ZSETTLE1.DBF). The values in this column will represent the destination to which the origin was allocated. The destination's key variable (i.e. the label) is used for this. If an origin cannot be allocated to a destination, because of distance restrictions, that location's value in the new column will be "No Allocation".

The third option (Allocation Center Distance), like the second, also causes a variable to be added as an attribute column to the origin file (ZSETTLE1.DBF). The values in this column will represent the distance from that specific origin to the destination to which it was allocated. If an origin cannot be allocated, that location's value in the new column will be -1.

The fourth option (Remaining Demand) causes a variable to be added as an attribute column to the origin file (ZSETTLE1.DBF). The values in this column represent the demand per origin, that was not allocated to one of the centers.

By selecting "Store", an new variable will be saved. If you want to save the new variable proceed as follows:

- **Select "Store"**

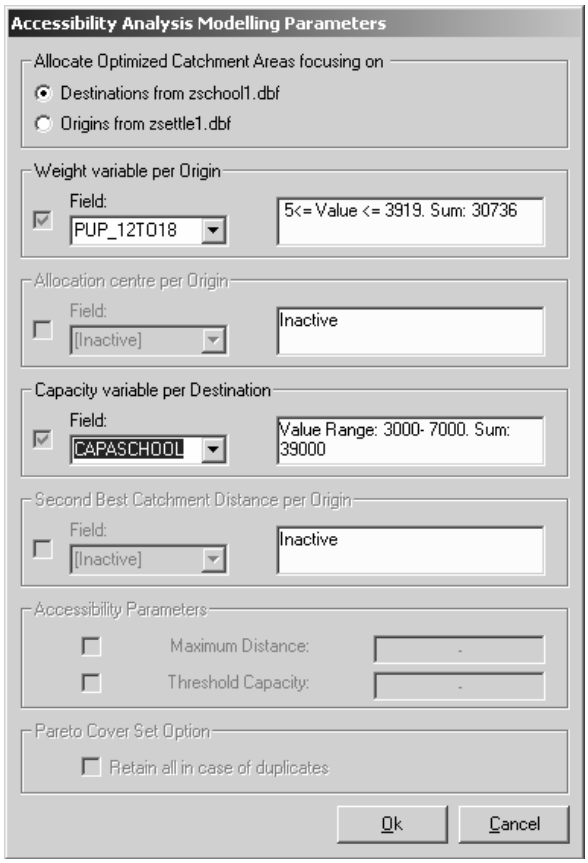
- **Enter a variable name in the "Filename or fieldname" entry box**
- **Enter the number of decimals with which the values should be stored**
- **Click on "OK"**

Now the "Flowmap7 Report" window appears, stating that the writing of the selected fields have been completed successfully.
- Click on "Ok"

You can view the results by opening the tables (Zschool1.dbf and Zsettle.dbf):
- **Select "File" in the menu bar**
- **Select "Table Manager"**
- **Click "View Table" and choose the appropriate file**

10.2 Catchment Area with Linear Optimization

If destinations have a maximum capacity, allocating origins to the nearest available destination, as is the case in a regular catchment analysis, is not always the best solution.
In a catchment area with linear optimization, however, origins are allocated to destinations in such a way that the total distance is as short as possible, thus reducing for example travel expenses.
- **Select "Analysis" in the menu bar**
- **Select "Catchment Area Analysis"**
- **Click on "Catchment Areas with Linear Optimization"**



A window pops up in which various settings can be made.

In the "Allocate Optimized Catchment Areas focusing on" box the destinations (ZSCHOOL1.DBF) or the origins (ZSETTLE1.DBF) can be selected. If you select the destinations, the origins will be allocated to the destinations. If you select the origins, the destinations will be allocated to the origins.

NOTE: *The origins and destinations on which a distance matrix is based can be the exact same file. If that is the case, then it is not possible to choose either origins or destinations.*

If the origins and destinations are not the same set:
- **Select either origins or destinations [ZSCHOOL1.DBF]**

Now, a choice can be made between either just counting the origins or destinations ([Count]) or using a related variable as a weighing factor.
- **Select either [Count] or a weight variable**
- **If you choose a weight variable, you must select the [PUP_12TO18] variable of which the values will be added up**

In the entry box “Capacity variable per Destination/Origin”, a maximum capacity for the destinations must be entered.

- **Select a variable [CAPASCHOOL]**
- **Click on “Ok”**

If supply and demand do not correspond, a window will appear stating that Flowmap will adapt the lowest value in order to correct this.

- **Click on “OK”**

In the window that appears next, the following results can be stored:

- The total number of origins per destination
- The label of the destination, to which the origin was allocated per origin
- The distance to the destination to which the origin was allocated per origin
- The shadow prize per destination (if the capacity of destination A is increased by one unit at the expense of the capacity of destination B, the total travel expenses increase by the difference between the shadow prizes A-B).
- The shadow prize per origin (if the capacity of origin A is increased by one unit at the expense of the capacity of origin B, the total travel expenses increase by the difference between the shadow prizes A-B).

By checking “Store”, a new variable will be saved. If you want to save the new variable and proceed as follows:

- **Select “Store”**
- **Enter a variable name in the “Filename or fieldname” entry box**
- **Enter the number of decimals with which the values should be stored**
- **Click on “OK”**

Now the “Flowmap7 Report” window appears, stating that the writing of the field has been completed successfully.

- **Click on “Ok”**

10.3 Alternate Catchment Locations

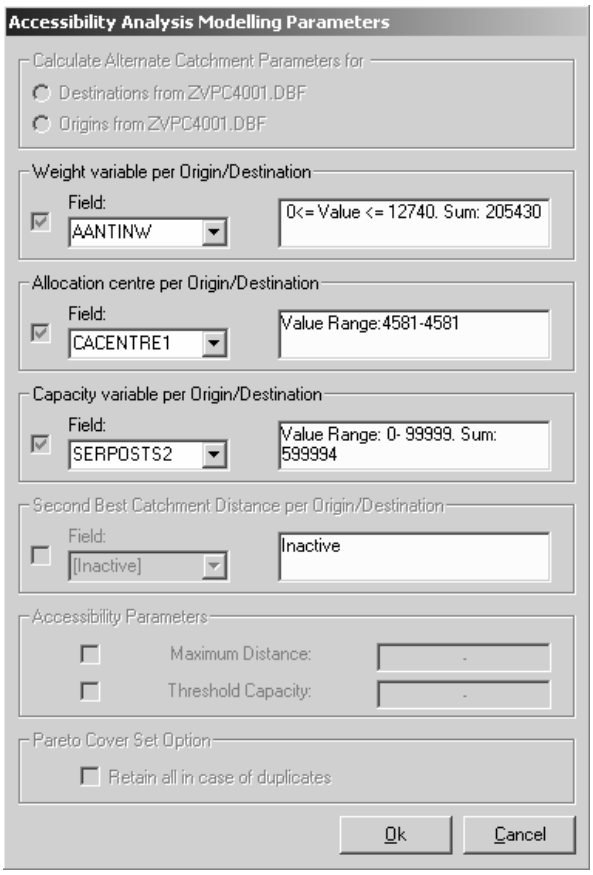
The alternate catchment location analysis consists of two different functions, the “Lowest Mean Trip Cost Alternate” and “Lowest Worst Case Cost Alternate”. The first will minimize the overall average distance, the second will minimize the worst case distance. This functionality determines for each catchment area the local average or worst case distance and inspects the catchment area for an alternate location that has a lower score on either average or worst case distance. If an alternate location has been found, the current location can be replaced by the lower scoring alternate location and the process can be repeated until no improvement from alternate locations can be reached. In order to carry out an alternate catchment location analyses a full catchment area analysis has to be carried out. See the beginning of chapter 10 for more information on catchment area analysis.

In this example we will need to create a new project with ZVPC.006 as map file, ANDTIJD.012 as a distance table and make sure that ZVPC4001.dbf is opened as origin and destination file.

NOTE: *The data used in this example is the same as in chapter 13. This example works best with multiple service posts (see chapter 13 for more info).*

After a full catchment area analysis the alternate catchment location analysis can be carried out. In this case the lowest mean trip cost alternate:

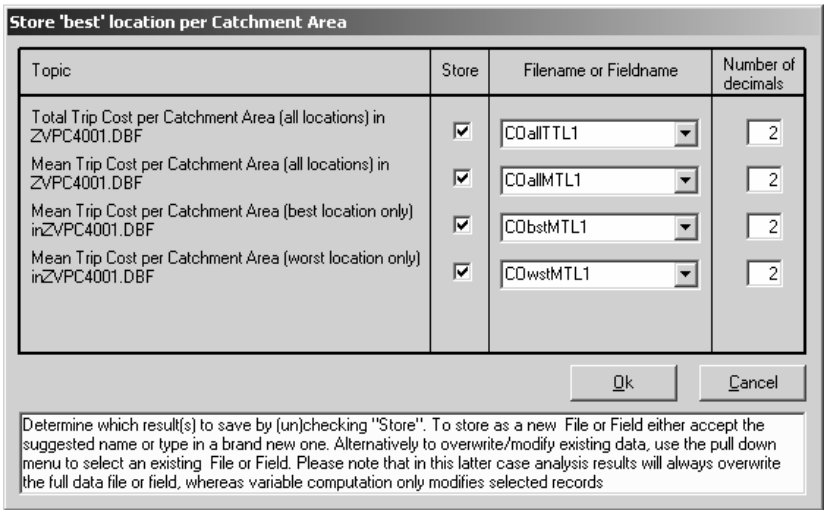
- **Select “Analysis” in the menu bar**
- **Select “Catchment Area Analysis”**
- **Select “Alternate Catchment Locations”**
- **Click on “Lowest Mean Trip Cost Alternate”**



The “Accessibility Analysis Modelling Parameters” window pops up in which certain settings can be made. As field containing the weight variable the “AANTINW” field needs to be selected, containing the number of inhabitants. As allocation centre the “CACENTRE1” field needs to be selected containing the new corresponding result from the catchment area analysis. The field containing the capacity variable will be “SERPOSTS1”.

- **Select “AANTINW” as weigh variable**
- **Select “CACENTRE1” as allocation centre**
- **Select “SERPOSTS1” as capacity variable**
- **Click on “Ok”**

A new window pops up in which the results can be stored. The first field will contain the total trip cost per catchment area. The second field will contain the average distance, in case the service location of its catchment area would be relocated to this location. The third field will contain the capacity value copied from “SERPOSTS1” in case a location holds the best score in its catchment area. The final field will contain the copied capacity value in case a location holds the worst score in its cathment area. The results corresponding with the first and last fields are rarely used.



- **Check the results which need to be stored**
- **Click on “Ok”**

The Flowmap report window will pop up containing an overview of the results.

- **Click on “Ok”**

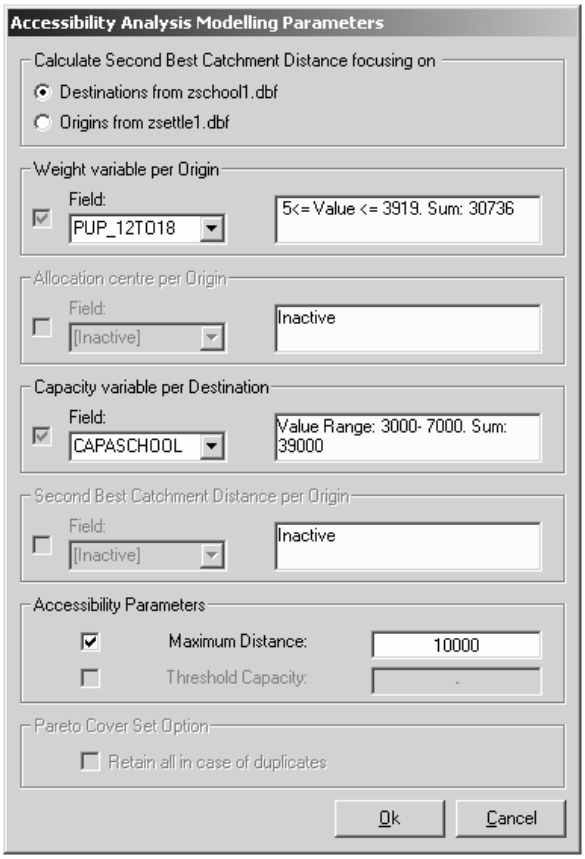
The Flowmap report window will pop up stating that the analysis has been carried out successfully.

- **Click on “Ok”**

10.4 Second Best Analysis

The second best analysis calculates the effect when a location closes down. First a regular accessibility analysis will be carried out before the final second best analysis will take place.

- **Select "Analysis" in the menu bar**
- **Select "Catchment Area Analysis"**
- **Select "Second Best Analysis"**
- **Click on "Second Best Catchment Distance"**



The "Accessibility Analysis Modelling Parameters" window will pop up which is practically the same as in the previous two paragraphs (See previous paragraphs for a detailed description).

If the origins and destinations are not the same set:

- **Select either origins or destinations [ZSCHOOL1.DBF]**

Now, a choice can be made between either just counting the origins or destinations ([Count]) or using a related variable as a weighing factor.

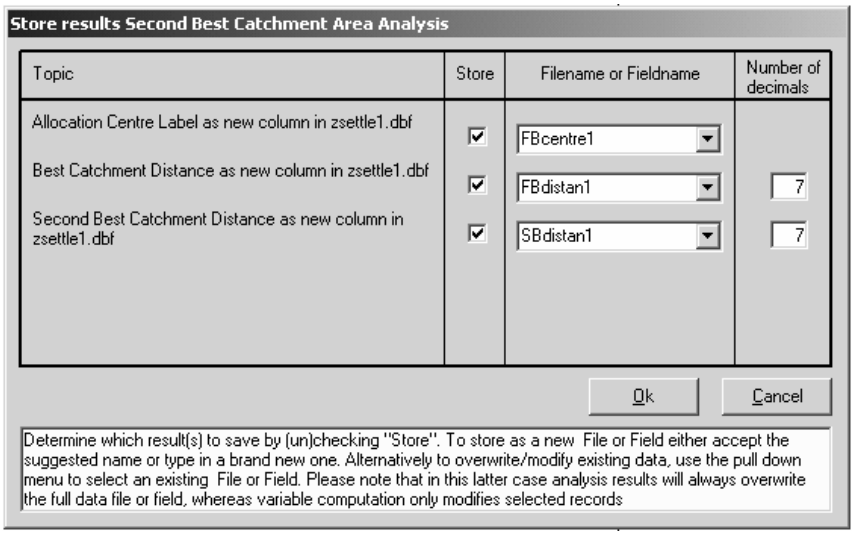
- **Select either [Count] or a weight variable**
- **If you choose a weight variable, you must select the [PUP_12TO18] variable of which the values will be added up**

In the entry box "Capacity variable per Destination/Origin", a maximum capacity for the destinations must be entered.

- **Select a variable [CAPASCHOOL]**

In the "Accessibility Parameters" box a maximum distance can be selected. In this example we will set a maximum distance of 10 kilometers:

- **Check "Maximum Distance in the "Accessibility Parameters" box**
- **Enter 10000 as maximum distance**
- **Click on "Ok"**



The “Store results Second Best Catchment Area Analysis” window pops up, the following results can be stored:

- The allocation centre label, which will be the first best centre.
- The best catchment distance, which will be stored at first best distance.
- The second best catchment distance, which will be stored as second best distance.

CHAPTER 11
Accessibility Analysis

This chapter discusses the accessibility analyses supported by Flowmap. First the necessary settings for these analyses will be dealt with. After that catchment profiles, location profiles, proximity counts, proximity counts in competition, regular threshold distances, threshold distances in competition, proximity coefficients, catchment area analyses, catchment area with linear optimization, origin constrained potential models, destination constrained potential models and "Gravity Surface Analyses" will be discussed. The Zeeland situation will serve as an example.

11.1 Settings for Accessibility Analysis

Accessibility analyses can only be carried out if a Distance Matrix is opened. Opening a distance matrix was already discussed in section 1.2.1, but it will now be repeated briefly:

- **Select "File" in the menu bar**
- **Select "Edit Project"**
- **Click in the white box beneath "Distance Table"**
- **Select a distance matrix [ZSCHOOL.011] in the "Open Distance Table"**
- **Click on "Open"**
- **Click on "Save"**

NOTE: *A distance table always refers to a specific map of origins, and a specific map of destinations. If those maps have not been opened yet, Flowmap automatically opens these upon opening a distance matrix. If non-related origin or destination maps were already opened, Flowmap closes these maps automatically and opens the origins and destinations maps that do relate to the distance matrix.*

For most of the examples in this chapter, the distance matrix ZSCHOOL.011 must be opened. It contains airline distances between settlements and secondary schools in the Zeeland province. This matches the (automatically) opened origins and destinations files, ZSETTLE1.DBF and ZSCHOOL1.DBF respectively.

In addition, the examples in sections 11.7, 11.9 and 11.10 use the distance matrix ZEEHEX.011. This matrix contains airline distances between settlements in the Zeeland province (ZSETTLE1.DBF) and (centroids of) a hexagonal tessellation of the Zeeland area (ZEEHEX01.DBF: see chapter 6). These hexagons are used for potential locations for a new secondary school in the Zeeland province.

The section on potentials (11.9) uses the distance matrix ZROADDIS.012, containing distances between the Zeeland municipalities (ZEELAND1.DBF), measured in meters over a network.

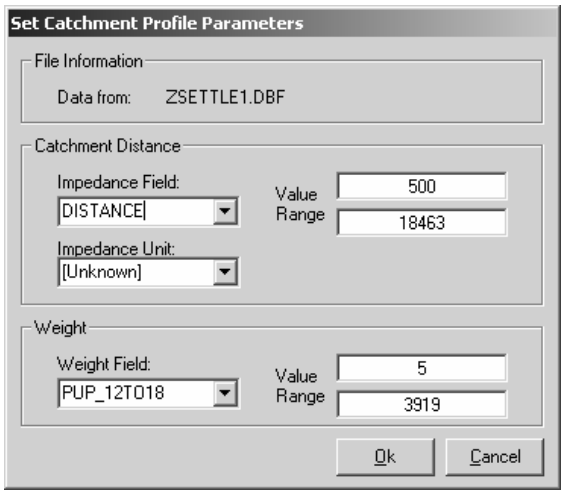
To carry out an accessibility analysis, neither a map file nor a flow data file needs to be opened.

11.2 Catchment Profile

A catchment profile is a cumulative graph, displaying the distance between the origins and the nearest destination. This is shown by means of distance classes.

This is how to calculate a catchment profile:

- **Click on "Graphs" in the menu bar**
- **Select "Catchment Profile (Overall)"**



The window to the right pops up in which various settings can be made.

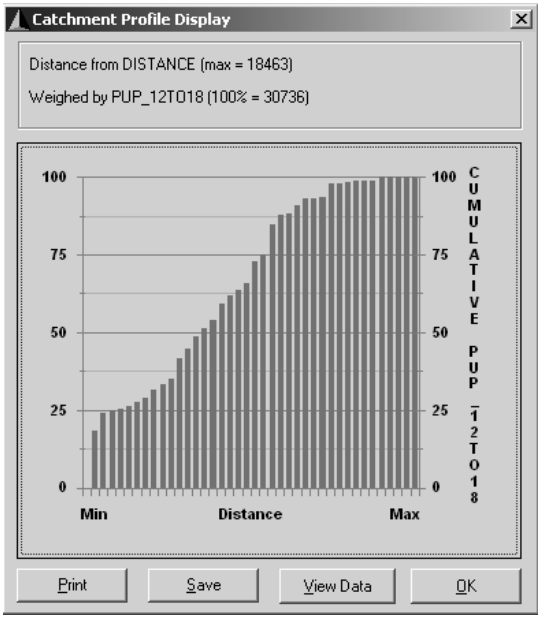
In the "Catchment profile type" box, one of two options can be chosen: "Frequency" and "Weight". If you select "Frequency", the number of origins for each distance class is displayed in the graph. If you select "Weight", a variable must be selected. Subsequently, the values of this variable for each distance class are displayed in the graph.

- **Select either "Frequency" [count] or "Weight" [Weight]**
- **If you select "Weight", you must enter a variable in the "Weight Field" box the values of which will be added up [PUP_12TO18]**

In the "Distance field" box, a variable must be selected, displaying the distance to the nearest destination for each origin. If no variable is available, a catchment analysis should be carried out first.

- **Select a variable in the "Distance field" box [DISTANCE]**
- **Click on "OK"**

The catchment profile appears. The X-axis is divided into forty distance classes. The Y-axis is divided into index numbers (from 0 to 100), representing the cumulative number of origins per distance class.



At the top of the window you can see the maximum distance between an origin and the nearest destination, as well as the total number of origins.

In this example, the class width is approx. 462.5 meters (minimal distance is 0 meter, maximum distance is about 18.5 kilometers, 40 classes are shown in the graph: 18.5/ 40 = 0.4625 kilometers).

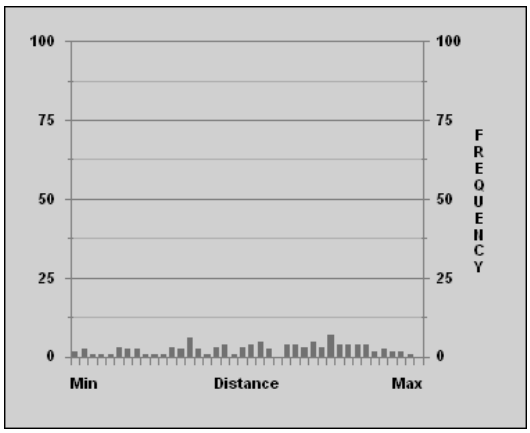
From this graph, you can conclude whether many origins are relatively far from the nearest destination, or relatively close. If the profile is convex, many destinations are relatively near to many destinations. If the profile is concave, few origins are relatively close to the nearest destination.

In the box “Highlighted Bar Properties” you can enter a percentage of origins in the “Cumulative” field. Click on “Update” and in the box “Distance Range” you will see the bounds of the distance class for this percentage.

- **Click on “OK”**

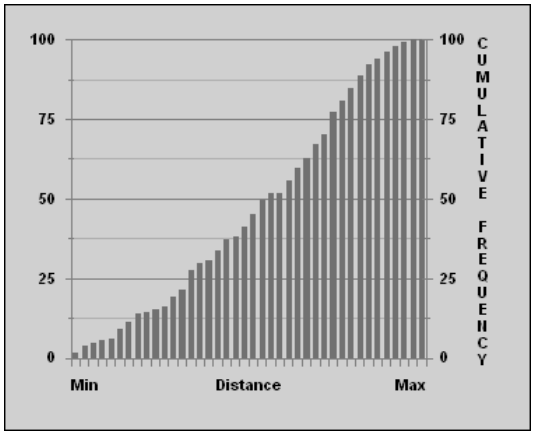
11.3 Location Profile

A location profile is a graph that always deals with just one single destination. The graph shows *how far* the various origins are apart from the destination concerned. This is shown by means of distance classes.



An example of a location profile is shown to the right. The X-axis is divided into forty distance classes. The Y-axis is divided into index numbers (from 0 to 100), representing the number of origins per distance class.

The profile can also be displayed in cumulative fashion. Flowmap also displays this cumulative graph when the location profile has been calculated.
The shape of the cumulative location profile provides some information on the centrality of the destination. If the profile is convex, the destination is close to many origins, meaning destination is located centrally.
If the profile is concave, the origins are further away from the destinations, so then the destination is not central. The graph shown on the right is a location profile of such a destination that is not central.



This is how to calculate a location profile:

- **Click on “Graps” in the menu bar**
- **Select “Location Profiles (Individual)”**

The window at the next page pops up in which various settings can be made.

In the “Display Location Profiles for” box either the destinations (ZSCHOOL1.DBF) or the origins (ZSETTLE1.DBF) can be selected. If the location profiles of the destinations should be displayed, then select the destinations (ZSCHOOL1.DBF). If location profiles of the origins should be displayed, then select the origins (ZSETTLE1.DBF).

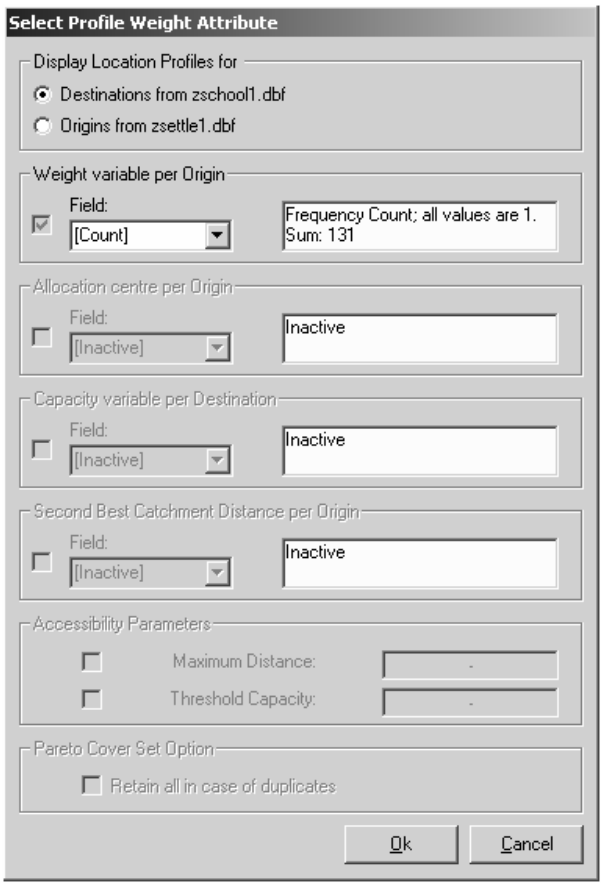
NOTE: *The origins and destinations on which a distance matrix is based can be the exact same file. If that is the case, then it is not possible to choose either origins or destinations in the “Display Location Profiles for” box.*

If the origins and destinations are not the same set:

- **Select either the origins or the destinations [ZSCHOOL1.DBF]**

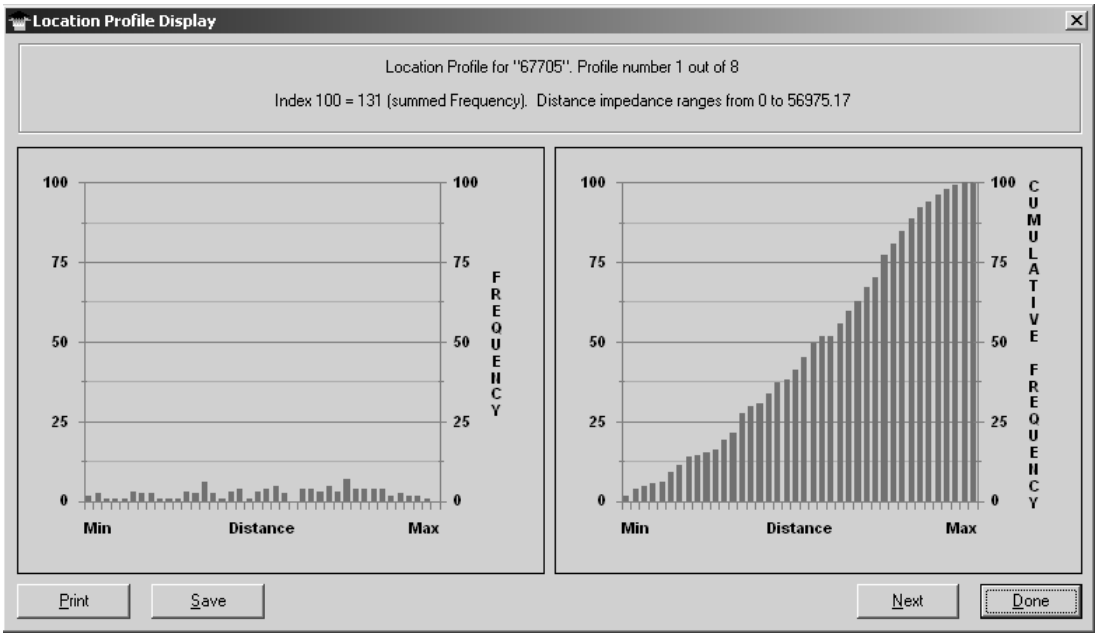
In the box below the one we have just dealt with, you can select [Count] or a weight variable. If you select [Count], the graph will display the number of origins or destinations per distance class. Or you can select a weight variable. The graph will then display that variable's values relating to the origins or destinations per distance class.

