Creating Futures

WISE

Waikato Integrated Scenario Explorer

Manual

Version 1.2.0

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For:
Creating Futures
FRST Project ENVW0601

Project team
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Product information
WISE (Waikato Integrated Scenarios Explorer) is an Integrated Spatial Decision Support System (ISDSS) designed especially for the Creating Futures project funded by the New Zealand Foundation for Research, Science and Technology (FRST). WISE has been developed for the Waikato region to support Waikato Regional Council's long term integrated spatial planning and decision-making. Information about the 'Creating Futures' project is available on the Internet, including an electronic copy of this report: http://www.creatingfutures.org.nz.

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WISE: Waikato Integrated Scenario Explorer

User Manual (Version 1.2.0)

RIKS BV (June, 2011)

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Introduction

Creating Futures is a 4-year project funded by the New Zealand Foundation for Research, Science and Technology (FRST). The project brings together an interdisciplinary team consisting of a key end user (Waikato Regional Council, WRC) and social, environmental and economic researchers. The project aims to develop new methods and tools to support integrated, long-term planning by 1) developing processes to evaluate, deliberate, and choose futures through scenario analysis and multi-criteria deliberation frameworks and 2) develop an integrated spatial decision support system (ISDSS) to support the evaluation and deliberation processes. Together these tools will help Waikato Regional Council and other councils evaluate links and trade-offs between economic, environmental and social/cultural outcomes and the cumulative effects of many decisions over space and time.

An ISDSS is an Integrated Spatial Decision Support System designed to help examine weakly-structured or unstructured problems characterised by many actors, many possibilities, and high uncertainty. The Waikato Integrated Scenarios Explorer, or WISE, is being developed for the Waikato region to support evaluation and deliberation of strategies and scenarios related in the context of Waikato Regional Council's long-term planning.

User Manual – An Overview

This is an overview of the user manual of WISE, an integrated spatial decision support system built with the GEONAMICA framework. WISE is developed for the Waikato region to support Waikato Regional Council's long-term council community planning process.

This manual contains five sections:
Section 1 "Getting started" explains how to install WISE on your computer and how to start the program. It also describes the main features of the graphical user interface.

Section 2 "Running the simulation" contains a step-by-step description of how to run a simulation in WISE.

Section 3 "Policy interface" describes the steps that a policy user should follow to carry out an integrated impact assessment with WISE.

Section 4 "Modeller interface" describes the interface for a modeller to access the underlying models and to update data and parameter settings through the system diagram in WISE.

Section 5 "The WISE menu system" offers a systematic description of each option in the menu system.

Through this documentation, for the convenience of the user, a special arrow symbol ➢ is used in a step-by-step description of how to complete the action that you can follow along at your computer. For example:
➢ Click Open project … on the File menu.

1 Getting started

This chapter explains how to install WISE on your computer and how to start the program. It also describes the main features of the graphical user interface.

1.1 Computer requirements

WISE runs on personal computers running Microsoft Windows XP and equipped with modern Intel or Intel compatible processors. It may also run on Windows 2000 and Vista, but has only been fully tested on Windows XP. To use WISE, your computer should have the following hardware components:

- At least 1GB of RAM
- A hard disk with at least 10GB free

To make full use of the application, you should have the following software packages installed on your computer:

- Microsoft® Excel (version 97 or later) (required)

If you experience problems when installing WISE on Windows Vista, please can contact us (see the section If you experience problems).

1.2 Installing WISE and accompanying tools

The following is a step-by-step description of the installation of WISE. The installation/uninstallation of WISE follows standard Windows procedures.

If you have a previous version of the WISE software installed on your machine, you will be asked whether you want to uninstall it first. We recommend uninstalling it. If you would want to keep it, make sure to put the latest version of WISE in a separate directory. During the installation you may encounter a message asking whether you want to keep or replace certain files. We recommend replacing those files for use with WISE. Keeping the old files may cause the software to malfunction.

To Install WISE:

- Step 1. Start Microsoft Windows XP.
- Step 2. Insert the WISE cd-rom into the drive.
- Step 3. Double-click on the WISE_#.#.#_setup.exe on the WISE cd-rom. the #.#.# refers to the version number of the software installation.
- Step 4. The wizard is started. Press the Next button.
- Step 5. The installation program asks you to choose the components of WISE you want to install. Select the WISE option and data option and press the Next button.
- Step 6. The installation program asks you to choose the install location for the program destination folder. The default path for installing the *WISE* programme is *C:\Program Files\Geonamica\WISE*. if you want to install *WISE* in a different directory, press the Browse... button and navigate to the desire location. Press the Next button.
- Step 7. The installation program asks you to choose the install location for the data destination folder. The default path is *C:\Documents and Settings\My Documents\Geonamica\WISE*. If you want to install the *data* in a different directory, press the Browse... button and navigate to the desire location. Press the Next button.

- Step 8. The installation program suggests adding WISE to the new program group *Geonamica*. You are free to create another group or to choose an existing one from the list shown. Press the Install button.

- Step 9. The installation programme now installs all the files and data needed to run WISE into the directories that you have selected. If you selected that option in step 8, the installation programme also creates a programme group named *Geonamica* under Start → Programs that contains a shortcut to WISE.

- Step 10. When the installation is complete, press the Finish button.

- Step 11. Follow the procedure outlined in the steps 1 to 10 to install the Map Comparison Kit on the WISE cd-rom.

To uninstall WISE:

- Step 1. Click the Start button in the Windows taskbar. Move the mouse pointer to control Panel and click. The Control Panel window will open. Select the Add or Remove Programs icon by double clicking on it. Next click the change or remove programs button in the Add or Remove Programs Properties dialog window.

- Step 2. Select WISE from the list of applications that can be automatically removed by Windows and press the Change/Remove button.

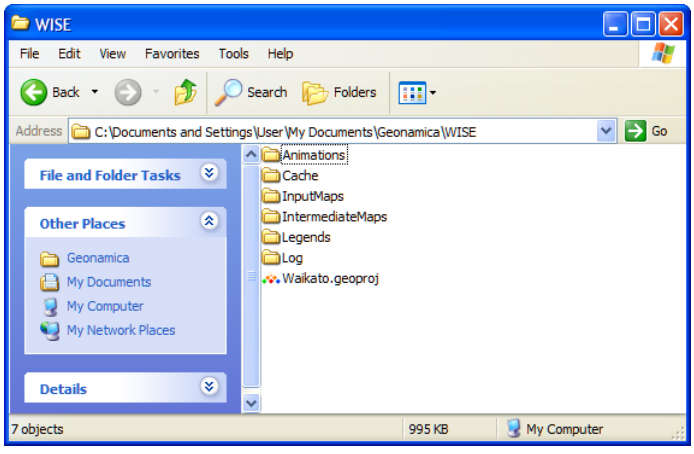
- Step 3. The Confirm File Deletion dialog window will open. Press the OK button to confirm that you want to remove WISE and all its files from your hard disk.

- Step 4. Repeat the steps 1 to 3 to uninstall the Map Comparison Kit.

1.3 Wise directory structure

By default WISE is installed in the directory *C:\Program Files\Geonamica.* The *WISE* directory includes *Geonamica.exe* and all the DLL-files required running the WISE system.

By default data for WISE is installed in *C:\Documents and Settings\User\My documents\Geonamica\WISE.* You will see the following directory structure.



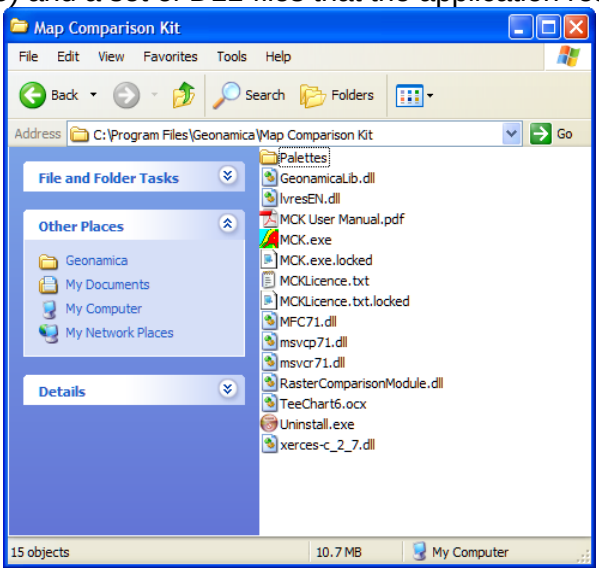
These directories include all the project files, data files, and intermediate map outputs needed to run WISE. Here you will also find the WISE project file, recognizable by the extension **.geoproj*. The project file contains the basic information the software needs to run a simulation. The data part of WISE typically contains the following sub-directories and files:

- *Animations*: animation maps generated during a simulation

- *Cache*: zoning maps generated during a simulation
- *InputMaps*: base maps required to run a simulation
- *IntermediateMaps:* intermediate output maps for the current simulation year
- *Legends*: map legends
- *Log*: logged maps generated during a simulation
- *Waikato.geoproj:* the project file of WISE.

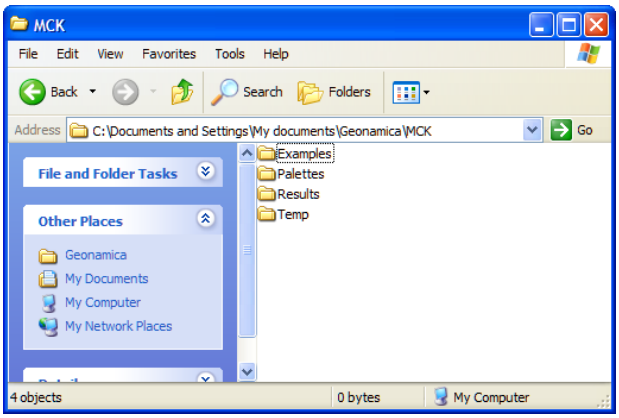
1.4 Map Comparison Kit directory structure

By default the Map Comparison Kit is installed in the directory *C:\Program Files\Geonamica.* The *Map Comparison Kit* directory contains the Map Comparison Kit application (*MCK.exe*) and a set of DLL-files that the application requires to run.



By default additional data for the Map Comparison Kit are installed in *C:\Documents and Settings\User\My Documents\Geonamica\MCK*. There are four sub-directories in this folder:

- *Examples*: examples developed for the Map Comparison Kit
- *Palettes*: palettes legends for the Map Comparison Kit
- *Results*: results generated with the Map Comparison Kit
- *Temp*: temporary outputs (e.g. reference maps) generated with the Map Comparison Kit.



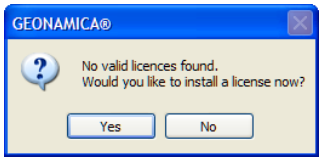
1.5 Starting WISE

Once installed, you can start the WISE application as follows:

- ➢ Click the Start button on the Windows taskbar
- ➢ Go to All Programs → Geonamica → WISE.
- ➢ Click the GEONAMICA icon .

1.5.1 Importing the licence file

The first time you start WISE a dialog window will appear asking you to install a licence file for WISE.



- Click the OK button on the message window.

A dialog window will open allowing you to navigate to the folder where you put the licence file for WISE that you received from RIKS.

- Select the licence file with the extension **.lic*
- Press the Open button of this dialog window.

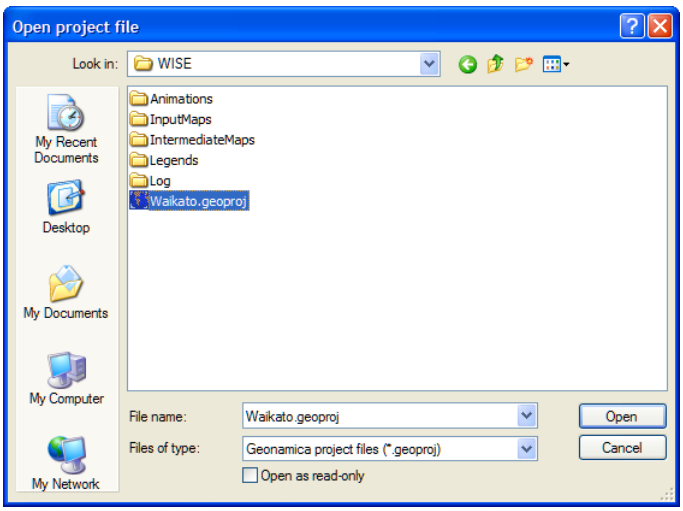
The licence file will be created automatically in the same directory as *Geonamica.exe*. After this, the system will not ask you again to open the licence file when you start WISE.

Each time you start WISE, the About window appears (see the section About).

- Click the OK button on the About window.

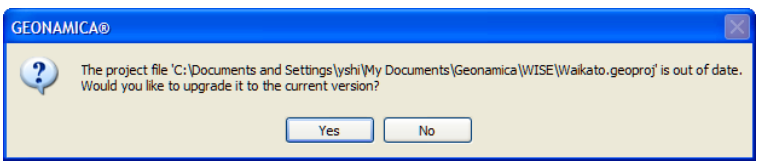
1.5.2 Opening the project file

- After you press the OK button on the About window, the Open project file dialog window opens.
- Navigate to the project file that you want to open and double-click on it.



If the project file you want to open is created with an older version of WISE, a message window appears to ask you whether to upgrade the project file to the current version of software.

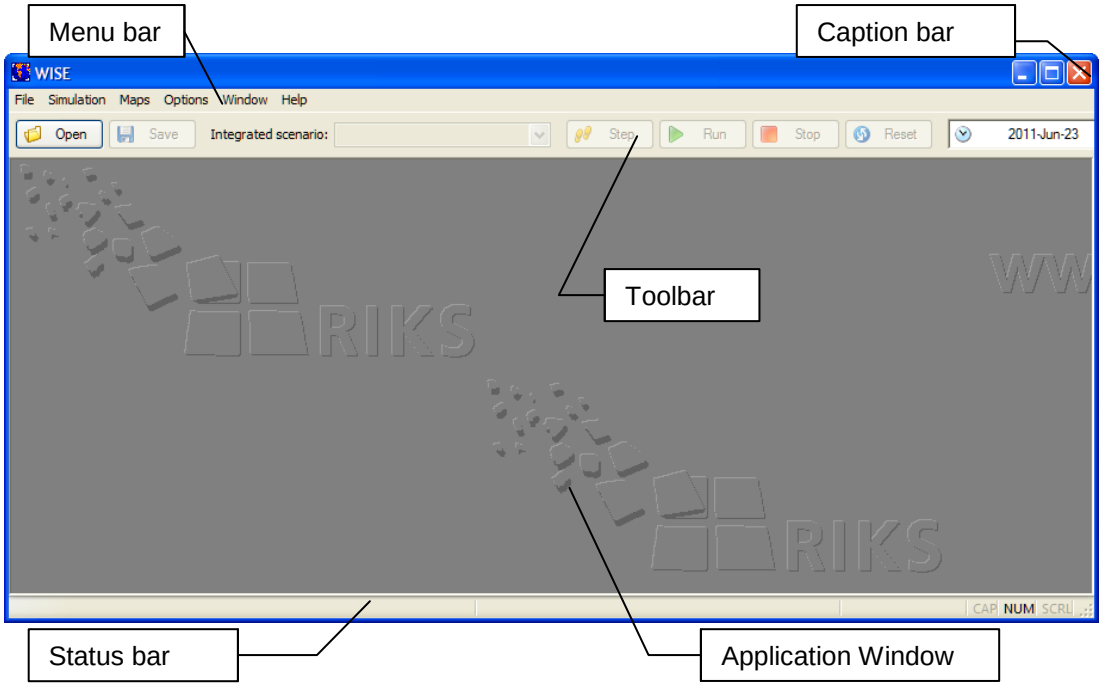
- Click the No button to exit the action. You could not open it with the current version of WISE. You can only open it with the older version of WISE with which you created this project file.
- Click the Yes button to upgrade the project file automatically. Then you can open it with the current version of WISE.



WISE will be started and you will see the WISE - ### application window on your screen, where "###" is the project file name that you selected.

1.6 Screen layout

When you start WISE, the application window opens immediately. This is the window in which you will run your models. You can arrange windows as you like in the application window. Before a project file has been opened, the window is empty except for its *Caption bar*, *Status bar*, *Toolbar* and *Menu bar*. The different components of this window will be described in the next paragraphs.



1.6.1 Caption bar and menu bar

The *Caption Bar*, also called title bar, of the application window shows the name of the application: Geonamica. As soon as a project file is opened, the title will be extended with the name of the project file.

The *Menu Bar* of the application window contains the main menu of WISE. The commands are logically organised in the menu so that you will quickly become comfortable with the various functions of the software. The menus are summarised in the table below; subsequent sections elaborate on the description. The section The WISE menu system gives an overview of all menu commands.

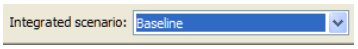
Menu	Function
File	Manage your project files
Simulation	Control the simulation
Options	Customise the workspace and select types of output
Window	Manage your windows on the screen
Help	Look up the system information and find help documentation

1.6.2 Toolbar

The *Toolbar* gives faster access to some of the more frequently used commands that are also accessible via the menu.

Button	Function
Open	Open a project file from the disk
Save	Save a project file to disk
Step	Advance the simulation with one simulation step
Run	Advance the simulation till the next pause is reached
Stop	Stop the simulation after the current step is finished
Reset	Reset the simulation and switch the simulation clock back to the initial year of simulation

A list box next to Integrated scenario is also displayed on the toolbar. All available integrated scenarios are displayed on the dropdown list where you can select – that is, load – an integrated scenario. When collapsed, the list box shows the name of the active scenario.



The *Toolbar* also displays the simulation clock. Each time step, the clock is updated to match the current value, which means that it increases with steps of1 year in WISE.

1.6.3 Status bar

The *Status bar* is displayed at the bottom of the application window. This area provides information to you on your actions while you are working with the application. The *Status bar* describes the following information:

- When you use the mouse or arrow keys to navigate through menus, it describes actions of menu commands.
- When you press the buttons on the toolbar, it describes actions of this button.
- When you move the mouse on a raster map, it describes the location of the cell that is pointed and the category or value on this cell is displayed in brackets.
- When you move the mouse on a network map, it describes the x and y coordinators of the location.

The *Status bar* also indicates which of the following keys are latched down: the Caps Lock key (CAP), the Num Lock key (NUM), or the Scroll Lock key (SCRL).

1.7 System Information

The different commands in the Help menu allow you to look up the system information about WISE, its commands, options, and tools. You can use the Help menu to select the type of information that you want WISE to display on the screen. For more information see the section Help menu.

1.7.1 Index

You can use the Index command to get the opening screen of the on-line help file of WISE. From the WISE documentation opening screen, you can jump to step-by-step instructions for using Metronamica. Click the topic that you want help on. Once you open the WISE documentation on-line help window, you can click the Close button whenever you want to exit.

1.7.2 Licence

You can use the Licence… command to get the licence information in the Licence window. All licences for the Geonamica-based software stored on your computer will be listed in the Licences found table

The system allows you to import the licence file by pressing the link of Read a licence file… to open the Open dialog window and select the licence file you received from RIKS.

After reading a licence file, the system will create files relevant to license under a folder. You can click on the Open licence folder… button to view the files and the directory of this folder.

You can use the Licence… command to get the licence information in the Licence window. The system allows you to import the licence file by pressing the link of Read a licence file… to open the Open dialog window.

1.7.3 Checking for updates

You can use the Check for updates… command to check if you are using the latest version of WISE software. If the software you are using is not the latest one, the system will provide you information about how to request an update of the software.

1.7.4 About

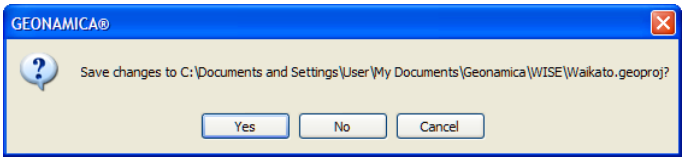
You can use the About… command to open the About window. You can find here the copyright notice and version number of WISE that you are using. The latter is important if you need assistance with the software from the developers (see the section If you experience problems) or when you request an update of the software.

1.8 Closing WISE

You can use the Close project command to close WISE.

- Click the File menu and click Close project.

If you have a project file open and you have made any changes, one message window will pop-up and will ask whether you want to save changes before closing.



If you confirm that you want to save changes, you will get the Set external file names dialog window.

- Click the Yes button of the Save dialog window to carry out the action of saving and closing.

More information on saving changes is given in the section Saving changes of this manual.

1.9 If you experience problems

If you experience problems installing or running WISE, please contact us with the version number of the Geonamica application that you are using (see the section About):

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To the attention of Hedwig van Delden
P.O. Box 463, 6200 AL Maastricht, The Netherlands
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2 Running the simulation

This section describes the primary steps of running a simulation with WISE: Opening a project file, editing input and displaying output, saving changes, running a scenario, saving results and analysing results.

2.1 Project file, integrated scenario and sub-scenario

It is important to understand how the input data/files and parameters that are required to run models in the system are organized in WISE. We use the terms *Project file*, *Integrated scenario* and *Sub-scenario* to describe the different levels of data and file management and parameter value settings.

In the context of this document a scenario is considered to be a set of values for each driver in WISE (for more information on drivers in WISE, see the section Setting up the drivers). In particular, you can make scenarios for each of the drivers that are accessible through the Main window. For example in the external factors you can define increased international exports for the relevant economic sectors and call this scenario *High export*.

When you want to run a simulation in order to investigate the effects of a scenario, you will have to select exactly one scenario for each of the drivers in WISE. This combination would also be named a scenario according to the definition of the term given above, but of course that is a recipe for confusion. To avoid such confusion we will qualify the term scenario to mean one of two things:

- A *Sub-scenario* is a set of values for one of the drivers in WISE that defines a possible future development of that driver.
- An *Integrated scenario* is a combination of one sub-scenario for each driver in WISE that together define a possible overall future development.

This means that the *High export* scenario mentioned above is a *sub-scenario* and that an *integrated scenario* defines all the values for all the drivers that are needed in order to perform a simulation run. The selected integrated scenario on the toolbar is called the *active integrated scenario*.

It should be noted that only sub-scenarios store values for each driver; integrated scenarios do not store values themselves as they are just a collection of sub-scenarios. Also, sub-scenarios can exist outside of integrated scenarios – e.g. several predefined sub-scenarios for climate change exist, though initially only one of them is selected in an integrated scenario.

A *project file* is used to configure various parts of the simulation and it contains references to all the files that are required to run models in the system. The *project file* used in WISE has the extension **.geoproj*. A *project file* contains at least one integrated scenario. The locations of input data and files and parameter values of all integrated scenarios can be stored in a single *Project file*. A *project file* must have at least one *Sub-scenario* specified for each *driver*. At most one *Sub-scenario* per *driver* can be indicated as the *Baseline scenario* which is by default read-only. This prevents users from making changes to that *Sub-scenario*. Additional *Sub-scenarios* that are created by the user are not read-only. See the section Saving changes for more information on how to save a *Sub-scenario*, *Integrated scenario* or *Project file*.

2.2 Opening a project file

In the section Getting started we explained how to install and start WISE. We assume from now on that you have read this information, that you have successfully installed

WISE on your computer and that you have knowledge of the different technical terms introduced.

2.2.1 Opening an existing project file

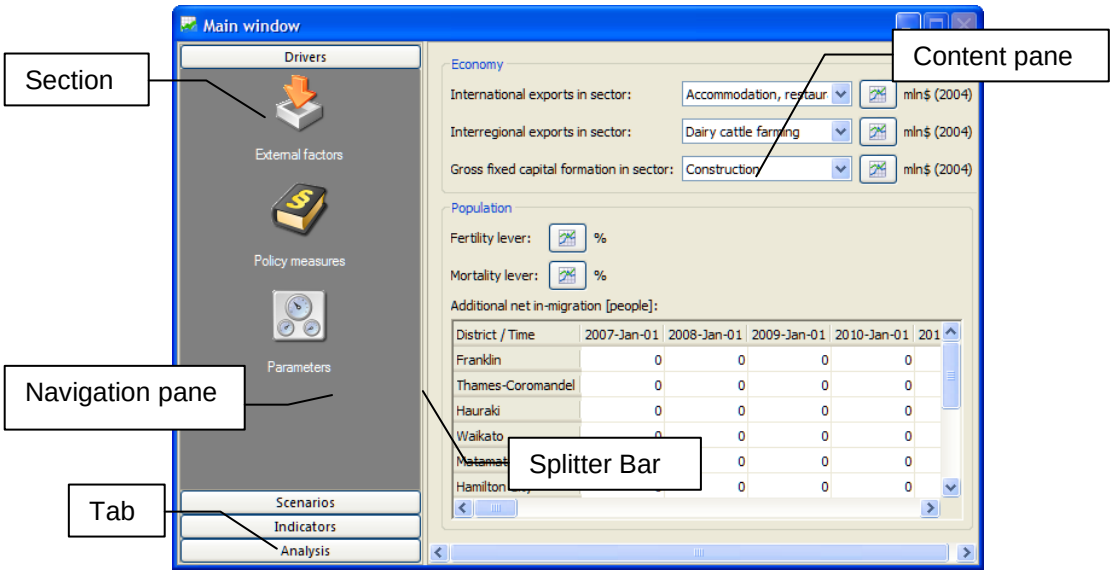
Make sure that you have started the WISE (see the section Starting WISE) and that the Geonamica application window is open on your screen.
The Open project file dialog box appears. If the open dialog box is not on your screen,

- Press the Open button on the toolbar or click Open project … on the File menu.
- In the Open project file dialog window, click the look in dropdown arrow and navigate to the *WISE* folder where you installed the data and project files. Remember the default installation path is *C:\Documents and Settings\My documents\Geonamica\WISE*.
- Double-click *Waikato.geoproj* or click *Waikato.geoproj* and press the Open button.

Once all files have been loaded, two windows appear in the application window: the Main window and the Land use map. These windows cannot be closed! You can move them and change their size to organise your workspace, including minimizing or maximizing them, but cannot close them.

2.2.2 Main Window

The Main window is divided into two parts: the navigation pane to the left of the splitter bar and the content pane to the right. The navigation pane consists of 4 tabs: Drivers, Scenarios, Indicators and Analysis. If one of the tabs is clicked, the list of *elements* appears below the tab. Clicking on an elements, the underlying contents is displayed on in the content pane on the right side of the main window. You can expand one of the tabs by clicking on this tab and you can close this tab by clicking another tab.



The Main window provides access to the policy user and the modeller interface. the section Policy interface and the section Modeller interface provide detailed descriptions of interface for these two types of users.

2.3 Editing Input and displaying output

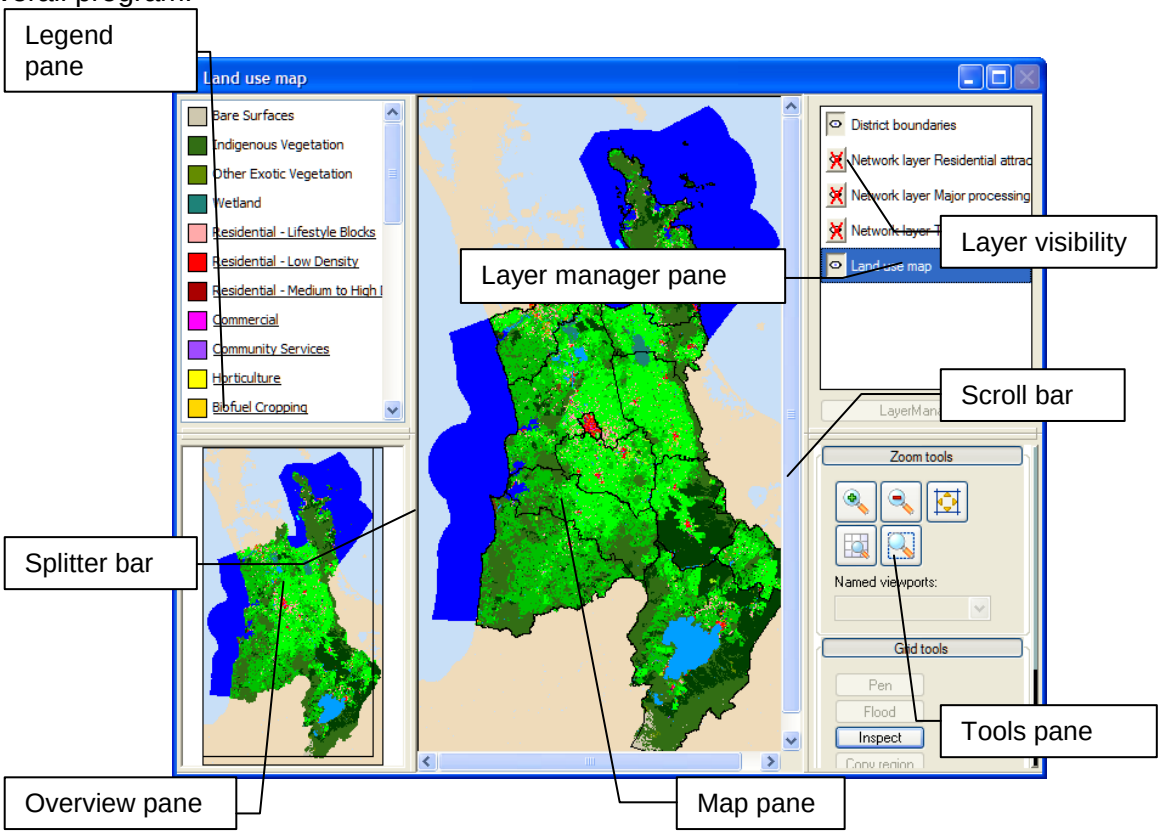
In the system of WISE, input and output are organised by the following categories:

- Map file
- Graph
- Single value
- Table.

The following sub-sections describe how to edit input and display output for each of those by categories.

2.3.1 Map window

The Land use map window is a Map window, which we will use as an example. A Map window is split into 5 viewing areas, called *panes*. You can open and close Map windows, except for the Land use map window. Beware: opened Map windows are updated while a scenario runs. This consumes processing time and will slow down the overall program.



2.3.1.1 Splitter bar and overview pane

Panes are separated from each other by means of *splitter bars*. You can move the splitter bars to change the size of a pane.

The *overview pane* is displayed in the lower-left portion of the Land use map window. It displays the entire modelled region, in this case the Waikato region. A wire-frame rectangle outlines the portion of the region that is currently displayed in the *map pane*. You can move the wire-framed rectangle by placing the mouse pointer inside it and clicking and holding the left mouse button. Moving the rectangle moves the map in the *map pane* accordingly.

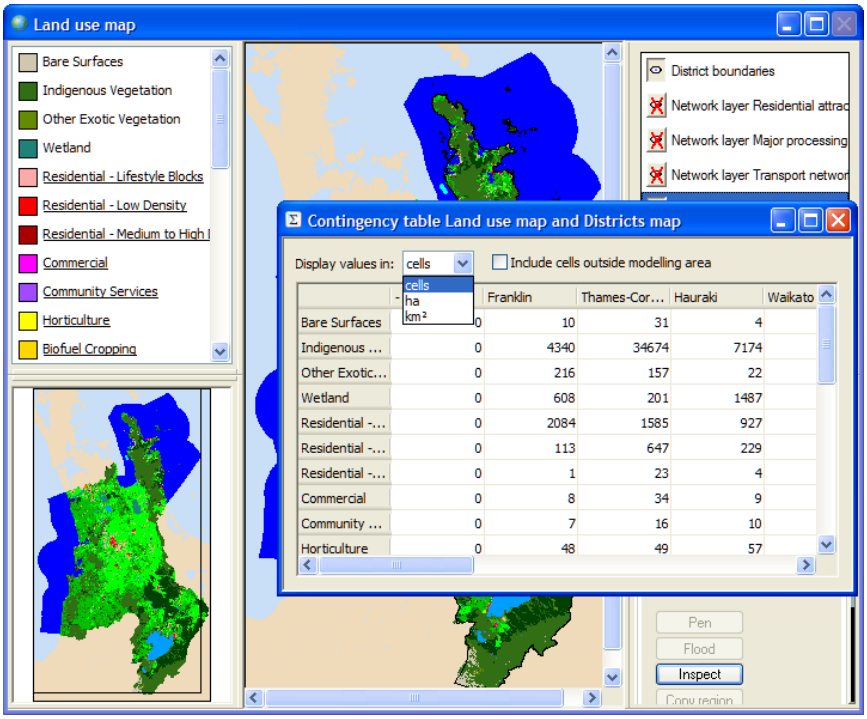
2.3.1.2 Map pane

The *map pane* is located in the middle of the Land use map window and displays a land use map for the modelled region. Specifically, the land use map for the current simulation year is shown. The *map pane* is equipped with both vertical and horizontal scroll bars. If you cannot see all the complete contents of the map pane, use the Zoom tools in the *tools pane* to adjust the image appropriately, e.g., zoom in/out, pan horizontally/vertically.

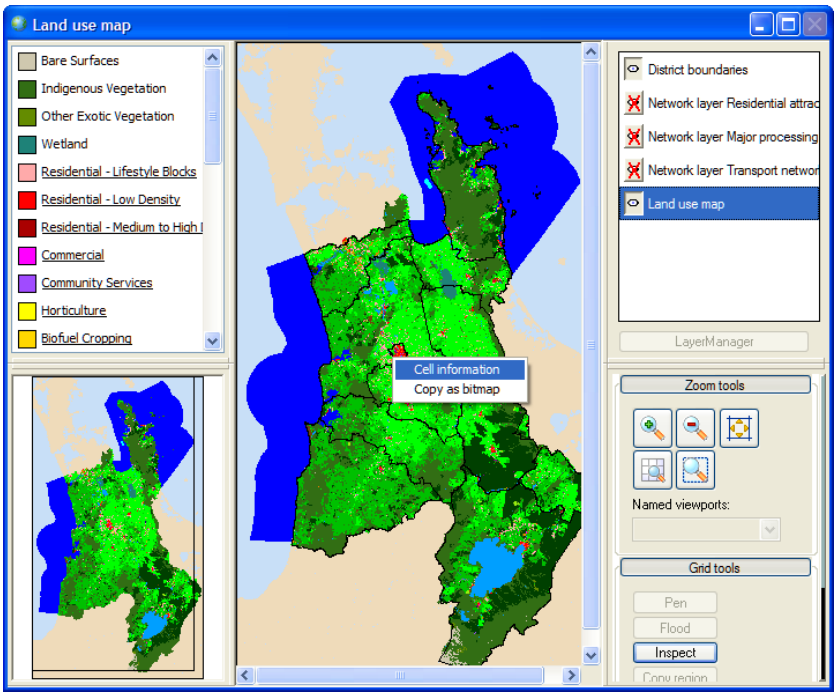
Land use information is presented for each grid cell. The cell states on the map represent the predominant land use on that location. To the left of the *map pane* is a *legend pane* that displays the land use legend. When a simulation is running, the Land use map window will be updated after each time step.

You can access the summary information on the land use map by double-clicking in the *map pane*. This opens the Contingency table Land use map and Districts map dialog

window that shows the number of cells and area surface of each land use for each district. You can select the unit for the area surface from the dropdown list next to Display values in. The table displays the summary in the selected unit. If you select the check-box next to Include cells outside modelling area, the land use outside the modelling area will be displayed in the first column. If this check-box is unselected, all the values in the first column should be zero. The total number of cells or area surface of each land use is displayed on the right-most column of the table.



You could inspect the information on a specific location by right-clicking in a map. The context menu appears. When you click on the Cell information item, the information of the districts map and the selected map for that location will be displayed in a yellow box. You could also access the same information by using the Inspect tool. For more information about the Inspect tool, see the section Grid tools.



2.3.1.3 Legend pane

The *legend pane* is displayed in the upper-left portion of the Map window. It shows the legend of the map selected in the Layer Manager (explained below). For example, if you select a land use map, the legend pane shows the legend of land uses.

The land use is subdivided into 3 types: *Vacant*, *Function*, *Feature*. In the legend of the map, the *Vacant* states appear at the top of the list, the *Function* states appear in the middle of the list and are underlined, and *Feature* states appear at the bottom of the list. The 3 different land use types are explained later in the section Land use classes.

2.3.1.4 Layer manager pane

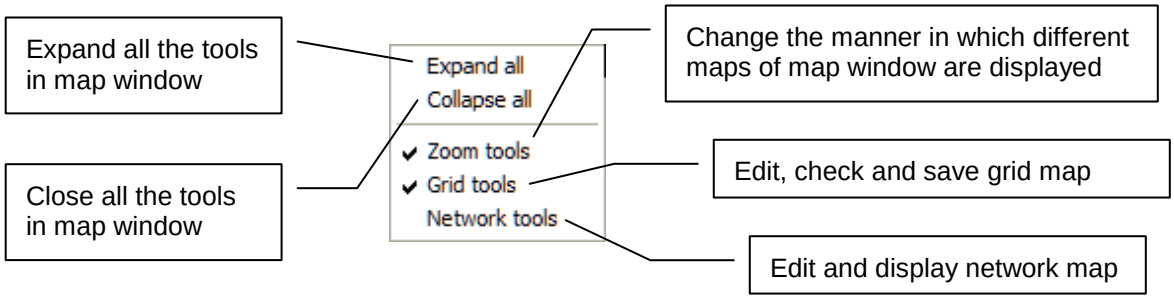
The *layer manager pane* is displayed in the upper-right portion of the Land use map window. It lets you turn map layers on and off in the *map pane*. In the example above, two maps are available: Land use map and District boundaries. Often other maps will also be available. Clicking on the button to the left turns map layer visibility on  or off  .

Button	Function
	Turn on layer visibility
	Turn off layer visibility

The WISE system allows you to view multiple layers simultaneously. Note that the District boundaries map layer is displayed in all Map windows.

2.3.1.5 Tools pane

The *tools pane* is displayed in the lower-right portion of the Map window. It shows the tools for viewing and editing selected map layers and includes the Zoom tools, Grid tools, and Network tools. You can open the *context menu* of the tool pane by right-clicking, which controls how tools are arranged on the desktop.



2.3.1.6 Zoom tools

Use the Zoom tools when you would like to see a location in more detail.

Button	Function
	Zoom in
	Zoom out
	Pan
	Zoom to selected
	Fit whole map to window

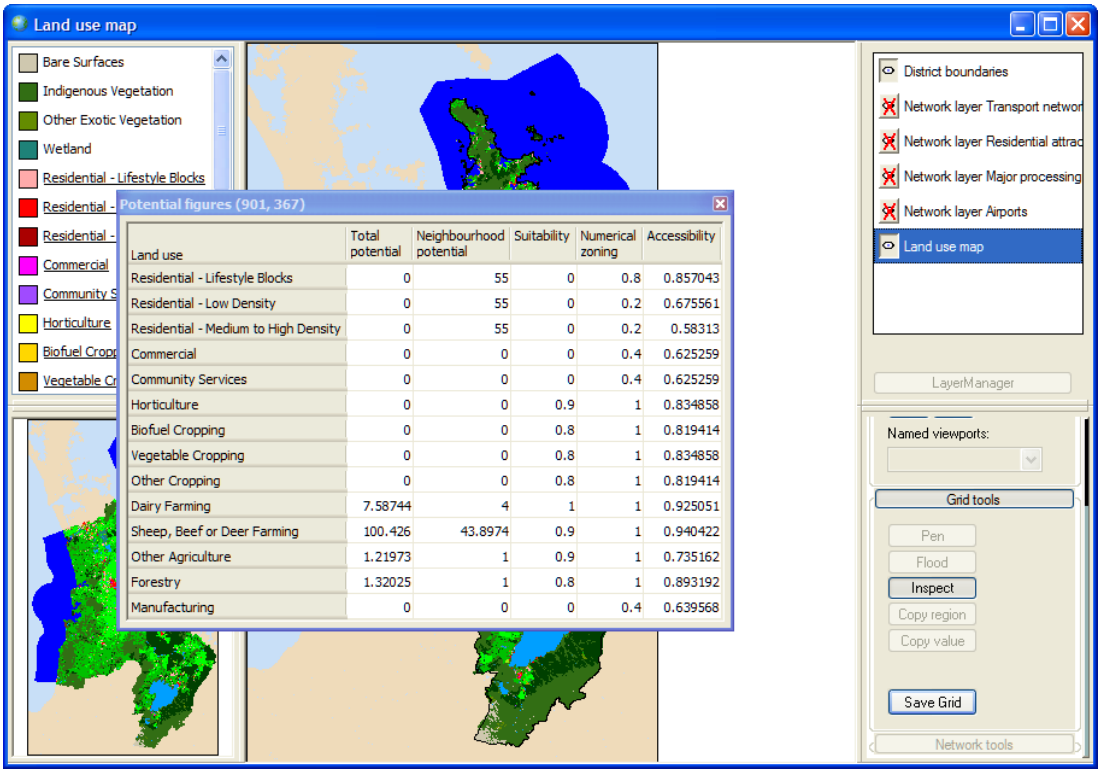
When you activate one of these buttons and click the mouse pointer on the map, you can carry out the selected zoom option.

2.3.1.7 Grid tools

Use Grid tools to edit and view the information of the editable *raster* or *grid* maps that you have selected.

Button	Function
Pen	Change the pointer to a pen. The pen is used to pick a value from the legend and enter it in a cell on the map.
Flood	Change the pointer to a bucket. The bucket is used to pick a value from the legend and enter it in larger, contiguous areas of the map.
Inspect	Display the information of the selected map on the map windows.
Copy region	Copy the shape and colour information in the selected area from another grid layer to the current grid layer. This option is not available in WISE.
Copy value	Copy the colour information on the selected area from another grid layer to the current grid layer. This option is not available in WISE.
Save Grid	Save the grid map that you select.

From the current land use map, accessible via Drivers → Parameters → Land use→ Land use tab → Show current land use map button, you can derive more information by using the Inspect tool. In the Potential figures dialog window that will open, the numbers displayed in the title represent the location in row and in column of the cell that you selected. The table lists the values for total potential, neighbourhood potential, suitability, numerical zoning and accessibility for each land use function for the selected location. This functionality is very useful during calibration.



2.3.1.8 Network tools

The Network tools become enabled only when a network map window is open. In WISE, there are several ways to open a network map window: through the Maps menu, through the policy user interface or through the modeller user interface. For more details, we refer to the section Network map window opened via the policy user interface and the section Network map window opened via the modeller user interface, respectively.

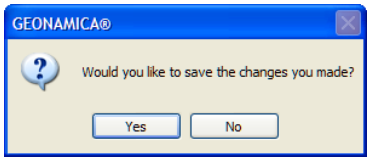
You can use the Network tools to view or edit the infrastructure network.

Button	Function
Select/edit	Change the mouse state to select or edit. Left-click on a link to select the link; Double-click on a link to edit the properties for the selected link; Left-click on a node to select the node; Change the location of the selected node by dragging it to a new location.
Add link	Change the mouse state to draw links and nodes. Pointer a location and drag the mouse to draw a new link; Left-click on a location to add a new node. This button will be greyed out for the non-editable maps.
Add node	Change the mouse state to draw nodes. Left-click on a location to add a new node. This button will be greyed out for the non-editable maps.
☑ Show nodes	Select this check box to display nodes of a network in the map pane; Clear this check box to not show nodes on the network map.
☑ Show links	Select this check box to display links of a network in the map pane; Clear this check box to not show links on the network map.

When the selected network layer is editable, the Add link and the Add nodes buttons in the Network tools section of the *tools pane* becomes enabled and the radio buttons in front of the legend appear in the legend pane on the top-left part. You can practice how

to use the tools under the Network tools tab to add link and to change the properties of link.

When you close the map window on which you made changes, one message window pop-ups to ask whether you want to save the changes you made or not. Press the No button not to save the changes you made. You can save the changes you made by clicking the Yes button and giving a new name with the extension *.shp*. For more information about how to work with an editable map, see the section Editable map.



- If it is only for the purpose of practising, do not save changes you made.
- Be aware that when you press the Yes button, you should give the map a new name. Otherwise, the map which you loaded previously will be overwritten.

You can use one of the link properties to present the link color for the network map. To do so, select the link property of interest from the dropdown list next to Color master field. In other words, the categories of the selected property of a link will be used as the color legend of the network displayed in the map pane. Similarly, you can use a link properties selected in the Line width master field to present the link width for the network map. For maps that display infrastructure elements, the *Acctype* is used by default to display the network map. The color legend and width legend are predefined in the system (see the section Network legends). You don't need to change them.

2.3.1.9 Network legends

The table below gives an example of the values and categories of the Acctype used to display network layers (e.g. transport network, major processing sites, residential attractants) in the system.

Acctype category	Acctype value	Legend
Residential road	-1	
Collector route	0	
Arterial route	1	
Principal highway	2	
Major highway	3	
Railway	4	
Dairy processing	5	
Timber processing	6	
Abattoir	7	
Residential attractants	8	

For other properties, you can create and edit your own legend on the Link color tab by double-clicking the legend pane. For more information, see the section Legend editor.

- Select the check box Show nodes to display the nodes of a network in the *map pane*.
- Select the check box Show links to display the links of a network in the *map pane*.

2.3.2 Legend editor

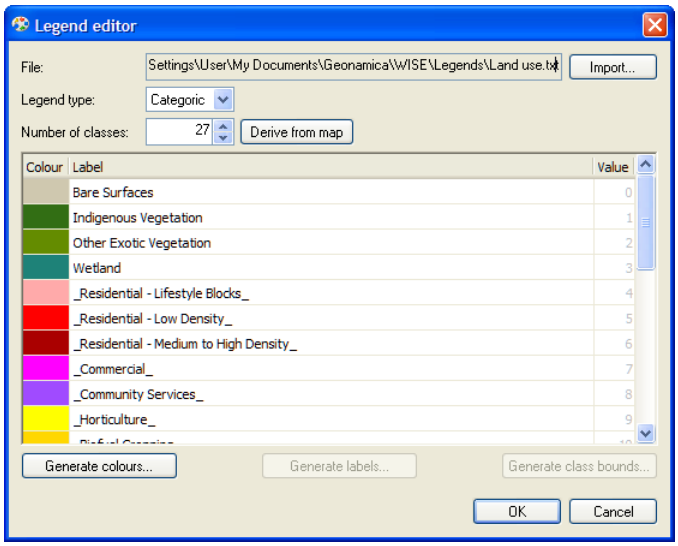
Each land use map, potential map, neighbourhood effect map, accessibility map, zoning map and network map in WISE is presented with its dedicated legend. These

legends are completely customizable. The legends may contain the colour information for the different classes or they may apply colours from a palette file.

A legend is a classification of values in a map and a mapping of those classes to several other characteristics, such as labels, ranges or colours. Basically, there are two distinct types of legends, namely *categorical* and *numerical* legends. *Categorical legends* divide the possible values in a map into categories that have a name and a colour. An example of a map with a categorical legend is the land use map in the Land use map window. *Numerical legends* make a partition of a range of values into smaller ranges – the classes – and allocate a colour to each class. Numerical legends are often useful for indicator maps.

2.3.2.1 Categorical legends

Double-clicking on the legend of the map window of interest opens the Legend editor dialog window where you can view and edit the legend for this map. The figure below shows the Legend editor dialog window for a land use map (categorical map).



To import an existing legend file for the map of interest:

- Click the Import button. A window will open where you can select an existing legend file (*.txt). The information in the Legend editor dialog window will be updated according to the newly imported legend file.

Note that the name of the legend file is not editable and will not change if you import another legend file. Whenever you press the OK button at the bottom, the changes you made in the Legend editor dialog window will be saved in the legend file displayed in the text box next to File. Changes made in the Legend editor dialog window will not be saved in the legend file if you press the Cancel button.

To define the legend type:

- Select the appropriate legend type for the selected map from the dropdown list next to Legend type. The contents of the table in the legend editor will be updated accordingly.

To define the number of classes:

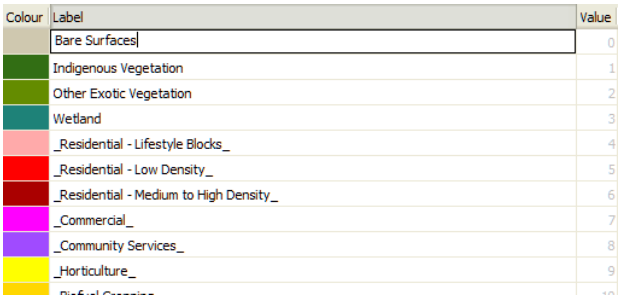
The number of classes of the legend is displayed next to Number of classes.

- You can increase or decrease this number by clicking on the up or down buttons or entering a new number in the text box.

For a Categoric legend, you can also derive the number of classes from the map itself by clicking on the Derive from map button. The number of lines in the table will be updated when you change the number of classes.

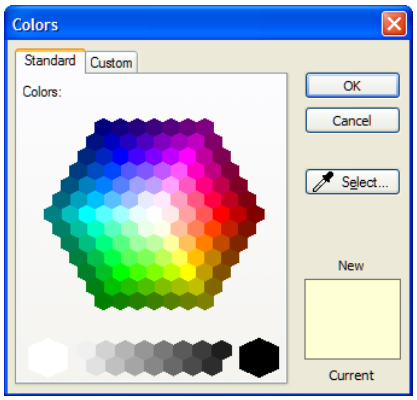
To edit labels:

- Double-click on the label of the class of interest to manually adjust its name.



To manually edit colours:

- Double-click on the cell in the Colour column for the class of interest to adjust its colour. The Colours dialog window opens.
- Select the desired colour either through the Standard tab or the Custom tab.
- Press the OK button to close the Colours dialog window.

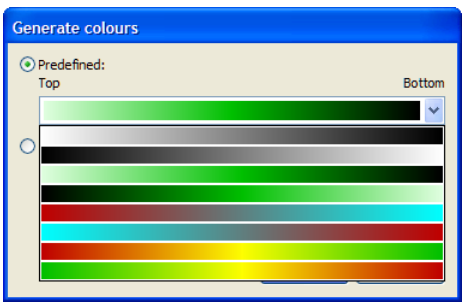


To generate colours:

You can also apply a predefined palette to the classes in the legend.

- Click on the Generate colours… button to open the Generate colours dialog window.
- Make sure Predefined is selected.
- Select an option from the dropdown list just below the Predefined label.
- Press the OK button to close the Generate colours dialog window.

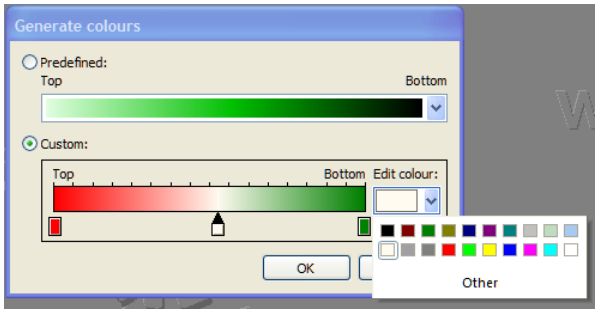
The Top and Bottom labels indicate how the colours will be applied in the table. The colour on the left will be applied to the top line in the table; the colour on the right will be applied to the bottom line.



You can also apply a customized colour scheme to the classes in the legend. The Custom part of the Generate colours window allows you to easily make a smooth palette that blends from one colour to the next.

- Click on the Generate colours… button to open the Generate colours dialog window.
- Click on the Custom radio button.

- Click on one of the boxes just below the custom colour scheme in order to select it. The dropdown list under Edit colour will display the colour of the selected box.
- You can change the colour of the selected box by clicking on the dropdown list under Edit colour.
- You can add intermediate boxes to blend from one colour to the next by anywhere on the custom colour scheme between Top and Bottom.
- You can delete an intermediate box by right-clicking on the box and selecting Delete from the context menu.
- Press the OK button to close the Generate colours dialog window and apply the colour scheme to the legend. Press the Cancel button to keep the legend colours as they are.

