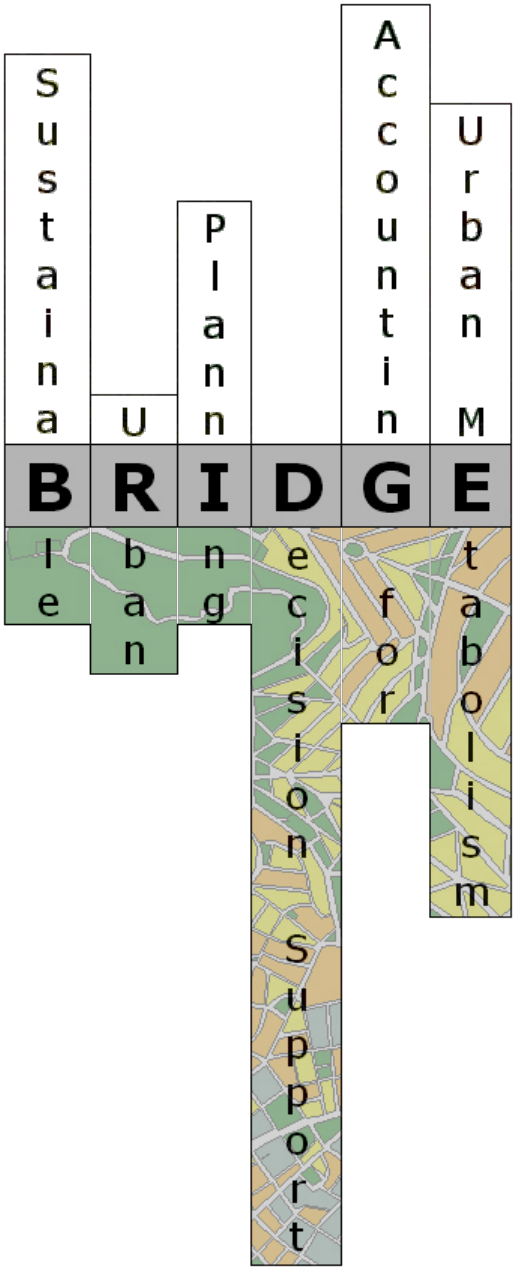

User Guide

BRIDGE Decision Support System

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Table of Contents

This document is divided into the following chapters:

- Chapter 1, “Introducing BRIDGE Decision Support System Software”.
- Chapter 2, “Key Features” gives an overview of the key features.
- Chapter 3, “Getting Started”, explains how to get started using the software.
- Chapter 4, “Quick Guide”, gives a brief description of how to use the system.
- Chapter 5, “Step by Step Instructions for using the system”, describes instructions for using the system.
- Chapter 6, “Guidelines for Result Interpretation”, describes the main guidelines for interpreting the assessment results.
- Chapter 7, “Troubleshooting”, is a troubleshooting chapter in the form of questions and answers.
- Appendix A, ‘Reference Documents’ lists all the reference documents
- Appendix B, ‘Glossary of Terms” provides definitions of both technical and non-technical terms that appear in this guide.
- Appendix C, ‘Acronyms” provides explanations of abbreviations used in this document.
- Appendix D, ‘Indicators Hierarchy” presents the hierarchy of indicators as used in BRIDGE.

Who Should Use It

This guide is intended for users of different degrees of knowledge and experience with Decision Support Systems. This guide explains how the system users can make a sustainability assessment regarding different planning alternatives.

Note: The BRIDGE DSS can be used for sustainability assessment of different planning alternatives in five cities: Helsinki, Athens, London, Firenze and Gliwice.

This guide assumes that you have some basic knowledge regarding the Windows Operating System and that you are familiar with Geographic Information Systems.

Typographical Conventions

This document uses the following typographical conventions:

- Command and option names appear in **bold** type in definitions and examples. The names of directories, files, machines, partitions, and volumes also appear in bold.

- Variable information appears in *italic* type. This includes user-supplied information on command lines.

1 Introduction

1.1 Purpose

The BRIDGE Decision Support System is a Prototype developed during the European 7th Framework Project BRIDGE (sustainaBle uRban plannIng Decision support accountinG for urban mEtabolism).