- **In the "Weight variable per Origin" box select under field either "Count" for a frequency count or another field as a weight variable**
- **If you select another field as a weight variable, then select "PUP_12TO18" of which the values will be added up**
- **Click on "OK"**



A "Profile Selection" window pops up in which you can select the parameters of the location profile which you want to be displayed.

- **Select [label] in the "Select Attribute" box**
- **Select [67705] in the "Select Object" box**
- **Click on "OK"**



The window above shows all this. The graph's header provides some further information. It is the first of eight school location profiles (the key variable is 67,705, which is a school located in the municipality of Hulst).
Also, the variable PUP_12TO18 was used as a weighing factor. The Y-axis has a maximum of 38,024 pupils, on which the index 100 number is based. The X-axis has a minimum distance of 0 and a maximum distance of almost 57 kilometers.
The class width in this example is about 1.4 kilometers (the minimum distance is 0 meters,

the maximum distance is about 57 kilometers, 40 classes are displayed: 57 / 40 ≈ 1.4 kilometers).
Below the graph two buttons are shown. You can print the location profile display by pressing the “Print” button or save it as a bitmap (.bmp) or jpeg (.jpg) by pressing the “Save” button. Pressing the “Next” button returns you to the “Profile Selection” window in which you can make another profile selection. This way all location profiles (in this case 8) can be shown. By pressing the “Done” button you can exit the display procedure at any moment.

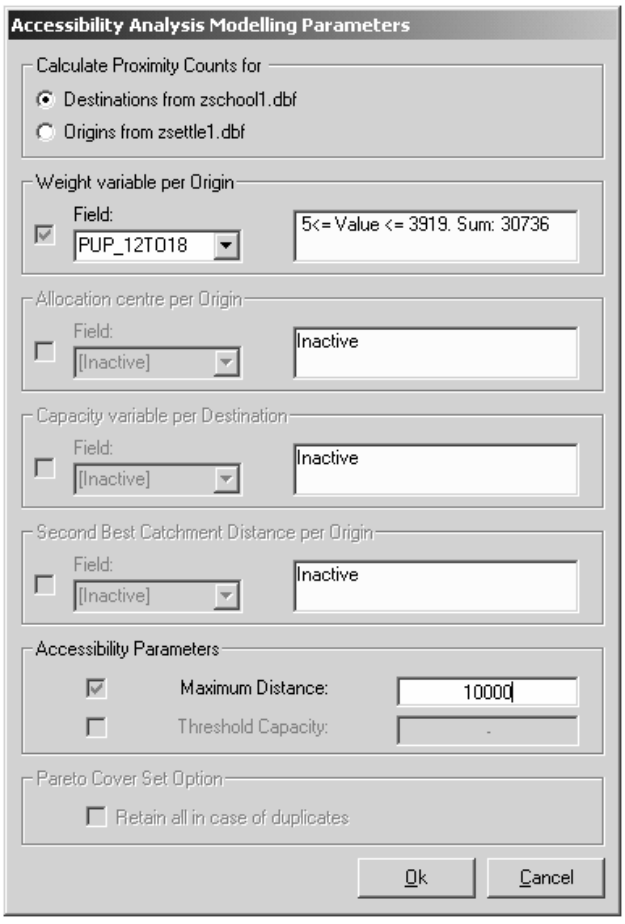
11.4 Proximity Counts

A proximity count is a measure representing the number of origins within a user-defined distance of each destination.
Instead of the number of origins, a related variable can be used, for instance the number of inhabitants of the origins involved. Then, instead of the number of origins, the number of inhabitants within that user-defined distance is counted.
A proximity count thus gives an indication of a potential market. Competition between the various destinations does not matter in a proximity count. This implies that if an origin is located within the defined distance of two destinations (schools, for example), it (or the number of inhabitants) will be included in the count of both destinations.
The distance that is to be defined matters a great deal. If this is set too large, all origins will be within the reach of the destinations. All destinations’ proximity counts then will be the same.

Actually, proximity counts can also be calculated the other way round, meaning that for every origin the number of destinations within a certain reach will be counted. Thus, there are two ways to calculate a proximity count:

1. The number of origins within reach of certain destinations using a certain pre-determined distance is counted.
2. The number of destinations within reach of certain origins using a certain pre-determined distance is counted.

- **Click on “Analysis” in the menu bar**
- **Select “Regular Accessibility Measures”**
- **Click on “Regular Proximity Count”**



The window to the right pops up in which various settings can be made.
In the box “Calculate Proximity Counts for” either the origins (ZSETTLE1.DBF) or the destinations (ZSCHOOL1.DBF) can be selected. If you want to know how many origins are within reach of a destination, then select the destinations (ZSCHOOL1.DBF). If you want to know how many destinations are within reach of an origin, then select the origins

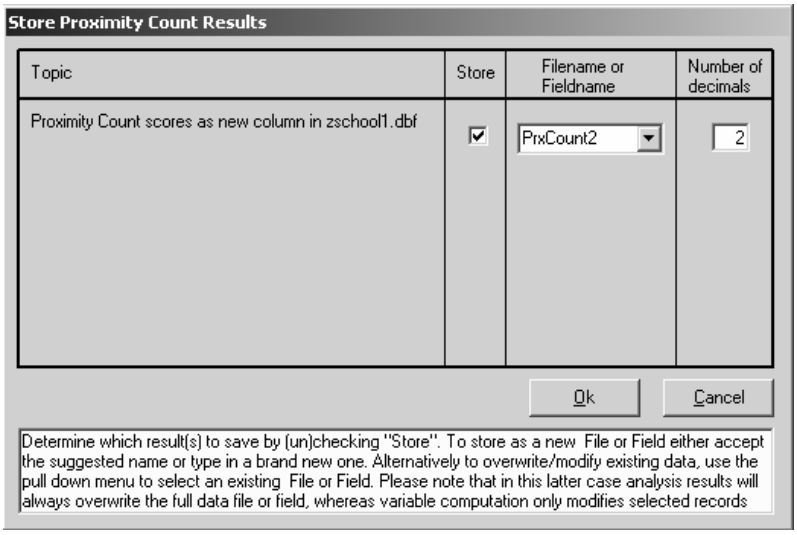
(ZSETTLE1.DBF).
NOTE: *The origins and destinations on which a distance matrix is based can be the exact same file. If that is the case, then it is not possible to choose either origins or destinations in the "Calculate Proximity Counts for" box.*

If the origins and destinations are not the same set:
- **Select either origins or destinations [ZSCHOOL1.DBF]**

In the box "Main Parameters" the maximum distance between the origins and the destinations for calculating the proximity counts should be entered.
- **Enter a distance [10,000 (meters)]**

NOTE: *The unit to be used for determining the value to be entered depends on the unit that was used for building the distance matrix. Often these are meters (as in this example). If a different unit was used for building the distance matrix (kilometers, miles, yards, hours, minutes, etc.), the maximum distance value to be entered should be expressed in that same unit.*

In the box below the one we have just dealt with, you can either select "Count" or a weight variable. If you select "Count", the origins or destinations are counted. If you select a weight variable, that variable's values relating to the origins or destinations within the maximum reach will then be added up.
- **Select either "Count" or a weight variable**
- **If you select a weight variable, you must select [PUP_12TO18] of which the values will be added up**
- **Click on "Ok"**



A window pops up allowing you to save the results in an attribute file. By checking "Store", an new variable is saved. To store as a new file or field you can accept the suggested name or enter a new name in the "Filename or Fieldname" box. In the box "Number of decimals" you can set the number of decimals in which the results will be shown. To store the file proceed as follows:
- **Check "Store"**
- **Enter a variable name in the "Filename or fieldname" entry box [PUPILS10KM]**
- **Enter the number of decimals with which the values should be stored [0]**
- **Click on "OK"**

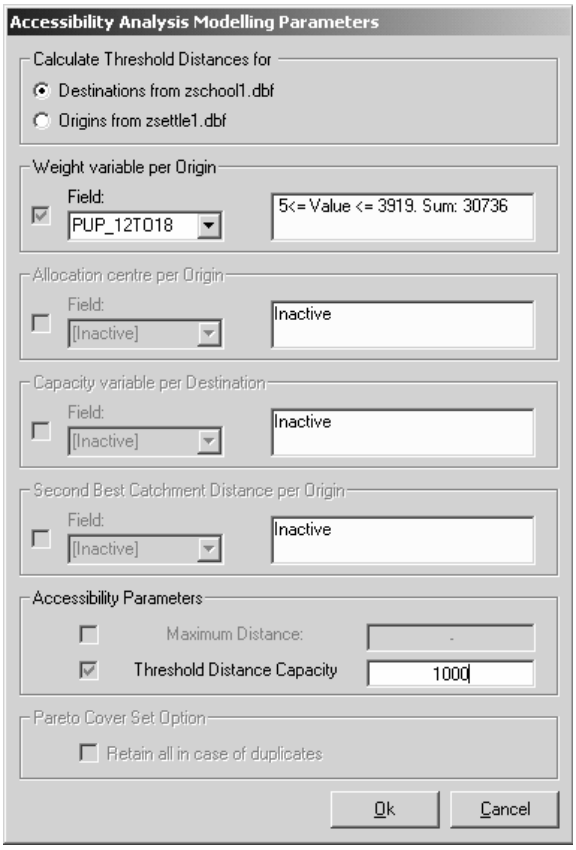
Now the "Flowmap7 Report" window appears, stating that the writing of field PUPILS10KM has been completed successfully.
- **Click on "Ok"**

11.5 Threshold Distance

A “Regular threshold distance” represents the distance around the destination up to which origins are required to reach a preset threshold value. Competition between different destinations is not taken into account. So if two destinations require a certain origin in order to reach their threshold value, this origin is counted for both destinations.

- **Edit the current project and open (once more) the distance table “ZSCHOOL.011”**
- **Select “Analysis” in the menu bar**
- **Select “Regular Accessibility Measures”**
- **Select “Threshold Distance”**
- **Click on “Regular Threshold Distance”**

A window pops up in which various settings can be made.



In the box “Calculate Threshold Distances for” either the destinations (ZSCHOOL1.DBF) or the origins (ZSET-TLE1.DBF) can be selected. If you want to calculate the maximum distance for which origins are needed in order to reach the threshold level, then select the destinations (ZSCHOOL1.DBF). If you want to know the distance to a predetermined number (threshold level) of destinations, select the origins.

NOTE: *The origins and destinations on which a distance matrix is based can be the exact same file. If that is the case, then it is not possible to choose either origins or destinations in the “Calculate Proximity Coefficients for” box.*

If the origins and destinations are not identical:

- **Select either the origins or the destinations [ZSCHOOL1.DBF]**

While calculating a “Threshold Distance” a choice can be made in the “Weight variable per Destination” box between either just counting the origins or destinations or using a related variable as a weighing factor.

- **Select either [Count] or choose a weight variable**
- **If you choose a weight variable, you must select the [PUP_12TO18] variable of which the values will be added up**

In the box “Accessibility Parameters”, the threshold level, the minimally required number, must be entered for the destination.

- **Enter a number [1,000 (pupils)]**

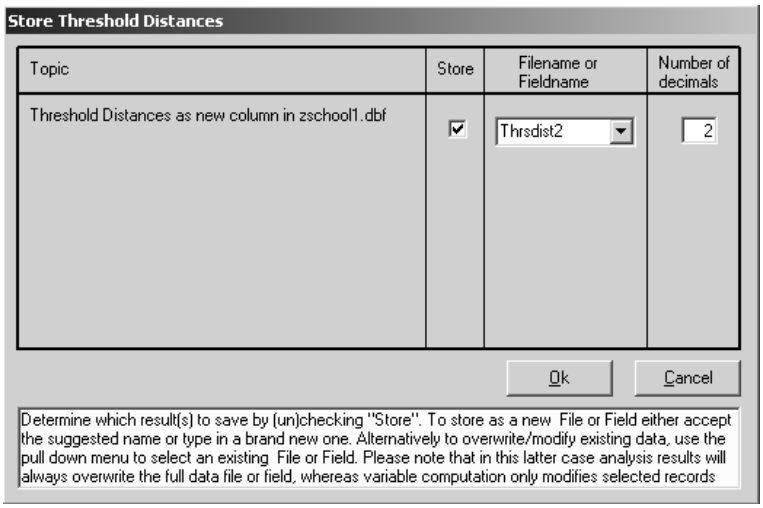
The number 1,000 in this example represents the number of pupils between 12 and 18 years old that is minimally required for a school.

- **Click on “OK”**

The window “Store Threshold Distances” now pops up.

By checking “Store”, the new variable and distances will be saved. To store the file proceed as follows:

- **Check “Store”**
- **Enter a variable name in the “Filename or fieldname” entry box [PUPILS10KM]**
- **Enter the number of decimals with which the values should be stored [0]**
- **Click on “OK”**



Now the “Flowmap7 Report” window appears, stating that the writing of field PUPILS10KM has been completed successfully.

- **Click on “Ok”**

You can view the results by opening the table (Zschool1.dbf):

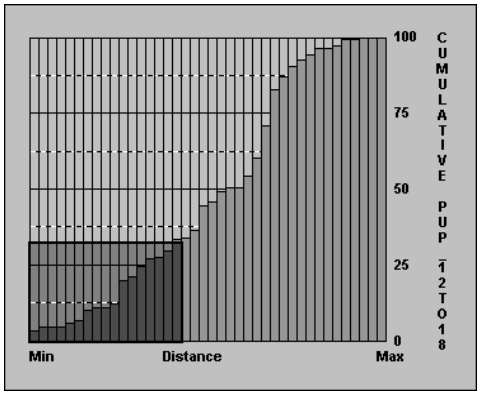
- **Select “File” in the menu bar**
- **Select “Table Manager”**
- **Click “View Table”**

A window pops up in which you can select and open the table (Zschool1.dbf). The table now contains a column with the new calculated variable. The values thus stored in the new column represent for each school the distance from which pupils should come in order to reach the threshold value of 1,000 pupils.

11.6 Proximity Coefficients

Location profiles, which were discussed in section 11.3, show the proximity of *all* surrounding origins. However, usually a service provider (for instance, a school) is not interested in how close all origins are, but only in those within a certain reach. For example, for a secondary school the number of pupils between 12 and 18 years old at a distance of more than 30 kilometers away is not relevant. Most probably these pupils will not go to this school anyway.

To get a better insight into the proximity of the real market, it could for instance be sufficient to take into account only those pupils that reside within an (airline) distance of 10 kilometers from the school. Thus, the location profile only applies to a distance of 10 kilometers on the X-axis. On the Y-axis, the location profile is only relevant until it reaches a certain threshold, for instance the school’s capacity; the number of pupils it can host.



Actually, only a small part of the location profile really matters. Let us take a closer look at that part of the curve that is of interest to us. In the figure below it is displayed graphically. The dark part of the graph is what we will be focusing on.

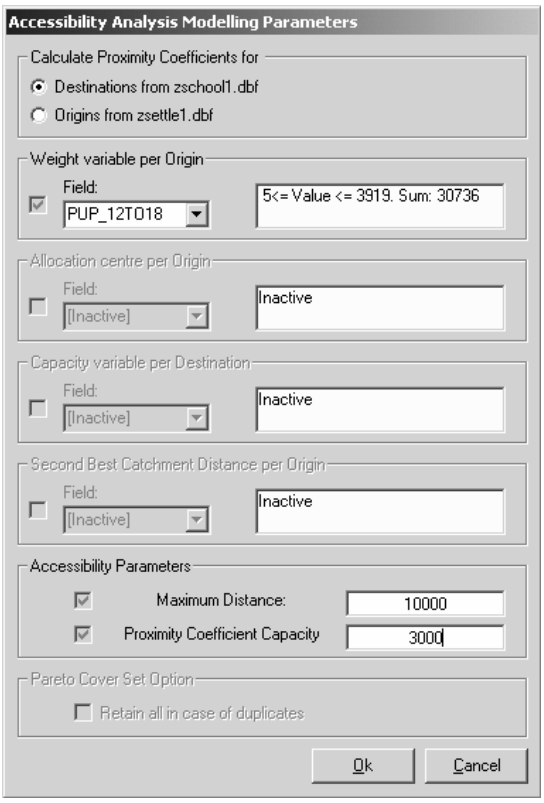
If the partial graph's surface below the curve (i.e. the bars in the dark area) is divided by the entire surface of the partial graph (i.e. the dark area as a whole), then that results in a percentage. This percentage is an indicator of the proximity of the potential market of the service provider. This percentage is called the proximity coefficient.

A percentage of 100 implies that the threshold level (the preferred number of pupils) is reached within a very short distance. A lower percentage indicates that the preferred number of pupils live further away from the school. A proximity coefficient of zero means that no pupils between 12 and 18 years old live within a distance of 10 kilometers of the school.

NOTE: *When determining the proximity coefficient Flowmap does not only consider the filled part of the partial graph. Whether or not the threshold value is reached within the predefined distance is also taken into account. Even if the proximity coefficient is very high, the threshold level might not be reached. In that case, the market is quite close to the service provider, but it is just not big enough. Flowmap then displays the proximity coefficient as a negative percentage. This does not imply that the percentage itself is smaller than zero; it only means that the threshold level was not reached within the distance that was set.*

- **Open (once more) the distance table "ZSCHOOL.011" in the project window**
- **Click "Analysis" in the menu bar**
- **Select the "Regular Accessibility Measures" option**
- **Select the "Proximity Coefficients" option**

A window pops up in which several settings can be made.



In the box "Calculate Proximity Coefficients for" either the origins (ZSETTLE1.DBF) or the destinations (ZSCHOOL1.DBF) can be selected. If you want to know the proximity coefficients for the destinations, then select the destinations (ZSCHOOL1.DBF). If you want to know the proximity coefficients for the origins, then select the origins (ZSETTLE1.DBF).

NOTE: *The origins and destinations on which a distance matrix is based can be the exact same file. If that is the case, then it is not possible to choose either origins or destinations in the box "Calculate Proximity Coefficients for".*

If the origins and destinations are not the same set:

- **Select either origins or destinations [ZSCHOOL1.DBF]**

When calculating this accessibility measure a choice can be made between either just counting the origins or using a related variable for weighing the origin.

- **Select either [Count] or a weight variable**
- **If you choose a weight variable, you must select the [PUP_12TO18] variable of which the values will be added up**

In the box “Accessibility Parameters” the maximum distance between the origins (ZSETTLE1.DBF) and the destinations (ZSCHOOL1.DBF) for calculating the proximity coefficients should be entered.

- **Enter a distance [10,000 (meters)]**

NOTE: *The unit to be used for determining the value to be entered depends on the unit that was used for building the distance matrix. Often these are meters (as in this example). If a different unit was used for building the distance matrix (kilometers, miles, yards, hours, minutes etc.), the maximum distance value to be entered should be expressed in that same unit.*

In the “Accessibility Parameters” box, in the entry box to the right of “Proximity Coefficient Capacity”, the preferred number of origins within the set distance should also be entered. If you have selected “Frequency”, you can just enter the *number of origins* from which the destinations should be reached.
If you have selected a weight variable, the preferred value, based on the chosen weighing factor, should be entered.

- **Enter a number [3,000 (pupils)]**

In this example, the number 3,000 represents the preferred number of pupils in the age class of 12 to 18 years old that should reside close enough to the school.

- **Click on “OK”**

The window “Store results Proximity Coefficient calculation” pops up.

By checking “Store”, the new variable and distances will be saved. To store the file proceed as follows:

- **Check “Store”**
- **Enter a variable name in the “Filename or fieldname” entry box or accept the suggested name**
- **Enter the number of decimals with which the values should be stored**
- **Click on “OK”**

Now the “Flowmap7 Report” window appears, stating that the writing of the field has been completed successfully.

- **Click on “Ok”**

11.7 Potential Models

Potential values indicate the proximity to a potential market. Two approaches are possible. On the one hand, proximity to a potential market of consumers might be of interest. For example, companies usually want to know from which location they can reach a maximum number of consumers. Such an approach calls for an origin constrained model.
On the other hand, proximity to a potential producer’s market might be the issue. For instance, city planners may want to find out which location is suitable for new residential development in the proximity of sufficient employment opportunities. In that case it might be of interest that potential employment opportunities are located not too far from the new residential area. Such an approach calls for a destination constrained model.
Potential values only have meaning in relation to each other. A value gives an indication of the centrality of a destination in comparison to the centrality of other destinations that was calculated in the same analysis. The location that is the most central with regard to the potential market gets the highest value. After that, all the other destinations potential values are scaled to that value. Potential values are always non-negative numbers.

11.7.1 An Origin Constrained Potential Model

First an origin constrained potential model will be discussed in brief. This will be followed by the procedure to carry out using Flowmap.

An origin constrained potential model consists of the following formula:

$P_j = \Sigma_i O_i * f(C_{ij},\beta)$ (1)

$f(C_{ij},\beta) = \exp(-\beta * C_{ij})$ in case of an exponential function
$f(C_{ij},\beta) = C_{ij}^{-\beta}$ in case of a power function

where:
P_j = Potential value for destination location j
O_i = Production value of origin location i
β = The distance decay parameter
C_{ij} = Distance between origin i and destination j

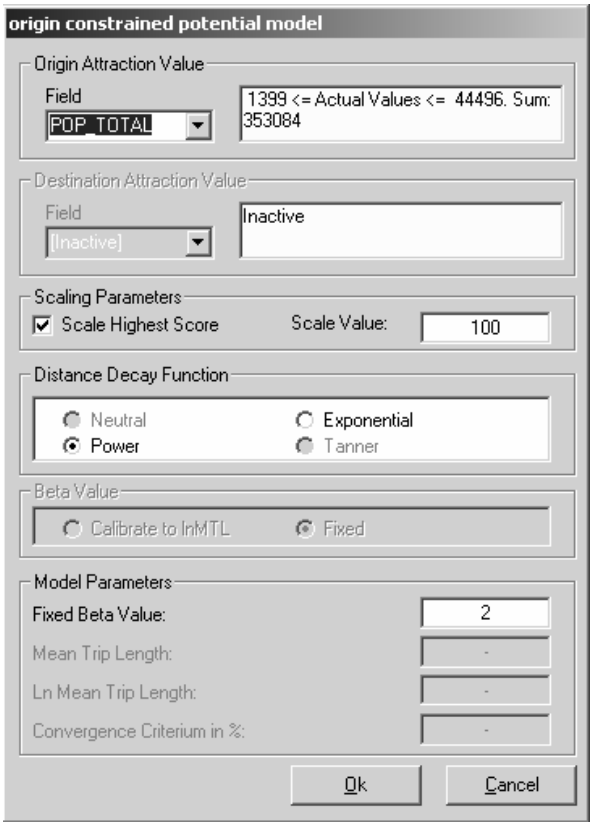
Thus, the potential value of destination j depends on the production values (for instance, a municipality's residential population) of *all* origins and the distances between the origins and the destination concerned. Also, the distance decay parameter plays a role in representing the importance of distance. A distance decay parameter indicates how important distance between origins and destinations is. If distance between origins and destinations is not very important, there is not much distance decay. The distance decay parameter then approximates zero. If distance between origins and destinations is important, this means there is a great deal of distance decay, resulting in a larger distance decay parameter.

NOTE: *The magnitude of the distance decay parameter is not dependent only on distance decay, but also on the unit in which distance is expressed. If distance is expressed in meters, the distance decay parameter is smaller than if it were put in kilometers. This should be taken into account when comparing two distance decay parameters.*
The examples in this section are all based on the distance matrix ZROADDIS.012, containing distances between the Zeeland municipalities measured in meters over a network.

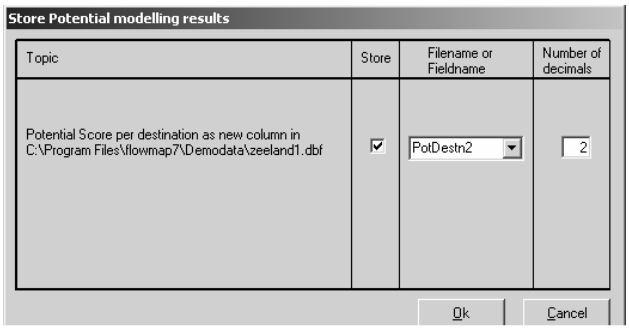
This is how you run an origin constrained potential model:

- **Configure the project and enter [Zroaddis.012] as the distance matrix**
- **Select "Analysis" in the menu bar**
- **Select "Regular Accessibility Measures"**
- **Select "Potential Scores"**
- **Click on "Origin Constrained Potential Model"**

A window pops up in which various



settings can be made.



In the "Origin Attraction Value" box, an origin constraint must be entered.

- **Select an origin constraint in the "Origin Attraction Value" box [POP_TOTAL]**

In the "Origin Attraction Value" box some statistics of the selected variable are shown. In this example, the total number of people stored in variable POP_TOTAL is 353,084. This is the total number of inhabitants of the Zeeland province. The minimum number of residents in a Zeeland municipality is 1,399 and the maximum is 44,496.

The default value in the "Scale to highest Score" box is 100. This indicates that every destination (in this case, every municipality) will get a potential value scaled between 0 and 100. Unless there is a good reason to do so, this number should not be changed.

In the "Distance Decay Function" box four types of functions can be chosen for distance decay. The first one is the Neutral Function. This is used only in gravity modeling (see Chapter 12). Running a potential model would result in the same outcome for each destination. The fourth possibility, the Tanner function, is not yet available in Flowmap 7. Both an exponential and a power function can be used for a potential model. For a potential model usually a power function is used. You can read more on the subject of power and exponential functions in Chapter 6, which deals with gravity modeling.

- **Select a distance decay function in the "Distance Decay Function" box [Power].**

In the "Model Parameters" box a distance decay parameter (Fixed Beta Value) must be set. This parameter depends on the maximum distance people are willing to travel between an origin and a destination. The default "beta" value is 2. This value should be changed depending on the spatial context.

- **If the distance decay parameter's default value must be changed, then enter a new value in the entry box to the right of "Initial Beta Value"**

Now all settings have been made.

- **Click on "OK"**

A window pops up allowing you to save the results in an attribute file.

