

WISE –

Waikato Integrated Scenario Explorer

User Manual (Version 1.3.0)

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For:

Creating Futures (FRST Project ENVW0601) and the Waikato Regional Council

Project team

Waikato Regional Council, Landcare Research, AgResearch, Environmental Economics Research Centre New Zealand (Massey University), NIWA, Scion, University of Waikato, Market Economics Ltd, RIKS and Université de Versailles Saint Quentin-en-Yvelines.

Product information

WISE (Waikato Integrated Scenarios Explorer) is an Integrated Spatial Decision Support System (ISDSS) developed as part of 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 1.3.0)

RIKS BV (October, 2012)

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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 for 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 Vista and Windows 7, 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 space

To use WISE, you should have the following software packages installed on your computer:

- Microsoft® Excel (version 2003 or later) (required)

If you experience problems when installing WISE, you can contact RIKS (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 want to keep it, make sure to put the latest version of WISE in a separate folder. 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. Download or copy the WISE setup.
- Step 3. Double-click on the WISE_#.#.#_setup.exe. The #.#.# refers to the version number of the software installation.
- Step 4. Follow the steps on the screen to install the software and data.
- Step 5. (Optional) Download the Map Comparison Kit from <http://www.riks.nl/mck>. Install it by double-clicking the downloaded file and follow the steps on the screen.

To uninstall WISE:

- Step 1. Open the Control Panel (this is normally available in the Windows Start menu). Open 'Add or Remove Programs' in the Control Panel. 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 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 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 on WISE.

Importing the license file

The first time you start WISE a dialog window will appear asking you to install a licence file for WISE. Once a license is installed, the software will skip this step, unless the installed license has expired.

- 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 have received.

- Open the licence file with the extension *.lic*.

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

- Click the OK button on the About window.

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.

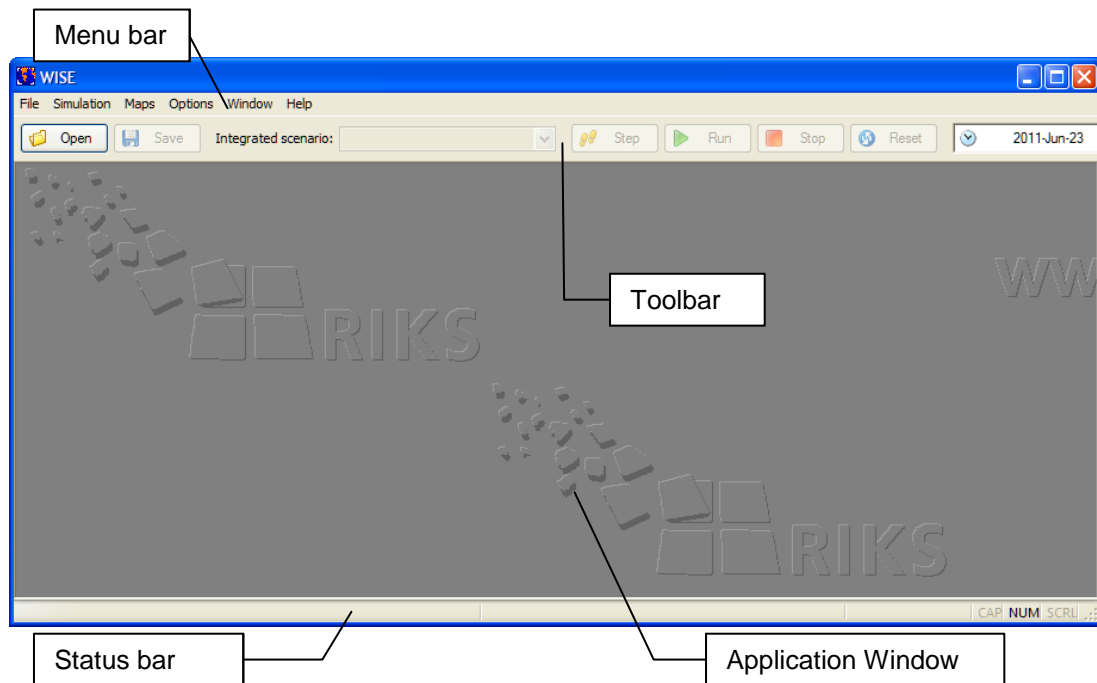
If the project file you want to open is created with an older version of WISE, a message window will appear to ask you whether to upgrade the project file to the current version of software.

- Click the No button if you still want to be able to open the project with an earlier version of the software.
- Click the Yes button to upgrade the project file automatically. Then you can open it with the current version of WISE. You will no longer be able to open the project with an earlier version of the software.

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



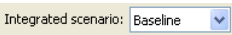





1.4 Screen layout

When you start WISE, the application window opens immediately. This is the window in which you will run your simulations. 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 *Status bar*, *Toolbar* and *Menu bar*. The different components of this window will be described in the next paragraphs.



The *Menu Bar* provides access to various functions in WISE. Each menu item is described in detail in the section [The WISE menu system](#).

The *Toolbar* gives fast access to some of the more frequently used functionality. Each item on the toolbar is described in the table below.

Item	Function
 Open	Open a project file from the disk.
 Save	Save the opened project file to disk.
 Integrated scenario: Baseline	Displays the active integrated scenario. The dropdown list shows all the available integrated scenarios. You can load an integrated scenario by selecting it from the dropdown list.
 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 to the initial year.
 2006-Jan-01	Displays the current simulation time whenever a project is open.

The *Status bar* is displayed at the bottom of the application window. It contains different sections that provide different kinds of information:

- The leftmost section provides general information. When you navigate through the menu, it describes the selected menu item.
- The second section from the left provides local information when you move the mouse over a map. For a raster map, it lists the cell index and the value in that cell. For network maps, it lists the x and y coordinates of the location.
- The third section from the left displays a progress bar while the model is calculating.
- The rightmost sections of the *Status bar* indicate which of the following keys are latched down: the Caps Lock key (CAP), the Num Lock key (NUM), or the Scroll Lock key (SCRL).

1.5 System Information

The different commands in the Help menu allow you to look up the system information about WISE. For more information see the section [Help menu](#).

Help

Click Index on the Help menu (or press the F1 key) to open the on-line help file of WISE. Use the Contents tab on the left side of the 'WISE User Manual' window to navigate to the topic that you want help on. You can also use the Search tab to find the relevant section in the user manual. If these tabs are not displayed, click the Show button at the top of the 'WISE User Manual' window.

Licence

Click Licence on the Help menu to get the licence information in the 'Installed licenses' window. All licences for the Geonamica-based software installed on your computer will be listed in the table. You can import a licence file (with extension .lic) by clicking the 'Read a licence file' button. To remove a license, click the 'Open license folder' button and remove the files with the license name you want to remove from the folder. You need to restart the application for the changes to take effect. There is no need to remove existing licenses before installing a new one.

Checking for updates

Click 'Check for updates' on the Help menu to check if you are using the latest version of WISE. If a newer version is available, the system will tell you how to get it.

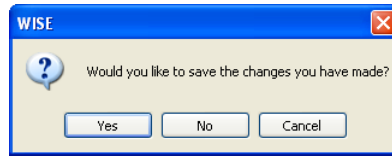
About

Click About on the Help menu to open the About window. Here you can find the copyright notice and version number of WISE. The latter is important if you need assistance with the software (see the section [If you experience problems](#)) or when you request an update of the software.



1.6 Closing WISE

You can close WISE by clicking Exit on the File menu. If you have a project file open, the application may ask whether you want to save your changes before closing.



Click the Yes button to save your changes, click the No button to discard your changes and close WISE or click the Cancel button to keep WISE open. More information on saving changes is available in the section [Saving changes](#).

1.7 If you experience problems

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

Research Institute for Knowledge Systems bv.
To the attention of Hedwig van Delden
P.O. Box 463, 6200 AL Maastricht, The Netherlands
Tel: +31 (43) 3501750
Fax: +31 (43) 3501751
E-mail: info@riks.nl
Website: www.riks.nl

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 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 terms introduced.

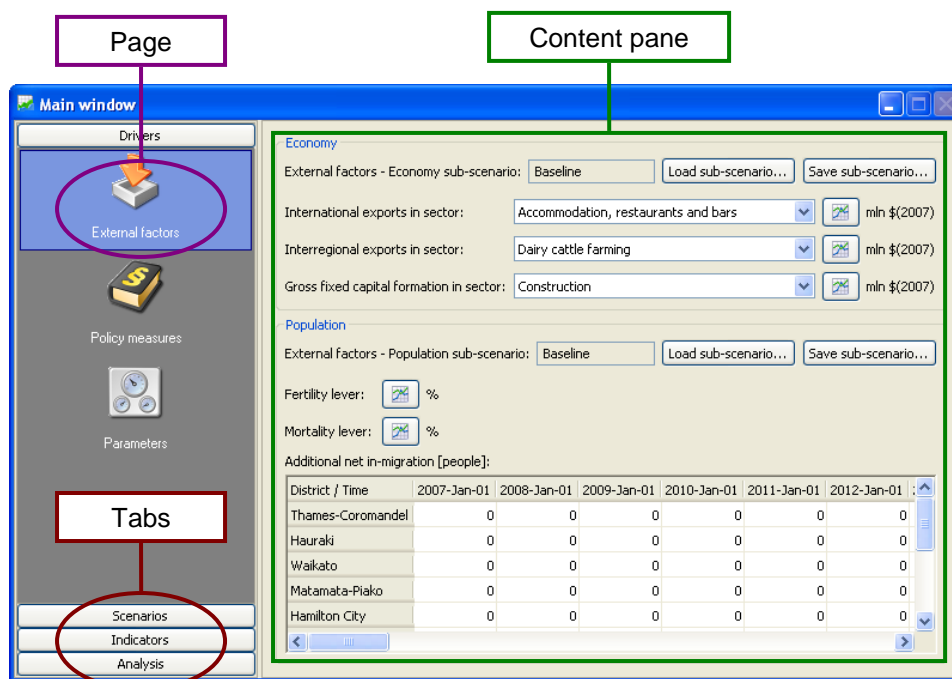
Opening an existing project file

- Open WISE if it is not already open – see the section [Starting WISE](#).
- Click the Open button on the toolbar if the 'Open project file' window is not already open.
- Navigate to the folder where you installed the WISE data and project files. By default, this is the folder *GeonamicaWISE* inside My Documents.
- Select the Waikato file and click the Open button.

Once all files have been loaded, two windows appear in the application window: the Main window and the Land use map. As you will need to use these windows most of the time, you cannot close these windows to prevent doing so accidentally. If they are in your way, click the Minimize button on the window and it will move to the bottom of the application window.

Main Window

The Main window is organised in *tabs* and *pages*, which are displayed on the left side of the window. The Main window has 4 tabs: Drivers, Scenarios, Indicators and Analysis. Each tab has one or more pages, which are displayed as icons when you click on a tab. Click on an icon to display a page in the right side of the window, called the *content pane*.



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

2.2 Editing Input and displaying output

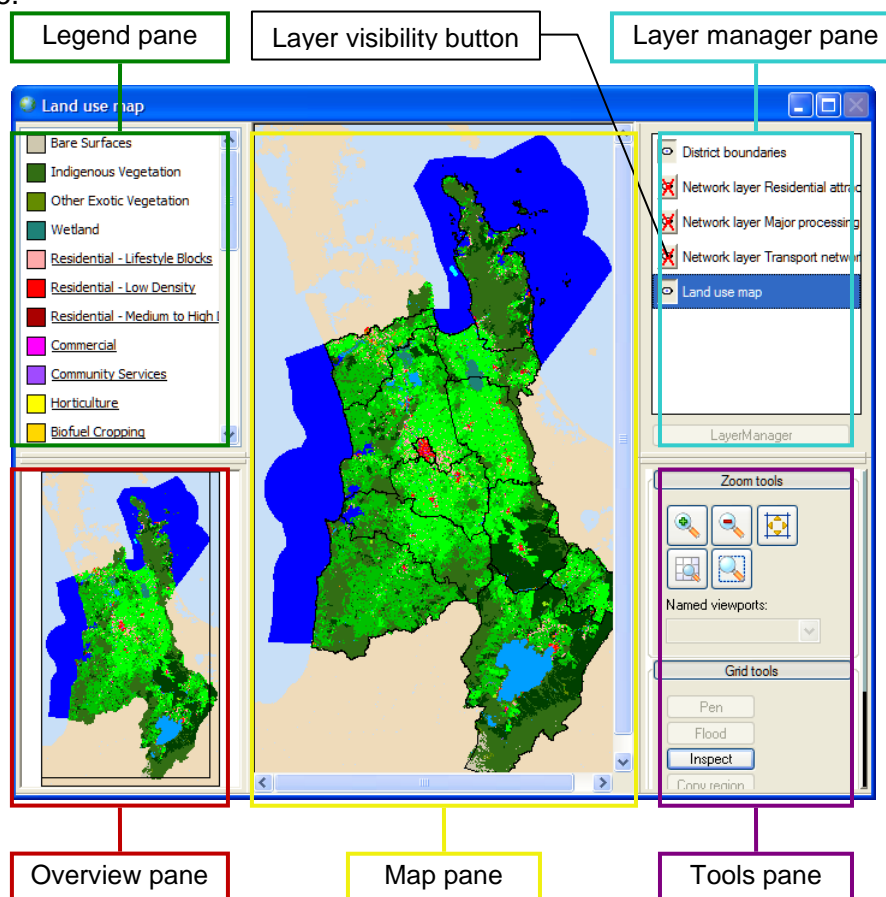
The models incorporated in WISE use and compute various forms of input and output data: spatial, temporal and tabular. These are represented in the graphical user interface in different ways to best fit the nature of the data. You will be able to find the following elements in the user interface:

- Maps
- Graphs
- Time series
- Tables

The following sub-sections describe how to edit input and display output for each of these elements.

Map window

Since all map windows in WISE work the same way, we will use the Land use map window that is opened when you open a project in WISE as an example. A Map window is split into 5 areas, called *panes* as depicted below. Panes are separated from each other by means of *splitter bars*. You can move the splitter bars to change the size of a pane.



Overview pane

The *overview pane* displays the entire modelled region. When the map is zoomed in, a rectangle is displayed that indicates the area displayed in the map pane. You can drag this rectangle to move the view of the map.

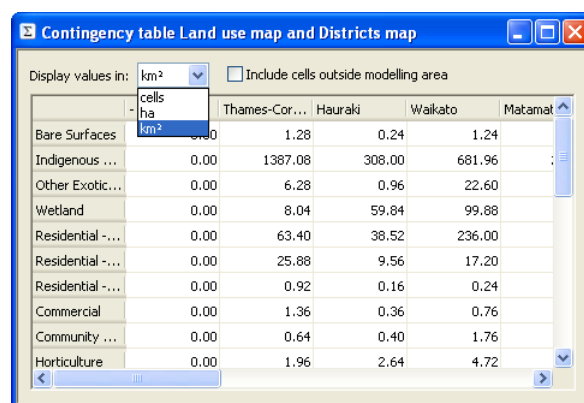
Map pane

The *map pane* in the Land use map window displays the land use map for the current simulation year. This is a raster map that displays the predominant land use for each

cell. When a simulation is running, the Land use map window will be updated after each time step.

Right-clicking inside the map pane will display a context menu. Click 'Cell information' on this menu to list the land use and district in the exact cell you right-clicked on. You can also access the same information by using the Inspect tool – see the section [Grid tools](#).

Double-clicking on the map pane of the Land use map window (this does not work for other map windows) opens the 'Contingency table Land use map and Districts map' window that shows the surface area of each land use in each district – see the image below. You can select the unit for the surface area from the 'Display values in' list. If you select the 'Include cells outside modelling area' checkbox, the land use outside the modelling area will be displayed in the first column. Otherwise, these values will be zero. The last row and column in the table display the totals.



	Thames-Cor...	Hauraki	Waikato	Matamat
Bare Surfaces	0.00	1.28	0.24	1.24
Indigenous ...	0.00	1387.08	308.00	681.96
Other Exotic...	0.00	6.28	0.96	22.60
Wetland	0.00	8.04	59.84	99.88
Residential -...	0.00	63.40	38.52	236.00
Residential -...	0.00	25.88	9.56	17.20
Residential -...	0.00	0.92	0.16	0.24
Commercial	0.00	1.36	0.36	0.76
Community ...	0.00	0.64	0.40	1.76
Horticulture	0.00	1.96	2.64	4.72



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 pane (explained below). For example, if you select a land use map, the legend pane shows the land use legend. Double-click in the legend pane to change the legend that is displayed – see the section [Legend editor](#).

Land uses are subdivided into 3 types: *Vacant*, *Function*, *Feature*. In the land use legend, the *Vacant* land uses appear at the top of the list, the *Function* land uses appear in the middle of the list and are underlined, and the *Feature* land uses appear at the bottom of the list. The 3 different land use types are explained in the section [Land use classes](#).

Layer manager pane

The *layer manager pane* is displayed in the upper-right portion of a map window. You can select a layer by clicking on its name (note that you cannot select the district boundaries layer). This will display the legend for the layer and allow you to edit the layer (if possible) – see the section [Grid tools](#) and [Network tools](#). You can show or hide a layer by clicking on the layer visibility button in the layer manager pane.

Button	Function
	Layer is visible
	Layer is hidden






Tools pane

The *tools pane* is displayed in the lower-right portion of the Map window. It shows the tools for viewing and editing maps and includes the Zoom tools, Grid tools, and

Network tools. Click on the corresponding name to expand or collapse the section for either of these three.



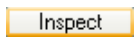

Zoom tools

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

Button	Function
	Click in the map pane to zoom in
	Click in the map pane to zoom out
	Drag in the map pane to change the viewed area
	Select an area in the map pane to zoom in on
	Zoom in/out to fit the entire map in the window

Grid tools

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

Button	Function
	Click in the map pane to change the value of a cell to the item selected in the legend pane. This button will be disabled for non-editable maps.
	Click in the map pane to change the value of a patch to the item selected in the legend pane. This button will be disabled for non-editable maps.
	Click in the map pane to list the value in a cell.
	Save the map to a file on disk.

If you have changed an editable map using the pen or flood tool, you will be asked if you want to save or discard your changes when you close the map window. Your changes will not be processed in the model until you close the map window and choose to save your change. If you choose to save your changes, make sure you save them in a new file and do not overwrite an existing file or, otherwise, the system may not process your changes correctly.




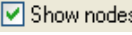
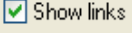
From the current land use map, accessible via Drivers → Parameters → Land use → Land use tab → 'Show current land use map' button, you can derive more information by using the Inspect tool. In the Potential figures dialog window that will open, the table lists the values for total potential, neighbourhood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

Potential figures (787, 456)					
Land use	Total potential	Neighbourhood potential	Suitability	Numerical zoning	Accessibility
Residential - Lifestyle Blocks	56.2634	90.3904	0.9	0.9	0.491585
Residential - Low Density	19.6942	100.485	0.9	0.4	0.38829
Residential - Medium to High Density	40.7746	150.582	0.9	0.4	0.387004
Commercial	65.3272	95.7351	0.9	1.5	0.257074
Community Services	48.9116	90.9189	0.9	1.5	0.253909
Horticulture	1.15255	0.8	1	1	0.748593
Biofuel Cropping	1.75981	0.8	0.8	1	1
Vegetable Cropping	3.10764	2.06863	0.8	1	0.836977
Other Cropping	1.48258	0.8	0.8	1	1
Dairy Farming	151.532	112.904	1	1	0.899138
Sheep, Beef or Deer Farming	1.22538	0.7	0.9	1	0.858725
Other Agriculture	2.44769	2.06863	0.9	1	0.616855
Forestry	0.779539	0.8	0.8	1	0.8809
Manufacturing	61.0192	100.683	0.9	1.5	0.296955

Network tools

The Network tools become enabled only when a network layer is selected in the layer manager pane. 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 [Creating network changes](#) 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
	Left-click on a node or link in the map pane to select it; Double-click on a node or link to edit the properties; Change the location of a node by dragging it to a new location.
	Drag in the map pane to draw a new link; the link will be drawn as a straight line from the start point to the end point. This button will be disabled for the non-editable maps.
	Left-click in the map pane to add a new node. This button will be disabled for the non-editable maps.
	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.
	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.