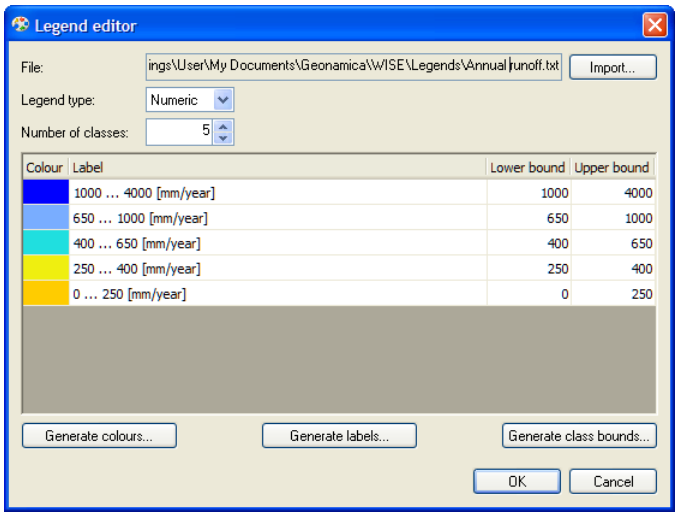


To save the legend:

- Press the OK button in the Legend editor dialog window to save the changes you made for this legend. The map will now be displayed using the new legend.

2.3.2.2 Numerical legends

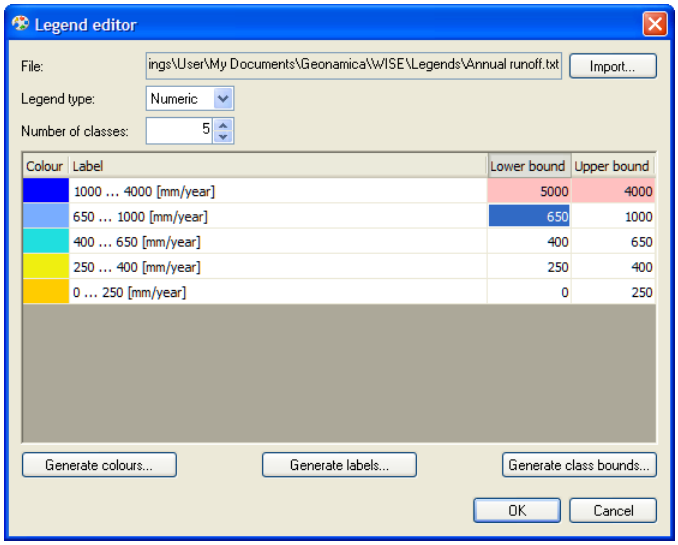
The figure below shows the Legend editor dialog window for a numerical legend. As you can see, more functions are available than for a categorical legend, namely generating labels and generating class bounds.



To manually adjust class bounds for a numerical legend:

- Make sure Numeric is selected on the dropdown list next to Legend type.
- Click on the upper or lower bound you want to change and enter the new value.

If the lower bound is larger than the upper bound, the values will be highlighted in red. Note that you cannot save the legend until you have adjusted these values.



To generate class bounds:

- Click the Generate class bounds button. The Generate class bounds window opens.
- Click on the dropdown list next to Order to choose the order of legend entries.
- You can specify the total range of the legend in the Display interval part by entering values in the Minimum value and Maximum value text boxes. Check the Choose automatically box to fill these values with the lowest and highest values in the map.
- Select a scaling method from the dropdown list in the Scale part.

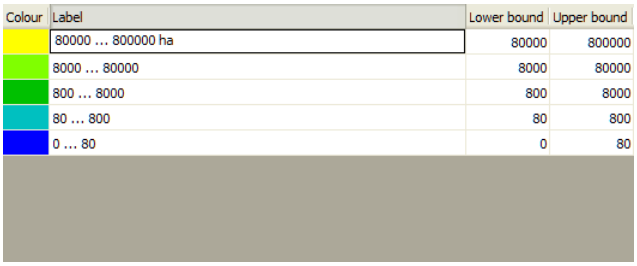
When a method is selected, the class ranges will be calculated, as well as an estimated effectiveness of the chosen scale that can range from 0 to 100%, where a higher value indicates a better scale. If the Find best scale button is clicked, the legend editor will iterate over all available scaling methods and select the one with the highest estimated effectiveness.

- Click the OK button to confirm the modification and close the Generate class bounds window. The updated lower bounds and upper bounds for all classes are displayed in the table of the Legend editor dialog window. Note that the labels in the table will not be updated.

To manually edit labels for the numeric legend:

For the numeric legend, it is best first to edit the class bound and then to edit labels and colours.

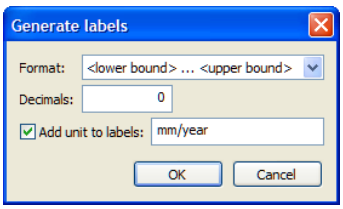
- Double-click on the label of the class of interest to manually adjust its name.



To generate labels:

You can also create labels in the same format for all classes.

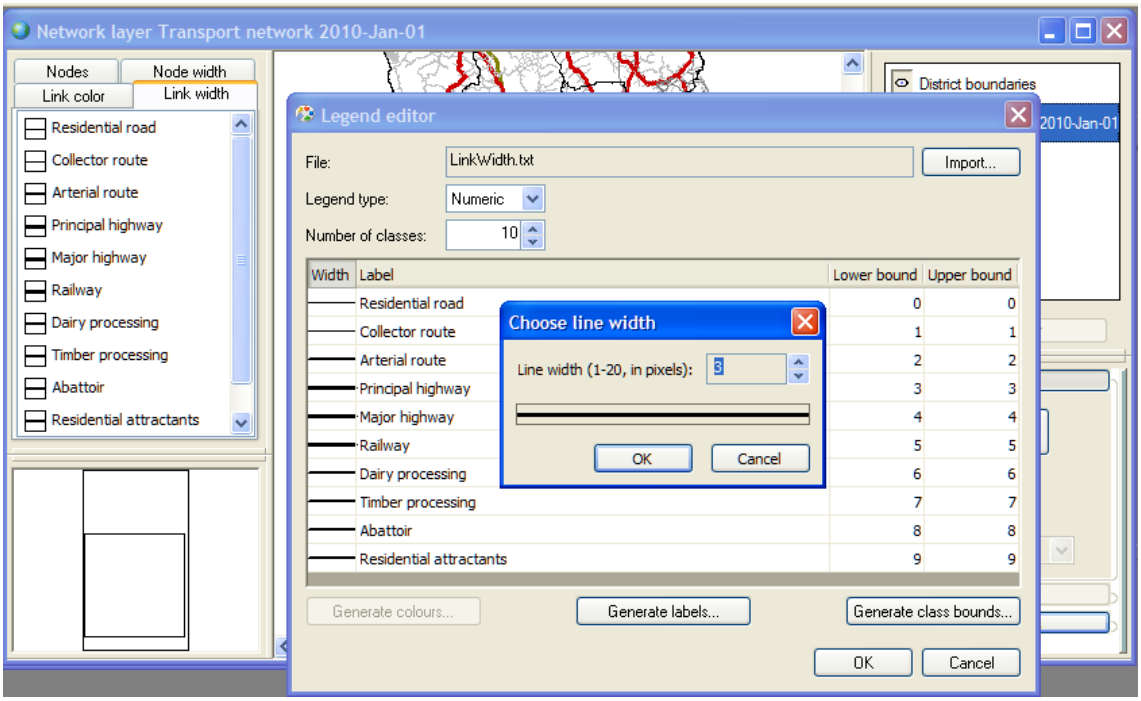
- Click on the Generate labels button. The Generate labels window opens.
- Select the desired format from the dropdown list next to Format.
- Define the number of decimals for the label in the text box next to Decimals.
- If you want to display a unit in the label, select the check box in front of Add unit to labels and enter the unit in the text box.
- Press the OK button to confirm update the labels displayed in the table.



To edit width of links or nodes for network layers:

You can edit the width of links or nodes for the network layer map. The road network map is used as an example of working with legend editor for the network layer map.

- Go to Drivers → Policy measures → Driver Infrastructure.
- Click the Transport network from the dropdown list next to Network.
- Click the Show/Edit network at time… button and select the year of interest and click OK button. The transport network for the selected year appears in the opened map window.
- Click on the Link width tab in the legend pane.
- Click on one of the classes to open the Legend editor dialog window.
- Click on the cell in the Width column for the class of interest to open the Choose line width dialog window.
- Click on the up/down spin buttons to select the line width of interest for the selected class.
- Press the OK button to confirm the change you made on the width for the selected class.



To save changes made in the legend editor:

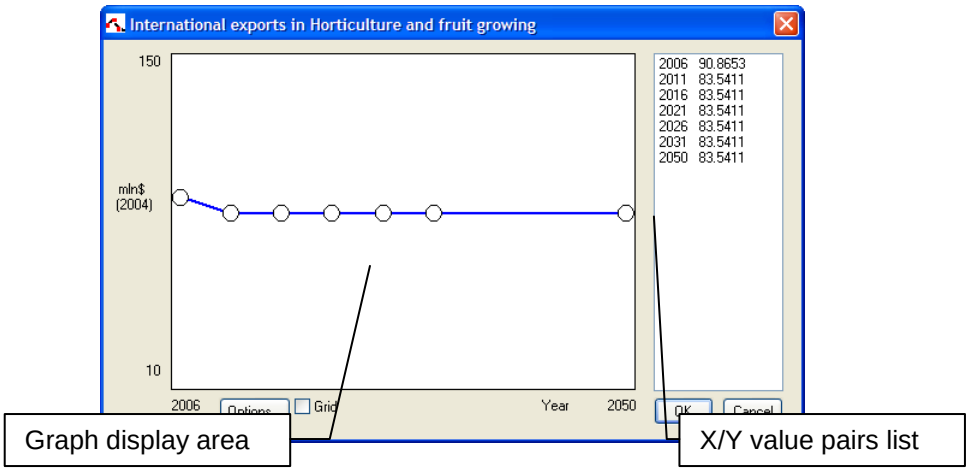
- Press the OK button in the Legend editor dialog window to confirm and save changes you made for the legend.

2.3.3 Graph

The graph editor is used extensively in WISE to define two-dimensional relations: time series and distance decay functions. At the left side of the *graph editor* window is graph display area. To the right is x/y value pairs list, showing you the x/y value of the graph. In general, except for the neighbourhood influence graph (see the section Land use change model), the graphs in WISE can be edited both in the *Graph display area* part which is indicated with the white background and it can also be edited in the *X/Y value*

pairs list part. Changes made in one of two parts will be immediately visible in the other part.

In the current version of WISE, for the editable graphs, we apply a linear interpolation between different points. This means that when you add or change the value of one point WISE will automatically interpolate between this point and its neighbour points.

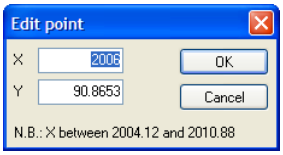


You can change a graph by entering points in the *graph display area*.

- Move the mouse pointer to the abscissa position for which you want to enter a new (ordinate) value.
- Double-click to add a point to the graph.

As a result a little circle will be drawn and line segments will connect the new point to the nearest points left and right in the graph created thus far. There are two ways to reposition a point in the graph display area:

- Left-click the point in the *graph display area*. Hold the mouse button down while dragging it to its new position. Then release the button.
- Move the mouse pointer to the point that you want to reposition and right-click. The Edit point dialog window opens where you can enter the abscissa (x) and ordinate (y) values.



The range of X within which you can choose is indicated on the bottom of the Edit point dialog window. If the value of X that you give is out of this range, one error message will appear to remind you enter the correct value. For the first and the last points on the graph, only the Y value is editable.

You can remove a point again from the graph as follows:

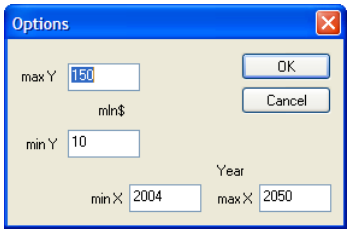
- Double-click the point on the graph.

You can also reposition a point in the *X/Y value pairs list* area.

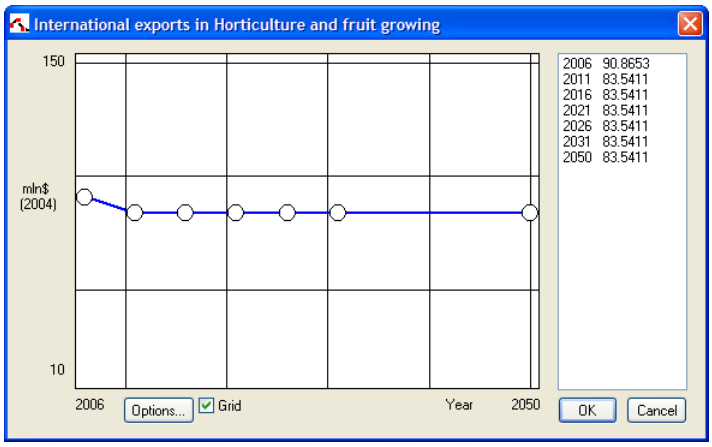
- Double-click the value in the *X/Y value pairs list* with known x and y coordinates. The Edit point dialog window open s where you can enter the abscissa (x) and ordinate (y) values.

You can change the range of the x- and y-axis as follows.

- Click the Options button at the bottom of the window. The Options dialog window opens.
- Enter the new value for the lower and upper bounds of the x- and y-axis.



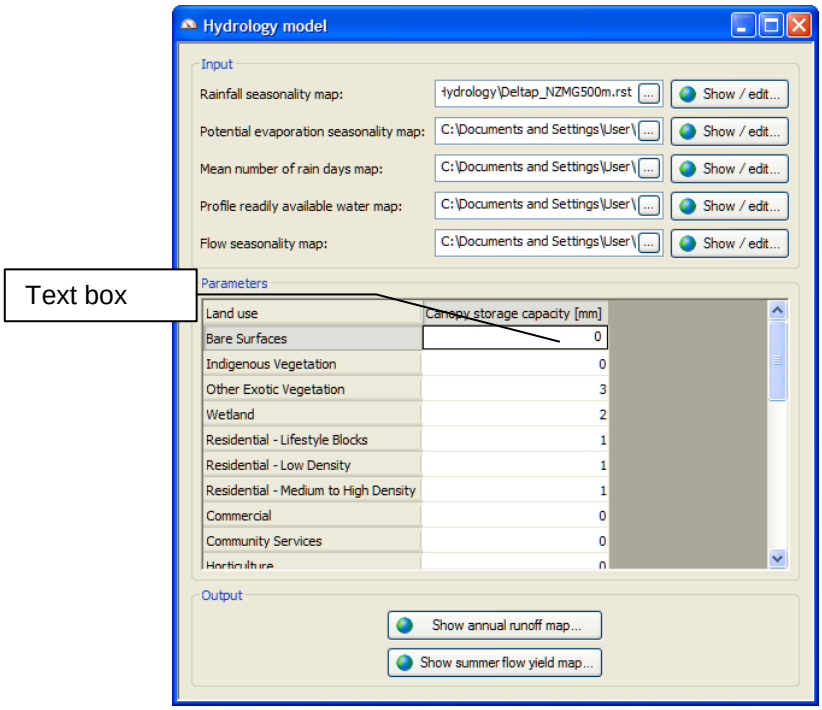
Additionally you can check the box next to Grid to show grids in the graph display area.



2.3.4 Single value

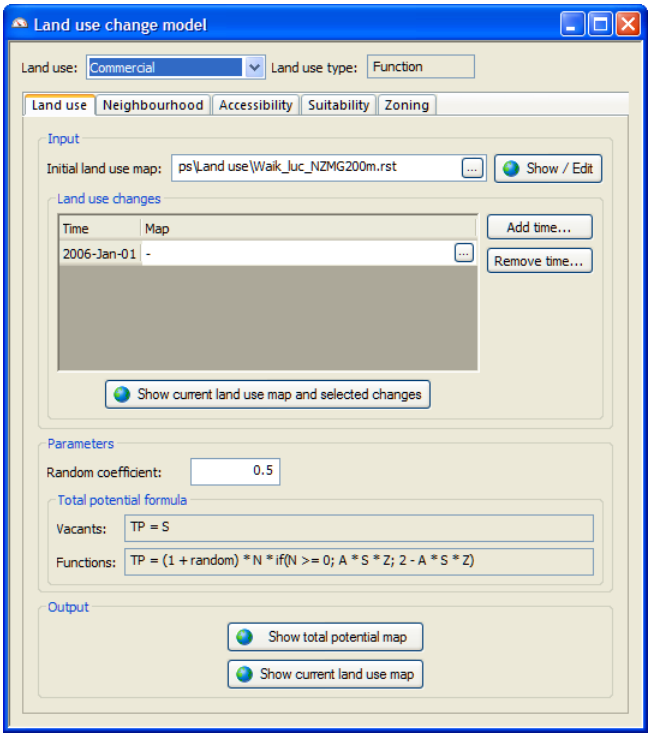
WISE permits you to edit the single value in the *text box* through the graphic user interface. Here is one example of how to edit single value.

- Go to Main window → Drivers → Parameters → Hydrology → Parameters.
- Move the mouse point on the text box next to the variable Bare Surfaces you want to edit. The text box becomes editable.
- Enter a new numerical value in the editable text box.

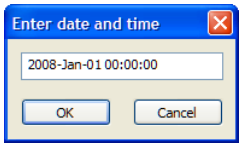


2.3.5 Date and time for map file

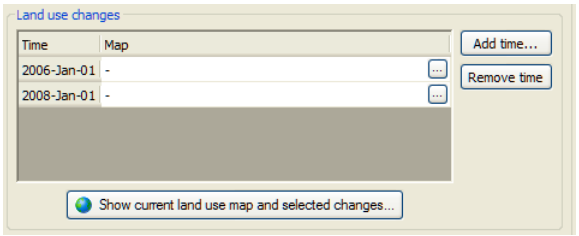
Dynamic changes over time are considered explicitly in WISE. Therefore, maps for specific point in time are used as input in certain models (Climate model, land use change model and terrestrial biodiversity model) in WISE. Here is one example of how to edit date and time for map files at this specified date and time (see the section Map file).



- Go to Main window → Drivers → Parameters → Land use → Land use tab → Land use changes section.
- Click the Add time… button. The Enter date and time dialog window opens.
- Left-click the text box. The text box becomes editable.
- Enter or edit a date and time in the text box, for instance, *2008-Jan-01 00:00:00*.
- Click OK.

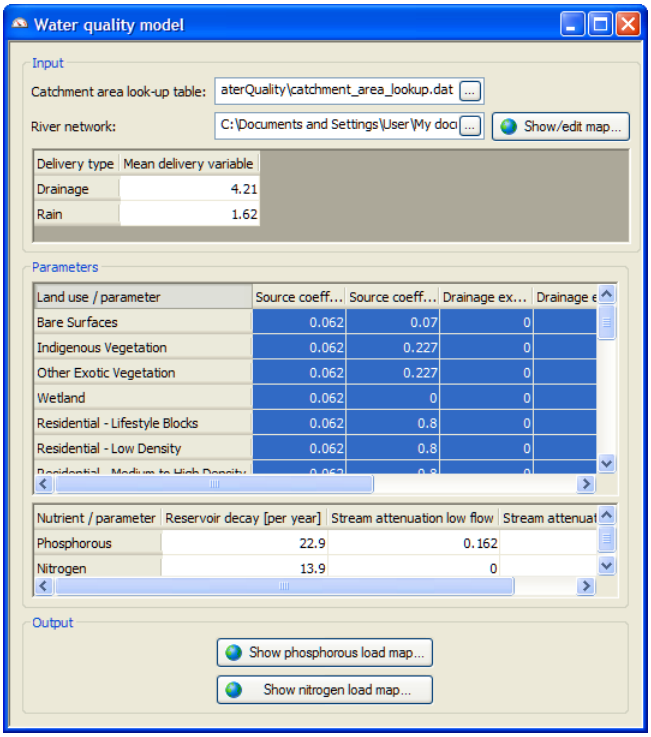


Then a line with the new added date is displayed on the list as depicted in figure below. Now you can introduce the map file for this new added date by clicking on the browse button on the right side. For more information, see the section Map file.



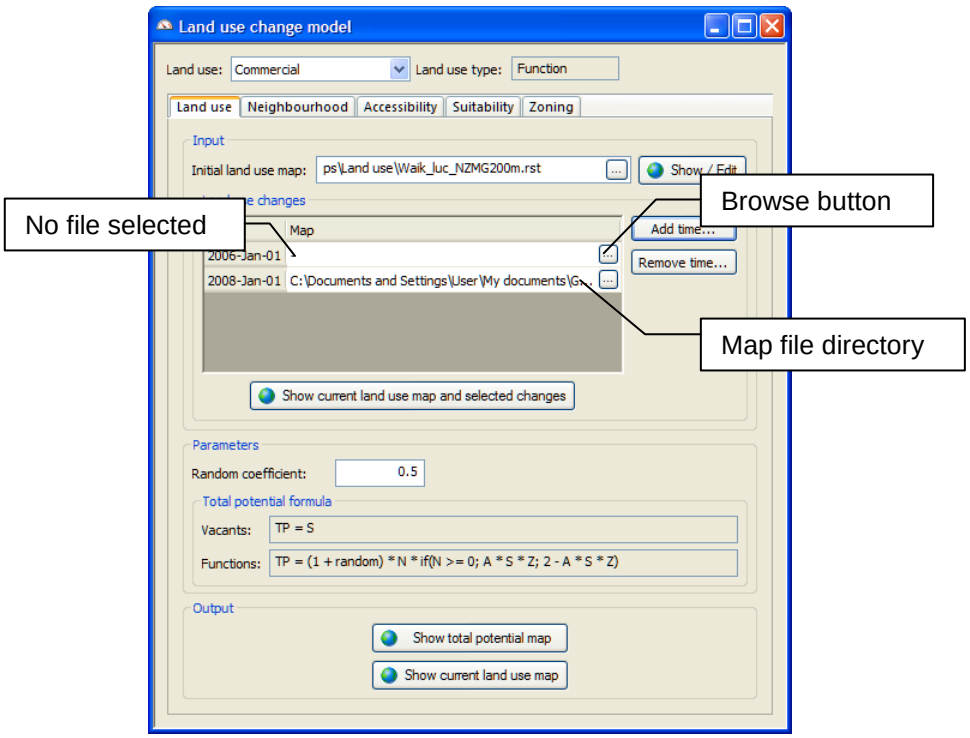
2.3.6 Table

The *table editor* enables you to enter a series of numerical values. You can the keyboard shortcuts *Ctrl+c* and *Ctrl+v* to copy and paste selected numerical values from the table in WISE to an Excel sheet or vice versa



2.3.7 Map file

The *map file editor* lets you add or change maps at a specific date and time. To enter the date and time, see the section Date and time for map file.

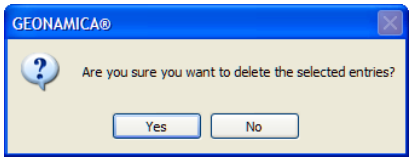


Before loading a map file, the status of the file is "*No file selected*" which is displayed as "-" in the File column. You can add a land use change for the year 2008. For instance, when the land use change for the year 2008 is presented in the file *lu_change_2008.asc* that you prepared and stored in advance:

- Repeat the action steps described in the section Date and time for map file.
- Left-click the Browse button in the row *2008-Jan-01* in the table. The Select dialog window opens.
- Navigate to the folder where you put the file *lu_change_2008.asc*.
- Double-click *lu_change_2008.asc* or left click *lu_change_2008.asc* and press the Open button.

Once the map file has been loaded, the directory of this map file is shown in the file status cell. You can delete one land use change map on the Map file list again.

- Click the land use change file that you want to delete. The path of the selected file is highlighted with blue background.
- Press the Remove time… button on the right side. One message window appears to ask you whether or not to delete the selected land use change.
- Press the Yes button on the message window.



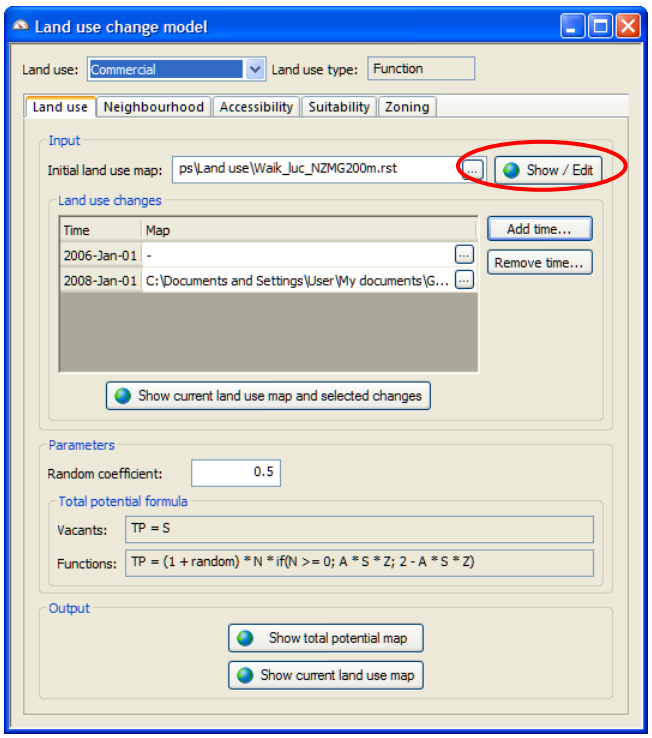
Once the map file has been deleted, this file and its time will disappear from the list.

2.3.8 Editable map

The WISE system allows you to edit some maps in the map window of the system, such as the maps used in the hydrology model, the initial land use map, suitability maps, zoning maps, the river network map and the transport network map. These maps are so-called *editable maps*. There are two ways to see whether a map is editable or not.

- Open your map of interest in a map window.
- Select your map of interest in the layer manager pane on the top-right side of the map window. It is highlighted with blue background.
- Go to the legend pane on the top-left of the map window. If the radio buttons shown in front of the legend, the selected map is editable.
- Or go to the tool pane on the bottom-right of the map window. If the tool buttons under Grid tools are enabled, the selected map is editable.

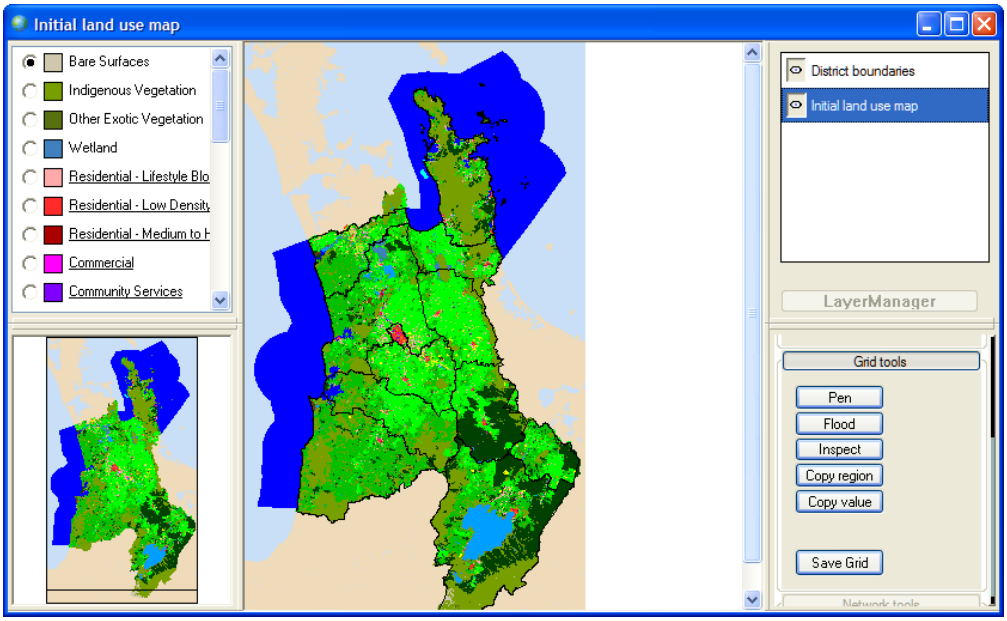
In this section, we use the initial land use map as an example. It is recommended however to edit your map in a GIS package for the sake of accuracy. You can use this example for the purpose of practising however



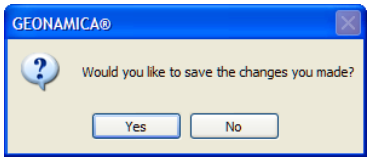
- Go to Main window → Drivers → Parameters → Land use → Land use tab → Input part.

- Click the Show/Edit… button. The Initial land use map window opens.

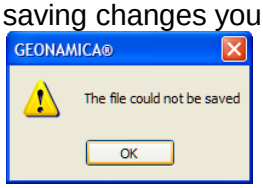
You can view or edit the initial land use map via the map window. For more information about how to use the Grid tools to edit the raster map in the map window, see the section Grid tools. For more information about how to use the Network tools to edit the network map in the map window, see the section Network tools.



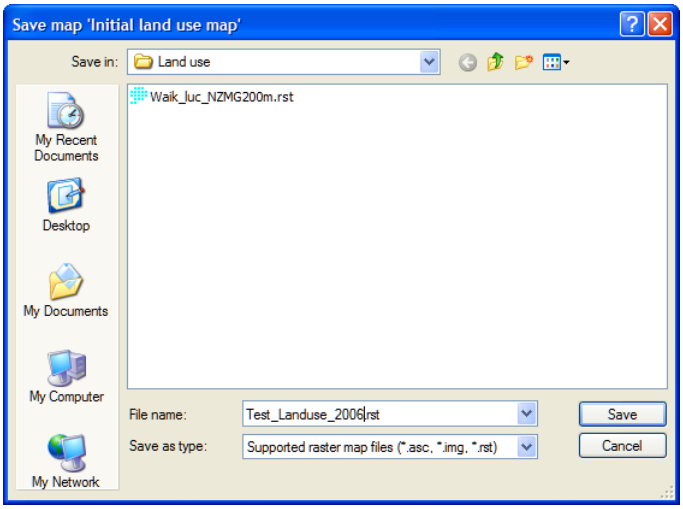
- Change the initial land use map with the tools under Grid tools.
- Close the Initial land use map window. One message window appears to ask you whether or not save changes you made.



- Press the No button to cancel saving changes you made.



- Press the Yes button to save the changes you made. The Save map 'Initial land use map' dialog window opens where you can save the changed map under a new name with its extension. It is strongly recommend entering *a new name* for the changed map so that you can always find the original map coming with the software; else, it will be overwritten.



2.4 Saving changes

The previous section Editing Input and displaying output describes how to edit the input in WISE. This section describes how to save changes that you made in WISE. As it is mentioned in the section Project file, integrated scenario and sub-scenario, input data/files and parameters which are required to run models are stored in the project file.

- The *set of values* that you changed for each driver in WISE will be saved in the corresponding *sub-scenario*. For example, sub-scenarios for high, medium and low GDP growth could be defined for the economic model. In parallel, high and low population growth sub-scenarios can be defined for the population model.
- The *sub-scenarios* that you defined can be combined as a new *integrated scenario*.
- The *integrated scenario/scenarios* that you defined can be saved in one *project file* with the extension **.geoproj*.
- Alternatively the *changes and combinations* that you defined can be saved in different *project files*.

The description above seems very complicated. However, the convenience of the user has been taken into account in WISE for the saving of changes. Therefore, saving a sub-scenario, saving an integrated scenario implies simply *saving a project file*.
The WISE system also considers changes that have been made even though you didn't change any value, for example when you press the OK button in an editable graph dialog window.

2.4.1 Save a project file

The Save project command on the File menu allows you to save changes to data/files and parameter values and to save the simulation output for the current simulation year in the *current project file*. The action of saving a project file includes saving sub-scenarios, saving an integrated scenario and saving external files.

The following sub-sections describe how to complete an action of saving a project file with the same name of the current project file. The steps are:

- Open an existing project file
- Select an integrated scenario as the active integrated scenario.
- Modify population and economic parameters in the external factors section.
- Save the sub-scenarios for the economy driver and population driver as new sub scenarios in the external factors section.
- Save a new integrated scenario "Growth", which inherently includes the newly defined sub-scenarios.
- Save the external files.
- Save the complete project file..

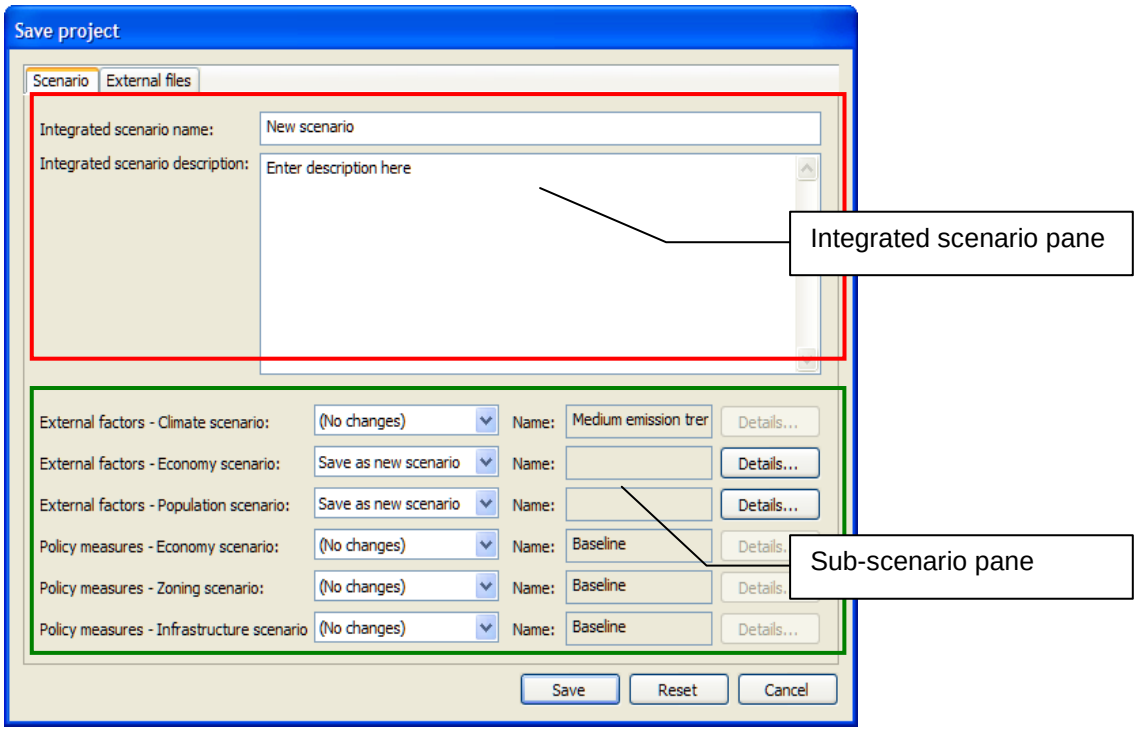
First of all, change 2 parameters in economic scenario and population scenario:

- Select the Baseline as the *active integrated scenario* by clicking on the dropdown list next to Integrated scenario on the toolbar.
- Go to Main window → Drivers → External factors → Population section.
- Click the graph icon next to the Fertility lever. The Fertility Lever window opens.
- Increase the value for 2050 by right-clicking on the point for 2050 and enter the new value in the text box next to Y. Press OK.
- Go to Main window → Drivers → External factors → Economy section.
- Click the dropdown list next to Interregional exports in sector. Click Dairy cattle farming. The International exports in Dairy cattle farming window opens.
- Increase the value for 2050 by right-clicking on the point for 2050 and enter the new value in the text box next to Y. Press OK.

Now you are ready to save changes that you made to the 2 parameters. The operations of saving sub-scenarios, saving an integrated scenario and saving a project file can be done in the same dialog window.

- Click the Save project command on the File menu. The Save project dialog window opens.

The figure depicted below shows the dialog window on the Scenario tab. On the top of the window, the area in the red frame is the *Integrated scenario pane*. On the lower part of the window, the area in the green frame is the *Sub-scenario pane*.



2.4.2 Saving sub-scenarios

First of all, we explore the actions related to saving sub-scenarios. The *Sub-scenario pane* part allows you to give a name and description for the sub-scenario that have been changed. The options available in the dropdown list for each driver can differ based on the state of the system and the characteristics of the active sub-scenario as listed in table below.

Option	Available if no values in the driver have been changed	Available if changes have been made and the active sub-scenario is read-only	Available if changes have been made and the active sub-scenario is writable
(No changes)	X		
Copy to new scenario	X		
Discard changes		X	X
Save as new scenario		X	X
Save in active scenario			X

- The name of each active sub-scenario is displayed in the text box next to Name.
- If the *Copy to new scenario* option or the *Save as new scenario* option is selected, the Details… button becomes enabled and the text box next to Name becomes empty. You can add a name and a description for the new sub-scenario in the Scenario details dialog window by clicking. on the Details… button.
- If the *No changes* option, *Discard changes* option or *Save in active scenario* option is selected, the name of the active sub-scenario is displayed.

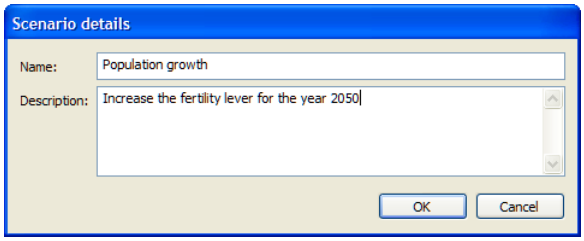
The new sub-scenario name that you give for the specific driver should be a unique sub-scenario name. For example, if you enter a “Baseline” sub-scenario name for the Population driver in the Scenario details dialog window, one error message appears to remind you that it already exists. The same word in different letter case is considered as different names. For example, if the “Baseline” already exists, it is still possible to enter “baseline” as a new sub-scenario name.

With this layout, the most important information is captured in one screen and details are hidden behind buttons.

Options	Description
(No changes)	No input data/files and parameters in the sub-scenario of the corresponding model have been changed.
Copy to new scenario	Copy input data/files and parameters in the sub-scenario of the corresponding model to a new sub-scenario. Add the name and description for the new sub-scenario by clicking the Details... button.
Discard changes	Cancel changes made to the input data/files and parameters in the sub-scenario of the corresponding model.
Save as new scenario	Save changes made to the input data/files and parameters in the sub-scenario of the corresponding model to a new sub-scenario. Add the name and description for the new sub-scenario by clicking the Details... button.
Save in active scenario??	Save changes made to input data/files and parameters in the sub-scenario for the corresponding model to the active sub-scenario. The active sub-scenario will be overwritten with changes you made.

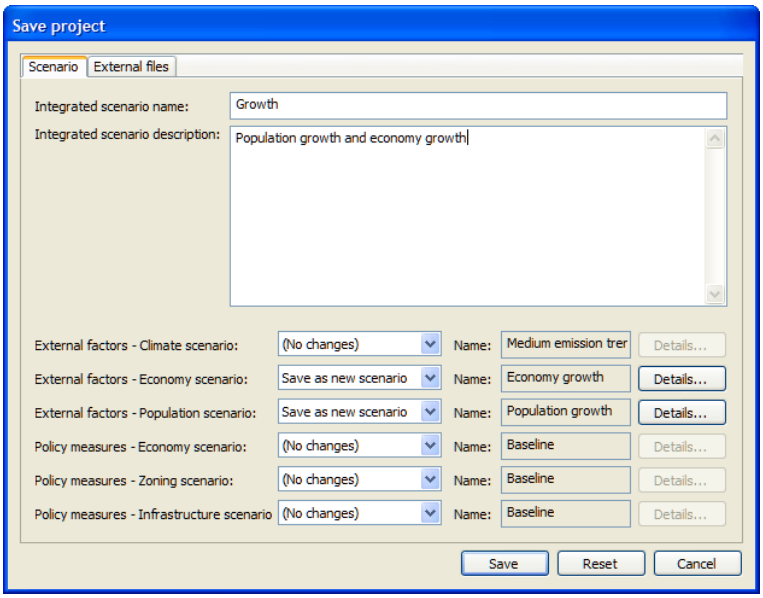
You can define the new sub-scenarios according to changes you made in the previous steps.

- Click the Details... button next to on the right side of the External factors - Population scenario raw. The Scenario details dialog window opens.
- Enter a new scenario name “*Population growth*” in the text box next to Name.
- Enter the description text in the text box next to Description.
- Click OK at the bottom of the Scenario details dialog window.



- Repeat the same steps for the *External factors – Economy scenario*.

The name of the sub-scenario Population growth is displayed in the External factors - Population scenario row and Economic growth is displayed in the External factors – Economy scenario row. The active sub-scenarios *Baseline* for the other drivers remains unchanged since the last time it was saved.

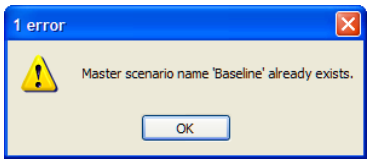


2.4.3 Saving an integrated scenario

The *Integrated scenario pane* part allows you to create a new integrated scenario and add its name and description on the base of the all available sub-scenarios. You can define a new integrated scenario as follows.

- Enter a new integrated scenario name *Growth* in the text box next to Integrated scenario name.
- Enter a description in the text box next to Integrated scenario description to describe the new integrated scenario.
- Check whether the combination of sub-scenarios in the *Sub-scenario pane* is correct.
- If you have checked the *External files*, click the Save button at the bottom of the Save simulation window to save both the definition of the integrated scenario and sub-scenarios on the Scenario tab and the files in the External files tab.

Similarly the sub-scenarios, names for new integrated scenarios should be unique in that project file. When you enter an integrated scenario name which already exists, for example, “Baseline”, an error message will appear to remind you that it already exists. The same name in different letter case is considered as different names. For example, if the “Baseline” already exists, it is still possible to enter “baseline” as a new integrated scenario name.



For more information of saving external files, see the next sub-section Saving external files. You can also click the Reset button to reset changes that you made in the Save simulation window. You can click the Cancel button to cancel the action of saving simulation.

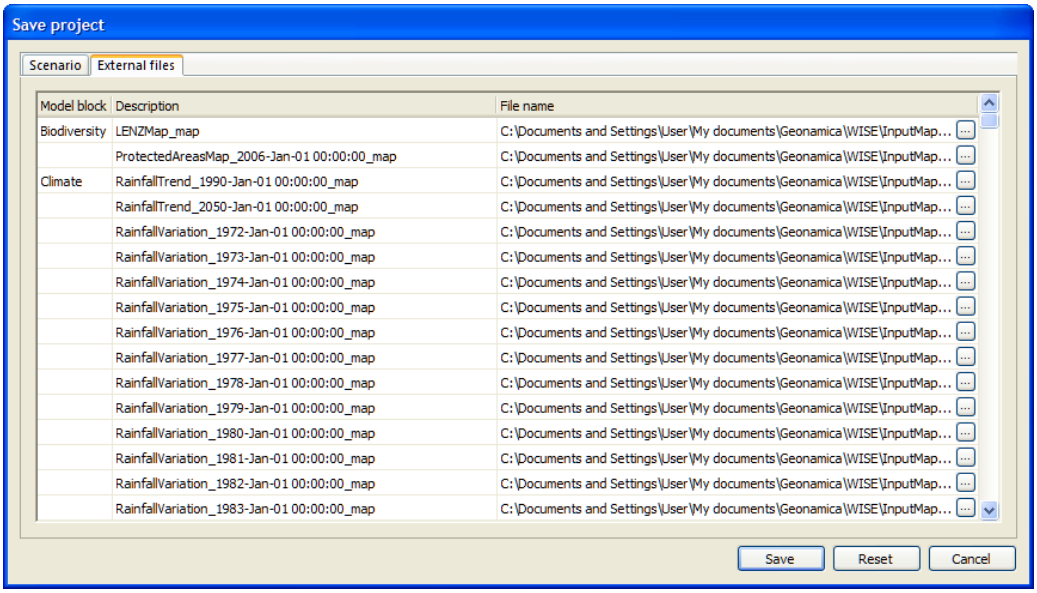
2.4.4 Saving external files

The project file contains parameters and references to all data files that are required to run models in the system and the simulated results for the current simulation year. All data files that are used as input and output for the current simulation year in the system are so-called *External files*.

Saving changes includes saving external files besides saving the integrated scenario and sub-scenarios.

➢ Click the External files tab on the Save project dialog window. The dialog window depicted as in the figure below appears.

The External files tab of the Save project dialog window shows an overview of all input data files are used and the output data/map files for the current simulation year in the current project file and their respective names and paths.



If you are a relatively new user of WISE, press the Save button to complete saving the project file and skip the remainder of this section. However, if you are more experienced with the system, this dialog window will help you to change the composition of your project file before saving it.

- *Keeping the same directories and file names for all data/map files*: If you press the Save button in the Save project dialog window, the file that has not been changed will be saved in the default directory which is configured in the current project file; the file that has been changed will be saved in the directories which is configured after its modification.

- *Changing the directory or the file name of each data file*: The directory of each external file displays in the cell of the File name column. The system allows you to specify the directory where you want to save each data file: by left-clicking on the path name in the cell of the File Name column. Once it is selected and marked blue, you can type any path or file name you want. The system allows you to change the format of data file by clicking ... and selecting the appropriate data type from the dropdown list. You can also specify the directory and the file name of each data file by clicking the browse button and navigating to the location you want to save and giving a new name for it.

- *No file*: The data file marked as "-" on the File name list indicates this file is not used or not required for the current simulation.

- You can always use the Reset to undo the changes in the table before you click the Save button.

Once you press the Save button of the Save project dialog window, the current project file will be overwritten, and the original information will be lost. Overwriting files can be avoided simply by choosing another file name than the current one (see the section Save a project file as).

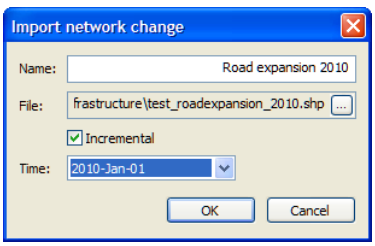
The intermediate results will not be saved through the External files tab. To save these, you should make use of the Write to Excel… command, the Log maps… command and the Animate maps… commands from the Options menu. You will find more information on these in sections Write to Excel, Log maps, Animate maps, respectively.

2.4.5 Save a project file as

The Save project as… command on the File menu allows you to save the changes to data/files and parameter values and to save the simulation output for the current simulation year with another project file name. The same as *saving project*, the action of *saving project as* will be completed by the combination of saving sub-scenarios, saving an integrated scenario and saving external files.

For this example, you can continue working on the *Waikato.geoproj* which has *Baseline* and *Growth* integrated scenarios available by importing a network change for the year 2008.

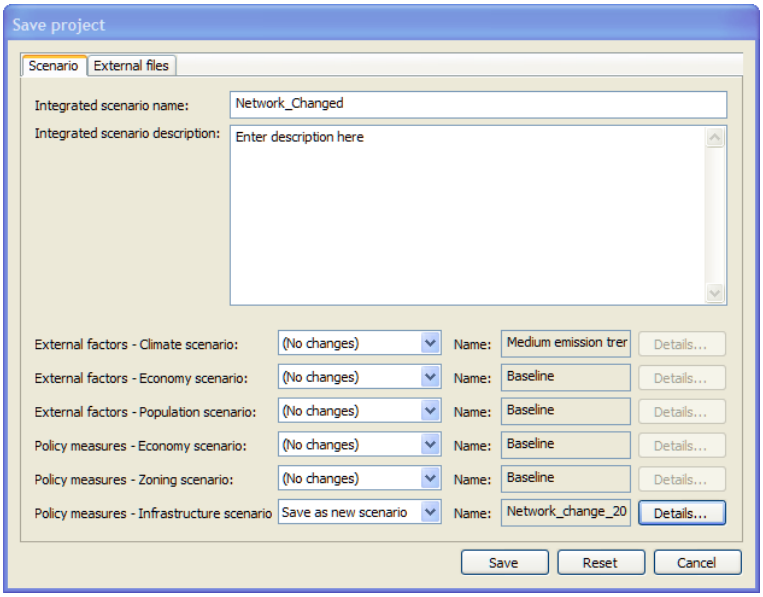
- Open *Waikato.geoproj* in WISE (see the section Opening an existing project).
- Select *Baseline* integrated scenario as the active integrated scenario by clicking on Baseline on the dropdown list next to Scenario on the toolbar.
- Go to Main window → Drivers → Policy measures.
- Select Infrastructure from the dropdown list next to Driver.
- Select Transport network from the dropdown list next to Network.
- Click Import network change… button. The Import network change dialog window opens.
- Select 2010 from the dropdown list next to Time.
- Click the checkbox next to Incremental.
- Click the browse button next to File. The Open network change layer dialog window opens.
- Select the network change for 2010 that you want to upload and click the Open button in the Open network change layer dialog window.
- Click the OK button in the Import network change dialog window.



Now, you import the incremental network change for 2010.

- Click the Save project as… on the File menu. The Save project file dialog window opens.
- Enter a new project file name *Waikato_NetworkChanged.geoproj*.
- Press the Save button on the Save project dialog window. The Save project dialog window opens.
- Specify the integrated scenario as Network_Changed in the *integrated scenario pane*.

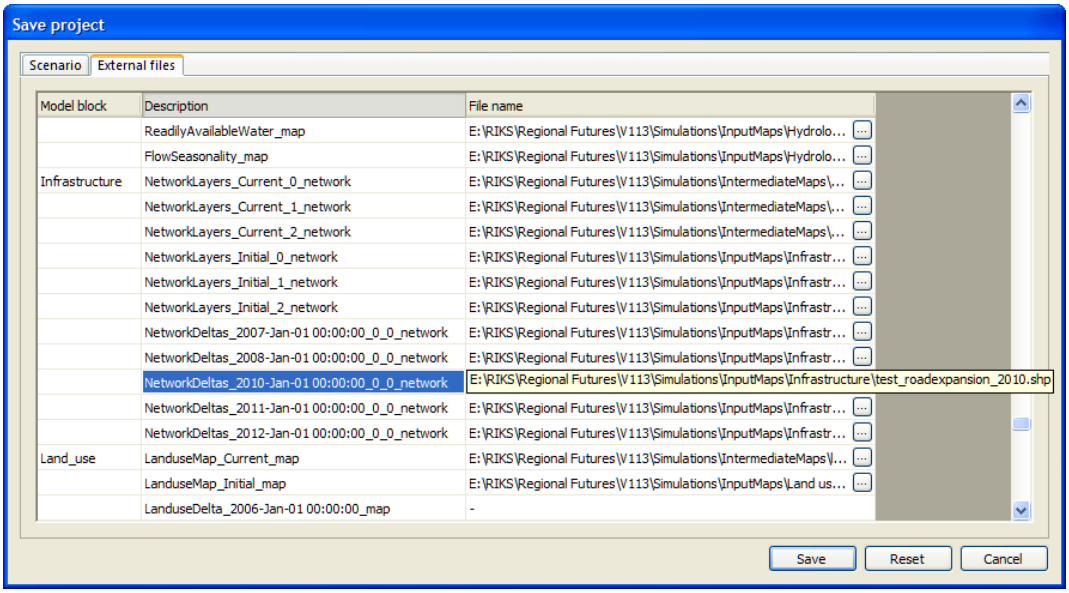
- Specify the Policy measures – Infrastructure scenario as Network_change_2010 in the *sub-scenario pane*. Press OK in the Scenario details dialog window.



You can specify the external files via the External files tab.

- Click the External files tab.
- Move the mouse to the Network part in the File name column and verify the path and file name for the *NetworkDeltas_2010_0_network*.

You will also see the Network change for 2010 is appeared on the list. The tooltip box shows the whole path and the file name.



For more information, see the section Saving external files.

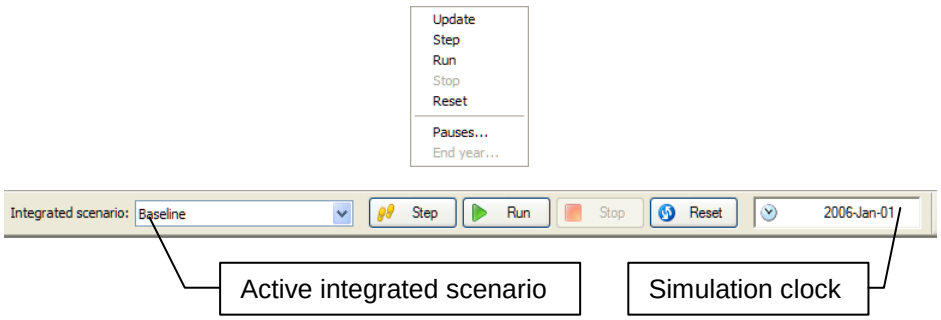
- Press the Save the button at the bottom of Save project dialog window to finalize saving project file as *Waikato_NetworkChanged.geoproj*.