By checking "Store", an new variable is saved. If you want to save the new variable proceed as follows:

- **Select "Store"**
- **Enter a variable name in the "Filename or fieldname" entry box**
- **Enter the number of decimals with which the values should be stored**
- **Click on "OK"**

Now the "Flowmap Results Confirmation" window appears, containing a column with the observed values for each destination.

11.7.2 A Destination Constrained Potential Model

First a destination constrained potential model will be discussed in brief. This will be followed by the procedure to carry out using Flowmap.
A destination constrained potential model consists of the following formula:

$P_i = \Sigma_j D_j * f(C_{ij},\beta)$ (2)

$f(C_{ij},\beta) = \exp(-\beta.C_{ij})$ in case of an exponential function
$f(C_{ij},\beta) = C_{ij}^{-\beta}$ in case of a power function

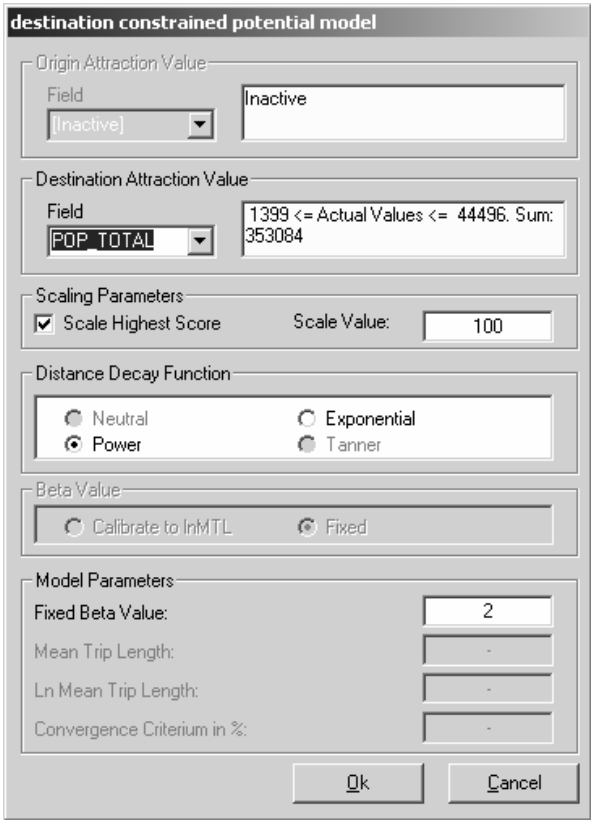
where:
P_j = Potential value for origin location j
D_j = Attraction value for destination location j
β = The distance decay parameter
C_{ij} = Distance between origin i and destination j

Thus, the potential value of origin i depends on the attraction values (for instance, a municipality's number of jobs) of *all* destinations and the distances between the destinations and the origin concerned. Also, the distance decay parameter plays a role in representing the importance of distance. A distance decay parameter indicates how important distance between origins and destinations is. If distance between origins and destinations is not very important, there is not much distance decay. The distance decay parameter then approximates zero. If distance between origins and destinations is important, this means there is a great deal of distance decay, resulting in a larger distance decay parameter.

NOTE: *The magnitude of the distance decay parameter is not dependent only on distance decay, but also on the unit distance it is expressed in. If distance is expressed in meters, the distance decay parameter is smaller than if it were put in kilometers. This should be taken into account when comparing two distance decay parameters.*

This is how to calculate a destination constrained potential model:

- **Select "Analysis" in the menu bar**
- **Select "Regular Accessibility Measures"**
- **Select "Potential Scores"**
- **Click on "Destination Constrained Potential Model"**



A window pops up in which various settings can be made.

In the "Destination Attraction Value" box, a destination constraint must be entered.

- **Select a destination constraint [POP_TOTAL]**

Below the box "Destination Attraction Value" some statistics are displayed, indicating the total number of people in the variable POP_TOTAL is 353,084. This is the total number of

inhabitants of the Zeeland province. The minimum number of people in a Zeeland municipality is 1,399, and the maximum is 44,496.

The default value in the "Scaling Parameters" box is 100. This indicates that every destination (every municipality in this case) will get a potential value scaled between 0 and 100. Unless there is a good reason for doing so, this number does not need to be changed.

In the "Distance Decay Function" you can choose one out of four functions for representing distance decay. The first one is a Neutral Function; however, this one only applies to gravity modeling (see Chapter 12). If you were to use this for a potential model, it would result in the exact same values for each destination. The fourth possibility, the Tanner function, is not yet available in Flowmap 7.2. Either an exponential or a power function can be used for a potential model. The main difference between a power function and a potential function is explained in Chapter 12 (Gravity Modeling).

- **Select a power function in the "Distance Decay Function" box [Power].**

To the right of the "Fixed Beta Value" box a distance decay parameter (Fixed Beta Value) must be set. This parameter depends on the maximum distance people are willing to travel between an origin and a destination. The default "beta" value is 2. This value should not be altered unless there is a good reason to do so.

- **If the distance decay parameter's default value must be changed, then enter a new value in the entry box to the right of "Initial Beta Value"**

Now all settings have been made.

- **Click on "OK"**

A window pops up allowing you to save the results in an attribute file.

By checking "Store", an new variable is saved. If you want to save the new variable proceed as follows:

- **Select "Store"**
- **Enter a variable name in the "Filename or fieldname" entry box**
- **Enter the number of decimals with which the values should be stored**
- **Click on "OK"**

Now the "Flowmap7 Report" window appears, stating that the writing of the field has been completed successfully.

- **Click on "Ok"**

11.8 Multi Modal Accessibility Analysis

The Multi Modal analysis will analyze the accessibility over multiple transport modes. This method is based on Qing Shen's model and can be carried out with a minimum of two and a maximum of four transport modes.

Qing Shen's model consists of the following formula:

$$A_i^v = \Sigma_j (O_j \, f(t_{ij}^v)) / (\Sigma_m \Sigma_k P_k^m \, f(t_{kj}^m))$$

where:

A_i^v = The accessibility opportunity seekers who live in zone i and travel by mode v
O_j = The number of relevant opportunities in zone j
$f(t_{ij}^v)$ = The impedance for travel from i to j by mode v
P_k^m = The number of opportunity seekers who live in zone k and travel by mode m

$f(t_{kj}^{m})$= The impedance for travel from k to j by mode m
For a metropolitan area with N zones, i, j, k = 1, 2, 3, …, N
For a metropolitan area with M modes, v, m = 1, 2, 3, …, M

In the multi modal analysis the total supply, O_j, the demand for opportunities, P_k^m, and the base mode, $f(t_{ij}^{v})$ and $f(t_{kj}^{m})$, needs to be calibrated and entered. Together these will be necessary to calculate the share of the 2nd, 3rd and 4th mode related to the base mode.

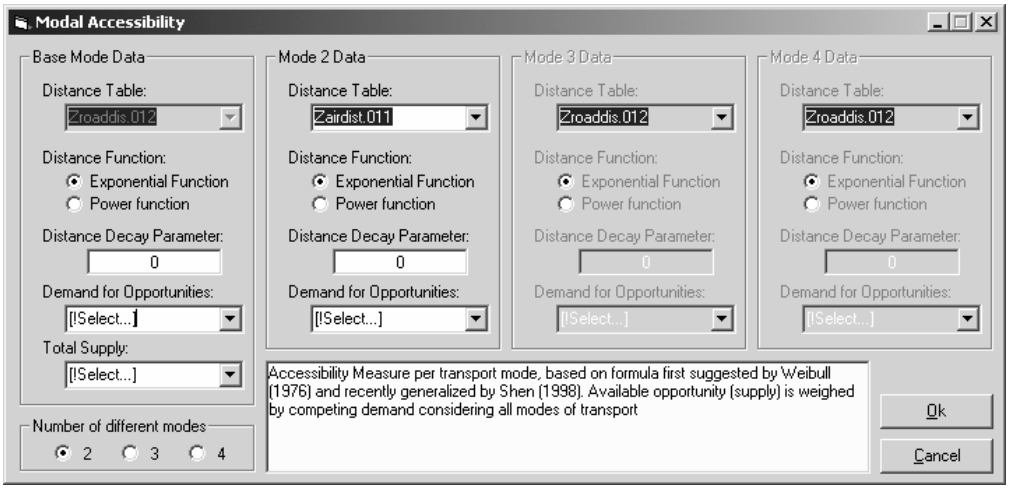
This is how you run a multi model:

- **Select "Analysis" in the menu bar**
- **Select "Regular Accessibility Measures"**
- **Click on "Multi Modal"**

The "Model Accessibility" window pops up in which certain settings can be made. A minimum of two modes is necessary to carry out the modal accessibility analysis. To activate the 3rd and 4th mode check the corresponding number in the "Number of different modes" box. The field containing the total supply must be entered in the corresponding box in the "Base Mode Data" box. Furthermore the field containing the demand for opportunities must be selected for every active mode. Also a distance decay parameter can be entered. The function between power and exponential can be related and this related distance decay parameter value needs to be entered.

In the "Base Mode Data" box:

- **Select the field containing the demand in the "Demand for Opportunities" box**
- **Select the field containing the supply "Total Supply" box**



In the "Mode 2 Data" box:

- **Select the field containing the demand in the "Demand for Opportunities" box**

- **Click on "Ok"**

A new window pops up in which multi modal calculations can be stored.

- **Either accept the default file name or enter a new name in the "Filename or Fieldname" box**
- **Click on "Ok"**

The multi modal analysis has now been carried out, the results can be checked by using the table manager.

11.9 Proximity Count in Competition

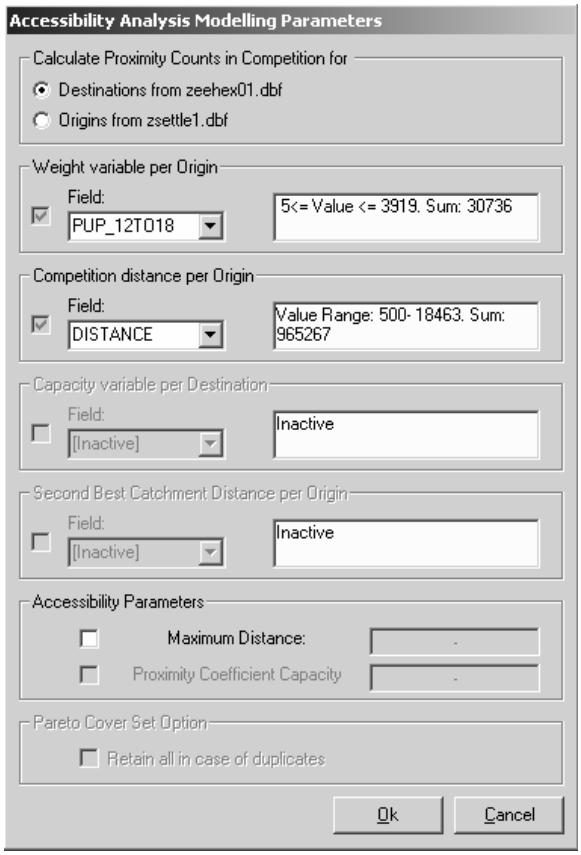
On the basis of a “Proximity in Competition” analysis, a suitable location for a new service can be calculated. For every potential new destination it is calculated how the origins are divided between the new destination and the existing ones. Only the number of expected origins per new destination will be shown in the results.
So, contrary to a regular proximity count, the competition between different destinations is taken into account when executing a “Proximity Count in Competition”. An origin is only assigned to a new destination when it is nearer than all other existing destinations. To do this, a variable is required that represents the distance to the nearest existing destination for each origin.

This variable is calculated by carrying out a “Catchment Area Analysis” first (see section 10.1). In order to be able to use this variable for a “Proximity Count in Competition” you cannot enter a maximum reach and maximum capacity.
In the example below, the variable “DISTANCE” was calculated with the help of a “Catchment Area Analysis”. It has the same characteristics as the variable in the example in section 10.1, except “Distance Constraint” and “Capacity Constraint”.

Then, a distance table [ZEEHEX.011] must be opened which has the same origins as the previous catchment area analysis [ZSETTLE1.DBF]. The destinations are the potential new locations [ZEEHEX01.DBF]. How to add files to the project is discussed in part I of this manual.

Now the program is ready to carry out a “Proximity Count in Competition”.

- **Select “Analysis” in the menu bar**
- **Select “Accessibility Measures in Competition”**
- **Click on “Proximity Count in Competition”**



A window pops up in which various settings can be made.

In the box “Calculate Proximity Counts in Competition for” either the destinations (ZEEHEX01.DBF) or the origins (ZSETTLE1.DBF) can be selected. In order to calculate how many origins can be expected for each new destination location, select destinations (ZEEHEX1.DBF). (Select origins if you would like to know how many destinations per origin can be expected.)

NOTE: *The origins and destinations on which a distance matrix is based can be the exact same file. If that is the case, then it is not possible to choose either origins or destinations in the “Calculate Proximity Coefficients for” box.*

- **Select either the origins or the destinations [ZEEHEX01.DBF]**

In the “Weight variable per Origin” box a choice can be made between either counting the origins or using a related variable for weighing the origin.

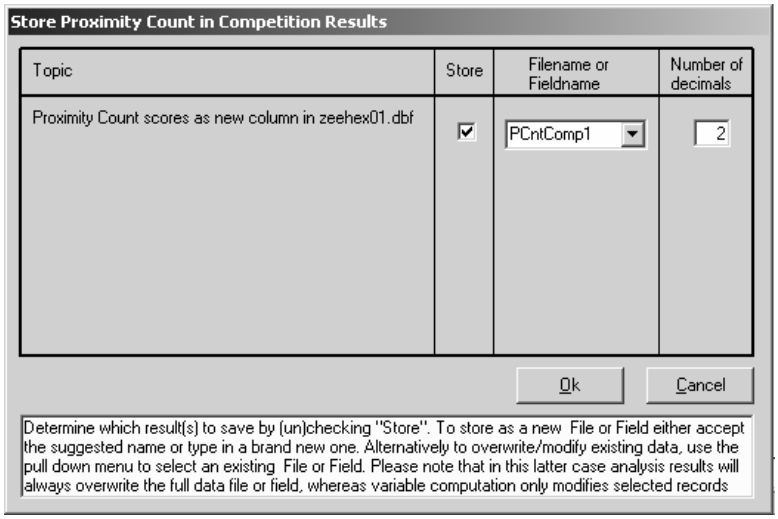
- **Select either [Count] or a weight variable in the “Field:” box**
- **If you select a weight variable then you must select the [PUP_12TO18] variable of which the values will be added up**

In the “Competition distance per Origin” box, the variable must be selected that represents the distance from the origins to the nearest original destination. This variable was calculated by the “Catchment Area Analysis”.

- **Select a variable [DISTANCE]**

Finally, in the box “Accessibility Parameters”, the maximum distance between an origin and a destination can be entered to the right of the box “Maximum Distance”. If the nearest destination is further away than the maximum distance, the origin will not be assigned to a destination.

- **Enter a number [10,000 (meters)] or make sure “Distance Constraint” is not ticked**
- **Click on “Ok”**



A window pops up allowing you to save the results in an attribute file. By checking “Store”, a new variable is saved. To store as a new file or field you can accept the suggested name or enter a new name in the “Filename or Fieldname” box. In the box “Number of decimals” you can set the number of decimals in which the results will be shown. To store the file proceed as follows:

- **Check “Store”**
- **Enter a variable name in the “Filename or fieldname” entry box [PUPILS10KM]**
- **Enter the number of decimals with which the values should be stored [0]**
- **Click on “OK”**

Now the “Flowmap7 Report” window appears, stating that the writing of field PUPILS10KM has been completed successfully.

- **Click on “Ok”**

You can view the results by opening the table (Zeehex01.dbf):

- **Select “File” in the menu bar**
- **Select “Table Manager”**
- **Click “View Table”**

A window pops up in which you can select and open the table (Zeehex01.dbf). The table now contains a column with the new calculated variable. The values thus stored in the new variable represent for each potential new school the number of 12- to 18- year-olds living within a 10 kilometer distance of the school for whom the new school is the nearest one.

11.10 Proximity Coefficients in Competition

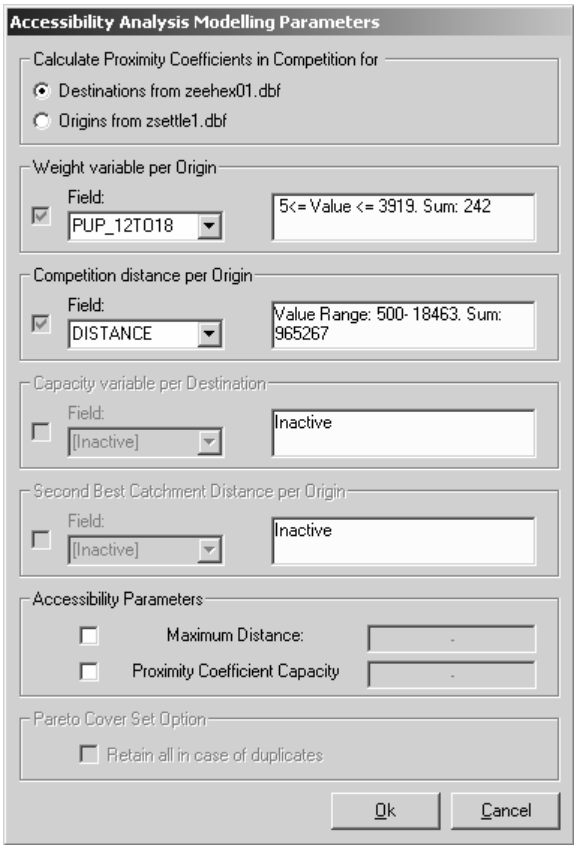
Related to the "Proximity Count in Competition", the "Proximity Coefficients in Competition" is practically carried out the same. It will calculate for every potential new destination how the origins are divided between the new destination and the existing ones. Only the number of expected origins per new destination will be shown in the results. An origin is only assigned to a new destination when it is nearer than all other existing destinations. To do this, a variable is required that represents the distance to the nearest existing destination for each origin. This variable is calculated by carrying out a "Catchment Area Analysis" first (see section 10.1).

In the example below, the variable "DISTANCE" was calculated with the help of a "Catchment Area Analysis". It has the same characteristics as the variable in the example in section 10.1, except "Distance Constraint" and "Capacity Constraint".Then, a distance table [ZEEHEX.011] must be opened which has the same origins as the previous catchment area analysis [ZSETTLE1.DBF]. The destinations are the potential new locations [ZEEHEX01.DBF]. How to add files to the project is discussed in part I of this manual.

After the project has been edited the "Proximity Coefficients in Competition" can be carried out.

- **Select "Analysis" in the menu bar**
- **Select "Accessibility Measures in Competition"**
- **Click on "Proximity Coefficients in Competition"**

A window pops up in which various settings can be made.

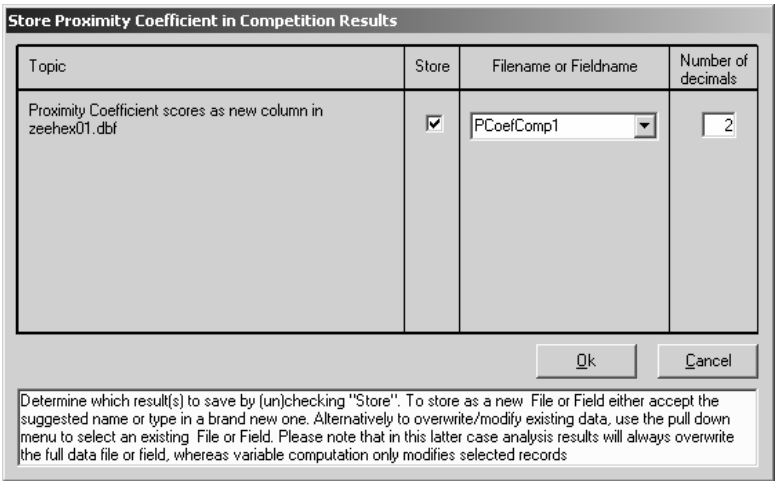


In the box "Calculate Proximity Coefficients in Competition for" either the destinations (ZEEHEX01.DBF) or the origins (ZSETTLE1.DBF) can be selected. In order to calculate how many origins can be expected for each new destination location, select destinations (ZEEHEX1.DBF) (Select origins if you would like to know how many destinations per origin can be expected.). In the "Weight variable per Origin" box a choice can be made between either counting the origins or using a related variable for weighing the origin. In the "Competition distance per Origin" box, the variable must be selected that represents the distance from the origins to the nearest original destination. This variable was calculated by the "Catchment Area Analysis". Finally, in the box "Accessibility Parameters", the maximum distance between an origin and a destination can be entered to the right of the box "Maximum Distance". If the nearest destination is further away than the maximum distance, the origin will not be assigned to a destination. It is also possible to enter a proximity coefficient capacity.

- **Select either the origins or the destinations [ZEEHEX01.DBF]**
- **Select either [Count] or a weight variable in the "Field:" box**

- **If you select a weight variable then you must select the [PUP_12TO18] variable of which the values will be added up**
- **Select a variable [DISTANCE]**
- **Click on "Ok"**

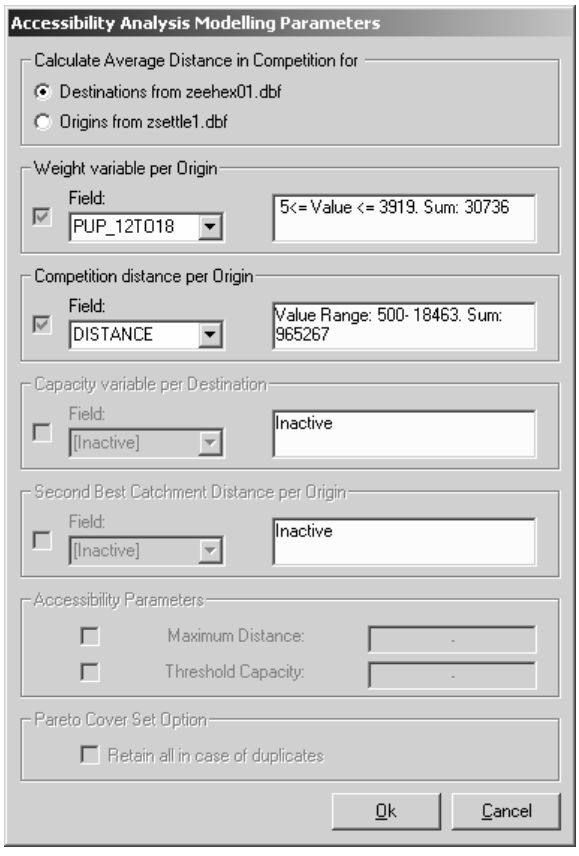
A window pops up allowing you to save the proximity scores as a new column in an attribute file. By checking "Store", a new variable will be saved. To store as a new file or field you can accept the suggested name or enter a new name in the "Filename or Fieldname" box. In the box "Number of decimals" you can set the number of decimals in which the results will be shown. To store the file proceed as follows:



- **Check "Store"**
- **Enter a variable name in the "Filename or fieldname" entry box**
- **Enter the number of decimals with which the values should be stored**
- **Click on "OK"**

11.11 Average Distance in Competition

The measure used to find the best supply location with as goal the minimisation of the overall average travel distance is called 'Average Distance in Competition'. The ´in competition´ means that already established supply locations are taken into account when looking for a new supply location. Before the average distance scores in competition can be calculated a "Catchment Area Analysis" needs to be carried out first (see section 10.1). In the example below, the variable "DISTANCE" was calculated with the help of a "Catchment Area Analysis". It has the same characteristics as the variable in the example in section 10.1, except "Distance Constraint" and "Capacity Constraint".Then, a distance table [ZEEHEX.011] must be opened which has the same origins as the previous catchment area analysis [ZSETTLE1.DBF]. The destinations are the potential new locations [ZEEHEX01.DBF]. How to add files to the project is discussed in part I of this manual.



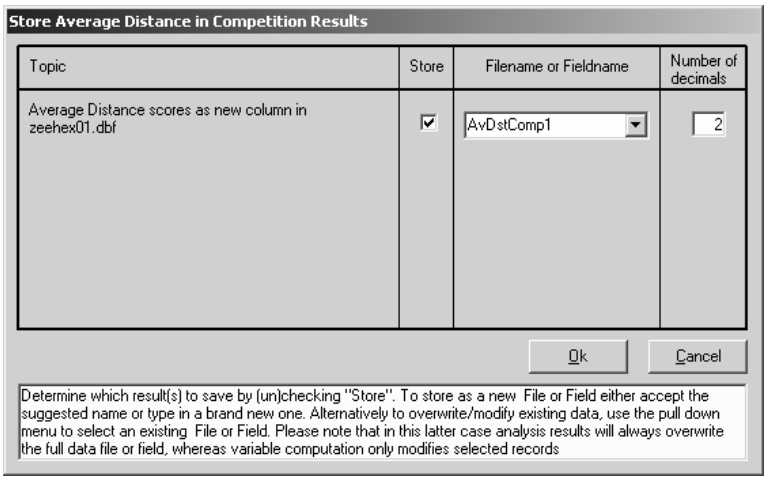
Now the program is ready to carry out the "Average Distance in Competition" analysis.

- **Select "Analysis" in the menu bar**
- **Select "Accessibility Measures in Competition"**
- **Click on "Average Distance in Competition"**

A new window pops up in which various settings can be made.
In the box “Calculate Average Distance in Competition for” either the destinations (ZEEHEX01.DBF) or the origins (ZSETTLE1.DBF) can be selected. In the “Weight variable per Origin” box a choice can be made between either counting the origins or using a related variable for weighing the origin. In the “Competition distance per Origin” box, the variable must be selected that represents the distance from the origins to the nearest original destination. This variable was calculated by the “Catchment Area Analysis”.

- **Select either the origins or the destinations [ZEEHEX01.DBF]**
- **Select either [Count] or a weight variable in the “Field:” box**
- **If you select a weight variable then you must select the [PUP_12TO18] variable of which the values will be added up**
- **Select a variable [DISTANCE]**
- **Click on “Ok”**

A window pops up allowing you to save the average distance scores as a new column in an attribute file. By checking “Store”, a new variable will be saved. To store as a new file or field you can accept the suggested name or enter a new name in the “Filename or Fieldname” box. In the box “Number of decimals” you can set the number of decimals in which the results will be shown. To store the file proceed as follows:



- **Check “Store”**
- **Enter a variable name in the “Filename or fieldname” entry box**
- **Enter the number of decimals with which the values should be stored**
- **Click on “OK”**

The average distance scores have now been calculated and stored in the table. The results can be viewed by using the table manager as explained in section 1.3.