Note: More information regarding the project can be found at http://www.bridge-fp7.eu

The purpose of this document is to define the functionality of the BRIDGE DSS Prototype, developed by FORTH.

The BRIDGE DSS has been developed to be used by local authorities and urban planners for the assessment of sustainability in urban planning decision making.

More information regarding the System Architecture can be found in "Design Report" (211345_001_DD_FORTH_DSS_Design_Report).

More information regarding the sustainability indicators and the decision making methodology can be found in "Report on the Impact Assessment Model for Urban Metabolism" (211345_010_TR_TCD_1_0_D52).

The user may need to refer to the ArcGIS manual for more information regarding the use of the software.

1.2 Scope

The BRIDGE DSS User's Guide aims at describing the procedure of installing and using the system aiming at evaluating planning alternatives in terms of environmental, social and economic indicators.

2 Describing the System

This chapter describes the key features related to the system.

2.1 Inventory

All files necessary for BRIDGE DSS Prototype should be included in the folder named "*BRIDGE_DSS_vx.x*". This folder and all its contents should be downloaded and stored in a local drive. See Chapter 3 for more information on system installation.

2.2 System Environment

BRIDGE DSS Prototype runs on Windows Operating System as an add-on for ArcGIS. The version of ArcGIS should be 9.3 or later. BRIDGE DSS requires a 30GB of storage memory to store all data and run.

3 Installing, Starting and Stopping the System

3.1 First-time Users

The BRIDGE DSS Prototype is developed and runs as an add-on for ArcGIS version 9.3 or later in Windows Operating System.

The System functions appear as a separate toolbar named “Bridge” in ArcGIS environment. Spatial Data and Maps appear as ArcGIS Layers. For more information on how to use these maps please refer to the ArcGIS tutorials (http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=Tutorials).

3.2 Installing the system

To install the system follow these steps:

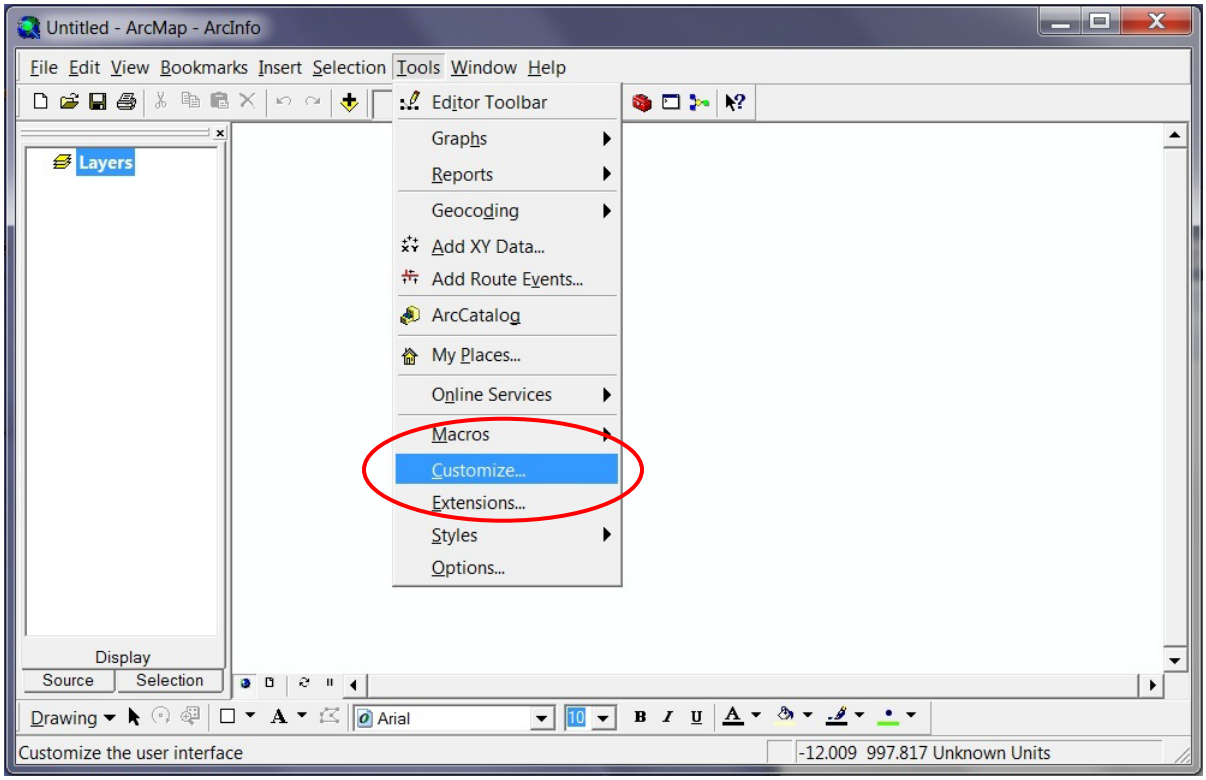
1. The core of the system is located in
   http://www.gipsynoise.gr/BRIDGE/DSS/BRIDGE_DSS_v1.0.7z
   Download, save and unzip it in a local directory.
2. The databases for each case study must be downloaded separately from:
   http://www.gipsynoise.gr/BRIDGE/DSS/Athens.7z
   http://www.gipsynoise.gr/BRIDGE/DSS/Firenze.7z
   http://www.gipsynoise.gr/BRIDGE/DSS/Gliwice.7z
   http://www.gipsynoise.gr/BRIDGE/DSS/Helsinki.7z
   http://www.gipsynoise.gr/BRIDGE/DSS/London.7z
   Download, save and unzip those files in the directory named ‘Databases’ that is found inside the system core folder.
3. Start ArcGIS. If you are using Windows Vista or Windows 7, start ArcGIS with full administrator rights (right-click on the application shortcut and then choose “Run as administrator”).
4. Go to **Tools** menu, and click on **Customize…**
5. Click the **Add from file…** button and point out the location of the file `bridgeTool.dll` in your local folder and click **ok**.
6. In the list of available toolbars make sure that **Bridge** is selected