You will see the Waikato_NetworkChanged displaying on the top-left of the Geonamica window.

2.5 Running a scenario

Once the Main window and the Land use map window have been opened, the program has read the default values for all the parameters as well as the initial values for all the state variables of models. The program is ready to run a scenario. You can run a

scenario with the control buttons on the *toolbar* or with the commands on the Simulation menu.



On the toolbar as depicted in the figure above, the left-most box displays the active integrated scenario. The right-most box displays the Simulation clock, which indicates the progress of the simulation: the year until which the simulation has run. The initial year is 2006 in WISE.

2.5.1 Active integrated scenario

Before you start running the simulation, you need first to select one integrated scenario as the active integrated scenario.

- Click the dropdown list next to Integrated Scenario on the toolbar. All the available integrated scenarios will be displayed on the list.
- Select your integrated scenario of interest from the list, for example, the *Baseline* integrated scenario.

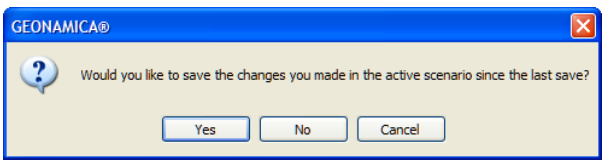
After you select the integrated scenario from the list, the system loads the integrated scenario immediately as the active integrated scenario. When collapsed, the list box shows the name of the active integrated scenario. You can easily switch to another integrated scenario from the active integrated scenario dropdown list on the toolbar. For example, the current active integrated scenario is the predefined *Baseline* integrated scenario, no change has been made and you want to switch to the *Growth* integrated scenario.

- Click Growth on the dropdown list next to Integrated Scenario, the Growth integrated scenario is displayed on the list.

The *Growth* integrated scenario is now loaded by the system.
However, if you made changes to the input data/files and parameters of the current active integrated scenario you need to save them first. For instance you want to switch to the *Growth* integrated scenario as the active integrated scenario from the *Baseline* integrated scenario.

- Click Growth on the dropdown list next to Integrated Scenario, the Growth integrated scenario is displayed on the list.

A message window as depicted in the figure below appears to ask you whether or not to save changes that you made in the active scenario.



- Click the Cancel button to cancel the action to switch *Growth* integrated scenario as the active integrated scenario.

- Click the No button to discard changes you made in the active integrated scenario. Then the system will load the *Growth* integrated scenario as the active integrated scenario.

- Click the Yes button to save changes you made in the active integrated scenario. The Baseline integrated scenario is displayed on the dropdown list on the toolbar and the Save project dialog window opens where you can determine how to save changes you made. For more information, see the section Saving changes. After you save the changes in a new integrated scenario via the Save project dialog window, the new created integrated scenario becomes the active integrated scenario automatically on the dropdown list on the toolbar.

Note that loading the active integrated scenario means loading the input data/files and parameters defined in this integrated scenario to the graphic user interface. In this case, the models have not been updated to the changes. You can use the Update, Step, Run and Reset command to update the models of the system to the changes.

2.5.2 Reset

You can switch the simulation clock back to the start year of the simulation by pressing the Reset button on the toolbar or by using the Reset command on the Simulation menu. This action resets all the parameters and maps to their initial value. The changes that you made to the parameters and maps, which include the changes to the initial values and initial maps, are affected by resetting the simulation because all of them are recalculated for the start year.

Whenever you change the initial values or initial maps for the start year, you need to reset to perform the changes.

2.5.3 Update

To update the models of the system to the changes that you made in the user interface for the current simulation year (hence, except for the changes to the initial values or initial maps), you can use the Update command on the Simulation menu. The action of updating will not take into account the changes that you made to initial values or initial maps. To that effect, you can use Reset or click the Step or Run button on the toolbar. After the model has been updated, the variables that are affected by changes are recalculated and the updated output will be displayed via the user interface.

You can use the Update command to have the model perform the changes that you made without advancing the simulation clock. This is especially useful to test the immediate effects of a newly entered (set of) parameter(s) before running the simulation.

2.5.4 Step

To verify that the program is ready to run, you can use the Step command on the Simulation menu or press the Step button on the toolbar. Once pressed, WISE goes through a number of essential phases, such as the updating the models and testing of its input, which are of no direct interest to the user before it makes one simulation time step. This takes a while. You will notice that the action is finished when the simulation clock changes to next simulation year and the land use map in the Land use map window is updated. If you select the Step command, the models will be automatically updated if this has not been done manually.

2.5.5 Run

To perform a simulation for the whole simulation period, you can use the Run command on the Simulation menu or press the Run button on the toolbar. The simulation starts running until the next pause moment has been reached and the progress can be followed as the Land use map window and the simulation progress clock are updated on a yearly basis.

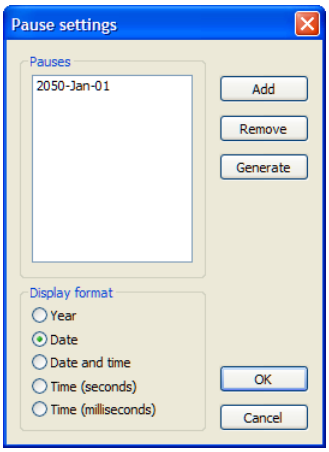
Unless other pauses are set (see the section Pauses), the simulation will halt at the end of the simulation period. If you select the Run command the models of the system will be automatically updated if this has not been done manually.

2.5.6 Stop

You can pause a running simulation by pressing the Stop button on the toolbar or using the Stop command on the Simulation menu. When the simulation is stopped, it finishes the calculations for the current simulation year and stops. The simulation continues when you select the Step or Run. You can also pause the simulation at predefined instances (see the section Pauses).

2.5.7 Pauses

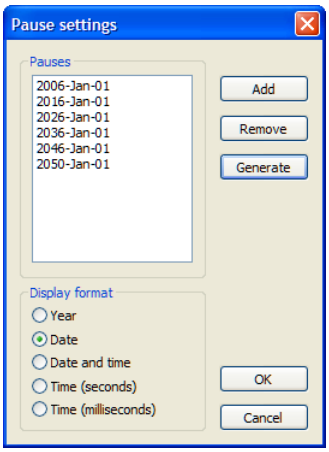
To set the pauses in the simulation, you can use the Pauses… command on the Simulation menu. When Pauses… is selected, the Pause Settings dialog window opens. You can use the Run command on the Simulation menu or press the Run button on the toolbar to advance the simulation again until the next pause is reached.



2.5.7.1 Display format

In the Display format pane of the Pause settings window, you can define the display format of pause tabs by clicking the radio button in front of the format that you want to display. When you switch the format, the list of pauses is displayed accordingly.

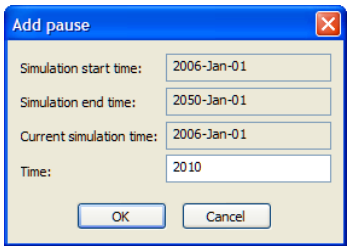
Be aware that the *Display format* that you defined in the Pause settings dialog window will be used for the integrated time in the system, such as the time format in the Log maps on the Options menu and Simulation clock on the toolbar.



2.5.7.2 Add and remove

You can add a new pause by clicking the Add button on the top-right of the Pause Settings dialog window. Enter the year in which you want to halt the simulation in the

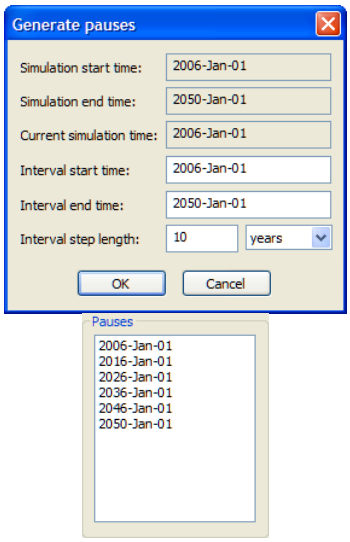
text box next to Time and then press OK. The pause at this year will be added to the Pauses list.



You can remove a pause by selecting the one that you want to remove and clicking the Remove button on the right hand side of the Pause settings window.

2.5.7.3 Generate

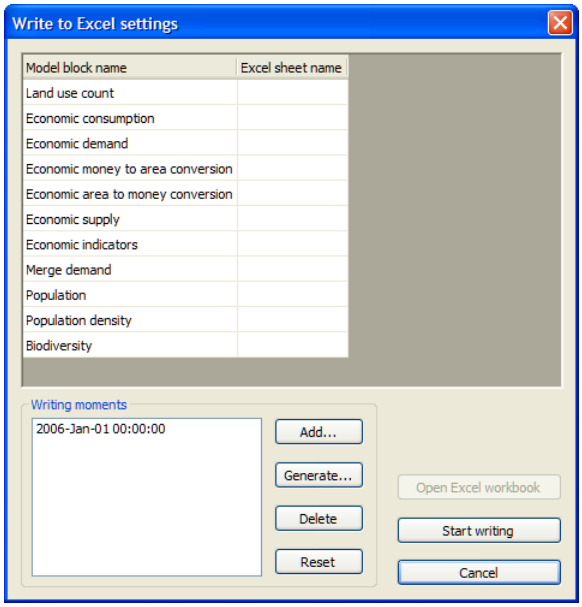
You can predefine pause instances by using the Generate command. The Generate pauses dialog window opens when you press the Generate button of the Pause settings window. You can enter the interval start time, the interval end time and the interval step length in the Generate pauses dialog window and press OK button. The pauses are generated and displayed on the pauses list of the Pause Settings dialog window.



2.6 Saving results

2.6.1 Write to Excel

You can select the Write to Excel… from the Options menu to establish (or interrupt) a link between WISE and a Microsoft Excel workbook. A new window appears as shown below. WISE is sending model output to the Excel Workbook while the simulation is advancing.



The data transferred to the Excel workbook shows results for the Economic model, Population model and Terrestrial biodiversity model.

2.6.1.1 Defining Excel sheet name

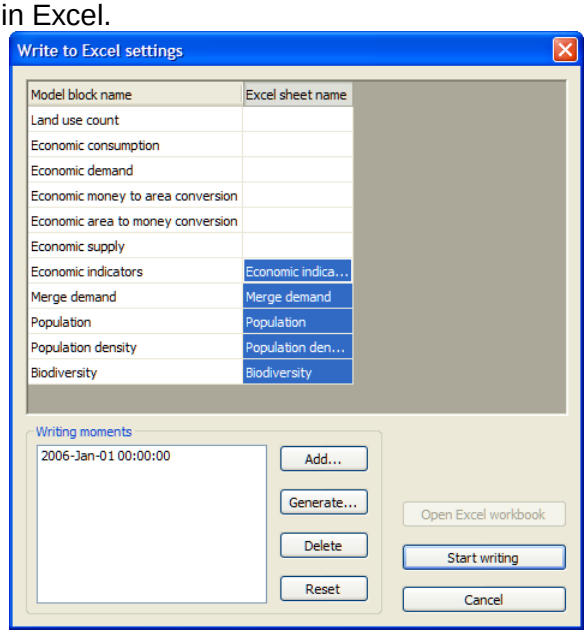
The list of predefined output options are displayed per model block from which they origin in the Model block name column on the top pane of the Write to Excel settings window. The system will only make links for the model blocks which are configured in the column of Excel sheet name.

- Select the cell next to this model block to enter a name by clicking on it.

If you want to use the model block as the Excel sheet name, you can use Ctrl+c and Ctrl+v on your keyboard to do so.

- Click on the model block name for which you want to make link to Excel sheet.
- Press Ctrl+c on your keyboard.
- Click the corresponding cell in the column of Excel sheet name.
- Press Ctrl+v on your keyboard.

The names that you add in the Write to Excel settings window will be displayed as the names of the sheets in Excel.



2.6.1.2 Defining writing moments

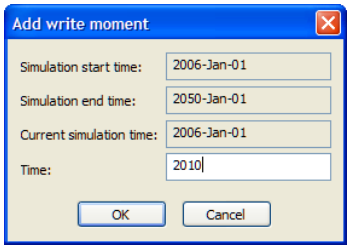
While a simulation is advancing, the system only writes model output for the moments that are determined in the Writing moments pane on the lower-left part of the Write to

Excel settings window. You can adjust the list of writing moments by using the Add… button, the Generate… button, the Delete button and the Reset button.

You can add a single moment as follows.

- Click the Add… button. The Add write moment dialog window opens.
- Enter the moment in the text box next to Time for which you want to display the model output in the Excel workbook.
- Press OK.

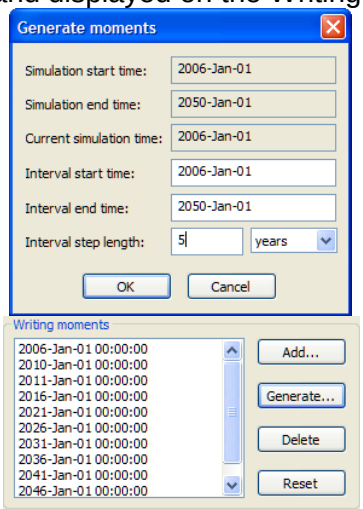
The write moment at this year will be displayed on the Writing moments list immediately.



You can define write moments at regular intervals as follows:

- Click the Generate… button. The Generate moments dialog window opens.
- Enter the interval start time, the interval end time and the interval step length in the Generate moments dialog window.
- Press OK.

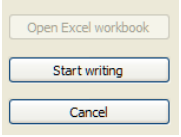
The moments are generated and displayed on the Writing moments list immediately.



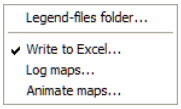
You can easily delete one or several writing moments by selecting the moments that you want to remove and clicking the Delete button. If you are not satisfied with the moments that you just created, you can undo the configuration by clicking the Reset button. This action will reset all writing moments to the value they had when you last opened the Write to Excel settings window.

2.6.1.3 Starting writing

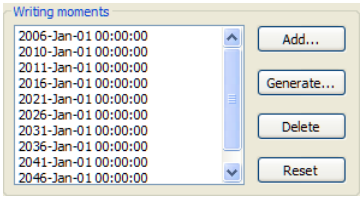
To finalise the link between WISE and Excel workbook, you can click the Start writing button on the right-low pane of the Write to Excel settings window. The Write to Excel settings window closes automatically. A link between WISE and Excel workbook is established after this action, although you cannot see this directly on your screen.



While this function is activated, Write to Excel on the Options menu is preceded with a tick mark.



Now you can run the simulation with the link to the Excel by clicking the Run button on the toolbar. Note that the system only starts writing results to Excel from the first writing moments after the current simulation year. For example, if the current simulation year is 2010, you press the Start writing button and then press the Run button. The first writing moment will be the year 2011 which is the first writing moments after the current simulation year (2010) as depicted in the figure below.



If you want to write results to Excel from the start year of the simulation after setting the writing moments, you can follow the steps below.

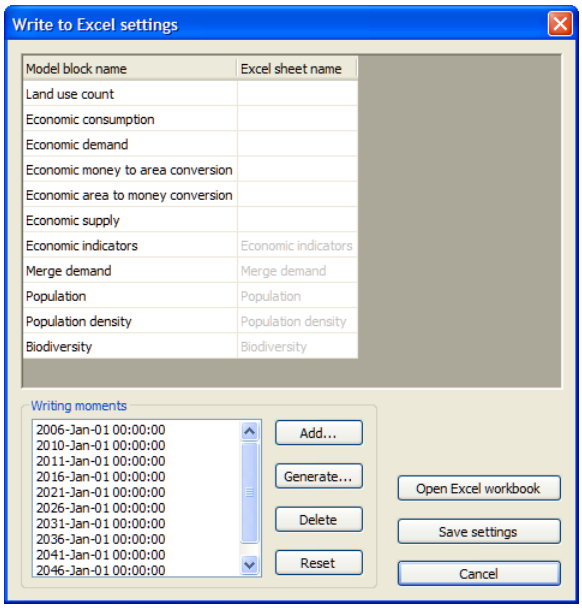
- Click the Start writing button of the Write to Excel settings dialog window.
- Click the Reset button on the toolbar.
- Click the Run button on the toolbar.

2.6.1.4 Saving settings

You can change settings for writing to Excel while the simulation is running.

- Click the marked Write to Excel option on the Options menu.

The Write to Excel settings window opens again. Now the Save settings, and the Open Excel workbook buttons become enabled on the right-low pane of the window. You can only change the settings of in the Writing moments but you cannot change settings in the Excel sheet name pane that are greyed-out.

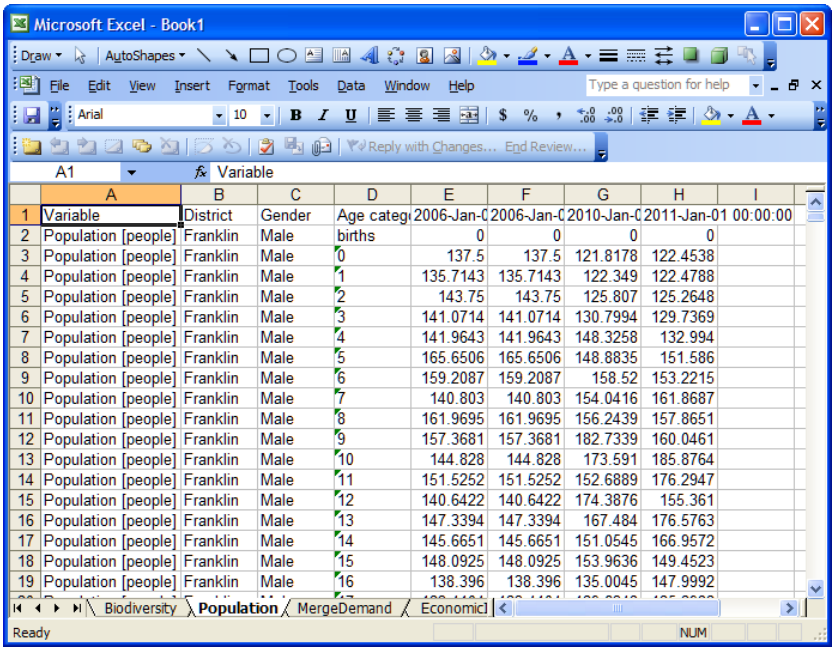


It is very important to press the Save settings button to finish the adjustments while keeping the system writing model output to the Excel workbook. Only the data for moments, which are later than the current simulated time, will be written to the Excel workbook. The function of Write to Excel on the Options menu is still preceded with a tick mark.

If you press the Open Excel workbook button, the function of Write to Excel will be switched off. You can always check whether the link to Excel is activated from the tick mark Write to Excel on the Options menu.

2.6.1.5 Opening Excel workbook

To stop writing to Excel and view the Excel workbook, you can press the Open Excel workbook button. The Excel workbook opens immediately, showing the worksheets with the names that you defined. You can use it now for further analysis of the simulation data.



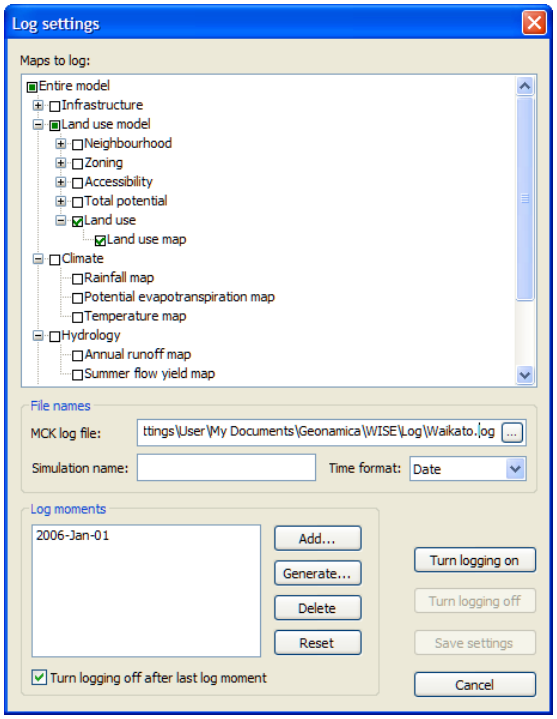
	A	B	C	D	E	F	G	H	I
1	Variable	District	Gender	Age categ	2006-Jan-0	2006-Jan-0	2010-Jan-0	2011-Jan-01	00:00:00
2	Population [people]	Franklin	Male	births	0	0	0	0	
3	Population [people]	Franklin	Male	0	137.5	137.5	121.8178	122.4538	
4	Population [people]	Franklin	Male	1	135.7143	135.7143	122.349	122.4788	
5	Population [people]	Franklin	Male	2	143.75	143.75	125.807	125.2648	
6	Population [people]	Franklin	Male	3	141.0714	141.0714	130.7994	129.7369	
7	Population [people]	Franklin	Male	4	141.9643	141.9643	148.3258	132.994	
8	Population [people]	Franklin	Male	5	165.6506	165.6506	148.8835	151.586	
9	Population [people]	Franklin	Male	6	159.2087	159.2087	158.52	153.2215	
10	Population [people]	Franklin	Male	7	140.803	140.803	154.0416	161.8687	
11	Population [people]	Franklin	Male	8	161.9695	161.9695	156.2439	157.8651	
12	Population [people]	Franklin	Male	9	157.3681	157.3681	182.7339	160.0461	
13	Population [people]	Franklin	Male	10	144.828	144.828	173.591	185.8764	
14	Population [people]	Franklin	Male	11	151.5252	151.5252	152.6889	176.2947	
15	Population [people]	Franklin	Male	12	140.6422	140.6422	174.3876	155.361	
16	Population [people]	Franklin	Male	13	147.3394	147.3394	167.484	176.5763	
17	Population [people]	Franklin	Male	14	145.6651	145.6651	151.0545	166.9572	
18	Population [people]	Franklin	Male	15	148.0925	148.0925	153.9636	149.4523	
19	Population [people]	Franklin	Male	16	138.396	138.396	135.0045	147.9992	

Note that in order to establish a successful link, it is required that Excel is installed on your computer. If WISE cannot find Excel, the Write to Excel on the Options menu will be greyed out.

2.6.2 Log maps

You can use the Log maps… command on the Options menu to store all the maps produced by the system in the form of .rst files. The system generates a Log File (*.log) automatically when you use the Log maps… command. In the Log File, all the maps that you selected to log are included.
You can analyse these logged maps files *.log with the Map Comparison Kit – see the section Analysing spatial results.

When Log maps…command is selected the Log settings dialog window opens.



2.6.2.1 Selecting maps

In the Maps to log pane, a tree of maps is available, which is organized by the type of information on the map. You can expand or collapse the branches of map tree by moving the mouse over the name of group and double-click or moving the mouse over the box in front of the group and left-click.

In this tree, you can indicate which maps you want to store. You could select/unselect all maps in a sub-model – e.g. all accessibility maps or all maps in the land use model – or in the entire model by clicking on the corresponding check box.

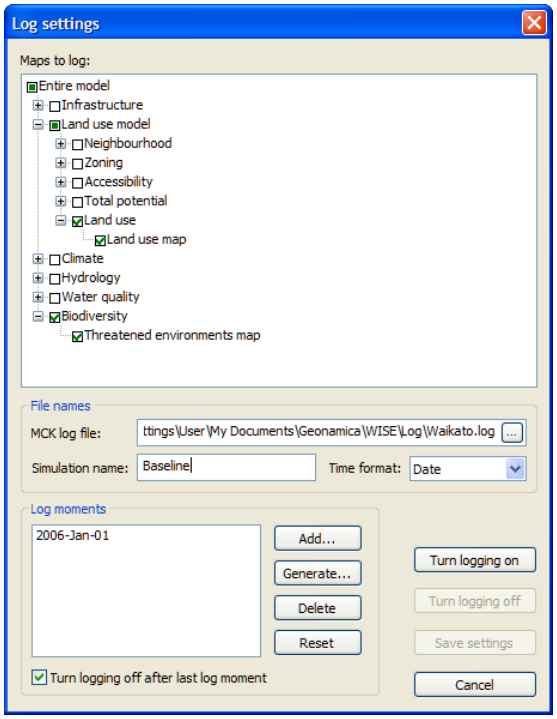
➢ Click the check box on the left side of the name of the map that you want to log.

Maps are selected for logging if the check box is checked with a green mark.

2.6.2.2 Defining path and file names

The WISE system will generate a log file with the extension *.log* containing the logged maps. You could specify the path and the name of the log file in the text box next to MCK log file. In the example as depicted below, the file *Waikato.log* is the MCK log file. You can double click this log file to open it and to load the logged maps into the MCK. For more information, see the section Analysing spatial results.

In the text box next to Simulation name, you need to enter a descriptive name that can represent the simulation you are going to run. The logged maps will be stored in the folder named with the Simulation name you specified. And the folder named with the simulation name will be stored under the folder named with the sub-model you selected in the previous step Selecting maps. You can select Year, Date or Date and time from the dropdown list next to Time format. The selected time format will be used as part of the names for the logged maps.



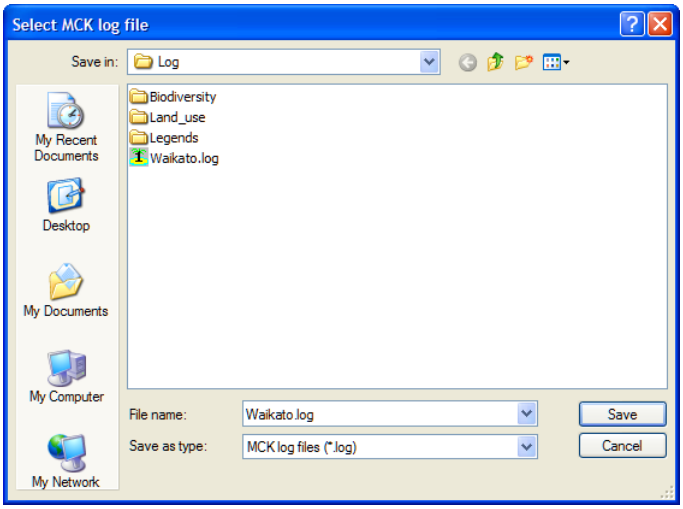
In the example as depicted above, the selected maps to log are land use maps under the Land use sub-model and the threatened environments maps under the Biodiversity sub-model. Then the logged land use maps will be stored in the folder under *\Geonamica\WISE\Log\Land_use\Baseline*. The logged habitat fragmentation maps will be stored in the folder under *\Geonamica\WISE\Log\Biodiversity*.

Besides to specify the path and the log file name, it is important to give a different and descriptive name for the Simulation name based on the scenario or simulation that you are running. Otherwise, previously logged maps will be overwritten.

You can modify the path and the name of the log file as follows:

- Click the browse button on the right side of the text box. The Select MCK log file window opens.
- Navigate to the location that you want to store the logged maps and click the Open button.
- Enter the name of the log file next to File name.
- Press the Save button.

If you are using an existing log file name, new logged maps will be added to the same log file which has already included logged maps from previous simulation runs. If the same simulation name is used, the logged maps in the folder named with the simulation name will be overwritten.



2.6.2.3 Editing log moments

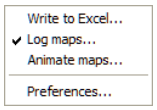
In the Log moments pane on the lower-left part of the Log settings window, you can specify moments for which maps will be logged. First of all, you can select the time format used in the file names of the logged maps from a number of presets, including the year, the full date and the full date and time. To do so, select the format of interest from the dropdown list next to Time format.

You can make a list of logging moments by using the Add…button, the Generate… button, the Delete button and the Reset button of the Log moments pane. This works similarly to Defining writing moments in the Write to Excel.

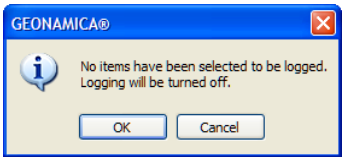
The system allows you to change the display format on the Add log moment and Generate log moments dialog windows by using the Pauses…command in the Simulation menu (see the section Pauses). You can change the settings in the Maps to log pane and the settings of in the Log moments pane while the simulation is still advancing.

2.6.2.4 Turning logging on

To activate the logging functions, you have to press the Turn logging on button on the lower-right pane of the Log settings dialog window. The selected maps in the tree of maps will be stored in the path you specified. The function of Log maps in the Options menu is preceded with a mark.



If there is no map selected, you are not able to turn the logging function on. A message window depicted as figure below appears.



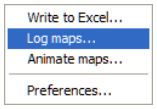
2.6.2.5 Saving settings

You can finish any adjustments made in the log settings by clicking the Save settings button. Only the maps for the moments, which are later than the current simulated time, will be logged. The function of Log maps on the Options menu is still indicated with a tick mark when it is activated.

When the function of log maps is enabled, the selected maps for the selected log moments will be logged while the simulation is running.

2.6.2.6 Turning logging off

You can stop the logging by clicking the Turn logging off button on the lower right pane of the Log settings dialog window. The function of Log maps on the Options menu is now displayed without a tick mark.

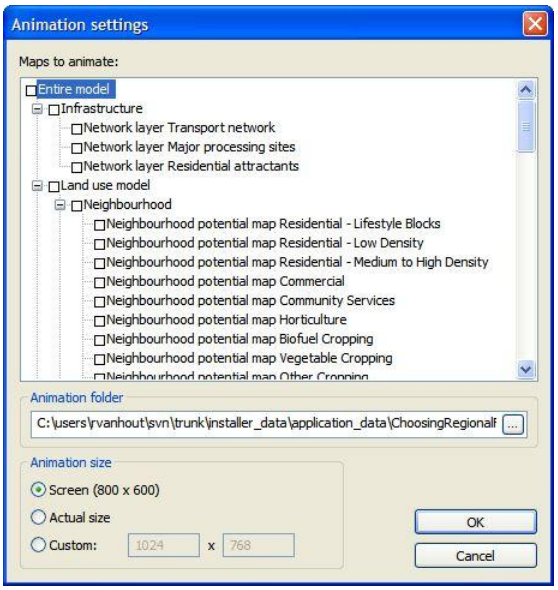


You can also let the system turn logging off automatically after the last log moment. To do so,

- Click the check box in front of Turn logging off after last log moment at the bottom of the dialog window.

2.6.3 Animate maps

It is also possible to make movies of maps during a simulation and store them for later use. To that effect, you can use the Animate maps… command from the Options menu. When this command is selected the Animation settings dialog window opens. Animations are stored in the form of *.gif* files.



2.6.3.1 Selecting maps

In the Maps to animate pane, a tree of maps is available, which is organized in groups with information on the map including raster maps and vector maps. You can expand or collapse the branches of map tree by moving the mouse over the name of group and double-click or moving the mouse over the box in front of the group and left-click.

In this tree, you can indicate which maps you want to store. You can select/unselect all maps in a sub-model – e.g. all accessibility maps or all maps in the land use model – or in the entire model by clicking on the corresponding check box.

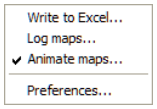
- Click the check box on the left side of the name of the map that you want to animate.

Maps are selected for animation when the check box is checked with a green mark.

2.6.3.2 Changing path of animation maps

The program automatically sets the location where the animations are stored as well as the file name in the Animation directory text box. You can change the filename and location by pressing the browser button on the right hand side.

When the Animate maps function is activated in WISE, this is indicated with a mark in front of this option on the Options menu. If no map is selected in the Animation settings dialog window, no animations will be generated during the simulation.



2.6.3.3 Animation size

When animating maps, the maps are transformed into an image (the animations are a number of images glued together into one file). The title on the animation will be displayed with fixed pixels. In the Animation size pane, you can choose the appropriate option among *Screen*, *Actual size* and *Custom* options.

- Screen (800x600): the animation will be rescaled according to the normal screen size, which is of width 800 pixels and height 600 pixels. It is recommended to choose this option if you want to make an animation movie for a presentation. The title is always readable in this case.
- Actual size: the animation will be the actual size of the map. In another words, one cell on the map is displayed as one pixel on the animation.
- Custom: the animation will be rescaled according to the specified height and weight. You can specify the height and width of generated animations by entering the values in the text boxes next to Custom.

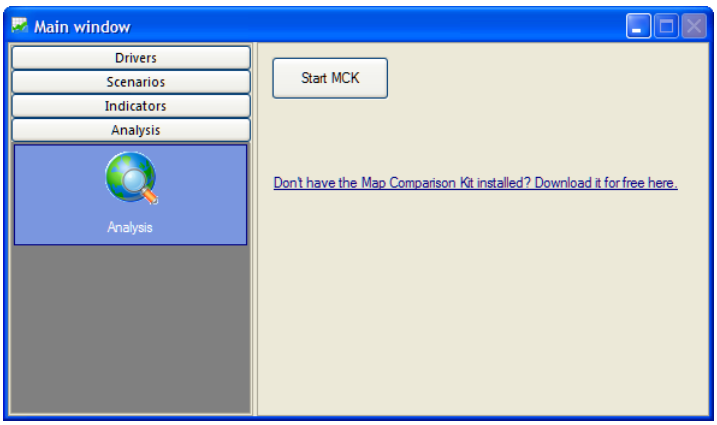
The aspect ratios of the animated maps will remain constant when maps are rescaled to fit the image size.

You can view the animations in most recent Internet browsers as well as some graphics packages equipped with an animation facility.

2.7 Analysing results

The Map Comparison Kit (MCK) is a stand alone software tool that includes a number of algorithms that you can use to analyse your results The WISE can open the MCK to analyse results as follows:

- Go to Main window → Analysis → Map Comparison.
- Click the Start MCK button in the content pane of the Main window. The Open dialog window opens in the Map Comparison Kit. If you do not have the MCK installed on you computer. You can click on the links to download it for free.



In the Open dialog window, the ###.log file generated in WISE is the default log file. For more information, see the section Log maps.

The MCK comes with its own dedicated manual which is delivered as an integral part of the WISE package. It explains the use of the MCK and describes in detail how you can analyse and compare logged maps generated by WISE in an interactive manner. All

logged maps generated by WISE can be read into the MCK in a straightforward manner.

One example about how to use Map Comparison Kit to compare scenarios for Policy user is given in the section Analysing results.

3 Policy interface

The user interface of the WISE system provides access for two types of users: the *policy user* who carries out impact assessment studies related to the impact of certain policies under a range of external conditions and the *modeller*, who is responsible for the underlying (scientific) information of the system and needs to adapt underlying data and parameters when more data or information becomes available over time.

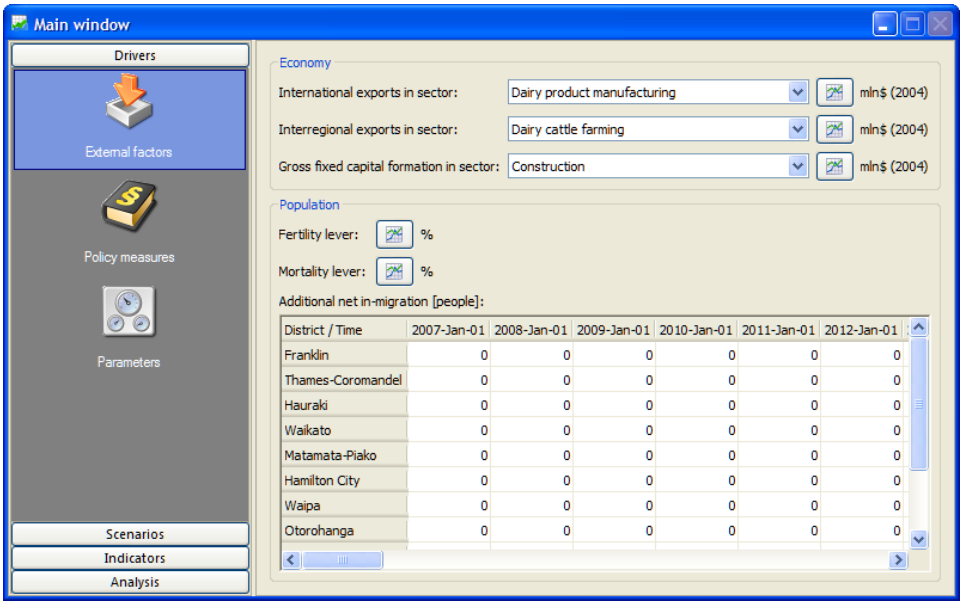
The Main window of WISE provides access for both types of users. The structure of the Main window is available in the section Main Window. Here we will first explain how the policy user can use the system and then how the modeller can access the models.

The *policy user* finds access to all information relevant for analysing the impact of policies and external factors on the left hand side of the Main window. Information is organised in such a way that the user can carry out a structured analysis. It follows the steps *Drivers*, *Scenarios*, *Indicators* and *Analysis*, each of which is explained in more detail below.

3.1 Overview of the policy interface

This section gives a brief overview of the steps you can take to carry out a policy impact assessment with WISE. In the following sections each step will be explained in detail.

When clicking on the Drivers tab in the navigation pane on the left hand side of the window you get access to the different types of drivers: External factors, Policy measures and Parameters. The first two are part of the policy analysis functionality of the system; the latter is the way scientists or modellers can get more detailed access to the underlying models, their data and their parameters. Clicking on each of the driver type icons opens the settings for this driver or set of drivers in the content pane on the right.



3.1.1 Step 1: Setting up the drivers

Drivers incorporated in the system are organised in two groups: External factors and Policy measures. When you click on one of these, you get access to the underlying information. This is also the entry point for adapting drivers and entering new data.

The result of this step is a set of sub-scenarios for each of the drivers. When developing a sub-scenario you can build on existing sub-scenarios which are part of the active *integrated scenario*. For example, if the *Baseline* integrated scenario is selected as the active integrated scenario, for the driver External factors, a *Baseline* sub-scenario for the external factors - population driver is loaded that includes all the baseline information about the population. If you want to build on this sub-scenario, you simply load the *Baseline* integrated scenario, make the required changes and save it under a different sub-scenario name for the population driver.

Drivers for policy user that are included in WISE are the following:

- External factors
  - Economy: international exports, interregional exports, gross fixed capital formation
  - Population: fertility lever, mortality lever, additional net in-migration for each district

- Policy measures
  - Economy: rates of change in land productivity, rates of change in labour force productivity
  - Population: proportion of people living in each residential land use category for each district
  - Zoning measures
  - Infrastructure

Steps required to view or change driver settings are described in the section Setting up the drivers.

3.1.2 Step 2: Creating integrated scenarios

In the second step, integrated scenarios can be assembled from a selection of existing sub-scenarios. For each of the drivers you need to select one sub-scenario.

When clicking on the Scenario manager icon in the navigation pane of the main window you gain access to that part of the interface where you can construct your integrated scenarios or upload an existing integrated scenario. Steps required to create integrated scenarios are described in the section Creating integrated scenarios.

3.1.3 Step 3: Running the simulation

Obviously you cannot investigate all land use changes, as well as other available information, while the system is running. Therefore you have several possibilities to export intermediate and final results of the simulation:

- You can select an individual map and export it to analyse it.
- You can create logged maps using log maps function which could be analysed afterwards in the Map Comparison Kit (part of the WISE package) or common GIS packages.
- You can make an animation that shows you the land use, indicators or other model results change over time. You can open the animation in a viewer, but can also incorporate them in presentations.
- You can create a link to Excel through which all selected model block results are directly written to Excel. This can be used for analyses and post-processing afterwards.

Before running the simulation you can decide which results you would like to save to disk. For details about running the simulation and saving results, please refer to the section Running a scenario and the section Saving results.

3.1.4 Step 4: Visualising indicators

After simulation is finished, WISE offers several options to analyse results. The first option is to visualise indicators that are being calculated by the system. The indicators are organised in four groups:

- Social indicators
- Economic indicators
- Environmental indicators
- Land use indicators

On a yearly basis each of these indicators is calculated. Depending on the type of indicator, it is calculated at one of the spatial levels (NZ & world, regional, district and local) or at several spatial levels. You gain access to the indicators by clicking the Indicators icon in the main window. Steps to take in visualising indicators are described in the section Visualising indicators.

3.1.5 Step 5: Analysing results

The final step of the impact assessment study is to analyse results within an integrated scenario (e.g. the temporal evolution of an integrated scenario) or to compare a set of integrated scenarios. In step 3 of the assessment you have selected what type of information you want to save for analysis. In this step you carry out the analysis thereof. The Excel files that have been created can be analysed with Excel; the animations can be shown in a viewer; and the logged maps that have been saved in log-files that can be opened in the Map Comparison Kit, which can be opened when going to the Analysis tab of the Main Window.

3.2 Setting up the drivers

In this section you will become familiar with the different drivers in the system and learn how to enter and change information related to these drivers. There are 3 sections under the Drivers tab: External factors, Policy measures and Parameters. Among them, the Parameters section is relevant only to a *modeller*. The detailed description about the Parameters section will be found in the next section Modeller interface.

When you start the system with the project file *Waikato.geoproj* all baseline data is loaded into the system. In the following sections you will learn how to view and change the baseline information step by step for each of the drivers in the system. Creating new sub-scenarios for the individual drivers can be done in two ways:

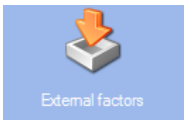
- By building on the baseline information. In this case adaptations are being made to the data that comes up when you open *Waikato.geoproj*.

- By building on information in other sub-scenarios. In this case you first have to load a sub-scenario for a specific driver and subsequently you can make your adaptations to this sub-scenario.

Both options will be shown in the following sections.

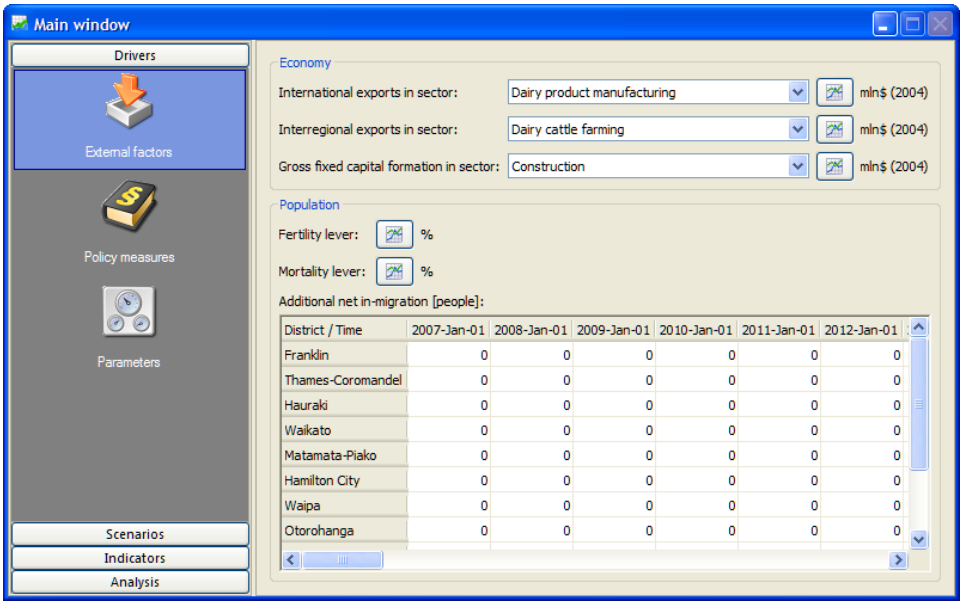
3.2.1 External factors

For true integration amongst different disciplines, WISE incorporates not only the economic model, but also models related to climate change, hydrology, water quality, demography, land use and terrestrial biodiversity. In the economic model, some parameters are external factors and some are policy measures.



When you click the External factors icon in the navigation pane on the left hand side of the Main window you will see that the content pane on the right hand side of this window. The *External factors* included in the current version of WISE are:

- Economy
- Population



When you have the External factors in front of you, you can carry out the following actions:

- View historic data
- View scenario data (future assumptions)
- Adapt historic and scenario data
- Load an existing sub-scenario
- Make changes to an existing scenario and save its results

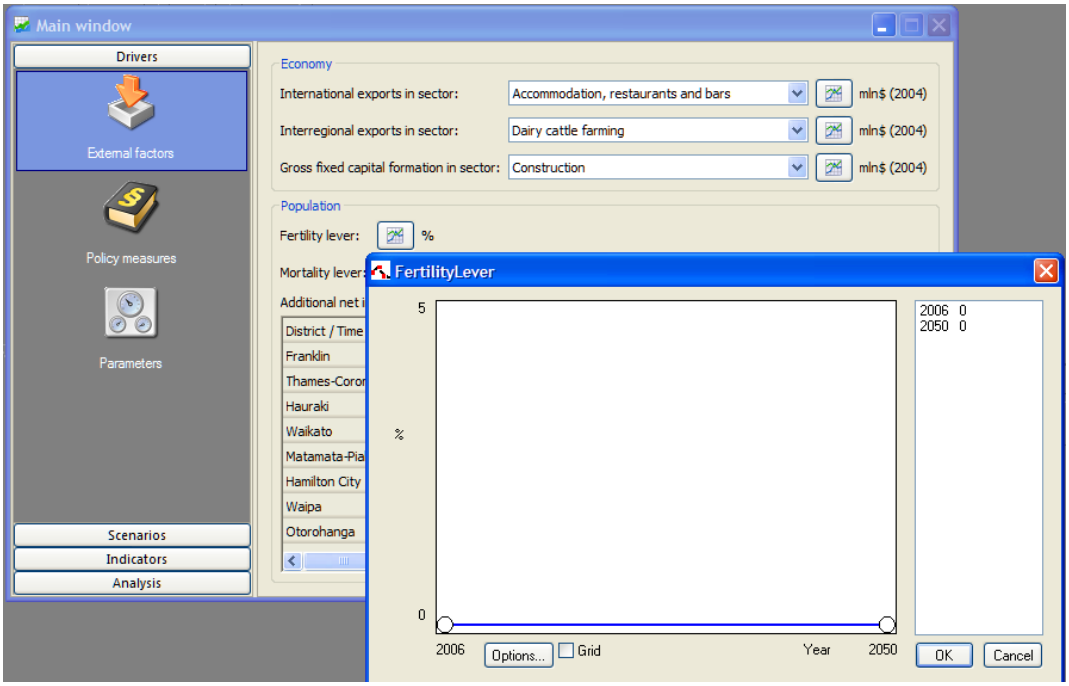
Since the steps are very similar for all external factors we take Population as an example to explain how you can work with the external factors.

3.2.1.1 How to view data and scenario data for the *Baseline* integrated scenario?

- Select the *Baseline* integrated scenario as the active integrated scenario from the dropdown list on the toolbar.
- Go to the Driver tab of the Main window.
- Click the External factors icon.
- Go to the Population part in the content pane.

- Click the graph icon of your interest. For instance, click the graph icon next to Fertility lever. The Fertility Lever graph window opens.

This graph shows the fertility lever in percentage on the y-axis and the year on the x-axis. You can press Cancel to go back to the Main window.



3.2.1.2 How to adapt values for external factors?

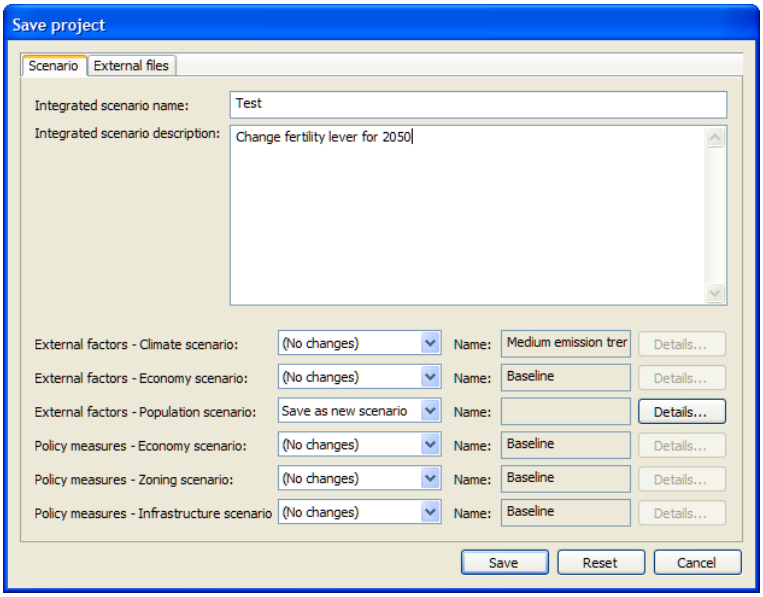
- Go to the Driver tab of the Main window.
- Click the External factors icon.
- Go to the Population part in the content pane.
- Click the graph icon next to Fertility lever. A graph window opens that displays the female fertility lever between 2006 and 2050.

There are several ways to enter new population figures in the system. The first way is to drag the bubbles in the graph to the desired value. You can also enter the precise values by clicking on a bubble with your right mouse button or by clicking on a value in the list on the right hand side of the window. More bullets can be added by double clicking with the mouse in the graph and bubbles can be removed by double clicking with the left mouse button on a bubble.

- Remove all points (bubbles) for which you do not want to provide scenario information.
- Add a point for years you would like to provide scenario information for.
- Drag the bubble(s) of the year(s) you would like to change to the desired location.
- Or right-click the bubble to enter the exact values for the year and the fertility lever.
- Press the OK button to save your results and close the graph.

You have now adapted the population scenario in the external factors section. After you have created a new sub-scenario for a driver you can save this sub-scenario.

- Go to the File menu.
- Click Save project. The Save project dialog window opens.



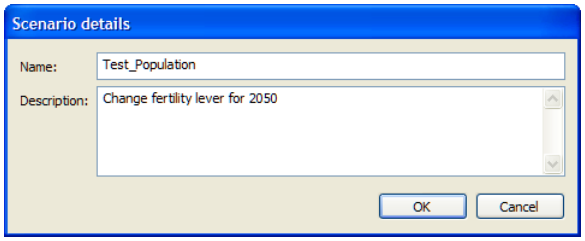
The system now allows you to choose between updating the non-predefined present integrated scenario and creating an integrated scenario under a new name. Note that you are not able to update sub-scenarios that are part of the predefined integrated scenarios. In this case the system will automatically inform you that you can only save the sub-scenario under a new name.

To create a new integrated scenario,

- Enter the new integrated scenario name in the text box next to Scenario name.
- Enter the description for this integrated scenario in the text box next to Scenario description.

To save the sub-scenario you have just created under a new name.

- Select Save as new scenario on the dropdown list for the Population scenario row.
- Click the Details… button. The Scenario details window opens.
- Enter a new sub-scenario name and add a short description of the sub scenario.
- Click the OK button.
- Click the Save button at the bottom of the Save project dialog window.



You have now created a new sub-scenario *Test_population* for the external factors - population scenario and a new integrated scenario *Test*. This sub-scenario can be used in the next step of the policy impact assessment: Creating integrated scenarios.

3.2.1.3 How to load an existing population sub-scenario?

To load an existing population sub-scenario, you should know how to work with the scenario manager. For more information, see the section Creating integrated scenarios.

- Go to the Scenarios tab of the Main window.
- Click the Scenario manager icon in the navigation pane.
- Click on the New… button on the top-right of the content pane. The Create new integrated scenario dialog window opens.
- Give your integrated scenario a new name and give a description of the integrated scenario (something you can remember the scenario by).

- Click on the dropdown list next to External factors - Population scenario. The existing external factors - population sub-scenarios display on the list. Select the one that you want to load.
- Select the sub-scenarios for other drivers and press the OK button of the Create new integrated scenario dialog window.
- Select the newly added integrated scenario on the dropdown list next to Integrated scenario on the toolbar.
- Go to the Driver tab of the Main window.
- Click the External factors icon.
- Go to the Population part in the content pane.

Now you have loaded the external factors - population sub-scenario that you had selected for the newly added integrated scenario. When you know the existing external factors - population sub-scenario that you are interested in is incorporated in a certain integrated scenario, you can load this integrated scenario.

- Select the integrated scenario which incorporates your external factors - population sub-scenario of interesting on the dropdown list next to Integrated scenario on the toolbar.
- Go to the Driver tab of the Main window.
- Click the External factors icon.
- Go to the Population part in the content pane.

Now you have loaded the external factors - population sub-scenario that is incorporated in the active integrated scenario.

3.2.1.4 How to make changes to an existing population scenario and save its results?

To save the changes that you made to an existing population sub-scenario, you should already know how to work with the saving changes. For more information, see the section Saving changes.