If you have changed an editable map, you will be asked if you want to save or discard your changes when you close the map window. Your changes will not be processed in the model until you close the map window and choose to save your change. If you choose to save your changes, make sure you save them in a new file and do not overwrite an existing file or, otherwise, the system may not process your changes correctly.

Legend editor

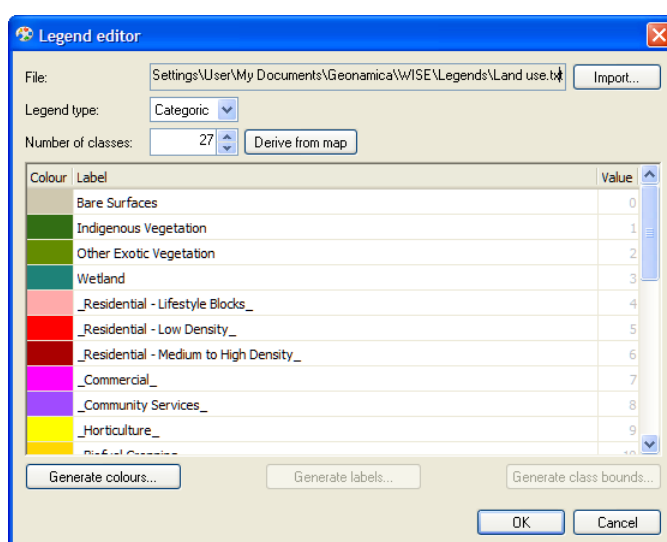
A legend assigns a label and a colour (and possibly other characteristics, such as line thickness) to each value in a map. Depending on what the values in a map represent, we can either use a categorical or a numerical legend. In a categorical legend, the values in the map are assumed to represent category indices, starting with the value 0 for the first category. An example of a categorical map is the land use map, where the land use classes form the categories. The values in a numerical map can, in principle, take any value. To limit the amount of entries in a numerical legend, we associate each entry with a certain range of values. An example of a numerical map is the annual amount of rainfall.

Double-click inside the legend pane of a map window to open the legend editor. Here you can change the properties of the legend to control how the map is displayed. Each distinct legend in WISE is stored as a file on disk; the file name is displayed at the top of the Legend editor window. You can click the Import button to copy the properties of another legend into the legend you are editing. Note that this does not change the file name of the legend you are editing.

You can choose whether a legend represents categorical or numerical data by selecting the appropriate entry from the 'Legend type' list. The other controls in the window will update accordingly. The following sections explain how to use them.

Categorical legends

When the Legend type in the legend editor is set to Categorical, the window will look similar to the image depicted below. You can set the number of classes manually or click the 'Derive from map' button to set the number of classes to the highest value found in the map plus one. Note that this button is disabled for the legends of a network layer.

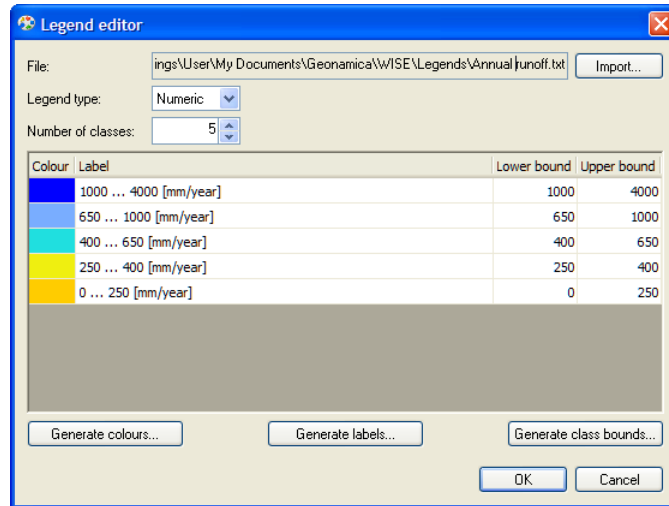


The table displays the categories in the order they will appear in the legend pane. Double-click on a label to change it. You can also copy-paste the labels from a text editor or Excel.

Click on an entry in the Colour column to change the colour of a category. A dialog will pop up where you can select the desired colour. You can also set the colour of all the categories by clicking the 'Generate colours' button – see the section [Generate colours](#).

Numerical legends

When the Legend type in the legend editor is set to Numerical, the window will look similar to the image depicted below. You can set the number of classes by typing the desired number or by clicking the up/down arrow buttons.

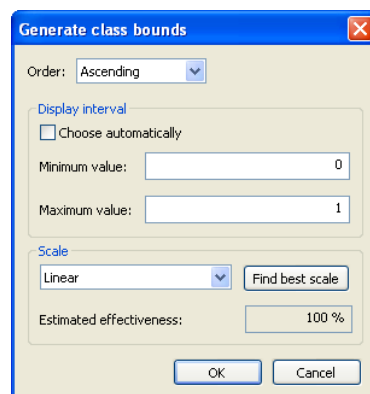


The table displays the classes in the order they will appear in the legend pane. You can change the lower and upper bound of each legend class by double clicking on the number in the table. When you set the lower bound higher than the upper bound of a class, the values will be given a red background to indicate the error. You have to adjust the values before you will be able to save the legend by clicking the OK button. Click the 'Generate class bounds' button to set the lower and upper bounds of each class according to some scale – see the section [Generate class bounds](#).

Double-click on a label to change it. You can also copy-paste the labels from a text editor or Excel. Click the 'Generate labels' button to set the labels according to the values in the lower and upper bound columns – see the section [Generate labels](#).

Click on an entry in the Colour column to change the colour of a category. A dialog will pop up where you can select the desired colour. You can also set the colour of all the categories by clicking the 'Generate colours' button – see the section [Generate colours](#).

Generate class bounds



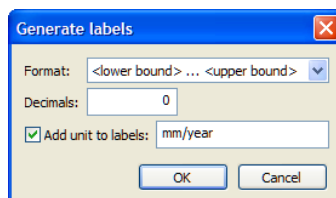
- Click the 'Generate class bounds' button in the legend editor to open the Generate class bounds window – see the image above.
- Click on the Order list to choose the order of legend entries.
- Enter a Minimum value and a Maximum value or select Choose automatically to set these values to the minimum and maximum value in the map. The lower bound of the lowest class will be set to the Minimum value. The upper bound of the highest class will be set to the Maximum value.
- Select a scaling method from the Scale list or click the 'Find best scale' button to select the scaling method that yields the highest Estimated effectiveness – this is a value between 0% and 100% that indicates how well the classification will be able to distinguish the variety of values that occur in the map. The available scaling methods are described in the table below.

- Click the OK button to update the lower and upper bounds in the legend editor window. Note that the labels in the table will not be updated.

Scaling method	Description
Linear	Each class will have the same width (i.e. difference between lower and upper bound).
Arithmetic	The width of the second lowest class will be twice the width of the lowest class. The width of the third lowest class will be three times the width of the lowest class. Etc.
Geometric	The ratio of upper bound divided by lower bound will be the same for each class.
Over-geometric	The ratio of upper bound divided by lower bound for the second lowest class will be twice that of the lowest class; for the third lowest class three times that of the lowest class; etc.
Harmonic	This scale is useful for data that follows a factorial distribution.
Quantiles	Each class will cover an approximately equal amount of values.
Standardised discretisation	The width of each class is set according to the standard deviation of the values in the map, centred around the average value in the map.
Method of Bertin	This scale applies two linear scales centred around the average value in the map.
Fifth-order polynomial	A fifth-order polynomial is fitted through the sorted values of the map using a least squares regression. Class bounds are then set to the value of the polynomial at equally sized intervals.

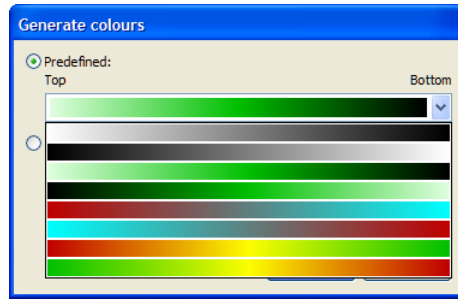
Generate labels

- Click on the 'Generate labels' button in the legend editor to open the Generate labels window – see the image below.
- Select the desired format from the Format list.
- Enter the number of decimals with which values should be displayed in the labels.
- If you want to display a unit in the label, select 'Add unit to labels' and enter the unit in the text box.
- Press the OK button to update the labels in the legend editor.



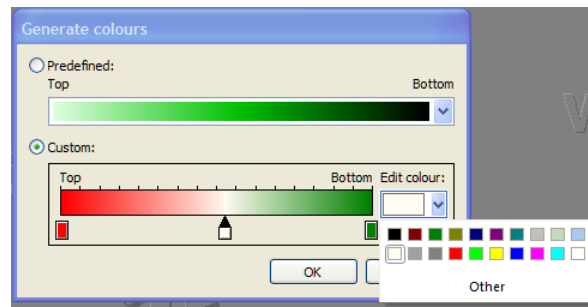
Generate colours

- Click on the 'Generate colours' button in the legend editor to open the Generate colours dialog window – see the image below.
- Select an option from the dropdown list just below the Predefined option. The Top and Bottom labels indicate how the colours will be arranged in the table.
- Press the OK button to update the colours in the legend editor.



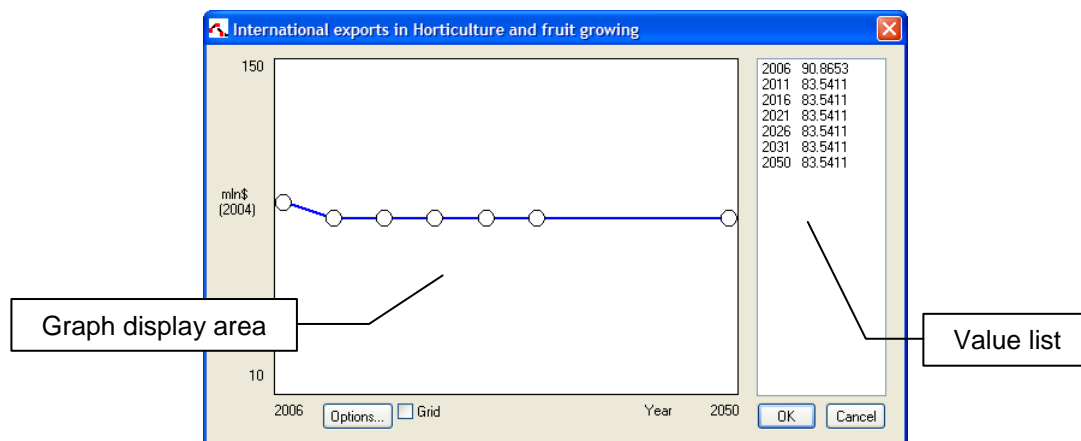
You can also set the colours in the legend according to a custom gradient. The Custom part of the Generate colours window allows you to easily make a smooth palette that blends from one colour to the next.

- Click on one of the boxes just below the gradient bar 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 using the dropdown list under Edit colour.
- You can add extra boxes by clicking anywhere on the gradient bar.
- You can delete an intermediate box by right-clicking on it and selecting Delete from the context menu.
- Press the OK button update the colours in the legend editor.



Graph

The graph editor is used extensively in WISE to define two-dimensional relations: time series and distance decay functions. The left part of the window displays a graph in which you can edit the values by moving, adding or deleting points. The right side of the window displays a list of the values in the graph. You cannot edit this list, but it is updated as you edit the graph. Values between points in the graph are always linearly interpolated. Values before the first point or after the last point are kept constant.



- You can add points to the graph by double-clicking on a location in the white part of the graph.
- You can remove points by double-clicking on the point you want to remove.

- You can move a point by dragging it. You cannot move a point beyond its left or right neighbour.
- You can precisely edit the value of a point by right-clicking on it. This will open a dialog where you can enter exact values.
- You can change the display range of the graph by clicking the Options button.

Single value

Single values in WISE are displayed in text boxes. Normally, the displayed value is rounded. However, when you click on the text box, the exact value will be displayed. You can change the value directly in the text box; press the Tab key to commit your change.

- Go to Main window → Drivers → Policy Measures → Socio-economic measures.
- The value for 'Rate of change in multi-factor productivity' is displayed in a text box with two decimals precision.
- Click inside the text box. The value will be displayed with full precision.
- Change the value in the text box. Press the Tab key to commit your change. You will see that the 'Policy measures – Economy sub-scenario' will change to "(modified)".
- Click the 'Load sub-scenario' button to reload the previous sub-scenario and undo your change.

Time series

Some time series are displayed as graphs in WISE. Others – for example, time series of maps – are displayed as a list of time-value pairs in a table. In this case, you can add or remove values for specific times in the time series by clicking the 'Add time' or 'Remove time' buttons next to the table.

- Go to Main window → Drivers → Parameters → Land use → Land use tab.
- Click the 'Add time' button. A window will pop up where you can enter the time you want to add to the time series.

Times are displayed and entered in WISE in the format "yyyy-mm-dd hh:mm:ss". Months are represented by the first three letters of the month's name. Note that everything after the first part is optional. For example, if you enter "2015" in the 'Enter date and time' window and click the OK button, the time 2015-Jan-01 00:00:00 will be added to the time series.

Table

The *table editor* enables you to enter a series of numerical values. You can select cells by clicking or dragging in the table. Click a row or column heading to select an entire row or column. Click the top-left header to select the entire table. Press Ctrl+C to copy the contents of the table or press Ctrl+V to paste copied values into the table. This way, you can easily exchange data between WISE and Excel or a text editor. Note that the values are copied as text, so if you copy data from Excel to WISE, you will lose precision if the number of displayed decimals in Excel is not set to a high enough value.

Input maps

Input maps are represented in the user interface by their file name. There is also a button that you can click to display the map. You can import a different map by simply changing the file name. You may have to reset the simulation for the map to be actually loaded and verified in the model. It is also possible to edit input maps in WISE by displaying them and using the Grid tools to change the map – see the section [Grid tools](#).

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

- Click the browse button inside the 'Initial land use map' box. A dialog will open that allows you to select a different file to import.
- Click the Cancel button in the 'Select initial land use map' window.
- Click the 'Show / Edit' button for the initial land use map. A map window will open where you can edit the initial land use map – see the section [Grid tools](#).

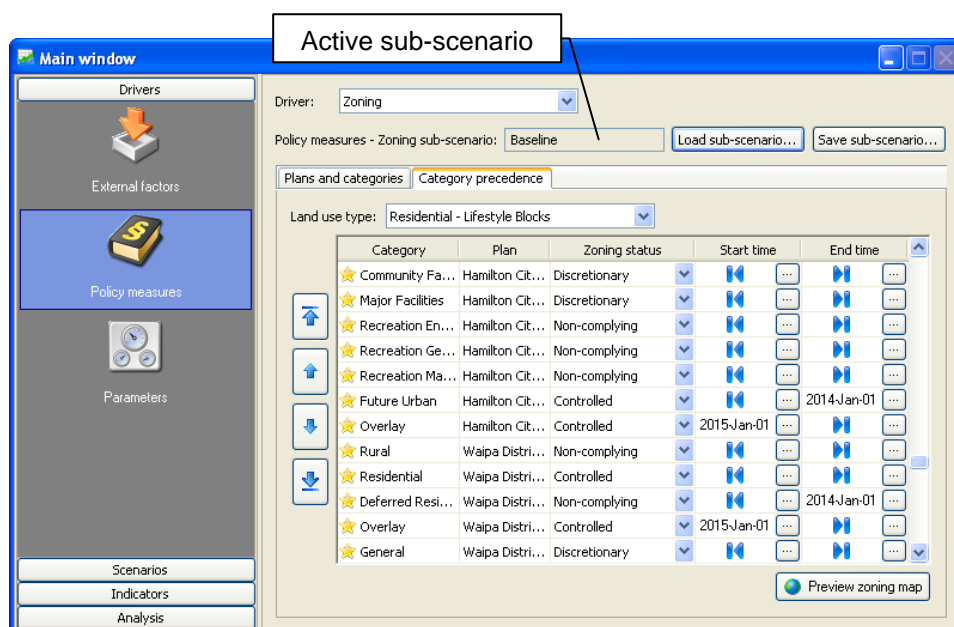
The changes you make in a map window will not be stored until you close the map window. At that time, you will be asked to save your changes. If you click the Yes button, you can select a file name where you want to store the altered map. It is important that you do not overwrite any existing files, as it could cause WISE to malfunction. When you have selected a new file name, the map will be saved and the new file name will be set in the 'Initial land use map' box.

2.3 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.

Saving sub-scenarios

Sub-scenarios can be defined for each driver in the Main window. The name of the active sub-scenario is displayed at the top of the driver – see the image below for an example. When you hover the mouse cursor over this name, a description of the sub-scenario will be displayed as well. The values that are displayed for the driver are the values that belong to the active scenario. Whenever you change a value, the name of the active sub-scenario will change to "(modified)" to indicate that the currently displayed value does not belong to any existing sub-scenario.



- Go to the zoning driver in the Main window.
- Change the zoning status for one of the categories. The name of the active sub-scenario will change to "(modified)".

You can load an existing sub-scenario by clicking the 'Load sub-scenario' button. A dialog will pop up listing the available sub-scenarios. When you select one and click the OK button, the values for the driver will be updated.

You can save the changes you have made to a driver in a new sub-scenario by clicking the 'Save sub-scenario' button. Provide a name and description in the dialog that will pop up and click the OK button. You will see that the name of the active sub-scenario will change to the name you just entered.

Integrated scenarios

Sub-scenarios can be defined for each driver in the Main window. The combination of one sub-scenario for each driver is called an *integrated scenario*. The active integrated scenario is always displayed in the toolbar. Here you can also load a different integrated scenario by selecting it from the dropdown list. When you do this, the according sub-scenarios will be loaded for each driver.

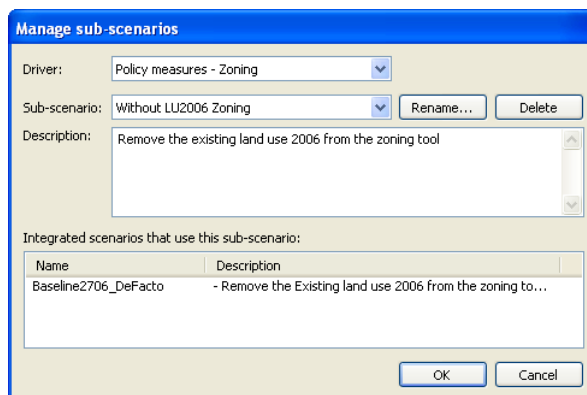
As is explained in the previous section, you can change the active sub-scenario for a driver in the Main window by clicking the 'Load sub-scenario' or 'Save sub-scenario' button. When you do this, the active integrated scenario displayed in the toolbar will be updated automatically. If an integrated scenario already exists for the set of active sub-scenarios, it will be selected. Otherwise, the active integrated scenario will be displayed as "(modified)". Also, when you change the value of a driver, the active integrated scenario will change to "(modified)" just like the active sub-scenario for the driver you have changed.

You can create new integrated scenarios by going to the 'Scenario manager' page in the Main window (under the Scenario tab). Click the New button and enter the requested information in the dialog that will pop up. Note that the new integrated scenario will not be activated automatically. To do so, select it from the 'Integrated scenario' list. You can also load sub-scenarios on this page; the effect will be the same as loading them on the page for the respective driver.

You can delete the active integrated scenario by clicking the Delete button on the 'Scenario manager' page in the Main window. This will not affect which sub-scenarios are loaded for each driver. Hence, the active integrated scenario will change to "(modified)", as no integrated scenario exists anymore for the current set of active sub-scenarios. You can define a new integrated scenario by clicking the New button or by saving the project (see section Saving a project).

Managing sub-scenarios

You can get an overview of all the available sub-scenarios and which integrated scenarios they are used in by clicking the 'Manage sub-scenarios' button on the 'Scenario manager' page in the Main window (under the Scenario tab). This will open a dialog similar to the one depicted below.



- Select one of the drivers from the list. The Sub-scenario list will be updated with the sub-scenarios that are available for the selected driver.
- Select a sub-scenario from the list to view its description. The Description and the list of 'Integrated scenarios that use this sub-scenario' will be updated.
- Click the Rename button to rename a sub-scenario. Your change will not be committed until you click the OK button.
- Click the Delete button to delete a sub-scenario. You cannot delete a sub-scenario that is used in one or more integrated scenarios. You will first have to

remove these integrated scenarios. The sub-scenario will not be deleted until you click the OK button.