11.12 Worst Case Distance in Competition

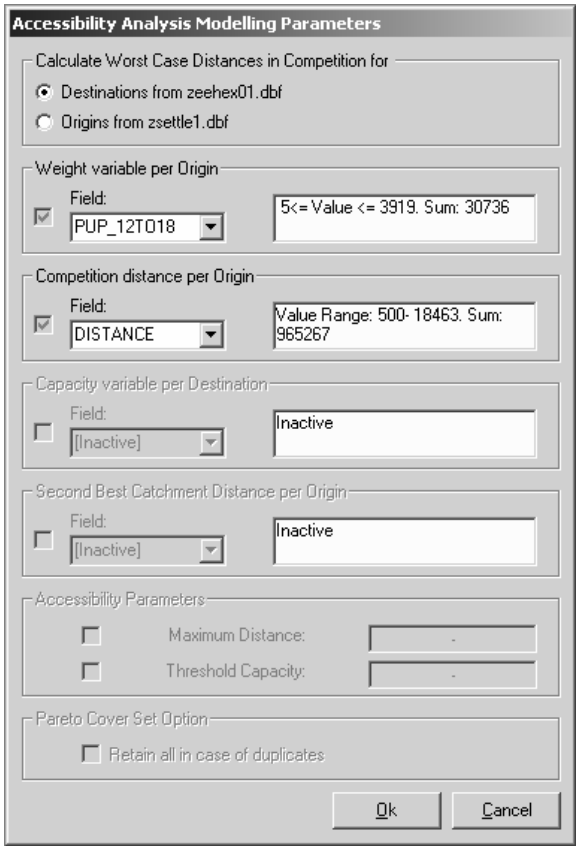
The measure used to find the best supply location with as goal the minimisation of the worst case travel distance is called ‘Worst Case Distance in Competition’. The ´in competition´ means that already established supply locations are taken into account when looking for a new supply location. Before the worst case distance scores in competition can be calculated a “Catchment Area Analysis” needs to be carried out first (see section 10.1). In the example below, the variable “DISTANCE” was calculated with the help of a “Catchment Area Analysis”. It has the same characteristics as the variable in the example in section 10.1, except “Distance Constraint” and “Capacity Constraint”.Then, a distance table [ZEEHEX.011] must be opened which has the same origins as the previous catchment area analysis [ZSETTLE1.DBF]. The destinations are the potential new locations [ZEEHEX01.DBF]. How to add files to the project is discussed in part I of this manual.

Now the program is ready to carry out the “Average Distance in Competition” analysis.

- **Select “Analysis” in the menu bar**

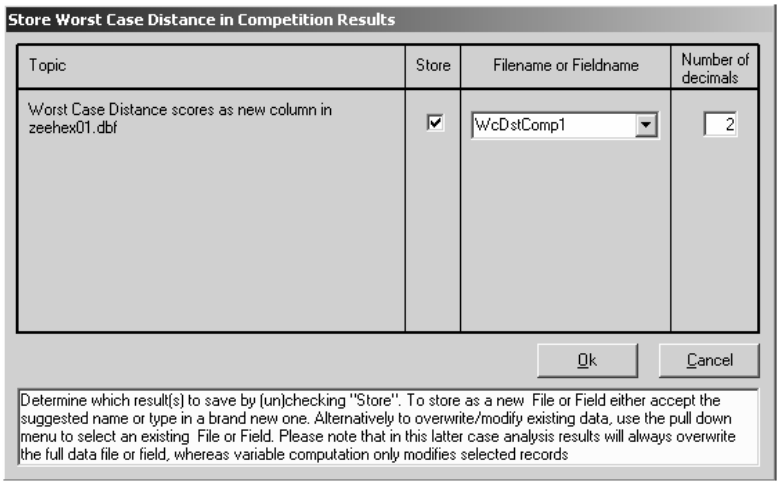
- **Select "Accessibility Measures in Competition"**
- **Click on "Worst Case Distance in Competition"**

A new window pops up in which various settings can be made.
In the box "Calculate Proximity Counts in Competition for" either the destinations (ZEEHEX01.DBF) or the origins (ZSETTLE1.DBF) can be selected. In the "Weight variable per Origin" box a choice can be made between either counting the origins or using a related variable for weighing the origin. In the "Competition distance per Origin" box, the variable must be selected that represents the distance from the origins to the nearest original destination. This variable was calculated by the "Catchment Area Analysis".



- **Select either the origins or the destinations [ZEEHEX01.DBF]**
- **Select either [Count] or a weight variable in the "Field:" box**
- **If you select a weight variable then you must select the [PUP_12TO18] variable of which the values will be added up**
- **Select a variable [DISTANCE]**
- **Click on "Ok"**

A window pops up allowing you to save the worst case distance scores as a new column in an attribute file. By checking "Store", a new variable will be saved. To store as a new file or field you can accept the suggested name or enter a new name in the "Filename or Fieldname" box. In the box "Number of decimals" you can set the number of decimals in which the results will be shown. To store the file proceed as follows:



- **Check "Store"**
- **Enter a variable name in the "Filename or fieldname" entry box**
- **Enter the number of decimals with which the values should be stored**
- **Click on "Ok"**

The average worst case distance scores have now been calculated and stored in the table. The results can be viewed by using the table manager as explained in section 1.3.

11.13 Threshold Distance in Competition

On the basis of a "Threshold Distance in Competition" analysis, a suitable location for a new service can be calculated. The maximum distance up to which origins must be found in order to reach a preset threshold is calculated. So, contrary to a "Regular Threshold Distance", competition is taken into account when executing a "Threshold Distance in Competition". Only those origins, that are closer to the location of a potential new destination than to an existing one, are considered in the analysis. An origin is only assigned to a new destination when it is nearer than all other existing destinations. To do this, a variable is required that represents the distance to the nearest destination for each origin.

This variable is calculated by carrying out a "Catchment Area Analysis" first (see section 10.1). In order to be able to use this variable for a "Threshold Distance in Competition" you cannot enter a maximum reach and maximum capacity.
In the example below, the variable "DISTANCE" was calculated with the help of a "Catchment Area Analysis". It has the same characteristics as "ALOC10KM" in the example in section 11.5, except "Distance Constraint" and "Capacity Constraint".

Then, a distance table [ZEEHEX.011] must be opened which has the same origins as the variable representing, for each origin, the distance to the closest destination [ZSETTLE1.DBF]. The destinations are the potential new locations [ZEEHEX01.DBF].

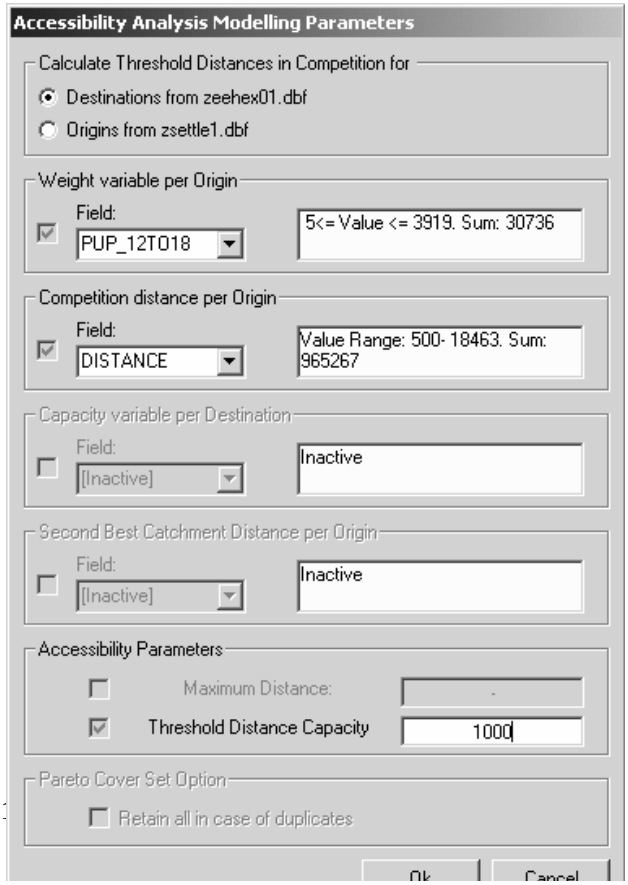
Now the program is ready to carry out a "Threshold Distance in Competition".

- **Select "Analysis" in the menu bar**
- **Select "Accessibility Measures in Competition"**
- **Click on "Threshold Distance in Competition"**

A window pops up in which various settings can be made.

In the box "Calculate Threshold Distances in Competition for" either the destinations (ZEEHEX01.DBF) or the origins (ZSETTLE1.DBF) can be selected. If you want to calculate the distance up to which origins are required in order to reach the threshold for the destinations, select destinations (ZEEHEX1.DBF). Select origins (ZSETTLE1.DBF) if you would like to know the distance to a predefined number of destinations (threshold).

NOTE: *The origins and destinations on which a distance matrix is based can be the exact same file. If that is the case, then it is not possible to choose either origins or destinations in the "Calculate Proximity Coefficients for" box.*



- **Select either the origins or the destinations [ZEEHEX01.DBF]**

Now, in the "Weight variable per Origin" box a choice can be made between either just counting the origins or destinations ([Count]) or using a related variable as a weighing factor.
- **Select either [Count] or a weight variable**
- **If you choose a weight variable, you must select the [PUP_12TO18] variable of which the values will be added up**

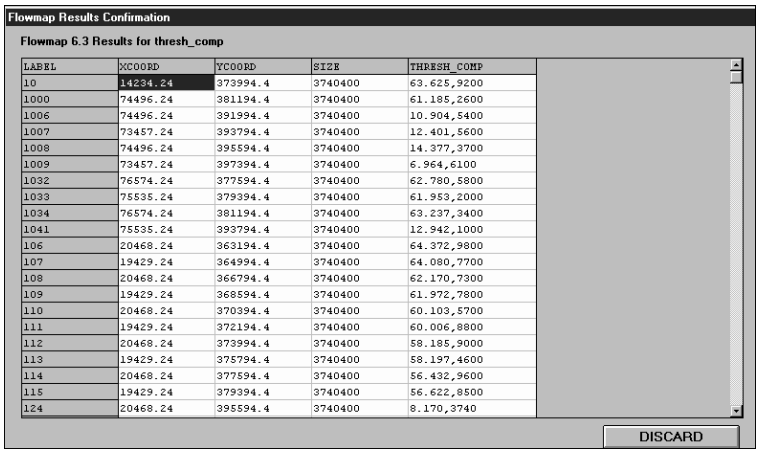
In the box "Competition distance per Origin", the variable must be entered representing the distance between the origins and the original destinations.
This variable was calculated earlier with the help of a "Catchment Area Analysis".
- **Select a variable [DISTANCE]**

Finally, in the box "Accessibility Parameters", you must enter the number of required origins to the right of the entry box "Treshold Distance Capacity". If you have selected [Count], the minimum number of origins must be entered. If you have selected a weight variable, the preferred value based on the weighing factor, must be entered.
- **Enter a number [1,000 (pupils)]**
- **Click on "Ok"**

A window pops up allowing you to save the results in an attribute file. By checking "Store", an new variable is saved. If you want to save the new variable and proceed as follows:
- **Select "Store"**
- **Enter a variable name in the "Filename or fieldname" entry box**
- **Enter the number of decimals with which the values should be stored**
- **Click on "OK"**

Now the "Flowmap7 Report" window appears, stating that the writing of field PUPILS10KM has been completed successfully.
- **Click on "Ok"**

You can view the results by opening the table (Zeehex01.dbf):
- **Select "File" in the menu bar**
- **Select "Table Manager"**
- **Click "View Table"**



LABEL	XCOORD	YCOORD	SIZE	THRESH_COMP
10	14234.24	373994.4	3740400	63.625,9200
1000	74496.24	381194.4	3740400	61.185,2600
1006	74496.24	391994.4	3740400	10.904,5400
1007	73457.24	393794.4	3740400	12.401,5600
1008	74496.24	395594.4	3740400	14.377,3700
1009	73457.24	397394.4	3740400	6.964,6100
1032	76574.24	377594.4	3740400	62.780,5800
1033	75535.24	379394.4	3740400	61.953,2000
1034	76574.24	381194.4	3740400	63.237,3400
1041	75535.24	393794.4	3740400	12.942,1000
106	20468.24	363194.4	3740400	64.372,9800
107	19429.24	364994.4	3740400	64.080,7700
108	20468.24	366794.4	3740400	62.170,7300
109	19429.24	368594.4	3740400	61.972,7800
110	20468.24	370394.4	3740400	60.103,5700
111	19429.24	372194.4	3740400	60.006,8800
112	20468.24	373994.4	3740400	58.185,9000
113	19429.24	375794.4	3740400	58.197,4600
114	20468.24	377594.4	3740400	56.432,9600
115	19429.24	379394.4	3740400	56.622,8500
124	20468.24	395594.4	3740400	8.170,3740

A window pops up in which you can select and open the table (Zschool1.dbf). The table now contains a new column with the calculated variable. The values thus stored in the new variable, represent for each potential new school, the distance from where pupils must come in order to reach the threshold of 1,000 pupils and at the same time frequent the nearest school. If a potential new location does not reach the minimum number of origins, the distance is set to the maximum distance to the area boundary.

11.14 Gravity Surface Analysis

With a "Gravity Surface analysis", the best location for a new service can be determined. Not only the location with regard to the market (i.e. population), but also with regard to the existing similar services is taken into account. For each potential location for a new service, the expected number of users is calculated by carrying out an origin constrained potential model, whereby the demand is divided between existing destinations and potential new ones. However, Flowmap does not give the results of the newly calculated expected values for existing destinations.

The origin constrained gravity model is discussed in section 12.2.3. The "Gravity Surface Analysis" is derived from this model and consists of the following formulas:

$T_{kj} = W_k * D_j * f(C_{kj}, \beta) / \Sigma_i W_i * f(C_{ij}, \beta) + W_k * f(C_{kj}\beta)$

$O_k = \Sigma_j T_{kj}$

$f(C_{xj}, \beta) = \exp(-\beta, C_{xj})$ in case of an exponential function
$f(C_{xj,} \beta) = C_{xj}^{-8}$ in case of a power function

Where:
W_i = Attraction value for destination location i
C_{ij} = Distance between origin i and destination j
β = Distance decay parameter
T_{kj} = Expected number of trips between origin location j and potential destination k
W_k = Attraction value for potential destination location k
D_j = Demand from origin location j
C_{kj} = Distance between origin i and potential destination k
O_k = Expected number of trips to potential destination location k

The expected number of trips to potential destination location k (O_k) depends on both the location of k with regard to existing destination locations and k's location with regard to the origin locations. A distance decay parameter indicates how important distance between origins and destinations is. The bigger the distance decay, the more important distance between origins and destinations becomes.

In this example, the same data are used that were used to calculate the proximity count in competition and the threshold distance in competition, namely the data on secondary schools and municipalities in the Zeeland province, and a hexagonal tessellation of Zeeland as an indication of all potential locations for a new secondary school.

- **Configure the project and enter (once more) [Zroaddis.012] as the distance matrix**

This is how to carry out a gravity surface analysis:

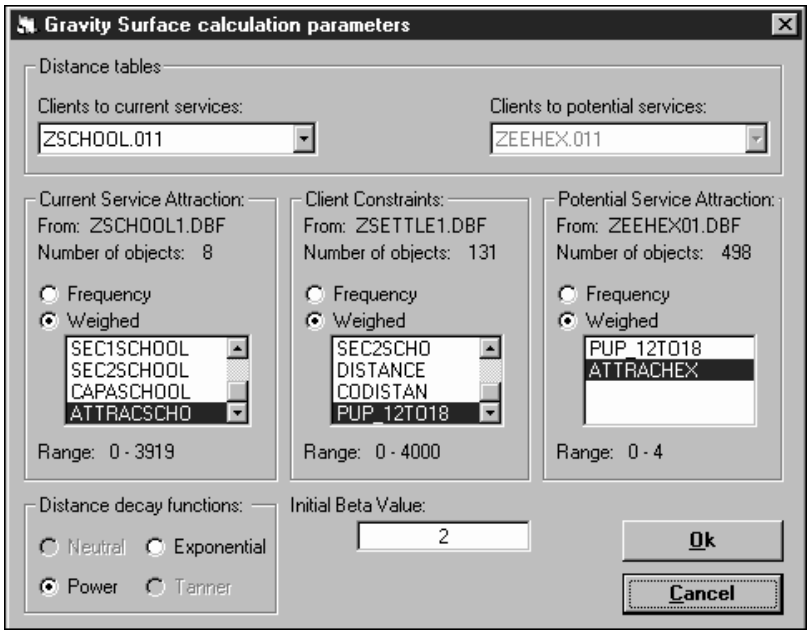
- **Select "Analysis" in the menu bar**
- **Select "Accessibility Measures in Competition"**
- **Click on "Gravity Surface"**

A window pops up in which various settings can be made.

In the top box, you can choose which distance matrices you want the program to use. In the box "Clients to current services" the distance matrix containing the distances between origins

and current destinations must be selected. In the box “Clients to potential services”, the distance matrix containing the distances between the origins and the locations of potential new destinations must be selected. In both distance matrices the demand (origins) must therefore be the same. One of both distance matrices must be opened.

- **Select a distance matrix in the box “Clients to current services” [ZSCHOOL.011]**
- **Select a distance matrix in the box “Clients to potential services” [ZEEHEX.011]**



Next, in the boxes “Current Service Attraction” and “Potential Service Attraction” you must indicate whether attraction values of the current services and attraction values of the potential services must be taken into account. If they should be taken into account, select “Weighed” and select a related variable to serve as a weighing factor. Select “Frequency” if the attraction values are not to be taken into account and are therefore the same for each destination. In the boxes “Current Service Attraction” and “Potential Service Attraction” the same choice must be made, otherwise the origins will be allocated incorrectly to the destinations.
In the box “Client Constraints”, a choice can be made between either counting the origins (by selecting “Frequency” or using a related variable as a weighing factor by selecting “Weighed”.

- **Select “Frequency” or “Weighed” in the box “Current Service Attraction”**
- **If you selected “Weighed”, you will still have to select a variable as a weighing factor [ATTRACSCHO]**

- **Select “Frequency” or “Weighed” in the box “Client Constraints”**
- **If you selected “Weighed”, you will still have to select a variable as a weighing factor [PUP_12TO18]**

- **Select “Frequency” of “Weighed” in the box “Potential Service Attraction”**
- **If you selected “Weighed”, you will still have to select a variable as a weighing factor [ATTRACHEX]**

If there are no suitable attraction values in the attribute file for the potential services (in this example: ZEEHEX01.DBF), you must, before you start running a Gravity Surface analysis, (if you selected the option “Weight”) add a new field containing attraction values to the attribute file. These values will all be identical and must be relatively close to the attraction values of the current services. In our example, in the file ZEEHEX01.DBF, each hexagon of the variable PUP12_TO18 was given the attraction value of 4,000 (pupils).

In the “Distance Decay Function” box, you can select one of two functions that can be used for a potential model: an exponential function and a power function. For more information on the subject of power and exponential functions, see Chapter 12, which deals with gravity modeling.

- **Select a distance decay function in the “Distance Decay Function” box [Power Function].**

To the right of the “Initial Beta Value” box a distance decay parameter (Initial Beta Value) must be set. This parameter depends on the maximum distance people are willing to travel between an origin and a destination. The default “beta” value is 2. This value should not be altered unless there is a good reason to do so.

- **If the distance decay parameter’s default value must be changed, then enter a new value in the entry box to the right of “Initial Beta Value”**

Now all settings have been made.

- **Click on “Ok”**

A window pops up allowing you to save the results in an attribute file or to look at them immediately.

By checking “Store”, an new variable is saved. If you want to save the new variable proceed as follows:

- **Select “Store”**
- **Enter a variable name in the “Filename or fieldname” entry box**
- **Enter the number of decimals with which the values should be stored**
- **Click on “Ok”**

Now the “Flowmap7 Report” window appears, stating that the writing of the field has been completed successfully.

- **Click on “Ok”**

In this example you will find in the new column at every hexagon the expected number of pupils should a new school be opened. You can view the results with the Table Manager as is discussed in part I.

CHAPTER 12
Gravity Modeling

This chapter discusses the first part of the Flowmap models section. Gravity modeling is used for analyzing spatial interactions. Data on observed trips can be analyzed. With the results of this analysis, predictions can be made with regard to potential future trips between origins and destinations. Not only the length of these trips, but also the amount of interaction between origins and destinations are taken into account. The amount of interaction between two areas is supposed to be directly related to the attraction of the areas and inversely to the distance between the two.

The fact that the amount of interaction is related to the distance between origins and destinations means that the attraction value of a destination is inversely proportional to the distance between origins and destinations. And inversely, the interaction between an origin and its surrounding destinations decreases as the destinations are further away from the origin. The function describing the attraction value between origins and destinations within a certain distance is called a distance decay function. The principle of this function is derived from physics: the famous law of gravity formulated by Newton. This is why this method is usually called gravity modeling.

Four types of distance decay functions are usually used:

1. *A neutral function.* This is used only to demonstrate that there actually is distance decay. It will not be discussed any further in this manual.
2. *An exponential function.* Compared to a power function (see 3 below), an exponential function represents a quickly declining distance decay
3. *A power function.* Compared to an exponential function (see 2 above), a power function represents a more gradually declining distance decay
4. *A Tanner function.* This function is not yet available in Flowmap 7. It will not be discussed any further.

Gravity modeling consists of three types of analyses. Firstly, the calculation of the mean trip length (MTL) of observed trips in the past. With this analysis, the distance people are willing to travel for a certain purpose can be calculated. For this type of analysis, no distance decay function is necessary. The calculated mean trip length can be used as input to calculate the distance decay function.
Secondly, the calculation of the distance decay function of observed trips. With the help of this function, we can gain insight in the distance decay over a certain period in the (recent) past between origins and destinations in a given area. For this analysis, a *doubly constrained model* is used. The sum of the estimated number of trips from every origin must be equal to a preset number per origin. The sum of the estimated number of trips to every destination must be equal to a preset number per destination. As the estimated number of trips must be equal to a preset number of trips (per origin and destination) both from each origin and to each destination, this model is called a doubly constrained model. The number of trips that must be preset from each origin and to each destination can be derived from the number of observed trips in the past. Also, an estimate must be made of the mean trip length between origins and destinations. To do this, you can use the observed MTL. However, this is not necessary.

The third type of gravity modeling is an analysis during which predictions are made about

future trips between origins and destinations. The results of the analysis of the observed trips can serve as a basis for this type of modeling. However, that is not necessarily the case. Four different types of models are distinguished to carry out this analysis:

1. *The unconstrained model.* To calculate the distance decay parameter, an estimate must be made of the mean trip length between origins and destinations. The number of trips between origins and destinations is determined by their production and attraction value respectively.
2. *The origin constrained model.* For this model, it is also necessary to make an estimate of the mean trip length between origins and destinations. Moreover, the sum of the estimated number of trips from every origin must be equal to a preset number per origin. The number of trips to every individual destination is determined by the attraction value of the destinations.
3. *The destination constrained model.* This model also requires an estimate of the mean trip length between origins and destinations The sum of the estimated number of trips to every destination must be equal to a preset number per destination. The number of trips from every individual origin is determined by the attraction value of the origins.
4. *The doubly constrained model.* The sum of the estimated number of trips from every origin must be equal to a preset number per origin. The sum of the estimated number of trips to every destination must be equal to a preset number per destination. Besides that the number of trips from every origin to any destination is inversely related to the distance between origin and destination.

NOTE: *In the models that were discussed above mention is made of the fact that the number of trips to be calculated has to be equal to a preset number per origin or destination. This is not exactly the case; in fact the predefined number of trips per origin or destination has to be approximated as closely as possible.*
When calculating the various gravity models, a so-called Convergence Criterion has to be set. This criterion determines how well the number of trips has to match the set number of trips. If the converge criterion is set too wide, the number of trips to be calculated matches the set number less accurately.

Finally, related to the gravity analysis, Garin-Lowry will be discussed. The Garin-Lowry model incorporates a number of calculation cycles of an origin and a destination constrained model.

12.1 Opening a Distance Matrix

In order to run a gravity model, a distance matrix has to be opened. The way to open a distance matrix is explained in section 1.2.2. The procedure is repeated briefly here.

This is how to open a distance matrix:
- **Select " File" in the menu bar**
- **Select "New Project"**
- **Click in the blank "Distance Table" box**
- **The "Open Distance Table" window pops up, select a distance file [ZROADDIS.012]**
- **Click on "Open"**

A distance matrix can be based on airline distances, or distances measured over a network (a road map). The matrix that is used as an example in this chapter [ZROADDIS.012], contains distances in meters, measured over a road network. The Zeeland municipalities will serve both as origins and destinations. The municipality data are stored in ZEELAND1.DBF. Flowmap can calculate distance matrices itself. This is discussed in Part II, Chapter 7.

NOTE: *A distance matrix always refers to a specific map of origins and destinations. If origin and destination maps have not been opened yet, Flowmap always opens them upon opening the distance matrix. If origin and/or destination maps that are not related to the chosen distance matrix were already opened, Flowmap closes these maps automatically and opens the origin and destination maps related to the distance matrix.*

In order to determine the mean trip length of observed trips, a flow data file must be opened:
- **Click in the blank "Flow File" box**
- **The "Open Flow File" window pops up, select a Flow file [FORE9502.DBF]**
- **Click on "Open"**
- **Click on "Ok"**

A map file (area map) does not need to be opened.
- **In the "View Settings" box you can check the boxes right of "Origin File" and "Destination File in the "All" column**
- **Click on the "Set" button**
- **In the box right of "Measurement Unit" select [Meters]**
- **Click on the "Save As" button and choose a proper project name in the new window**
- **Click on "Save" to save the new project**

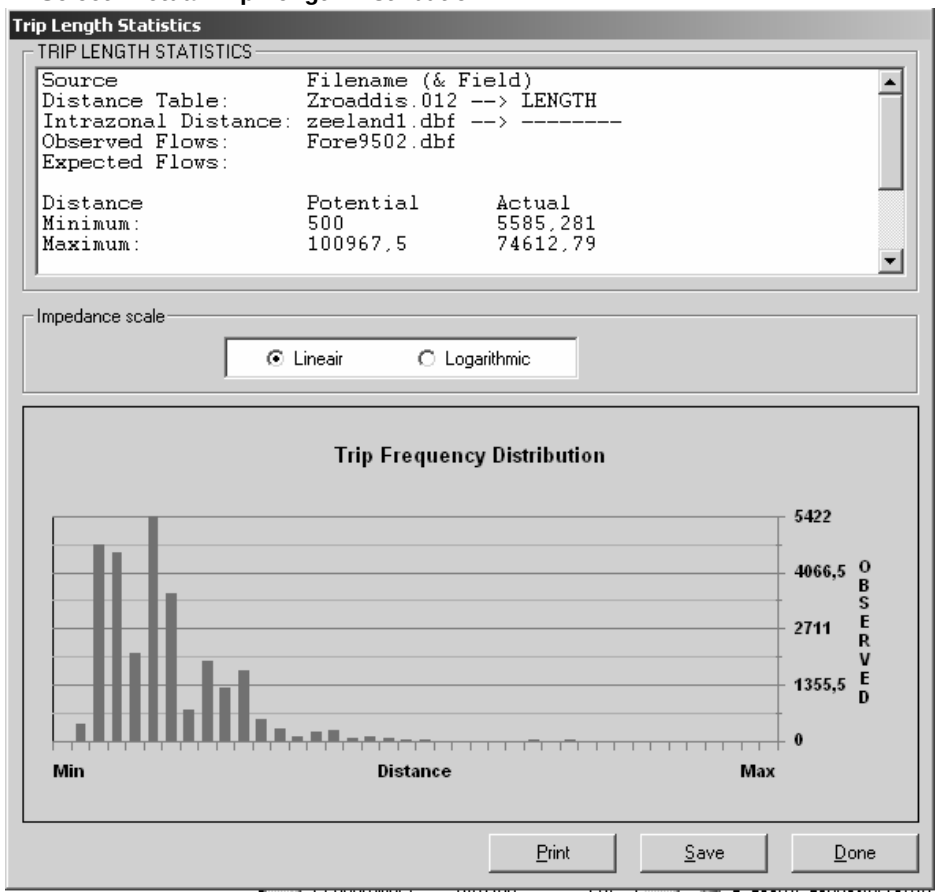
12.2 Gravity Modeling

This section discusses several gravity models. First we will focus on calculating the mean trip length (MTL). Next the doubly constrained gravity model will be discussed with which the distance decay function of observed trips can be calculated. After that, the interaction prognosis models will be discussed: the production constrained, attraction constrained, and unconstrained model.
Because the data output of all gravity models is similar with each model, this is explained in a separate section (12.2.5), which will be referred to repeatedly. An exception, however, is the Garin-Lowry model. Data output related to this model will be discussed at the end of the section explaining it.