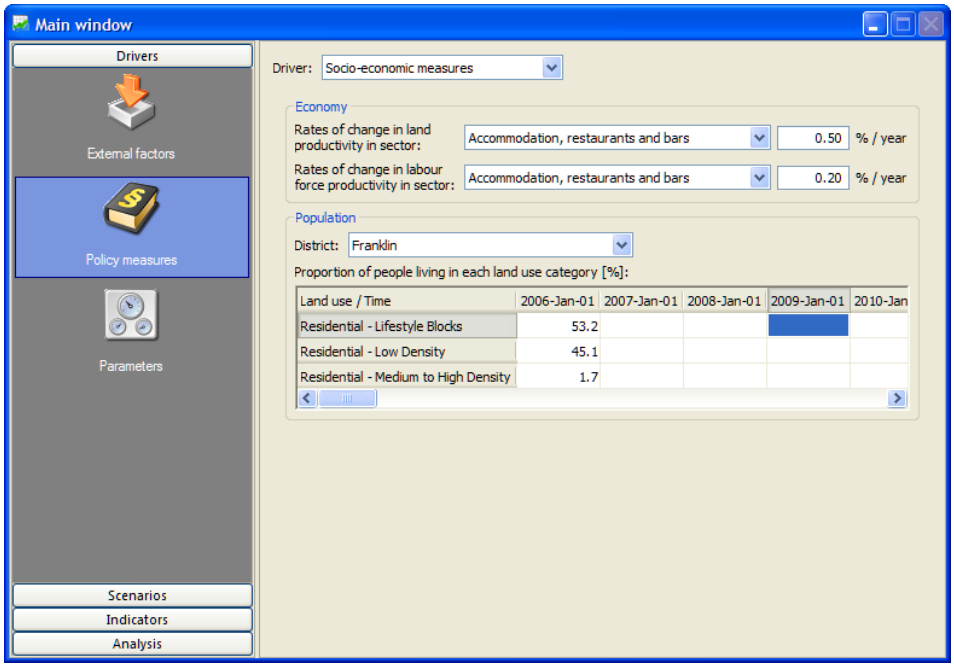
- Load an existing scenario as explained in the section 'How to load an existing population sub-scenario?'
- Make your changes as explained in the section 'How to adapt values for external factors?'
- Choose the Save project command on the File menu. The Save project dialog window opens.
- Give your integrated scenario a new name and give a description of the integrated scenario (something you can remember the scenario by).
- Click the Save as new scenario option next to Population scenario.
- Click the Details... button next to on the right side of the External factors - Population scenario row. The Scenario details dialog window opens.
- Enter a new sub-scenario name in the text box next to Name.
- Enter the description text in the text box next to Description.
- Click OK at the bottom of the Scenario details dialog window.
- Repeat the same steps for the other drivers if you have made changes.
- Click the Save button at the bottom of the Save project dialog window.

You have now created a new sub-scenario for population. This sub-scenario can be used in the next step of the policy impact assessment: Creating integrated scenarios.

3.2.2 Policy measures

Besides external factors, WISE also incorporates measures for economy, population, zoning regulations and infrastructure. These measures can be found by clicking on the Policy Measures icon under the Drivers tab in the navigation pane on the left hand side of the Main window. On the top part of the window you can enter and display the

economic information, the middle part the population and zoning information, and the bottom part is reserved for infrastructure network. First, you will learn how to adapt the economic and population measures. Second, you will learn how to work with the *Zoning Tool*. Finally, the options related to the *Infrastructure* will be explained.



You can find the Economy part on the top right of the Policy measures window. Here you can adapt the values of *Rate of change in land use productivity* and *Rate of change in labour force productivity* for each sector.

3.2.2.1 How to adapt values of economy measures?

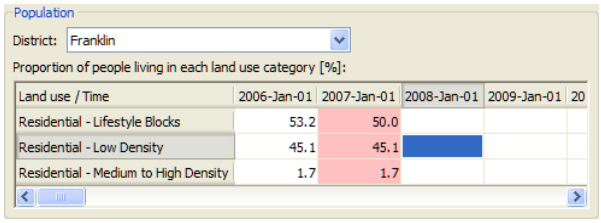
- Go to the Driver tab of the Main window and click the Policy measures icon in the navigation pane.
- Select the Socio-economic measures from the dropdown list next to Driver.
- Go to the Economy part in the content pane.
- Select the economic sector of your interest from the dropdown list next to Rates of change in land productivity in sector.
- Enter a new value in the text box on the right side for Rates of change in land productivity in sector.

You have now changed the value of the rates of change coefficient for a certain sector.

3.2.2.2 How to adapt values of population measures?

- Go to the Driver tab of the Main window and click the Policy measures icon in the navigation pane.
- Select the Socio-economic measures from the dropdown list next to Driver.
- Go to the Population part in the content pane.
- Select the district of your interest from the dropdown list next to District.

The values of proportion of people living in each residential land use category for the selected districted are displayed in the table. The sum of proportion of people living for each land use category should be exactly 100. Otherwise, the values in that column are highlighted in red background.



The values for the start year of the simulation are given by default. If the columns are displayed as empty, that means the values for the start year will be used constantly over the simulation period. If the values are specified for more than one year, the system takes the interpolated values for the unspecified years on the basis of the values for its two closest specified years.

- Specify the values for a specific year by entering new values for each residential land use category. The sum of proportion of people living for each land use category for this year should be exactly 100.

You have now changed the policy measure for population for a certain district.

Besides socio-economic policy measures, WISE also incorporates measures for zoning regulations and transport. You can select one of them on the dropdown list next to Driver in the content pane.

First, you are going to learn how to incorporate the spatial planning with a tool named *Zoning tool*. Next, the options related to the *Infrastructure* will be explained.

3.2.2.3 Zoning maps

Zoning maps represent the policy part of the land use allocation process. Different locations have different restrictions for particular land uses. Areas that can be facilitating for one land use can be restrictive for other land use functions like protected nature, which facilitates natural land uses and at the same time restricts developments in residential or industry & commerce land uses. For this reason there is a specific zoning map for each main land use function incorporated in the system: *residential (lifestyle blocks, low density and medium to high density)*, *commercial*, *community services*, *horticulture*, *biofuel cropping*, *vegetable cropping*, *other cropping*, *dairy farming*, *sheep, beef or deer farming*, *other agriculture*, *forestry* and *manufacturing*. The vacant land uses do not have a specific zoning map since we assume that this type of land use is allowed everywhere, but that there are no areas where it is specifically planned. In general, vacant land uses are the land uses that appear when (agricultural) land is abandoned and also the land use that can easily be taken over when population or economic functions expand.

3.2.2.4 Zoning tool

In WISE, the *Zoning tool* developed by RIKS is incorporated in the system that allows you to incorporate your spatial planning to the system by creating and edit zoning maps based on a number of spatial plans. With the *Zoning tool*, you can enter spatial zoning plans directly via the graphical user interface (GUI) and set the characteristics of each plan (parameters) and add new plans in the GUI as well in a comprehensible way. Plans can be ordered hierarchically, such that one overrules the other. When more information on zoning plans becomes available, this can be incorporated in the zoning maps, either by the project team, or by the users themselves.

Before you start working on creating or editing the zoning maps with the zoning tool, you should understand the meaning of terms which are used in the *Zoning tool*.

Plan – A plan is a map that represents any spatial plan. It contains source data which is not interpreted yet. The data in a plan should be categorical, not numerical. The map that represents the plan should have the same geo-reference as the region map (lower-left x coordinate, lower-left y coordinate, cell size, number of rows and columns). The data itself need not cover the entire modelling area, for example because it only covers one municipality. Uncovered areas must have a ‘no data’ value.

Category – A spatial plan can have one or several categories, each of which is represented by a category in the map. For example, a plan that outlines the protected areas can have the categories protected forests, protected natural area and non-protected nature. *No data* values in the map will be interpreted as no data in the zoning tool – that is, they cannot be assigned a zoning status other than *no data*.

Zoning status – Each category in a plan needs to be interpreted in terms of their zoning status for each land use function separately. Moreover, a category can be interpreted as no data, meaning that the specific category does not influence a specific land use function or that no information for that location is available.

Start time / *End time* – A category in a plan can start and stop at any given time in the simulation.

Zoning map – The zoning map is the result of the interpretation and combination of all categories in all spatial plans. It indicates the zoning status in each cell for a particular time span. Zoning maps are specific for each land use function and have a timestamp, since zoning regulations can change over time.

Numerical zoning map – The numerical zoning maps are used to calculate the total potential maps. They are derived from the (categorical) zoning maps for the current simulation time and the current land use map. Strictly, numerical zoning maps do not exist in the zoning tool itself, since the conversion to numerical values takes place when computing the total potential. For more information, see the section Zoning.

The following paragraphs describe the *features* of working in the zoning tool.

- Each category in a spatial plan is interpreted for all land use functions separately. In WISE, A category can be given one of the following interpretations/zoning status: *Permitted*, *Controlled*, *Restricted discretionary*, *Discretionary*, *Non-complying*, *Prohibited* and *Unspecified*. Refer to the Specification Report for more information about the zoning status used in WISE.
- Some plans can overrule others; hence the order of the plans represents a hierarchy. This can mean that restrictions in one plan become allowed in the final zoning map, because they are overruled. This hierarchy can be set at the level of the categories (per plan). For example, an order could consist of Plan A, category 1; Plan B category 1, Plan A category 3, Plan C category 1, etc. This hierarchy among categories is assumed to be the same for all land use functions.
- A category in a plan can start or stop at any given point during the simulation. By default a plan is valid from the start year of the simulation until the end year of the simulation. However the start year, the end year or both can be set per category. This time setting per category is assumed to be equal for all land use functions.
- The result of the combination of the categories of all plans is a categorical map (the zoning map) that shows the zoning status for each cell. However, since plans can start and stop at any given time in the simulation, there is a separate zoning map for each point in time when a new plan starts or ends.
- Since some plans only start after the initial year of the simulation, each year the zoning status is corrected for the De Facto land use. Hence, if a location has a certain land use, it will not be removed because of newly introduced zoning plans. To disable this option, uncheck all the check box in the De Facto zoning table through the modeller user interface. For more information, see the section Zoning.

3.2.2.5 General steps to create zoning maps in the zoning tool

You can take the following steps in general to introduce a new spatial plan and create the zoning maps.

- Go to the *Zoning tool* via Main window → Drivers → Policy measures → Driver Zoning.
- Import the maps representing the spatial plans into the system.
- Set the hierarchy among categories by clicking on the category and clicking the scroll buttons on the left side of the table to move them upwards or downwards through the hierarchy. This hierarchy is assumed to be the same for all land use functions, and therefore it only needs to be set once.
- Set for each category the start year and the end year when this is different from the default value. This start year and end year per category is assumed to be similar for all land use functions and therefore needs to be set only once.

- For each land use function interpret all categories. This can be done by selecting the proper interpretation from the available options.
- Set the matrix of De Facto land uses that is used to compute the numerical zoning maps through the modeller user interface. For more information, see the section Zoning.

In the following steps you will learn in detail how to set up the zoning regulations for a new project and import a new plan to the existing overlay via the GUI of the zoning tool.

3.2.2.6 How to set up spatial planning for a project file with an empty zoning tool?

For example, a WISE project file has been set up without information on spatial planning. You would like to introduce a *district reserves and covenants map* and a *protected areas map* and you know how to interpret the values in these maps.

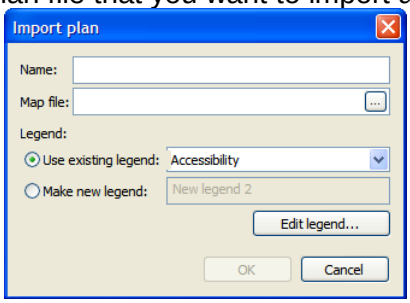
- Make sure that you have opened the new project file to which you want to introduce these maps.

To access the zoning tool:

- Go to the Drivers tab of the Main window and click the Policy measures icon.
- Select Zoning in the dropdown list next to Driver in the content pane on the right side of the Main window. It is empty in the content pane except for some buttons at the bottom.

To import a new plan:

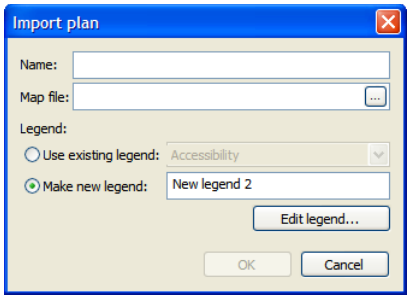
- Make sure that the plans you want to introduce are pre-processed to the correct raster format for inclusion in WISE. They should have the same size, resolution, projection, lower-left coordinate as the regions map used in the system and with the file extension .asc, .img or .rst.
- Click the Import plan… button at the bottom of the content pane. The Import plan dialog window opens.
- Enter a name for the spatial plan District Reserves and Covenants that you are going to import in the text box next to Name. Click the browse button next to Map file. The Select zoning plan map window opens.
- Navigate to the spatial plan file that you want to import and double-click on it.



To use an existing legend for the newly imported plan:

If the legend for the spatial plan that you just imported already exists in the system, you can use this existing legend:

- Click on the radio button in front of Use existing legend.
- Select the legend from the dropdown list next to Use existing legend.
- Press the OK button in the Import plan dialog window.



To create a new legend for the newly imported plan:
If there is no legend file for the spatial plan that you just imported, you can create a new legend for it.

- Click on the radio button in front of Make new legend.
- Enter the legend file name for in the text box next to Make new legend.
- Click the Edit legend… button. The Legend editor dialog window opens.
- Edit the legend for the spatial plan that you just imported in the Legend editor dialog window. For more information, see section Legend editor.

It is important to define the categories with correct number of classes and proper labels in the Legend editor dialog window when you import a new plan.

- Press the OK button in the Legend editor dialog window and close the Legend editor dialog window.
- Press the OK button in the Import plan dialog window.

Now you have imported the spatial plan and selected or created a legend file for it.

To modify the legend for a newly imported plan:

- Select the spatial plan on the Plans and categories tab.
- Click on the Edit… button. The Edit zoning plan dialog window opens.
- Click the Edit legend… button.
- In the Legend editor dialog window, you can enter new labels and set new colours. For more information, see section Legend editor
- Press the OK button in the Legend editor dialog window and close the Legend editor dialog window.
- Press the OK button in the Edit zoning plan dialog window.

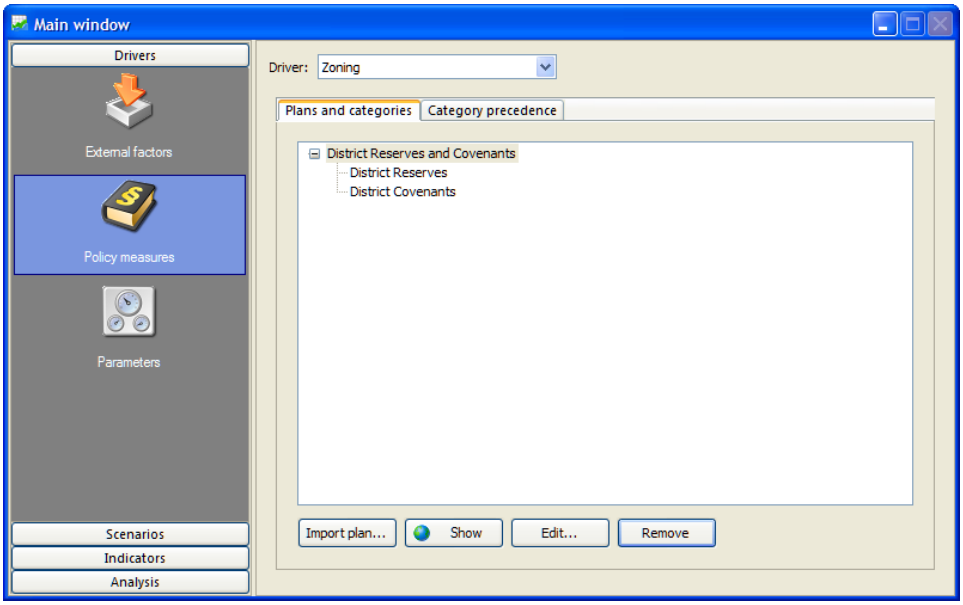
The categories of this plan will be updated automatically. If you want to modify the legend of a spatial plan, it is important for you to access the Legend editor dialog window via the Edit… button instead of the Show button on the Plans and categories tab.

It should be noted that except for editing colours, changing other parts of the legend will cause the reset of the zoning tool. In other words, the setting you made on the Category precedence tab will be initialized. Therefore, it is recommended to first edit the legend (including defining the labels) for the imported plan before setting the parameters on the Category precedence tab.

To show a plan and its categories

- Go to the Plans and categories tab.
- Double-click the plan *Protected areas* that you just imported.

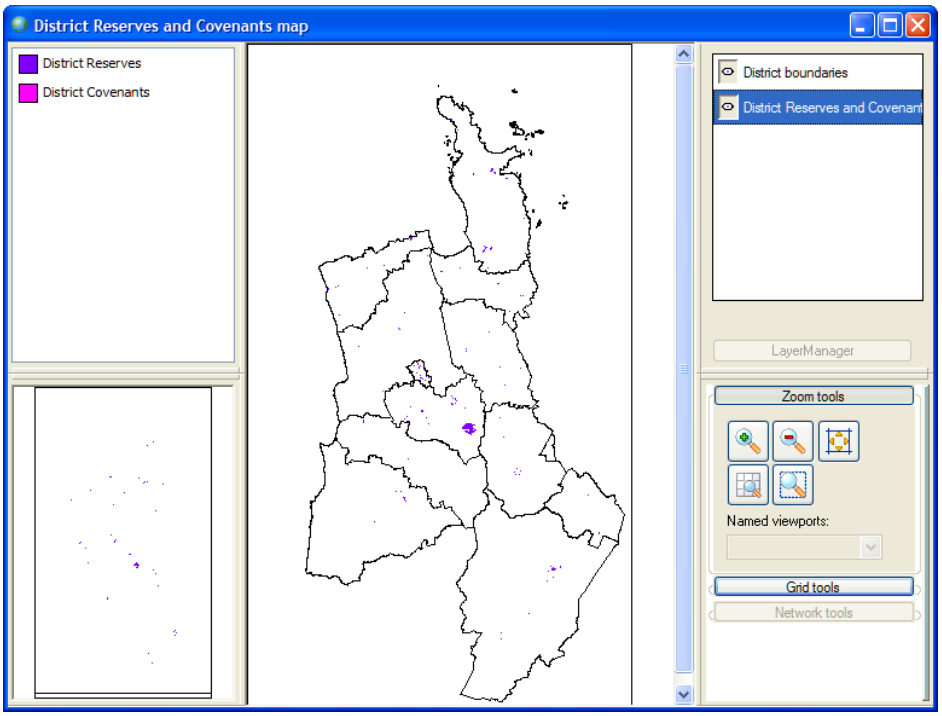
The content pane under the Plans and categories tab now fills with a hierarchy three that shows an item District Reserves and Covenants with the two sub-items *categories*: District Reserves, and District Covenants.



You can expand or collapse the braches of plan and categories tree by moving the mouse over the name of plan and double-click or moving the mouse over the box in front of the name and left-click.

To check that you selected the right map,

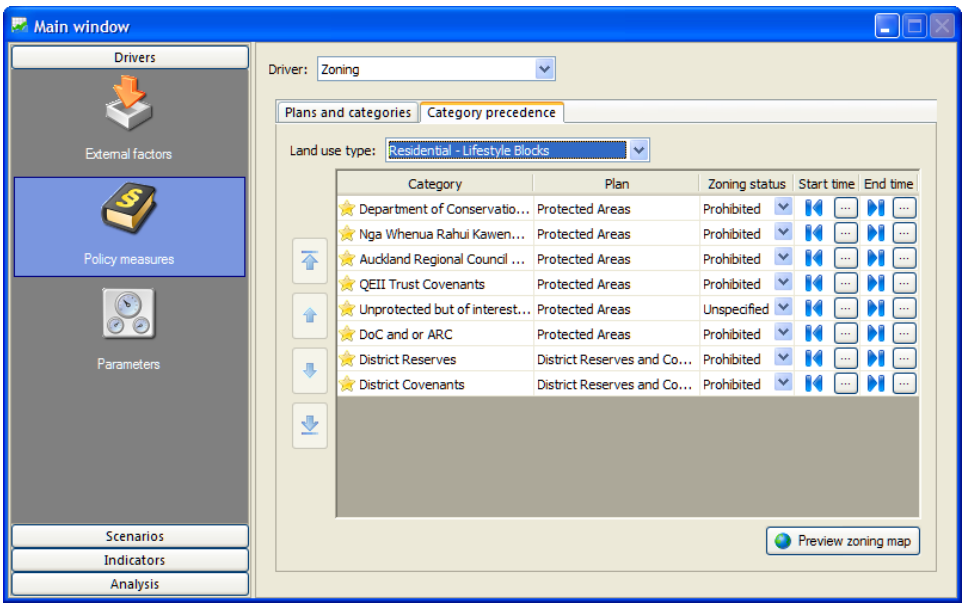
- Select the District Reserves and Covenants item under the Plans and categories tab.
- Click the Show… button under the plans and categories tree. A map window opens showing you the District Reserves and Covenants map window.
- Close the District Reserves and Covenants map window.



You can import a second plan similarly:

- Click the Import plan… button. The Import plan dialog window opens.
- Enter a name for the *Protected Areas* map click the browse button next to Map file to select the map file for *Protected Areas*.
- Create a new legend for the *Protected Areas* map.
- Click the OK button in the Import plan dialog window.

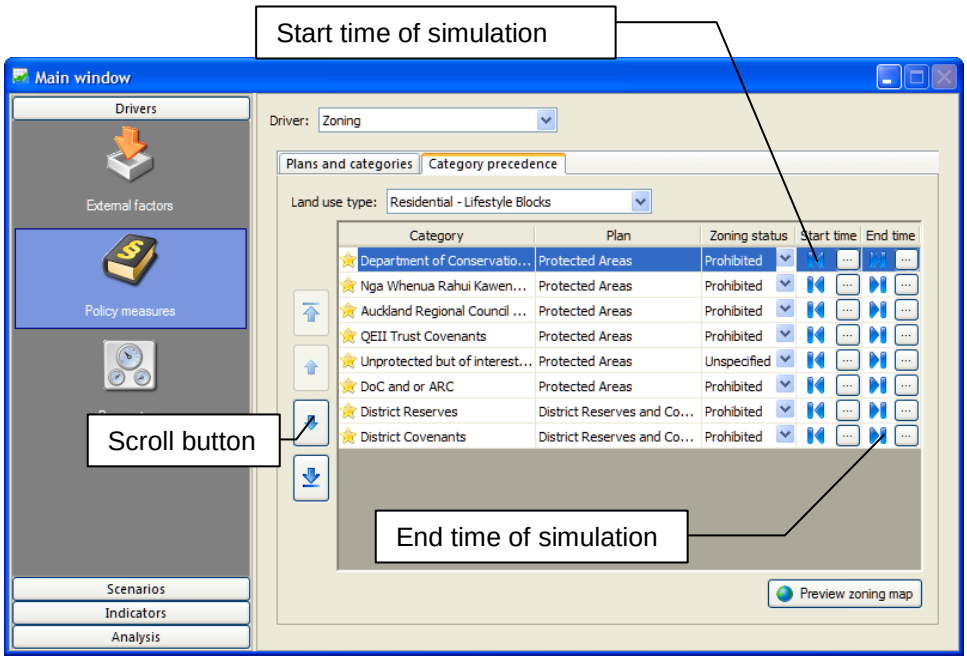
The Protected Areas hierarchy tree is added in the content pane which shows the item Protected Areas with its six categories.



By default, the zoning status of each category is set to *unspecified*. According to your interpretation of each category, you can set the *Zoning tool* by the following steps:

- Go to the Categories precedence tab.
- Set the hierarchy among categories by selecting the category and clicking the scroll buttons to move them upwards to downwards through the hierarchy. A category that is higher on the list will overrule categories that are lower on the list in case they are in conflict.

We assume that the hierarchy is a function of the plan itself, and not for the specific land use type in WISE. Therefore you don't need to set up the hierarchy for each land use type as it is the same for all land use functions.

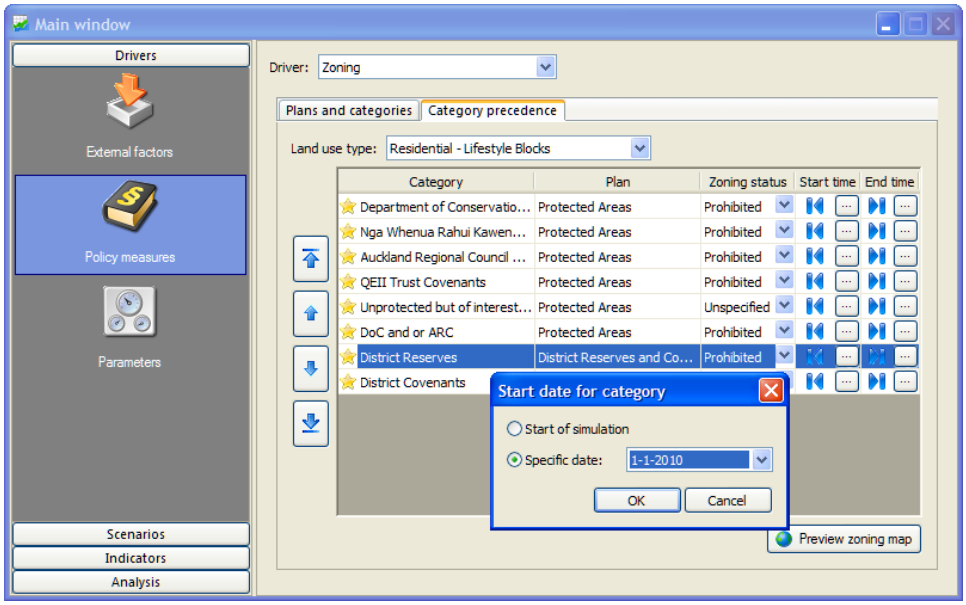


- Select Residential – Lifestyle Blocks from the dropdown list next to Land use type.
- Set the zoning status for each category on the list by selecting the one from the drop down list in the Zoning status column.

Finally, you need to set the start and end time of each category. By default these are set to begin and end of the simulation, which is fine for the most categories. For

example, the restriction to develop Residential – Lifestyle Blocks according to the District Reserves only starts from 2010.

- Click the browse button in the Start time column and the District Reserves raw. The Start date for category dialog window opens.

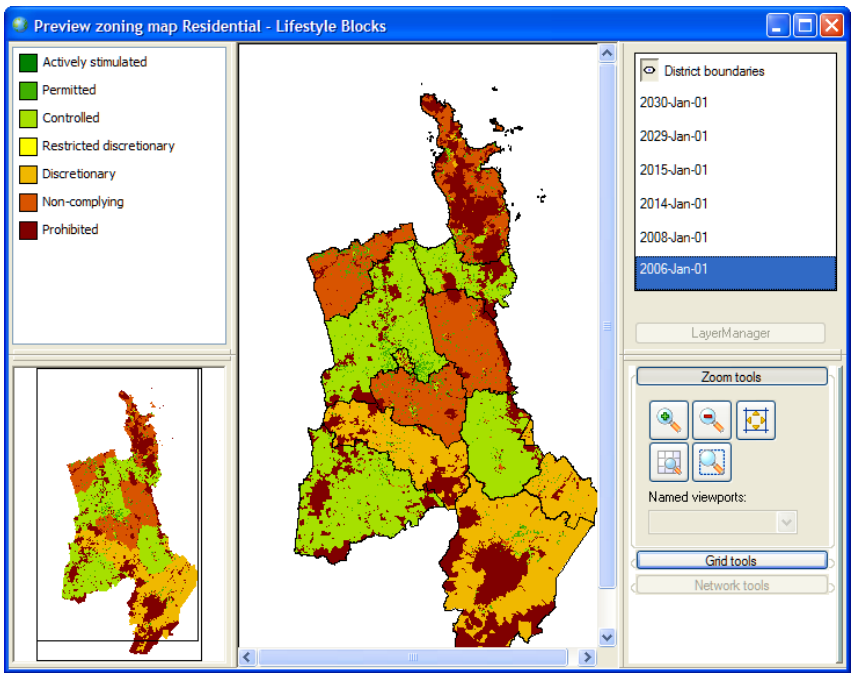


- Click the radio button in front of the Specific date and click the 1-1-2010 from the dropdown list. Then press the OK button.

The specific start time appears in the corresponding cell of the table. For the categories for which you have not specified the start time or the end time, the symbol ⏮ is displayed in the start time column and the symbol ⏭ is displayed in the end time column to indicate the start of simulation and the end of simulation, respectively.

The zoning regulations for the land use function Residential – Life style blocks is set as depicted in the figure above. Now you can preview the zoning map for this land use.

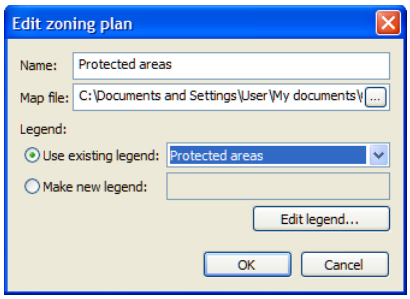
- Make sure you have selected Residential – Life style blocks on the drop down list next to Land use type.
- Click the Preview zoning map button at the bottom of the content pane of the Spatial planning window. The Preview zoning map Residential – Lifestyle Blocks window opens.



In the map window, multiple layers of the zoning map for Residential – Lifestyle Blocks at different time points are available in the layer manager pane. The map displayed in the Map pane represents the zoning map for the selected time point. The reason for displaying these layers is that these time points are used to set as either the start time or the end time for different categories for the selected land use. For more information about working with a map window, see the section Map window.

3.2.2.7 How to change a plan in the list?

- Make sure that you have opened the *Zoning tool*.
- Go to the Plans and categories tab in the content pane.
- Select the plan that you want to edit on the plan and categories tree by clicking on it.
- Click the Edit… button under the plan and categories tree. The Edit zoning plan dialog window opens where you can change the name of the plan in the text box next to Name, you can load a new plan and load a new legend file or edit the legend of the plan.
- Click the OK button in the Edit zoning plan window to save changes that you made.



3.2.2.8 How to remove a plan from the list?

- Make sure that you have opened the *Zoning tool* in front of you.
- Go to the Plans and categories tab in the content pane.
- Select the plan that you want to remove on the plan and categories tree by clicking on it.
- Click the Remove button under the plan and categories tree.

You have removed the selected plan from the list. The corresponding categories of this plan will be removed as well in the Categories precedence tab.

3.2.2.9 How to introduce a new plan to the set of zoning regulations?

Based on the zoning regulations that you just set up in the previous section (How to set up spatial planning for a project file with an empty zoning tool?), you can now introduce a new plan. This new plan should be pre-processed in a GIS package with the correct raster format to be used by WISE.

- Make sure that you have opened the *Zoning tool* in front of you.
- Click the Import plan… button. The Import plan dialog window opens.
- Enter the name of the new plan, and load the map and its legend on your computer. Click the OK button in the Import plan dialog window.

The new plan hierarchy tree is added in the content pane with the sub-items as *categories*.

- Click the Categories precedence tab. The categories in the new plan show up lowest in the hierarchy. By default new plans are valid for the whole simulation period and the zoning status is set to ‘unspecified’.

Now you need to adjust settings for the categories in the new plan on the basis of the existing hierarchy that already includes protected areas and district reserves and covenants. According to your interpretation of each category, you can interpret the new zoning regulation as follows:

- Go to the Categories precedence tab.

- Set the hierarchy among categories in the new plan by selecting the category and clicking the scroll buttons to move them upwards to downwards through the hierarchy. From the top to the bottom, the one on the top overrules the one on the above.
- Drag the category *No data* to the bottom of the hierarchy.
- Set the hierarchy among categories in the new plan by selecting the category and clicking the scroll buttons to move them upwards to downwards through the hierarchy.

You have adjusted the hierarchy for all the categories in the three plans now. You don't need to adjust the hierarchy for each land use type because this is the same for all land use functions.

- Select Residential – Lifestyle Blocks from the drop down list next to Land use type.
- Set the zoning status for each category in the new plan by selecting one from the drop down list in the Zoning status column.

You need to set the zoning status for each category, and specify the start and end time of each category. The final zoning regulations for the land use function Residential – Lifestyle Blocks is set on the basis of three plans. Now you can view the zoning map for industry that you just set up.

- Make sure you have selected Residential – Lifestyle Blocks on the dropdown list next to Land use type.
- Click the Preview zoning map button at the bottom of the content pane of the Zoning window. The Preview zoning map Residential – Lifestyle Blocks window opens.

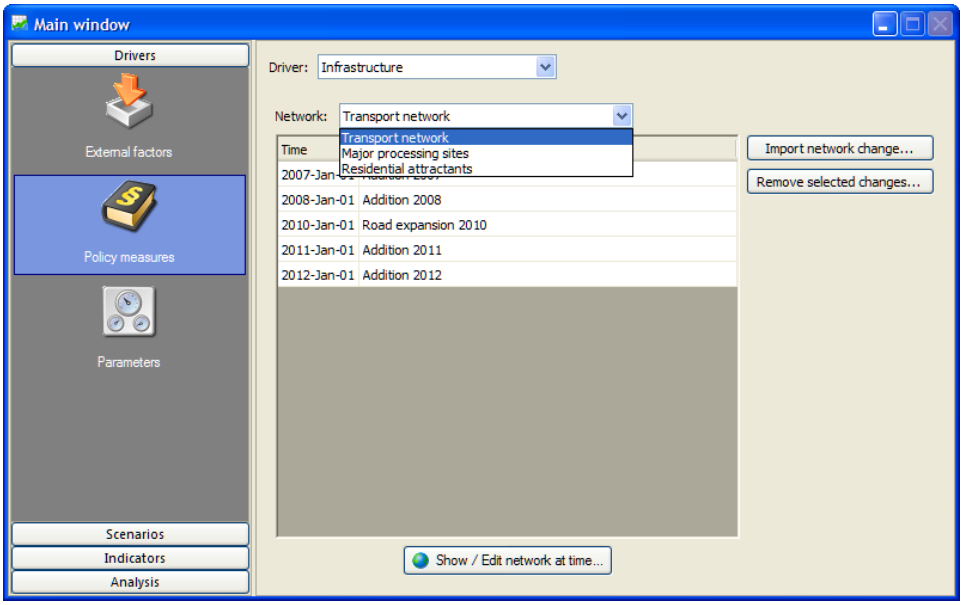
The set of zoning maps is recomputed when the simulation is opened and every time a change is made in the settings of the *Zoning tool*. The zoning map displayed in the Preview zoning map window will be updated automatically if a change is made in the setting of the *Zoning tool*.

3.2.2.10 Infrastructure networks

The relationship between land use and transport systems is generally recognized, by planning professionals as well as scientists. Also, and importantly, it is recognized that the relationship is reciprocal, which means that developments in land use are in part a consequence of the transport system and, at the same time, developments in the transport system are by large the effect of land use changes.

The current version of WISE only incorporates a one-way interaction from transport on land use. In future versions a transport model can be incorporated with which the impact of land use on transport can also be calculated. In WISE infrastructure is represented as network layers. There are three network layers incorporated in WISE: *Transport network* (road and railway), *Major processing sites* and *Residential attractants.*

Accessibility is a function of the distance of a location to this network and its importance, which can be set from the modeller user interface. Policy decisions related to the changing accessibility are mainly the construction of roads, railways and (possibly) irrigation networks. In this exercise you will learn how to adapt the road network.



The figure above shows the policy user interface for the Infrastructure driver. The changes to the network are listed in the table with time and descriptive names. It is allowed to have several changes in the same year. You can use the button Show / Edit network at time… to open a window with a single network map displaying the network at the chosen time (incorporating all specified network changes). You can add or remove elements from this network or change the *accessibility type* of an element (residential road, etc.) by using the Import network change… button or the Remove selected changes… button. You can store the changes you made as a new network change and give a descriptive name. You can view and edit each network change in isolation in the modeller user interface via Main window → Drivers → Parameters → Land use → Accessibility → Go to infrastructure layers button → Infrastructure layers window (for more information see the section Accessibility).

3.2.2.11 How to view an infrastructure network?

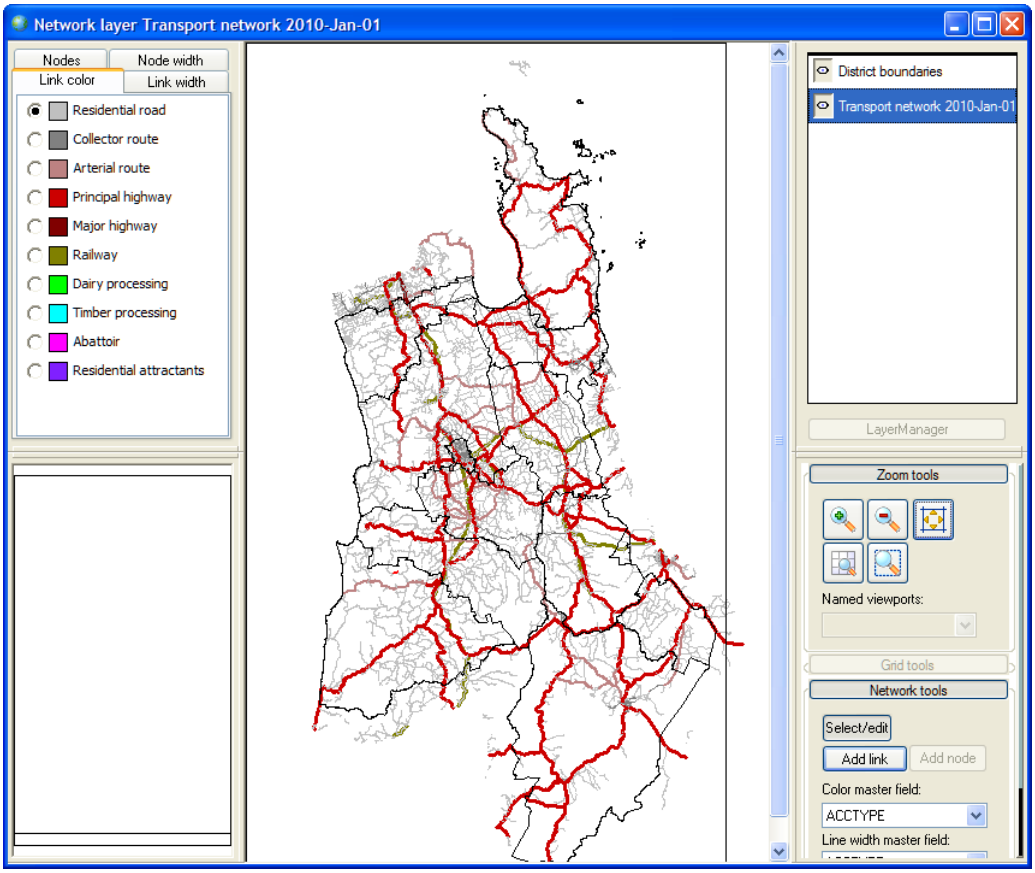
- Go to Drivers tab of the Main window.
- Click Policy measures icon in the navigation pane on the left side of the Main window.
- Select Infrastructure from the dropdown list next to Driver.

You will see the information related to infrastructure displayed on the content pane.
To view a network at a specific time:

- Select the infrastructure network of interest from the dropdown list next to Network.
- Click the Show network at time… button at the bottom of the window. The Select time for network dialog window opens.
- Select your date of interest on the dropdown list of the Select time for network window.
- Click the OK button in the Select time for network window. The Network layer ### *** map window opens, where ### represents the name of the selected infrastructure network and *** represents the selected date.

3.2.2.12 Network map window opened via the policy user interface

The user interface of the network map window opened via the policy user interface is different from the one opened via the modeller user interface. In this section, we focus the one opened via the policy user interface. For the latter one, please refer to the section Network map window opened via the modeller user interface.

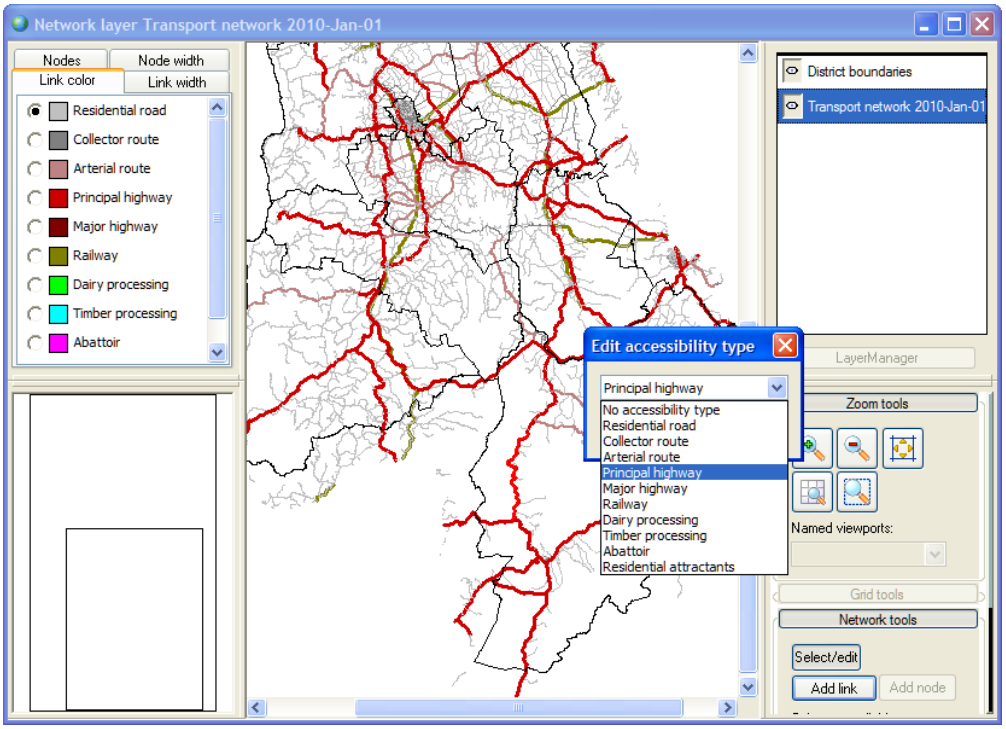


This window with a single network map displays the network at the chosen time (incorporating all specified network changes). The figure above is an example of the transport network for 2010. The title of the network map window indicates the descriptive name of the selected network and the selected year. As depicted in the figure above, besides the District boundaries layer, there is only one layer Transport network 2010-Jan-01 visible in the *layer manager pane*, which shows the high-level overview of the network changes for the selected time in the *map pane*.

The *legend pane* consists of 4 legend tabs which are used for editing the legend of network map. The Link color tab and Link width tab are the most useful tabs. For more information about how to edit legend, see the section Legend editor.

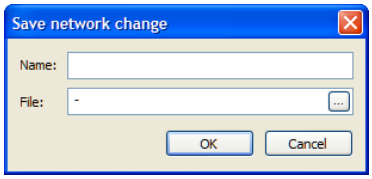
- In WISE, for all infrastructure layers, the categories of *Acctype* are used as the legend. For more information, see the section Network legends.

The ratio buttons in the *legend pane* indicate that this network map is editable. You can view and edit the link properties or add new links on the network map.



For all the Infrastructure layers in WISE, you can view or edit the accessibility type.

- Select the network layer of interest from the dropdown list next to the Network, for example, the Transport network.
- Double-click on the link of interest on the selected network layer. The Edit accessibility type dialog window opens. This is the link property used in the land use model. You can edit the accessibility type for the selected link from here.
- Click Cancel to close the Edit accessibility type dialog window.
- Or click OK to confirm the change that you made. A message window appears to ask you whether or not to save the changes you have made.



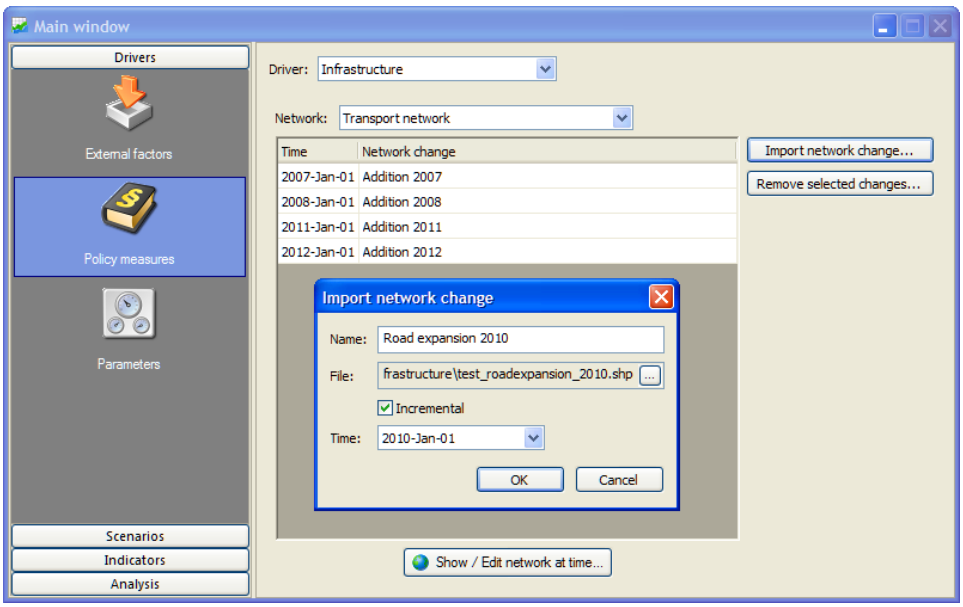
- Specify the name and path of the file that you want to save changes to.
- Press OK.

3.2.2.13 How to import a network at a specific time?

You are going to import a network change for the year 2010 that only indicates the information of the new roads which will be built in the year 2010. The network change map is prepared in a GIS package with the correct format required in WISE.

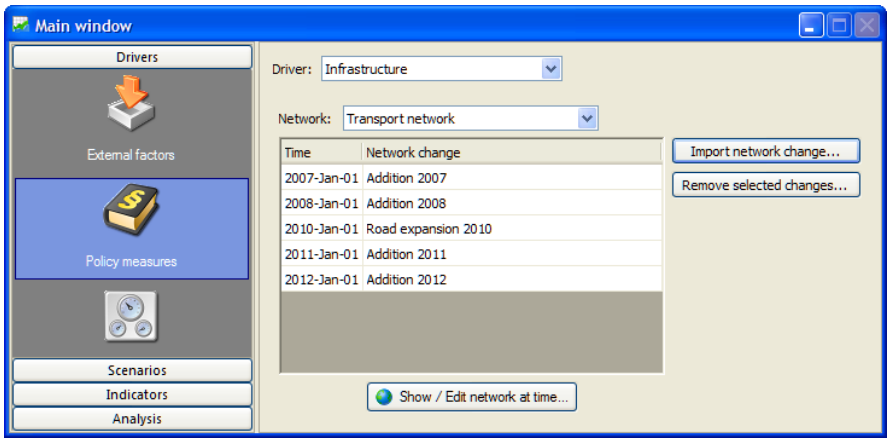
- Go to Drivers tab of the Main window.
- Click Policy measures icon in the navigation pane on the left side of the Main window.
- Select Infrastructure from the dropdown list next to Driver.
- Select Transport network on the dropdown list next to Network.
- Click the Import network change… button on the right side of the content pane. The Import network change dialog window opens.
- Enter a name that could describe this network change in the text box next to Name.
- Click the browse button next to File. The Open network change layer dialog window opens.
- Select the network change map for the year 2010 and double click it. This map file should have the extension *.shp.
- Select 2010-Jan-01 on the dropdown list next to Time.
- Click the checkbox next to Incremental.

➢ Press the Ok button in the Import network change dialog window to save changes that you made.



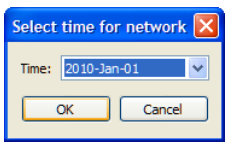
- If the network change map that you are importing only indicates some new changes for the chosen time, you should select the option of *Incremental* by clicking the checkbox next to Incremental.
- If the network change map that you are importing indicates the whole network map including new changes and non-changed parts for the chosen time, you should not select the option of *Incremental.*

Now you see the network change for the year 2010 is added on the list.



To verify the network change map that you just imported

➢ Click the Show / Edit network at time… button on the bottom-right of the content pane. The Select time for network dialog window opens.
➢ Select the date 2010-Jan-01 on the dropdown list next to Time.
➢ Click the OK button in the Select time for network dialog window. The Network layer ### *** map window for the selected time opens, where ### represents the selected network layer and *** represents the chose time.
➢ Unselect the check box next to Show nodes in the Network tools to display all links on the map.



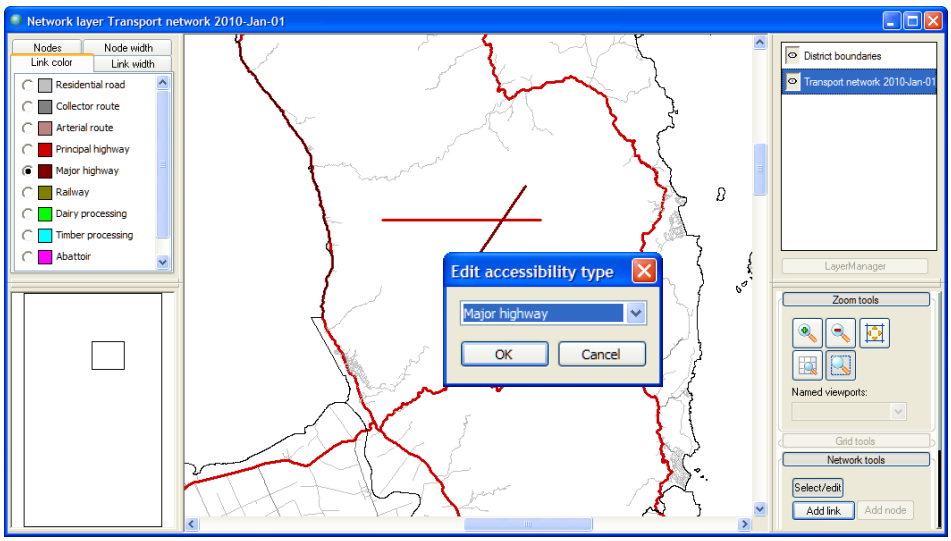
For more information about how to work with the map window, see the section Map window.

3.2.2.14 How to adapt a network at a specific time?

There are two ways to introduce a new road; you can either do it by drawing a line in the user interface of WISE, or by introducing it as a shape file that you prepared in a GIS package. Since the manually drawn segments are often inaccurate and not connected to the rest of the road network, it is advisable to introduce the new road in a GIS first. For the sake of the exercise however, we explain how to draw and remove a road in WISE.

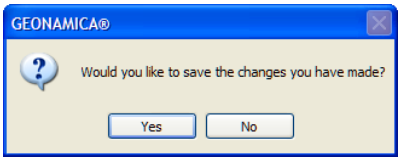
To add a new road

- Go to Drivers tab of the Main window.
- Click Policy measures icon in the navigation pane on the left side of the Main window.
- Select Infrastructure from the dropdown list next to Driver.
- Select Transport network on the dropdown list next to Network.
- Click the Show / Edit network at time… button at the bottom of the window. The Select time for network dialog window opens.
- Select 2010-Jan-1 on the dropdown list of the Select time for network window.
- Click the OK button in the Select time for network window. The Network layer Transport network map window for the selected year opens.
- Zoom in your area of interest with the zoom tools. See the section Zoom tools.
- Select the radio button in front of the network category of interest in the *legend pane*.
- Click the Select/edit button under Network tools.
- Click the Add link button under Network tools.
- Move the mouse pointer to the location where you want to add the new road and drag it to draw the road. The new road is displayed in the colour defined in the legend pane.
- Click the Select/edit button again to disable the Add link button.
- Double click on the road you just draw or right-click on it and select the option Properties. The Edit accessibility type dialog window opens.
- Verify or select the accessibility type from the dropdown list.