Saving a project

Click the Save button on the toolbar or select 'Save project' from the File menu in order to save all the changes you have made thus far in the opened project. When you save a project, you have to save any changes you made to a driver (or discard the changes) and save the set of active sub-scenarios in an integrated scenario. Any changes made to other parameters (accessible from the Parameters page in the Main window) are also saved. You cannot discard these changes and you cannot create scenarios for them.

- Re-open the Waikato project. Discard any changes you made to an open project.
- Go to Main window → Drivers → Policy measures → Zoning. Click on the 'Category precedence' tab.
- Change the zoning status for one of the categories in the table. The active sub-scenario will change to "(modified)".
- Click the Save button on the toolbar. The 'Save project' dialog will pop up. It looks similar to the image depicted below.

The 'Save project' dialog box is shown. It contains settings for various drivers. The 'Policy measures - Zoning' section is expanded, showing options to 'Save as new sub-scenario', 'Discard changes', 'Save in active sub-scenario', or 'Save as new sub-scenario'. The 'Save as new integrated scenario' option is selected. The 'Integrated scenario description' field contains the text: 'Baseline scenario for all drivers, except zoning. Uses 'My new zoning sub-scenario'.'

The top part of this dialog provides settings for each driver. If a driver has not been changed since the last time it was saved, the (disabled) list will show "(No changes)". Otherwise, the list will provide the option to discard the changes or to save them in the active or a new sub-scenario. By default, the settings in the 'Save project' window will be set to overwrite the last active sub-scenario (i.e. the one that was active before you made changes), unless that sub-scenario is read-only.

- Select the option 'Save as new sub-scenario' for the zoning driver. Note that the 'Save as active integrated scenario' option will become disabled. This prevents you from accidentally overwriting an integrated scenario.
- Click the More button to enter a name and description for the new sub-scenario.
- Enter the integrated scenario name and update the description.
- Click the Save button to save the project.

Exporting a project

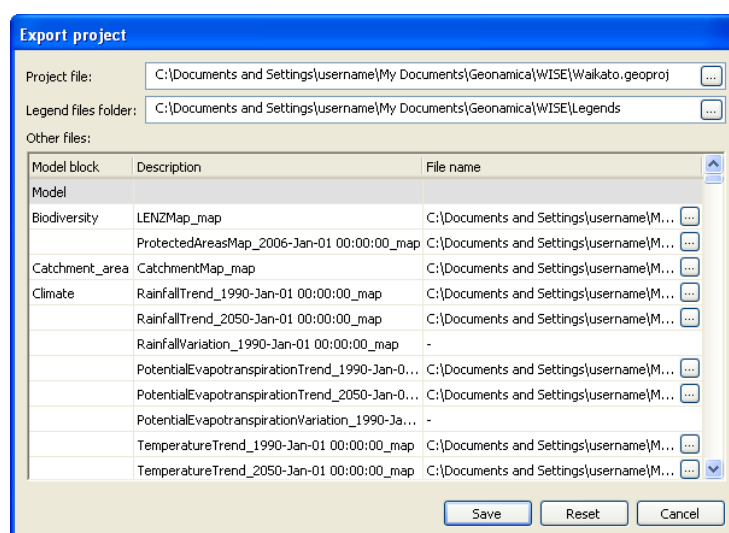
When you save a project – as explained in the section [Saving a project](#) – you overwrite the project file. This is no problem for the drivers, since you can save different values in different sub-scenarios. But for all the other parameters (accessible from the

Parameters page in the Main window), you can only save one value in a project. Therefore, to save different values for these drivers (e.g. while calibrating) you need to save different project files. This is possible when you select 'Save project as' from the File menu to save the project. However, caution is advised when using this option, because different project files will share the same data stored in external files (e.g. maps). A good guideline to follow in this situation is to always reset the simulation before saving the project.

WISE also provides the option to save a project together with all required external data files (e.g. maps). This option is convenient when you want to copy your project to a different computer.

- Select 'Export project' from the File menu.

If you have made any changes since the last save, the 'Save project' dialog will pop up asking you to save your changes. This works the same as explained in the section [Saving a project](#), only when you click the Save button, your project will not be saved immediately, but first the 'Export project' dialog will pop up. If you did not make any changes, the 'Export project' dialog will pop up immediately when you export a project. It looks similar to the image depicted below.

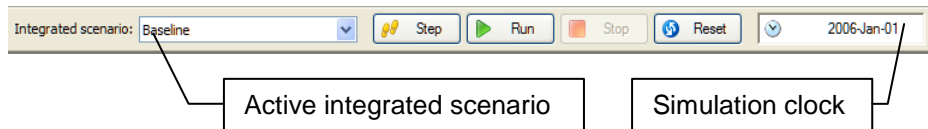


The table on the dialog lists the file names of all external data files that are used by the project. Each file name can be changed individually or you can copy-paste the last column to a text editor or Excel to easily change all the files.

- Select the last column in the table by clicking on the 'File name' column header.
- Copy the contents of the last column by pressing Ctrl+C on the keyboard.
- Paste the copied text to a new Excel workbook (or your preferred text editor).
- Select Replace from the Edit menu and replace the folder of the project file with a different folder – e.g. you can replace "C:\...\WISE\" with "C:\...\WISE copy\". Click the 'Replace All' button.
- Copy the changed text from Excel (Ctrl+C).
- Click on the 'File name' column header in the 'Export project' window.
- Press Ctrl+V to paste the changed file names into the table.
- Check that all the file names in the table now refer to the same folder.
- Change the 'Project file' to the correct folder.
- Change the 'Legend file folder' to be a subfolder of the folder where you will save the project file. All the files in the legend folder will be copied.
- Click the Save button to export the project.

2.4 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 current simulation time. The initial year is 2006 in WISE.

Active integrated scenario

Before you start running the simulation, check which integrated scenario is active. This determines which scenario will be calculated.

- Expand the 'Integrated scenario' dropdown list on the toolbar by clicking on the downward arrow. The available integrated scenarios will be displayed on the list.
- Select an integrated scenario from the list, for example, the *Baseline* integrated scenario.
- When collapsed, the list box shows the name of the active integrated scenario. When you select a different integrated scenario, it will be loaded and become the active integrated scenario. However, if the previously active integrated scenario was "(modified)", a message box will pop asking if you want to save your changes. If you click the No button, your changes will be discarded and the selected integrated scenario will be loaded. If you click the Yes button, the project will be saved as if you pressed the Save button on the toolbar – see the section [Saving a project](#). Afterwards the selected integrated scenario will be loaded.

Note that loading an integrated scenario means loading the associated input data and parameter values to the user interface. The results that are calculated by the model are not updated for the newly loaded scenario immediately. You can use the Update, Step, Run and Reset commands to calculate the models.

Reset

You can reset the simulation clock to the start year of the simulation by clicking the Reset button on the toolbar or by clicking Reset on the Simulation menu. While the model is calculating, a progress bar will be displayed in the status bar. The progress bar will disappear when the calculations are finished.

Whenever you change initial values or initial maps in WISE, you need to reset to complete the changes.

Update

Click Update on the Simulation menu to recompute the model without changing the current simulation time. Changes to initial values, parameters that do not affect the current simulation time or time-dependent variables in the model (such as the land use map) will not be recalculated when you update the simulation. For this reason, updating a simulation is mostly much quicker than resetting or running the simulation. While the model is calculating, a progress bar will be displayed in the status bar. The progress bar will disappear when the calculations are finished.

Step

Click Step on the Simulation menu or click the Step button on the toolbar to advance the simulation clock by one time-step (mostly one year). This option is useful to view the effect of the changes you have made on time-dependent variables calculated by the model. While the model is calculating, a progress bar will be displayed in the status bar. The progress bar will disappear when the calculations are finished.

Run

Click Run on the Simulation menu or click the Run button on the toolbar to progressively advance the simulation clock till the end of the simulation period (or the next simulation pause). The simulation clock and the displayed results will be updated after each time-step of the model. While the model is calculating, a progress bar will be displayed in the status bar. The progress bar will disappear when the calculations are finished.

Stop

Click Stop on the Simulation menu or click the Stop button on the toolbar while running a simulation to stop the simulation. The simulation may not stop immediately, because the calculations for the current simulation step are completed first in order to avoid corrupting the system. Some functions in the user interface require you to stop the simulation first. In this case, click the Stop button on the toolbar and wait till the calculations are completed – the progress bar in the status bar will disappear.

2.5 Saving results

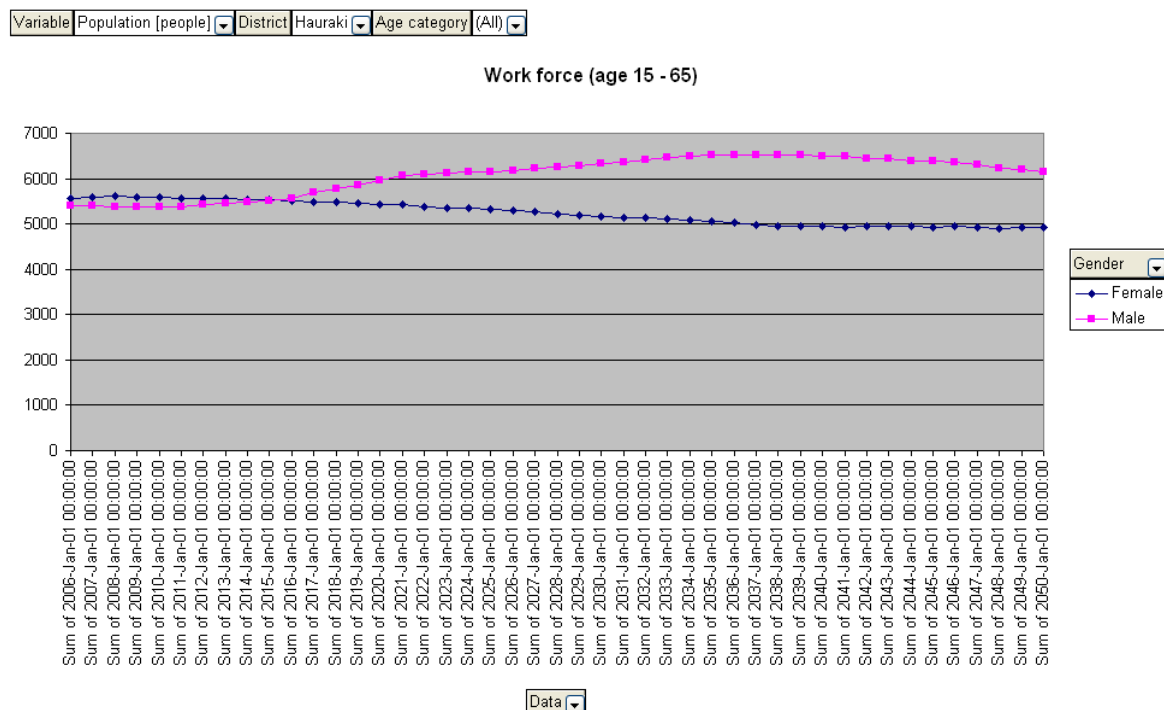
Write to Excel

Click 'Write to Excel' on the Options menu to open or close a link between WISE and a Microsoft Excel workbook. The window that will appear, will display a list of model blocks that allow their results to be written to Excel. Enter a unique sheet name for each model block that you want to write to Excel – you can copy-paste the model block names. Then enter a list of simulation times at which the model results should be written. When you click the 'Start writing' button, a new Excel workbook is opened in the background and the model results will be written as you run the simulation. While the link between WISE and the Excel workbook is open, you can see that 'Write to Excel' on the Options menu is checked. Come back to the 'Write to Excel settings' window and click the 'Open Excel workbook' button to stop writing to Excel and display the created workbook.

- Click 'Write to Excel' on the Options menu. The 'Write to Excel settings' window will appear.
- Select all of the model block names and press Ctrl+C to copy the names.
- Select the cell just below the 'Excel sheet name' column heading and press Ctrl+V to paste the copied names. The values in the 'Excel sheet name' column should now match the values in the 'Model block name' column.
- Click the Generate button. The 'Generate moments' window will appear. The default settings in this window will generate a list of moments for each year of the simulation period.
- Click the OK button. The list of Writing moments in the 'Write to Excel settings' window will be filled.
- Click the 'Start writing' button. WISE will open a new Excel workbook in the background.
- Take one or more simulation steps by clicking the Step button on the toolbar.
- Click 'Write to Excel' on the Options menu again.
- Click the 'Open Excel workbook' button. The Excel workbook that WISE has written the model results to will open.

Model results are written to Excel in a format that is suitable for making pivot tables. This way you can easily arrange the values in Excel in the way you want to present them.

- Select the Population sheet in the open Excel workbook.
- Click 'PivotTable and PivotChart report' on the Data menu. A wizard will appear where you can configure a PivotTable or PivotChart.
- Select the option 'PivotChart report' in the wizard and click the Finish button. A PivotTable and PivotChart will be created in new sheets.
- Drag items from the 'PivotTable Field List' window onto the chart to configure the graph the way you want. For more information advice the Excel help function.



Log maps

Click 'Log maps' on the Options menu to save maps that are calculated by WISE to disk for further analysis. The logged maps are automatically added to a log file that can be opened with the Map Comparison Kit – see the section [Map comparison](#). The maps themselves are saved in subfolders of the log file. You can store the maps for different simulation runs in different subfolders. This way you can easily log the maps for different scenarios and then compare the scenario results in the Map Comparison Kit. Note that network maps can be logged, but are not added to the MCK log file and cannot be displayed in the MCK.

- Make sure the Baseline integrated scenario is active by selecting it from the 'Integrated scenario' list on the toolbar.
- Click 'Log maps' on the Options menu. The 'Log settings' window will appear.
- In the 'Maps to log', select the land use map (Entire model → Land use model → Land use → Land use map).
- Change the 'MCK log file' if you want to store the maps in a different folder.
- Enter a 'Simulation name' that is equal to the active integrated scenario (Baseline).
- Click the Generate button and change the settings to generate log moments for: 2010, 2020, 2030, 2040 and 2050.

- Click the OK button in the 'Generate log moments' window. The 'Log moments' list should now contain the values: 2006, 2010, 2020, 2030, 2040 and 2050.
- Make sure the 'Turn logging off after last log moment' option is selected. If it is not, you risk overwriting previously logged maps. By automatically turning off the logging at the end of a simulation run, you will have to manually turn it back on when you run e.g. a different integrated scenario. At that time, all you need to change in the 'Log settings' window is the 'Simulation name'. By choosing a unique name, you will prevent overwriting previously logged maps.
- Click the 'Turn logging on' button. 'Log maps' on the Options menu will now be checked to indicate that maps will be logged when you run a simulation.
- Click the Reset button on the toolbar. When the simulation is reset, click the Run button to run the simulation till the end year.
- Go to Main window → Analysis → Map Comparison.
- Click the 'Start MCK' button. The Map Comparison Kit will open with the log file that you selected before in the 'Log settings' window. In the MCK you can compare the different maps that have been logged. See the MCK user manual for more information.

Animate maps

Click 'Animate maps' on the Options menu to create animated images of maps that are calculated by WISE for use in a presentation or on a website. Animations are stored as animated GIF files. Each simulation step will be one frame in the file.

- Click 'Animate maps' on the Options menu. The 'Animation settings' window will appear.
- In the 'Maps to animate', select the land use map (Entire model → Land use model → Land use → Land use map).
- Change the animation folder if you want to save the animated GIF files in a different folder. For example, you can use the name of the active integrated scenario as the last subfolder.
- Under 'Animation size', select the option 'Screen (800 x 600)' if you want to generate an animation for a presentation or website. Select the option 'Actual size' if you want to assure that each pixel in the land use map corresponds to one pixel in the animated image.

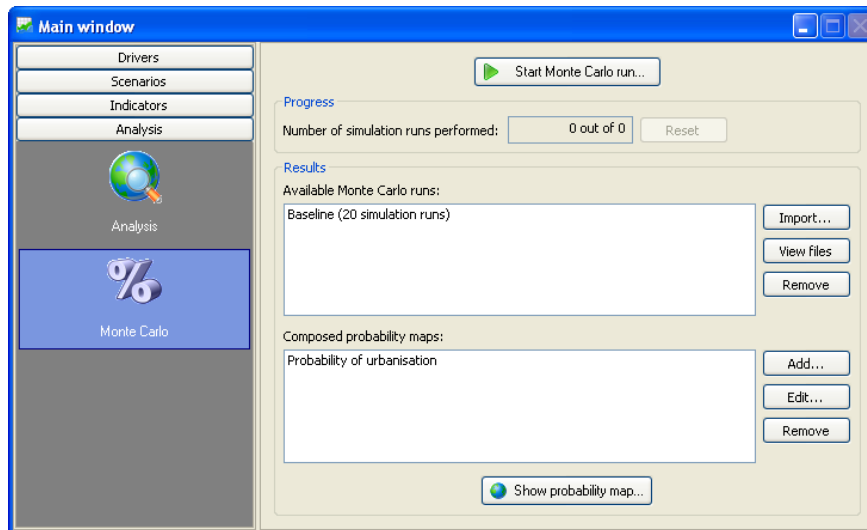
Note that the exact size of the generated images can differ from the selected size, because the aspect ratio of a map is preserved. The selected option will limit the maximum size of the image, so if you selected 'Screen (800 x 600)' the generated image will be no wider than 800 pixels and no higher than 600 pixels.

- Click the OK button in the 'Animation settings' window. 'Animate maps' on the Options menu will now be checked to indicate that maps are animated when you run a simulation.
- Click the Reset button on the toolbar. When the simulation is reset, click the Run button to run the simulation till the end year.
- The animated GIF files are stored in the folder you have selected. You can view them with any descent browser or image viewer. Note that the simulation time is printed in the top-left corner of the image.
- To turn map animations off, click 'Animate maps' on the Options menu again. Then deselect all 'Maps to animate' and click the OK button. You will see that 'Animate maps' on the Options menu is no longer checked.

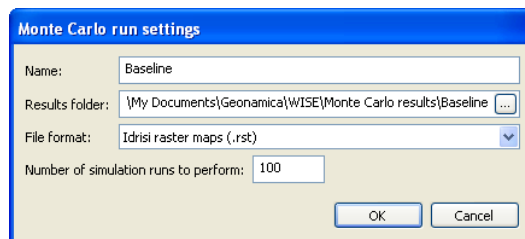
2.6 Tools for analysing results

Monte Carlo tool

The 'Monte Carlo' page in the Main window (under the Analysis tab) allows you to run a simulation repeatedly for a specified number of times. The stochastic nature of the land use model will yield slightly different results for each simulation run. The Monte Carlo tool counts the frequency of occurrence of each land use class in the land use map at the end of the simulation period. It also provides the ability to combine and display this information comprehensibly in a *composed probability map*. However, before you can display these maps, you will need to perform a Monte Carlo run or import the results of a Monte Carlo run from another computer – see below.



To perform a Monte Carlo run, click the 'Start Monte Carlo run' button and enter the settings in the dialog that pops up – see the figure below. For the name, you'll probably want to use the name of the active integrated scenario. The results folder will be used to store the probability map for each land use. Make sure this is an empty folder.



While the Monte Carlo run is being performed, you can view the progress in the Main window. When the run is completed, the results will be saved to disk and the run will be added to the 'Available Monte Carlo runs' in the results section. Save the project (see the section [Saving a project](#)) in order to store the entries in this list. Otherwise, you can still import the saved results by clicking the Import button.

To copy the results of a Monte Carlo run to another computer, select the Monte Carlo run in the 'Available Monte Carlo runs' list and click the 'View files' button. This will open a new window displaying the contents of the folder in which the results have been saved. Copy all the files in this folder to another computer and, on that computer, click the Import button to import the copied files.

After you have performed or imported a Monte Carlo run, you can view the probability map for each land use class by clicking the 'Show probability map' button. This will open a dialog similar to the one depicted below. Select the Monte Carlo run and the land use for which you want to display the map and click the OK button. The map will

display values between 0 and 1 that indicate the fraction of simulation runs in which the selected land use occurred in the land use map at the end of the simulation period.

It is also possible to display more comprehensive maps, in which the probability map for different land uses can be combined with information from the initial land use map. These are called *composed probability maps* in the system. You can create one by clicking the Add button next to the list of composed probability maps in the Monte Carlo tool. This will open a dialog similar to the one depicted below.