12.2.1 Determining the Mean Trip Length of Observed Trips in the past

The observed MTL provides insight into the distance people have traveled for a certain purpose. The MTL can also serve as an input factor in a gravity model. The default distance in Flowmap is based on the maximum and minimum distances from the distance matrix. You can also determine a mean trip length yourself. Or you can use the mean trip length of observed trips in the past.
This is how to determine it:

- **Select "Graphs " in the menu bar**
- **Select "Actual Trip Length Distribution"**



The information display window shown above pops up.
A frequency distribution is shown. The X-axis is divided into classes by default in a linear way. The difference between the shortest and longest possible distances is divided into forty equal-width classes on the X-axis. The number of trips actually made per class is displayed on the Y-axis. Usually there are many short distance trips. If a linearly scaled X-axis is used, most trips will be found in only a few distance classes. For a better view of the short-distance trip distribution, you can view an X-axis with a logarithmic scale. By selecting "Logarithmic Statistics" in the top section of the window, the X-axis is displayed in a logarithmic scale.

In the box above the frequency distribution the following statistics are displayed:

- Minimum and maximum distance; the "Potential" column displays *possible* minimum and maximum distances in the ZROADDIS distance matrix. The "Actual" column displays the minimum and maximum distances that have actually been traveled.
- The mean trip length; displayed both in linear distance (for an exponential distance decay function) and as a logarithmic distance (for a power distance decay function). In this example the commuters on average travel about 16 kilometers from home to work and back.
- The number of flows is displayed both in absolute numbers and in percentages. Apart from

the total number of flows, the number of intrazonal flows and the number of flows with the shortest distance is shown. The shortest distance is set while building a distance matrix (see Chapter 7). In this case, it is 500 meters. Finally the number of non-zero cells is shown (combinations of origins and destinations between which trips take place).

If you want to use the observed MTL as input for calculating the distance decay function, you will have to remember it (about 15,750 meters for an exponential function, or 9,58 for a power function). It might be a good idea to write it down, since Flowmap does not store it. How exactly to use it is explained in the following sections.

- **Click on "Done" to continue**

NOTE: *It is also possible to print the "Trip Length Statistics" window by clicking the "Print" button or to save it as a Bitmap (.bmp) or Jpeg file (.jpg) by clicking the "Save" button.*

12.2.2 The Doubly Constrained Gravity Model

First the doubly constrained model will be explained briefly. Next, the steps to be taken in Flowmap will be discussed. A doubly constrained gravity model estimates the most probable distribution of flows in a matrix of origins and destinations.

The model consists of three formulas:

$T_{ij} = A_i.B_j.O_i.D_j\, f(C_{ij},\beta)$ (1)

$A_i = 1 / (\Sigma_j\, B_j.D_j.f(C_{ij},\beta))$ (2)

$B_j = 1 / (\Sigma_i\, A_i.O_i.f(C_{ij},\beta))$ (3)

$f(C_{ij},\beta) = \exp(-\beta.C_{ij})$ in case of an exponential function
$f(C_{ij},\beta) = C_{ij}^{-\beta}$ in case of a power function

where:
T_{ij} = the estimated number of trips between origin i and destination j
A_i = the balancing factor for origin i
B_j = the balancing factor for destination j
O_i = the constraint value for origin i
D_j = the constraint value for destination j
β = the distance decay parameter
C_{ij} = the distance between origin i and destination j

The balancing factors ensure that the sum of the estimated outflows per origin equals the known origin total and the sum of the estimated inflows per destination equals the known destination total.
Formula 1 calculates the actual trips in the origin destination matrix.
Formula 2 takes care of equating the total number of trips from origins in the matrix to the set number (the "origin constraint").
Formula 3 takes care of equating the total number of trips to the destinations in the matrix to the set number (the "destination constraint").
The value of the distance decay parameter should be known before the equations given above can be solved. Flowmap offers the possibility of entering the value of this parameter yourself based upon theoretical considerations or earlier research, or the model can be calibrated on

the Mean Trip Length. In the Beta value box you will find the option “Calibrate on MTL”, which means that the model estimates the interaction matrix on the basis of the origin and destination totals and Flowmap determines a starting value for the distance decay parameter. The estimated MTL is then calculated using the following formula:

$$MTL = (\Sigma_i \Sigma_j T_{ij}.C_{ij}) / (\Sigma_i \Sigma_j T_{ij}) \qquad (4)$$

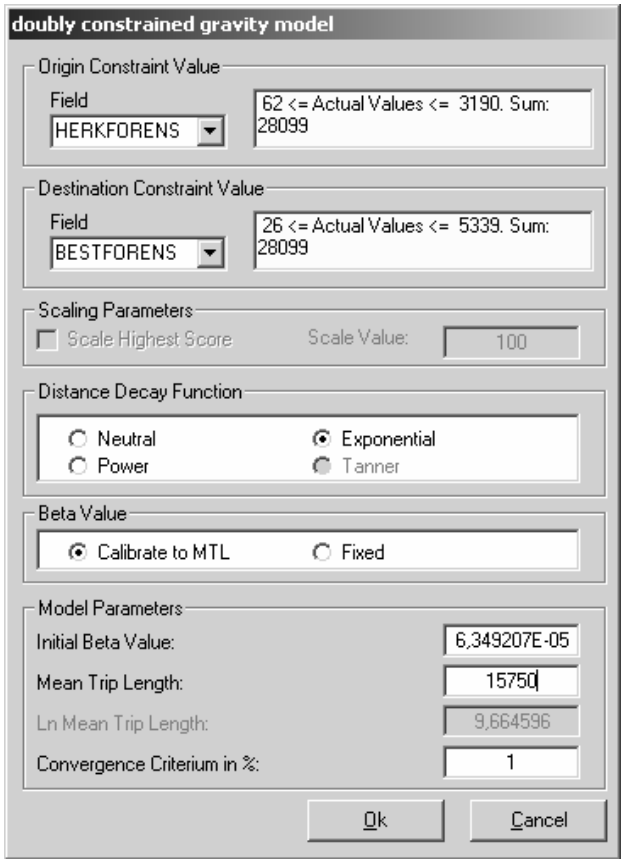
where:
T_{ij} = the estimated number of trips between origin i and destination j
C_{ij} = the distance between origin i and destination j

If the distance calculated with the starting value of the distance decay parameter β diverges too much from the set MTL, the above-mentioned steps are all run through again, until the estimated MTL equals the set MTL.

NOTE: *If you determine the value of the distance decay parameter or the value of the MTL yourself and not on the basis of your own observed data, you should check whether those values are feasible for the data you have. The Range option in Flowmap 7 Professional makes this possible.*

This is how to run a doubly constrained gravity model:

- **Select “Models” in the menu bar**
- **Select “Gravity Models”**
- **Select “Doubly Constrained”**



The “Doubly constrained gravity model” windows pops up, in which various settings can be made.
Next, both an origin constraint and a destination constraint have to be set.

- **Select an origin constraint in the “Origin Constraint Value” box [HERKFORENS]**
- **Select a destination constraint in the “Destination Constraint Value” box [BESTFORENS]**
- **Select a distance decay function in the “Distance Decay Function” box [Exponential Function]**

In the example used in this chapter, the variables HERKFORENS and BESTFORENS are used as an origin constraint and a destination constraint respectively. These variables contain the total daily outflow per municipality and the total daily inflow per destination in 1995.
These variables are calculated with the commuter flows stored in the FORE9502.DBF file. Flowmap provides a special procedure for adding an attribute (i.e. an attribute file, a point location map) of total outflows per origin and total inflows per destination, gathered from a file with flow data. This procedure is discussed in section 12.5. Of course origin and destination constraint data do not necessarily need to be derived from a flow data file.

- **Choose “Calibrate to MTL” in the “beta value” box**

In the “Modeling Parameters” box some changes can be made.

- **Enter the MTL in the entry box to the right of “Mean Trip Length” [15,750 (see section 11.2.1)]**

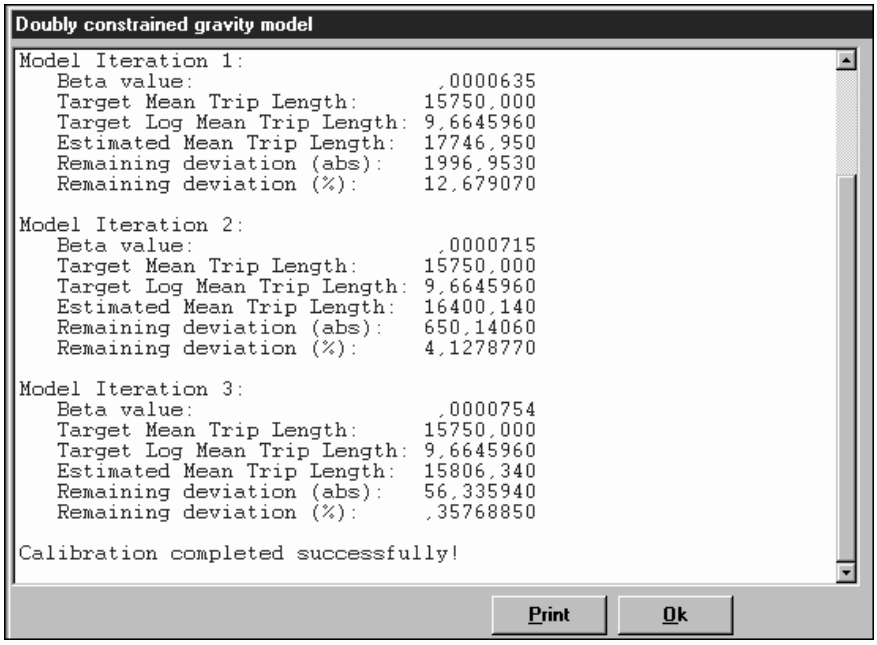
NOTE: *We chose to set the MTL equal to the one that was calculated using the observed flow data. The alternative is to enter a value for the distance decay parameter.*

The convergence criterion must also be set. This determines *how well* the number of trips that is to be estimated from the origins and to the destinations has to equal the set variables for the origin and destination constraints respectively. The convergence criterion *also* determines how well the MTL that is to be estimated has to equal the distance as was set above.

- **Enter a value in the entry box to the right of “Convergence Criterion” [1(%)]**
- **Click on “OK”**

A window pops up allowing you to save the results in an attribute file. By checking “Store”, an new variable will be saved. See section 12.2.5.

Now the model is calculated. As soon as the procedure is completed, a window appears displaying the value of the distance decay parameter. In this example the outcome is 0.0000754. By the way, Flowmap does not store this parameter. If necessary, the figure should be remembered or written down.



NOTE: *The distance decay parameter (0.0000754) in this example is very small and seems negligible.*
However, the small value is not necessarily caused by a small distance decay. In this case the small value is caused by using meters as a unit. Per meter the distance decay is not very big. If kilometers had been used, the value of the distance decay parameter would have been much higher.

- **Click on “OK”**

Now the “Flowmap7 Report” window appears, stating that the writing of the field has been completed successfully (see section 12.2.5).

- **Click on “Ok”**

12.2.3 The Origin and the Destination Constrained Gravity Models

The Origin and Destination constrained gravity models are used mostly for predictions about future interactions between origins and destinations. Both are singly constrained models. Both models work in the same fashion, only the direction differs. In an origin constrained model the number of people originating from certain locations is fixed; it is predicted where they will be going. In a destination constrained model the number of people going to certain destinations is fixed; it is predicted where they will originate from. In this section a destination constrained model will be discussed.
First some explanation will be given of the singly constrained model. After that the Flowmap steps to take will be demonstrated.
The singly constrained gravity model estimates the most probable distribution of movements in a matrix with origins and destinations. The model consists of two formulas. For a destination constrained model these are:

$T_{ij} = B_j * W_i * D_j * f(C_{ij},\beta)$ (5)

$B_j = 1 / (\Sigma_i W_i * f(C_{ij},\beta))$ (6)

$f(C_{ij},\beta) = \exp(-\beta * C_{ij})$ in case of an exponential function
$f(C_{ij},\beta) = C_{ij}^{-\beta}$ in case of a power function

where:
T_{ij} = the estimated number of trips between origin i and destination j
B_j = the balancing factor for destination j
W_i = the attraction value for origin i
D_j = the constraint value for destination j
β = the distance decay parameter
C_{ij} = the distance between origin i and destination j

Formula 5 calculates the actual number of trips in the matrix of origins and destinations. Formula 6 makes sure the total number of trips to the destinations in the matrix is equal to the set number (the destination constraint).

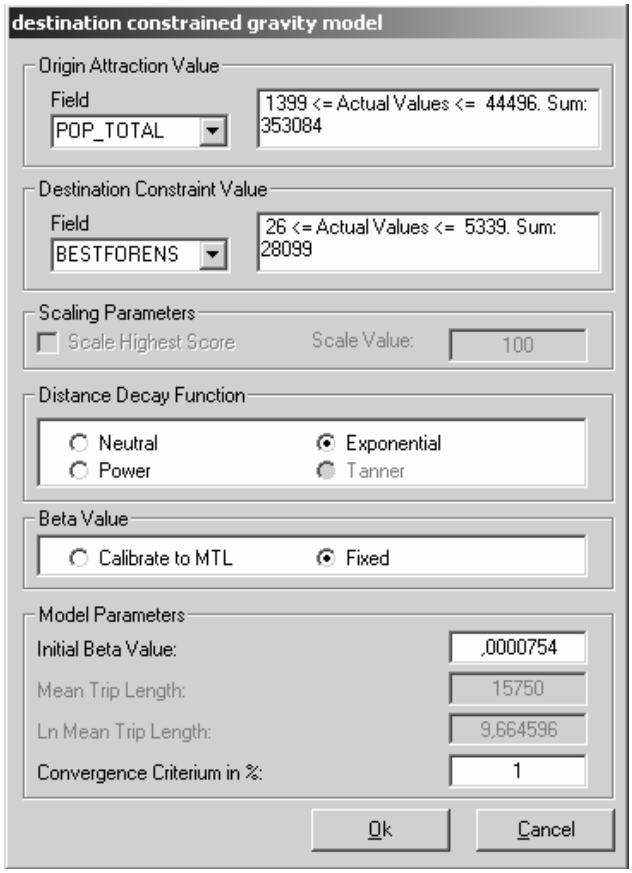
Just as in the case of the doubly constrained model you can choose to calibrate the model on the MTL or to determine the value of the distance decay parameter yourself.
This is how to calculate a destination constrained gravity model:
- **Select “Models” in the menu bar**
- **Select “Gravity Models”**
- **Click on “Destination Constrained”**

A window pops up in which various settings can be made.

A production value and a destination constraint must be entered.
- **Select a production value in the “Origin Attraction Value” box [POP_TOTAL].**
- **Select a destination constraint in the “Destination Constraint Value” box [BESTFORENS]**

In this example, the BESTFORENS variable was chosen for a destination constraint. In this variable, the total daily inflow per destination in 1995 is stored.
The variable is calculated using the commuter flows that are stored in the FORE9502.DBF file. Flowmap provides a special procedure for adding total inflow per destination and total outflow per origin to the attribute file (or the "points map"), derived from a flow data file. This procedure is discussed in section 12.5.

NOTE: *If an origin constrained model is to be run, then select the option "Origin Constrained Gravity Model" instead of the "Destination Constrained Gravity Model" . Next an origin constraint must be entered in the "Origin Constraint Value" box, and an attraction value in the "Destination Attraction Value" box.*



- **Select a distance decay function in the "Distance Decay Function" box [Exponential]**

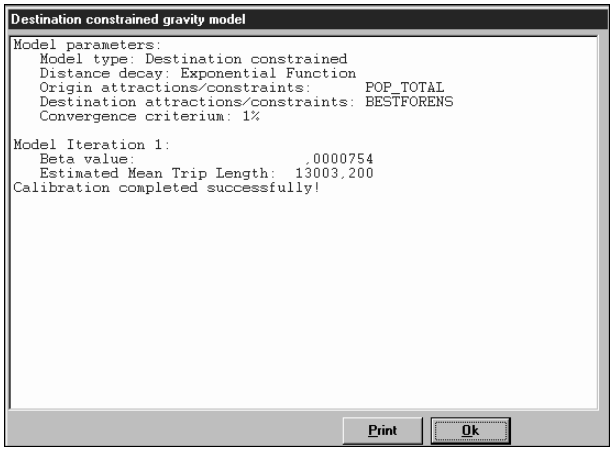
Some settings can be made in the "Modeling Parameters" box. The choice depends upon what you have chosen in the beta values box, this time we will use a fixed value.

- **Choose "Fixed" in the "beta value" box**
- **Enter the beta value you found when calculating the doubly constrained model (see section 11.2.2) in the entry box to the right of the "Initial Beta Value" [0,0000754]**
- **Click on "OK"**

A window pops up allowing you to save the results in an attribute file. By checking "Store", an new variable will be saved. See section 12.2.5.

Now the model is being calculated. Once this procedure is completed, the MTL (Calculated Distance) is calculated using the production values of the origins and the destination constraints. In this example it is 13,003.2 meters.

- **Click on "OK"**



Now the "Flowmap7 Report" window appears, stating that the writing of the field has been completed successfully (see section 12.2.5).

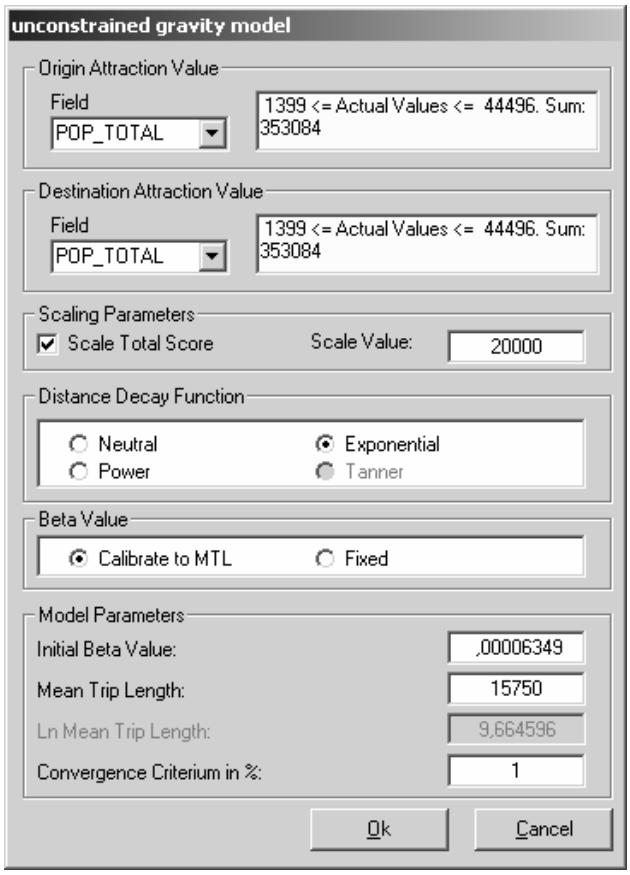
- **Click on "Ok"**

12.2.4 The Unconstrained Gravity Model

In an unconstrained gravity model neither origin nor destination constraints are of any interest. The unconstrained gravity model uses the attraction values of the origins and destinations. Based on these variables and an MTL, the flows between origins and destinations are estimated.
Before the calculation can be executed, the total sum of flows must be entered. This total will be distributed between all possible origin-destination sets, taking into account the mean trip length.
This is how to run an unconstrained gravity model:

- **Select "Models" in the menu bar**
- **Select "Gravity Models"**
- **Click on "Unconstrained"**

A window pops up in which various settings can be made.



A production value and an attraction value must be entered.

- **Select a production value in the "Origin Attraction Value" box [POP_TOTAL].**
- **Select a attraction value in the "Destination Attraction Value" box [POP_TOTAL]**
- **Select a distance decay function in the "Distance Decay Function" box [Exponential]**

In the "Modeling Parameters" box some changes can be made.

- **Enter the MTL in the entry box to the right of "Mean Trip Length" [15,750 (found in section 11.2.1)]**

NOTE: *We chose to set the MTL equal to the one that was calculated using the observed flow data. The alternative is to enter a value for the distance decay parameter.*

Next a convergence criterion must be entered. The convergence criterion determines how closely the MTL to be estimated must equal the distance that was entered above.

- **Enter a value in the entry box to the right of "Convergence Criterium in %" [1]**

As described before, you can also set the value for the distance decay parameter (Initial Beta Value) yourself. Flowmap provides a default value. This value should be left unaltered unless there is a good reason to change it.

Next the total number of flows to be distributed among all the possible origin-destination sets has to be entered.

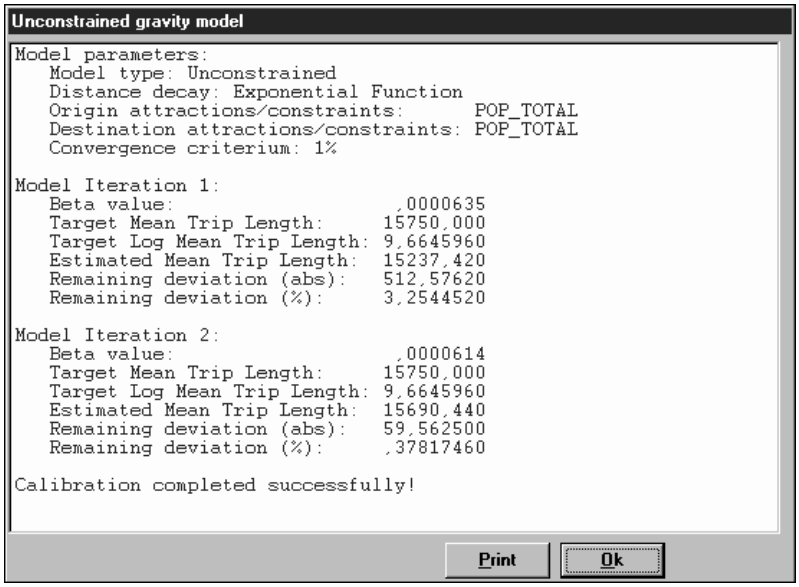
- **Select "Scale Total Score"**
- **Enter the expected number of flows in the entry box to the right of "Scale Value" [20,000]**
- **Click on "OK"**

NOTE: *The number of trips, 20,000, as was given in this example, was simply a number that was made up. The "Total Predicted Interaction Scale" should be a value that was determined as a result of research.*

A window pops up allowing you to save the results in an attribute file. By checking "Store", an new variable will be saved. See section 11.2.6.

Now the model is calculated. When the procedure is finished, the Distance Decay Parameter is calculated using the attraction values of the origins and the destinations. In this example it turned out to be 0.0000614.

- **Click on "OK"**



Now the "Flowmap7 Report" window appears, stating that the writing of the field has been completed successfully (see section 12.2.5).

- **Click on "Ok"**

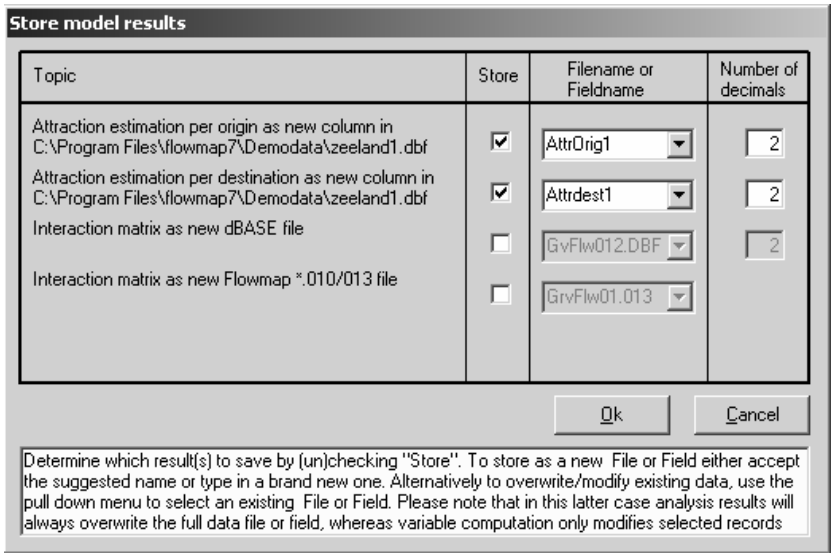
12.2.5 Exporting Calculated Data

For all types of gravity modeling discussed in previous sections (apart from the Garin-Lowry model), exporting the calculated data is done in the same way. This is why the procedure is discussed in this specific section.

The "Store Model Results" window enables you to select the data that need to be stored right away and those you would like to look at immediately.

Now you have four export options:

1. Estimated production value / total number of trips per origin
2. Estimated attraction value / total number of trips per destination
3. Estimated trip numbers as a dBASE-file
4. Estimated trip numbers as a Flowmap distance table (*.013)



The first two options are there for adding the calculated attraction values of the observed flow data, either per origin or per destination, to the attribute file.
In order to calculate a destination constrained gravity model, an attraction variable of the origins is

required. It is impossible to predict which variable (if applicable) is most suitable. Possible attraction variables are for instance the size of the population, the population density, the size of the working population, the number of people with a higher education, the number of cars per inhabitant, etc. etc. A suitable attraction variable could be selected with the help of the attraction values of the origins that were calculated using a doubly constrained model.
Let us take the case where, for example, the location of employment is known, but it is not yet known where the employees will be coming from. An attraction variable of the origins must be set when a destination constrained model is run. Using a doubly constrained model, the attraction value of the origins in the past can be calculated, since the size of the flows from the origins to the destinations is known. A variable in which the variation in origins approximates the variation in attraction values in the past would serve best. And these happen to be exactly the values that are calculated by the doubly constrained model. In that case, the calculated attraction values of the origins in the past can serve to make a well-founded choice for an attraction variable when calculating a singly constrained model.
In order to determine an attraction variable for the destinations (to be used in an origin constrained model) you can save the attraction values of the destinations.

In Flowmap, it is not possible to look at the trips or the distance matrix directly. By selecting "Store", a result will be saved.

The estimated production value/total number of trips per origin and the estimated attraction value/ total number of trips per destination are added to the matching attribute file by saving them.

The estimated number of trips can be saved as a dBASE file. These potential interaction data can in turn be displayed on the screen by opening the file (as a "flows" file) and drawing the flows on the screen as described in the sections 2.8 and 2.9.