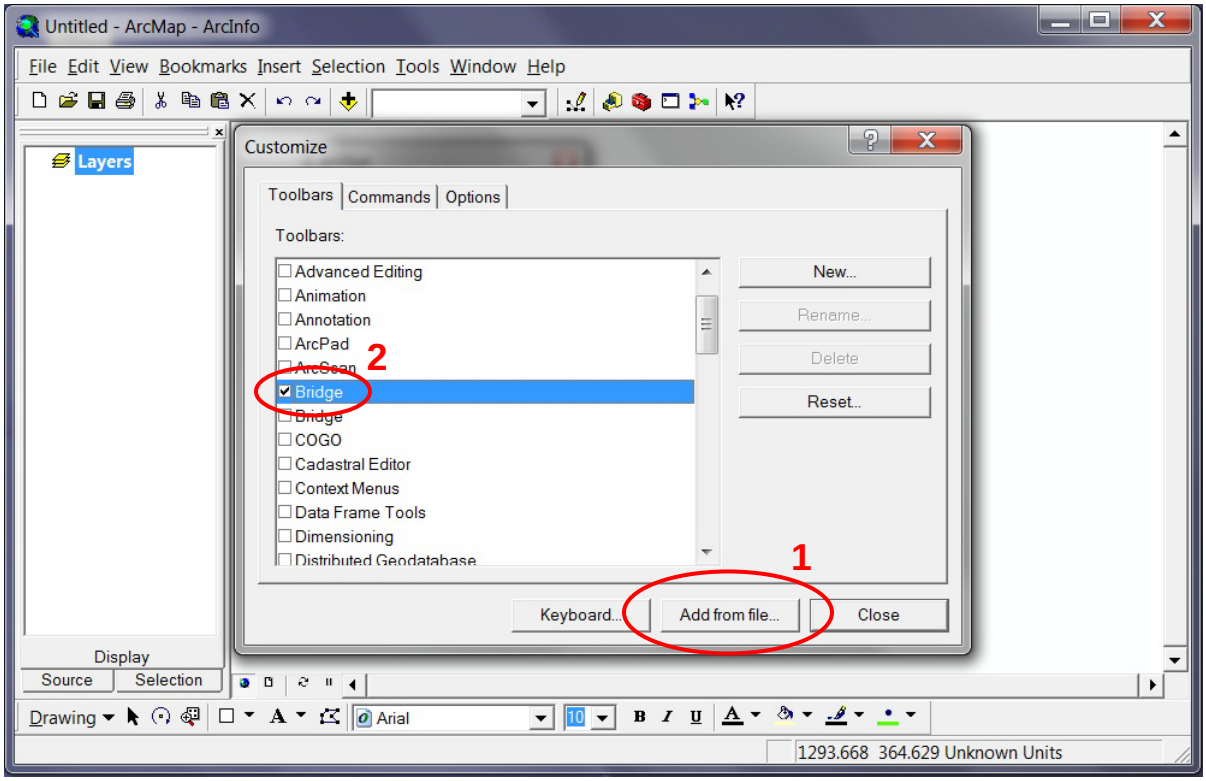
The Bridge Toolbar will appear as a separate toolbar in the ArcGIS environment.