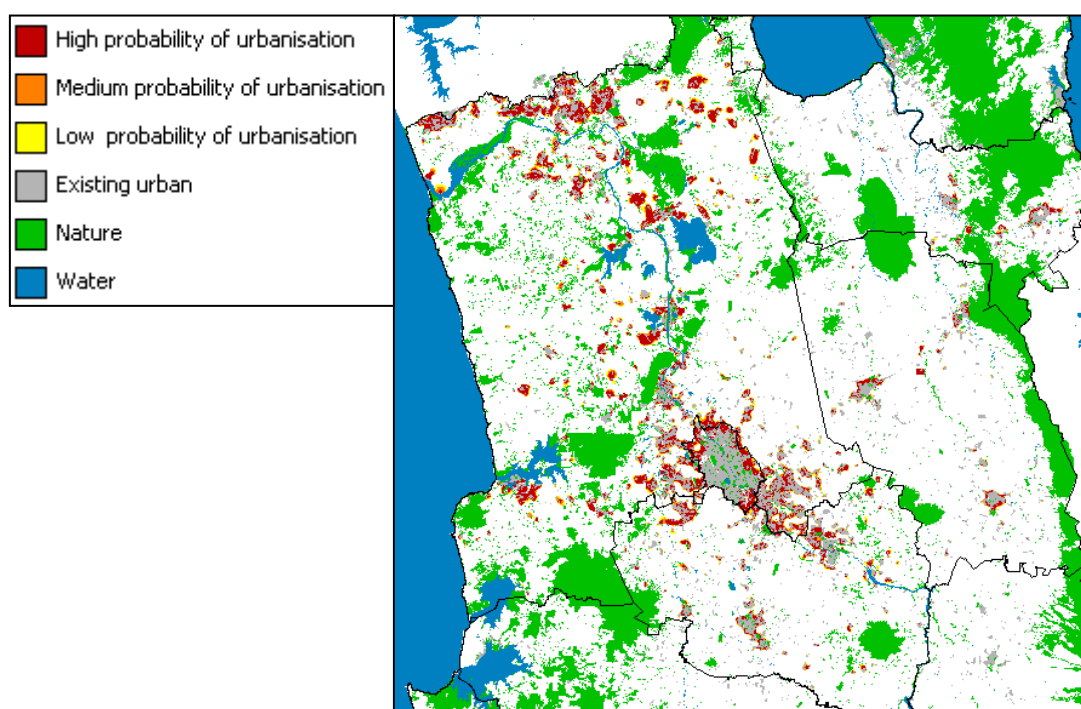
Click the Add button in this dialog to add a column in the 'Combined probabilities' table. Each column represents the probability that one of the land uses selected in that column occurs in the simulated land use map. For example, to define the probability of urbanisation, select all the urban land uses.

You can list the categories that will be displayed in the composed map in the Rules table. Each row in this table represents one category in the composed map. The rules are evaluated from top to bottom and the first rule that applies determines the value in the composed map. If no rules apply, the value in the composed map will be 'no data'. The first column in the Rules table specifies the name of each rule. The second column specifies a selection of land use classes for each rule. The rule only applies if the initial land use is one of the selected classes. The third and subsequent columns match the columns in the 'Combined probabilities' table. These columns specify a boundary condition within which each rule applies. For example, in the dialog depicted above, the rule 'High probability of urbanisation' only applies in those cells that have a probability of urbanisation larger than 0.75. Note that this rule does not apply to locations with an urban land use in the initial land use map, as these location will be categorized as

'Existing urban', which is listed above the 'High probability of urbanisation' rule in the Rules table.

The order in which the rules need to be defined thus depends on how they should be interpreted, i.e. which rules should take precedence over which other rules. This order may not be the most suitable order to list the categories of the composed map in its legend. Therefore, you can change the order of the legend categories in the Legend table by selecting one or more categories and clicking the 'Move up' or 'Move down' buttons.

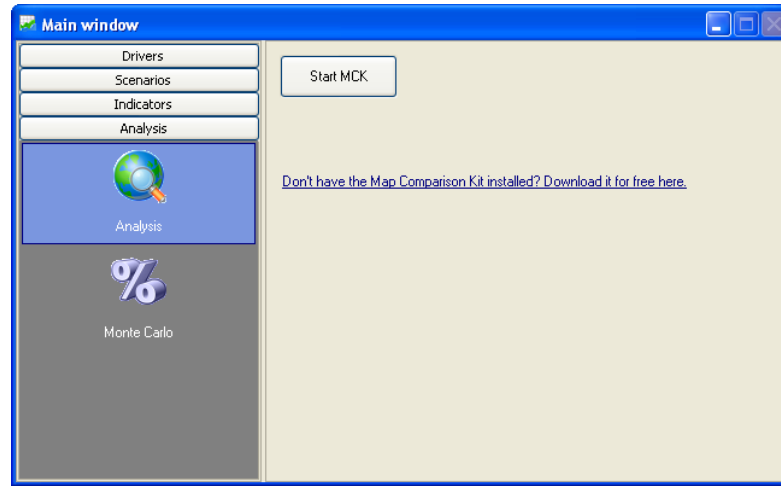
You can view any composed probability map you have defined for any Monte Carlo run that you have performed or imported. For example, you can create "Probability of urbanisation" maps for the baseline scenario as well as an alternative scenario. To view the maps, click the 'Show probability map' button in the Monte Carlo tool. Select the desired Monte Carlo run and composed probability map and click the OK button. An example of the "Probability of urbanisation" map that we defined above is depicted below.



Map comparison

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. 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. If you do not have the MCK installed on your computer. You can click the link to download it for free.



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 in the MCK in a straightforward manner.

An example of how to use the Map Comparison Kit to compare scenarios is given in the section [Analysing results](#).

3. Policy interface

The user interface of WISE provides access for two types of users: *policy users* who carry 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 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](#). This chapter explains how the policy user can use the system and the next chapter explains how the modeller can access the models.

The *policy user* finds access to all policy-relevant information in the Main window. This 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 Main window you get access to the different types of drivers: External factors, Policy measures and Parameters. The first two are part of the policy interface of the system; the last provides access to the details of the underlying models for scientists or modellers. Clicking on each of the icons opens the settings for this driver or set of drivers in the content pane on the right.

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. For example, you can load the baseline sub-scenario, change it and then save the changes as a new sub-scenario. Then you can load the baseline scenario again and made different changes.

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 eco-efficiency, rates of change in multi-factor productivity
 - Population: proportion of people living in each residential land use category for each district
 - Zoning measures
 - Infrastructure

The steps required to view or change driver settings are described in the section [Setting up the drivers](#).

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.

The steps required to create integrated scenarios are described in the section [Integrated scenarios](#).

Step 3: Running the simulation

In order to investigate the impact of certain scenarios, you need to run the simulation for each integrated scenario of interest. While you run simulations, there are several ways to export intermediate and final results of the model for later use in step 5.

- You can log maps which can be analysed afterwards in the Map Comparison Kit (part of the WISE package) or GIS packages – see the section [Log maps](#).
- You can make an animation of a map that shows how the map changes over time – see the section [Animate maps](#). You can open the animation in a viewer, but can also incorporate them in presentations or on a website.
- You can create a link to Excel through which all selected model results are directly written to Excel – see the section [Write 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](#).

Step 4: Visualising indicators

After a simulation is finished, WISE offers several options to analyse results. The first option is to visualise indicators. The indicators are organised in four groups:

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

Each of these indicators is calculated on a yearly basis. Depending on the type of indicator, it is calculated at one or more spatial levels (regional, district and local). You gain access to the indicators by clicking the Indicators tab in the Main window. Steps to take in visualising indicators are described in the section [Visualising indicators](#).

Step 5: Analysing results

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

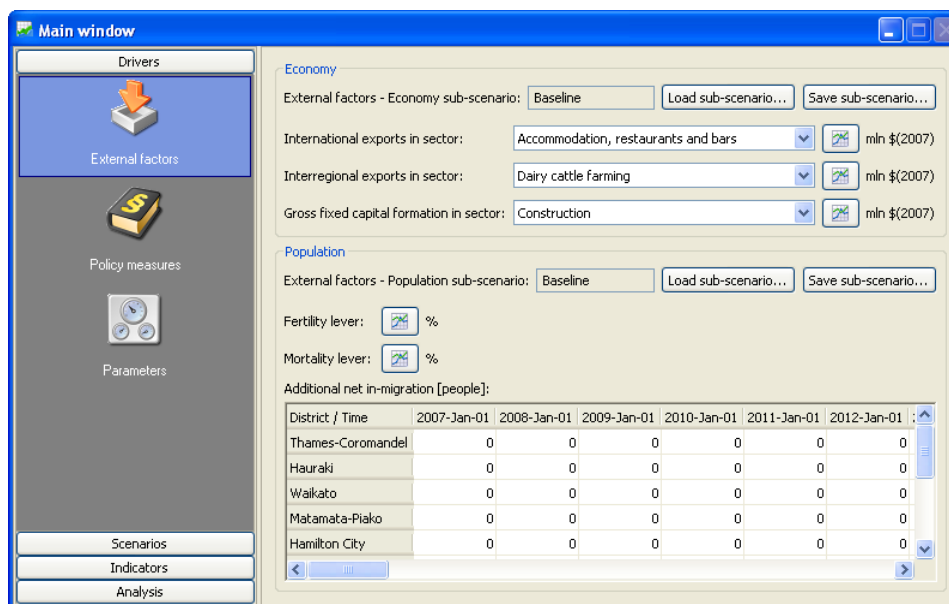
3.2 Setting up the drivers

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 section [Modeller interface](#).

External factors

For true integration of 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. The external factors are accessible on the 'External factors' page in the Main windows (under the Drivers tab).



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

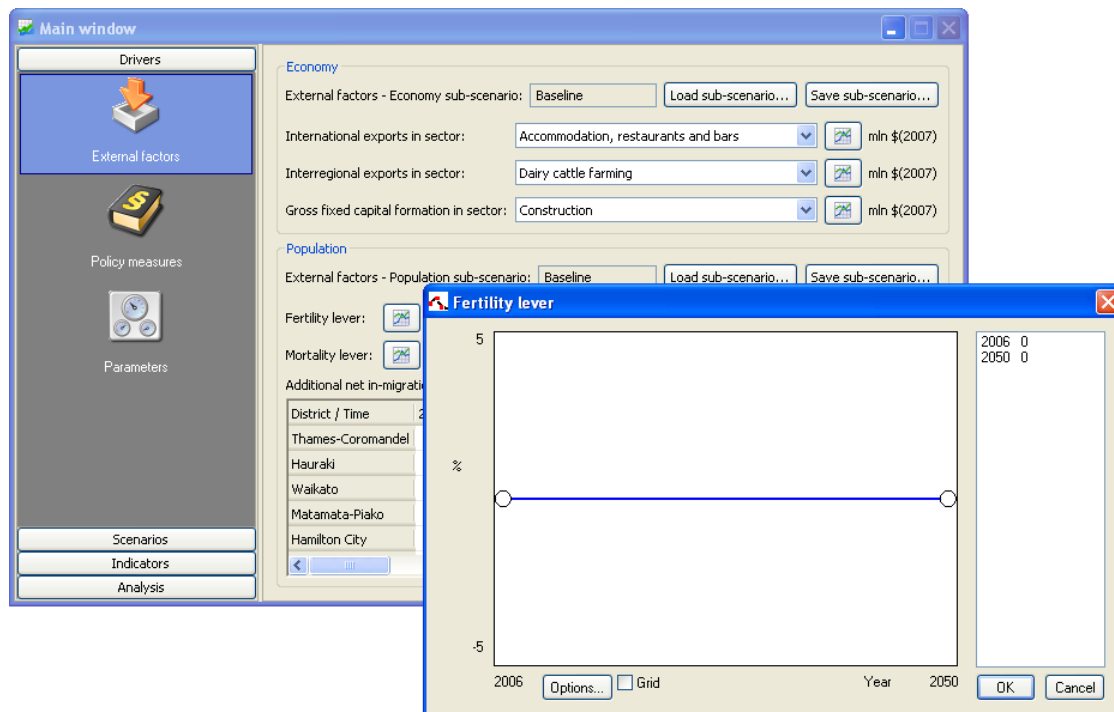
- View historic data and projections
- Adapt historic data and projections
- Load an existing sub-scenario
- Make changes to an existing sub-scenario and save it as a new sub-scenario

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.

How to view data and projections for the **Baseline** sub-scenario?

- Go to the Drivers tab in the Main window.
- Click the External factors icon.
- If the Population sub-scenario is not set to Baseline, click the 'Load sub-scenario' button and load the Baseline sub-scenario.
- Click the Fertility lever button. The 'Fertility lever' graph window will open.

This graph shows the fertility lever as a percentage on the vertical axis and the year on the horizontal axis. You can click the Cancel button to go back to the Main window.



How to adapt values for external factors?

- Go to the Drivers tab of the Main window.
- Click the External factors icon.
- Click the Fertility lever button. The 'Fertility lever' graph window will open.

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 right-clicking on a bubble. More bubbles can be added to the graph 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.
- Right-click the bubbles to enter the exact values for the year and the fertility lever.
- Press the OK button to save your results and close the graph.

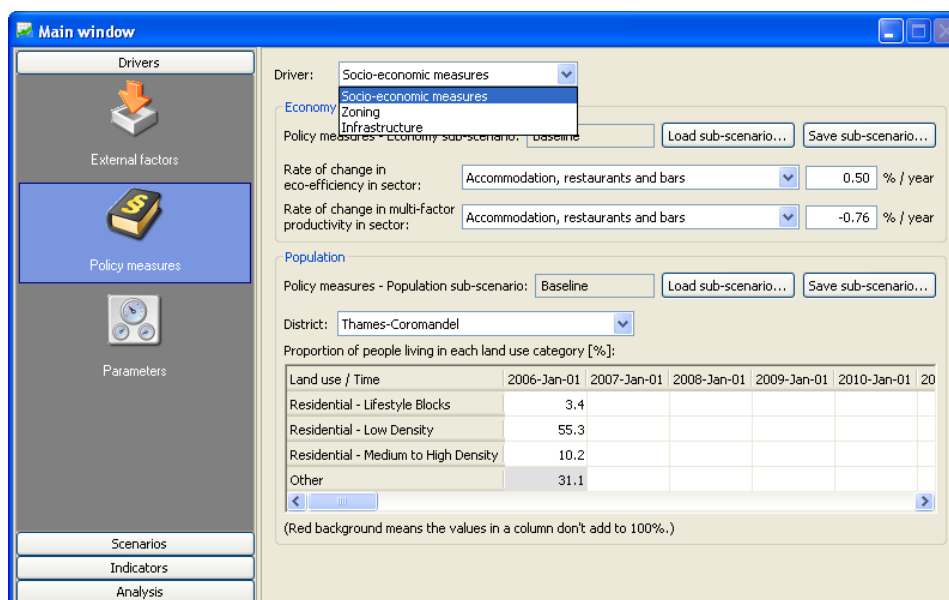
You have now adapted the population scenario in the external factors section. The active sub-scenario at the top of the driver reflects this by showing the name "(modified)". You can create a new sub-scenario with the values you just entered by clicking the 'Save sub-scenario' button.

- Click the 'Save sub-scenario' button. The 'Save external factors – Population sub-scenario' window will pop up.
- Enter the name "Test population" (without quotes) after the 'Save in new sub-scenario' option.
- Enter a description and click the OK button.

You have now created a new sub-scenario Test_population for the external factors - population scenario.

Policy measures – socio-economic measures

Besides external factors, WISE also incorporates socio-economic policy measures. These measures can be found by clicking on the Policy Measures icon under the Drivers tab in the Main window and selecting 'Socio-economic measures' from the Driver list.



How to adapt values of economic measures?

- Go to the Drivers tab in the Main window and click the Policy measures icon.
- Select the Socio-economic measures from the Driver list.
- Select the economic sector of your interest from the 'Rates of change in eco-efficiency in sector' list.
- Enter a new value in the text box to the right.
- Press the Tab key on your keyboard.

You have now changed the value of the rates of change coefficient for a certain sector. You will see that the active sub-scenario has changed to "(modified)". Click the 'Save sub-scenario' button to save your changes as a new sub-scenario or click the 'Load sub-scenario' button to load an existing sub-scenario and discard your changes.

How to adapt values of population measures?

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

The proportion of people living in each residential land use category for the selected district are displayed in the table. The value in the last row is automatically updated to make the column total 100%. If the values for residential classes sum to more than 100%, the values in that column are highlighted with red background. These values are invalid and will not be transferred to the model until a valid set of values is entered.

The values for the start year of the simulation are given and cannot be changed. Some columns are empty, meaning the values in that year will be determined from a linear interpolation of the previous and next defined values. After the last year for which values are specified, the values will be kept constant.

- Double the proportion of people living in "Residential – Medium to High Density" by 2015. You will see that the proportion of people living in non-residential land uses is updated automatically.
- You can reset a value to its linearly interpolated value by selecting the cell in the table and pressing the Delete key on your keyboard.

You have now changed the policy measure for population. The active sub-scenario will be displayed as "(modified)". Click the 'Save sub-scenario' button to save your changes

as a new sub-scenario or click the 'Load sub-scenario' button to load an existing sub-scenario and discard your changes.

Policy measures – Zoning

Zoning maps represent the policy part of the land use change model. Different locations have different restrictions for particular land uses. For any particular area, the development of one set of land uses can be allowed, while the development of another set of land uses can be prohibited. 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 socio-economic functions expand.

Zoning tool

The *Zoning tool* in WISE allows you to incorporate your spatial planning in the land use change model. You can enter spatial plans in the zoning tool and interpret their meaning for different land use classes in a comprehensible way. Plans can be ordered hierarchically, such that one overrules the other in case of conflict. When more information or new zoning plans become available, this can be incorporated in the zoning tool, either by the project team, or by the users themselves.

Before we will start to use the zoning tool, let's go over the most important terminology that will be used in the explanation.

Plan – A plan is a map that represents any spatial zoning plan. It contains source data which is not interpreted in terms of its effect on land use yet. A plan can contain one or more categories, such as "protected forests", "flood prone areas" or "residential". Any number of plans can be entered in the zoning tool, for example, the spatial plans of each district as well as regional plans can all be incorporated as separate zoning plans.

Category – A plan can have one or more 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 not be interpreted in the zoning tool – that is, they cannot be assigned a zoning status.

Zoning status – Each category in a plan needs to be interpreted in terms of their zoning status for each land use function separately. The following zoning statuses are available in WISE: *Permitted*, *Controlled*, *Restricted discretionary*, *Discretionary*, *Non-complying*, *Prohibited* and *Actively stimulated* (see the specification report for more information). Moreover, a category can be interpreted as "unspecified", meaning that the specific category does not influence a specific land use function or that no information for that category is available.

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

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.

Because multiple zoning plans can be introduced in the zoning tool, it is possible that two plans will provide conflicting zoning information – e.g. according to one plan residential development is allowed, whereas it is prohibited in another plan. To resolve such conflicts, the set of all categories in all zoning plans is ordered hierarchically in the zoning tool. Higher ordered categories overrule lower ordered categories. This hierarchy among categories is assumed to be the same for all land use functions.

Importing or editing zoning plans

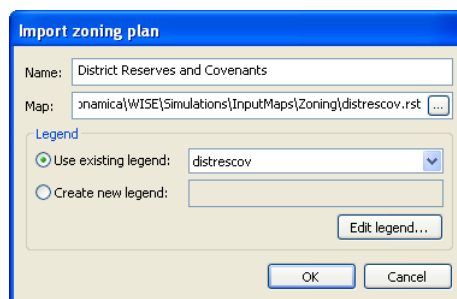
Zoning plans are represented as raster maps with categorical data. You can import a new zoning plan, if the map that represents that plan fulfils the following criteria:

- The projection, extents and cell size of the raster map match those of the land use map.
- The values in the map are subsequent integers starting from 0 (first category) up to but excluding the number the number of categories. A maximum of 250 categories per zoning plan is allowed.
- The 'no data' value in the map should be set to 255.

Maps can be preprocessed in a GIS to fulfil these criteria.