You can also save these potential interaction data as a Flowmap distance matrix (*.013) and compare them to observed data at a later stage (see section 12.3).

If you want to save the calculated results proceed as follows:
- **Check "Store" behind the results you want to save**
- **Enter a variable name for each result in the "Filename or fieldname" entry box**
- **Enter the number of decimals with which the values should be stored for each result**
- **Click on "OK" when you have finished**

NOTE: *If you save the estimated number of trips as a dBASE file, make sure the name of this file ends in "2"and make sure the extension is ".DBF".*

Now the "Flowmap 7 Report" window appears for each variable where "Store" was checked, containing a column with the new calculated variable.
- **Click on "Ok"**

You can view the results by opening the relevant table(s):
- **Select "File" in the menu bar**
- **Select "Table Manager"**
- **Click "View Table" and choose the appropriate file**

12.3 Comparing Measured and Predicted Flows

Observed flows and expected flows can be compared in Flowmap by means of a graph. For this procedure both the observed flow data (???????2.DBF-file) and the expected flows data (*.010/*.013 file) must be opened. The way to make such a *.010/*.013-file is explained in section 12.2.5.

If these files have not been opened yet:

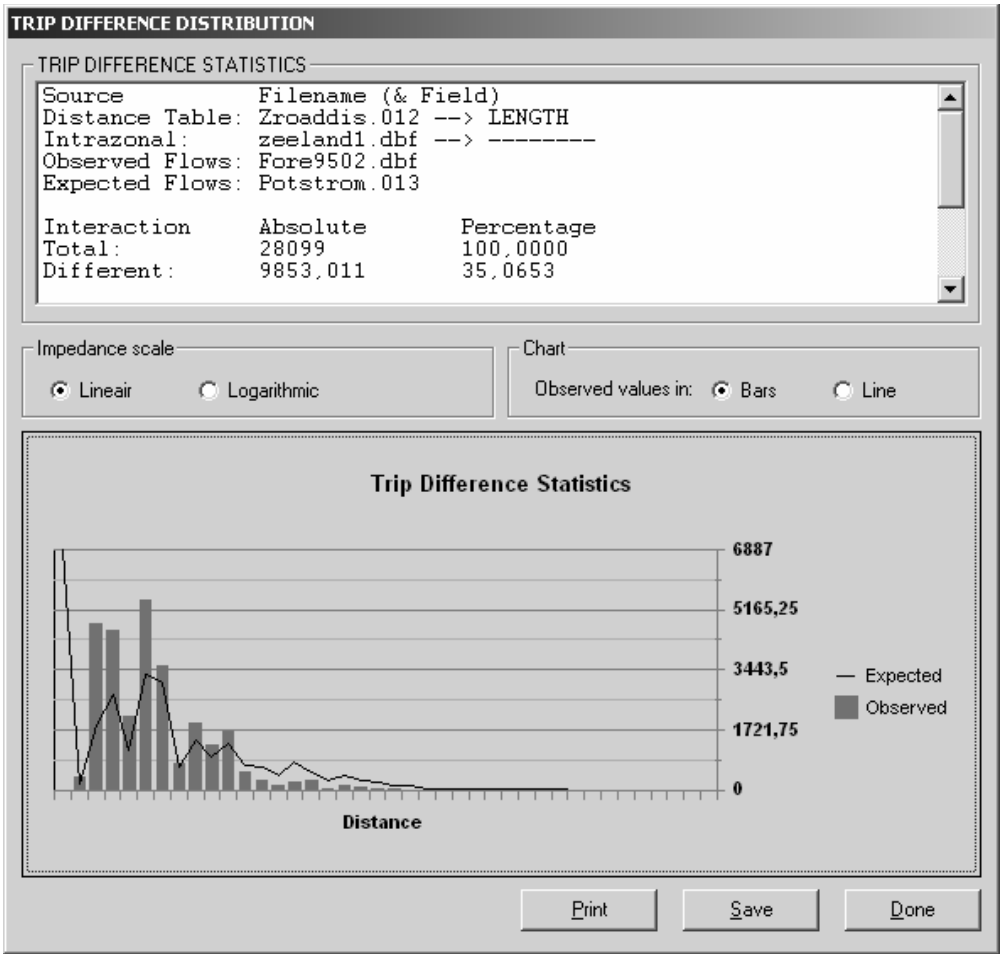
- **Click on "File" in the menu bar**
- **Click on "Edit Project"**
- **Click in the "Flow File" box**
- **The "Open Flow File" window pops up, select a flow file [FORE9502.DBF]**
- **Click on "Open"**
- **Click in the "Flow Table" box**
- **The "Open Flow Table" window pops up, Select a flow table file [POTSTROM]**
- **Click on "Open"**
- **Click on the "Save" button to save the edited project**

Now you can display the graph on the screen:

- **Click on "Graphs" in the menu bar**
- **Click on "Predicted vs Actual Trip Distribution"**

A "Flowmap 7 Report" window pops up:

- **Click on "Ok"**



First Flowmap scans both files. A new window pops up, showing a graph, and some statistics. The graph exists of a bar and a line graph. The bar graph displays the number of flows per

distance class from the observed flows file, and the line graph shows the number of expected flows calculated using gravity modeling.

Above the graph several statistics concerning the graph are displayed. From top to bottom:

1. The total number of flows both absolute and percentage wise (always 100%)
2. The difference in the number of flows between the observed distribution over the classes, and the expected one. In the example of the graph just shown this adds up to 9,853 flows, or 35,1% of the total number of flows. To a large extent this is the result of the large number of expected short distance flows, compared to the virtual absence of current shortest distance class flows. That is: the observed flows do not contain intrazonal flows; very small flows were never taken up into the file containing the number of flows that were observed.
3. The two numbers (σ (sigma) and X^2 (chi square)) give an indication of how well the observed and calculated flows correspond. They are called the "Goodness of Fit Statistics". They are both displayed in absolute numbers and percentages. The absolute numbers result from the following formulas:

$$\sigma = \sqrt{(\Sigma_i \Sigma_j (E_{ij} - O_{ij})^2 / N)} \qquad (7)$$

$$X^2 = \Sigma_i \Sigma_j (E_{ij} - O_{ij})^2 / O_{ij}) \qquad (8)$$

Where:

E_{ij} = Expected trips between origin i and destination j
O_{ij} = Actual past trips between origin i and destination j
N = The number of origins times the number of destinations

However, these values are strongly influenced by the absolute values of the data set that was used. This is why there is also a percentage, ranging from 0 to 100. 0 indicates an exact fit of observed and expected flows. 100 indicates that all flows are different. However, the values will most probably be somewhere between 0 and 100.
The advantage of relative values is that different numbers are comparable. Even values of different data sets can be compared.

4. Finally the shortest and longest distance are shown for both past and expected trips.

12.4 Combining Measured and Predicted Flows

Observed and calculated flows can be combined into one file. This way they can be more easily compared, outside Flowmap that is. This can only be done by saving calculated potential flow data as a *.010/*.013-file (see section 11.2.6, point 4). Both this *.010/*.013-file and the observed flow data file (???????2.DBF) must be opened.

- **Click on "File" in the menu bar**
- **Click on "Edit Project"**
- **Click in the "Flow File" box**
- **The "Open Flow File" window pops up, select a flow file [FORE9502.DBF]**
- **Click on "Open"**
- **Click in the "Flow Table" box**
- **The "Open Flow Table" window pops up, Select a flow table file [POTSTROM]**
- **Click on "Open"**
- **Click on the "Save" button to save the edited project**

This is how you can combine the files:

- **Click on "Create" in the menu bar**
- **Select "Flow Data Preparations"**
- **Click on "Combine Flow File and Flow Table"**

NOTE: *the next view steps are only available in the professional edition.*

The names of the files to be combined are displayed on the dots. Next Flowmap displays a window with total counts of the number of flows in both files.
- **Click on "OK"**

Flowmap asks for a file name.
- **Enter a name [COMBINAT]**
- **Click on "OK"**

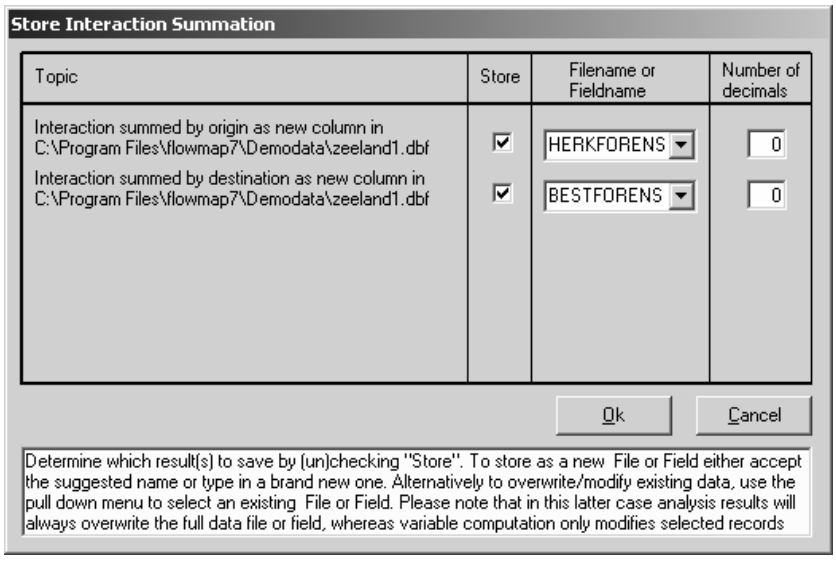
Now a dBASE file is made. Flowmap cannot carry out any further analysis with this; such analysis has to be done in MS Excel, MS Access or other programs.

12.5 Calculating Measured Total In- and Outflows

As stated in section 12.2.2, for calculating a doubly constrained gravity model, every origin's total observed outflow and every destination's total inflow can be used. This section will discuss how to calculate these totals.
Flowmap itself provides a method to calculate outflow and inflow. The total numbers will be stored in the attribute file of origins and destinations (in this chapter's example this means the ZEELAND1.DBF file in both cases).

This is how to do it:
- **Click on "Create" in the menu bar**
- **Select "Flow Data Preparations"**
- **Select "Sum Row/Column Totals"**

The "Store Interaction Summation" window pops up, in which you can choose the variables that must be stored in the attribute file.
- **Check "Store" behind the results you want to save**
- **Enter a variable name for each of them in the "Filename or fieldname" entry box [HERKFORENS] [BESTFORENS]**
- **Enter the number of decimals with which the values should be stored for each result [0]**
- **Click on "OK" when you have finished**

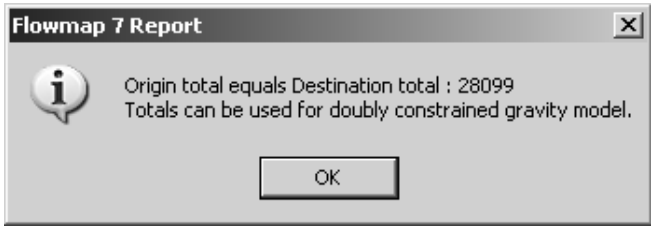


Because the fieldname already exists, a window pops up asking if you want to overwrite the field.
- **Click on "Ok"**

The window to the right pops up showing the total number of trips.

- **Click on "OK"**

Now the "Flowmap 7 Report" window pops up.
It contains the origin's number of commuters daily leaving that specific area as calculated by Flowmap.

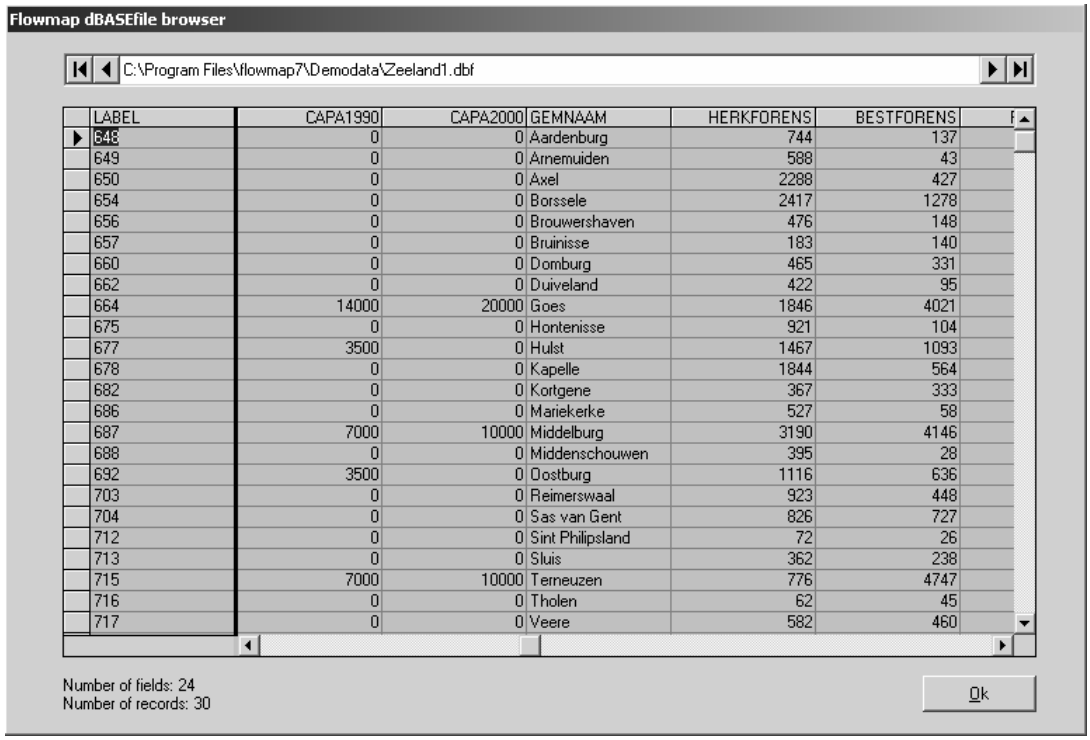


- **Click on "Ok"**

You can view the results by opening the relevant table(s):

- **Select "File" in the menu bar**
- **Select "Table Manager"**
- **Click "View Table" and choose the appropriate file**

The total number of commuters leaving an origin location and of those arriving at a destination location have now been calculated. These results can be used for one of the types of gravity modeling that were discussed in section 2 of this chapter. But this is not obligatory.



LABEL	CAPA1990	CAPA2000	GEMNAAM	HERKFORENS	BESTFORENS
648	0	0	Aardenburg	744	137
649	0	0	Arnemuiden	588	43
650	0	0	Axel	2288	427
654	0	0	Borssele	2417	1278
656	0	0	Brouwershaven	476	148
657	0	0	Bruinisse	183	140
660	0	0	Domburg	465	331
662	0	0	Duiveland	422	95
664	14000	20000	Goes	1846	4021
675	0	0	Hontenisse	921	104
677	3500	0	Hulst	1467	1093
678	0	0	Kapelle	1844	564
682	0	0	Kortgene	367	333
686	0	0	Mariekerke	527	58
687	7000	10000	Middelburg	3190	4146
688	0	0	Middenschouwen	395	28
692	3500	0	Oostburg	1116	636
703	0	0	Reimerswaal	923	448
704	0	0	Sas van Gent	826	727
712	0	0	Sint Philipsland	72	26
713	0	0	Sluis	362	238
715	7000	10000	Terneuzen	776	4747
716	0	0	Tholen	62	45
717	0	0	Veere	582	460

12.6 The Garin-Lowry Model

The Garin-Lowry model consists of two singly constrained gravity models (see section 12.2.3) that are run consecutively: a “residential model” and a “service model”. The “residential model” is used to calculate the number of people that will settle in the sub-areas of a region. This takes place on the basis of the amount of basic employment available in the various sub-areas and the residential attraction of the areas. Next, using the “service model”, the amount of employment in the service sector generated by the people that have settled there because of the basic employment is calculated. This takes place on the basis of the number of people that live in the various sub-areas according to the “residential model” and the so-called “service attraction”. The “service attraction” of a sub-area indicates the attractiveness to companies to offer their services there.
As more service employment comes into the region, more people will move there. Therefore, the “residential model” is run again and after that the “service model”. This cycle continues until hardly any new employment is being created, and (almost) no new people will come to live in the area. Thus, both models are run a number of times.
The Garin-Lowry model provides a number of results. Two distance decay parameters are calculated: one for the “residential model” and one for the “service model”. Also, the allocated population per sub-area and the allocated employment in the service sector per sub-area, are calculated.
These last two results can be added as a new variable to the attribute file of the sub-areas. The calculated distance decay parameters can be used for calculating the interaction matrices, by means of the procedure that was discussed in section 12.2.3.

The Garin-Lowry model can be outlined as follows:
1. The size and the location of the basic employment must be known;
2. Working people are allocated in residential zones;
3. The total population per zone is calculated;
4. The service employment per service zone is calculated;
5. Points 1 to 4 are repeated until the increase of service employment is very limited;
6. The population and the service employment per zone are calculated;
7. The home-to-work and home-to-service trip matrices have to be calculated.

The “residential model” and the “service model” are both singly constrained models. These models were discussed in section 12.2.3., so their background is not explained any further here. In this section only those variables and parameters are discussed that have to be entered in the window for calculating the Garin-Lowry model.
First you need to open the files ZROADDIS.012 and ZEELAND1.dbf. See for more information about opening a distance matrix section 11.1.
- **Click on “Models” in the menu bar**
- **Click on “Integrated Gravity (Garin_Lowry)”**

The entry window for the Garin-Lowry model pops up.

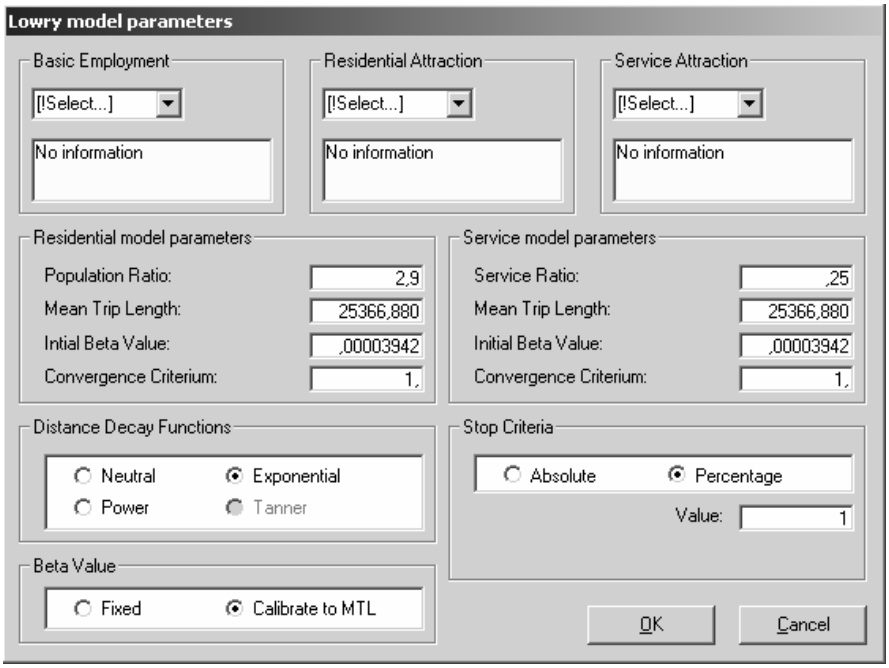
In this window a number of variables must be selected and a number of parameters entered.
- **Click on a variable indicating the basic employment in the “Basic Employment” box**
- **Click on a variable indicating the residential attraction per sub-area in the “Residential Attraction” box**
- **Click on a variable indicating the service attraction per sub-area in the “Service Attraction” box.**

Next the Population Ratio must be entered. The population ratio indicates how many people a worker brings along when settling in a sub-area. A population ratio could be the average family size (that is, assuming only one family member has a job)

- **Enter a number in the entry box to the right of "Population Ratio"**

Besides that, a "Service Ratio" must be entered. This indicates the number of jobs a person using services generates on average. (For example: one baker per hundred residents, one butcher per two hundred residents, and one teacher/professor per five hundred residents. This would result in a (very hypothetical) service ratio of 0.017.)

- **Enter a number between 0 and 1 in the entry box to the right of "Service Ratio"**



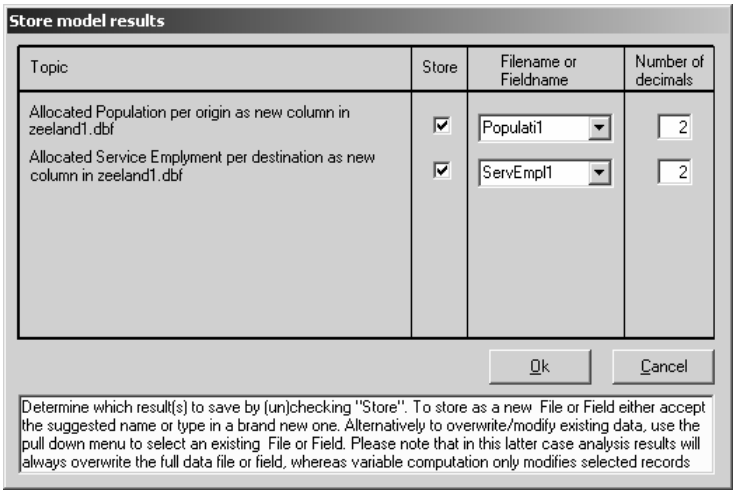
Both models require some parameters in the entry window. These are the MTL, the distance decay parameter (Initial Beta Value) and the Convergence Criterion. These were discussed in section 12.2.3. Default values have been preset. If there is a good reason to change them, you can do so (see section 12.2.3.)

Next one of the three functions in the "Distance Decay Functions" must be selected. In the beginning of this chapter the difference between these functions was explained.

- **Click on one of the three functions in the "Distance Decay Functions" box**

After that, a stop criterion must be set. As was discussed earlier in this section, the Garin-Lowry model consists of two gravity models that are consecutively run again and again, until no employment is generated and no more people come to live in the area.
Actually, the model always finds a small increase. However, this can be extremely small, so the model must stop at a certain point. This is what the stop criteria is for. It can be set in percentages (of the number of people in the service employment) or in absolute numbers.

- **If the stop criterion should be a percentage then click on "Percentage" in the "Stop Criteria" box. If the stop criteria should be an absolute number, click on "Absolute" in the "Stop Criteria" box.**
- **Enter a percentage or absolute value that still must be added in the "Value" entry box before the procedure halts.**



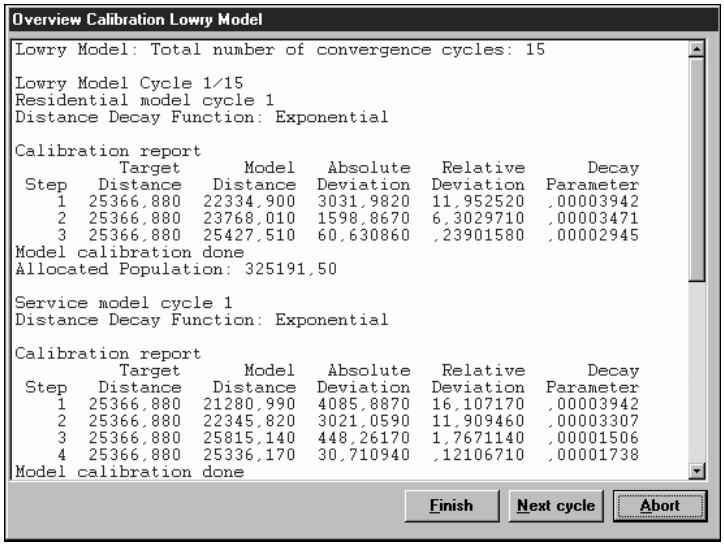
If everything is set, then:

- **Click on "OK"**

Now the output window will appear. Two variables can be stored in the attribute file of the origins and destinations: the number of inhabitants per origin and the employment per

destination.
By selecting “Store”, an new variable is saved. Choosing “Preview” allows you to look at the calculated variable. If you first want to save the new variable proceed as follows:

- **Check “Store”**
- **Enter a variable name in the “Filename or Fieldname” entry box**
- **Enter the number of decimals with which the values should be stored**
- **Click on “Ok”**



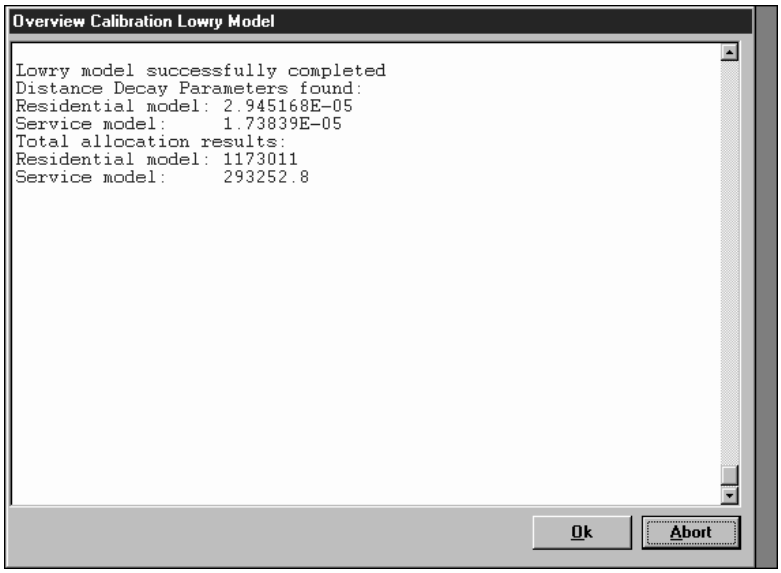
Now the Garin-Lowry model calculates, in a number of cycles, the distance decay parameters of both the residential model and the service model. The number of inhabitants and the amount of employment in the service sector are also calculated in a number of cycles.

A window pops up, telling how many cycles the model needs.

- **Click on “Start” if that number is acceptable to you.**

Now the analysis will be carried out. After the first cycle, the window to the right pops up. By clicking on “Next Cycle” after each one, you will also get an overview of the next cycles. By clicking on “Finish”, the rest of the cycles will be run without stopping.

- **Click on “Finish”**



After the point of convergence is reached, a window pops up in which the two distance decay parameters are shown.

NOTE: *If the distance decay parameters will be needed later on to calculate another model, you should remember to write them down, because Flowmap will not store them!*

- **Click on “OK”**

Now the “Flowmap7 Report” window appears, stating that the writing of the field has been completed successfully.

- **Click on “Ok”**

You can view the results by opening the table:

- **Select “File” in the menu bar**
- **Select “Table Manager”**
- **Click “View Table” and select the relevant file**

CHAPTER 13

Service Location Modeling

In this chapter the second part of the models sections of Flowmap will be discussed. The service location models part of Flowmap consists of four different models:

1. *Coverage Models.* This model entails the question of how many different locations are required to meet a minimum level of service. Flowmap provides the 'Spatial Pareto' method to solve the problem which uses the concept of efficient locations to significantly reduce the number of permutations in a full brute force solution.