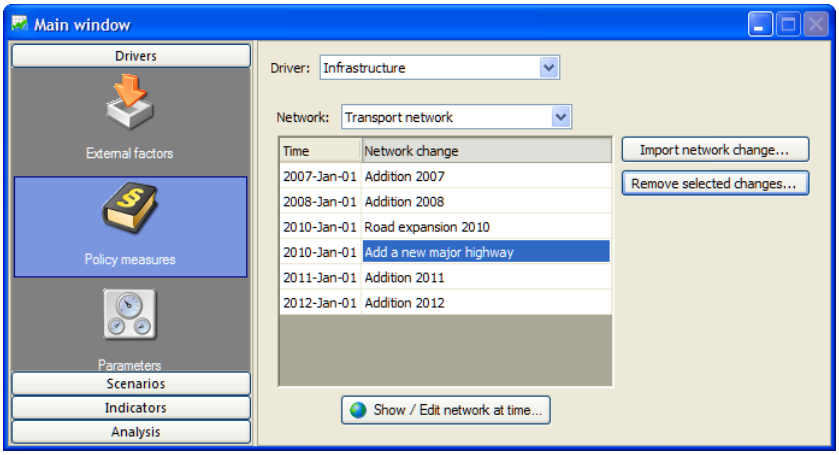
To save the changes

- Close the map window. A message window pops up to ask you whether or not save the changes you made.



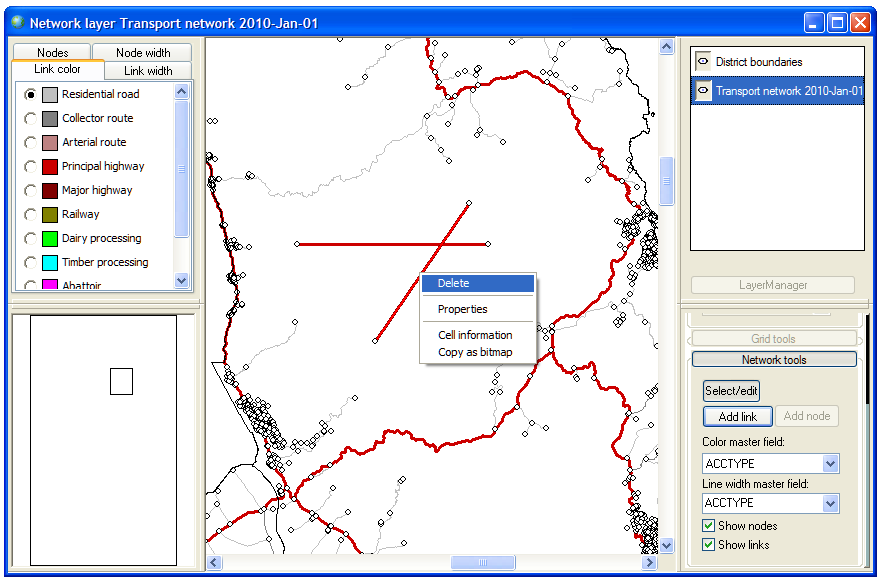
- Click the Yes button in the message window. The Save network change dialog window opens.
- Enter a name to describe the changes that you made in the text box next to Name.
- Click on the browse button next to File. The Save network change layer dialog window opens.
- Navigate to the folder that you want to save the file and give a new name for this file with extension *.shp*.
- Click the Save button in the Save network change layer dialog window.
- Click OK in the Save network change dialog window.

The newly added change for 2010 is displayed in the Network change list.



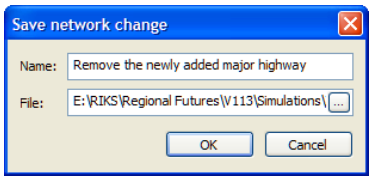
To delete the new link that you just drew

- Click the Show / Edit network at time… button at the bottom of the window.
- Select 2010-Jan-1 on the dropdown list of the Select time for network window.
- Click the OK button in the Select time for network window. The Network layer Transport network map window for the selected year opens.
- Zoom in your area of interest with the zoom tools. See the section Zoom tools.
- Click the Select/edit button.
- Right-click on the newly drawn link and click the *Delete* on the context menu.
- Repeat the steps above to delete the two nodes of this link as well.
- Close the map window.

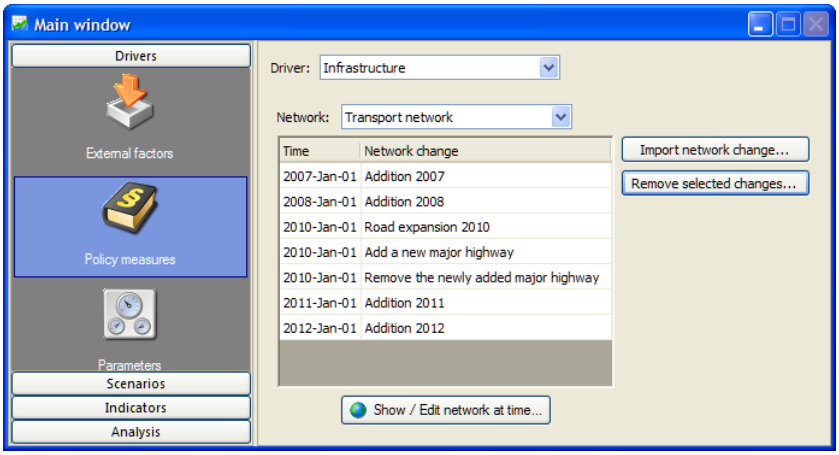


A message window opens where you are asked whether you want to save changes you made or not.

- Click the Yes button in the message window. The Save network change dialog window opens.
- Enter a name to describe the changes that you made in the text box next to Name.
- Click on the browse button next to File. The Save network change layer dialog window opens.
- Navigate to the folder that you want to save the file and give a new name for this file with extension *.shp*.
- Click the Save button in the Save network change layer dialog window.
- Click OK in the Save network change dialog window.



The newly added change for 2010 is displayed in the Network change list.



The text above describes how to save changes that you made on the network map.
Be aware that if you use the present name, the existing file will be overwritten with the same name. For more information about how to work with an editable map, see the section Editable map. For more information about how to work with the network map, see the section Network tools

You can also draw a new link or remove a link in the modeller user interface via Main window → Drivers → Parameters → Land use → Accessibility → Go to infrastructure layers button → Infrastructure layers window (for more information see the section Accessibility). It is strongly recommend to add a new link or to remove a link via the policy user interface as described above because the policy user interface doesn't display all the technical details.

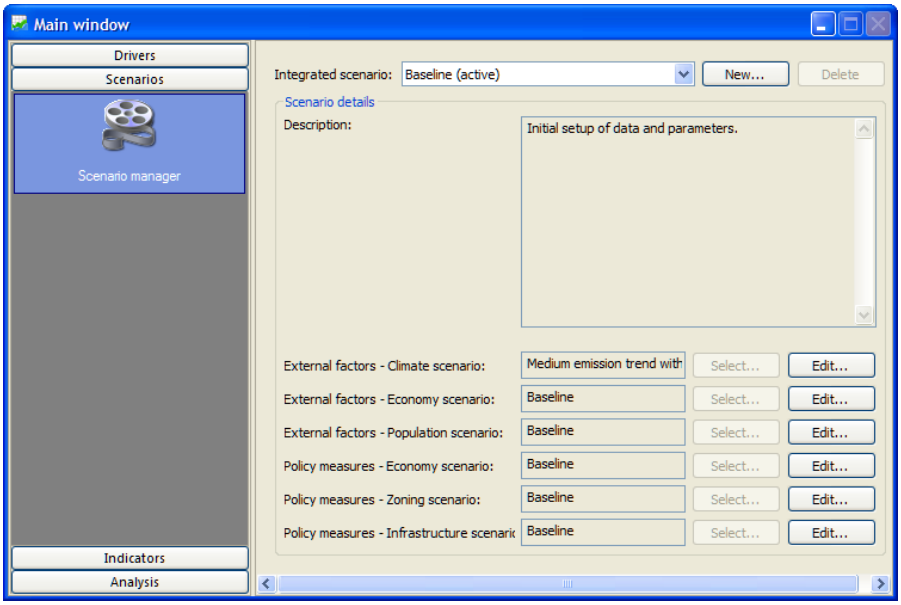
3.2.3 Filtering the economic sectors

In WISE, there are 48 sectors of WRDEEM included in the economic model. These sectors are filtered for display in the external factors, policy measures and economic indicators. A default selection is implemented in WISE. You could adjust the selection which sectors are available for each respective driver or indicator in the economic model window (see the section Sector filter). The filtered lists of sectors are ordered alphabetically for easier look-up.

In this section you have become familiar with the different drivers in the system. In the next section you will learn how to combine these sub-scenarios to create integrated master scenarios.

3.3 Creating integrated scenarios

In the previous sections you have read how to adapt the different drivers that are incorporated in the system. Furthermore, you have learned that each of these drivers can be stored in different sub-scenarios (see the section Saving sub-scenarios). Through this section, the project file *Waikato.geoproj* will be used as an example.



3.3.1 Predefined scenarios

WISE contains one integrated scenario, the *Baseline* scenario, which is predefined and is not editable by the user. All sub-scenarios that constitute this integrated scenario are read-only as well.

Particularly, WISE provides 8 predefined sub-scenarios for *External factors – Climate* driver and you can use them to create new integrated scenarios. The sub-scenario *Medium emission trend with variability* is read-only since it is used in the *Baseline* integrated scenario; other sub-scenarios for the climate driver are editable. For more information of these climate scenarios, we refer to the specification report of WISE.

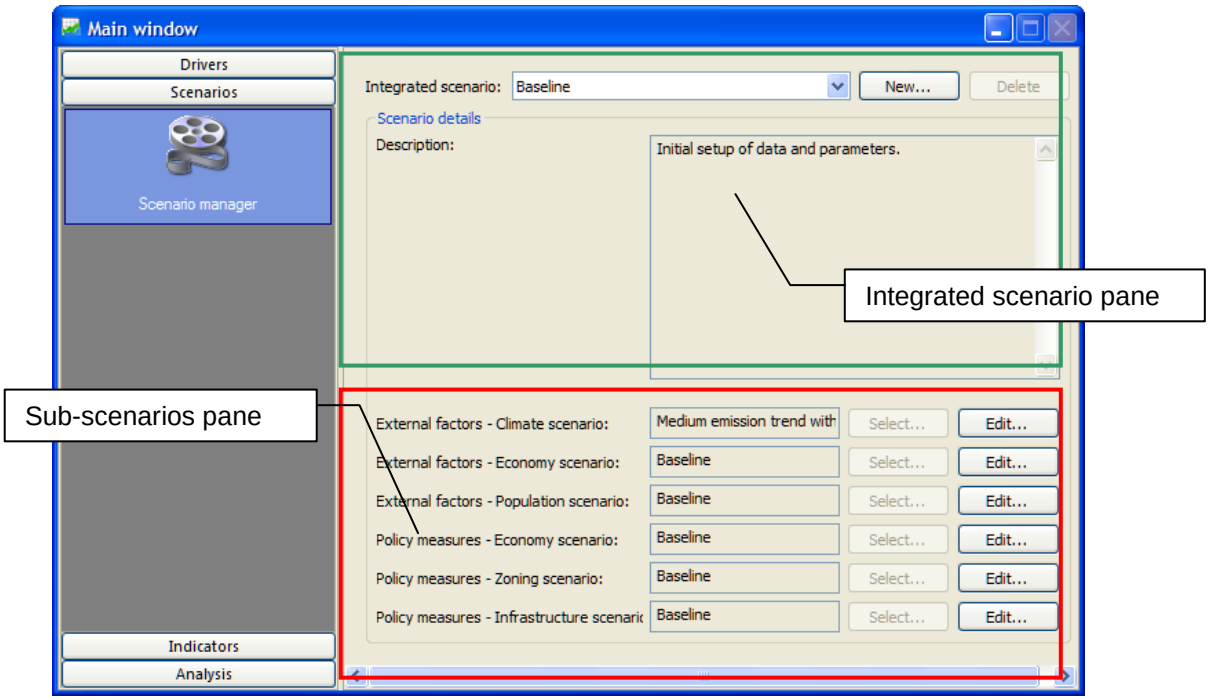
3.3.2 cenario manager

The Main window in WISE is structured according to the four steps involved in an impact assessment analysis:

1. Set up relevant drivers.
2. Combine and run scenarios.
3. View indicators visually.
4. Analyse scenario results visually and analytically.

Each step corresponds with a tab in the main window. The scenario manager is involved in the first two steps.

You can access the *Scenario manager* by clicking on the Scenarios tab of the Main window. The Scenario manager icon is selected automatically in the navigation pane on the left side of the Main window. The content pane on the right side of the Main window shows the content of the scenario manager.



The *Scenario manager* allows you to change the description of non-read-only integrated scenarios, create new integrated scenarios and delete non-read-only integrated or non-read-only sub-scenarios.

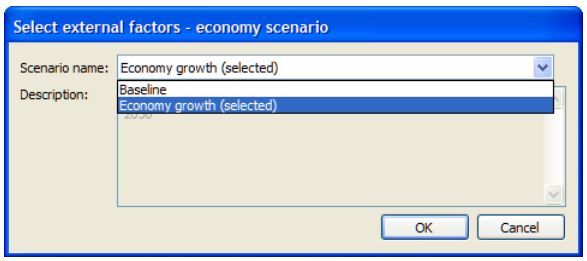
The *Integrated scenario* pane is in the top part and the *Sub-scenario* pane is in the lower part of the content pane of the Main window. Note that the term sub-scenario is not used in the user interface. For more information, see the section Project file, integrated scenario and sub-scenario.

- On the top of the *Integrated scenario* pane, you can select an integrated scenario from a dropdown list. The active integrated scenario is indicated in the list marked with the word *active*.

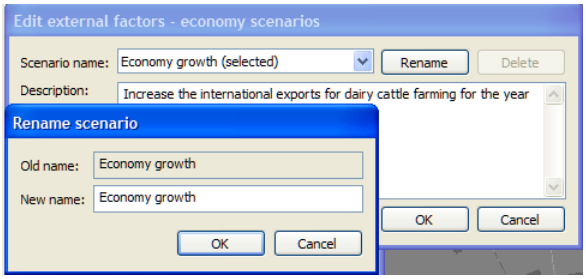
- When you select an integrated scenario from the list, the description of the selected integrated scenario is shown in the *Integrated scenario* pane and the selected integrated scenario details in the *Sub-scenarios pane* will be updated. If you hover the mouse pointer over one of the sub-scenario names, its description is displayed in a tooltip box – the pop-up box with a yellow background.

- You can edit the description of the integrated scenario directly, unless the integrated scenario is read-only.

- When the active integrated scenario or a read-only integrated scenario is selected, the Select… button is disabled. When the non-active and non read-only integrated scenario is selected, you can change a sub-scenario which is part of that integrated scenario by clicking the Select… button for the corresponding driver (e.g. Economic scenario, Population scenario, etc). A dialog window opens as depicted below, where you can select one of the available sub-scenarios.



You can view all the sub-scenarios and you can edit the sub-scenarios which are not read-only by clicking the Edit… button. A dialog window opens as depicted below, where you can edit the name and description of that sub-scenario. Sub-scenarios can only be deleted if they are not selected in any of the available integrated scenarios.



3.3.2.1 How to view an existing integrated scenario?

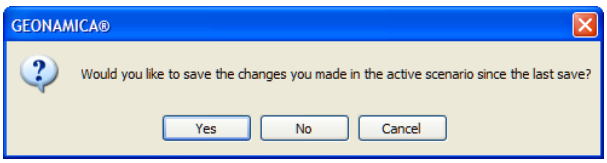
- Go to the Scenario tab of the Main window.
- Click your integrated scenario of interest on the dropdown list next to Integrated scenario on the top of the right side of the window.
- View the description of the selected integrated scenario in the *Integrated scenario* pane.
- View the sub-scenario for each driver that is incorporated in the selected integrated scenario in the *Sub-scenarios pane*.
- Move the mouse over the name of your sub-scenario of interest. Its description displays in a tooltip box with yellow background.

Selecting and viewing an integrated scenario does not automatically mean that its data is loaded into the system. Only the active integrated scenario is loaded into the system.

3.3.2.2 How to load an existing integrated scenario?

- Click the dropdown list next to Integrated Scenario on the toolbar at the top of the Geonamica application window (note this is not the list next to Integrated Scenario at the top of the Integrated scenario pane of the Scenario manager window). All the available integrated scenarios will be displayed on the list.
- Select an integrated scenario from the list as the active integrated scenario.

Now this integrated scenario is loaded by the system. However, if changes are made to the input data/files and parameters in the current active integrated scenario, a message window appears to ask you whether or not to save the changes when you switch to another integrated scenario.



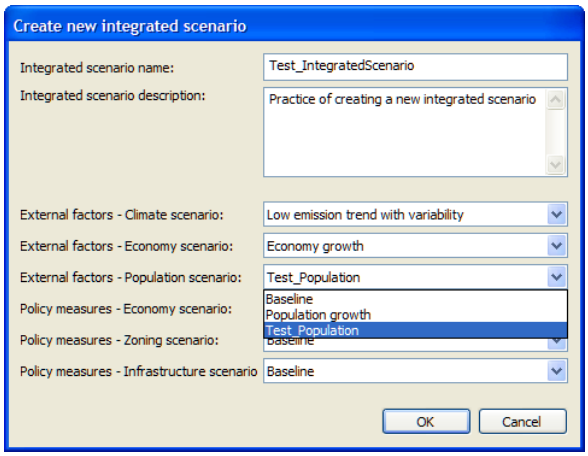
- Click the Cancel button if you wish to cancel the action of loading another integrated scenario.
- Click the No button if you wish to discard changes you made in the active integrated scenario. Then the system loads the new integrated scenario as the active integrated scenario.
- Click the Yes button if you wish to save changes you made in the active integrated scenario. The current integrated scenario is displayed on the dropdown list on the toolbar and the Save project dialog window opens where you can determine how to save changes. For more information, see the section Saving changes. After you save the changes in a new integrated scenario via the Save project dialog window, the newly created integrated scenario becomes the active integrated scenario automatically on the dropdown list on the toolbar.

Note that loading the active integrated scenario means loading the input data/files and parameters defined in this integrated scenario to the graphic user interface. In this case, the models have not been updated to the changes. You can use the Update, Step, Run and Reset command to update the models of the system to the changes.

3.3.2.3 How to create a new integrated scenario?

An integrated scenario is a collection of existing sub-scenarios for each driver. There are two ways to create a new integrated scenario in WISE. We first introduce how to create a new integrated scenario in Scenario manager.

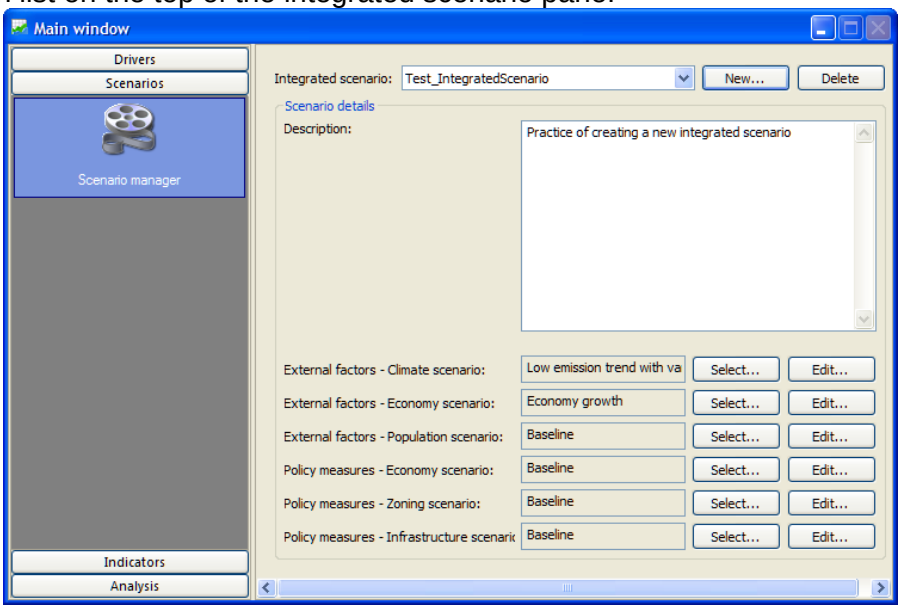
- Go to the Scenario tab of the Main window.
- Click the New… button on the integrated scenario pane on the right side of the Main window. The Create new integrated scenario dialog window opens.
- Name the new integrated scenario in the text box next to Integrated scenario name and give a short description in the text box.
- In the sub-scenario pane, select an existing sub-scenario from the dropdown list for each driver.



The existing sub-scenarios on the list has been created when you saved changes by using Save project or Save project as… command on the File menu.

- Click the OK button in the Create new scenario window.

The new integrated scenario *Test* that you just created is displayed immediately on the dropdown list on the top of the integrated scenario pane.



We now introduce how to create a new integrated scenario by using the Save project command. You can create a new integrated scenario based on an existing integrated scenario.

- Load your integrated scenario of interest by selecting it from the dropdown list next to Integrated Scenario on the toolbar. See 'How to load an existing integrated scenario?'.
- Adapt your external factors or policy measures of interest. See the section Setting up the drivers.
- Click the Save project command on the File menu. The Save project dialog window opens.
- Give a new name for the integrated scenario that you adapted and define the sub-scenarios for each driver if necessary. For more information, see the section Saving an integrated scenario.
- Press the Save button on the Save project dialog window.

You have now created a new integrated scenario and it displays as the active integrated scenario on the toolbar.

- If you would like to learn how to create sub-scenarios for different drivers or if you would like to learn how to see the data that is used in the different drivers, go to the section Setting up the drivers.

- If you want to carry out a simulation with your new integrated scenario, press the Reset button on the toolbar or click the Reset command on the Simulation menu.

3.3.2.4 How to delete an integrated scenario?

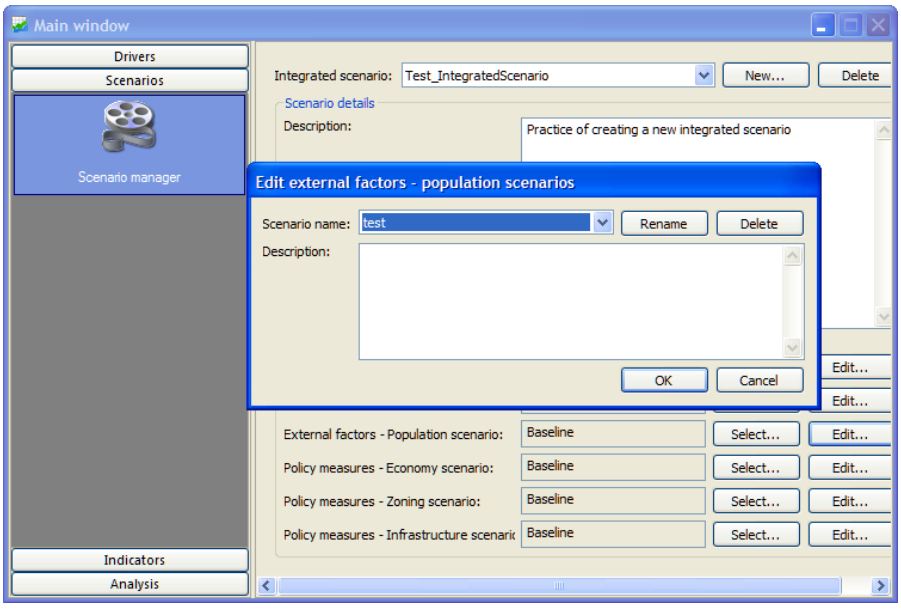
You can only delete any integrated scenario which is not read-only and which is not the active one.

- Go to the Scenario tab of the Main window.
- Click the integrated scenario that you want to delete on the dropdown list next to Integrated scenario on the top of the right side of the window. The Delete button becomes enabled if the selected integrated scenario is not read-only and is not the active one.
- Click the Delete button on the top-right of the window.

The integrated scenario that you deleted disappears from both the dropdown list on the toolbar and the dropdown list on the top of the main window. You have now deleted the integrated scenario.

3.3.2.5 How to delete a sub-scenario for a specific driver?

You can only delete a sub-scenario which is not read-only and which is not part of any existing integrated scenario.



- Go to the Scenario tab of the Main window.

- Click the Edit… button next to the specific driver, e.g. External factors - Population scenario. The Edit external factors - population scenarios dialog window opens.
- Click the dropdown list next to Scenario name of the Edit population scenarios dialog window. All the available sub-scenarios for this driver are displayed on the list.
- Click the sub-scenario you want to delete. The Delete button becomes enabled if the selected sub-scenario is not read-only and is not part of any existing integrated scenario.
- Click the Delete button on the top-right of the Edit external factors - population scenarios dialog window. The sub-scenario that you deleted immediately disappears from the dropdown list of the Edit external factors - population scenarios dialog window. But it has not been completely deleted until you press the OK button.
- Click the OK button on the Edit external factors - population scenarios dialog window.

To verify that it is completely deleted,

- Click the Edit… button next to that specific driver, e.g. External factors - Population scenario. The Edit external factors - population scenarios dialog window opens.
- Click the dropdown list next to Scenario name on the Edit external factors - population scenarios dialog window. The deleted sub-scenario is not displayed on this list any more.

3.3.3 Examples of using the scenario manager

The section above describes the detailed information in the scenario manager. This section provides outlines for best use of the scenario manager in WISE. Several case studies will be explained in a step-by step manner.

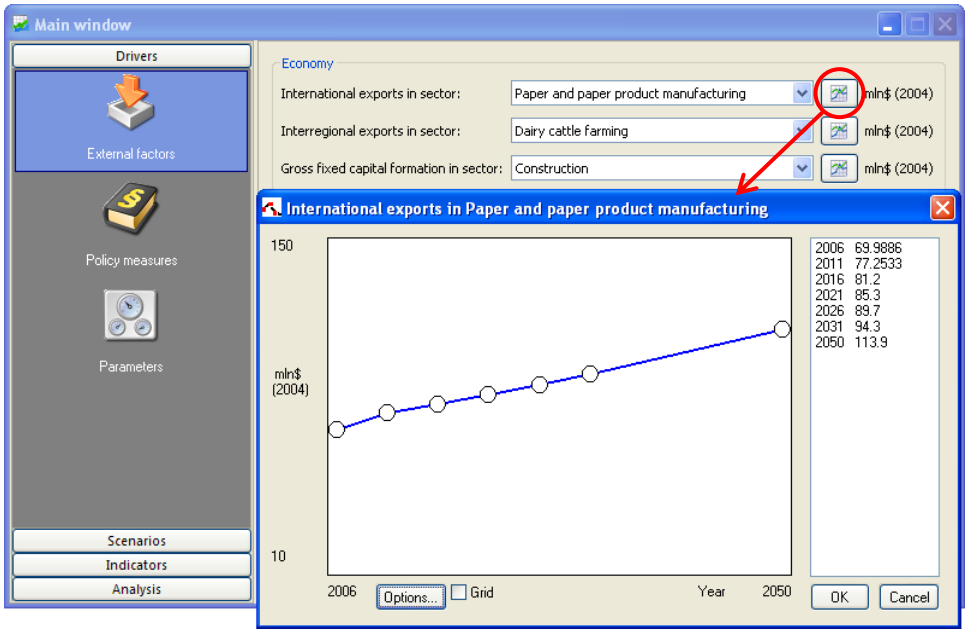
3.3.3.1 Creating your own sub-scenarios

When you first open WISE, it only contains the baseline, or business as usual, sub-scenarios and the predefined sub-scenarios for climate. There is exactly one integrated scenario called *Baseline*, which combines the baseline sub-scenario for each driver. You can develop your own sub-scenarios on the basis of these baselines.

Defining a High export sub-scenario

- Go to the Drivers tab in the Main window and click on External factors.
- Select the Paper and paper product manufacturing sector from the list for the International exports.
- Click the graph button to open the graph window showing the time line of international exports for the selected sector – see 0.
- Click the Options button to set the maximum value on the Y-axis to 150.
- Right click on the bubbles in the graph to set the values as shown in 0. These values assume a 1% annual growth from 2011.
- When you are done, click the OK button.

You have now changed the time line for international exports for one of the relevant sectors. If you would like, you can repeat the steps above for other sectors as well.

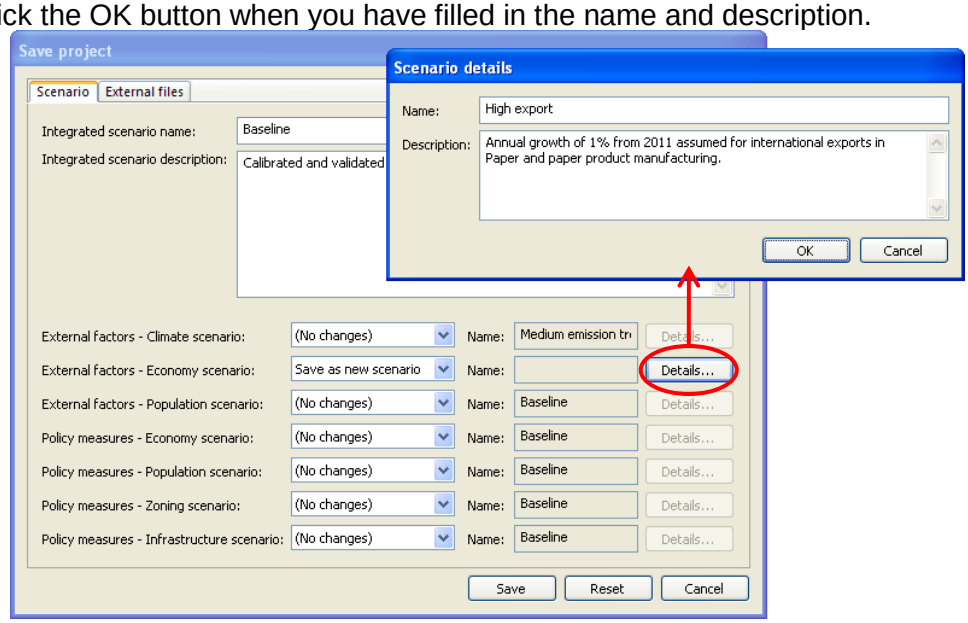


Graph window for international exports opened from the External factors in the Main window

Saving the High export sub-scenario

You have now entered a scenario for increased international exports in the system and are ready to save this to disk.

- Click the Save button on the toolbar in order to save your changes as a new sub-scenario.
- Select Save as new scenario for the External factors – Economy scenario.
- Click on the Details button to enter a name and description for the sub-scenario – see 0.
- Click the OK button when you have filled in the name and description.



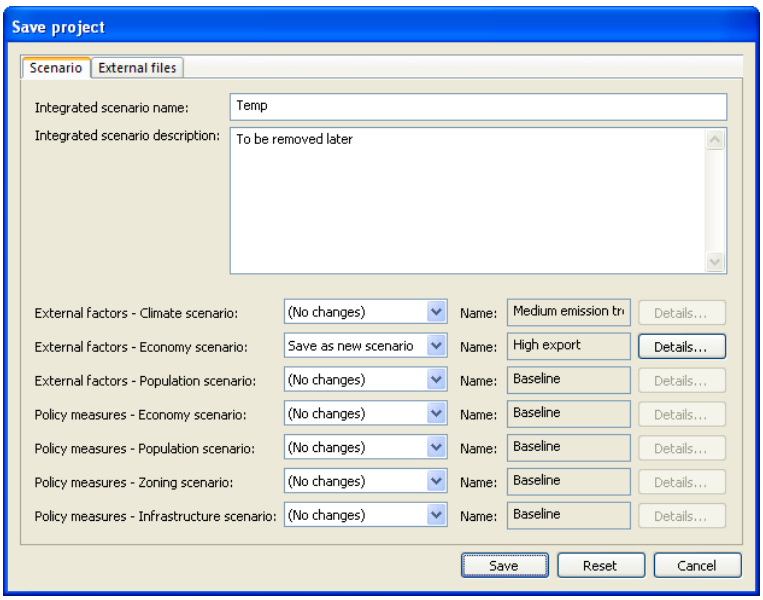
Scenario details window opened from the Save project window

When you save a project in WISE you cannot save only part of the changes you have made, in the same way that you cannot save half a Word document or send half an e-mail. Therefore, you have to either save or discard the changes you have made for each of the drivers. You can overwrite the currently selected sub-scenario or save in a new sub-scenario – thereby retaining the currently selected sub-scenario.

You also have to specify an integrated scenario that will consist of the sub-scenarios you are about to save. Here again, you can either overwrite an existing integrated scenario or save to a new integrated scenario. Since we want to retain the *Baseline* integrated scenario for later, we have to specify another name. It doesn't really matter

which name you use right now, since you are just interested in saving the sub-scenarios. In the next section, you will combine the sub-scenarios you create now into integrated scenarios.

- Enter the name Temp for the integrated scenario in the Save project window.
- Click the Save button in order to save the project.



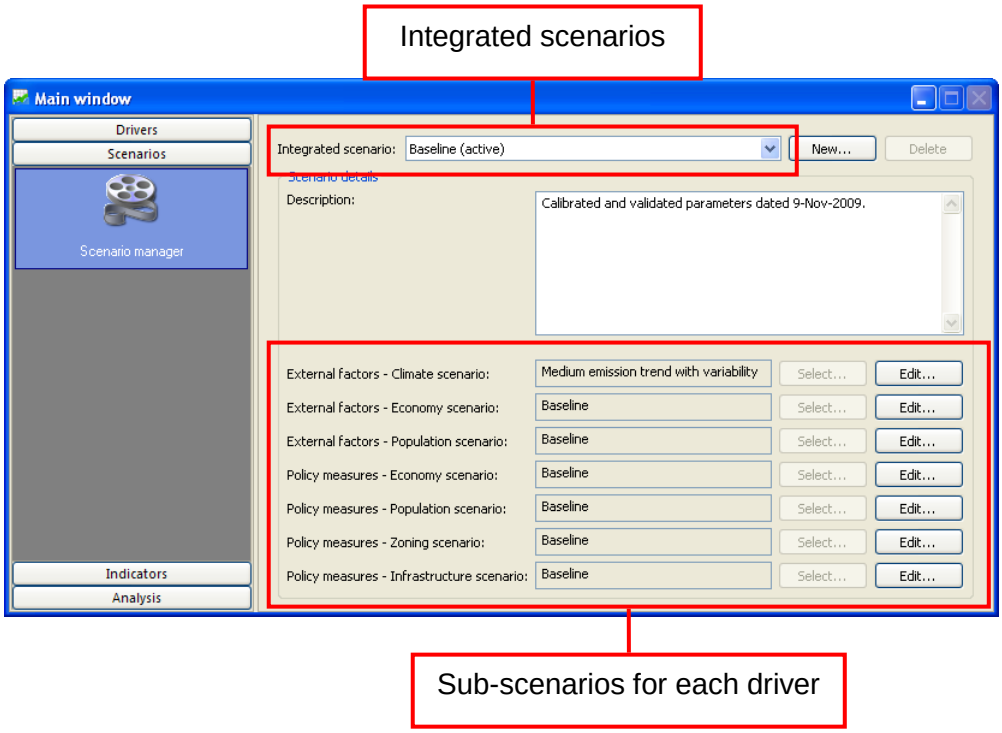
Save project window after all information has been entered

You have now created a new sub-scenario for External factors – Economy that assumes an increase in international exports. In the same way you can create another sub-scenario that assumes a decline in international exports, or you can define sub-scenarios for the other drivers available in WISE.

In the next section we will learn how to combine the sub-scenarios we created as part of integrated scenarios for which we can perform a simulation run and investigate the impacts of our assumed driver developments.

3.3.3.2 Managing integrated scenarios

If you have followed the steps in the previous section, you now have two integrated scenarios: *Baseline*, using the baseline sub-scenario for *External factors – Economy* and *Temp*, using the *High export* sub-scenario. You can verify this in the Scenario manager that is opened by clicking the Scenarios tab in the Main window – see 0.

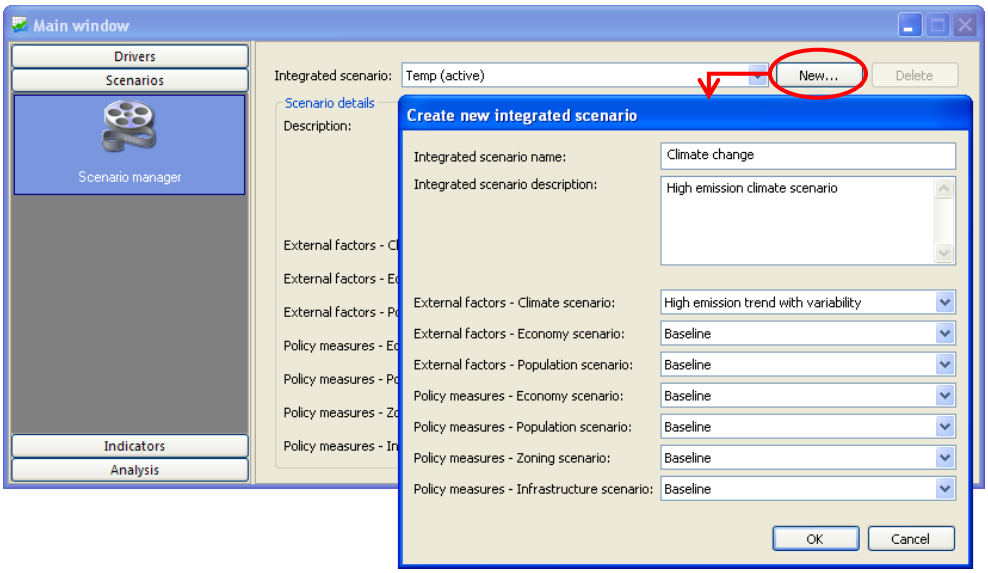


The Scenario manager in the Main window

Creating a new integrated scenario

If you want to investigate the impact of climate change, you can run a simulation using e.g. the high emission climate scenario and compare the results with the baseline integrated scenario that uses the medium emission climate scenario. In order to do this, we first have to create a new integrated scenario that uses the high emission sub-scenario for climate.

- Go to the Scenarios tab in the Main window.
- Click the New button to create a new integrated scenario.
- Select the High emission trend with variability sub-scenario for climate.
- Select the Baseline sub-scenario for the other drivers.
- Enter the name Climate change for the integrated scenario.
- Click the OK button.

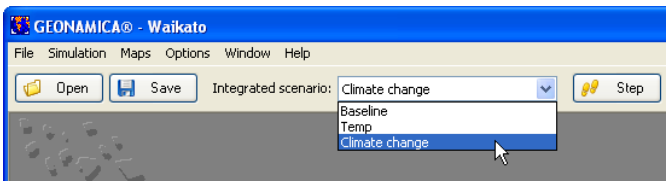


Create new integrated scenario window opened from the Scenario manager in the Main window

To run a simulation with the newly created integrated scenario, you must first activate it.

- Select the integrated scenario Climate change from the list in the toolbar – see 0.
- Click the Run button on the toolbar to run the simulation.

- If you don't want to wait for the simulation to finish, click the Stop button on the toolbar.



Selecting the newly created integrated scenario

Removing an integrated scenario

Remember that when you created and saved a sub-scenario in the previous section, you also saved a new integrated scenario. Since you don't need that one anymore, you can remove it.

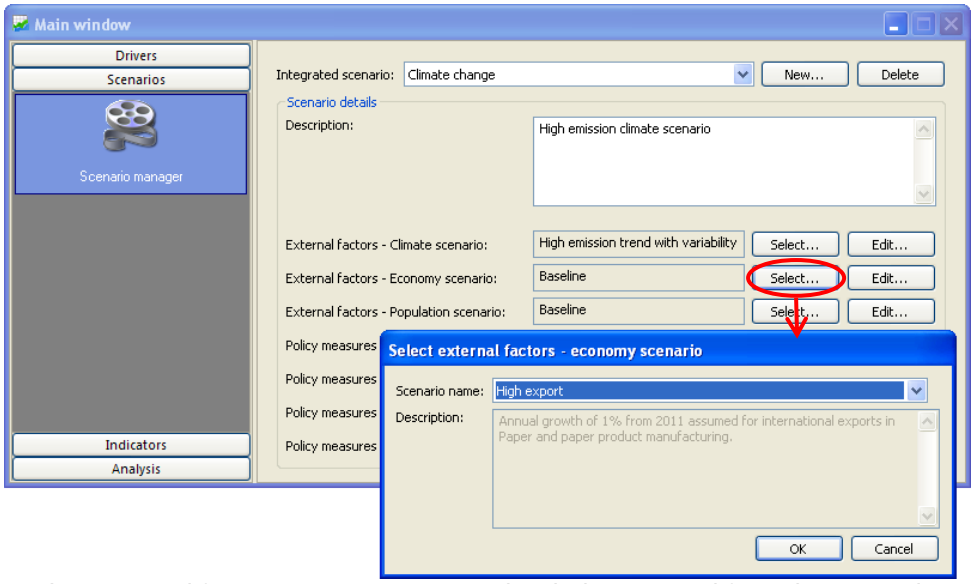
- Make sure that in the toolbar, the active integrated scenario is set to Baseline.
- Go to the Scenarios tab in the Main window.
- Select the integrated scenario Temp.
- Click the Delete button.
- Click the Save button in the toolbar to save your project.

Note that it is not possible to remove an integrated scenario when it is selected as the active scenario. In that case, you first have to activate another integrated scenario in the toolbar.

Changing an integrated scenario

You can change an integrated scenario by selecting another sub-scenario for one of the drivers. E.g. in the integrated scenario *Climate change* we have selected the baseline sub-scenario for *External factors – Economy*, but we could change this to the *High export* sub-scenario that we have created earlier.

- Make sure that in the toolbar, the active integrated scenario is set to Baseline.
- Go to the Scenarios tab in the Main window.
- Select the integrated scenario Climate change.
- Click the Select button next to the External factors – Economy scenario.
- Select the sub-scenario High export.
- Click the OK button.
- Click the Save button in the toolbar to save your project.



Select external factors – economy scenario window opened from the Scenario manager in the Main window

Note that it is not possible to change an integrated scenario when it is selected as the active scenario. In that case, you first have to activate another integrated scenario in the toolbar.

3.4 Running the simulation

A more general description about running the simulation is available in the section Running the simulation. In this section you will learn how to load an integrated scenario and run the simulation and save its output results while running the simulation.

3.4.1 Saving output results

There are several ways in WISE that you can save output results. Before you run the simulation, you need to set up in which way and what you want to output.

3.4.1.1 Exporting individual maps

To export a map you need to have the map open in your active Map window. In this window you find the Save grid button in the Tools pane on the right low part of the window (see for example the Land use map window).

Clicking on the Save grid button allows you to export the map to any folder you like. There are several different file types that you can choose to export maps, from these the Arc ASCII format (*.asc) and the IDRISI raster format (*.rst) the most common formats. These file types can be used in the MAP COMPARISON KIT (MCK).

3.4.1.2 Creating log maps

Log maps can be created by clicking on the option Log maps…on the Options menu as described in the section Log maps. When turning on the log functionality, remember that more maps you select and more disk space you need to save them.

You can decide yourself how many maps you want to store for eventual analysis. You can open these maps in the MCK (part of the WISE package) or a common GIS packages, for further analysis after the simulation has run.

3.4.1.3 Creating animations

Animations are movies that show the spatial developments (e.g. land use, accessibility, …) over time. Animations can be created by clicking on the option Animate maps… on the Options menu as described in the section Animate maps. All selected maps which are categorised by model blocks will be saved in *Animated* GIF format which you can play in a web browser or picture viewer.

3.4.1.4 Writing model results to Excel

Model results can be written to Excel by clicking on the option Write to Excel on the Options menu. A Write to Excel settings window pop-ups that allows you to select what information you would like the WISE system to write to Excel. For a detailed explanation on how to write information to Excel, go to the section Write to Excel.

3.4.2 Running the simulation

Land use change has a spatial as well as a temporal aspect. The spatial aspect is visible in the form of a map; the temporal aspect is included in the dynamic computation of changes. You have learnt to create your integrated scenarios in last section. You will investigate what outcome the integrated scenarios will produce.

- Make sure you have opened your project file of interest in WISE on your screen.
- Activate your integrated scenario from the dropdown list next to Integrated scenario on the toolbar. For more information, see the section Active integrated scenario.

The selected integrated scenario is loaded into the system. When the Step, Run and Reset buttons on the toolbar become enabled, the system is ready to run. To run a simulation, you have the following basic options, which are also described in the section Toolbar. You can find these buttons on the toolbar on the top of your screen, but you can also access to them through the Simulation menu):

- When you press Step, WISE computes the change for one year.
- Run lets the simulation run until the final year or the next pause. By default 2050 is the final year for this version of WISE.

- Stop lets the simulation stop at the end of the year it is currently computing.
- Reset finally resets the simulation to the initial starting year, in this case 2006.

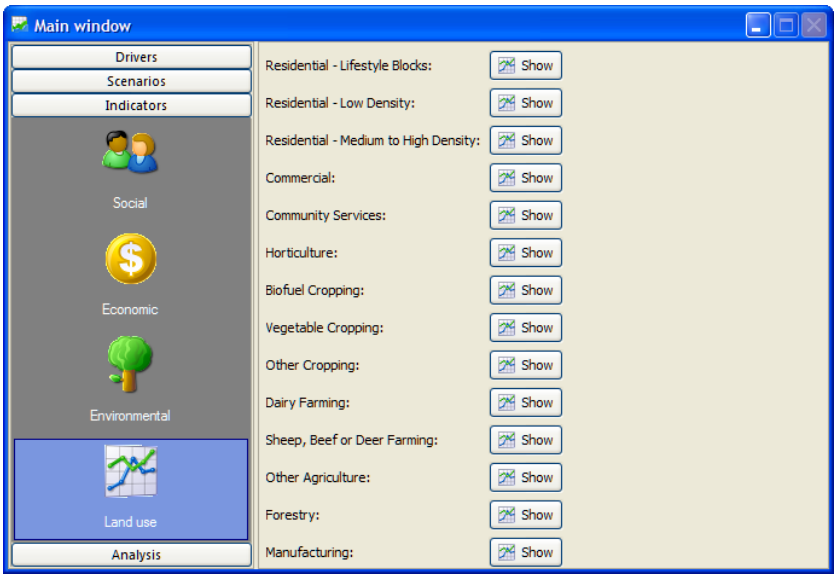
Besides the basic functionality there are two advanced options to run a simulation: Update and Pauses. These options can be found through the Simulation menu. They are described in the section Simulation menu.

3.5 Visualising indicators

The basic output WISE produces are maps (land use map, climate maps, hydrology maps, water quality maps and threatened environment map) and numerical values. However, these maps and figures are not always easy to interpret at first instance. For that reason, WISE offers you the opportunity to compute indicators as well. An indicator in this context is a measure to make a particular phenomenon perceptible that is not – at least not immediately– detectable.

Indicators are organised in four groups in the user interface:
- Social indicators
- Economic indicators
- Environmental indicators
- Land use indicators

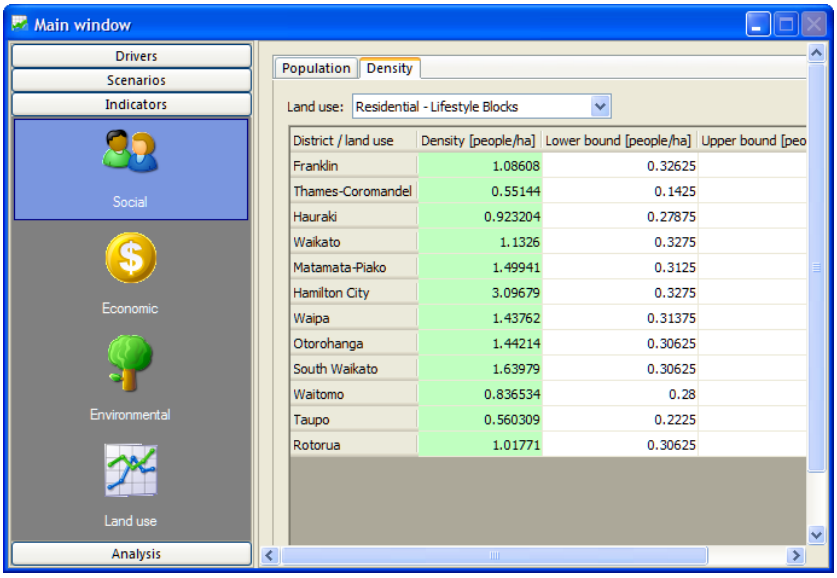
Some of these indicators describe a state or a condition (e.g. the maps under the Environmental indicators section, the age-cohort figure and the numerical values in the tables) and others show a change over time (the timeline graphs). The first set of indicators for the start year is already available when starting up the simulation; for the second set the simulation requires a step first; otherwise no change can be calculated.



You can visualise the social indicators, economic indicators, environmental indicators and land use indicator at any point in time (any year) during the simulation. To visualise an indicator, take the following steps:
- ➢ Go to the Indicators tab of the Main window.
- ➢ Select sections in the navigation pane on the left hand side of the Main window the type of indicator you are interested in: Social, Economic, Land use and Environmental.

To visualise the numerical values in the table or single values
- ➢ Go to the Social section of the Indicators tab.
- ➢ Click the Density tab.

➢ Select your residential land use of interest on the dropdown list next to Land use. The values of the density, the lower bound and the upper bound for each district and for the selected residential land use are displayed on the screen.



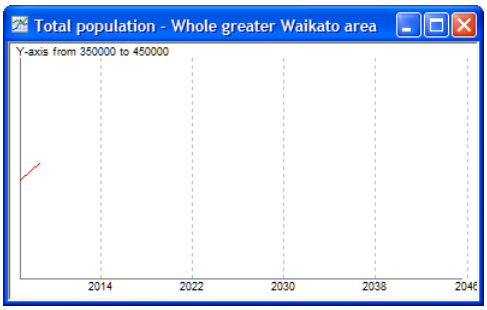
Particularly, if the density for the selected land use is between the lower bound and upper bound, the values are highlighted with green background. If the density for the selected land use is smaller than the lower bound or bigger than the upper bound, the values are highlighted with red background.

- Density smaller than lower bound indicates that the proportion of people living in the selected residential land use is too small.
- Density bigger than upper bound indicates that the proportion of people living in the selected residential land use is too big.

You need to adjust the proportion of people living in each residential land use category via the Policy measures section under the Drivers tab. For more information, see the section Policy measures.

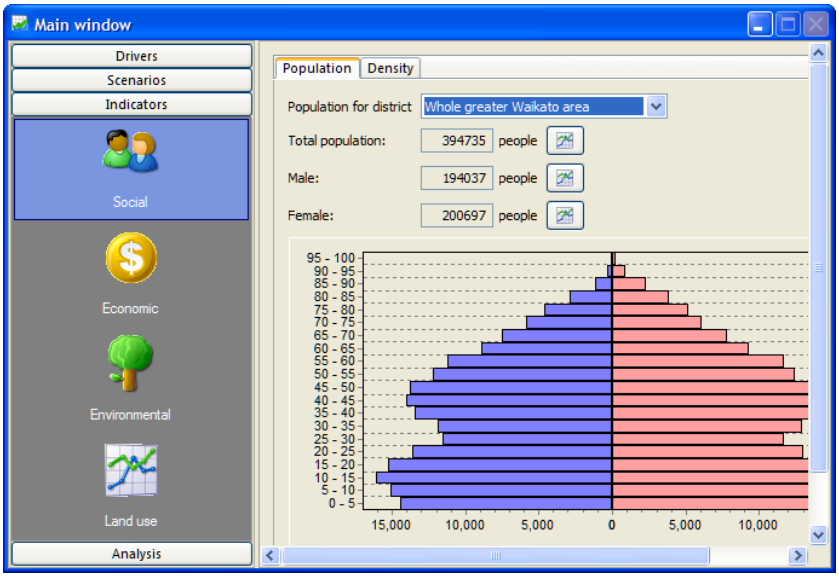
To visualise time line graphs

➢ Go to the indicator group of interest the Indicators tab.
➢ Select your district or sector of interest on the dropdown list.
➢ Click the graph icons behind the names of your variables of interest. The corresponding time line graph window opens where changes are displayed over time.



To visualise the chart and figure for the social indicators

➢ Go to the Social section of the Indicators tab.
➢ Click the Population tab to view the age cohort figure for the current simulation year.