To import a new zoning plan:

- Go to Main window → Drivers → Zoning → Plans and categories.
- Click the 'Import plan' button.
- Enter a Name.
- Click the browse button inside the Map box to open the zoning plan to import.
- Select an existing legend or create a new one. Click the 'Edit legend' button to preview or change the legend – see the section [Legend editor](#).
- Click the OK button. The zoning plan will be added to the list in the 'Plans and categories' tab of the zoning tool. The categories in the zoning plan will be added to the bottom of the table on the 'Category precedence' tab. The default settings of these categories will be such that they have no influence on the zoning maps that are calculated by the system. If you later change the legend of the zoning plan, the settings for these categories will be reset to their defaults, so make sure the legend you enter is correct before you click the OK button.
- You can view the imported zoning plan by selecting it on the 'Plans and categories' tab and clicking the Show button.



To edit an existing zoning plan:

- Go to Main window → Drivers → Zoning → Plans and categories.
- Select the zoning plan you would like to edit.
- Click the 'Edit' button. Change the settings in the window that pops up and click the OK button to confirm. The information in the zoning tool will be updated. If you have changed the legend of the zoning plan or if you have selected a different legend, the settings on the 'Category precedence' tab of the zoning tool will be reset to the default values for the categories on the edited zoning plan. You will find the categories at the bottom of the table.

Interpreting zoning plans

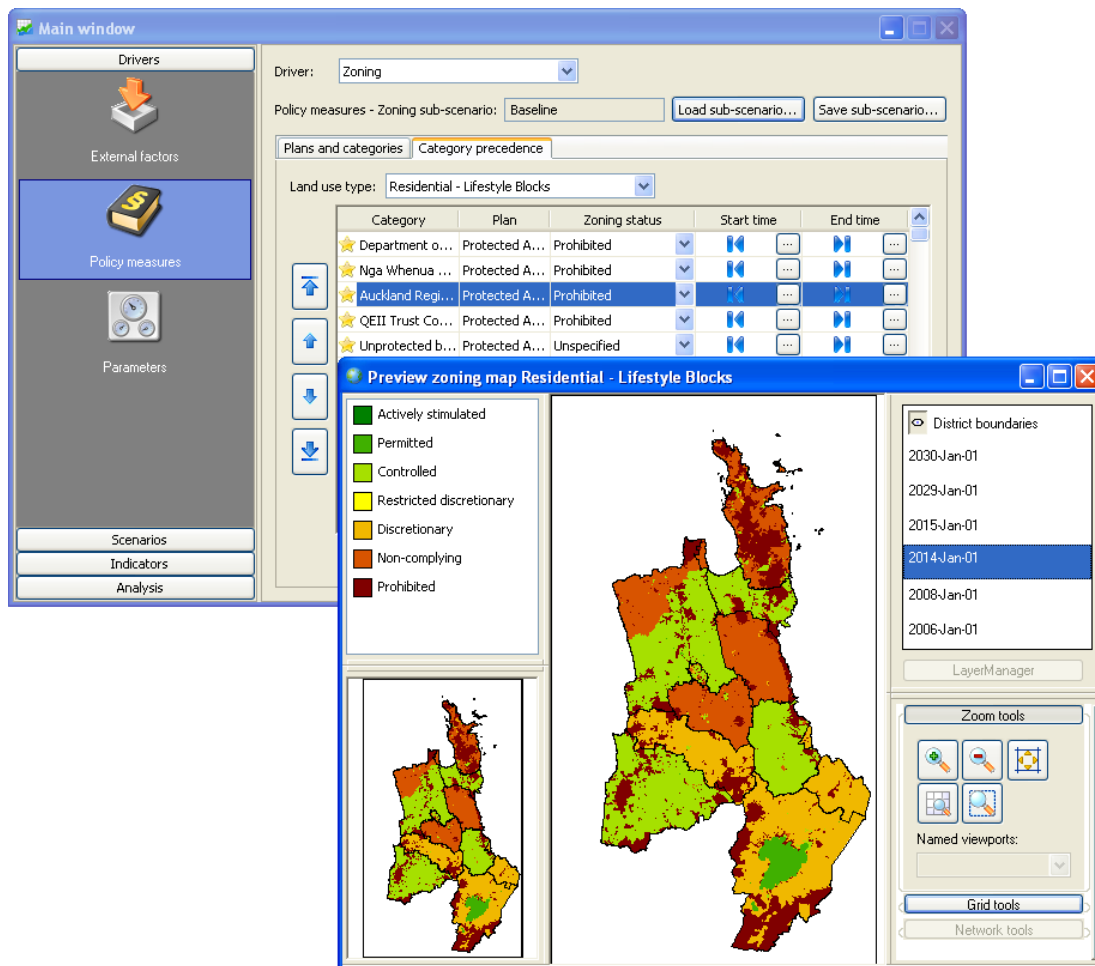
After you have imported all zoning plans, you can interpret them to indicate the effect for each land use function. On the 'Category precedence' tab of the zoning tool, the interpretation of all zoning plans is displayed in a table. The order of the categories in the table indicates the precedence; categories at the top overrule lower-placed categories. You can change the order by selecting a category (i.e. a row in the table) and clicking the buttons to the left of the table. The order is the same for all land use functions.

The start and end time of each category can be set in the last two columns. These settings are the same for all land use functions. Double-click the browser button (⋮) inside the cell to change the start or end time. The displayed icons indicate the start of the simulation period (📅) or the end of the simulation period (📅). When the start time of a category is set to 1-1-2010, that category will not influence the land use change model before that date. This means that the category first has an effect on zoning on the first day of 2010, which is only considered in the land use allocation on the first day of 2011. The end time indicates the simulation time from which a category no longer has an influence. If this is set to 1-1-2020, the category will not influence zoning on the first day of 2020, which is used for the land use allocation on the first day of 2021. But the category will still have an influence on zoning on the first day of 2019, which is used for the land use allocation on the first day of 2020.

In contrast to the other settings, the zoning status of a category is specified for each land use function individually. You can view or change the zoning status for a particular land use by selecting it from the 'Land use type' list above the table. You can change the zoning status of a category by double-clicking in the table and selecting a different zoning status from the dropdown list. When the zoning status is set to "Unspecified", the category will not be considered in calculating the zoning map for the selected land use function.

Viewing zoning maps

You can view how all the settings in the zoning tool are combined into a zoning map for each land use by clicking the 'Preview zoning map' button on the 'Category precedence' tab in the zoning tool. This will open a map window that displays the zoning map for the selected land use. In the layer manager pane on the top-right of the opened map window, you can see a list of times. These are the simulation times at which the zoning map for the selected land use will change. Click on a time to display that zoning map.



You can change the settings on the 'Category precedence' tab in the zoning tool while the 'Preview zoning map' window is open. The map will be updated interactively as you make changes to the settings. This way you can immediately observe the influence of your changes on the zoning map. Note though that the system needs to recalculate the zoning map after every change you make in the 'Category precedence' tab, so the system may become somewhat slower to respond. You can close the 'Preview zoning map' window at any time and open it again later.

It is not possible to preview zoning maps for multiple land uses at the same time. As soon as you change the selected 'Land use type' in the 'Category precedence' tab, the 'Preview zoning map' window will be closed automatically.

For more information about working with a map window, see the section [Map window](#).

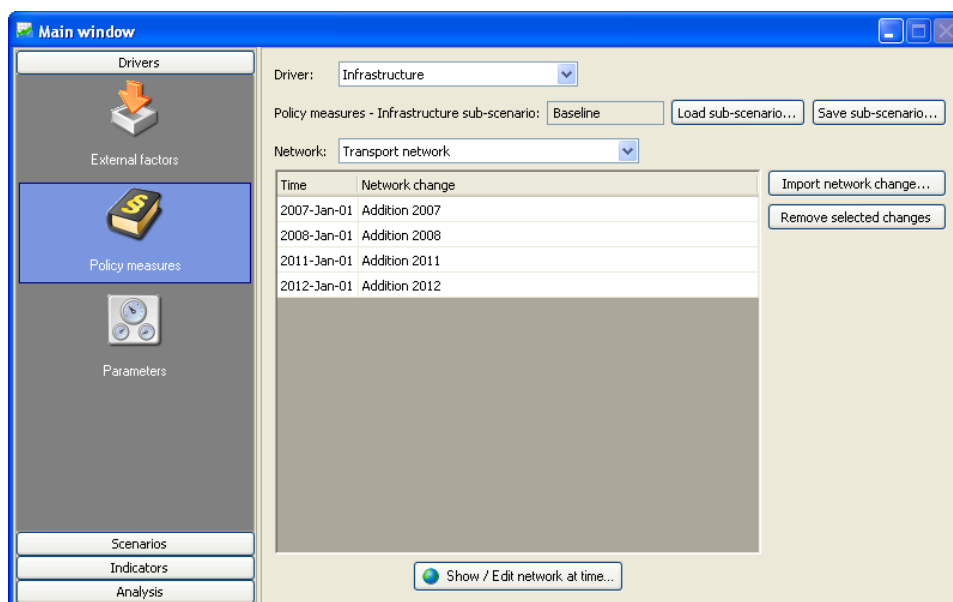
Policy measures – Infrastructure

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 influence of transport on land use. In future versions a transport model could be incorporated with which the impact of land use on transport can also be simulated. Currently, the transport network (roads and railways) is incorporated in the infrastructure driver. Other infrastructure layers incorporated in WISE are: *Major processing sites* and *Residential attractants*.

Land use is influence by the infrastructure driver through accessibility, which is a function of the distance to different types of infrastructure elements (e.g. local roads or

highways). Policy decisions that influence accessibility are mainly the construction of roads, railways or processing sites. 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 'Show / Edit network at time' button to open a window with a single network map displaying the network at the chosen time (incorporating all specified network changes up to that time). You can add or remove elements from this network or change the *accessibility type* of an element. 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](#)).

Displaying an infrastructure network

- Go to Main window → Driver → Policy measures → Infrastructure.
- Select "Transport network" from the Network list.
- Click the 'Show / Edit network at time' button at the bottom of the window. A window will open where you can select the simulation time for which you want to display the network.
- Select a time from the list and click the OK button. A map window will open displaying the selected infrastructure network at the selected time. You can draw links in this network, remove links or change the type of a link. Therefore, the nodes of each link are displayed as small circles. You can hide these by clicking on the 'Network tools' button in the tools pane in the bottom-right of the map window and deselecting 'Show nodes'. For more information, see the section [Network tools](#).

Creating network changes

- Go to Main window → Driver → Policy measures → Infrastructure.
- Select "Transport network" from the Network list.
- Click the 'Show / Edit network at time' button at the bottom of the window. A window will open where you can select the simulation time for which you want to display the network.
- Select a time from the list and click the OK button. A map window will open displaying the selected infrastructure network at the selected time.
- To add a link, select which type of link to add from the 'Link color' legend, then click the 'Add link' button on the Network tools and draw the link in the map by dragging

the mouse from the start point to the end point. You may first want to zoom in on the area of interest. Note that you can only draw straight lines.

- To remove a link, zoom in on it, right-click on it and select Delete from the context menu that will pop up.
- To change the type of a link, zoom in on it, right-click on it and select Properties from the context menu that will pop up. A window will open where you can select the infrastructure type.
- Close the map window to save your changes as a new network change. You will be asked to enter a name for the change and a file name where the map will be saved. It's best to save this in a subfolder of the project file. Note that the system always creates incremental network change maps, meaning only the nodes and links that have been added, removed or changed are saved.

Importing a network

When data on infrastructure developments is available or can be prepared in a GIS (as an ESRI shape file), you can import these directly in WISE. You can either import a complete network that replaces the previous network in a simulation run, or you can import a network that only indicates which network elements should be added or removed. In the latter case, the network needs to have a property (column) called "DeltaType" (case insensitive) with value 1 for all elements that should be deleted. If the property is missing, all elements in the file will be added to the network.

- Go to Main window → Driver → Policy measures → Infrastructure.
- Select type of infrastructure network that you want to import from the Network list.
- Click the 'Import network change' button. A window will open where you can enter the information required to import a network.
- Click on the browse button inside the File box to open the file to import.
- Select the Incremental check box if the network to import only contains the elements to be added or removed. Clear the check box if the network should replace the existing network at the specified simulation time.
- Click the OK button when you have entered all information. The network change will be added to the in the Main window.

3.3 Visualising indicators

The integrated model in WISE contains several components that calculate policy-relevant indicators. In order to calculate these, the model also calculates various other results, which are not useful for scenario-analysis, but can be used by modellers to calibrate or validate the models. The Indicators tab in the Main window provides organised access to all policy-relevant output calculated by the integrated model.

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 at the current simulation time (e.g. the maps under the Environmental indicators section and the age-cohort figure). Other indicators show a change over time. Note that these will be empty when you first open the simulation, or after you have reset the simulation, but are filled with data as the simulation progresses and display the full picture at the end of a simulation. You can visualise the social, economic, environmental and land use indicators at any point in time during a simulation.

Social indicators

On the Population tab of the social indicators, you will find a population pyramid for the current simulation time and the district selected in the 'Population for district' list. You can click the graph buttons to display a graph window that shows the evolution of the

total, male or female population for the selected district over the course of the simulation period.

On the Density tab, you will find a table of average population densities for the current simulation time and for the residential land use selected on the 'Land use' list. Density values that lie within the upper and lower bound are indicated with a green background; otherwise a red background will be displayed. This is an indication that the total residential area in a district will be over- or underrepresented in the simulation, given the simulated population in that district.

Economic indicators

All economic indicators are displayed as graphs that show the evolution of an indicator over the course of a simulation. You can open these graphs by clicking the graph buttons. The lists before the graph buttons display the sectors for which the indicator is relevant, as well as an entry for "All sectors". This will display a total value over all sectors in the economic model. The unit of each indicator is displayed to the right of the graph buttons.

Environmental indicators

The environmental indicators in WISE include maps and graphs. The graphs work the same way as for the economic indicators. The maps can be opened by clicking the 'Show map' button for an indicator. These all display the value of the indicator for the current simulation time. To save maps for different moments during a simulation run, see the section [Log maps](#).

Land use indicators

Land use indicators display a dual graph for each land use function that can be opened by clicking the 'Show' button. The upper graph displays the demand for land as calculated by the population model (for residential land uses) or the economic model (for all other land uses). The lower graph displays the amount of land that was allocated by the land use change model. When the graphs coincide, all demanded land could be allocated. When the graphs deviate from each other, this means that less land is available for a land use than what is demanded based on the projected growth of population and the economy. The competition between land uses is taken into account in this respect. Hence, you will likely see land scarcity affect agricultural land uses, but not residential or commercial land uses.

3.4 Analysing results

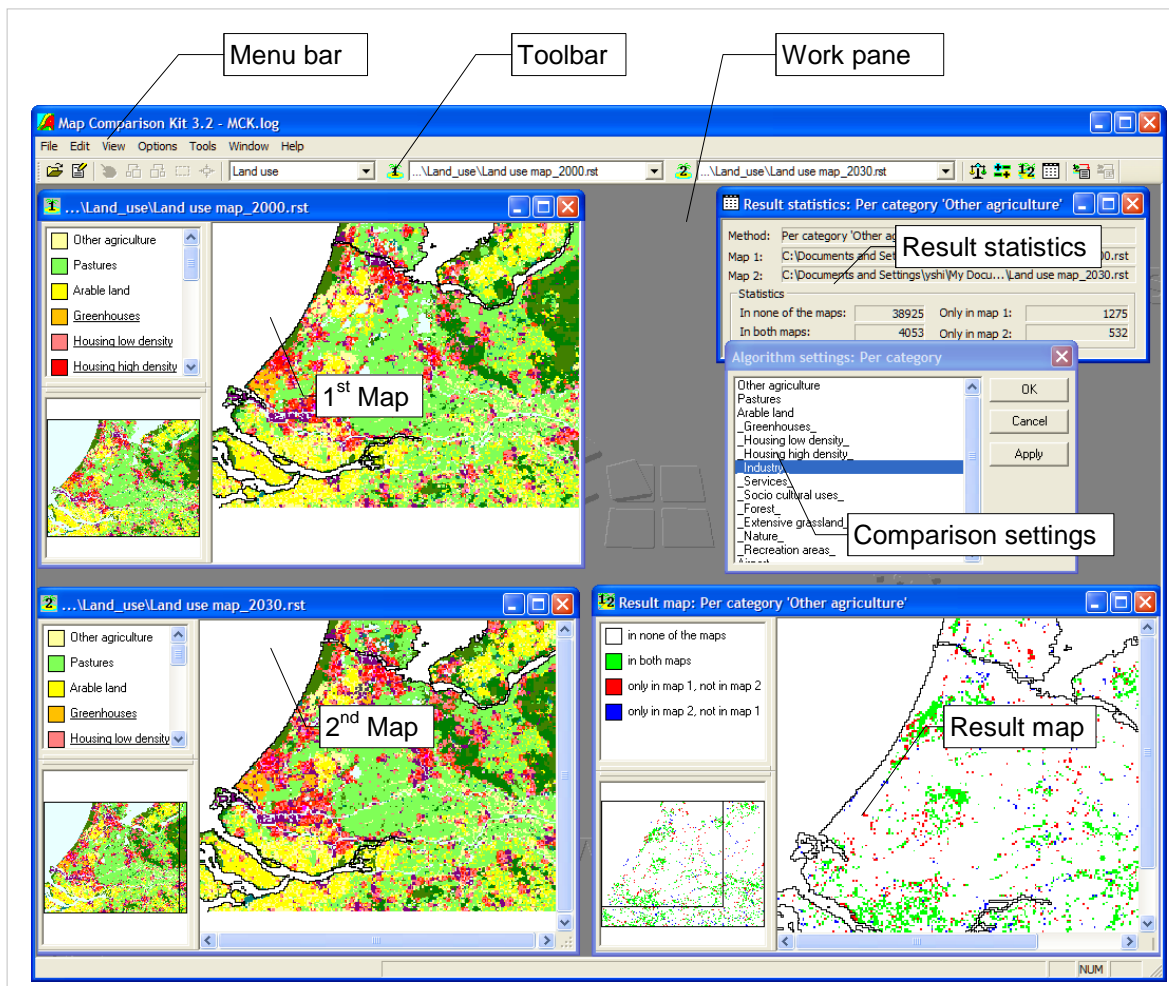
The final step of the impact assessment study is to analyse results within an integrated scenario (e.g. the temporal evolution of an integrated scenario) or to compare a set of integrated scenarios.

In 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 (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 user manual that comes with the MCK.

Short overview of the MCK

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. You can open it by clicking the '1' icon on the toolbar (🗺️). The list next to the toolbar displays which map is selected. You can select a different map from the dropdown list and the map displayed in the 1st map window, as well as the result map and results statistics will be updated immediately.
- The *2nd Map* window contains the second map to compare/analyse. It works the same way as the 1st map window.
- The *Result map* window contains the result map. It can be opened by clicking the '1/2' icon on the toolbar (🗺️). This map shows the spatial result of the 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 numerical (non-spatial) results of the last performed map comparison. It can be opened by clicking the table icon on the toolbar (📊).
- The *Comparison settings* dialog window allows you to change the settings of the current comparison algorithm. It can be opened by clicking the '+-' button on the toolbar (⚙️).

Comparing maps in the MCK

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.
- Click the 'Start MCK' button. The Open window of the MCK opens. The MCK log file that has been generated by the 'Log maps' functionality in WISE will be preselected in the Open window.
- Click the Open button. The MCK log file will be loaded.
- Select which type of maps you want to compare from the left-most list on the toolbar. The lists for the first and second map will be updated according to your selection.
- Select the first and second map to compare. Click the 1 or 2 icons on the toolbar to display these maps. The maps in the list are ordered by simulation name (as entered in the 'Log settings' window in WISE) and by year.
- Select a comparison algorithm by clicking the balance icon on the toolbar (). For categorical maps, such as land use, zoning or threatened environments, the 'Per category' or Kappa algorithms will be most useful. For numerical maps, the 'b – a' or 'b divided by a' algorithms will be most useful.
- Click the '1/2' icon on the toolbar () to display the comparison map and click the table icon () to display overall comparison statistics.
- Some comparison algorithms can be further refined with special settings. For example, the 'Per category' comparison algorithm can be refined by selecting which category to compare. Click the '+-' icon on the toolbar () to adjust these settings. If a comparison algorithm has no settings, this icon will be greyed out. You can click the Apply button in the 'Algorithm settings' window to update the comparison results directly.

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.