2. *Expansion Models.* The expansion model entails the question of how many different locations are required to meet a minimum level of service. There are four different model alternatives to get to a solution: "maximize customer coverage", "minimize overall average distance", "minimize overall worst case distance" and "maximize individual market share". The first maximizes coverage by adding an additional service centre at a location where the highest market share would be realized. The second will minimize the overall average distance by removing step by step that service centre which will have the least impact on the increase in average distance. The third model differs from the second alternative because it removes the service centre which has the least impact on the increase in worst case distance. The last option will maximize the individual market share by maximizing the overall increase in customer coverage by removing the service posts which will have the least impact on the decrease in the amount of covered customers.

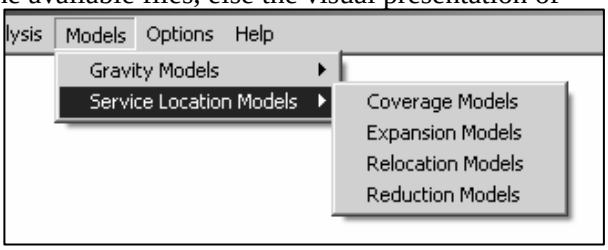
3. *Relocation Models.* The relocation model optimizes the location of a given set of service locations. There are three different model alternatives: "minimum average distance", "minimum worst case distance" and "maximize spatial competition". The first two are carried out practically the same. For each start or solution set a catchment area analysis is performed and that for each (alternate) location with that catchment area is investigated whether or not the score on the solution criterion would improve compared to the current solution. The last one maximizes spatial competition by using the Hotelling model, which picks the worst location with the smallest cover area and replaces it with the optimum available location. This procedure will be repeated until it reaches a sub-optimum.

4. *Reduction Models.* The reduction models contain four different model alternatives: "least effect on customer coverage", "least effect on average distance", "least effect on worst case distance" and "remove worst market position". These four model alternatives are the exact opposites as the four model alternatives discussed in the previous expansion models section.

First the coverage models will be discussed. Next the expansion models will be discussed, with help of the expansion model the data set will be modified by adding extra service posts which are necessary for discussing the other models. Third the relocation models are discussed. The coverage and relocation models are more or less related to each other and they will be discussed with the help of an imagined ambulance posts example. The Hotelling based procedure, an alternative option from the relocation model, will be discussed separately. Finally, the reduction models will be discussed.

For the models the following files need to be opened in a new project (see section 1 for more information on creating new projects): ZVPC.006 as Map File, ANDTIJD.012 as a Distance Table and make sure that file ZVPC4001.dbf is opened as Origin and Destination File. It is

also important to set the view settings for the available files, else the visual presentation of the models can't be carried out.



The models are located under the "Service Location Models" menu.

- **Select "Models" from the menu bar**
- **Select "Service Location Models"**

13.1 Coverage Models

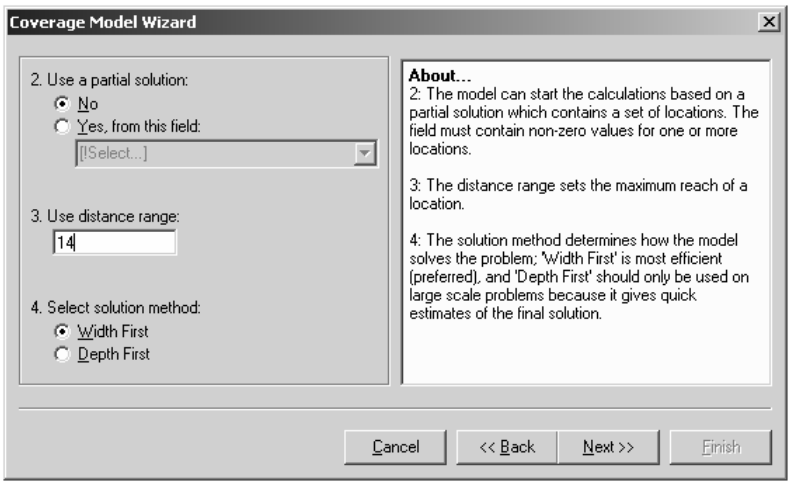
The first model entails the question of how many different locations are required to meet a minimum level of service. This model will use the Spatial Pareto procedure which will calculate to optimize one position regarding the other position and choose the best option.

NOTE: *This model uses the resulting dataset with multiple service locations. See section 13.2.*

- **Select "Models" from the menu bar**
- **Select "Service Location Models"**
- **Click on "Coverage Model"**

The "Coverage Model Wizard" window pops up. The first step is to select a model alternative. In this case only the Spatial Pareto procedure can be selected.

- **Click on "Next"**

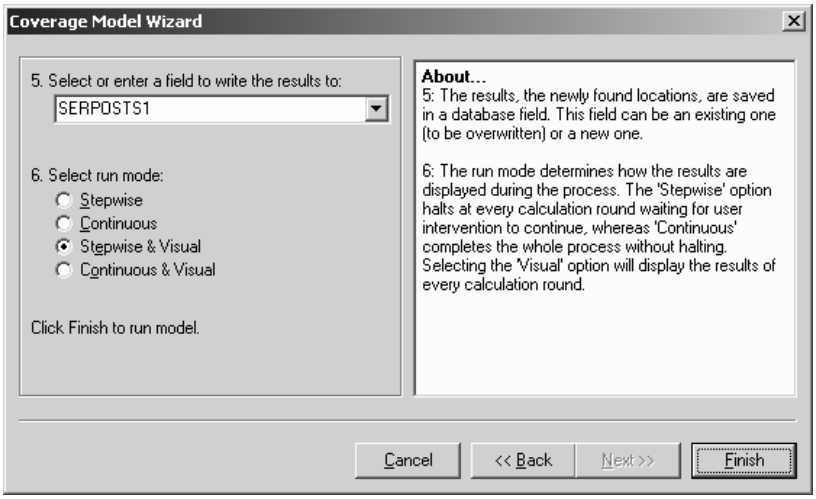


The window to the right pops up. In step two it is possible to select a file containing a partial solutions. This could be for example a file containing the locations of already existing ambulance posts. In the next step a distance range needs to be entered which is in this example 14 minutes. In step four two available solution methods can be selected. 'Width First' will check at the first step all available solutions, at the next step it will again check all available solutions and so on. This method is preferable when working with smaller problems. The 'Depth First' method is preferable when working with bigger problems. It will calculate one possible path until it has found a better solution path and can drop all worse paths.

- **Enter '14' as distance range**
- **Click on "Next"**

The window to the right will appear. In step five a field need to be selected or entered to which the results will be written. By default this would be "SERPOSTS1". In step six the run mode needs to be selected, by selecting "stepwise" Flowmap will pause after every calculation round, by selecting "continuous" Flowmap won't pause after every calculation round, by selecting "visual" Flowmap will give a visual representation of the results.

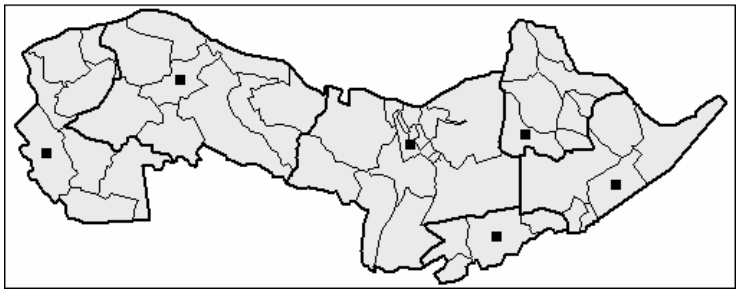
- **Click on "Finish"**



Flowmap will now step for step run the model.

- **Click on "Resume" until the model has finished**

When the model has finished the result should look like the map on the right. Notice that only six ambulance posts with a 14 minute radius are needed to cover the whole area.



- **Click on "Ok"**

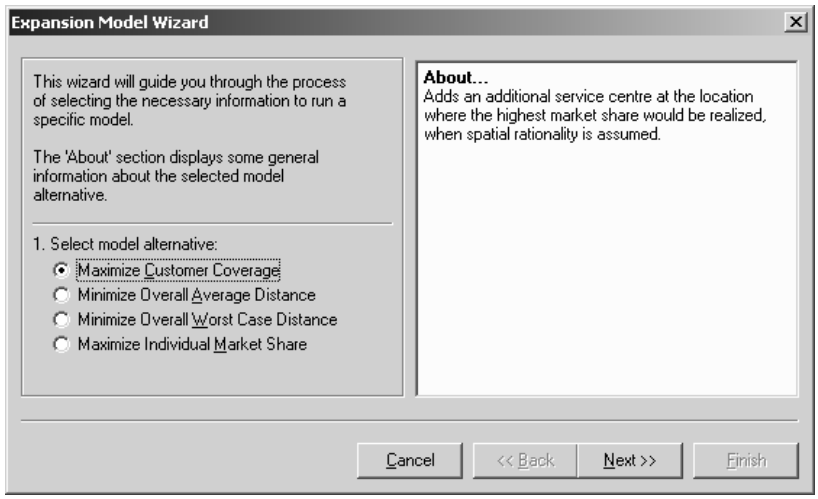
13.2 Expansion Models

The expansion models entail the question of how many different locations are required to meet a minimum level of service.

This models will be discussed with the help of an ambulance post example. In the study area of Zeeuws Vlaanderen we would like to place new ambulance posts from which people can be reached in 14 minutes or less. So the research question of this example would be how many and where the ambulance posts need to be situated so that they can reach the whole study area in 14 minutes or less.

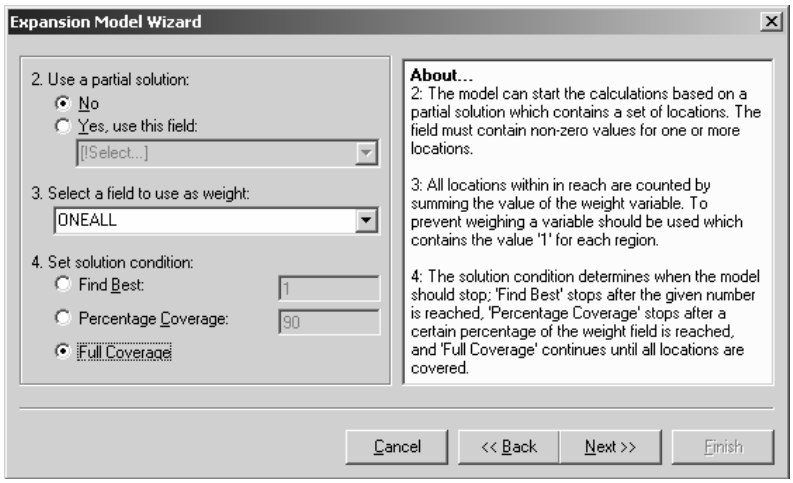
- **Select "Models" from the menu bar**
- **Select "Service Location Models"**
- **Click on "Expansion Models"**

The "Expansion Model Wizard" window to the right will pop up. In the first step one can choose between four different model alternatives. The first option (Maximize Customer Coverage), which will be used in this example, will add an additional service centre at that location which contains the



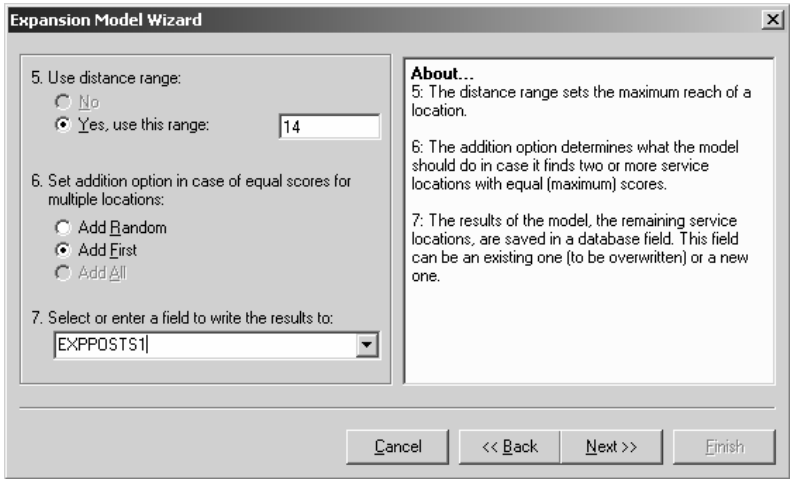
highest market share. In case of the ambulance post example it will calculate at each step that location which will cover the largest possible area which can be reached in 14 minutes or less. The “Minimize Overall Average Distance” will remove step by step the service centre which will have the least impact on the increase in average distance. The “Minimize Overall Worst Case Distance” differs from the previous option because it removes the service centre which has the least impact on the increase in worst case distance. The final “maximize Individual Market Share” option will maximize the overall increase in customer coverage by removing the service posts which will have the least impact on the decrease in the amount of covered customers.

- **Select “Maximize Customer Coverage”**
- **Click on “Next”**



In step two one can choose to use a field as a partial solution. Once selected, the model will start its calculations based on this partial solution. In the third step a weight field needs to be selected. In the fourth step a solution condition can be set. There are three options available. The first is to let Flowmap find a number of best solutions, which by default is 1. The second is to enter a percentage which needs to be covered, which by default is 90. The third is to select a full coverage of 100%.

- **Check “No”, so no partial solution will be used**
- **Select [ONEALL] as weight field**
- **Check the “Full Coverage” option**
- **Click on “Next”**

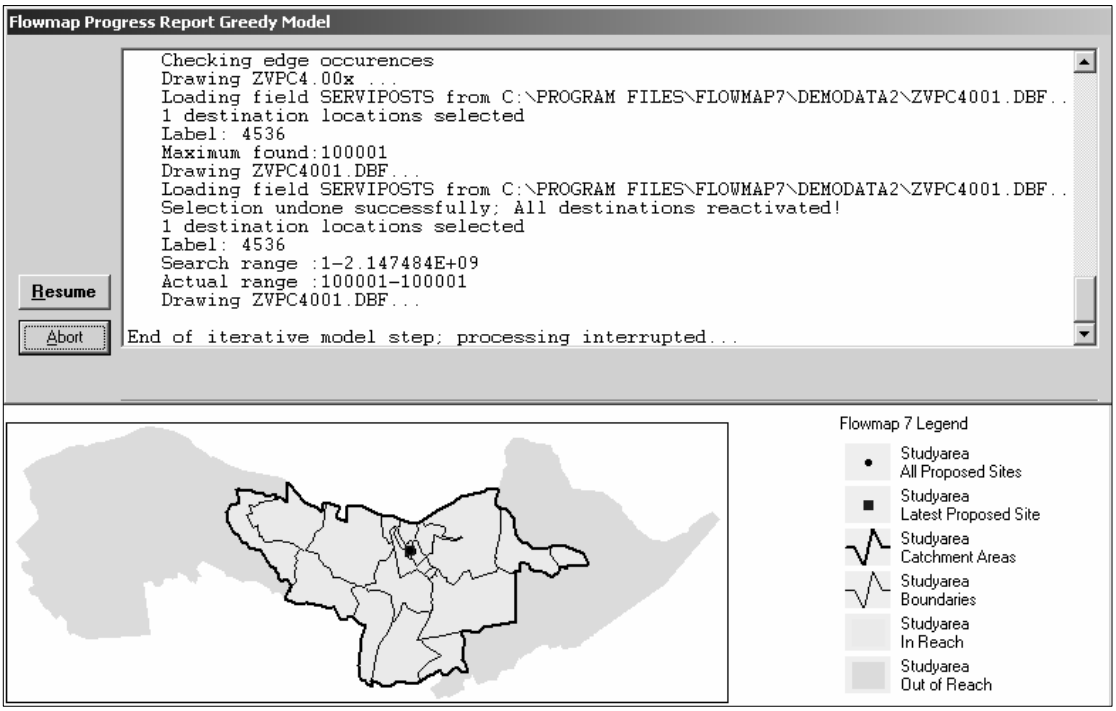


In step five a distance must be entered. The ambulance posts need to cover an area in 14 minutes or less so the distance range must be set at 14. In step six one can set an additional option what the model should do in case of service locations with equal maximum scores. By default “Add Random” is checked, in which the model will randomly assign the service locations with equal scores. In this example the “Add First” option will be selected, so the resulting map should be the same as the one in this manual. In step seven a field needs to be selected to which Flowmap can write the results. You can either select an existing field or enter a new fieldname.

- **Enter “14” as range**
- **Check “Add First” as additional option**
- **Select [SERVPOSTS1] to write the results to**
- **Click on “Next”**

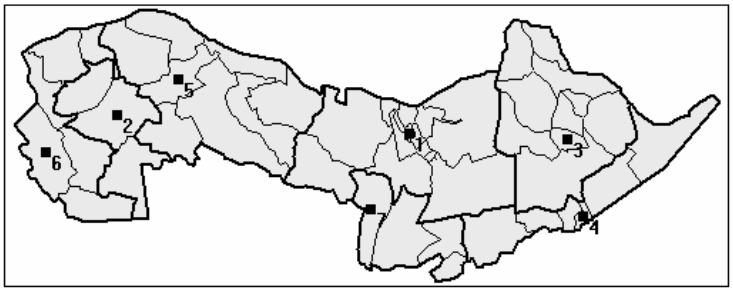
Finally, in the next window, choose one of the four run methods. Choose “Stepwise” and every step needs a confirmation before continuing. Choose “continuous” and Flowmap will carry on until the analysis has been completed. The last two are practically the same, only Flowmap will give a visual presentation during the analysis

- **Choose “Stepwise & Visual” as run mode**
- **Click on “Finish”**



The model will now begin to run. After the first step has been completed Flowmap will pause until you click on “Resume” in the report window. Below the report window is the visual representation of the first step showing the first ambulance post and the corresponding area covered within a 14 minutes radius.

- **Click on “Resume” until the model has finished**



If carried out successfully the map will now look like the one on the right. Notice that Flowmap has added numbers to the ambulance posts. The first post has number one, the second number etc.. A total of seven posts are needed to cover the whole area. It is also possible to save or print the progress results by clicking the corresponding buttons in the report window.

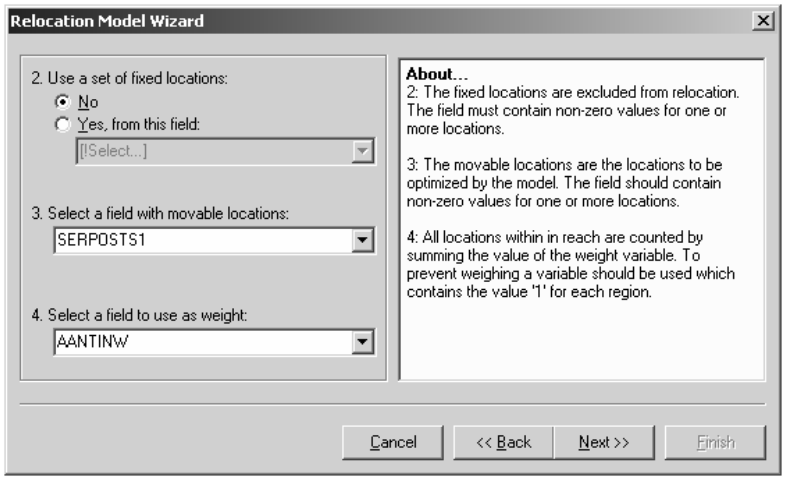
- **Click on “Ok”**

13.3 Relocation

In this section we will proceed from the ambulance post solution as has been calculated from one of the previous sections. With help of the coverage model a solution has been found consisting of six posts covering the whole area within a 14 minutes or less radius. Now we are going use the relocation model to optimize the current solution considering the location of the inhabitants in the area.

There are two relocate alternatives possible which are carried out practically the same and one alternative which follows the Hotelling procedure. The first two options are the minimum average distance (Minimize Average Distance) or the minimum worst case distance (Minimize Worst Case Distance). Because we are dealing with ambulance posts we are choosing for the last option.

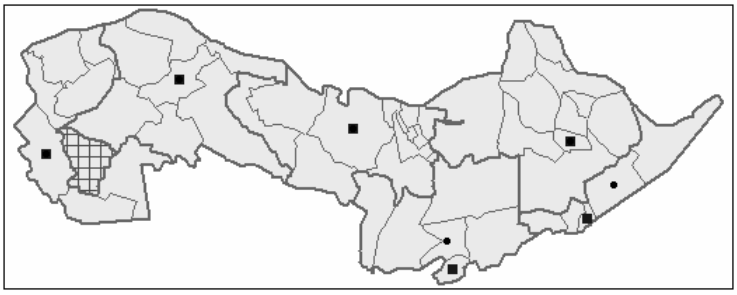
- **Select "Models" from the menu bar**
- **Select "Service Location Models"**
- **Click on "Relocation Models"**
- **Select "Minimize Worst Case Distance"**
- **Click on "Next"**



The movable locations are the six locations as has been calculated with the coverage model. Select [AANTINW], containing the total numbers of inhabitants, as a weight file. In step three a new filename can be entered or an existing field selected in which the results can be stored or overwritten.

- **Leave "No" checked, so no set of fixed locations will be used**
- **Select [SERPOSTS1] as field containing the start locations**
- **Select [AANTINW] as weight field**
- **Click on "Next"**
- **Use in the next window the default filename or enter a new one**
- **Select "Continuous & Visual"**
- **Click on "Finish"**

Flowmap will now run the model. The map with the new locations should look like the one on the right. The checked area represents a study area with no-demand. The squares represent the old locations, the new locations are represented by circles. The new locations have now been optimized for inhabitants.



- **Click on "Ok"**

NOTE: *Relocation models do not always result in the overall optimal solution, they optimise a set of start locations. If this set is somehow unlucky or when fixed locations are set, there is always a change the relocation model may end in an overall suboptimum.*

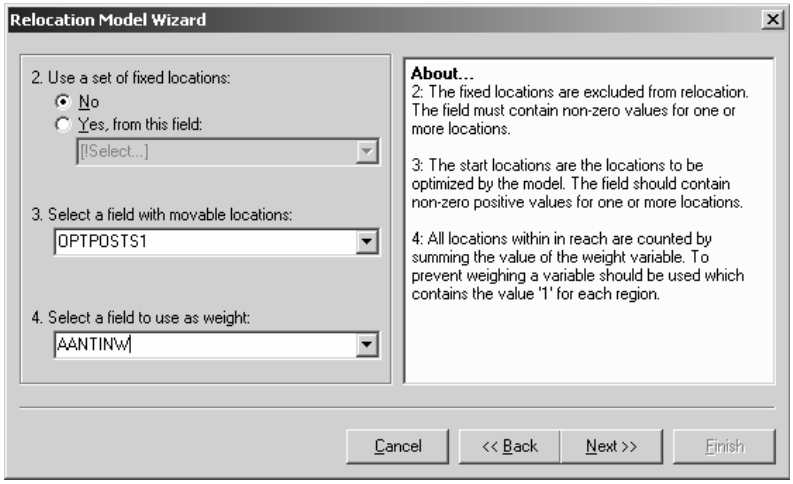
13.4 Maximizing Spatial Competition

The “Maximize Spatial Competition” option in the relocation model is based on the Hotelling model and picks the worst location with the smallest cover area and replaces it with the optimum available location. In the next steps it again picks the worst location in the new situation and replaces it with the best available location etc..

- **Select “Models” from the menu bar**
- **Select “Service Location Models”**
- **Click on “Relocation Models”**
- **Select “Maximize Spatial Competition”**
- **Click on “Next”**

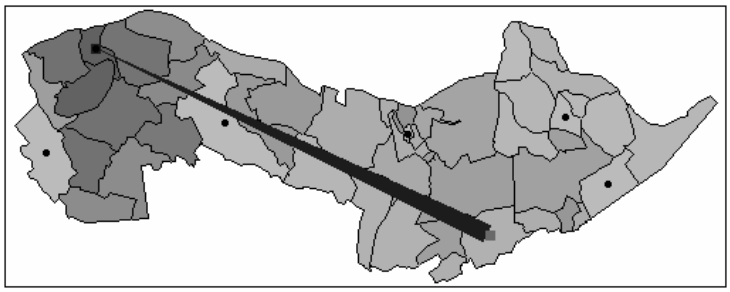
The window below appears. This wizard is practically the same as the optimization wizard. See for a description of the different options the previous section.

- **Leave “No” checked, so no set of fixed locations will be used**
- **Select [OPTPOSTS1] as the field containing the start locations**
- **Select [AANTINW] as weight field**
- **Click on “Next”**
- **Select in the next screen [HOTELPOSTS1] to write the results to**
- **Select “Stepwise & Visual”**
- **Click on “Finish”**



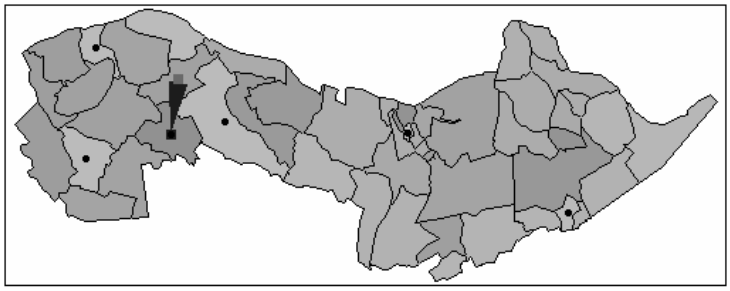
Flowmap will now begin to run the process.

After it has completed the first step it suggests to move the lower right location to the upper left location as is shown on the right map. Notice that in the ‘Flowmap Progress Report Hotelling Model’ window the worst service centre improves from 4950 to 44400. The greyer the area, the more intense the market of that area.



- **Click on “Resume” until the model has finished**

When the model has finished the solution procedure has run into an endless loop. The last map with the new positions will look like the one on the right.



- **Click on “Ok”**

13.5 Reduction Models

The reduction models are the exact opposite of the expansion models. The model will start with a set of (current) starting locations and each step the location with the least effect on accessibility or the lowest individual market share will be removed from the set.

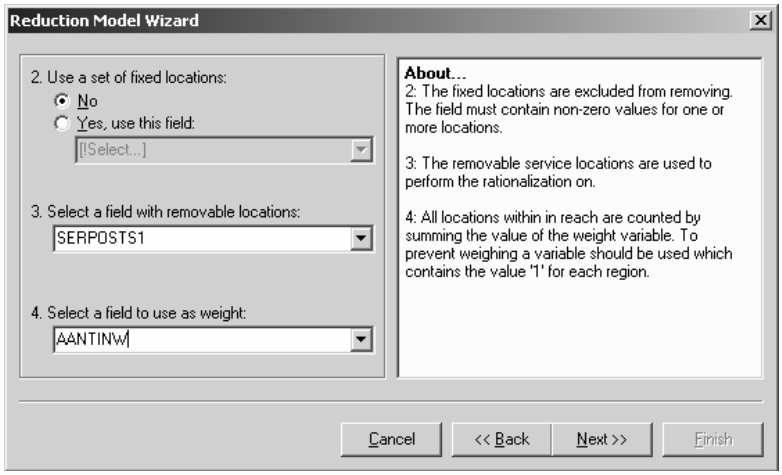
- **Select "Models" from the menu bar**
- **Select "Service Location Models"**
- **Click on "Reduction Models"**

The "Reduction Model Wizard" window will pop up. In the first step four different model alternatives can be selected. These alternative models are more or less the opposite of the procedures as described in the "Expansion Model Wizard". In this ambulance post example the emphasis will be placed on the inhabitants (customer) coverage. So we will choose the "Least Effect on Customer Coverage" model alternative to calculate which post should be removed with the least impact on the inhabitants coverage.