In order for some features of the BRIDGE DSS to work it is necessary to activate two extensions of the ArcGIS: 3D Analyst and Spatial Analyst. In order to do so...

7. Go to **Tools** menu, and click on **Extensions…**
8. Enable *3D Analyst* and *Spatial Analyst*

See the installation video on http://www.youtube.com/watch?v=s3n-whSN7qk

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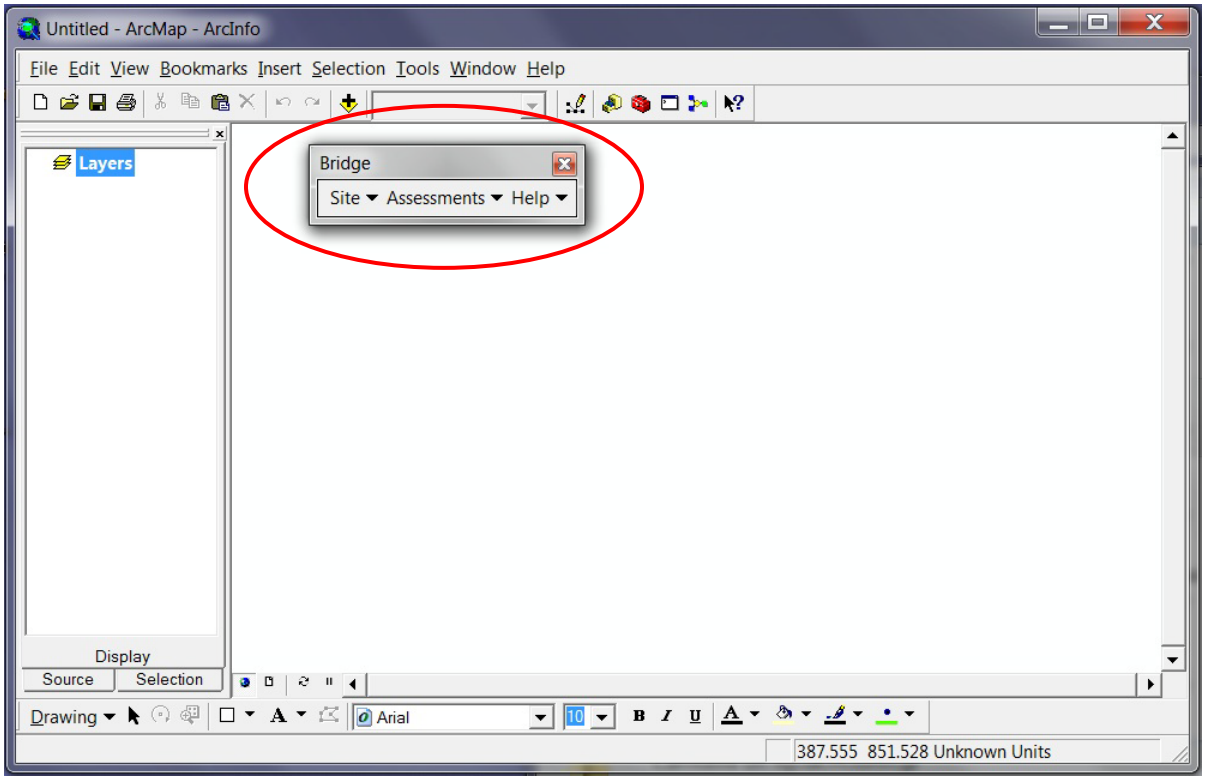
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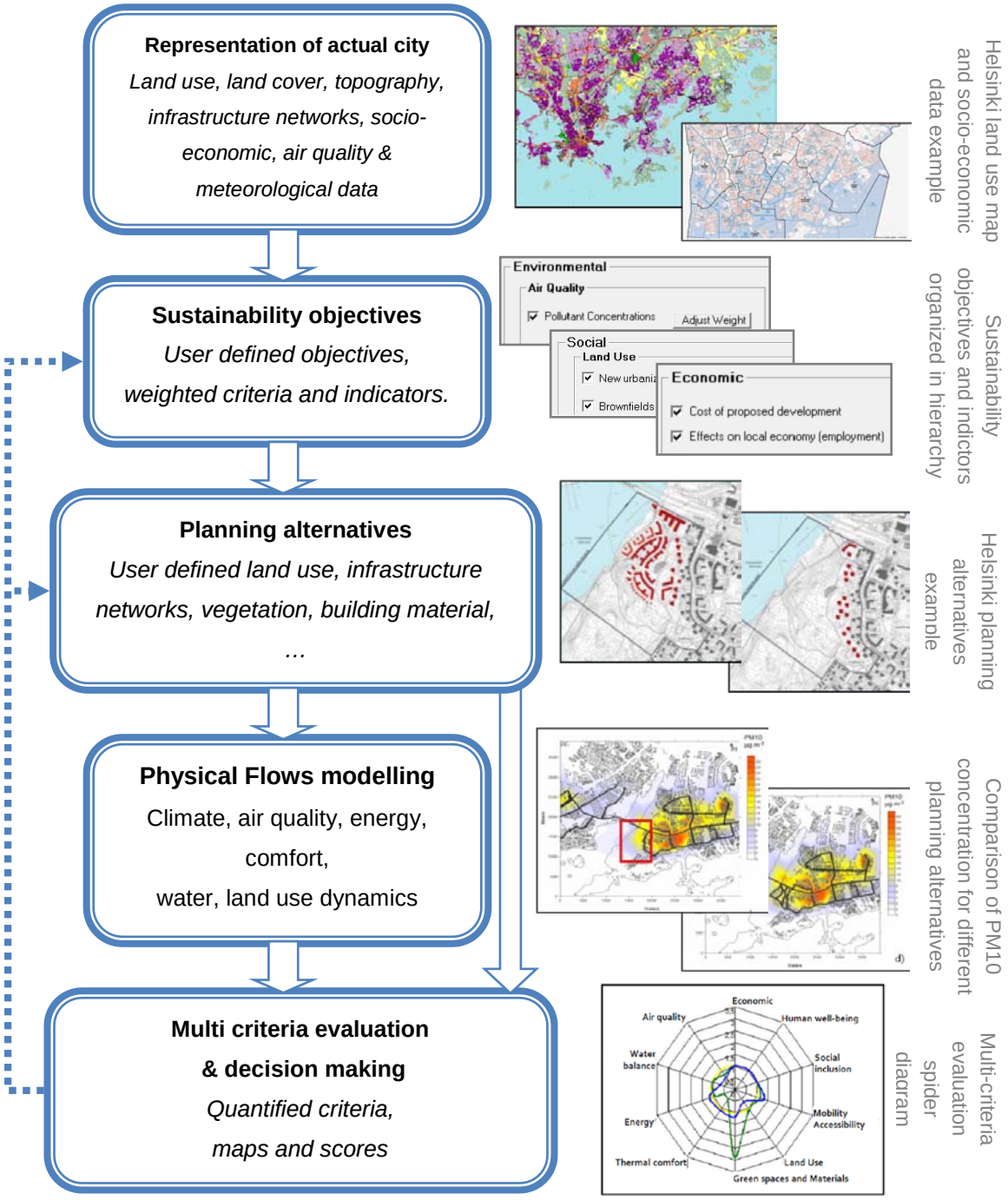
3.3 Starting the system

Once the system is installed as an add-on on ArcGIS, it will appear every time that ArcGIS starts. If not,

1. Go to **Tools** menu, click on **Customize…**
2. In the list of available toolbars make sure that **Bridge** is selected

4 Quick Guide



5 Step by Step Instructions for using the system

5.1 Instructions on how to run an assessment

In order to run an assessment the following steps should be done:

1. Choose a case study to work with
2. Choose the indicators to be used in the assessment
3. Assign weights to the indicators (and indicators groups)
4. Provide user-defined indicator values (those that are not provided by the models)
5. Run environmental models to obtain indicator values
6. Run the assessment procedure

See the video on how to run an assessment in http://www.youtube.com/watch?v=SqDSQXSzeBc.