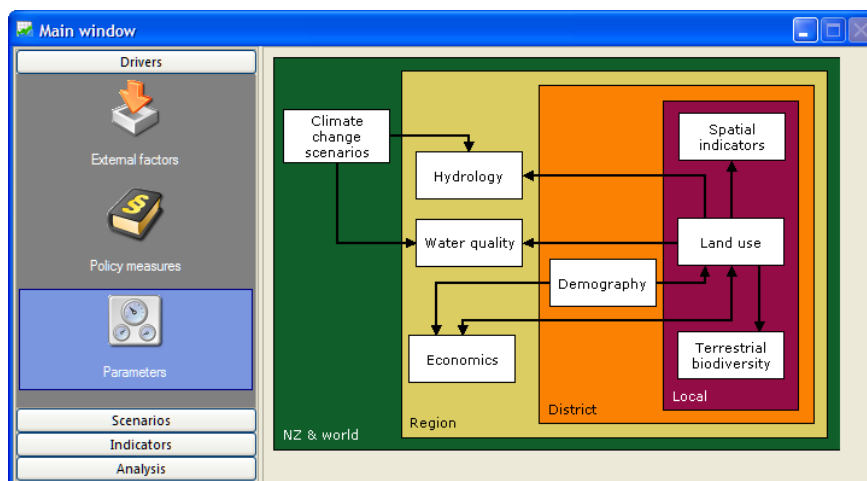
Detailed information about how to update data and parameters through the modeller user interface is given per individual model in the section [Individual model components](#). Notice that setting the parameters is part of the calibration of the system. Changing the parameter settings can have a major 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

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 greenhouse gases emissions scenarios (low, medium, and high) have been produced as input for the climate model in WISE.

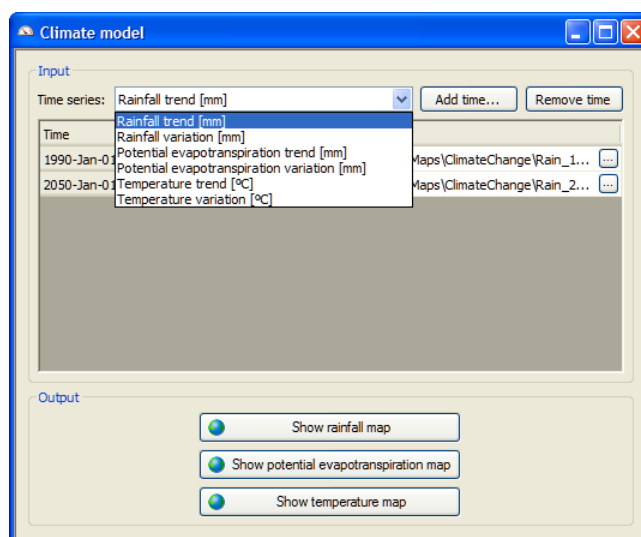
To access the modeller user interface for the *Climate model*,

- 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. 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, several predefined climate change sub-scenarios are available in the scenario manager. For more information, see the section [Managing sub-scenarios](#).

A 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.

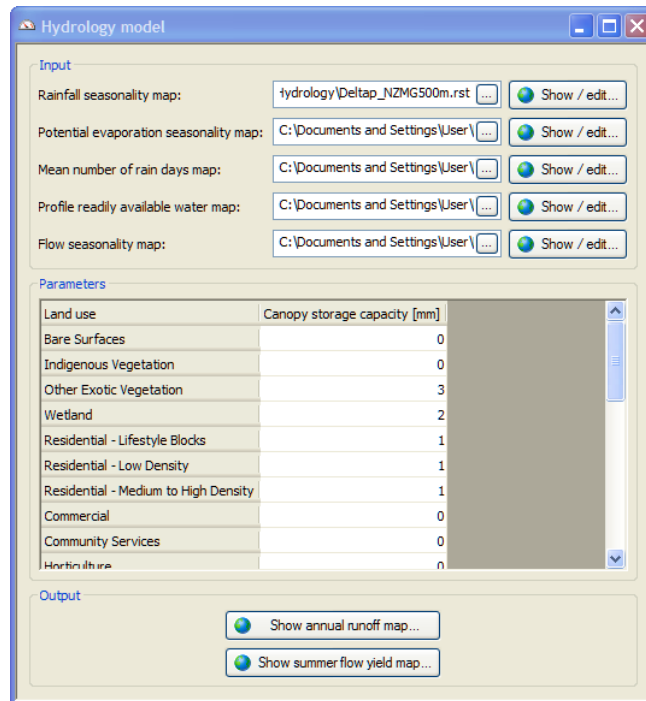
The values from the climate change scenarios will be used as input information for the [Hydrology model](#).

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.

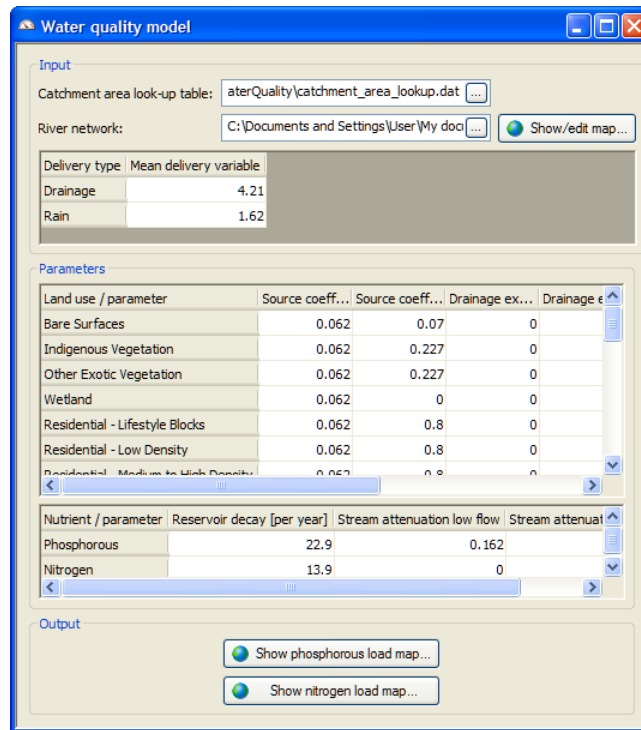
In the Input part of the Hydrology model dialog window, you can view and edit the input maps for the hydrology model by clicking on the Show/edit... button next to the input map of interest.

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.

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

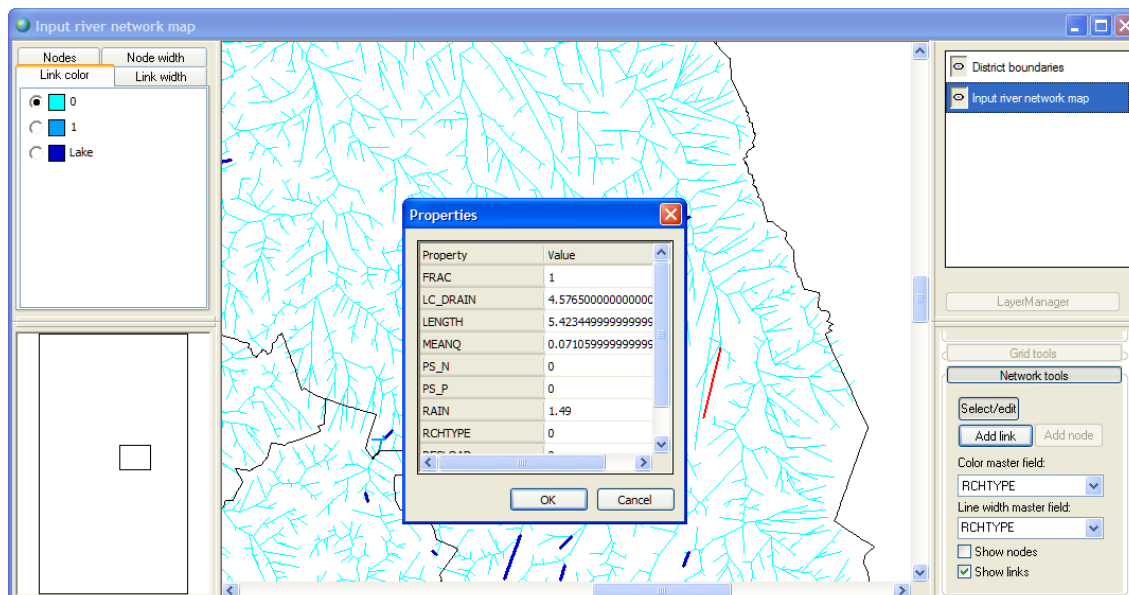
You can upload a new catchment area look-up table by clicking the browse button next to Catchment area look-up table on the top of the window and double-clicking on the new file. The *catchment area look-up table* is a binary file containing the following information:

- 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

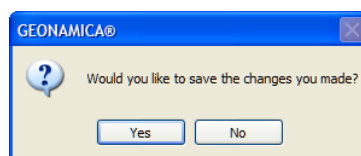
You can upload a new river network by clicking the browse button next to River network and double-clicking on the new map. The *river network* map is in shape format. The reach network is a dendrite system of reaches and nodes. Each reach has a single sub-catchment associated with it. A reach may also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

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 divided over several tabs: Sector filter, Sector-land use correspondence, Consumption, Demand, Land use constraint, Supply and Indicators.

Scrolling tabs

Use the icons at the top-left of the 'Economic model' window to scroll the tabs, when some of them are not visible.

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' window mainly consists of tables. Some of the headings of the tables are not displayed completely. The complete heading is displayed when you hover the mouse cursor over it. You can change the width of a column by dragging the right edge of the column heading. Double-click this edge to size the column to fit the contents.

Sector filter

The 'Sector filter' tab shows which sectors are displayed on various lists in the Main window. You can adjust the selection by selecting or clearing the check boxes.

Sector – land use correspondence

On the top of the 'Sector – land use correspondence' tab, the '*Sector to land use correspondence*' table is shown. 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 coefficient. Note that the values are fractions and that all fraction for each sector should add up to exactly 0 or 1.

Press the Apply button under the Sector to land use correspondence table to confirm the modifications. The system allows you to undo changes in coefficients you have made since its last applied state by means of the Reset button. The Apply and Reset buttons are only active after a change has been made.

On the bottom of the 'Sector – land use correspondence' tab, you can find the 'Inverse correspondence' table. This shows the extent to which each sector contributes to each land use function. The coefficients in this table will be used to convert land use demand per function to land use demand per sector. The values in the 'Inverse correspondence' table are updated after each simulation step.

Consumption

The Consumption tab displays the household consumption per sector. This is updated after each simulation step according to the growth of population. People of different

ages or gender can have a different effect on total consumption, which is captured in the 'Consumption scalars'.

Demand

The Input section of the Demand tab displays four components of final demand: *International exports*, *Interregional exports*, *Gross fixed capital formation* and *Changes in inventories*. Different values can be entered for different times. The Time list shows for which simulation times a value has been specified. In between these times, values will be linearly interpolated according to the previous and next specified time. You can add or remove times to the list using the corresponding buttons.

The total of these four components and household consumption is the 'Final demand' displayed in the Output section. These values are multiplied with the 'Inverse Leontief matrix' of the Parameters section to calculate the 'Unconstrained output' displayed in the Output section. These values will be used to calculate land use demands in the next tab.

Land use constraint

After the 'Unconstrained output' is calculated, the values are converted from a monetary value per sector to a surface area per land use function. This is done using the 'Sector to land use correspondence' and the 'Land productivity'. 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 between monetary values and surface area.

On the bottom part of the Land use constraint tab, two tables with two columns each are displayed. The columns have the following meaning:

- The *Unconstrained land use demand [ha]* per land use function is the demand from the economic model.
- The *Allocated land use [ha]* per land use function is the amount of land allocated by the land use change model.
- The *Output corresponding to allocated land use* per sector displays the amounts from the 'Allocated land use' column after they have been converted back to monetary values.
- The *Change in output due to land use constraint* per sector is the difference between the 'Unconstrained output' (Demand tab) and the 'Output corresponding to allocated land use'.

Supply

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*, the *Constrained final demand* and the *Constrained output* per sector. The last is used for the calculation of the indicators.

Indicators

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. 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 multi-factor productivity* and the *Rate of change in eco-efficiency* per sector. On the bottom, you can see the output of the 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 that of the previous year.
- Each year, all the indicators are multiplied by the growth factor and corrected for the corresponding rate-of-change.

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.

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.

The screenshot shows the 'Population model' dialog window with the 'Population' tab selected. The window is divided into three main sections: Input, Parameters, and Output.

Input section:

- Excel parameter file: [Browse button]
- First year:
- Last year:

Parameters section:

- Birth gender bias towards boys:
- [Edit times...] button
- ☐ Interpolate

Table of parameters:

Parameter / ...	2006-Jan-01	2050-Jan-01
Fertility leve...	0	0
Mortality lev...	0	0
Net migratio...	0	0
Net migratio...	0	0
Net migratio...	0	0

Output section:

- Population [people] [Dropdown menu]

Table of output data:

Age / District	Franklin	Thames-Cor...	Hauraki	Waikato	Matamata
0	239,045	269,978	192,562	690,526	408
1	263,171	275,93	213,822	744,422	443
2	262,228	270,134	209,513	736,184	415
3	279,081	274,951	216,559	721,908	434
4	270,548	279,13	232,606	735,492	430

All data inputs to the population model (base population, migration rates, fertility rates, and survivorship rates) are contained in a Microsoft Excel workbook. 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

The Parameters dialog window shows a text input for 'Birth gender bias towards boys' with the value 0.51338199513382. Below it is a table with columns for '2006-Jan-01' and '2050-Jan-01'. The table lists various levers for different districts, all with a value of 0.

	2006-Jan-01	2050-Jan-01
Fertility lever [%]	0	0
Mortality lever [%]	0	0
Net migration lever for Franklin [%]	0	0
Net migration lever for Thames-Coro...	0	0
Net migration lever for Hauraki [%]	0	0
Net migration lever for Waikato [%]	0	0
Net migration lever for Matamata-Pi...	0	0
Net migration lever for Hamilton City...	0	0
Net migration lever for Waiata [%]	0	0

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

The Edit moments dialog window has a list box containing the years 2006-Jan-01, 2010-Jan-01, and 2050-Jan-01. To the right of the list are buttons for 'Add...', 'Generate...', 'Delete', and 'Reset'. At the bottom are 'OK' and 'Cancel' buttons.

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.

Parameters

Birth gender bias towards boys: 0.51338199513382

Edit time... ☐ Show interpolated values

	2006-Jan-01	2010-Jan-01	2050-Jan-01
EDA population effect for Rotorua [p...	0		0
Mortality lever [%]	0		0
Net migration lever for Franklin [%]	0		0
Net migration lever for Thames-Coro...	0		0
Net migration lever for Hauraki [%]	0		0
Net migration lever for Waikato [%]	0		0
Net migration lever for Matamata-Pi...	0		0
Net migration lever for Hamilton City [...]	0		0

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.

Parameters

Birth gender bias towards boys: 0.51338199513382

Edit time... ☒ Show interpolated values

	2006-Jan-01	2010-Jan-01	2050-Jan-01
Fertility lever [%]	0	1	0
Mortality lever [%]	0	0	0
Net migration lever for Franklin [%]	0	0	0
Net migration lever for Thames-Coro...	0	0	0
Net migration lever for Hauraki [%]	0	0	0
Net migration lever for Waikato [%]	0	0	0
Net migration lever for Matamata-Pi...	0	0	0
Net migration lever for Hamilton City [...]	0	0	0

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.

Output

Population [people]

Population [people]

Male population [people]

Female population [people]

Average life expectancy [years]

Natural increase

	Hauraki	Waikato	Matamata-Pi...	Han
0	0	0	0	0
1	257.771	270.394	208.228	727.465
2	271.866	273.294	217.465	705.428
3	266.591	279.501	233.163	721.155
4	267.484	297.58	251.576	718.12
5	298.102	323.932	234.241	766.5
6	300.609	330.131	243.59	750.478
7	306.004	333.000	245.000	750.000

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.

Population model

Population Residential land use demand

Input

Density [people/cell]:

District / land use	Residential - Lifest...	Residential - Low D...	Residential - Mediu...
Franklin	4.344306192383	67.886741638109	290.26408996573
Thames-Coromandel	2.205758160322	31.242622762954	128.69114731554
Hauraki	3.692817900068	57.904866580996	247.88583989719
Waikato	4.5303978802697	69.021408414295	292.42569009715
Matamata-Piako	5.9976424690648	74.503961130657	289.40475335678

Parameters

Time: 2006-Jan-01 Add time... Remove time

Proportion of people living in each class:

District / land ...	Residential - Lif...	Residential - L...	Residential - M...	Sum
Franklin	0.5320913373...	0.4508493567...	0.0170593059...	1
Thames-Coro...	0.1310883646...	0.7579293936...	0.1109822417...	1
Hauraki	0.1936770689...	0.7502242968...	0.0560986342...	1

Output

Land use demand [cells]:

District / land use	Residential - Lifest...	Residential - Low D...	Residential - Mediu...
Franklin	2084	113	1
Thames-Coromandel	1585	647	23
Hauraki	927	229	4

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.

Enter date and time

2010-Jan-01 00:00:00

OK Cancel

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.

Parameters

Time: 2010-Jan-01

Proposed: 2006-Jan-01 in each class:

District / land ...	Residential - Lif...	Residential - L...	Residential - M...	Sum
Franklin	0.4320913373...	0.4508493567...	0.1170593059...	1
Thames-Coro...	0.1310883646...	0.7579293936...	0.1109822417...	1
Hauraki	0.1936770689...	0.7502242968...	0.0560986342...	1

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.

Output

Land use demand [cells]:

District / land use	Residential - Lifesty...	Residential - Low D...	Residential - Mediu...
Franklin	2084	113	1
Thames-Coromandel	1585	647	23
Hauraki	927	229	4
Waikato	4044	371	5
Matamata-Piako	1078	305	7

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.

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.

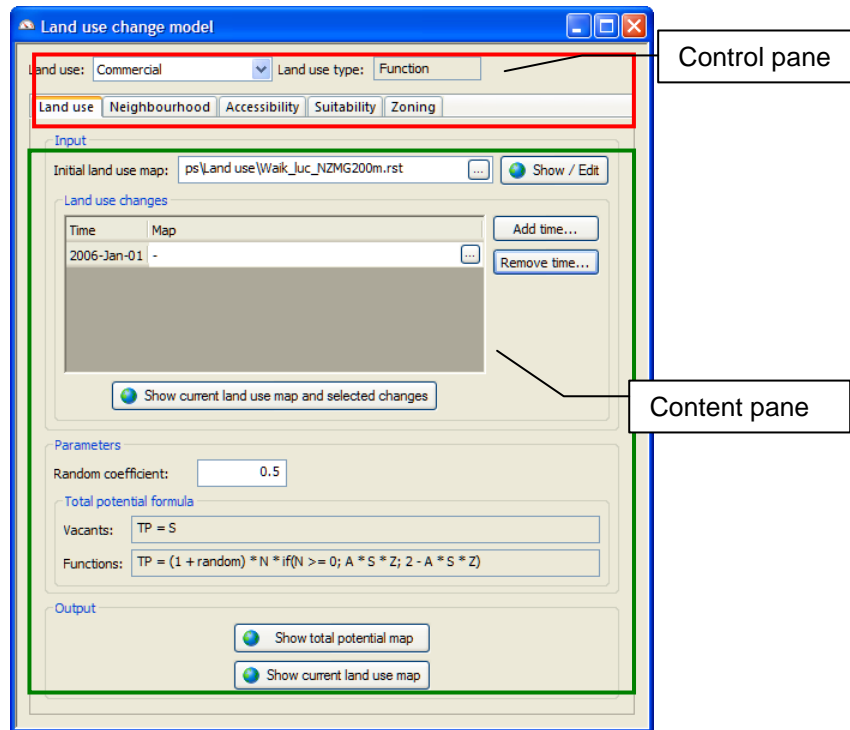
The non-dynamic land uses are called *Features*. Features are land use classes that are not supposed to change in the simulation, like water bodies or airports. However, they do influence the dynamics of the *Function* land uses, and thus influence their location. For example a *Function* 'Tourism' would 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

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.