- **Select "Least Effect on Costumer Coverage"**
- **Click on "Next"**

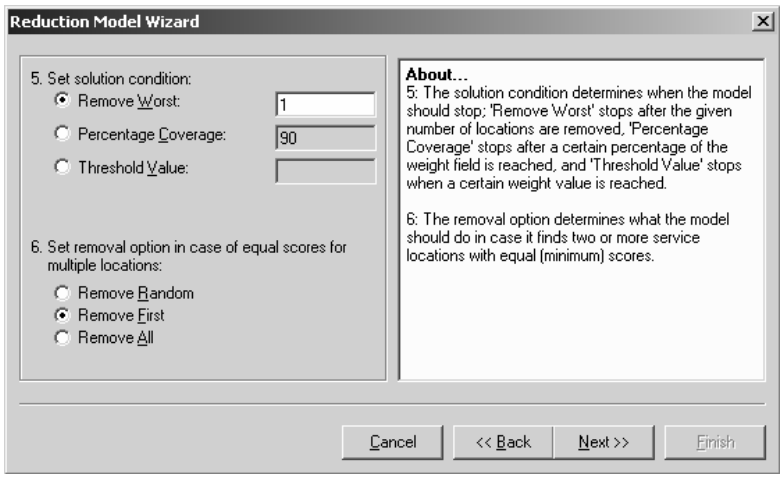
The next window pops up in which we will choose [SERPOSTS1] as the field containing the ambulance posts. [AANTINW] will be the weight field containing the number of inhabitants.

- **Leave "No" checked, so no set of fixed locations will be used**
- **Select [SERPOSTS1] as field containing the removable locations**
- **Select [AANTINW] as field to use as weight**
- **Click on "Next"**



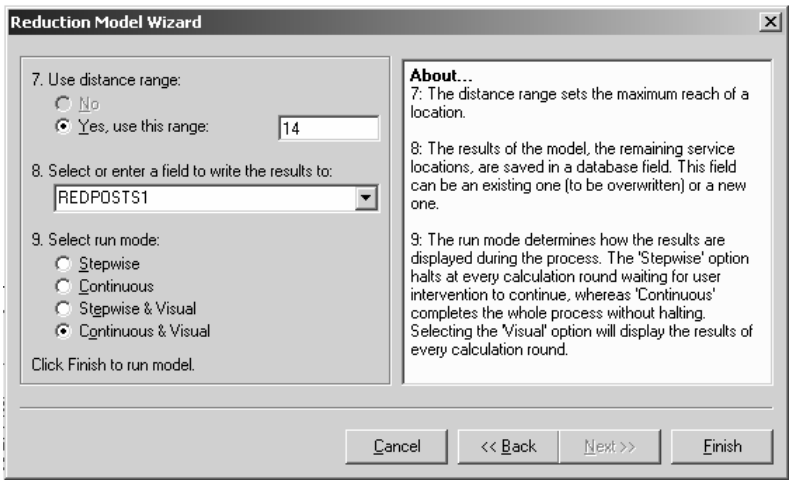
In step five a solution condition can be set. In this case the worst one will be removed.

- **Enter [1] in the "Remove Worst" field**
- **Select "Remove First" as removal option**
- **Click on "Next"**

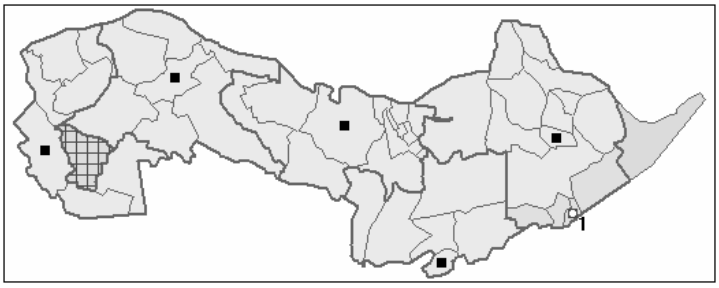


In the next model wizard window, enter [14] as distance range and either choose the default name or enter a new one to write the results to.

- **Enter [14] as distance range**
- **Choose [REDPOSTS1] as field to write the results to or enter a new one**
- **Select "Continuous & Visual" as run mode**
- **Click on "Next"**



The model will now carry out the calculations. The final result will show one, numbered, location marked as a white point. This is the location which will have the least effect on the coverage area if it is removed.



Part 4
The professional edition

This section deals with the features that are only available in the professional edition of Flowmap 7. These features can be of great help for research purposes, but they are irrelevant for the educational version.
The above-mentioned features are present in the program, but they will not be activated until you register. The first section describes how to register and how to activate Flowmap's professional features by entering the registration code.
The second section discusses how you can explore the range within which the MTL should be (Exploration Mean Trip Length). The next two sections are about converting a distance matrix from dBASE to Flowmap and vice versa. In the next section, changing databases is dealt with. The last section discusses using a log file, in order to save a procedure.

CHAPTER 14

Additional options in the professional edition

In this chapter, registration of the professional edition of Flowmap is explained. Then, the five options that are only available in the professional edition are discussed: “Range Exploration Mean Trip Length”, converting a distance table from dBASE to Flowmap, converting a distance table from Flowmap to dBASE, changing databases and using a log file.

14.1 Registration of the Professional Edition

Registration is done in three steps. First, type your name and, if applicable, the name of your organization. Second, Flowmap then makes a temporary registration file and a registration letter. The latter is sent by e-mail to the Flowmap Development Team. Once they have received all the necessary information and your payment, you will get a registration code. Finally, this registration code is entered, upon which Flowmap makes a definitive registration file. The professional features of Flowmap will be activated. These steps will be discussed in detail in the following sections.

14.1.1 Entering the required information

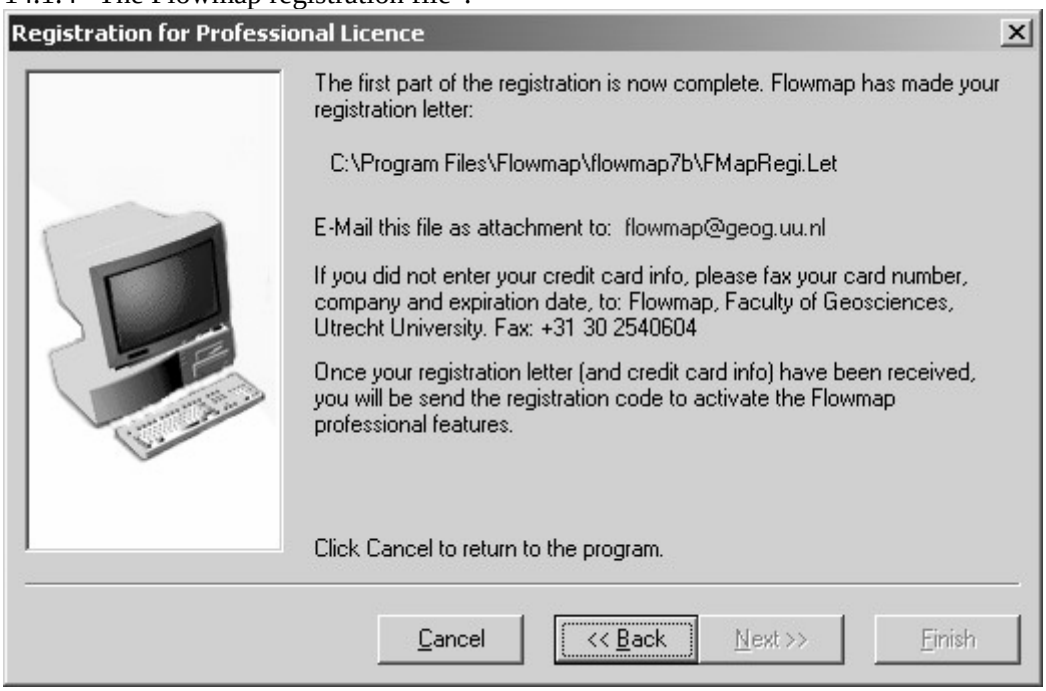
You can upgrade Flowmap to the professional edition in the Flowmap 7 disclaimer window.

- **Select “Help” from the menu bar**
- **Click on “Professional Licence”**

Now the “Flowmap Professional Registration” window will pop up.

In the first two fields of this form you can enter your name, and, if applicable, the name of your organization. A maximum of 40 characters is available for the user name, as well as for the name of your organization. Both fields must contain at least 8 characters. From now on, these names will appear in the disclaimer message, every time you start up Flowmap.

The Flowmap Professional edition costs US$ 250, payable by credit card. You can enter your credit card information (number, company, valid until) in the bottom half of the "Flowmap Professional Registration" window; this information will be encoded when you send us your registration letter by e-mail. You can also fax us this information (see further below). After entering the names and your credit card information, click on "Finish". The window shown below will appear. Flowmap has now made a registration letter (FMapRegi.Let). Flowmap has also made a temporary registration file (FMapProf.Lic). This file is used by Flowmap to check the registration; please take care never to copy or change it in any way, because this might invalidate your Flowmap Professional registration. For more information, see section 14.1.4 "The Flowmap registration file".



14.1.2 Sending the registration letter

In the Flowmap Program Directory you will find a file called FmapRegi.Let. It contains several lines of text, including your own name and the name of your organization, and a 32-character code.

```
FlowMap Professional Registration Letter
Send this file by e-mail to flowmap@geog.uu.nl
By sending this file you agree to pay US$250
User: Jeroen van der Zwan
Organisation: StapZwan Brouwerij B.V.
Registration Code: JRLZTWUM5YNEJNPP6UIK644IEJP3ZLCE
```

Send this file by e-mail or attached to an e-mail message to flowmap@geog.uu.nl. Please make sure the lines starting with "User:", "Organization:" and "Installation Code:" remain unaltered.
If you did not enter your credit card information in the "Flowmap Professional Registration"

window, you can fax the information (card number, company and 'valid until' date) to "Flowmap, Faculty of Geographical Sciences Utrecht", fax 030 – 2540604 (international: +31 – 302540604)
As soon as we have received all relevant information, we will send you a 16-character registration code by e-mail.

```
Thank you for registering FlowMap Professional.

We have filed your registration for
FlowMap version 7 Professional
User: Jeroen van der Zwan
Organization: StapZwan Brouwerij B.V.

Your registration code is: JRLZTWUM5YNEJN
Enter this code to activate the professional features.
```

14.1.3 Entering the registration code

Once you have started your registration (upon completion of the first step). You can again open the licence window as explained in paragraph 14.1.1, now Flowmap will ask you to enter the registration code. This code contains 16 characters, from the ranges "A" thru "Z" and "2" thru "7" (not "zero" nor "one", in order to avoid confusion with "O" and "I"). In most cases, you can copy your registration code to the clipboard with the option "edit; copy" from your e-mail program; you can then paste it onto the form using your right mouse button and the option "paste".

If you have entered your registration code, click on "Finish".

The registration of the professional version is completed. From now on, the professional features of Flowmap are activated. When you start up Flowmap, the registration file FMapProf.Lic will tell the program that the professional version was registered. For more information, see section 14.1.4 "The Flowmap registration file".

14.1.4 The Flowmap registration file

On starting up, Flowmap checks the registration of Flowmap Professional by means of the registration file FMapProf.Lic in the Flowmap program directory. This file contains several lines of text, including your user name, the name of your organization and a code, that enables Flowmap to identify the installation.

Any modifications to this file or the Flowmap installation can invalidate your registration. Or, to be more precise:

- The file “FmapProf.Lic” cannot be modified in any way. Even opening the file in a word processor or editor can invalidate your registration.
- The file “FmapProf.Lic” cannot be copied.
- The Flowmap program directory cannot be copied.

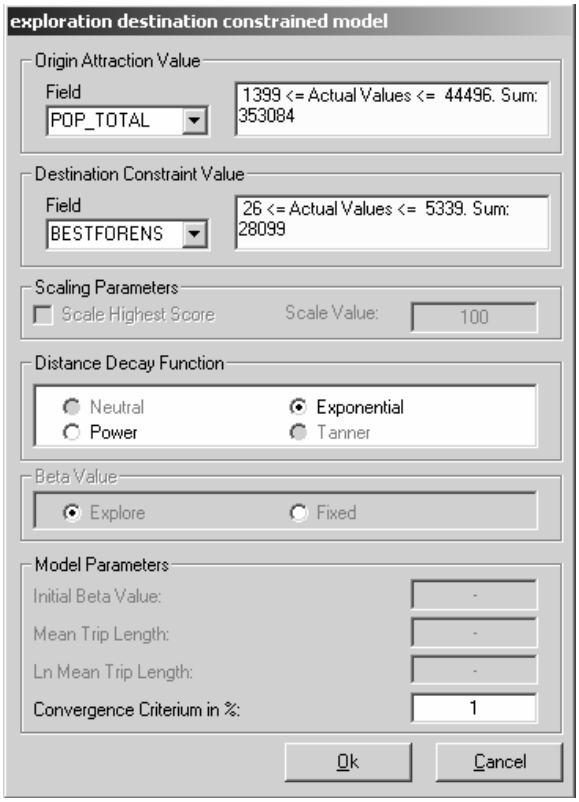
You can do several things, however, without affecting your registration:

- You can change the name of the Flowmap program directory; you can transfer (but not copy!) the Flowmap program directory as a whole (including the registration file “FmapProf.Lic”) to another directory on your hard disk.
- New patches and versions of Flowmap can be installed in the Flowmap program directory as long as the main version number does not change (that is the number before the dot; a registration for version 6.3 is also valid for 6.4, 6.5 and so on, but not for version 7.2)

14.2 Range Exploration Mean Trip Length

In order to run a gravity model, you often have to enter a Mean Trip Length (MTL). For this, you can use the mean trip length of observed trips in the past (see the section discussing the Actual Trip Length Distribution). If no data on observed trips in the past are available, the program can generate and calculate a number of mounting values for the distance decay parameter (Beta value) in order to determine fair values for the MTL and/or the distance decay parameter.

- **Select “Analysis”**
- **Select “Range Exploration Mean Trip Length”**
- **Click on “Exploration Unconstrained model”, “Exploration Origin Constrained Model”, “Exploration Destination Constrained Model” or “Exploration Doubly Constrained Model”: [Exploration Destination Constrained Model]**



The window displayed alongside will pop up.

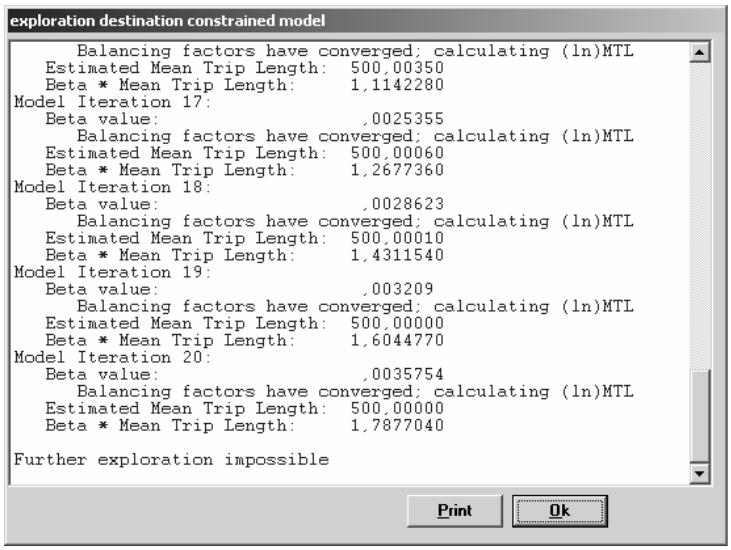
An origin constraint or production value (depending on the chosen gravity model), and a destination constraint or attraction value (depending on the chosen gravity model) must be selected.

- **Select a variable in the “Origin Attraction Value” box [POP_TOTAL]**
- **Select a variable in the “Destination Constraint Value” box [Bestforens]**
- **Select a distance decay function in the “Distance Decay Function” box [Exponential Function]**

Now a convergence criterion must be set.

- **Enter a value in the entry box to the right of "Convergence Criterion" [1(%)]**
- **Click on "OK"**

The window alongside pops up, containing the results. The estimated MTL has been calculated for different distance decay parameters. Experience shows that the distance decay parameter ranges between 1/MTL and 2/MTL (in case of an exponential function); in case of a power function, this value will range between 1 and 2.



- **Click on "Print" if you would like the results to be printed**
- **Click on "OK"**

14.3 Converting a Distance Table: dBASE to Flowmap

Importing a distance table is only possible in the professional edition of Flowmap.
In Flowmap you can use a distance table that was created outside Flowmap, provided that this file:

1. consists of three columns: the first one for the origin label, the second one for the destination label, and the third one for the distance value between the origin and destination concerned.
2. is stored as a dBASE III (DBF) file.
3. contains only labels that correspond with labels in a related location (???????1.DBF) file.

The dBASE-file you want to convert must be in the directory opened in Flowmap.

- **Select "File" in the menu bar**
- **Select "Convert Files"**
- **Select "dBASE III->"**
- **Select "dBASE->Flowmap Table**

A window pops up in which you can select the file to be converted.

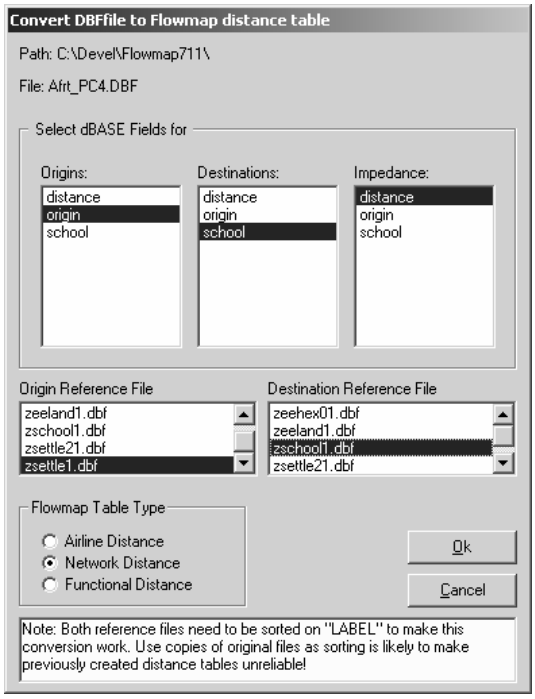
- **Select the dBASE file you want to convert**
- **Click on "OK"**

In the next window, you can store the new Flowmap table.

- **Type a name behind "File Name" (or leave the existing name, saving the Flowmap table under the same name as the dBase table)**
- **Click on "Save"**

The window on the next page pops up. You can select which columns from the dBASE table represent origins, destinations and the distance between the two.

- **Select the origins in the “Origins” box**
- **Select the destinations in the “Destinations” box**
- **Select in the “Impedance” box the column that reflects the distance between each origin and each destination**



Next, select a reference file for both origins and destinations.

- **Select an Origin Reference File**
- **Select a Destination Reference File**

NOTE: *Reference files are sorted on label. If they had not been sorted yet, they are likely to make previously created distance tables unreliable. Make sure you use copies of original files as reference files!*

Finally, you have to select which type of distance table you want to create: a table based on airline distances, network distances or functional distances.

- **Select a distance table type**
- **Click on “OK”**

After a while Flowmap informs you that the conversion was carried out successfully.

- **Click on “OK”**

14.4 Converting a distance table: Flowmap to dBASE

You can also convert a Flowmap distance table to a dBASE distance table. The distance table must be opened in the project, see Chapter 1 for more information about creating and editing projects.

- **Select “File” in the menu bar**
- **Select “Convert Files”**
- **Select “Flowmap ->”**
- **Select “Flowmap Distance Table -> dBASE”**

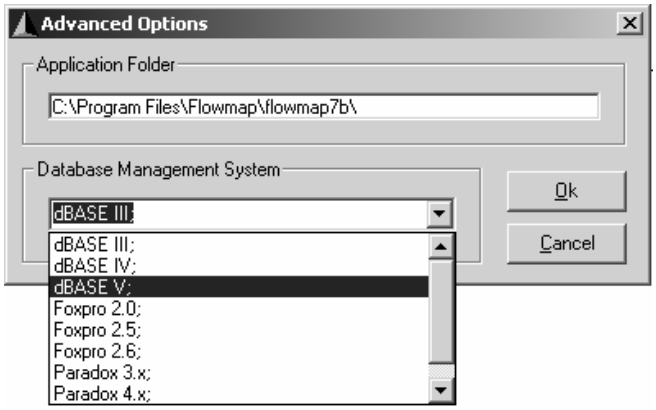
In the next window, you can store the dBASE file. The file is saved automatically as a dBASE III file.

- **Type a name behind “File Name” or leave the existing name, saving the dBASE file under the same name as the Flowmap file**
- **Click on “Save”**

Then Flowmap informs you the table was converted successfully.

- **Click on “Ok”**

14.5 Changing database systems



You can use attribute files from another database system. It is necessary, however, that all attribute files are in the same database system. This implies that you have to choose another database system at the beginning of a Flowmap session and that all files that are opened are in this database system.

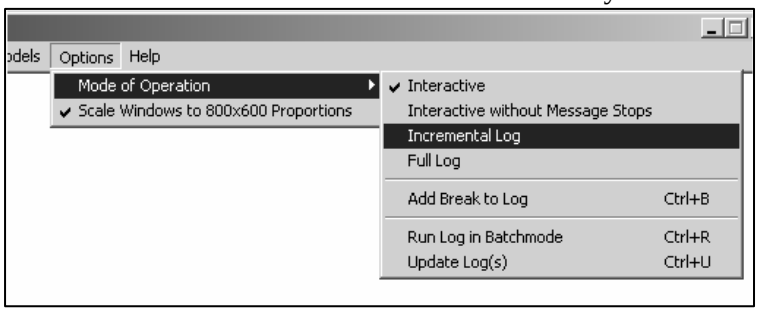
- **Select "File" in the menu bar**
- **Click on "New Project" or "Edit Project"**
- **Click on "Options" in the "Project" window**

The "Advanced Options" window pops up

- **Click on the arrow in the "Database Management System" box**
- **Select a database system**
- **Click on "OK"**

14.6 Using a log file

In this section, using a log file is explained. A log file contains each step that has been made from the moment the log file is activated until the moment it is deactivated. It enables you to retrace your steps. The most important feature of a log file is the fact that it can be modified, allowing you to simply repeat a procedure (for instance an analysis) with a different variable. The other options in the options menu are explained in section 1.4.



You can make an "Incremental log file" or a "Full log file". A "Full log file" also remembers which directories and files have been opened. For this reason, it is bigger than an "Incremental log file". It is recommended to make a "Full log file" when you will want to use it again in another session. Once the log file is run, the correct directories and files are opened automatically.

- **Select "Options" in the menu bar**
- **Select "Mode of Operation"**
- **Click on one of the following items:**
  - **"Full Log" to make a full log file**
  - **"Incremental Log" to create a log file that contains no information on opened directories and files**

The window "Open Flowmap Log File" pops up. You must now save the log file.

- **Type a name [FMlog001] and save the file as a "FlowMap logfile (*.flg)**
- **Click on "Save"**

Now, a procedure can be carried out in Flowmap. For example we want to display the total population of 20000 and more in Zeeland.

- **Select "File" in the menu bar**
- **Select "New Project" and open the Map File [Zeeland.006]**
- **Save the project**

- **Select “Maps” in the menu bar**
- **Select “Advanced Display”**
- **Select “Draw Map File”**
- **Select “Draw Edges/Lines”**
- **Click on “Uniform Drawing” and select a symbol, now the map will be drawn**
- **Select “Subset” in the menu bar**
- **Click on “Select objects Map File”**
- **Select on [POP_TOTAL] en use the “Range Method” and click on “Ok”**
- **Change the minimum range in 20000 and click on “Ok”**

Now draw the subset the same way as the map file has been drawn (Maps -> Advanced Display etc.). As soon as the procedure is finished, the log file can be deactivated.

- **Select “Options” in the menu bar**
- **Select “Mode of Operation”**
- **Click on “Interactive” or “Interactive without message stops”**

A log file is a text file. It can be edited with a text editor such as WordPad or NotePad.

- **Open the log file [FMlog001] in WordPad/Notepad**

All steps that were taken during the analysis are displayed. If you want, you can change a variable at this point. For example change the lower bound of the subset into 10000. and save the file as FMlog002.

```
        357794
     # X-COORDINATE UPPER RIGHT CORNER:
        77697
     # Y-COORDINATE UPPER RIGHT CORNER:
        417763
     # MAP MEASUREMENT UNIT:
        Meters
# END PROJECT SECTION
# MENU BUTTON: maps
# MENU BUTTON: create
# MENU BUTTON: graphs
# MENU BUTTON: analysis
# MENU BUTTON: graphs
# MENU BUTTON: create
# MENU BUTTON: maps
   # MENU BUTTON: draw map file
      # MENU BUTTON: uniform drawing
# BEGIN DRAW SECTION
     # DRAW OPTION:
        uniform drawing
     # PALETTE NUMBER (LEFT-RIGHT/TOP-DOWN = 0-31):
        14
# END DRAW SECTION
# MENU BUTTON: subset
   # MENU BUTTON: select objects map file
# BEGIN SUBSET SECTION
     # SUBSET OPTION:
        select objects map file
     # SUBSET METHOD:
        RANGE
     # SUBSET FIELD:
        POP_TOTAL
     # SUBSET LOWER BOUND:
        20000
     # SUBSET UPPER BOUND:
        44496
     # SELECTION TYPE:
        SIMPLE
     # BEGIN MESSAGE
        4 map objects selected
        Labels: 664/687/715/718
        Search range :20000-44496
        Actual range :31730-44496
     # END MESSAGE
# END SUBSET SECTION
# MENU BUTTON: maps
   # MENU BUTTON: draw map file
      # MENU BUTTON: uniform drawing
# BEGIN DRAW SECTION
```

NOTE: *Make sure you that you save the file as a Flowmap log file (.flg) and not as a text file (.txt or .doc) .*

Now you can run the log file you just altered in Flowmap.

- **Select “Options” in the menu bar**
- **Select “Mode of Operation”**
- **Click on “Run log file in Batch mode”**

The “Run log file in Batch mode” window appears.

- **Select the log file you want to run [Fmlog002]**
- **Click on “Open”**

The analysis is now carried out and the ”Progress Report” window pops up. In this window, you can observe the progress of the log file.

- **Click on “OK”**

In the case of an analysis, one or more new columns with results have been created. In the case of a drawing, the result is a map**.** In our example 11 areas will be selected with a population of 10000 or more, instead of the 4 areas with a population of 20000 or more.

During the creation of the log file it is also possible to add a break point. This can be done by selecting “Add Break to log” from the “Options -> Mode of Operation” menu. It is also possible to edit the log file in a text editor and type “#BREAK” at the point where you want the break point.

In a log file references are created to the different folders containing the data needed to carry out the process. Once the data has been moved to different folders or different computers you need to actualize the log files. This can be done by selecting “Actualize Log(s)” from the “Options” menu.
First select the source folder which contains the log file(s). The original folder names in the log file(s) will appear in the corresponding box. Next select a folder path from the original folder box which has been changed. Once selected a new window will pop up in which you can browse to the need folder containing the data. Once this has been done with all the changed folders the actualization can be carried out by clicking on apply. The log file has now been updated.