(Select full screen and high definition for a better view)

5.1.1 Choose a case study

BRIDGE DSS Prototype can be used for evaluating planning alternatives in the BRIDGE case studies: Athens, Firenze, Gliwice, Helsinki and London. Before running an assessment it is necessary to choose the case study.

See the video on how to Choose a case study: http://www.youtube.co0.4m/watch?v=KioplKkO-VI

(Select full screen and high definition for a better view)

Before selecting the desired case study to work with you need to define the Main Database file. This is done by selecting from the menu:

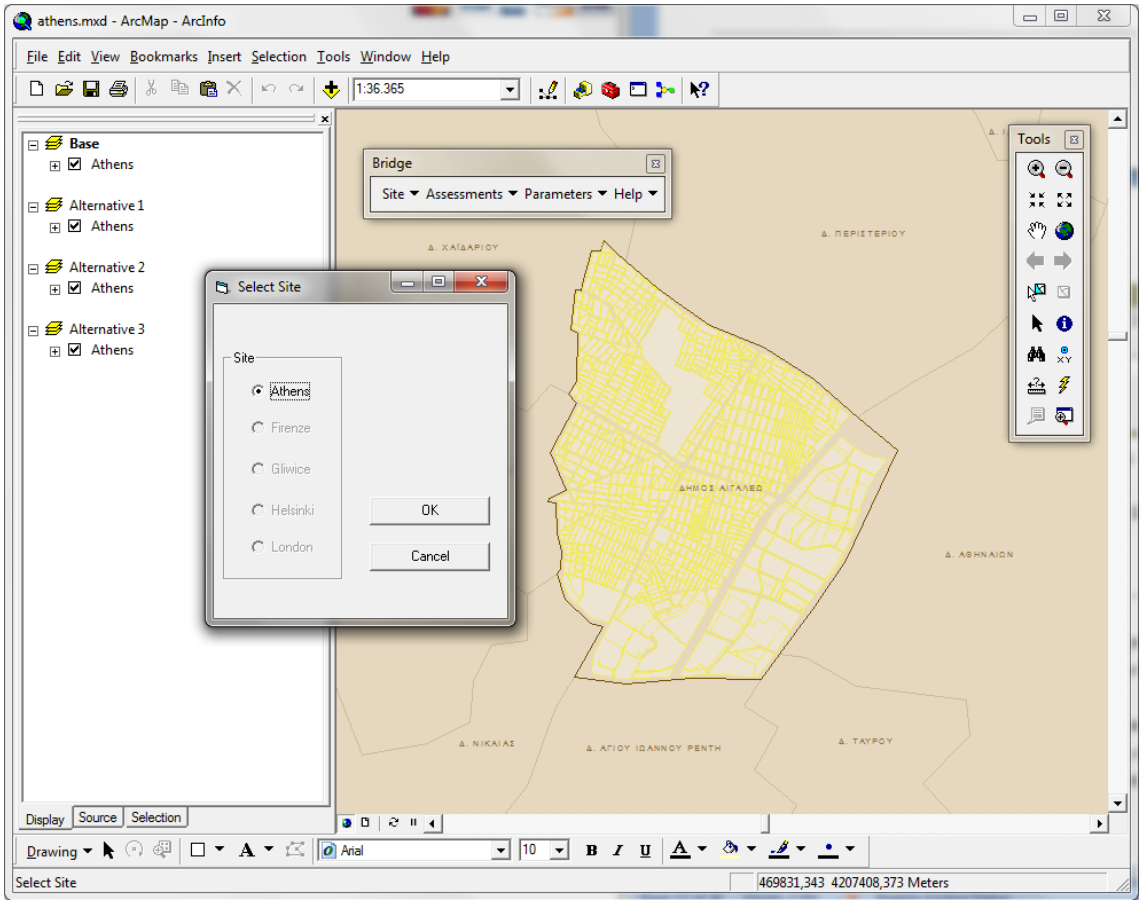
Parameters → Options

The *Main Database* has to be set to the bridge.mdb file found in the main folder of the DSS.