To visualise detailed environmental indicator maps

- Go to the Environmental section of the Indicators tab.
- Click the Show map button next to the indicator of interest. The corresponding map is displayed in a map window.

All spatial indicators can be stored in log maps and as animations. All other indicator results can be written to Excel. For more information about how to writing information to Excel and how to create log maps and animations, see the section Saving results. How to compare indicators over time and between scenarios is described in the section Analysing results.

3.6 Analysing results

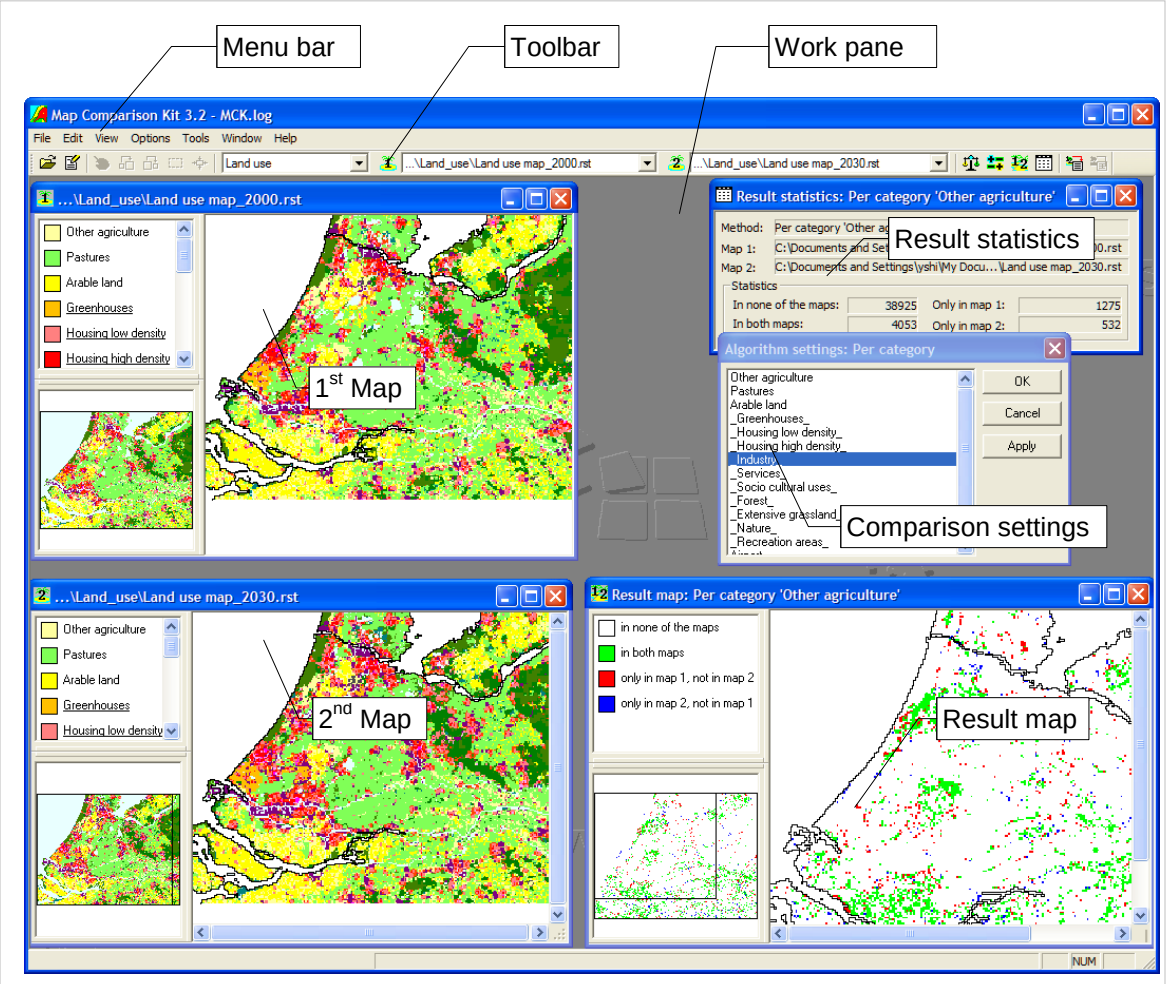
The final step of the impact assessment study is to analyse results within an integrated scenario (e.g. the temporal evolution of an integrated scenario) or to compare a set of integrated scenarios.

3.6.1 Analysing spatial results

In order to analyse spatial results (maps) more carefully it is often helpful to analyse them pixel by pixel or to compare only the land use type you are interested in.
You have run the simulation with different integrated scenarios and saved result maps using Log maps command on the Options menu. To investigate these maps you will use the Map Comparison Kit, abbreviated to MCK. This is a tool that contains a multitude of algorithms to compare maps on a pixel by pixel basis. For more information, we refer to the accompanying *MCK user manual* of the MCK software.

3.6.1.1 Short overview of the MCK

An overview of the MCK looks as depicted below.



The Map Comparison Kit application window consists of the *Menu bar*, the *Toolbar* and the *Work pane*. You can simultaneously open different windows for maps and statistics. Furthermore, it is possible to keep the Comparison Settings dialog window opened while working with the tool:

- The *1st Map* window contains the first map to compare/analyse. To change the contents of toolbar the *1st Map* window, choose another map from the dropdown list next to the 1-button on the. If the *1st Map* window is not open yet, then you can do so by clicking the 1 button.

- The *2nd Map* window contains the second map to compare/analyse. To change the contents of the *2nd Map* window, choose another map from the combo box next to the 2-button on the toolbar. If the *2nd Map* window is not yet open, then you can do so by clicking the 2 button.

- The *Result map* window contains the result map. This map shows the spatial result of the last performed map comparison. Depending on the selected comparison method the results are presented in a continuous scale or a nominal scale.

- The *Result statistics* window contains the statistical results of the last performed map comparison.

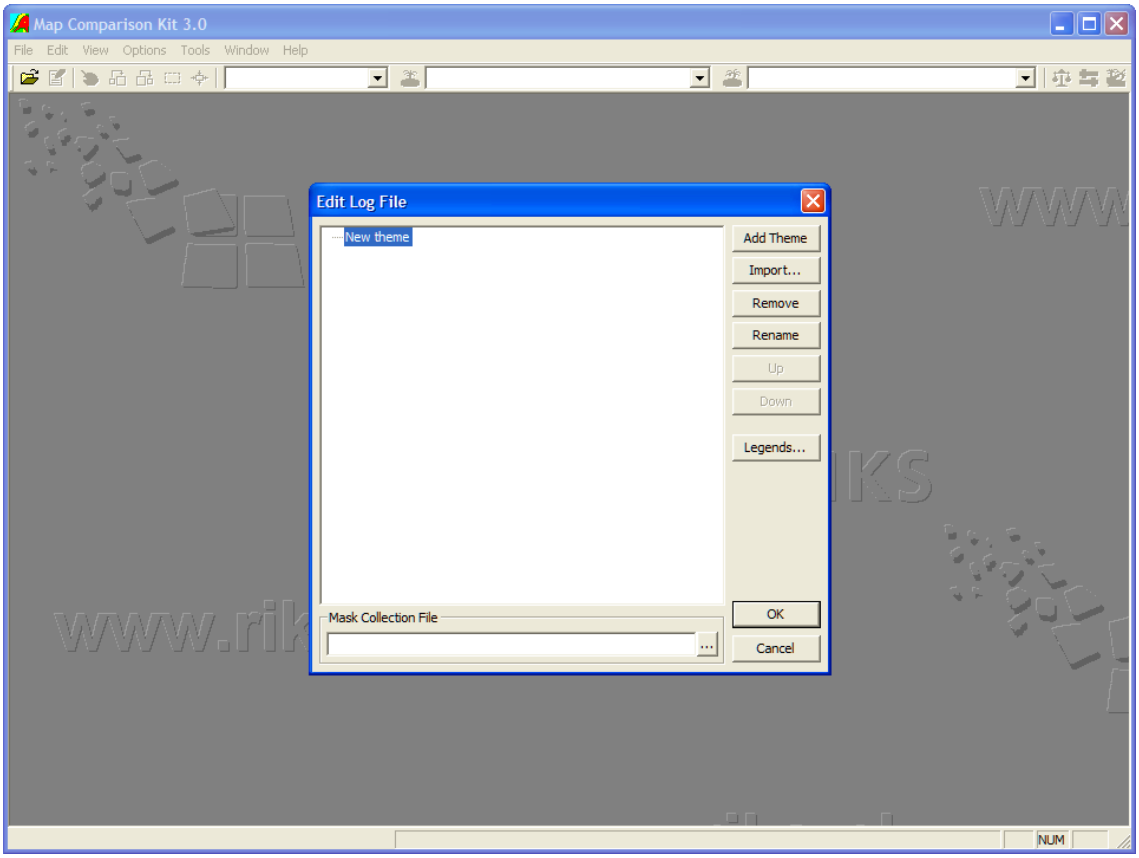
- The *Comparison settings* dialog window allows setting and viewing the settings belonging to the active comparison method.

3.6.1.2 Comparing different years of one scenario

First we will analyse how the maps of the Baseline integrated scenario changes over time:

➢ Go to the Analysis tab in the navigation pane on the left hand side of the Main window of WISE.

- Press the Open Map Comparison Kit button in the content pane on the right hand side of the window. The Open dialog window of the MCK opens.
- Click the Cancel button in the Open dialog window.
- Select the Open option on the File menu of the Map Comparison Kit. The Edit Log File dialog window of the MCK opens.



- Click the New theme item and give a name Land use for the new group of maps that you are going to import.
- Press the Import… button in the Edit Log File window. The Import… dialog window opens.

You will find the logged maps (*.rst) of the baseline scenario in the folder of *\My documents\ Geonamica\WISE\Log* by default or in the specific folder that you defined in the section Log maps.

- Select the *.rst in the Files of type box.
- Select the map that you want to compare. Repeat this step to import all the maps that you want to compare. The imported maps are displayed on the Land use list.
- Click the OK button in the Edit Log File dialog window. A Save as dialog window opens where you are required to name and save the project file of MCK in **.log* format. Name the log file and press the OK button in the Save as window.

A *.log file is actually a file which contains a reference to one or several maps that you want to perform comparisons. When you open a log file in MCK, you can easily load all maps referred in the log file.

- Select the maps that you want to analyse from the dropdown list in the toolbar next to 1 and next to 2, for instance, *Land use map_2006.rst* as Map 1 and *Land use map_2030.rst* as Map 2.
- Click the 1 button to open the land use map for 2006 in the *1st Map* window and click the 2 button to open the land use map for 2030 in the *2nd Map* window.

Note that the current legends in the left side of the map windows are still set by default. There are two ways to change the legend files of the land use maps that you imported in the MCK.

- Edit the legend one by one in the Legend Editor by clicking on the Legend… option on the Edit menu on the menu bar. For more information, we refer the *MCK user manual*.

- Copy the content of the land use legend file *\My documents\Geonamica\WISE\Legends\LandUse.txt* that you used in WISE to the legend file *\Legends\Land Use.txt* that the Land use theme in MCK is used. This way you can have the same legend for the land use maps in MCK as the one used in WISE.

Now you are going to set comparison algorithm.

- Click the Algorithm button on the toolbar. The Comparison algorithm dialog window opens.
- Click the checkbox in front of Per category in the Comparison algorithm window. Press the OK button on the top-right of the window.
- Now to choose which land use you want to investigate, click the Parameters button on the toolbar. The Algorithm settings: Per category dialog window opens.
- Select Commercial land use and click the OK button in the Algorithm settings: Per category dialog window.
- Click the Compare button on the toolbar. Now the Result map: Per category Commercial opens where there are 4 options available: *in none of the maps*, *in both maps*, *only in map 1 and not in map 2* and *only in map 2 and not in map 1*.

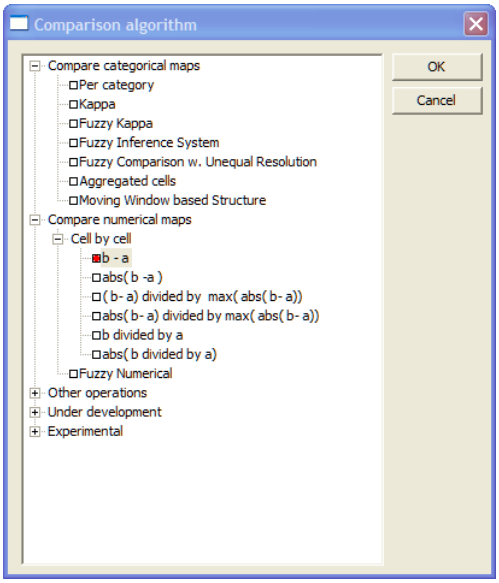
Besides the land use map, you can also analyse other categorical maps in the same way. To do this, import and select another type of categorical map from the dropdown list on the toolbar and repeat the steps above.

If you are interested in looking at the statistical information regarding the changes, you can go to the option Result statistic on the Options menu or press the Statistics button on the toolbar.

Numerical maps, like the accessibility maps, suitability maps etc that show numerical values, can be compared using measures that can be found under the Compare numerical maps in the Comparison Algorithm window.

Select the total potential maps for certain land use (or any other numerical map) in the dropdown list on the toolbar.

- Click the Algorithm button on the toolbar. The Comparison Algorithm dialog window opens.
- Select Comparison Algorithm → Compare numerical maps → Cell by cell → b-a.
- Investigate the changes in total potential for certain land use over time.



In this exercise you have investigated the actual land use change over one simulation. A more interesting investigation would be to compare the results of two different scenarios. This you will do next.

3.6.1.3 Comparing output maps of integrated scenarios

The simulation that you used until now, the Baseline integrated scenario, represents an extrapolation of observed historic developments combined with expected future developments. You can say it shows a 'business as usual' scenario that incorporates the processes as they are observed in the past and expected for the future. However, the full power of a spatial decision support system lies not in this baseline integrated scenario but in investigating different integrated scenarios and analysis of scenarios and effects of policy measures. Hence it helps you to answer "what if. . . ." type of questions.

In this exercise you will compare an alternative integrated scenario with the Baseline integrated scenario. For this we will again use the MCK.
To incorporate the logged maps from the alternative integrated scenario,

- Go to the option Log file… on the Options menu. The Edit Log File dialog window opens.
- Press the Import… button on the right hand side of the Edit Log file window.
- Select the **.rst* file type and select the logged maps of your integrated scenario of choice.
- Click the OK button in the Edit Log File window.

Instead of comparing the start and end map of the simulation within one integrated scenario you can investigate the difference between two integrated scenario results. We will again do this per category.

- In the MCK select the Baseline integrated scenario result map in 2030 as Map 1 and the alternative integrated scenario result map in 2030 as Map 2.

Now you can investigate the categorical maps in more detail.

- Click the Algorithm button on the toolbar. The Comparison algorithm dialog window opens.
- Click the checkbox in front of Per category in the Comparison algorithm window. Press the OK button on the top-right of the window.
- Click the Parameters button on the toolbar.
- Select your land use of interest in the Algorithm settings: Per category dialog window.

If you have already import the logged map of the suitability map for commercial,

- Select the suitability maps for commercial from the dropdown list in the Toolbar in the MCK.
- Investigate the changes in suitability map for commercial between integrated scenarios by selecting Comparison Algorithm – Compare numerical maps – Cell by cell – b-a.

Now you can investigate the difference between the result maps of two integrated scenarios.

3.6.2 Summary

In the last section you have analysed different results maps of the WISE system. You have compared results from different years within an integrated scenario as well as results of a certain year between integrated scenarios. For this you have used the MCK functionality to compare categorical maps on a cell by cell basis, to compare numerical maps on a cell by cell basis and to show integrated statistics.

4 Modeller interface

This section deals primarily with the interaction between the *Modeller* and the software. The modeller can have more detailed access to the underlying models of the system diagram to update data and parameters and to check the output. For details about the models, we refer to the accompanying *Model descriptions* of WISE.

Only a global overview of the model itself and the features which are not directly linked to the model description will be described in this user manual.

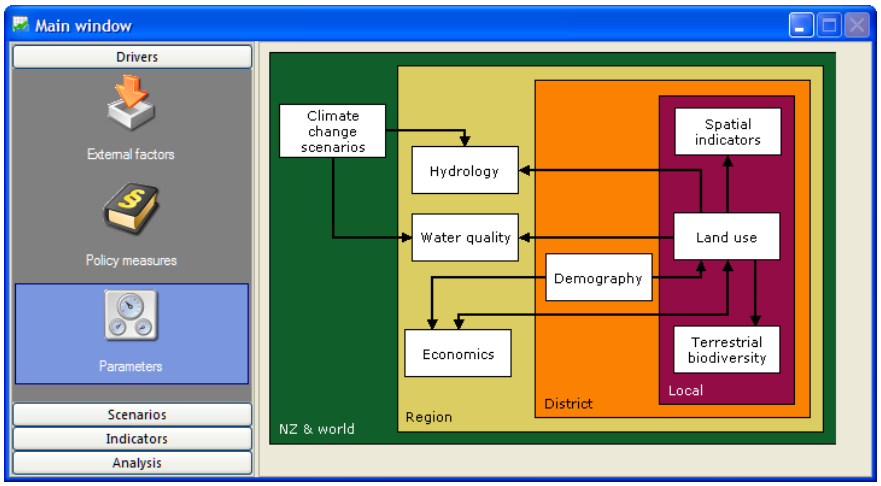
Detailed information about how to update data and parameters through the modeller user interface is given per individual model in the section Individual model components. Notice that setting the parameters is part of the calibration of the system. Changing the parameter settings can have a major impact on the behaviour of the system. If you do not have a good understanding of the individual models, we suggest you to use the default settings.

4.1 Overview of the system diagram

To access the modeller user interface,

- Go to the Drivers tab of the Main window.
- Click the Parameters icon in the navigation pane. The system diagram of the integrated models becomes visible in the content pane on the right hand side of the Main window.

The system diagram in the content pane is the most essential feature of the user interface for the modeller. It shows an overview of the structure of the integrated models at the most abstract level and enables access to the details of the model at this level but also at lower levels. You should learn to use it as a graphical explorer of the model. You can change neither the model structure, nor its graphical representation.



The WISE system has been implemented by means of the software framework Geonamica. Geonamica models consist of *Model Building Blocks* (MBBs) that contain the code and/or data required to calculate and execute mathematical operations varying from a single operation, such as the sum of two numbers, to a complex set of interlinked operations (set of mathematical equations). Model Building Blocks are graphically represented in the user interface by means of a rectangle with the name of the MBB in it. They are connected to one another by means of *MBB-Connectors*.

The WISE MBBs are structured by 4 spatial levels: NZ & World, Region, District and Local level. The MBBs incorporated in WISE are:

- Climate change scenarios (Climate model)
- Hydrology (Hydrology model)

- Water quality (Water quality model)
- Economics (Economic model)
- Demography (Population model)
- Terrestrial biodiversity (Terrestrial biodiversity model)
- Land use (Land use change model)
- Spatial indicators (not available in this version)

The representation of the system diagram in the Main window has been created with the help of the following basic elements: *MBBs*, *MBB-Connectors*, *Connections*, and *MBB-Dialog windows*.

4.2 Model Building Blocks (MBB)

Model Building Blocks are represented in the system diagrams by means of a rectangle with the name of the MBB displayed in it.

An active MBB is represented in black. When you move the mouse pointer over such a block its colours becomes inverted. Next, if you click on it, a dialog window will be open. This dialog window is the graphic user interface of the MBB. It has the function to receive the user input and to display the model output.

4.3 Connectors and connections

Variables and parameter values can be passed from one MBB to the other via *Connections*, or *Pipes*. MBBs will dispense variable or parameter values with the rest of the models via *Out-connectors*, and will take-in information from other MBBs via *In-connectors*.

The actual data exchange between MBBs is possible via a Connection between an Out-connector of the issuing block and the In-connector of the receiving block. Once there is a variable or parameter value that is exchanged, a connection is displayed in the diagram.

Symbols	Connector
	In-Connector
	Out-Connector

4.4 Dialog windows

Each MBB has a *dialog window* associated with it. It is the vehicle that permits the interactive exchange of information between the user and the Model Building Block. The MBB communicates the results (output) of its numerical operations to the user and it takes in the data entered (input and parameter) by the user that are required for the execution of the MBB. It concerns data that are internal to the MBB which it does not get from other MBBs via its In-Connectors.

Clicking on one of the model names gives you access to the underlying model. In general, the dialog window that pops-up is organised in such a way that the (external) input, parameters, and output are displayed from top to bottom. For some MBBs, the structure of the dialog window might be different according to the features of the MBBs, such as the Economic model.

In WISE, the input and output are organised by *map*, *map file*, *graph*, *single value* and *table*. The user can find the detailed description about how to edit input and display

output by the categories of *map*, *map file*, *graph*, *single value* and *table* in the section Editing Input and displaying output.

Information on all of the underlying models and their data and parameters can be found in the Model description reports of WISE. For each individual model component, see the section Individual model components.

4.5 Individual model components

4.5.1 Climate model

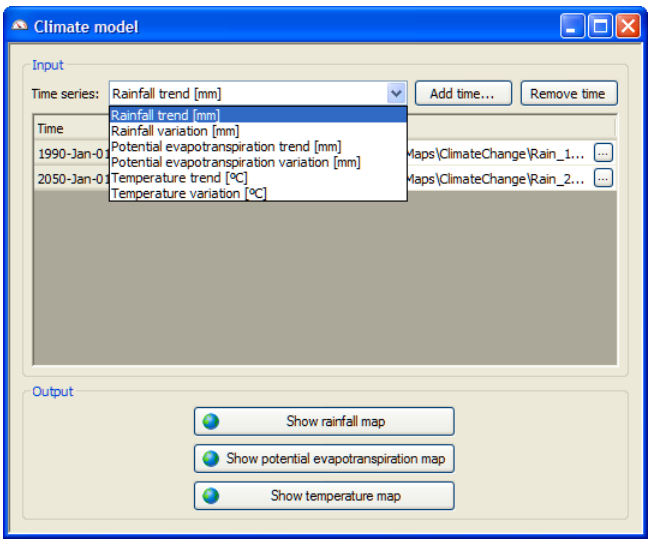
Projected changes to 2050 of New Zealand annual rainfall, temperature and potential evapotranspiration (PET) corresponding to three Intergovernmental Panel on Climate Change (IPCC) global greenhouses gases emissions scenarios (low, medium, and high) have been produced as input for the climate model in WISE.
To access the modeller user interface for the *Climate model,*

- Go to the Drivers tab of the Main window.
- Click the Parameters icon in the navigation pane on the left side of the window. The system diagram displays in the content pane on the right side of the window.
- Click the Climate change scenarios MBB box at the NZ & world level in the system diagram. The Climate model dialog window opens.

The Climate model dialog window is structured so that the Input and Output parts are displayed from top to bottom. In WISE, maps for six climate variables are required as the input in the climate change model. They are:

- Rainfall trend: the trend for mean annual rainfall
- Rainfall variation: the variation between the actual rainfall and the trend for rainfall
- Potential evapotranspiration trend: the trend for mean annual potential evapotranspiration (PET)
- Potential evapotranspiration variation: the variation between the actual PET and the trend for PET
- Temperature trend: the trend for mean annual temperature
- Temperature variation: the variation between the actual temperature and the trend for temperature

Depending on the climate change scenario, different maps and different combinations are used. For more information, see the section Predefined scenarios. These maps are raster maps with spatial resolution of 0.05° lat/long (approximately 5km) grid. The values of each map represent the mean annual values for that type of map.



On the top part of the Climate model dialog window, you can select the climate variable of interest from the dropdown list next to Time series. For all the variables, you can

change the map of interest by clicking on the browse button next to the specific time and upload a new map.

- For the trend type variables, such as rainfall trend, PET trend and temperature trend, you can add a map for a specific year by using the Add time… button on the right-top of the dialog window. The system calculates the interpolated values for the year that are not explicitly defined. You can also delete a map for a specific year by using the Remove time button the right-top of the dialog window.

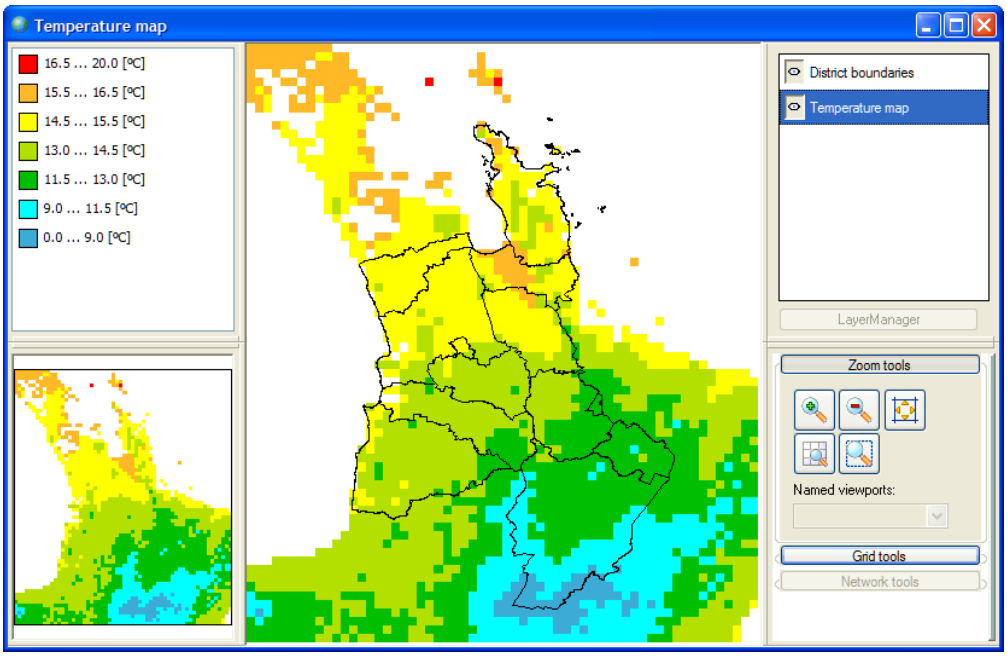
- For the variation type variables, such as rainfall variation, PET variation and temperature variation, the maps of 36-year period from 1972 to 2007 are used repeatedly for the period 1972-2007, 2008-2043 and 2044-2079. These data will be used to superimpose the natural year-to-year variations of these variables upon the climate change trends for each emission scenario to 2050. You can add a map for a specific year by using the Add time… button on the right-top of the dialog window. You can also delete a map for a specific year by using the Remove time button the right-top of the dialog window. If there is no variation map for a specific year, then the system takes value 0 as the variation for this map and for this year.

In WISE, 8 predefined sub-scenarios for the climate change have been incorporated in the scenario manager. For more information, see the section Predefined scenarios.

The climate map (rainfall map, PET map or temperature map) for a specific year is the sum of the climate trend map and the climate variation map for that specific year. For instance, the rainfall map for a specific year is the sum of the rainfall trend map and the rainfall variation map. It holds true for the PET map and temperature map.

On the lower part of the Climate model dialog window, you can view the climate maps for the current simulation year by clicking the Show ### button where ### represents the climate map of interest.

The values from the climate change scenarios will be used as input information for the Hydrology model.

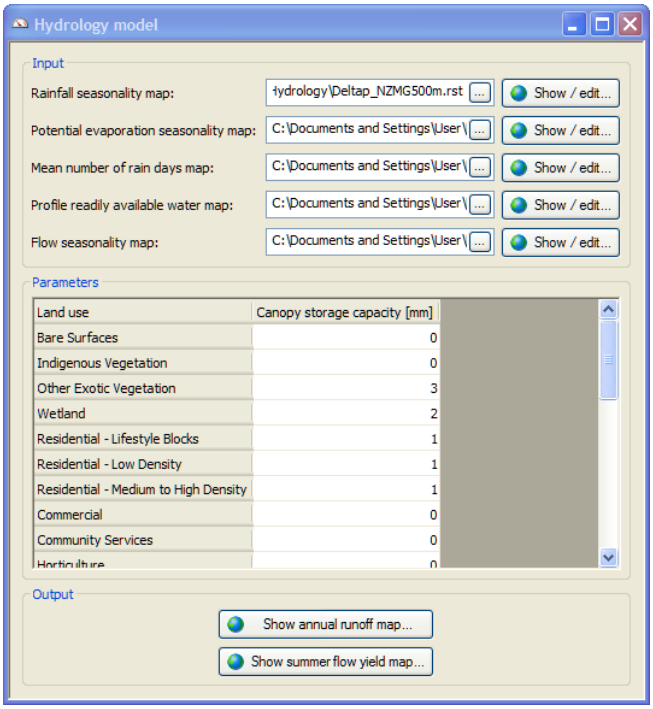


4.5.2 Hydrology model

The hydrology model is a simple hydrological simulation model for annual water runoff. It includes the impacts of spatially-varying climate, soil and vegetation hydrological response. The outputs of the model are the annual runoff for each year, and the expected water yield in the driest summer month.

To access the modeller user interface for the *Hydrology model,*

- Go to the Drivers tab of the Main window.
- Click the Parameters icon in the navigation pane on the left side of the window. The system diagram displays in the content pane on the right side of the window.
- Click the Hydrology MBB box at the Region level in the system diagram. The Hydrology model dialog window opens.



The Hydrology model dialog window is structured so that the Input, Parameters and Output parts are displayed from top to bottom. In WISE, besides the output from the climate change scenarios, six kinds of maps are required as the input in hydrology model. They are:

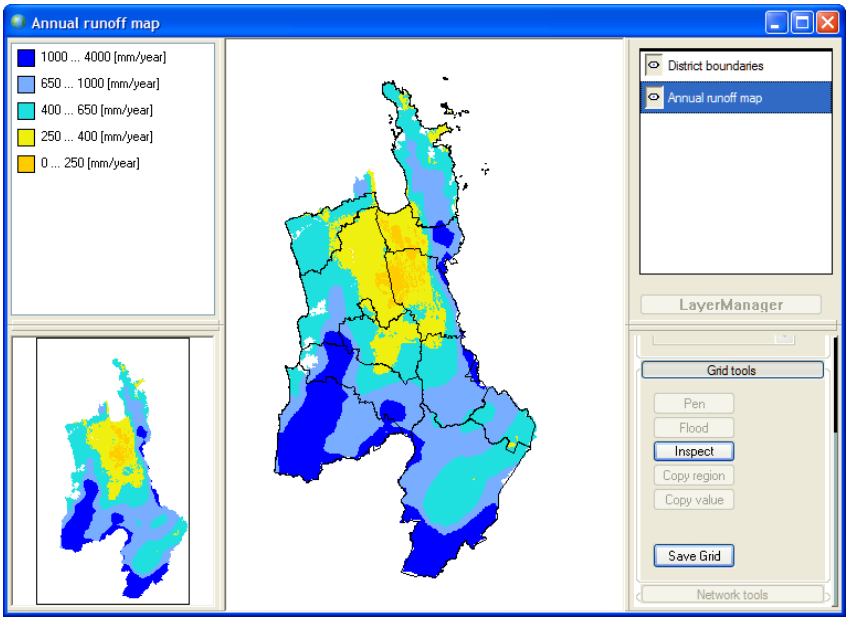
- Rainfall seasonality map
- Potential evaporation seasonality map
- Mean number of rain days map
- Profile readily available water map
- Flow seasonality map

These maps are raster maps with a spatial resolution of 500 meter.

In the Input part of the Hydrology model dialog window, you can view and edit the input maps for the hydrology model by clicking on the Show/edit… button next to the input map of interest.

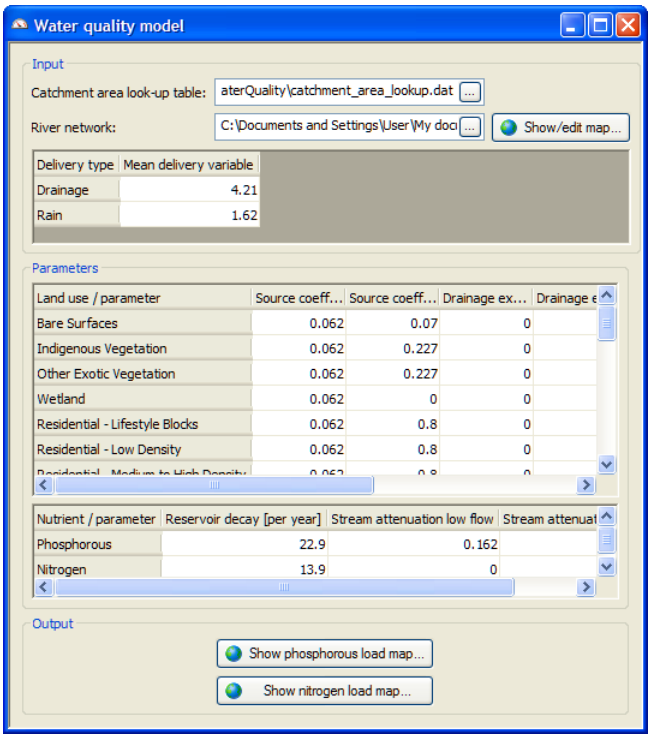
In the Parameters part of the Hydrology model dialog window, you can view and edit the Canopy storage capacity for each land use by clicking on the cell of interest and entering a new value. In the hydrology model, the changes in climate affect the rain and potential evaporation, whereas changes in vegetation affect mainly the water holding capacity of the plant canopy.

In the Output part of the Hydrology model dialog window, you can view the annual runoff map and the summer flow yield map for the current simulation year by clicking the corresponding button at the bottom.



4.5.3 Water quality model

The water quality model in WISE system is aimed at explaining and predicting average annual loads of nutrients from present and future distributions of point sources, climate, soil types, land slope, drainage characteristics, and land uses.



To access the modeller user interface for the *Water quality model,*

- Go to the Drivers tab of the Main window.
- Click the Parameters icon in the navigation pane on the left side of the window. The system diagram displays in the content pane on the right side of the window.
- Click the Water quality MBB box at the Region level in the system diagram. The Water quality model dialog window opens.

The Water quality model dialog window is structured so that the Input, Parameters and Output parts are displayed from top to bottom. In WISE, besides the information on climate and land use, two kinds of input are required in the water quality model. They are:

- Catchment area look-up table

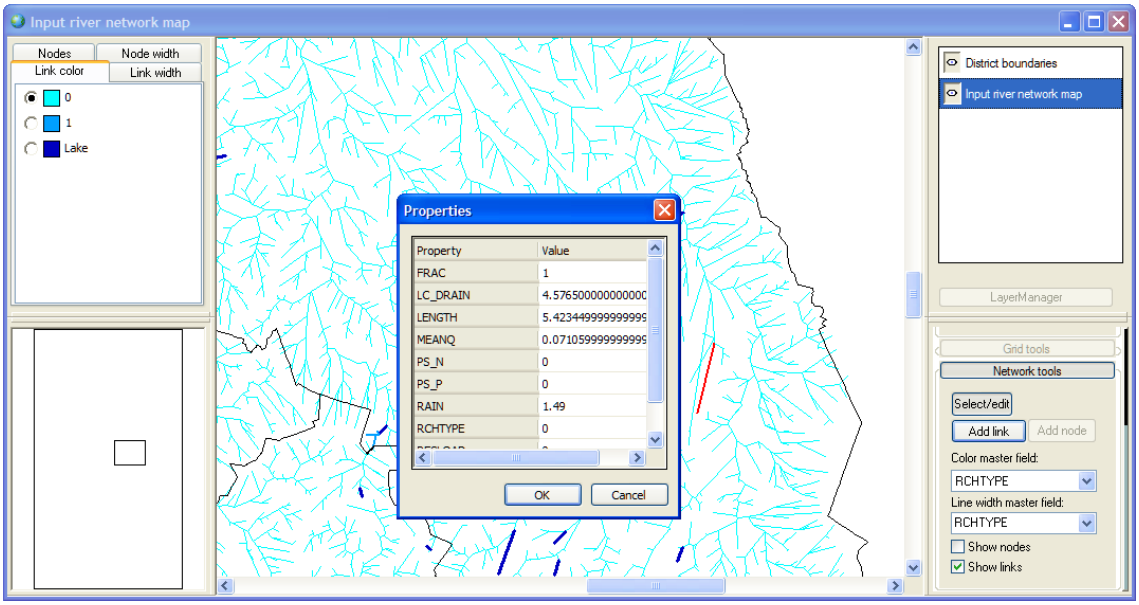
- River network map

You can upload a new catchment area look-up table by clicking the browse button next to Catchment area look-up table on the top of the window and double-clicking on the new file. The *catchment area look-up table* is a binary file containing the following information:

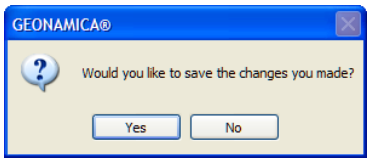
- A list of entries with for each entry
- Unsigned integer (32-bit) with row index in higher 16 bits and column index in lower 16 bits
- Unsigned integer (32-bit) with index of catchment where the index is the link ID in the river network
- Unsigned short (16-bit) with the area (in m2) of the cell that lies in the catchment

You can upload a new river network by clicking the browse button next to River network and double-clicking on the new map. The *river network* map is in shape format. The reach network is a dendrite system of reaches and nodes. Each reach has a single sub-catchment associated with it. A reach may also have a lake associated with it. Information on a reach and its associated catchment characteristics are stored in the properties table for each reach.

You can view the river network by clicking the Show/edit map… button next to River network. The Input river network map window opens. You can zoom in the area of interest and right-clicking on the reach of interest. The selected reach becomes red. Click on the Properties on the context menu. The Properties dialog window opens where you can edit the properties for the selected reach.



After editing the river network map, the system will ask you whether or not save the changes you made. Click on the Yes button and giving a new file name to save the changed river network map.

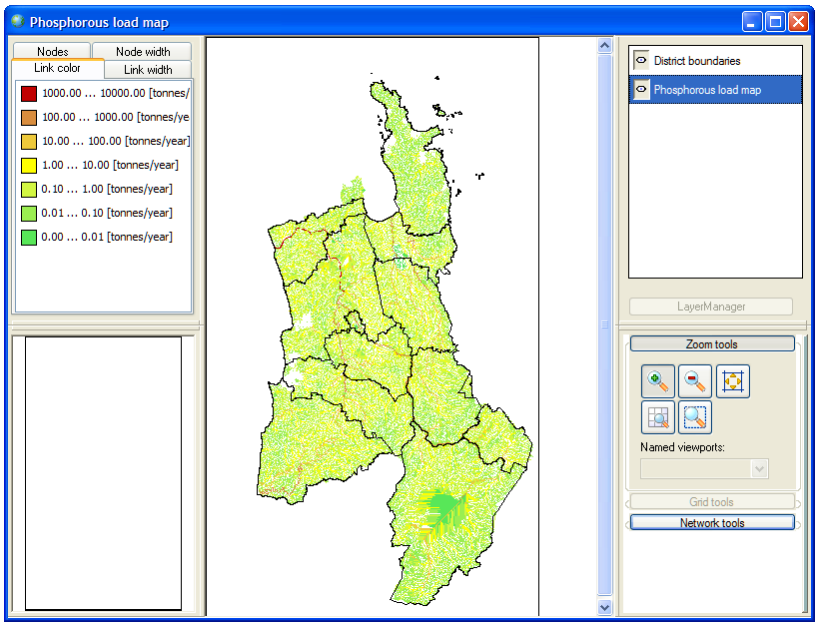


In the water quality model, the point sources of nutrients are delivered from land to water by two ways: drainage and rain. You can view and edit the mean delivery value over river network for each deliver type in the table in the Input part.

Delivery type	Mean delivery variable
Drainage	4.21
Rain	1.62

In the Parameters part of the Water quality model dialog window, you can view and edit the *source coefficient phosphorus*, *source coefficient nitrogen*, *drainage exponent phosphorus*, *drainage exponent nitrogen*, *rain exponent phosphorus* and *rain exponent nitrogen* for each land use in the Land use/parameter table. You can view and edit the *reservoir decay*, *stream attenuation low flow* and *stream attenuation high flow* per nutrient type in the Nutrient /parameter table.

In the Output part of the Water quality model dialog window, you can view the annual phosphorous load map and the nitrogen load map for the current simulation year by clicking the corresponding button at the bottom of the Water quality model dialog window.

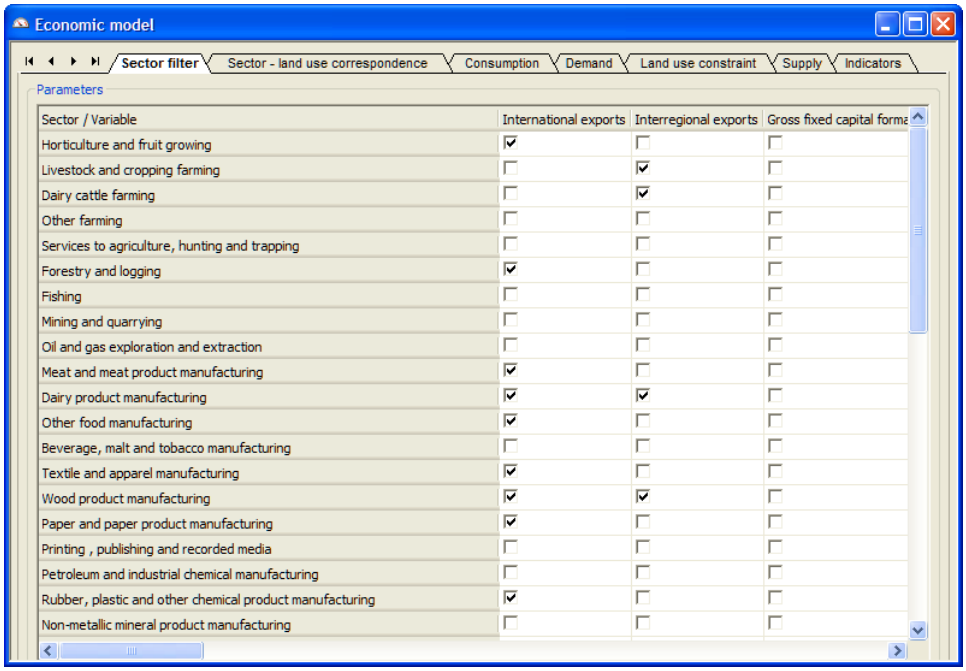


4.5.4 Economic model

The economic model in WISE is designed to simulate the combined environmental and economic implications of economic change in the Waikato Region. The model is driven by scenarios of economic growth.

To access the modeller user interface for the *Economic model,*

- Go to the Drivers tab of the Main window.
- Click the Parameters icon in the navigation pane on the left side of the window. The system diagram displays in the content pane on the right side of the window.
- Click the Economics MBB box at the Region level in the system diagram. The Economic model dialog window opens.



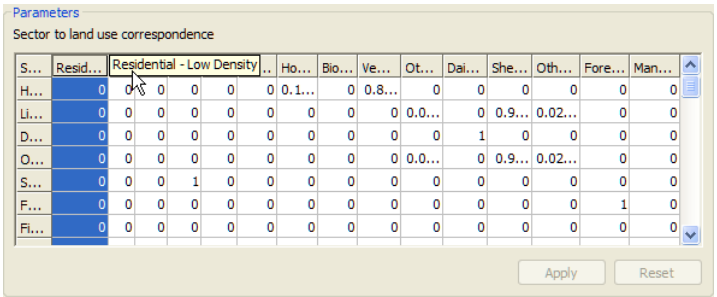
The Economic model dialog window is structured by 7 tabs: Sector filter, Sector-land use correspondence, Consumption, Demand, Land use constraint, Supply and Indicators.

4.5.4.1 Scroll bar and slider in the table

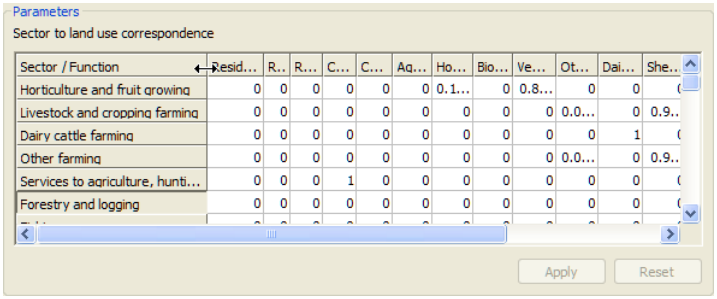
The *Scroll bar* is located the left top part of the dialog window. Four scroll buttons are positioned that enable the user to arrange the tabs of the dialog window in an easier way to work when the 6 tabs are not all displayed in the Economic model dialog window.

Use this command	To…
	Move to the left end tab
	Move tabs to left
	Move tabs to right
	Move to the right end tab

The Economic model dialog window mainly consists of tables. Some of the headings of the tables are not displayed completely. In general, the complete heading could be highlighted by moving the mouse pointer over the heading.



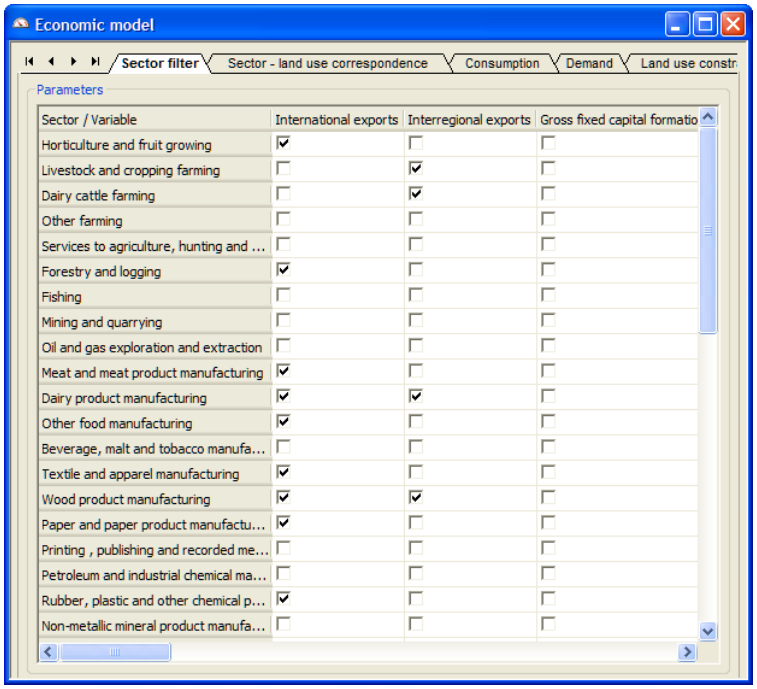
The slider can be used to resize the width of columns in the table. Move the mouse pointer to the border of two columns that you want to enlarge. Then press the left button of the mouse and drag to resize.



4.5.4.2 Sector filter

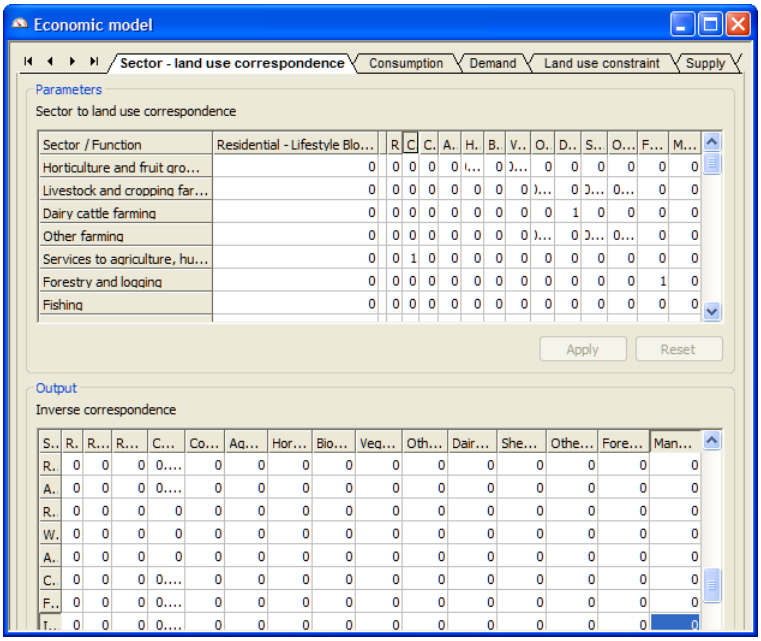
On the Sector – land use correspondence tab, the Parameters table consists of the 48 sectors of WRDEEM and the variables related to the external factor, policy measures and indicators. The sectors on the list will be filtered for display in the external factors, policy measures and economic indicators in WISE. A default selection is implemented in WISE.

You could adjust the selection by selecting/unselecting the check box in the row and column of interest. The selected sector (in row) will be displayed for the selected driver or indicator in the policy user interface.



4.5.4.3 Sector – land use correspondence

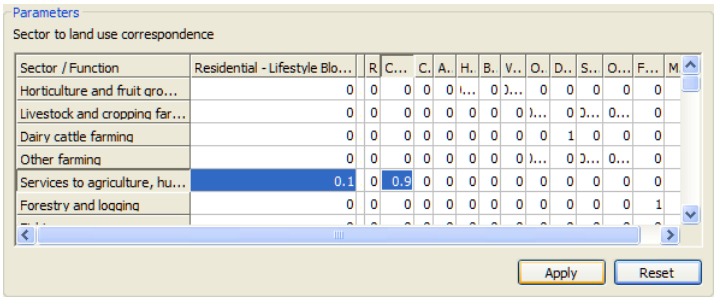
The Sector – land use correspondence tab is structured by the Parameters section and the Output section.



On the top of the Sector – land use correspondence tab, a default S*ector to land use correspondence* table is shown, representing the land use functions of the land use change model in the rows and the sectors in the columns. Here we specify the extent to which each land use function contributes to each sector. The ratio coefficients in the Sector to land use correspondence table are used to convert land use demand per sector to land use demand per function.

You can view or adjust the relation between land use functions and sectors by clicking on the corresponding cell in the table, and adjusting the ratio coefficient. Note that the values are fractions and that all fraction for one sector should add up to exactly 0 or 1.

Press the Apply button under the Sector to land use correspondence table to confirm the modification. One system message window will pop up to remind you to reset the coefficients if the values for each sector don't sum to 0 or 1. The system enables you to undo changes in coefficients you have made since its last applied state by means of the Reset button in the Economic model dialog window. The Apply button and Reset button are only active after a change has been made.



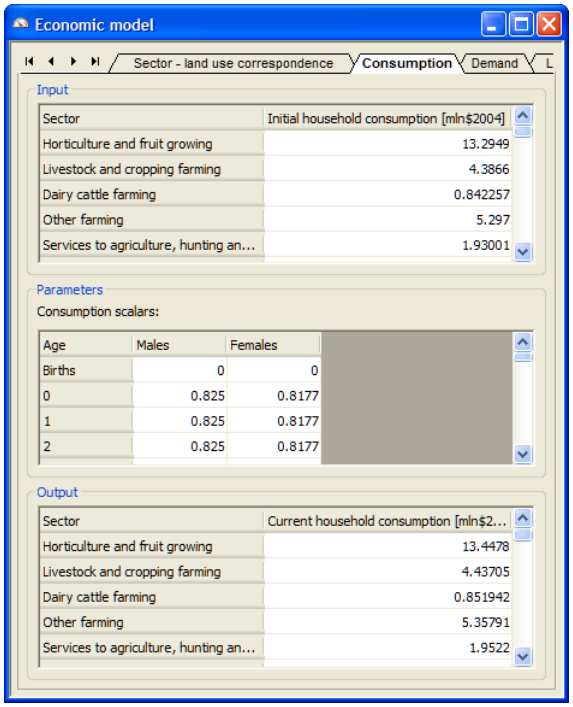
On the bottom of the Sector – land use correspondence tab, you find the Inverse correspondence table representing the land use functions of the land use change model in the rows and the sectors in the columns. Here the outputs of the extent to which each sector contributes to each land use function are shown. The ratio coefficients in the Inverse correspondence table will be used to convert land use demand per function at the local level to land use demand per sector at the regional level. In the inverse correspondence table, all fraction for one function should add up to exactly 0 or 1

The values of the Inverse correspondence table are updated over time. You can observe the change of the Inverse correspondence table after taking one step

simulation if the change of the ratio coefficients has been made in the Sector to land use correspondence table.