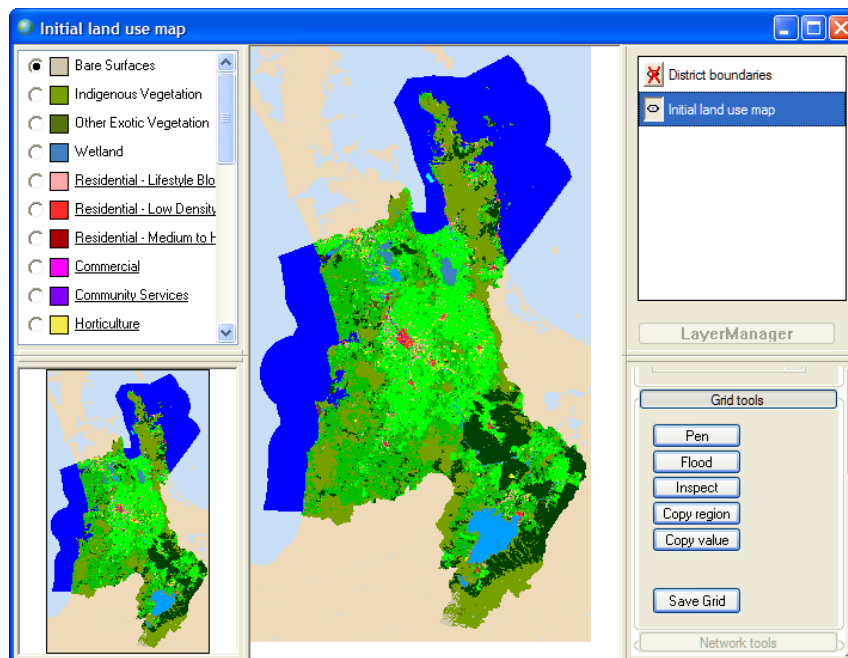
Most of the contents in the content pane are related to the selected land use in the control pane except that the Input and Parameters parts on the Land use tab, Neighbourhood tab and Zoning tab are for all the land uses.

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 edit a land use map, see the section [Grid tools](#).



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 can not 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.

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.

Parameters

Random coefficient:

Random seed: ☐ Variable ☒ Fixed to:

Total potential formula

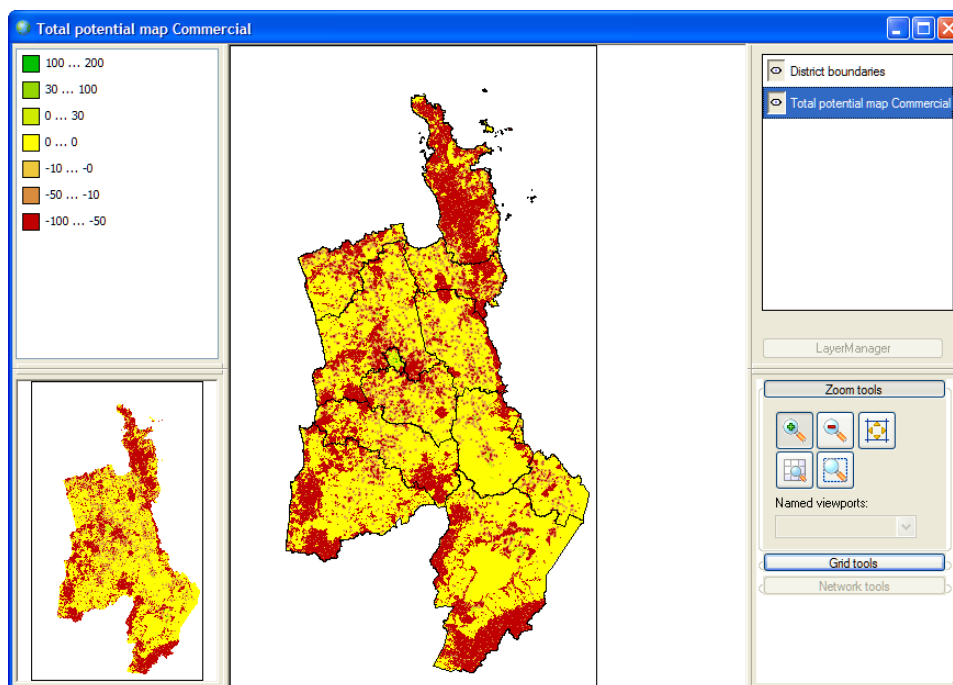
Vacants:

Functions:

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.

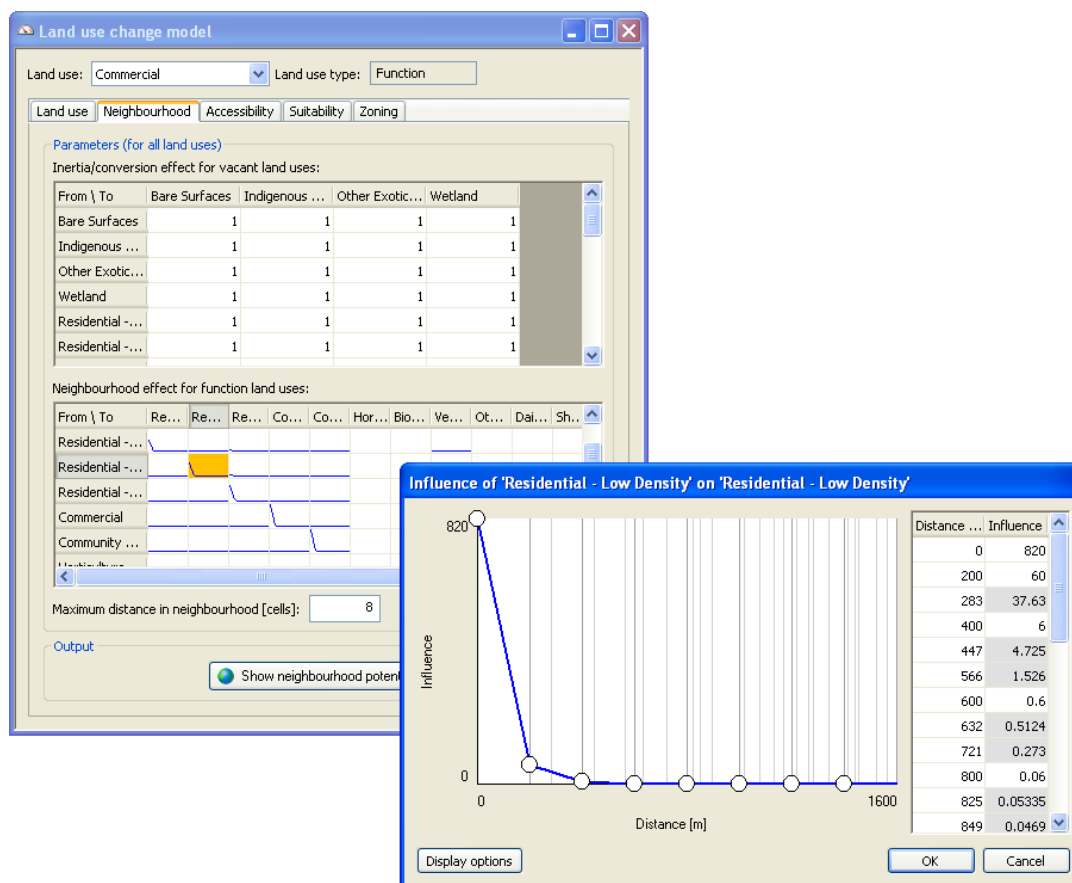
Neighbourhood

The neighbourhood rules table displays the influence land uses have on each other. 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, which is represented as a piecewise linear

function. An example of such a function is shown in the figure below, 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.

Click the Neighbourhood tab on the 'Land use change model' window to access the neighbourhood rules. The top table in this window displays the 'Inertia/conversion effect for vacant land uses'. This can be altered to change how vacant land uses are allocated, which only happens after all land use functions have been allocated.



The 'Neighbourhood effect for function land uses' table displays the neighbourhood rules. Click on a cell in this table to open a window in which you can change the influence rule.

- You can drag one of the bubbles to change its value.
- You can double-click on a bubble to edit the value precisely.
- You can right-click on a bubble to remove it from the graph.
- You can right-click outside any bubbles to add a new bubble to the graph.
- You can click the 'Display options' button to change how the graph is displayed. Here, you can also switch the distance unit between meters and cells.

The system provides a table with the coordinate pairs for all discrete cell distances on the right hand side of the window. Influence values with a grey background represent interpolated values and cannot be changed. Influence values with a white background correspond to bubbles in the graph. These values can be edited in the table as well as in the graph.

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 potential in each cell for each land use function. Click the 'Show neighbourhood potential map' button to display the neighbourhood potential map for

the land use selected in the 'Land use' list at the top of the 'Land use change model' window.

Accessibility

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

The screenshot shows the 'Land use change model' window with the 'Accessibility' tab selected. At the top, 'Land use' is set to 'Commercial' and 'Land use type' is 'Function'. Below the tabs, there are two buttons: 'Go to infrastructure layers' and 'Go to zonal accessibility'. The 'Parameters' section includes checkboxes for 'Land use is built-up' (checked) and 'Land use is impassable' (unchecked). It also has input fields for 'Implicit accessibility of built-up areas' (1) and 'Implicit accessibility of non-built-up areas' (0.5). A table lists infrastructure types with their distance decay and weights. At the bottom, there is a 'Show accessibility map' button.

Infrastructure type	Distance decay [cells]	Weight
Residential road	6.000	0.500
Collector route	8.000	0.900
Arterial route	8.000	0.850
Principal highway	8.000	0.800
Major highway	8.000	0.800
Railway	8.000	0.400
Dairy processing	1.000	0.000
Timber processing	1.000	0.000
Abattoir	1.000	0.000
Residential attractants	80.000	1.000

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.

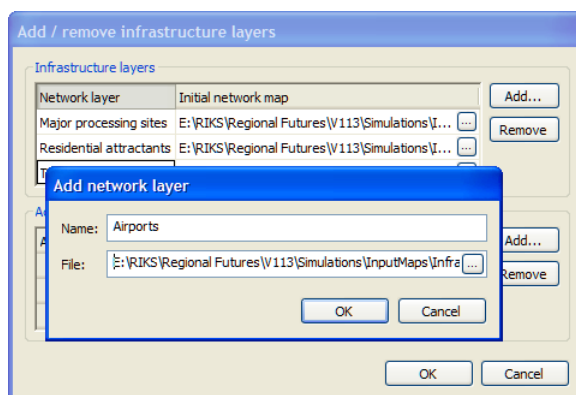
The screenshot shows the 'Infrastructure layers' dialog window. The 'Input' section has a button 'Add / remove infrastructure layers...'. Below it, a table lists infrastructure layers with their file paths. The 'Parameters' section has a dropdown for 'Network layer' set to 'Transport network'. Below that, a table shows 'Network changes' with columns for Time, Name, Incremental, and File. At the bottom, there are buttons for 'Add...', 'Remove...', and 'Show / Edit selected'.

Network layer	Initial network map
Transport network	E:\RIKS\Regional Futures\V113\Simulations\InputMaps\Infrastructure\Roads_and_Railway.shp
Major processing sites	E:\RIKS\Regional Futures\V113\Simulations\InputMaps\Infrastructure\Major_Processing.shp
Residential attractants	E:\RIKS\Regional Futures\V113\Simulations\InputMaps\Infrastructure\residentialaccesscentres_2006.shp

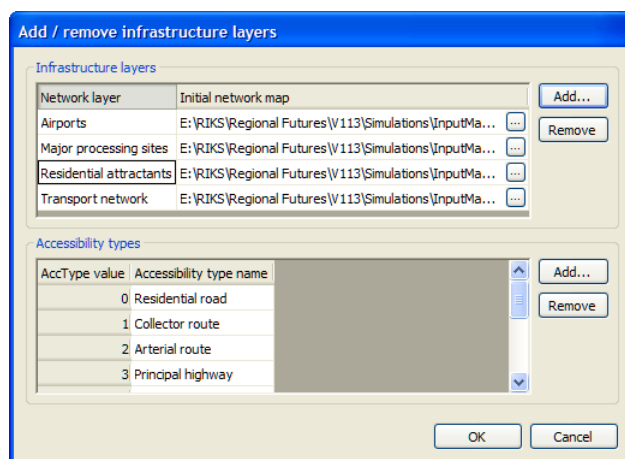
Time	Name	Incremental	File
2007-Jan-01	Addition 2007	<input type="checkbox"/>	E:\RIKS\Regional Futures\V113\Simulations\InputMaps\Infrastru...
2008-Jan-01	Addition 2008	<input type="checkbox"/>	E:\RIKS\Regional Futures\V113\Simulations\InputMaps\Infrastru...
2010-Jan-01	Road expansion 2010	<input checked="" type="checkbox"/>	E:\RIKS\Regional Futures\V113\Simulations\InputMaps\Infrastru...
2010-Jan-01	Add a new major highway	<input checked="" type="checkbox"/>	E:\RIKS\Regional Futures\V113\Simulations\InputMaps\Infrastru...
2010-Jan-01	Remove the newly added major highway	<input checked="" type="checkbox"/>	E:\RIKS\Regional Futures\V113\Simulations\InputMaps\Infrastru...
2011-Jan-01	Addition 2011	<input type="checkbox"/>	E:\RIKS\Regional Futures\V113\Simulations\InputMaps\Infrastru...

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.

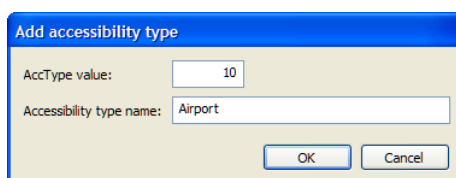
Clicking the Add / remove infrastructure layers button to open the Add / remove infrastructure layers window. You can change the name of the network layers by entering a new name in the text box in the Network layer column. You can adapt the initial network layer by clicking on the browse button and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

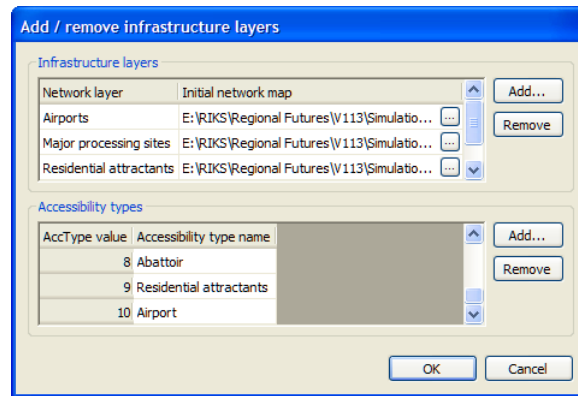


You can add a new network layer by clicking the Add.. button on the upper-right side of the Add / remove infrastructure layers window. After entering a name and loading the map for the new network layer, press the OK button. The newly added network layer will be displayed on the list of the Infrastructure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

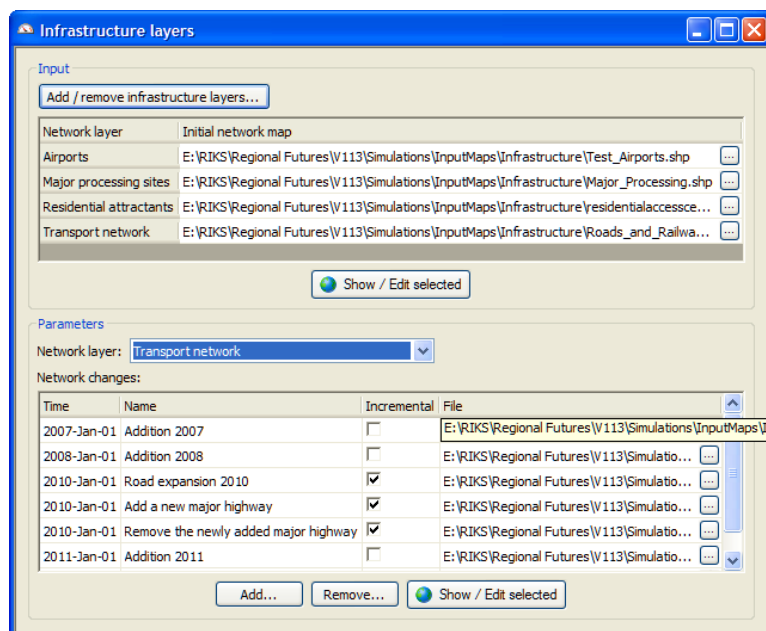


You can also add a new accessibility type by clicking the Add... button on the lower-right side. The Add accessibility type window opens. Enter the value and name for the accessibility type in the text boxes AccType value and Accessibility type name, respectively. The newly added accessibility type will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

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 entire network at a specific simulation time via the policy user interface. For more information, see the section [Displaying an infrastructure network](#). The settings for network changes in the 'Infrastructure layers' window links directly to the setting on the Policy measures page in the Main window.

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

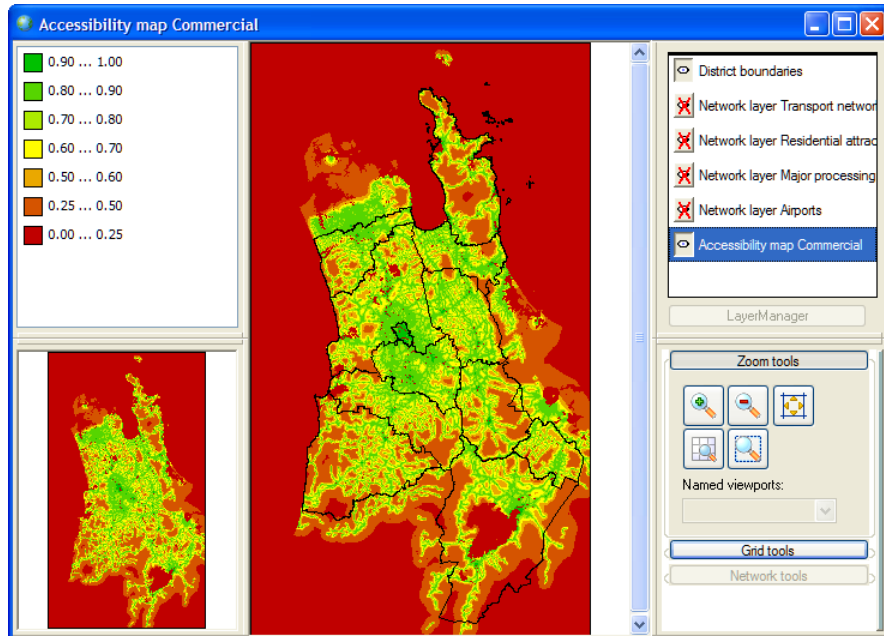
functions. In the Parameters part, the system allows you to specify the parameters used for the accessibility maps for each function land use by following steps:

- 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 its 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 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.