To select the case study to work with, select from the menu:

Site → Select Site

and select the case study you want to work with.



The GIS files corresponding to the three Athens case study alternatives appear in the ArcGIS Table of Contents (left) as different Data Frames.

To be able to see the contents of a data frame, you need to activate the respective data frame. This is done by *right- clicking* on the desired alternative and then choose **Activate** from the pop-up menu. A description of the provided alternatives for each case study can be seen by choosing:

Site → Alternatives Description

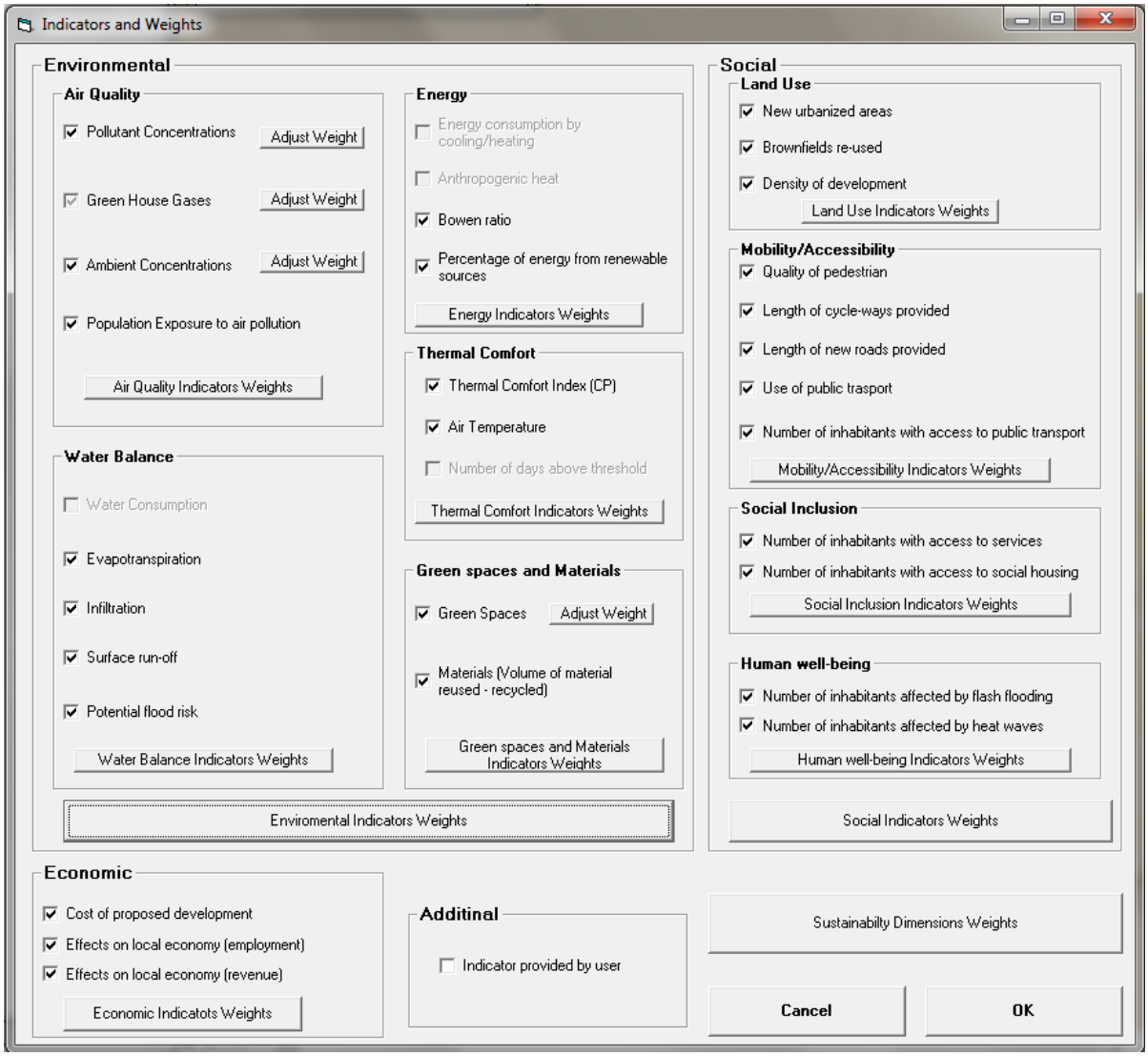
5.1.2 Choose indicators for the assessment