4.5.4.4 Consumption

The Consumption tab is structured by Input, Parameters and Output section. You can review and edit the inputs in the table of Input section. This represents the initial household consumption per sector for the start year of the simulation.

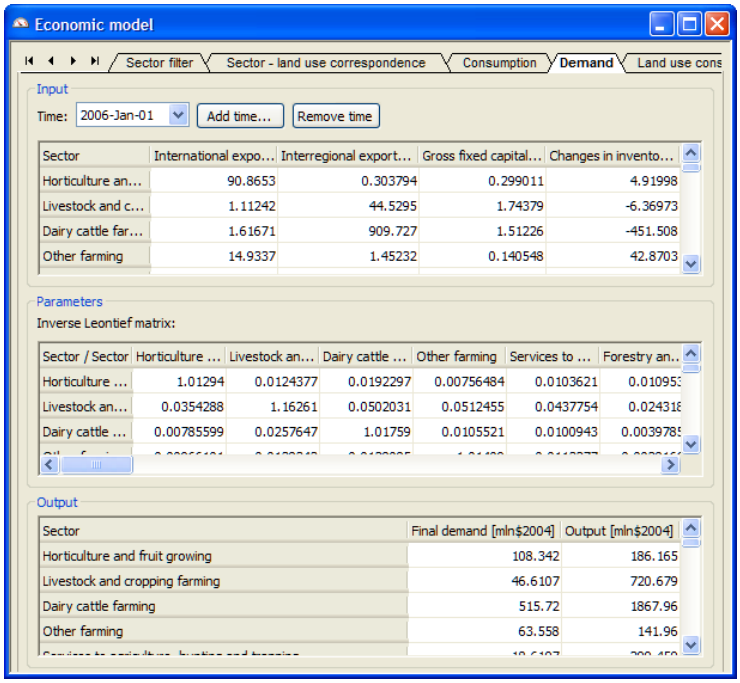


In the middle of the Consumption tab, you can review or edit the consumption scalars per age-sex cohort in the table of the Parameters section. The consumption scalars are used to convert the outputs from the population model to the average person equivalent.

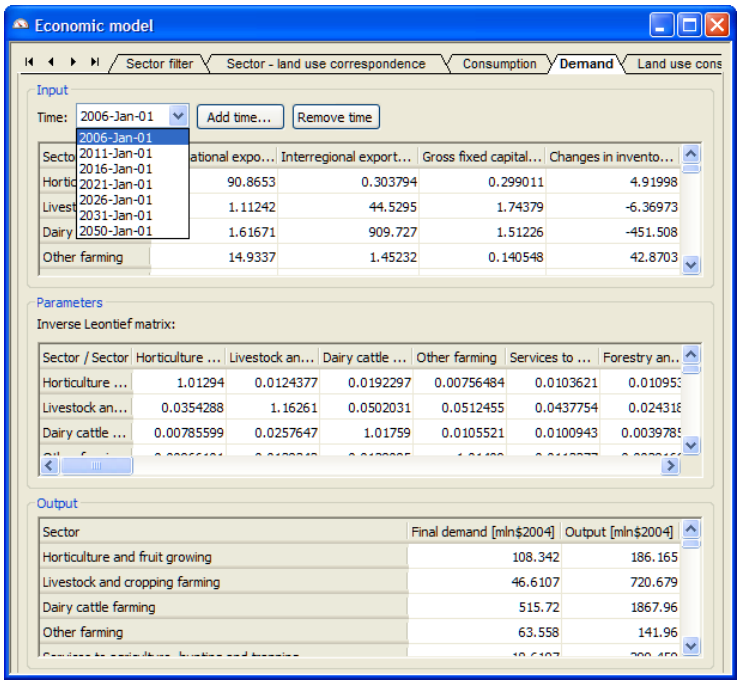
On the bottom of the Consumption tab, it features the output of the current household consumption for each sector. The values of the Current household consumption table are updated over time. You can observe the changes in the Current household consumption table after taking one step simulation. However, in order to have the consistent parameter values over time, it is suggested to reset the simulation before running it.

4.5.4.5 Demand

The Demand tab is split in 3 parts by sections: Input, Parameters and Output section.

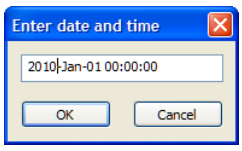


In the Input table of the Demand tab, the system allows you to edit the input of *International exports*, *Interregional exports*, *Gross fixed capital formation* and *Changes in inventories* for a specific year.

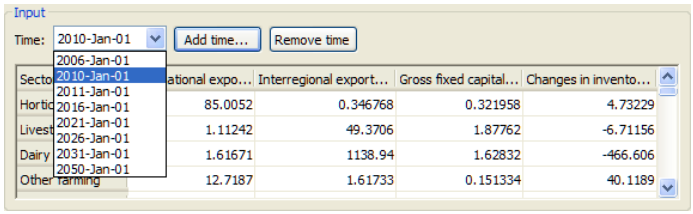


You can select a specific year from the dropdown list Time. The table then shows the input for this selected year. You can edit the values per specific year.

The system enables the user to edit the time list by using the *Add time* function and the *Delete time* function. The Enter data and time dialog window opens when the Add time… button is clicked. You can enter the specific time in the text box of the Enter data and time dialog window.



After you press OK, the specific time will be displayed immediately on the dropdown list Time. The system takes the interpolated value for the new added time on the basis of the values for the specific years on the dropdown list.



You can easily delete the table for one specific year by selecting this specific year on the dropdown list next to Time and press the Remove time button on the top. A message window opens. Press the Yes button of the message window to carry out the action of deleting table for the selected year. Press the No button of the message window to cancel the action of deleting table for the selected year.

In the middle of the Demand tab, the *Inverse Leontief matrix* from sector to sector is editable in the Parameters section. The inverse Leontief matrix shows how the output of one sector is an input to each other sector. Each column of the inverse Leontief matrix reports the monetary value of a sector's inputs and each row represents the value of a sector's outputs. Suppose there are three sectors. Column 1 reports the value of inputs to sector 1 from sectors 1, 2, and 3. Columns 2 and 3 do the same for those sectors. Row 1 reports the value of outputs from sector 1 to sectors 1, 2, and 3. Rows 2 and 3 do the same for the other sectors.

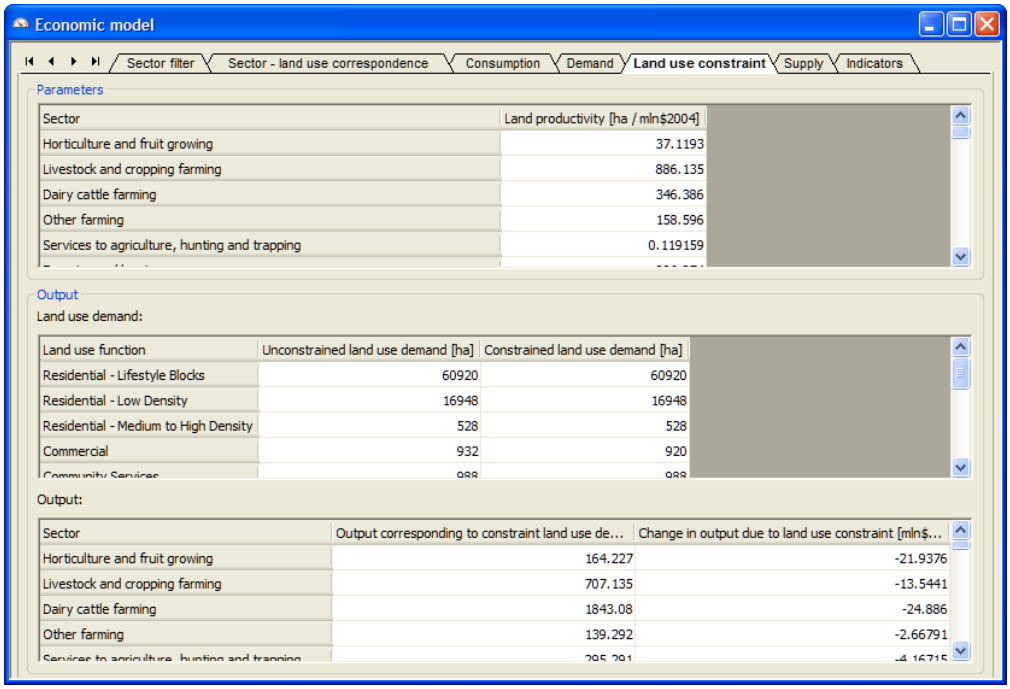
On the bottom of the Demand tab, the output of the *Demand* module includes the *Final demand* and the *Output* in mln$2004 per sector. The outputs are updated dynamically over the simulation period.

- The *Final demand* of the Demand tab is calculated on the basis of *International exports*, *Interregional exports*, *Gross fixed capital formation*, *Changes in inventories* and the *Current household consumption* in the Consumption tab.
- The *Output* per sector of the Demand tab is the output of all sectors which are caused by the *Final demand* for this specific sector.

4.5.4.6 Land use constraint

After the *Final demand* and *Output* of the Demand module are calculated, the land use demand estimated in the *Land use model* are taken into account as depicted on the Land use constraint tab. This Land use constraint tab is split into Parameters section and Output section.

On the top of the Land use constraint tab, you can view and edit the *Land use productivity* per sector. The *Land use productivity* is used to convert the mln$2004 per sector to hector and vice versa.



On the bottom part of the Land use constraint tab, two tables are displayed as the outputs which are updated over the simulation period.

- The *Unconstrained land use demand* per land use function is the demand from the economic model.

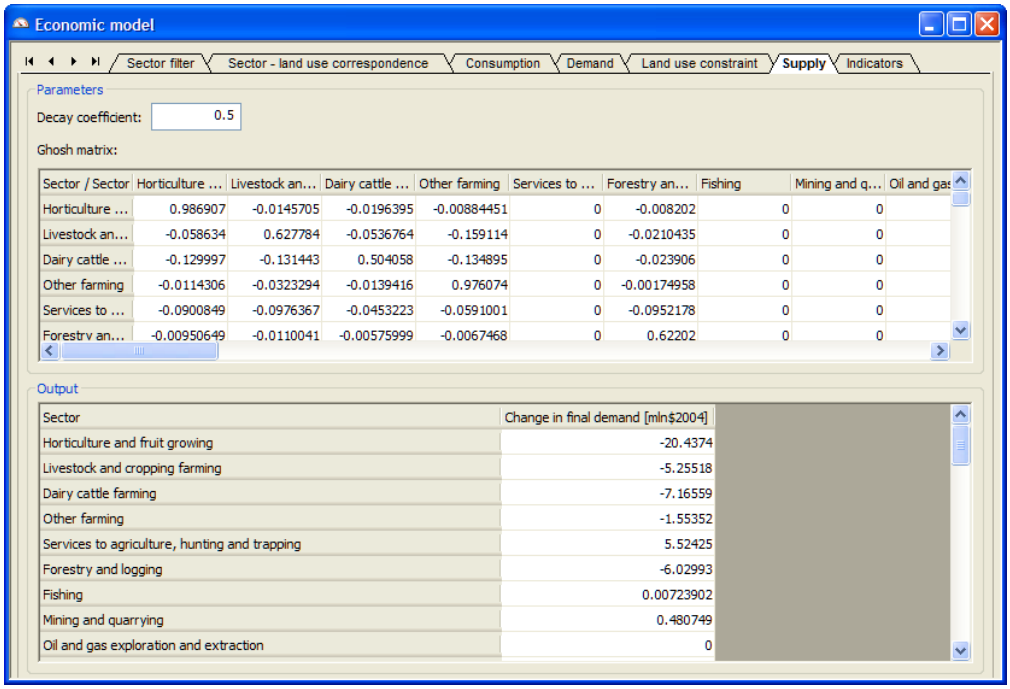
- The *Constrained land use demand* per land use function is the demand that could be allocated, as constrained by the available space in the land use change model.

- The *Output corresponding to constraint land use* per sector is output based on the constrained demand from the land use change model.

- The *Change in output due to land use constraint* per sector is the difference between *Output corresponding to constraint land use* and the *Output* of the Demand tab. It therefore expresses the missed economic opportunity due to a lack of available space.

4.5.4.7 Supply

The Supply tab is split in 3 parts: Input, Parameters and Output section.

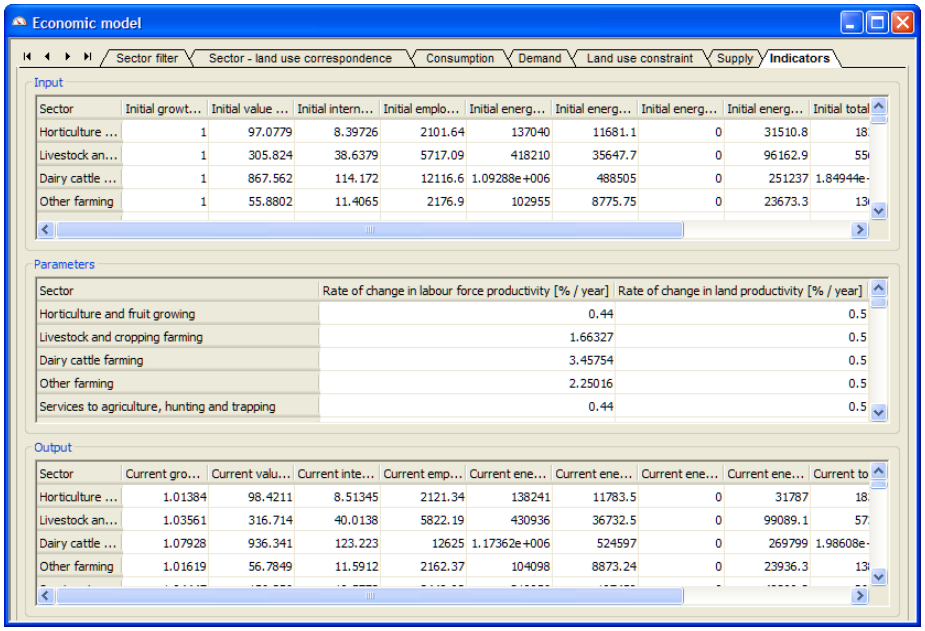


On the top part of the Supply tab, the system allows you to view and edit the *Ghosh matrix* from sector to sector.

On the bottom part of the Supply tab, you can observe the *Change in final demand* per sector which is updated over the simulation period.

4.5.4.8 Indicators

The Indicators tab is structured by the Input, Parameters and Output sections.



On the top of the Indicators tab, it shows the Input table where you can view and edit the initial values of the indicators per sector for the start year of the simulation. It should be noted that the initial value must be non-negative.

In the Parameters table you can view and edit the *Rate of change in labour force productivity* and the *Rate of change in land use productivity* per sector. On the bottom, you can see the output of indicators per sector.

- The *Current growth factor* in the first column of the Output table shows the ratio of output in the current year to the one in the previous year.

- The *Current value added* and *current employment* take into account the *current growth factor* and their values in the previous year.
- The *Current international imports* take into account the *Current growth factor* and the *Initial international imports*.
- The *Current employment* takes into account their values in the previous year, the *current growth factor* and the *Rate of change in labour force productivity*.
- The rest indicators of the Output table take into account their values in the previous year, the *current growth factor* and the *Rate of change in land use productivity*.

4.5.5 Population model

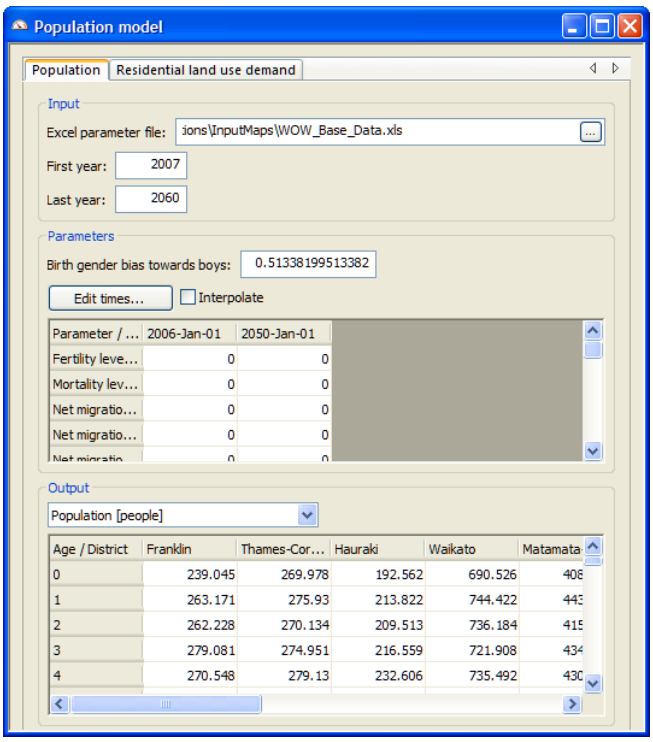
The population model in WISE system generates possible future populations, referred to as population projections, starting from a given base population and assumptions about the demographic processes of fertility, mortality and migration.
To access the modeller user interface for the *Population model,*

- Go to the Drivers tab of the Main window.
- Click the Parameters icon in the navigation pane on the left side of the window. The system diagram displays in the content pane on the right side of the window.
- Click the Demography MBB box at the District level in the system diagram. The Population model dialog window opens.

The Population model dialog window is composed of two tabs: Population and Residential land use demand.

4.5.5.1 Population

The Population tab on the Population model dialog window is structured so that the Input, Parameters and Output parts are displayed from top to bottom.



All data inputs to the population model (base population, migration rates, fertility rates, and survivorship rates) are contained in a Microsoft Excel spreadsheet. This Excel parameter file includes the data necessary required by the population model for a simulation:

- *Survivorship rates* by single year of age and gender per district
- *Fertility rates* by single year of age for all females aged 13-49 per district
- *Base population* by single year of age and gender per district
- Additional migration from Economic Development Assumptions (EDA) per district
- *Migration rates* by single year of age and gender per district

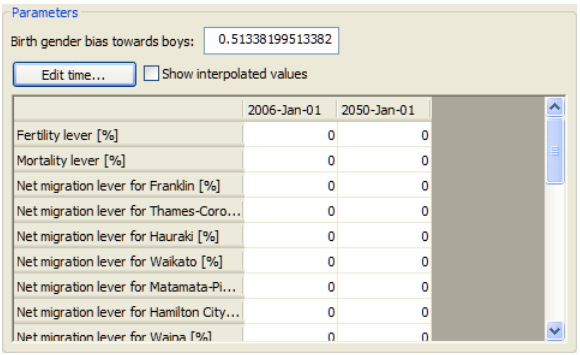
In the Input part, you can upload a new population parameter file by clicking the browse button next to Excel parameter file.

You can view and edit the first year and the last year of the data in the Excel parameter file in the text box next to First year and Last year, respectively. The *column B* of each sheet in the excel parameter file is interpreted as the year that you determined in the text box next to First year. The year in the text box next to Last year just indicates the range of columns of each sheet that are available in the excel parameter file.

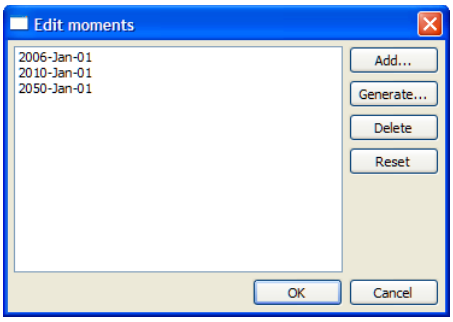
In the Parameter part of the Population model dialog window, first of all, you can view and change the value for Birth gender bias towards boys.

The survivorship rates, fertility rates, and migration rates in the population model can all be altered in order to test the effect of different policies on the projected population. Of course, this would require some assumptions to be made about the impact of policies on the demographic variables. These policy levers are displayed in the table of the Parameters part: *Fertility lever*, *Mortality lever*, *Net migration lever* per district and *EDA population effect* per district in the start year and the end year of the simulation. The system takes the interpolated values for other years.

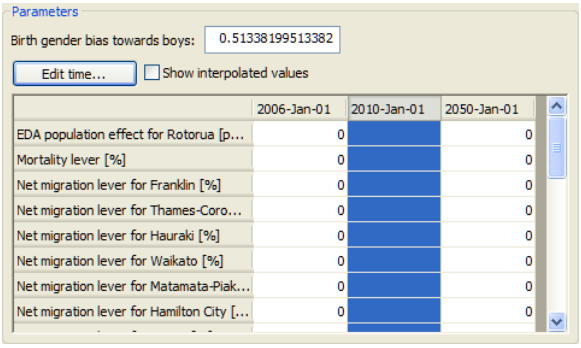
- Fertility lever: the percentage of increase or decrease for the fertility rate
- Mortality lever: the percentage of increase or decrease for the mortality rate
- Net migration lever: the percentage of increase or decrease for the net migration rate
- EDA population effect: the number of additional people that migrate to a region based on economic development assumptions



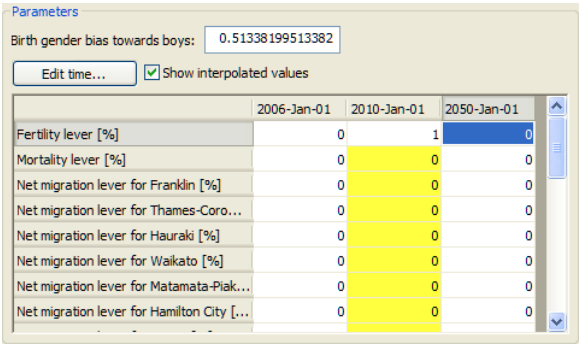
You can view or edit the value by clicking the cell of interest and entering a new value.



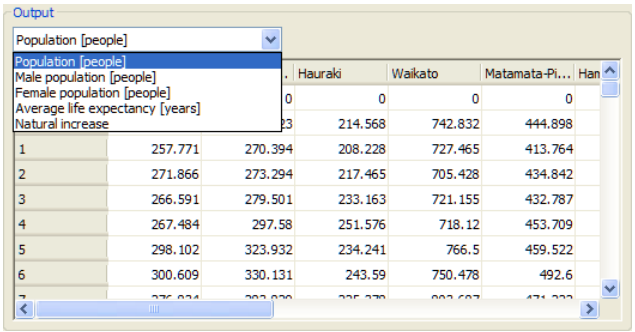
You can specify values for these parameters for a specific year. To add or remove a year, click on the Edit time… button on the top of the table. The Edit moments dialog window opens. Press the Add… button to add a specific year. Press Generates… to create a series of years. Click the Delete button to remove the selected year on the list. The system enables you to undo changes in moments you have made to its last applied state by means of the Reset button in the Edit moments dialog window. Click the OK button to confirm the changes that you made and close the Edit moments dialog window.



An empty column for the newly added year is displayed in the table. Select the check box next to Interpolate. The system takes the interpolated value for the newly added time on the basis of the values for its closest defined years in the table. The interpolated values are highlighted with yellow background. You can specify the values for the newly added time as well. Once you give a specific value for a parameter and for the newly added time, this cell is displayed with a normal white background again.

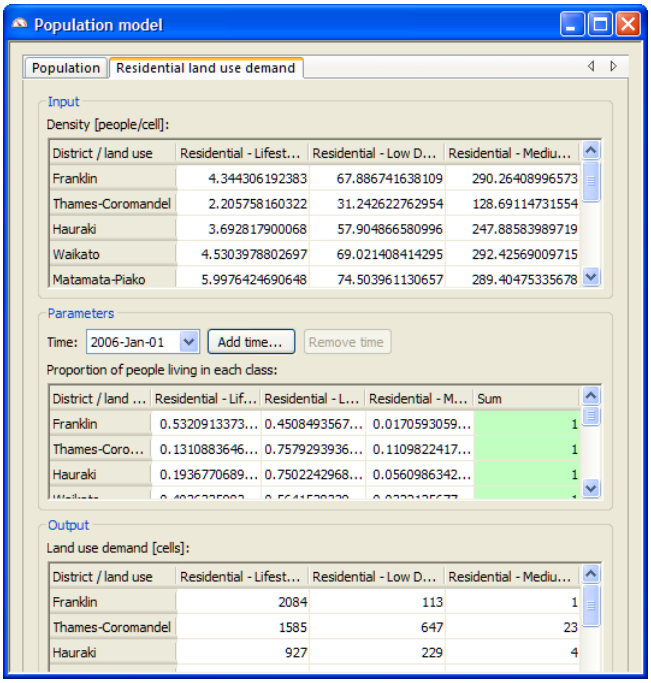


In the Output part of the Population tab, you can view the output for total population, *male population* and *female population* by single year of age and per district for the current year of the simulation. You can also view the *average life expectancy* by gender per district and the *natural increase* in people and in percentage per district for the current year of simulation. Click the dropdown list under Output and select the variable of interest. The results for this variable are displayed in the table.



4.5.5.2 Residential land use demand

The Residential land use demand tab on the Population model dialog window is structured so that the Input, Parameters and Output parts are displayed from top to bottom.

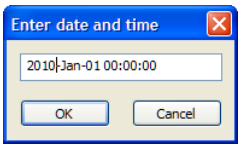


The table in the Input part shows the population density per residential land use class and per district. You can view and edit the density in this table. The residential land use classes include:

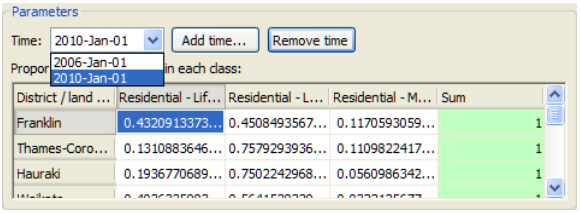
- Residential – Lifestyle blocks
- Residential – Low density
- Residential – Medium to high density

In the Parameters part of the dialog window, the proportion of people that live in each residential class is displayed per district and for the selected year. You can view and edit these values by clicking the cell of interest and entering a new value. The sum of the proportions of people for each district should be exactly 1. If this is true, the Sum column in the table is highlighted with green background; otherwise, it will be highlighted with red background. That means you should change the values for that district to meet the condition that the sum of the three residential classes should be 1.

The values of the proportions of people for the start year of the simulation are given by default. You can specify the values of proportion of people for a specific year. To do so, click the Add time… button in the Parameters part. The Enter date and time dialog window opens. In the text box, you can enter a new year for which you want to specify the values. Once you press the OK button, the newly added year will be displayed on the dropdown list next to Time on the Residential land use demand tab.

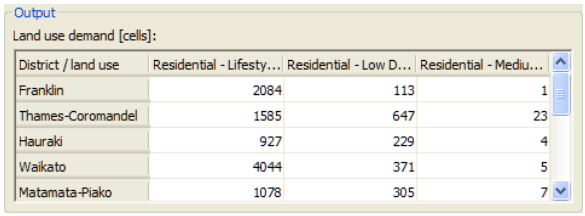


By default, the system takes the values for the previous specified year as the values for the newly added year. Select the newly added year from the dropdown list next to Time. You can now view and specify the values for this year in the table. The system takes the values for undefined years on the basis of linear interpolation of the values for its two closest defined years.



You can remove the added year(s) from the dropdown list next to Time by clicking on the Remove time button on the top of the table. The start year of the simulation is not removable.

In the Output part of the Residential land use demand tab, the table shows the land use demand in cells per residential land use class and per district for the current simulation year.



4.5.6 Land use change model

To access the modeller user interface for the *Land use change model*

- Go to the Drivers tab of the Main window.
- Click the Parameters icon in the navigation pane on the left side of the window. The system diagram is displayed in the content pane on the right side of the window.
- Click the Land use MBB box at the Local level in the system diagram. The Land use change model dialog window opens.

4.5.6.1 Land use classes

Land use is classified in categories, some of which are modelled dynamically while others remain static. Dynamic land uses are called *Functions* or *Vacant* land uses.

- *Vacant* states are classes that are only changing as a result of other land use dynamics. Computationally at least one vacant state is required. Typically abandoned land or natural land use types are modelled as vacant state, since they are literally vacant for other land uses or the result of the disappearance of other land use functions.

- *Functions* are land use classes that are actively modelled, like residential or industry. Functions change dynamically as the result of the local and the regional dynamics.

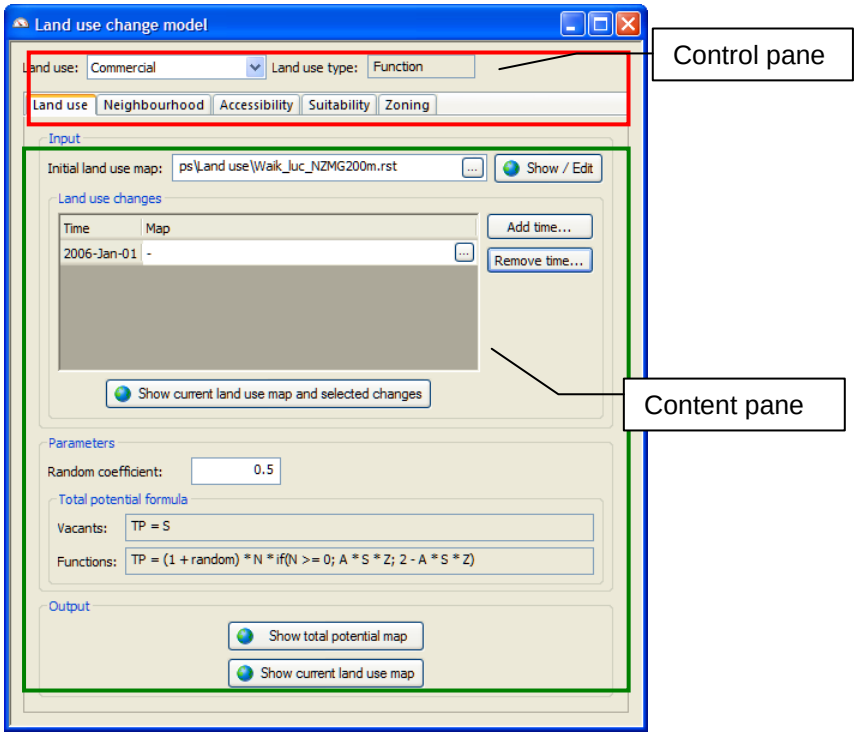
The non-dynamic land uses are called *Features*. Features are land use classes that are not supposed to change in the simulation, like water bodies or airports. However, they do influence the dynamics of the *Function* land uses, and thus influence their location. For example a *Function* 'Tourism' would be influenced (expressed by a spatial interaction rule) by the occurrence of the *Feature* 'Beach', due to the simple fact that tourists tend to recreate near the sea at the beach.

In WISE, the following land uses are modelled:

Land use	States
Bare Surfaces	Vacant
Indigenous Vegetation	Vacant
Other Exotic Vegetation	Vacant
Wetland	Vacant
Residential - Lifestyle Blocks	Function
Residential - Low Density	Function
Residential - Medium to High Density	Function
Commercial	Function
Community Services	Function
Horticulture	Function
Biofuel Cropping	Function
Vegetable Cropping	Function
Other Cropping	Function
Dairy Farming	Function
Sheep, Beef or Deer Farming	Function
Other Agriculture	Function
Forestry	Function
Manufacturing	Function
Marine	Feature
Aquaculture	Feature
Utilities	Feature
Mines and Quarries	Feature
Urban Parks and Recreation	Feature
Fresh Water	Feature
Airports	Feature
Land Outside Study Area	Feature
Marine Outside Study Area	Feature

4.5.6.2 Overview

The Land use model dialog window has been grouped in so-called *Control pane* and *Content pane* which are indicated in the red and in the green frame respectively in the figure depicted below.



In the control pane, you can select a land use class of interest in the land use change model from the dropdown list next to Land use. The selected land use type is displayed on the right side of the control pane.

The content pane is structured by tabs. Each tab has its own dialog window allowing you to set parameter values and view results. The content of these dialog windows for the same tab can differ per land use type.

The content pane is structured by Land use tab, Neighbourhood tab, Accessibility tab, Suitability tab and Zoning tab.

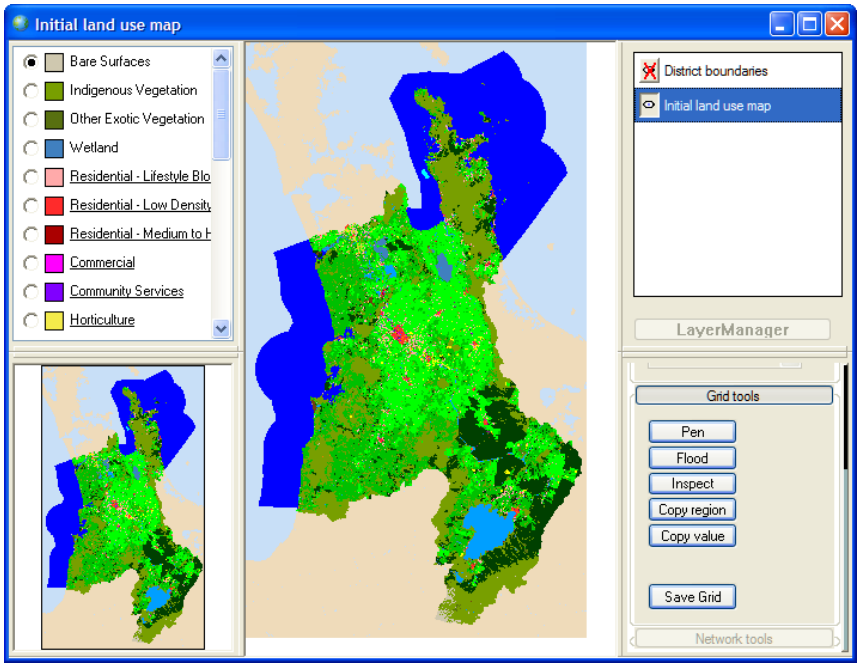
Most of the contents in the content pane are related to the selected land use in the control pane except that the Input and Parameters parts on the Land use tab, Neighbourhood tab and Zoning tab are for all the land uses.

4.5.6.3 Land use

Click the Land use tab to access the contents depicted as the figure above.

The Input part is on the top of the Land use tab. The system allows you to view or edit the initial land use map here. You can change the initial land use map by clicking on the browse button next to Initial land use map and selecting the file that you want to import.

A Map window of Initial land use map opens after pressing the Show/Edit… button on the left side of the text box. You can view or edit the initial land use map via the map window. For more information about how to work with an editable map, see the section Editable map.



Land use changes after the start year of the simulation can be incorporated as *land use deltas*. These can be used to change the presence or location of the incorporated feature classes. Since vacant and function classes are allocated by the model, changes in these cannot be made explicitly in the system. It is recommended to prepare your land use deltas map in a GIS package before you import it into WISE. The land use delta map should only include the information on the land use feature classes. If you have a new land use map for a specific year, you can extract the location of the land use feature classes in a GIS package into a new land use delta map. This new extracted map will be used as one land use delta for specific year.

You can use the Add time… or Remove time… button to add or delete the land use changes. The description about how to add or delete the map files is available in the section Map file.

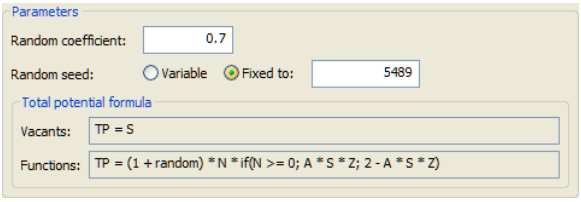
When you move the mouse over a land use change on the map file list and click on it, this land use change is highlighted with blue background. Then press the Show current land use map and selected changes… button at the bottom of Input section, and a Land use changes map window opens which is an overlay of the land use map for the current simulation and the selected land use changes.

The Parameters part is in the middle of the dialog window. You can edit and view the general parameters for the land use change model here: Random coefficient and Total potential formula. These parameters work for all the land uses. In this version of software, the total potential formula is not editable.

The random coefficient controls the stochastic perturbation effect to simulate the effect of unpredictable occurrences. The system enables you to enter the Random coefficient in the Parameters part on the Land use tab. The value of this parameter must be not less than 0. According to our experience, range of (0, 2) is recommended. A value of 0 means no random effects.

You can determine the *Random seed* to run the simulation.

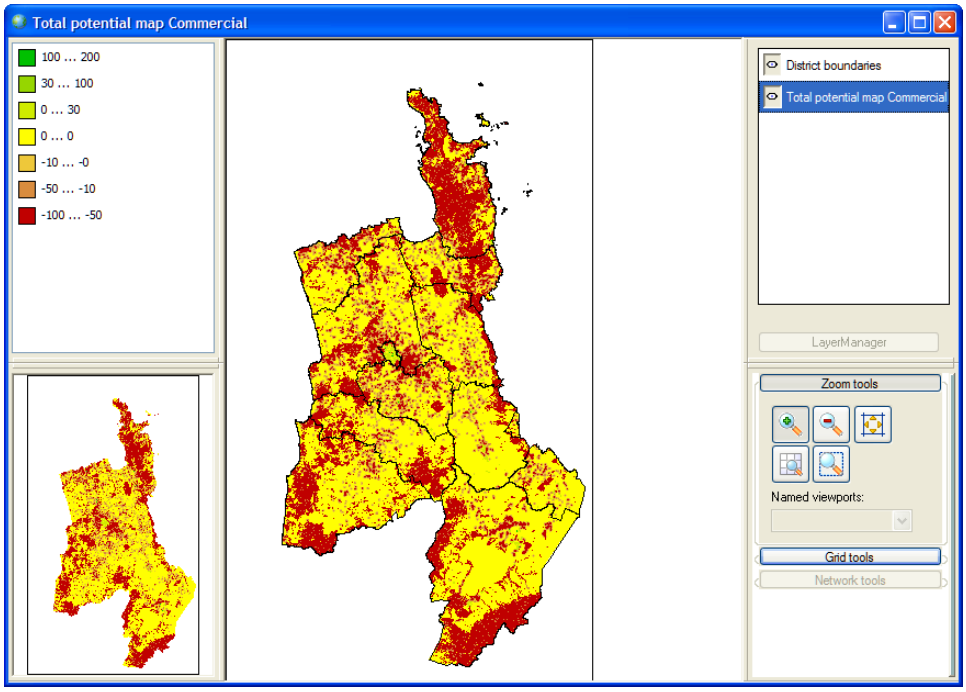
- Select the radio button next to Variable to run the simulation in full random mode.
- Select the radio button next to Fixed to run the simulation in a pseudo-random mode. You can enter the number of random seed in the text box next to Fixed to.



The total potential for *function* states combines the effect of the *neighbourhood*, *suitability*, *zoning* and *accessibility*. The total potential for *vacant* states is a function of its suitability only. The default total potential algorithm is displayed in the text box under Total potential formula.

There are two kinds of output maps on the Land use tab: the total potential map and the current land use map.

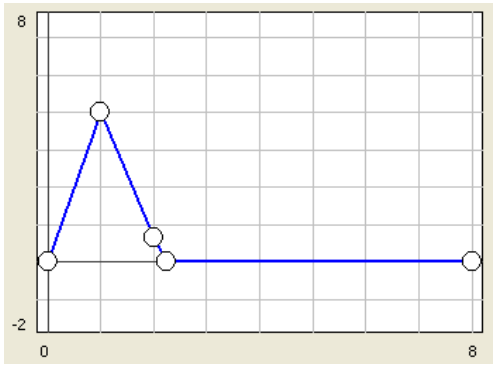
You can view the total potential map of the current simulation year for the selected vacant or function land use by pressing the Show total potential map button in the Output part. A potential map displays the transition potential of a cell to allocate to the land use specified. On the basis of the transition potentials the model decides which land use will be allocated to each cell in the next simulation step. Colours in the total potential map range from red to green. Cells in red are not attractive for the indicated land use. In contrast, the green cells are. In the legend of the potential map you find next to the colour symbol two numbers. The figure to the right is the upper limit of the category. The figure to the left is the lower limit. Since the total potential map is only calculated for each vacant and function land use, the Show total potential map button in the Output part is not available for feature land uses.



You can view the land use map of the current simulation year by pressing the Show current land use map button in the Output part.

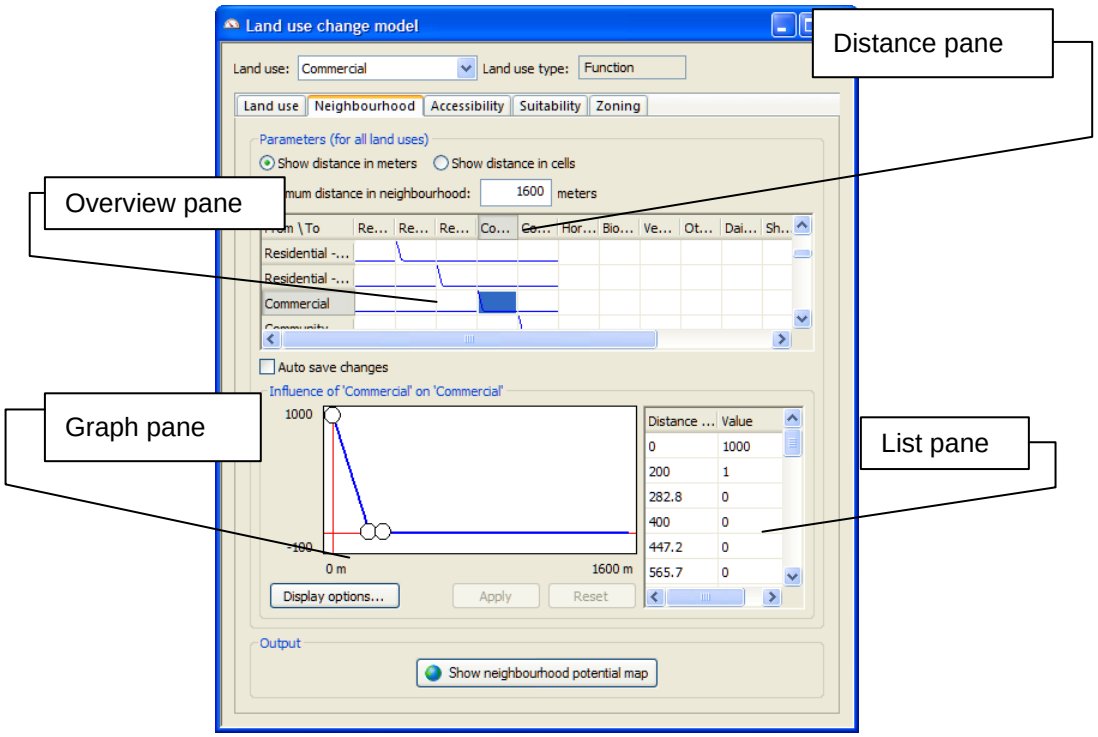
4.5.6.4 Neighbourhood

The neighbourhood rules table displays the influence land uses have on each other, as used by the land use change model. For example, people do not like to live close to an industrial area, so industry will have a negative influence on housing that decays as the distance between the two places increases.



The influence that a certain land use has on another land use (or itself) is described as a function of the distance between two cells (a so-called spline), which is made up of a series of points that are connected. An example of such a function is shown in the figure above, where the points are connected by linear interpolation. In this graph, the distance runs along the horizontal axis and the vertical axis displays the influence that land use A has on land use B. We see that, when land use A and B are situated at a distance of 1 (cells), land use B has a positive effect on land use A of approximately 5.

Click the Neighbourhood tab to access the contents depicted as the figure below. The dialog window is divided by 4 panes: Overview pane, Graph pane, Distance pane and List pane.

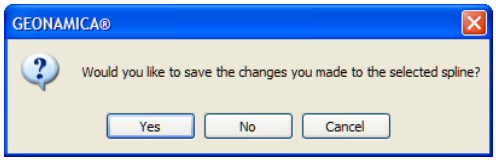


We now describe all the functionality on the Neighbourhood tab dialog window, as indicated in the figure above.

In the *Distance pane*, you can determine the units for displaying the distance in the neighbourhood in the list pane and the graph pane, either in meters or in cells.

In the *Overview pane*, the influence table displays the influences of each land use on each function land use: *From… To….* Some of the cells in this table show what the spline that describes the corresponding influence looks like. If a spline is flat (0 influence for all distances), it is not displayed in the table. Click on a cell in the table to select that interaction rule. The spline that describes that influence is displayed in the *Graph pane* of the dialog window.

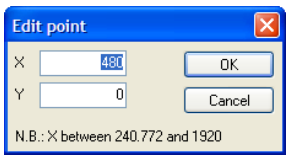
Auto save changes. When you select another cell in the influence table or when you close the Land use change model dialog window, if the check box is selected, changes that you made will automatically be saved; if not, when you activate another rule, a window will pop-up and ask you whether or not to save the change that you made.

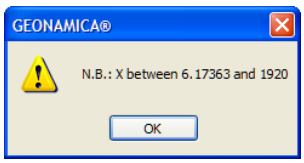


In the *Graph pane*, the *Spline graph* displays the neighbourhood rule that is currently selected in the influence table. You can find the name of this rule above the graph. The x-axis represents the *Distance* and the y-axis represents the *Value* of influence. The points of the spline are displayed as small circles, which are connected by a blue line.

- Points in the graph can be moved by dragging them with the mouse. When you click on a point, it turns red. Holding *Ctrl* or *Shift* and clicking on a point will (de)select multiple points. If you hold Ctrl or Shift, you can also make a selection rectangle by dragging with your mouse. All points within the selection rectangle will be added to the selection when you release the left mouse button. By selecting several points, you can move all of them without affecting their mutual relation, with the constraint that points cannot be dragged outside the graph area.

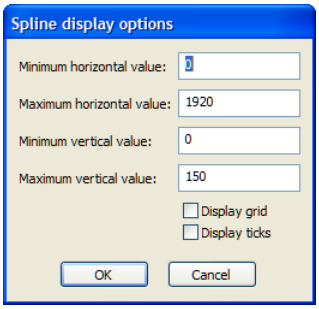
- Right-clicking on a point in the graph will open a small dialog that allows you to view or enter the coordinates of a point, as shown in the figure below. At the bottom of this Edit point dialog window, a note for the range of X values is given. You can only enter values for X that fall in this range; otherwise a message pop-ups to remind you again of this range. Next paragraph describes how to determine the ranges of X and Y.





Display options. This opens the Spline display options dialog window as shown in the figure below. In this dialog window, the extent of the graph can be altered.

- The system allows you to determine the range of the x- and y-axis enter the lower and upper bounds in the text boxes.
- When the Display grid check box is checked, grids are drawn in the *Graph pane*. When the Display ticks check box is checked, vertical lines at all possible cell distances are drawn in the *Graph pane*.



Apply. This will save changes you have made to the current spline. It is available only after you made a change.

Reset. This will undo changes you have made to the current spline, by resetting it to its last saved state. The Reset button is available only after a spline is changed and before you press Apply.

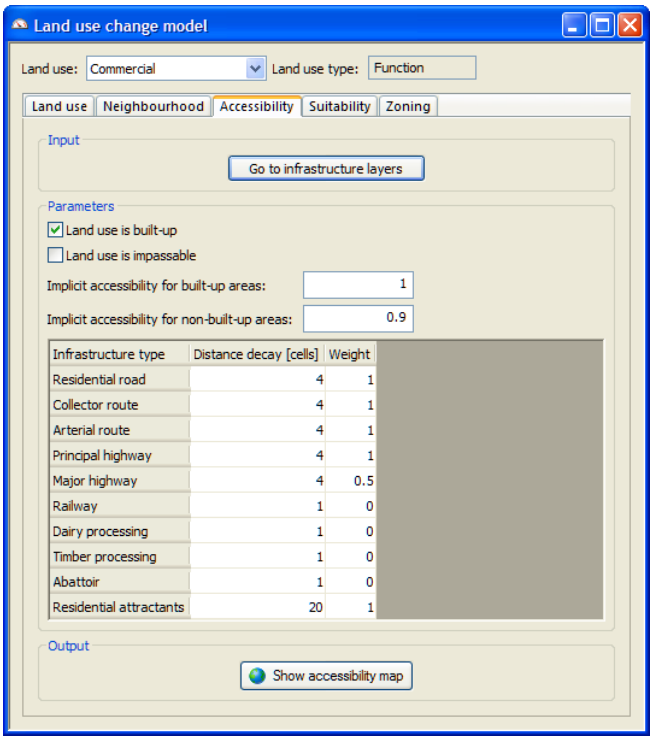
The system provides a table with the coordinate pairs for all discrete cell distances in the *List pane* on the right hand side of the window. The value list is not editable since interactions can be edited in the graph only. Changes made are immediately visible in the spline graph and on the value list.

The neighbourhood influence rules describe the effect of one land use on another at each distance in the neighbourhood. These influences are accumulated to produce the neighbourhood effect in each cell for each land use function. The neighbourhood potential map shows this neighbourhood effect for the selected land use function for each cell, which will be used to calculate the total potential map.

You can view neighbourhood potential map for the current simulation year by clicking the Show neighbourhood potential map button in the Output part of the Land use tab. The Neighbourhood potential for the selected land use function map window opens. Colours in the Neighbourhood potential map range from green to red. Cells in green have very high neighbourhood potential for the specific function land use. In contrast, the red cells have not. Since the neighbourhood potential map is only calculated for function land uses, the Show neighbourhood potential map button in the Output part is not available if the selected land use is feature or vacant.

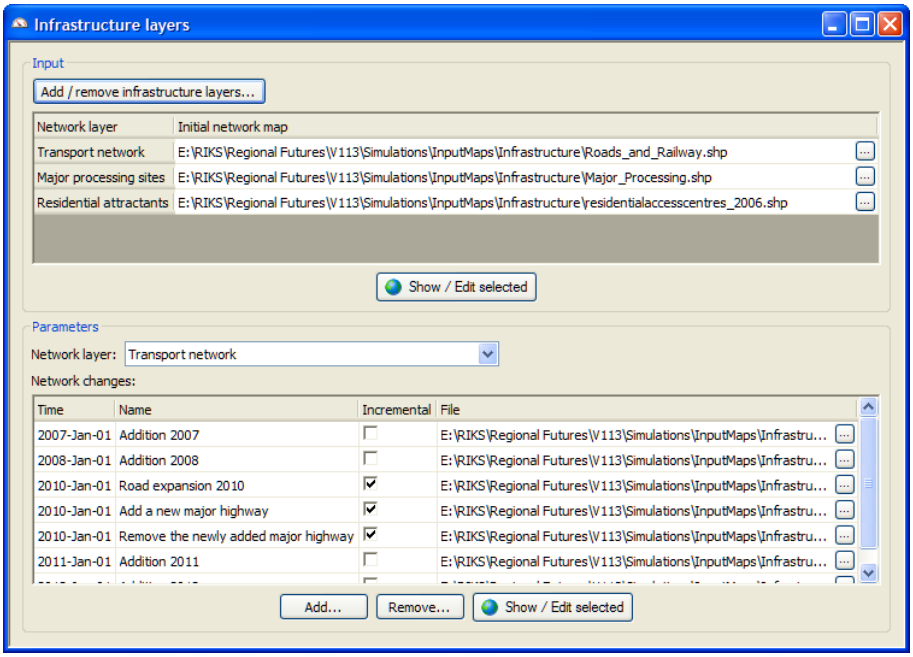
4.5.6.5 Accessibility

Click the Accessibility tab to access the contents depicted in the figure below.



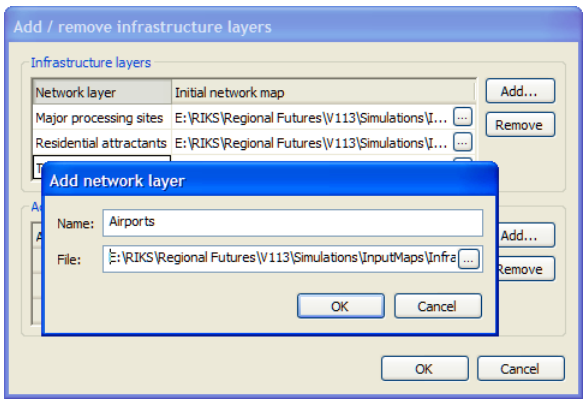
The accessibility for each function land use is calculated as a function of the distance to the nearest infrastructure network and the weight of this particular network. It represents how easy a location can fulfil its needs for transportation for a particular land use.

The input of the *Accessibility* component of the land use change model is the *Infrastructure layers* in WISE. You can access the detailed infrastructure information by clicking the Go to infrastructure layers button in the Input part. The Infrastructure layers dialog window opens.