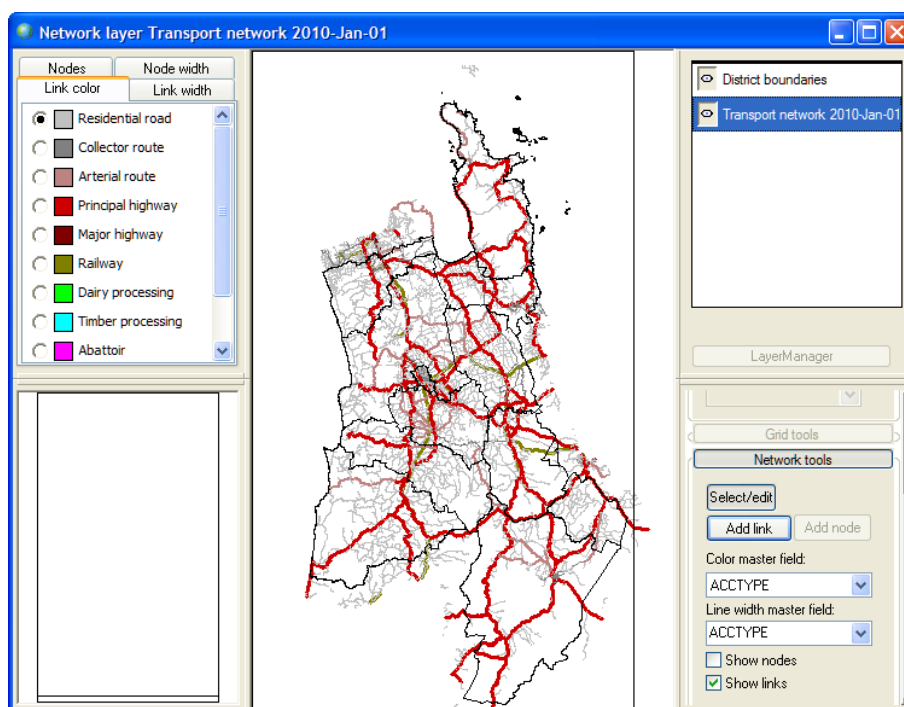


Network map window opened via the modeller user interface

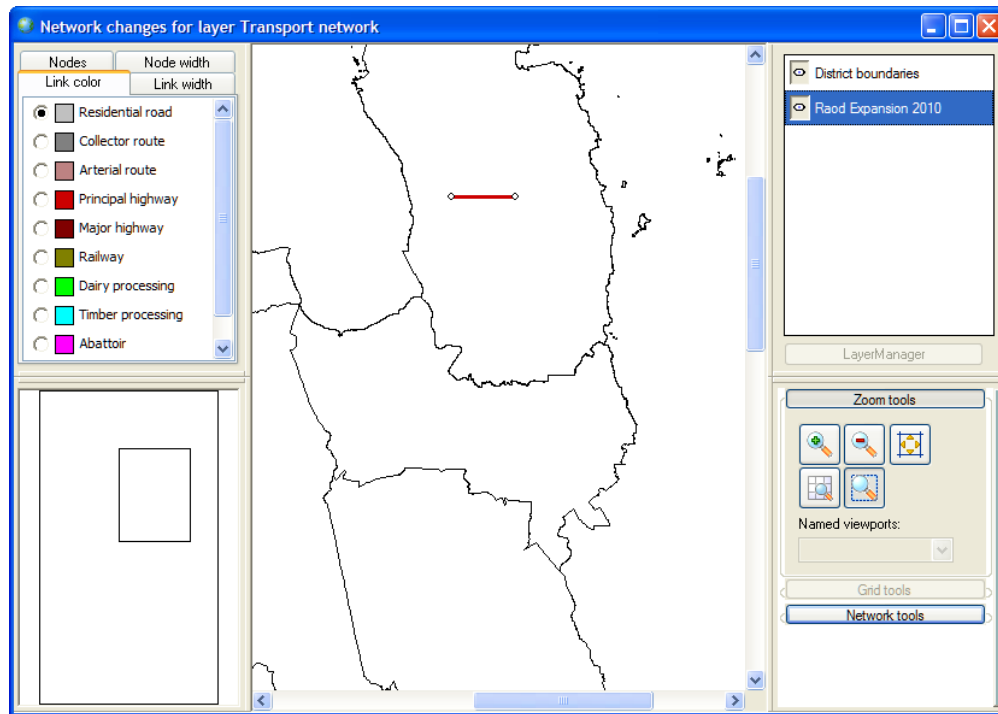
The user interface of the network map window opened via the policy user interface is different from the one opened via the modeller user interface. In this section, we focus the one opened via the modeller user interface. For the other one, please refer to the section [Creating network changes](#).

- 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 [Creating network changes](#).

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.

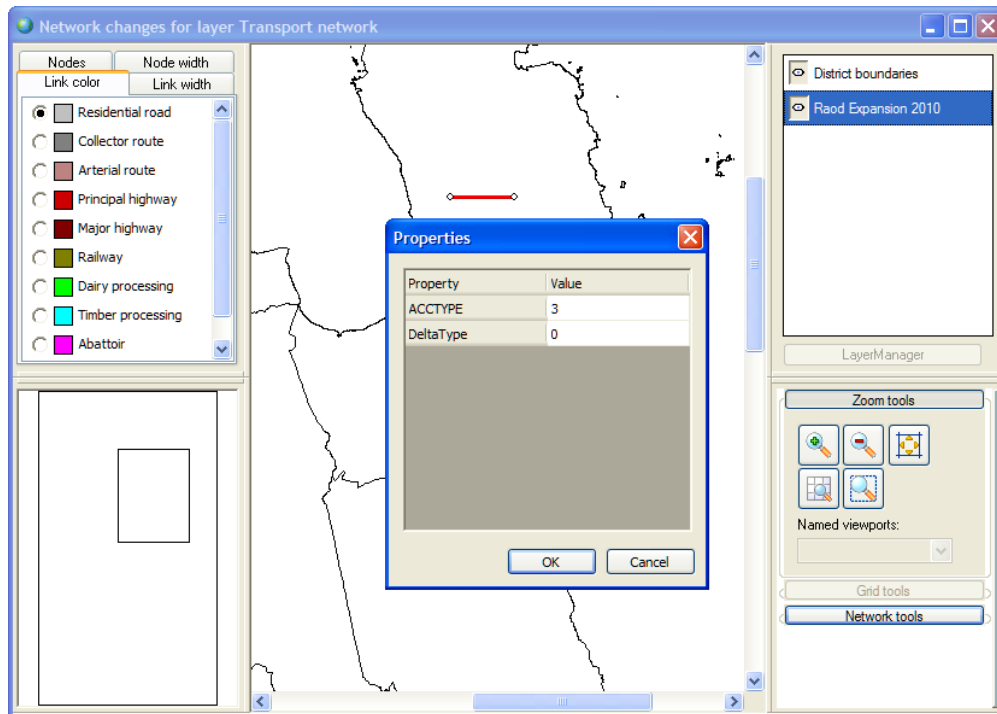


The title of the network map window indicates the descriptive name of the selected network and the selected year. As depicted in the figure above, besides the District boundaries layer, there is only one layer Road expansion 2010 visible in the *layer manager pane*, which shows the exact network changes for the selected time in the *map pane*.

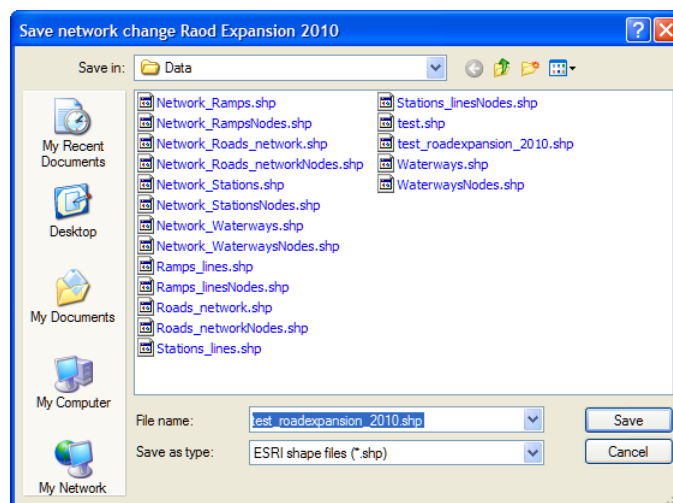
The *legend pane* consists of 4 legend tabs which are used for editing the legend of network map. The Link color and Link width tab are most useful. For more information about how to edit legend, see the section [Legend editor](#). For all the networks, the categories of Acctype are used as the legend.

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.



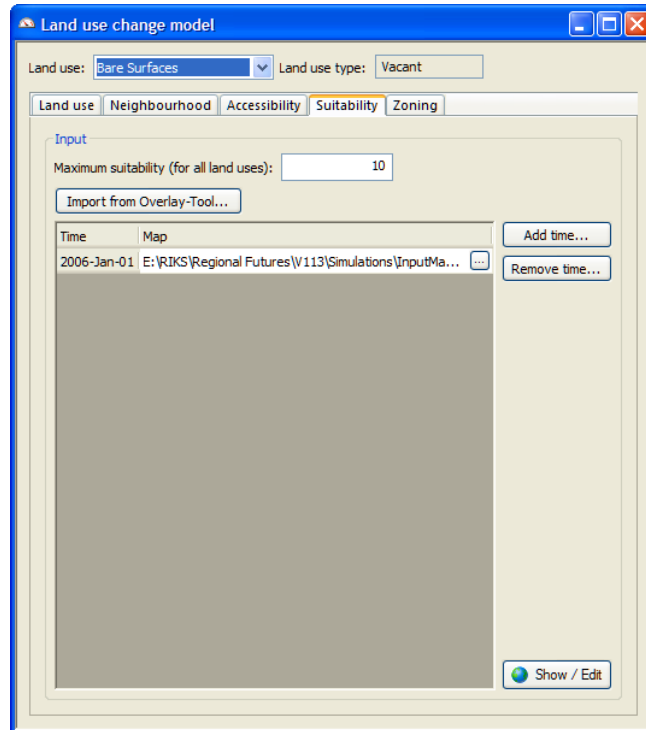
- Click Cancel to close the Properties dialog window.
- Or click OK to confirm the change that you made. A message window appears to ask you whether you want to save the changes you have made or not.



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

Suitability

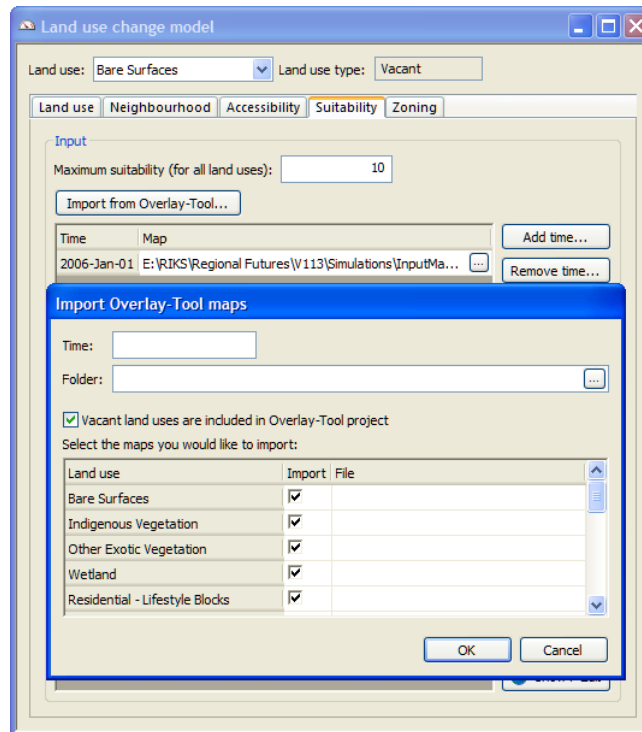
Click the Suitability tab to access the contents depicted as the figure below.



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.

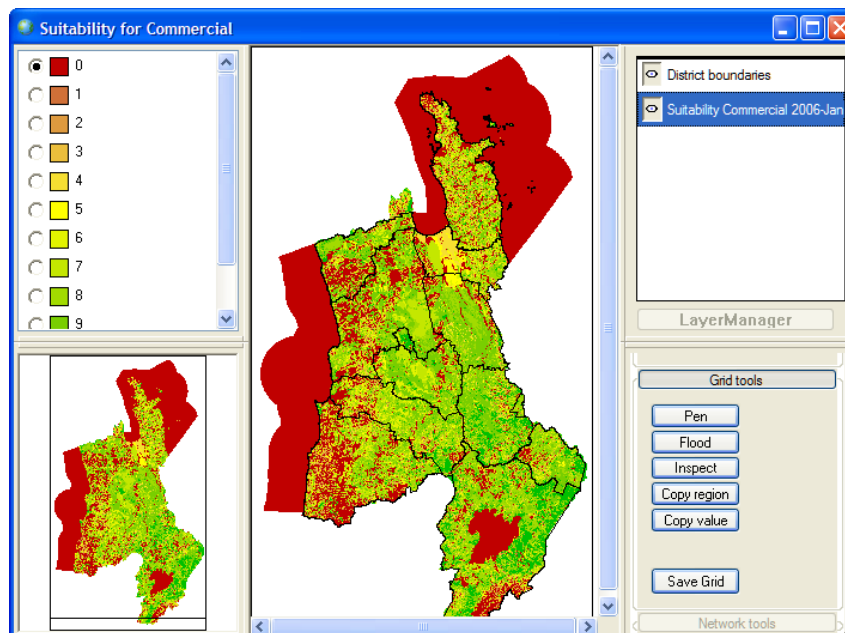


The system provides you the opportunity to set up the maximum suitability (for all land uses) by entering a value in the range of (0, 255) in the text box next to Maximum suitability on the top of the Suitability tab. This maximum suitability value should be the highest value on any suitability map in 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.

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 [Grid tools](#).



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.

Land use: Commercial Land use type: Function

Land use Neighbourhood Accessibility Suitability **Zoning**

Input

Go to zoning tool

Parameters

De Facto zoning:

Land use / function	Residential -...	Residential -...	Residential -...	Commercial	Comm
Bare Surfaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Indigenous Vege...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other Exotic Veg...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wetland	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Residential - Life...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Zoning state values:

Zoning state / function	Residential -...	Residential -...	Residential -...	Commercial	Cc
Actively stimulated	1.2	1.2	1.2	1.2	1.2
Permitted	1	1	1	1	1
Controlled	0.8	0.8	0.8	0.8	0.8
Restricted discreton...	0.6	0.6	0.6	0.6	0.6
Discretionary	0.4	0.4	0.4	0.4	0.4

Output

Show numerical zoning map

The input to the Zoning part of the land use model are the *Zoning maps* which are generated with the help of the 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 on the Zoning tab. For more information about the zoning tool, see the section [Zoning tool](#).

The *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 on the Zoning tab.

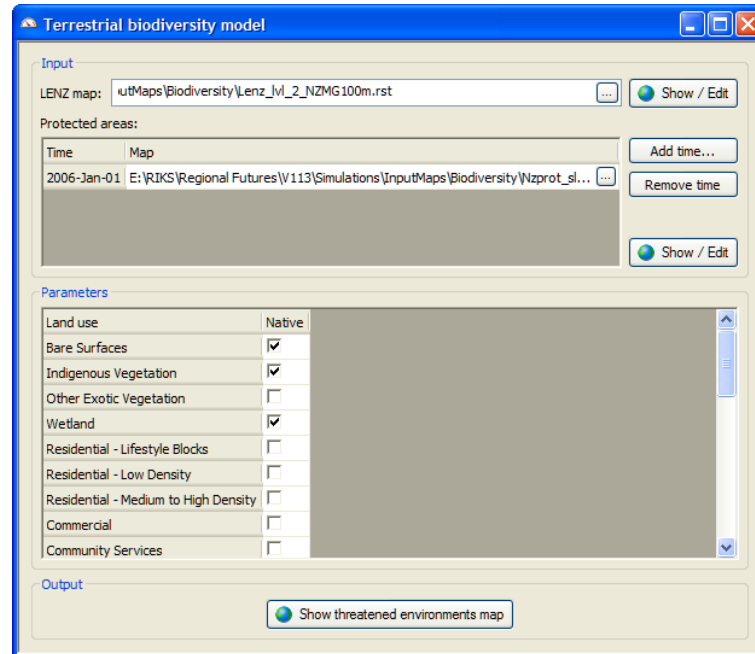
Terrestrial biodiversity model

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.

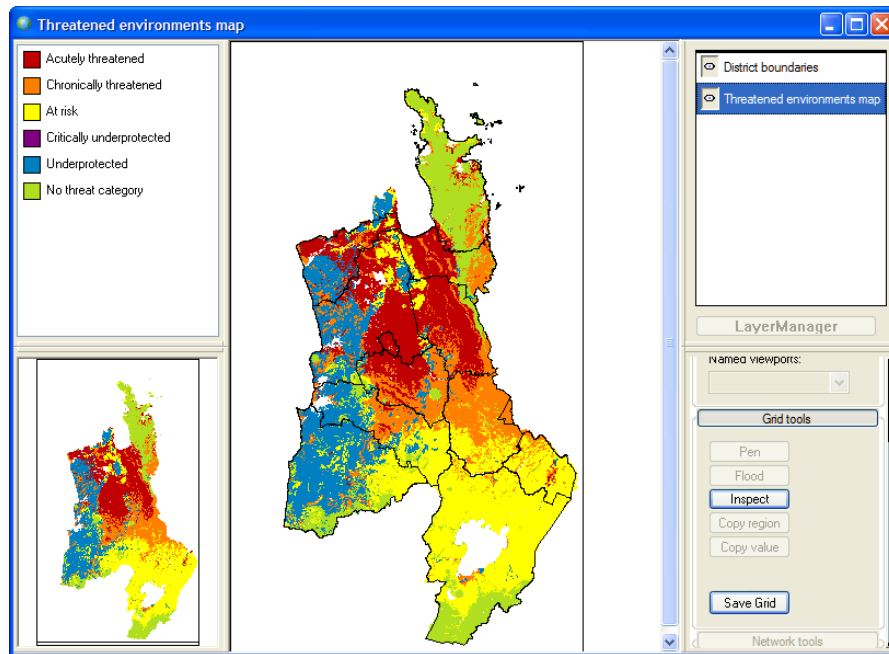
- *LENZ map*: the Land Environments of New Zealand map shows information on land environments that serve as surrogates for ecosystems and habitats
- *Protected area map*: Protected areas network of New Zealand map is a database of legally protected areas.

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 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 Saving changes
Save project as	Save a project under a different name	Section Saving changes
Export project	Save a project and all associated data files to a new location	Section Exporting a project
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 at which times a simulation run will be stopped automatically	

5.3 Maps menu

You can use the Maps menu to open map windows. All available maps are structured hierarchically by themes in the menu. There are essentially two types of maps: input maps and output maps. Input maps are editable and output maps calculated for the current simulation time 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
Preferences	Manage various application settings of WISE..	Section Preferences

Preferences

Click Preferences on the Options menu to control various application settings. In the Preferences window that will open, you can select how to deal with file associations made by the application, whether to check for newer versions automatically and where to store temporary files created by the application.

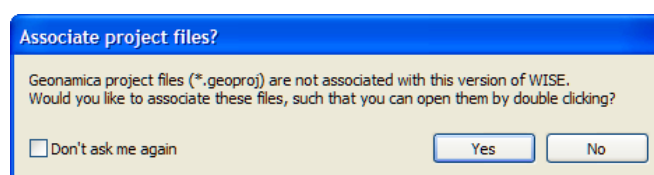
File associations

File associations are a mechanism in Windows using which you can open a file in a specific program based on the files extension. For example, Microsoft Word files have an extension .doc or .docx. If you double click on such a file in Windows Explorer, the file will be opened in Word. You can use the same mechanism for Geonamica project files. However, if you have multiple versions of WISE installed or you have more than one Geonamica-based system installed on your computer, all of them will use the file

extension .geoproj for their project files. When you double-click on such a file, only one of these programs can be opened.

When you open WISE, it checks whether Geonamica project files (with file extension .geoproj) are associated with this application and not another version or another Geonamica-based application. If this is not the case, WISE will do one of three things, controlled by the setting in the Preferences window.

- If the 'Do nothing' option is selected, the file association will be left as it is.
- If the 'Automatically associate' option is selected, the file association will be changed to open this application next time you double-click on a Geonamica project file.
- If the 'Ask me what to do' option is selected, a message window similar to the one depicted below will be displayed to indicate the possibly erroneous file association. In this window, you can select what to do by clicking one of the available buttons. If you select the 'Don't ask me again' check box before clicking one of the buttons, the option in the Preferences window will be updated to reflect your choice.



Raster map cache folder

Some projects use maps that are larger than what can be safely stored in working memory. In these cases, the system needs to store calculated maps on the hard drive while a project is open. You can control where these maps are stored by changing the 'Raster map cache folder' setting on the Preferences window. By default this is set to the Windows temporary files folder. When you open a project that has support for large raster maps enabled, you need to make sure that the selected folder is located on a hard disk with ample free space.

5.5 Window menu

You can use the Window menu to arrange or activate one of the opened windows in WISE.

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 open the integrated help functionality of WISE or to access troubleshooting information.

Option	Function	Link
Index	Open the integrated help functionality	Section Help
Licence	Open the Licence window	Section Licence
Check for updates	Check if a newer version of WISE is available	Section Checking for updates
About	Open the About window	Section About

Annex 1 WISE release history

Version 1.3.0 (5 October 2012)

- Added the Monte Carlo tool
- Improved the user interface for the scenario manager to make it easier to use
- Updated the district maps to show post-2010 boundaries
- Updated the parameters of the population model
- Allow part of the population to reside in non-residential areas; population densities have been adjusted accordingly
- Added a sub-scenario with planned infrastructure improvements till 2020
- Added Carbon Farming and Future Proof scenarios
- Added functionality to export a project
- Added support for GeoTIFF raster file format
- Added inertia for vacant states
- Various improvements to the way accessibility is calculated
- Added zonal accessibility
- Various minor user interface enhancements

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