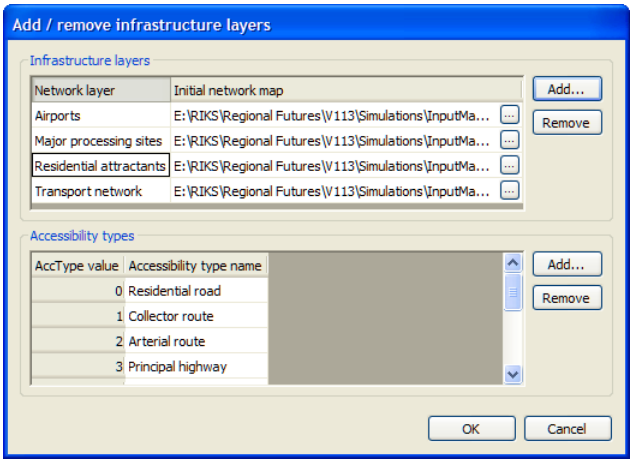


On the top of the dialog window, the default file names and file paths for the initial network layers are listed in the table by *Network layer* name. You can adapt an initial network layer for the specific layer by clicking on the browse button next of the specific layer and selecting the file that you want to upload. You can also view and edit the selected initial network map by clicking the Show / Edit selected button.

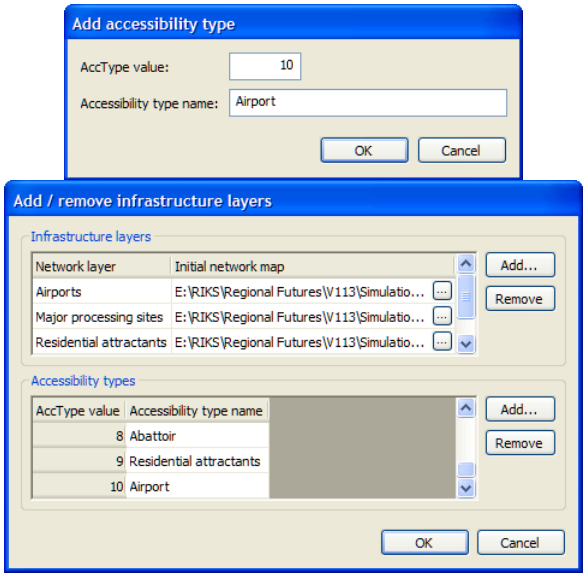
Clicking the Add / remove infrastructure layers button to open the Add / remove infrastructure layers window. You can change the name of the network layers by entering a new name in the text box in the Network layer column. You can adapt the initial network layer by clicking on the browse button and uploading a new file.



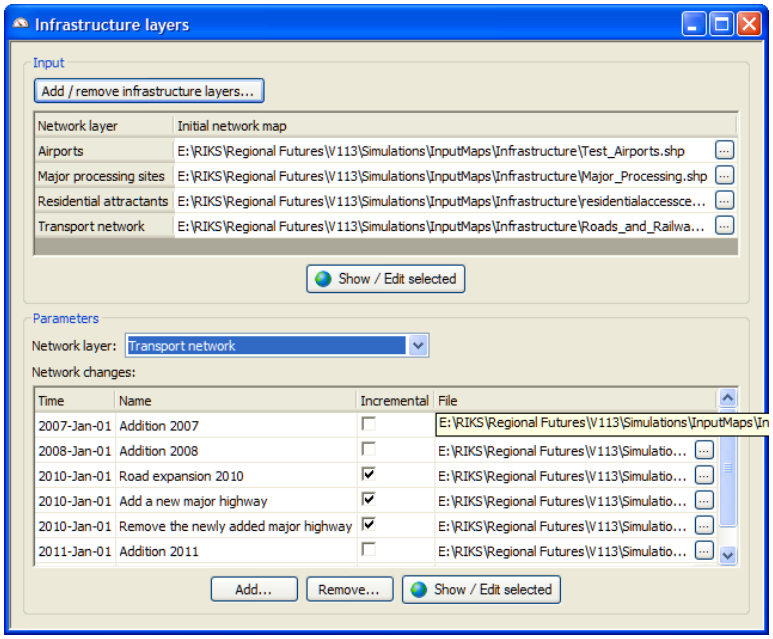
You can add a new network layer by clicking the Add.. button on the upper-right side of the Add / remove infrastructure layers window. After entering a name and loading the map for the new network layer, press the OK button. The newly added network layer will be displayed on the list of the Infrastructure layers. You can remove one existing network layer by selecting it and press the Remove button on the upper-right side of the window.



You can also add a new accessibility type by clicking the Add… button on the lower-right side. The Add accessibility type window opens. Enter the value and name for the accessibility type in the text boxes AccType value and Accessibility type name, respectively. The newly added accessibility type will be displayed on the list of Accessibility types.



Click the OK button at the bottom to confirm the changes and close the Add accessibility type window.



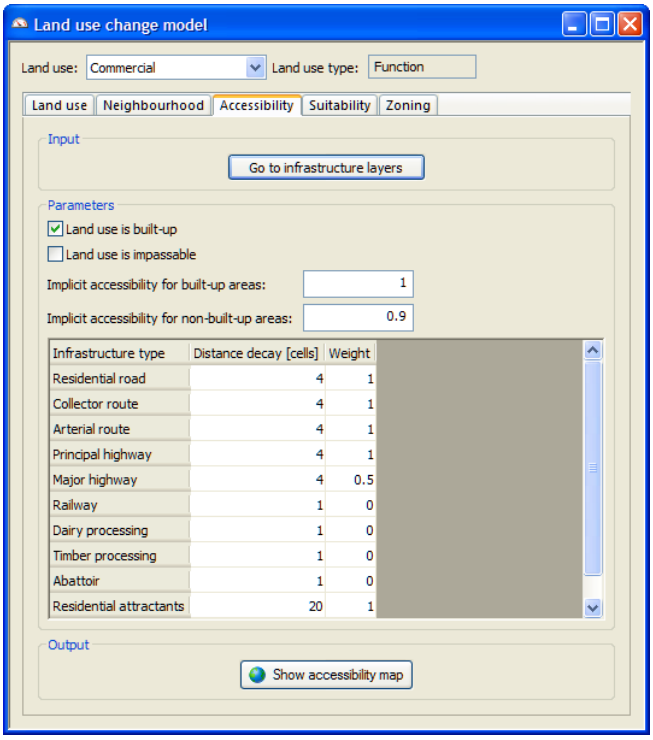
Go to the Parameters part of the Infrastructure layers window. You can select your network of interest on the dropdown list next to Network layer. The detailed information for all the network changes for the selected layer is displayed in the table.

- Click the Add… button to import a network change at a specific time for the selected network.
- Click the Remove button to delete a network change at a specific time for the selected network.
- You can view and edit each network change in isolation by selecting the change of interest from the table and clicking the Show / Edit selected button.
- Click the Show / Edit selected button to display a network change in isolation at a specific time for the selected network.

These operations regarding the Add… button, Remove button and Show / Edit selected button work similarly with the operations described in the section How to import a network at a specific time? and How to adapt a network at a specific time?.

For more information about the network map window opened by pressing the Show/Edit selected button, see the section Network map window opened via the modeller user interface.

You can view the high-level overview of the entire network at a specific time via the policy user interface. For more information, see the section Network map window opened via the policy user interface. The setting of network changes in the Infrastructure layers dialog window links directly to the setting of network changes under the Policy measures section.



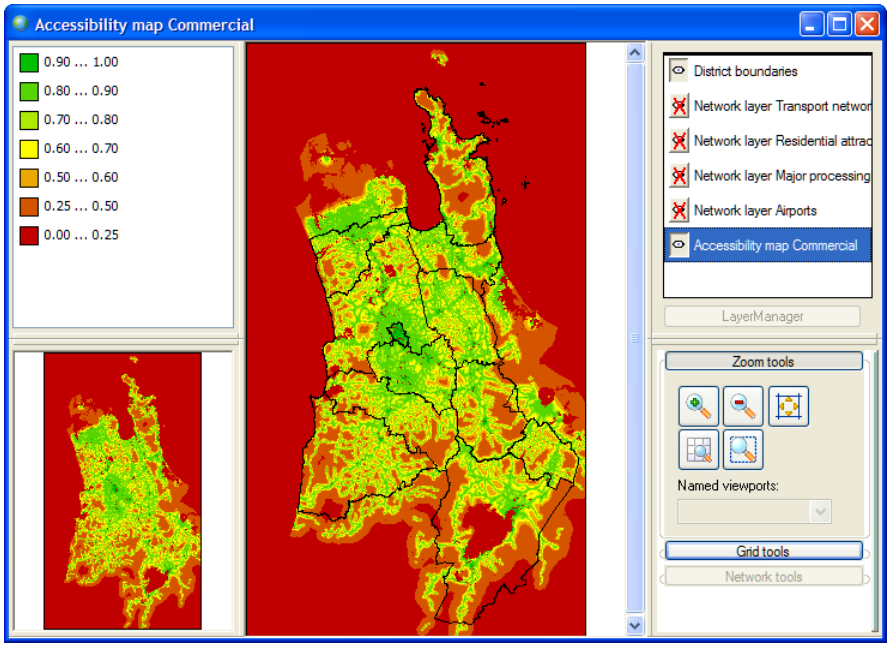
Go to the Accessibility tab of the Land use change model window. Accessibility parameters, which describe the influence of certain land uses to be close to elements of the infrastructure network play an important role in the allocation of the land use functions. In the Parameters part, the system allows you to specify the parameters used for the accessibility maps for each function land use by following steps:

- Select the land use of interest in the dropdown list Land use in the control pane.
- Select the check box in front of Land use is build up if the selected land use in the model is contained in the set of urbanised land uses (for example residential land use). You need to determine whether a land use is build up or not for all land uses.
- Select the check box in front of Land use is impassable if the selected land use is impassable (for example water). You need to determine whether a land use is impassable or not for all land uses.
- Set the implicit accessibility parameters for each land use function. The *Implicit accessibility* values range from 0 to 1. Enter the *Implicit accessibility* parameter for the selected land use function on a build-up area in the text box next to Implicit accessibility for build-up areas. Enter the *Implicit accessibility* parameter for the selected land use function on a non build-up area in the text box next to Implicit accessibility for non-build-up areas. The text boxes of *Implicit accessibility parameters* are only available when one of the land use functions in the model is currently selected on the dropdown list.
- Specify the distance decay and weight parameters per land use function. The parameter table allows you to set the *Distance decay* for the effect of each Infrastructure type of the network on the selected land use function and it's Weight. The distance decay is the number of cells after which the effect is halved (for positive decays) or doubled (for negative decays). The weight determines the relative importance of the infrastructure element for the particular land use function. The distance decay can be positive – for example, industries like to be near highways – or negative – for example, natural areas are preferably not located close to highways. With positive decays this is then the maximum value and with negative decays the minimum value. To turn off the accessibility effect of a specific land use function, you can set its weight to zero.

In order to visualize the accessibility map of a function land use, it is imperative that the simulation has been initialised (see the section Reset) or the accessibility has been computed (see the section Step). Use the Step command to compute the new accessibility maps after the network has been changed (see the section How to adapt a network at a specific time?) or when accessibility parameters have been changed.

You can view the accessibility map of the selected land use function for the current simulation year by pressing the Show accessibility map button. The Accessibility for the selected land use function map window opens. Accessibility is expressed in the range 0 to 1 and is displayed in colours varying from red to green: red meaning low accessibility (0) and green meaning high accessibility (1). All the network layers incorporated in the system are displayed as well in this map window.

Since the accessibility map is only calculated for function land uses, the contents in the Parameters part and the Show accessibility map button in the Output part are not available if the selected land use is vacant or feature.



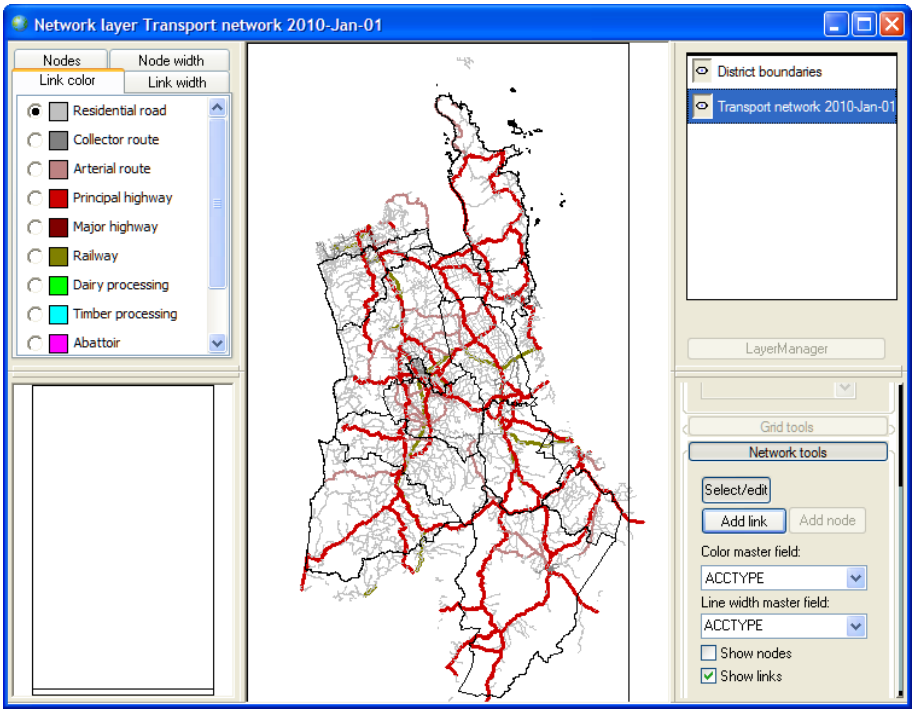
4.5.6.6 Network map window opened via the modeller user interface

The user interface of the network map window opened via the policy user interface is different from the one opened via the modeller user interface. In this section, we focus the one opened via the modeller user interface. For the other one, please refer to the section Network map window opened via the policy user interface.

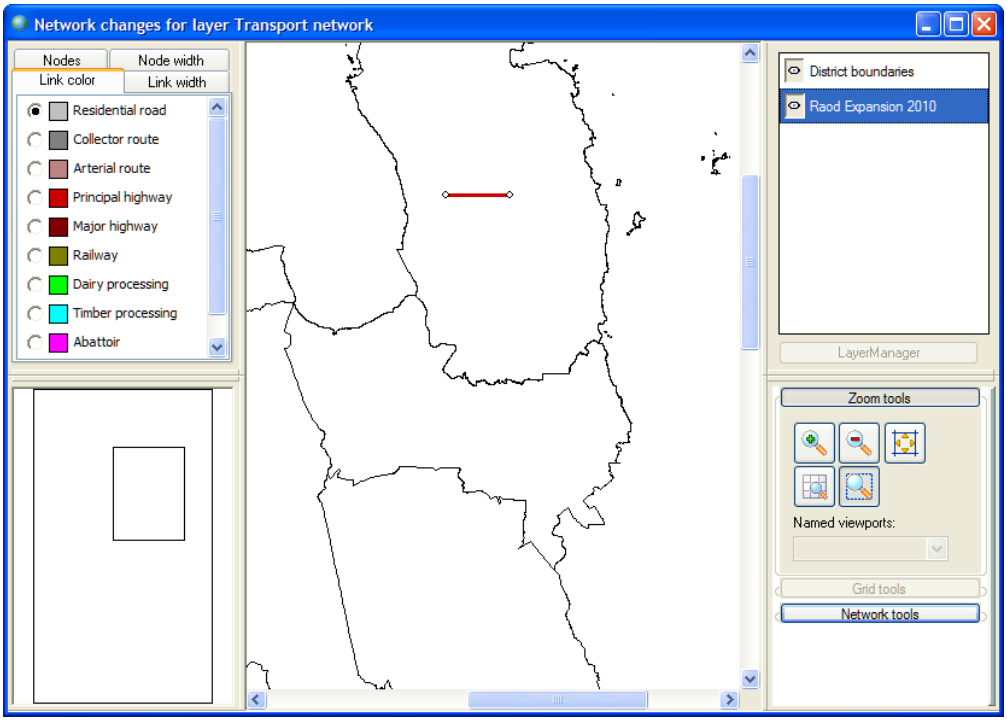
- You can view and edit the exact network changes for the selected network and for the specific year in the Network map window opened via the modeller user interface.

- You can view the high-level overview of network layer for the selected network and for the specific year in the Network map window opened via the policy user interface.

For instance, the figure below shows the network map window opened via the policy user interface. All the roads on the Transport network layer for 2010 are displayed.



The figure below shows the network map window opened via the modeller user interface. Only the expansion roads added for 2010 are displayed.

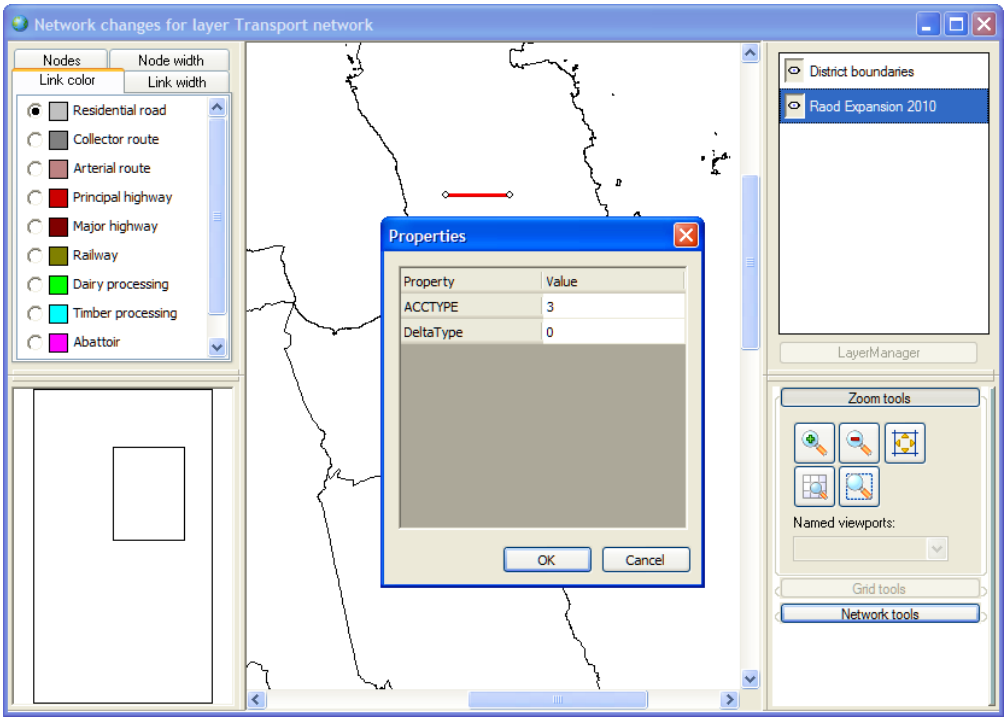


The title of the network map window indicates the descriptive name of the selected network and the selected year. As depicted in the figure above, besides the District boundaries layer, there is only one layer Road expansion 2010 visible in the *layer manager pane*, which shows the exact network changes for the selected time in the *map pane*.

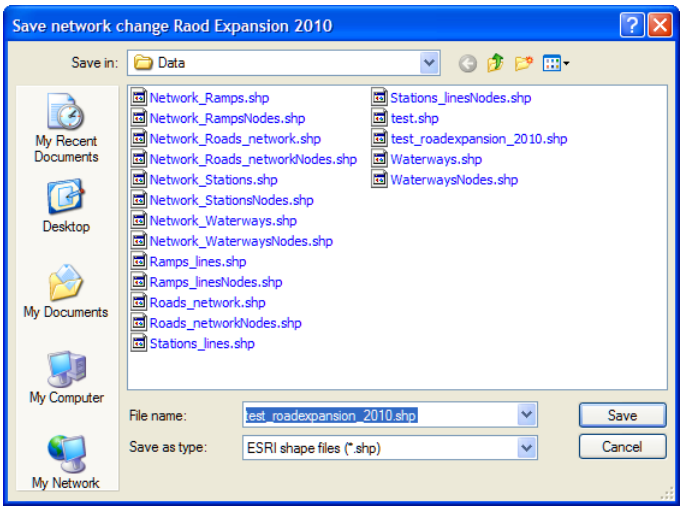
The *legend pane* consists of 4 legend tabs which are used for editing the legend of network map. The Link color and Link width tab are most useful. For more information about how to edit legend, see the section Legend editor. For all the networks, the categories of Acctype are used as the legend. For more information, see the section Network legends.

The ratio buttons in the *legend pane* indicate that this network map is editable. You can view, edit the link properties or add new links on the selected network layer.

- Select the network of interest from the dropdown list next to Network layer.
- Select the network change for the time of interest to open the network change map window.
- Double-click on the link of interest on the network changes map window. The Properties dialog window opens. All the available link properties of the selected network are displayed in the Properties dialog window. You can edit the link properties for the selected link from here.
- If you want to add the selected link, enter value 0 in the cell for DeltaType.
- If you want to delete the selected link, enter value 1 in the cell for DeltaType.



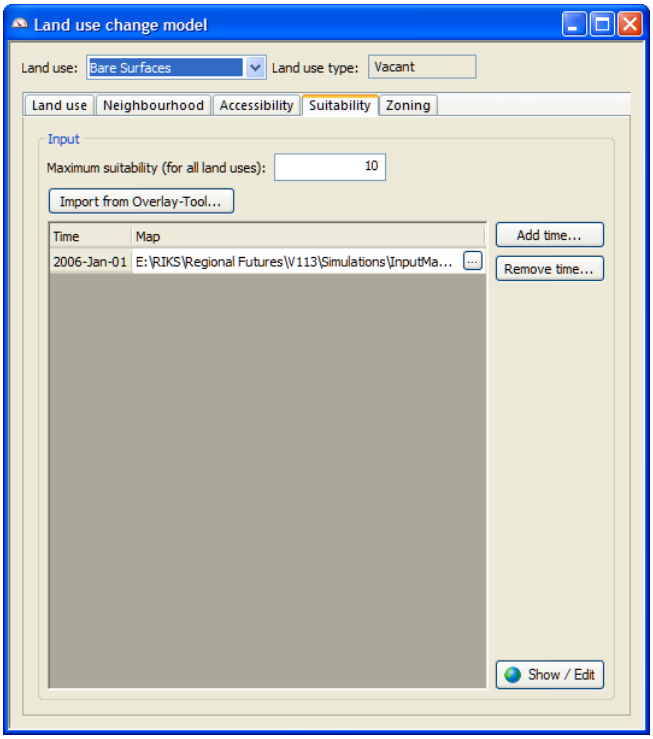
- Click Cancel to close the Properties dialog window.
- Or click OK to confirm the change that you made. A message window appears to ask you whether you want to save the changes you have made or not.



- Specify the name and path of the file that you want to save changes to.
- Press Save.

4.5.6.7 Suitability

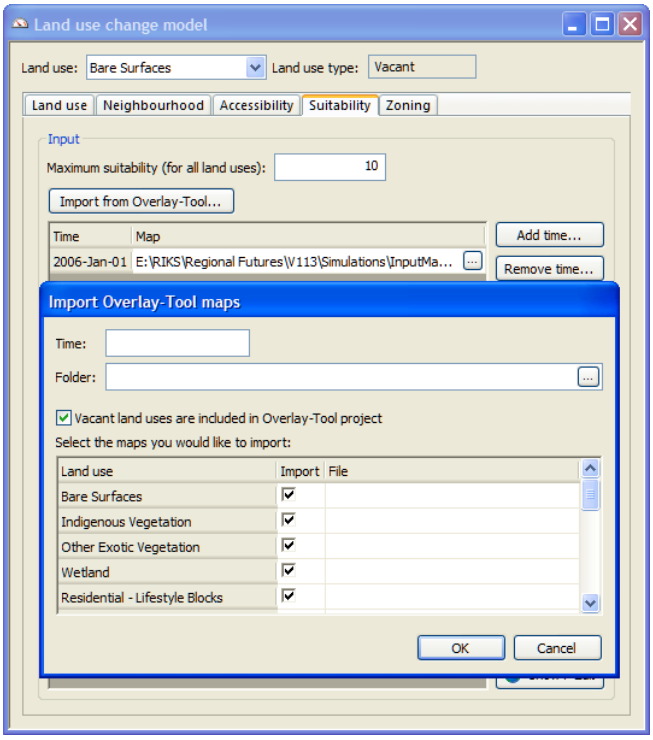
Click the Suitability tab to access the contents depicted as the figure below.



Suitability is represented in the land use change model by a map for each vacant or function land use. Values on the suitability map quantify the effect that physical characteristics of the land have on the possible future occurrence of land uses. The suitability maps can be created with the help of the Overlay-Tool.

It is important to keep the default names of these suitability maps which are assigned by the Overlay Tool in the case you can import one or all suitability maps generated by Overlay tool by clicking the Import from Overlay-Tool… button. In the Import Overlay-Tool maps dialog window, enter the time for which you want to import the suitability maps; select the location where you stored all suitability maps generated by Overlay tool; check the check box next to Vacant land uses are included in Overlay-Tool project. You need to verify if the suitability maps in the File column are corresponding to the land uses in the Land use column by switching on or off the check box mentioned above. Check the check boxes for each land use in the Import column to import the suitability maps for the checked land uses.

If you generated suitability maps using other tools, for example the ArcGIS package, you need to import the suitability map one by one for the selected land use by clicking the browse button in the path edit box.

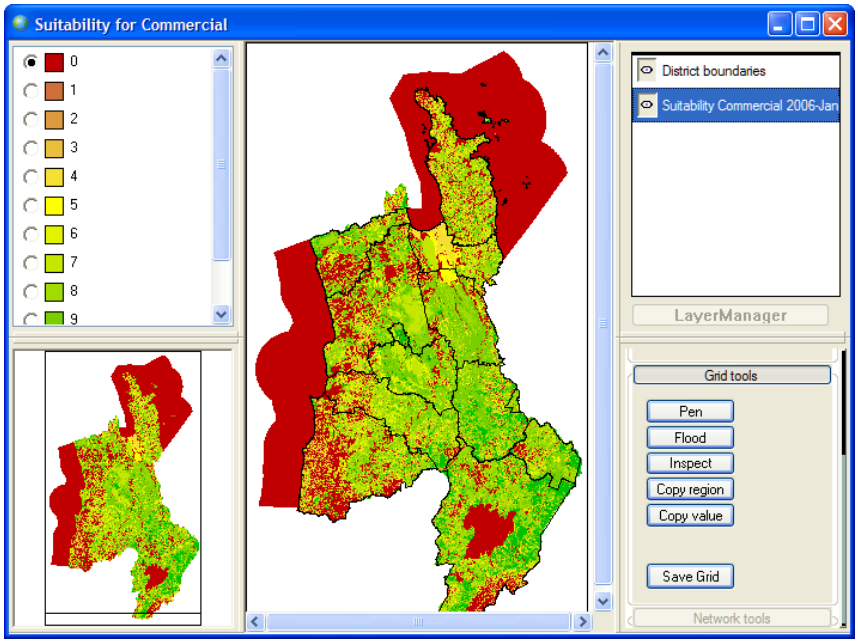


The system provides you the opportunity to set up the maximum suitability (for all land uses) by entering a value in the range of (0, 255) in the text box next to Maximum suitability on the top of the Suitability tab. This maximum suitability value should be the highest value on any suitability map in WISE. In general, if the suitability map is created in the Overlay-Tool with a maximum suitability value of 10, it can be used directly in WISE system.

The path of the suitability map file for the function land use for the first date is displayed by default when you open the system. The system allows you to add or delete the suitability map for a selected land use at a specific time by clicking on the Add and Delete button. The description about how to add or delete the map files is available in the section Map file.

You can view or edit the suitability map for the selected vacant or function land use and for the selected time by clicking on the Show/Edit… button at the bottom of the Suitability tab.

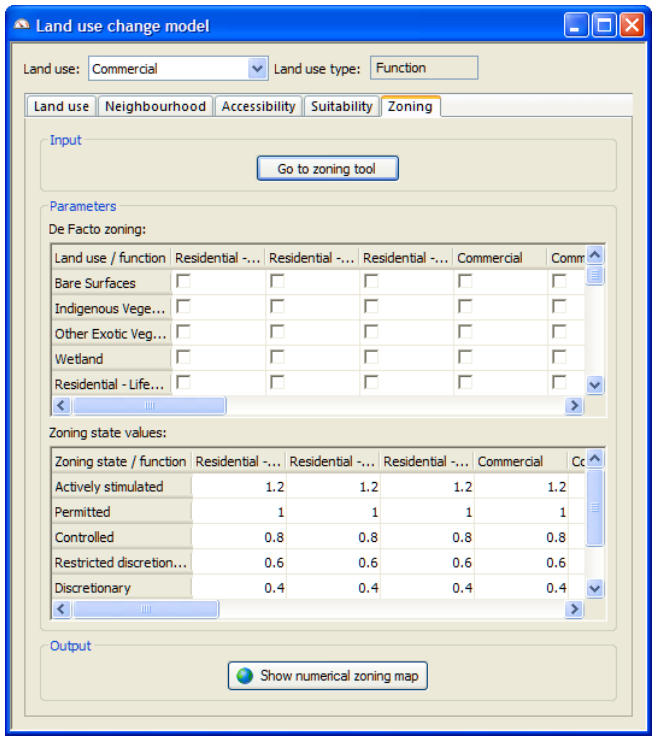
With the opened Suitability map window, it is possible to change the suitability value of individual cells. A higher value indicates a higher suitability. Suitability is displayed in the map in colours varying from red to green, representing values between 0 (not suitable) and 10 (perfectly suitable). Before you add the suitability map to the system, you have to ensure that the values on the map are integer values. For more information about how to work with an editable map, see the section Editable map.



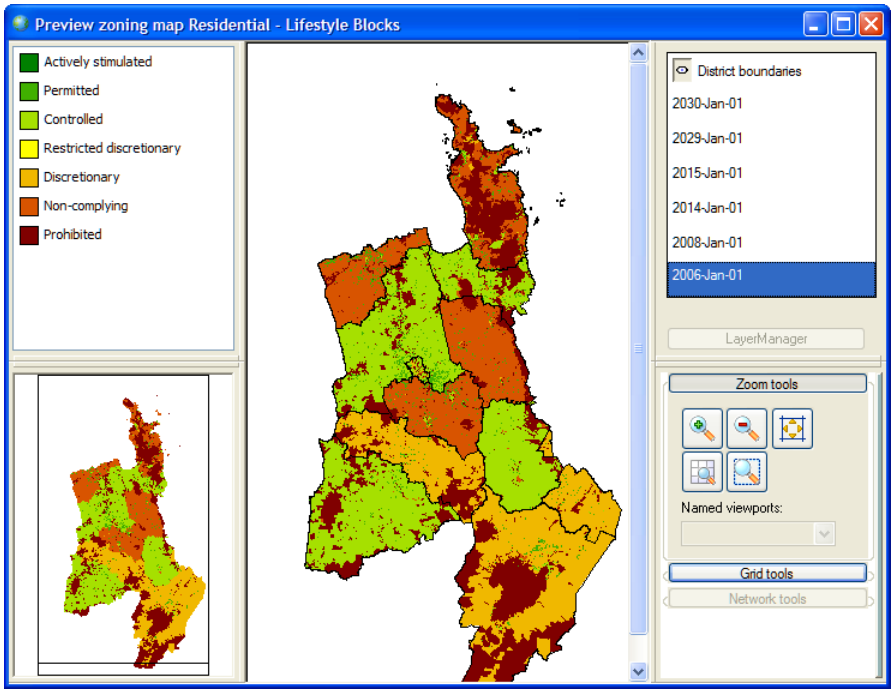
4.5.6.8 Zoning

The zoning or institutional suitability is characterized by one map for each land use function. It is a composite measure based planning documents available from the national or regional planning authorities and can contains information from among others ecologically valuable and protected natural areas, protected cultural landscapes, buffer areas, etc.

Click the Zoning tab to access the contents depicted as the figure below.



The input to the Zoning part of the land use model are the *Zoning maps* which are generated with the help of zoning tool in WISE. A zoning map is a categorical map with the zoning state values. No data values are depicted on the map as white.



You can access the zoning tool via the user interface of the land use model by clicking the Go to zoning tool button in the Input part of the Zoning tab. For more information about the zoning tool, see the section Zoning tool.

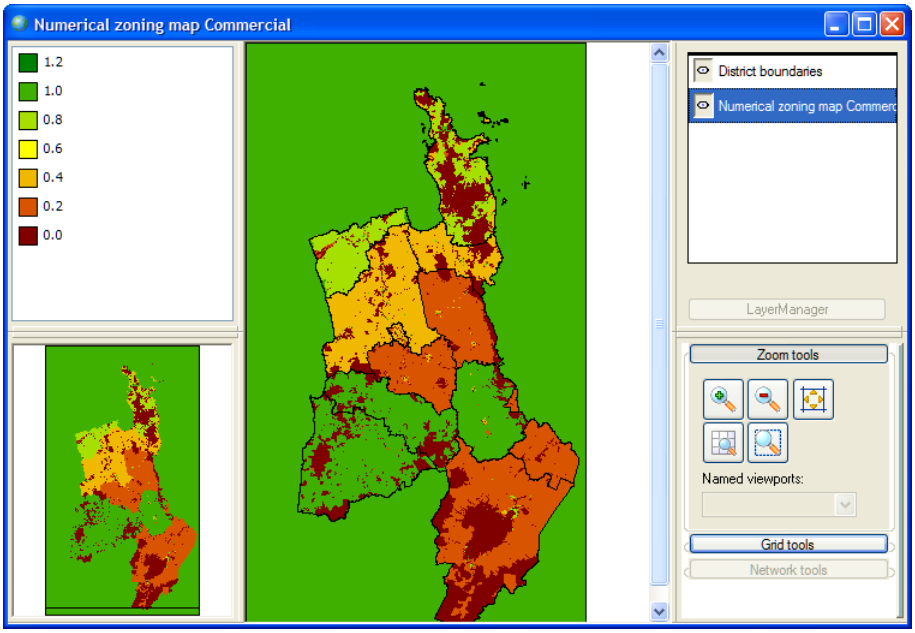
These *categorical zoning maps* need to be converted into *numerical zoning maps* which have numerical values to be used in the computation of the total potential. You can set the parameters to interpret the categories in the Parameters part of the Zoning tab. The conversion takes into account the *De Facto zoning* and the *zoning state value* for each land use function.

- If a check box in the De Facto zoning table is selected for certain land use and for certain function, each year the zoning status will be corrected for the De Facto land use. For instance, the check box for Agriculture land use and for the Agriculture function is checked, if a location has agriculture on the calculated land use map, you introduce a new zoning plan where the agriculture is not allowed to develop on this location. The zoning status for agriculture function will still be allowed at this location.

- If a check box in the De Facto zoning table is unselected for certain land use and for certain function, the zoning status will be corrected for the De Facto land use each year. For instance, when the check box for the Agriculture land use and the Agriculture function is checked, a location that has agriculture on the calculated land use map cannot be removed as a consequence of introducing a new zoning plan. Even though this new zoning plan indicates that agriculture is not allowed at that location.

You can set the zoning state values for each land use function and each zoning state category in the Zoning state value table. The zoning state values will be used to calculate the numerical zoning map.

You can view the numerical zoning map by clicking the Show numerical zoning map button at the bottom of Zoning tab. The Numerical zoning map for the selected land use map window opens as depicted in the figure below.

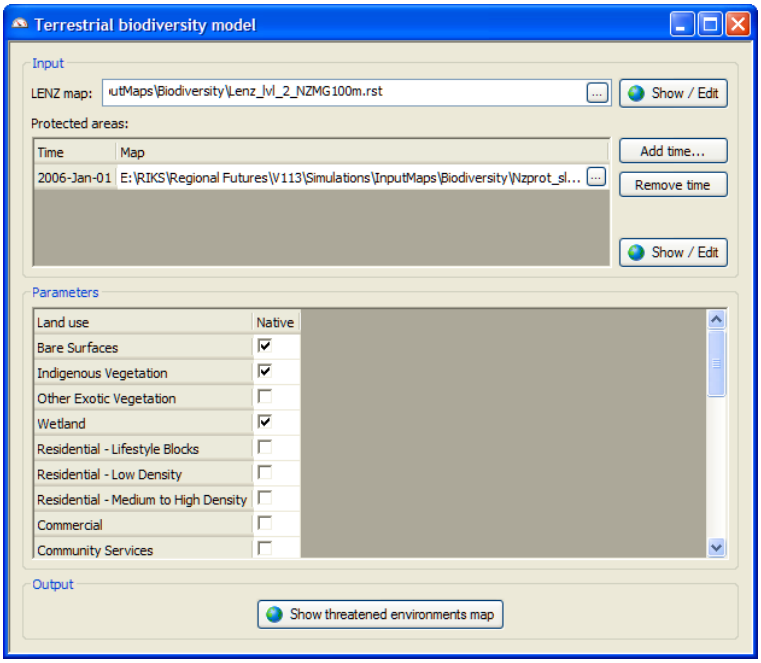


4.5.7 Terrestrial biodiversity model

The terrestrial biodiversity model in WISE performs an analysis to identify unique combinations of land environments, protected areas, and land use. It combines information on all land uses including vegetation state with information from two other primary data sources to produce an indicator of ecosystem representativeness.
To access the modeller user interface for the *Terrestrial biodiversity model,*

- Go to the Drivers tab of the Main window.
- Click the Parameters icon in the navigation pane on the left side of the window. The system diagram displays in the content pane on the right side of the window.
- Click the Terrestrial biodiversity MBB box at the Local level in the system diagram. The Terrestrial biodiversity model dialog window opens.

The Terrestrial biodiversity model dialog window is structured so that the Input, Parameters and Output parts are displayed from top to bottom.



Besides the land use map, the LENZ map and Protected area map are required as input in the terrestrial biodiversity model.

- *LENZ map*: the Land Environments of New Zealand map shows information on land environments that serve as surrogates for ecosystems and habitats

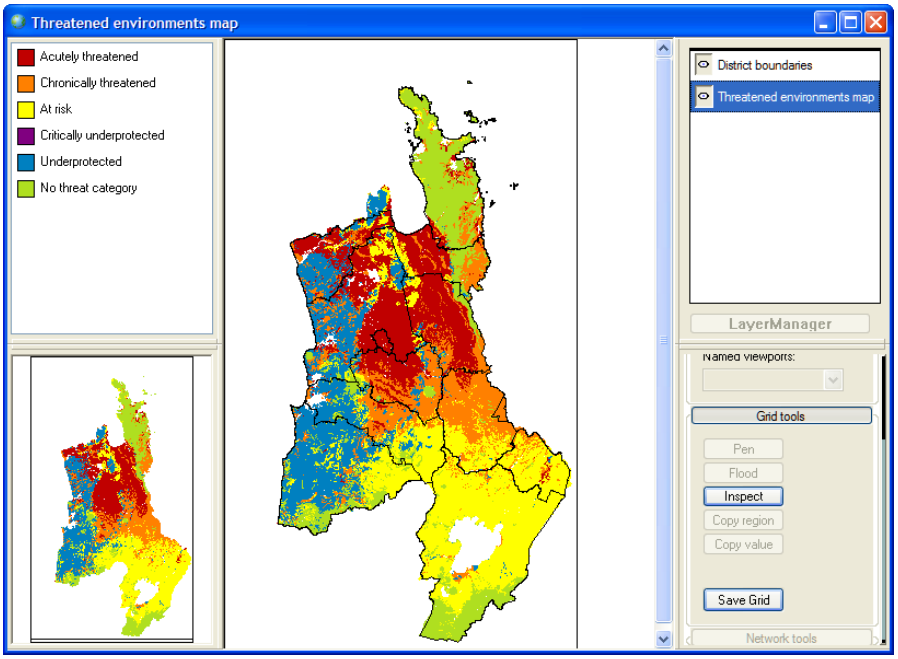
- *Protected area map*: Protected areas network of New Zealand map is a database of legally protected areas.

You can upload a new LENZ map by clicking the browse button next to LENZ map and double-clicking the new map.

You can add a protected area map for a specific year by clicking the Add time… button and importing a new map for the added year. You can delete a protected area map for a specific year from the list by selecting the directory of map and clicking the Remove time button. You can view the protected area map by selecting it and clicking the Show /Edit button on the middle-right side of the Terrestrial biodiversity model dialog window.

In the Parameters part of the Terrestrial biodiversity model dialog window, you can indicate whether a land use is a land use growing native vegetation by selecting the check box next to this land use.

In the Output part of the Terrestrial biodiversity model dialog window, you can view the output map by clicking on the Show threatened environments map… button at the bottom of the window. The Threatened environments map window opens where 6 categories are assigned to each environment: acutely threatened, chronically threatened, at risk, critically under protected, under protected and not threat category.



5 The WISE menu system

This section explains the different functions that are available from the WISE menu system. Some Geonamica functions are not available in WISE. These are greyed out; they are visible in the menu in a light grey colour, but they do not result in further actions when invoked. Consequently, these functions are not described in detail in this section.

Other functions are only accessible when they are relevant. For instance, the Stop command in the Simulation menu is only accessible when the simulation is running.

The menus are treated as they appear in the Menu bar from left to right and per menu from the top to the bottom. Most commands in this section have already been described in other sections. You can find more detailed information for these commands through the links in the table.

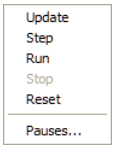
5.1 File menu

You can use the File menu to open and save project files, and to exit WISE. The WISE system saves project files with a *.geoproj* extension attached to the file name.

Option	Function	Link
Open project…	Open a project file stored on a disk	Section Opening a project file
Save project	Save changes to the current project file	Section Save a project file
Save project as…	Save a project to a disk	Section Save a project file as
Close project	Close the project	
Recent file list	Display the names and the paths of the 4 most recently opened project files. If you select one of the 4 files, it will be opened	
Exit	Quit Geonamica	

5.2 Simulation menu

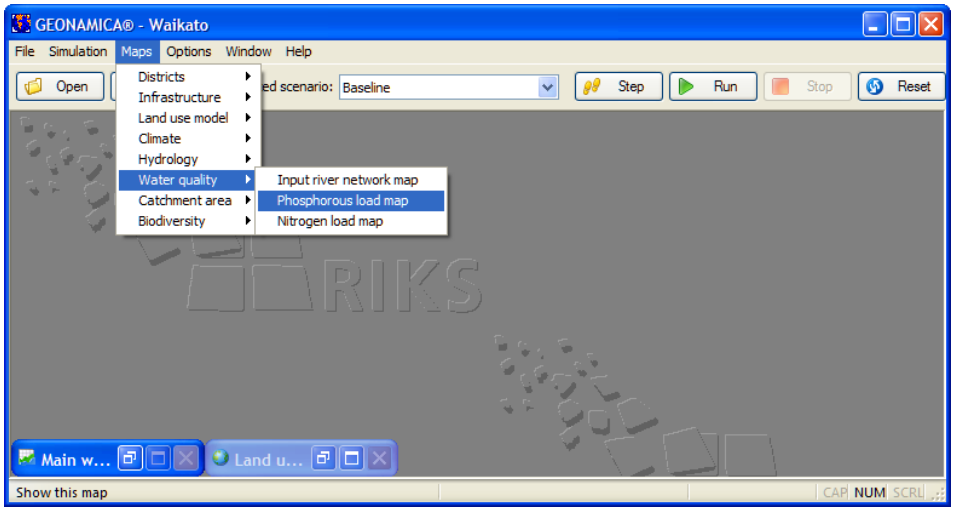
You can use the Simulation menu to control a simulation. The commands Update, Run, Stop and Reset can also be invoked when pressing the respective buttons on the Toolbar.



Option	Function	Link
Update	Recalculate variables that are affected by changes (except for the initial values and initial maps) via the user interface for the current simulation year. This command will not change the simulation time.	Section Update
Step	Advance the simulation with one time step	Section Step
Run	Advance the simulation till the next pause moment has been reached	Section Run
Stop	Stop a simulation run	Section Stop
Reset	Recalculate variables that are affected by changes (including the initial values and initial maps) via the user interface for the start year of the simulation. Switch the simulation clock back to the start year of simulation.	Section Reset
Pauses…	Set the pauses of the simulation	Section Pauses

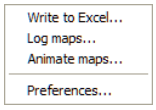
5.3 Maps menu

You can use the Maps menu to select different maps and open their map windows. All available maps for the user are structured hierarchically by themes. There are essentially two types of maps: input maps and output maps. All the input maps are editable and all the output maps calculated for the current simulation year by the system are not editable.



5.4 Options menu

You can use the Options menu to personalise your workspace or to access the additional functionalities of WISE.

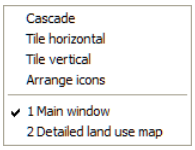


Option	Function	Link
Write to Excel	Establish or interrupt a link between WISE and the Microsoft Excel Workbook	Section Write to Excel
Log maps	Store maps produced by the system in the form of .rst files	Section Log maps
Animation maps	Store dynamic maps produced by the system in the form of .gif animations	Section Animate maps

Option	Function	Link
Preferences	Set if the geo project file will be associated to the current version of WISE.	Section Adjusting file association in preferences

5.5 Window menu

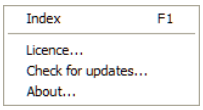
You can use the Window menu to arrange the contents of the screen and to activate one of the opened windows.



Option	Function
Cascade	Arrange multiple opened windows in an overlapped fashion
Tile horizontal	Arrange multiple opened windows one above another in a non-overlapped fashion
Tile vertical	Arrange multiple opened windows side by side in a non-overlapped fashion
Arrange icons	Arrange the icons for minimized windows at the bottom of the screen
List of Windows	Active the selected window on the list of opened windows

5.6 Help menu

You can use the Help menu to select the type of help that you want WISE to display on the screen. The different commands in this menu permit you to look up information about WISE, its commands, options, and tools.



Option	Function	Link
Index	Get the opening screen of the on-line help file of WISE	Section Index
Licence…	Open the Licence window	Section Licence
Check for updates	Check the version of WISE	Section Checking for updates
About…	Open the About window	Section About

Annex 1 WISE release history

Version 1.2.0 (30 June 2011)

- Improved the performance of the zoning tool
- Changed the hydrology model to account for changes in land use
- Fixed hydrology model parameters
- Changed the link between the economic and land use model
- Incorporated carbon forestry sectors in the economic model
- Revised the user interface of the legend editor
- Added scenario support to 'log maps' functionality
- Added download link for the Map Comparison Kit in the analysis section
- Added an online version check
- Changed license system (old licenses cannot be used anymore)

Version 1.1.1 (3 November 2010)

- Bug fixes

Version 1.1.0 (17 August 2010)

- Added 'zoning tool'
- Fixed computation of adjusted rates in population model
- Password protected population parameter file
- Fixed computation of change in final demand in economic supply model
- Added support for addition and removal of infrastructure layers through the user interface
- Added 'land use indicators' displaying the difference between land use demand and allocated land over time
- Support animation of river network maps and infrastructure network maps
- Added integrated help functionality
- Documented guidelines for best use of the scenario manager
- Various user interface enhancements
    - Added 'maps' menu
    - Added economic sector filter in policy user interface
    - Display overview of total potential figures for a single cell
    - Improved the 'log maps' functionality
    - Made infrastructure policy measures more user-friendly
    - Removed 'changes in inventories' from external factors

Version 1.0.7 (16 November 2009)

- Updated hydrology parameters (maps)
- Renamed "eco-efficiency" as "land productivity"

Version 1.0.6 (11 November 2009)

- Updated land use model parameters
- Updated colours of land use map

Version 1.0.5 (9 October 2009)

- Changed simulation start year from 2004 to 2006
- Updated initial land use map
- Updated land use model parameters
- Fixed implementation of population model

- Updated population model parameters
- Changed formula to compute average life expectancy
- Changed allocation of residential land use functions from regional to district level
- Added population density model
- Added ‘decay coefficient’ to economic supply model
- Fixed drawing of output graphs
- Display infrastructure networks on top of accessibility maps
- Updated ‘About box’
- Adopted ‘WISE’ as the name of the system

Version 1.0.4 (17 August 2009)

- Changed marine land use from vacant to feature
- Changed aquaculture land use from function to feature
- Updated data for land use model and biodiversity model

Version 1.0.3 (24 July 2009)

- Replaced catchment map with catchment area lookup-table (water quality model)

Version 1.0.2 (17 July 2009)

- Incorporated hydrology model
- Added social indicators
- Updated ‘About box’

Version 1.0.0 (10 July 2009)

- Incorporated various sub-models:
    - Climate
    - Water quality
    - Population
    - Terrestrial biodiversity

Version 0.5.1 (1 December 2008)

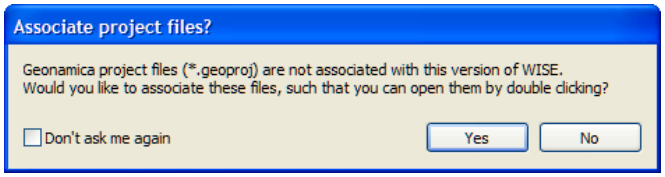
- Added suitability maps

Version 0.5.0 (30 November 2008)

- First prototype including land use and economic models

Annex 2 Associated project file and versions of WISE

When you have multiple versions of WISE installed on your computer and you have opened the WISE geoproject file with different versions of WISE, the dialog window may appear as depicted in the figure below asking you whether or not you want to associate the *WISE* project file with the current version of WISE that you accessed in the steps described in the section Starting WISE.



This functionality provides the possibility to associate project files with the extension **.geoproj* with different versions of WISE installed on your computer. This is the case when there is more than one Geonamica-based system installed on your computer.

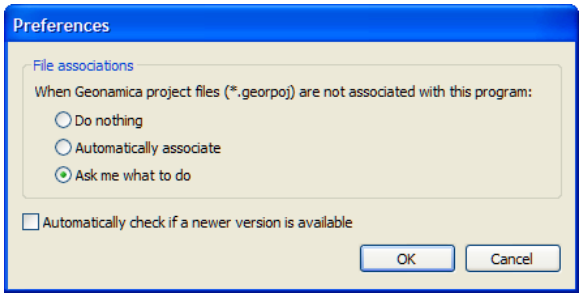
Associating project file

When Geonamica project files (*.geoproj) are not associated with this version of WISE, you will see the Associate project files dialog window on start up.

- If you select the checkbox in front of Don't ask me again before you click the Yes or No button, your answer will be remembered next time. When you open next time WISE, the system will always take the action that it remembered and the system will not display this dialog window.
- Clicking the Yes button on the message window above means that the next time you double-click the icon of the project file *Waikato.geoproj*, the WISE application window will open directly which is linked to the current version of WISE.
- Clicking the No button on the message window above means that nothing will be changed. The next time you double-click the icon of the project file *Waikato.geoproj*, the application window will open with which *.geoproj files are currently associated.
- It makes no difference whether you press the Yes or No button if you have only one version of *Geonamica.exe* installed on your computer. You can skip this sub-section.

Adjusting file association in preferences

After defining the setting for the project file association, you can adjust it via the Options menu in WISE. To do so,



- ➢ Go to Options menu → Preferences. The Preferences dialog window opens with three options.
- ➢ Select the option of your interest and press the OK button in the File association part.

Here you can select which action should be taken when Geonamica project files (*.geoproj) are not associated with this version of WISE. Note that this is only verified when you open WISE. The default option is “Ask me what to do”. If this is selected and project files are not associated with Metronamica, you will see the Associate project files dialog window described above on start up.
The system will check automatically if there is a newer version of WISE available if the check box at the bottom is selected.

Checking the associated version

You can check with which version of Geonamica the .geoproj project file is associated using the following steps.

- Right-click on My Computer and select Explore.
- Click on Tools from the menu bar and select Folder Options… from the drop-down menu.
- Click the File Types tab in the Folder Options window.
- Scroll down in the Registered file types: window and select GEOPROJ under the Extensions column.
- Click the Advanced button near the bottom of the Folder Options window.
- Select Open with Geonamica from the list in the Actions window and then click the Edit… button to the right side.
- The Editing action for type: Geonamica®Project window opens.
- In the text box under Application used to perform action, you can see the path of the Geonamica.exe with which the .geoproj file types are currently associated.

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