In order for an assessment to run, the sustainability indicators to be used in the analysis need to be defined and weighted. This is done by selecting from the menu:

Assessment → Indicators and Weights

The screen that appears shows all indicators that can be used for the assessment. Indicators that appear in gray are invalid for the respective case study due to lack of data. Indicators used in BRIDGE are organized in a hierarchy (see Appendix D).

You can choose the indicators to be used in the assessment by ticking the boxes. Only selected indicators will be used in the analysis.



5.1.3 Assign indicators weights

In order for an assessment to run, the sustainability indicators to be used in the analysis need to be defined and weighted.

Indicators are organized in a hierarchy. Weights can be assigned to all levels of indicators hierarchy. Weighting in all cases is performed by using pair-wise comparison (Saaty, 1980). In pair-wise comparison, elements at a given hierarchy level are compared in pairs to assess their relative importance with respect to each of the elements at the next higher level. Verbal terms shown in the table below are used to assess the intensity of preference between two elements.

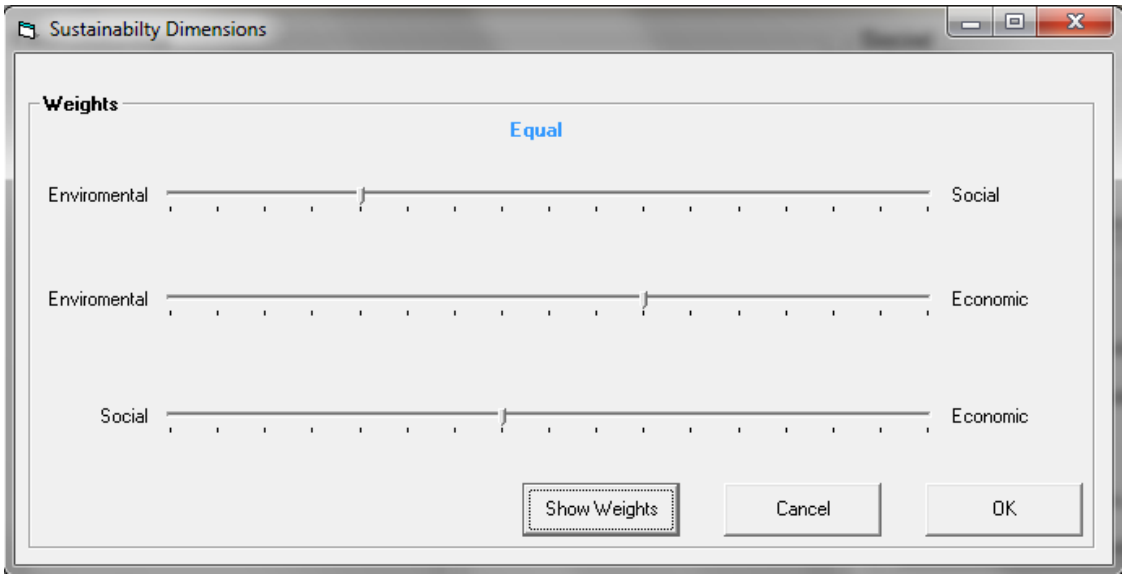
	Verbal Term
0	same importance
1	slightly more important
2	weakly more important
3	weakly to moderate more important
4	moderately more important
5	moderately to strongly more important
6	strongly more important
7	greatly more important
8	absolutely more important

Weighting means answering to the question “What is more important for this decision? Element A or Element B?” If the answer to this question is for example “Element A is weakly more important than Element B, then the bar should be adjusted to 2”.

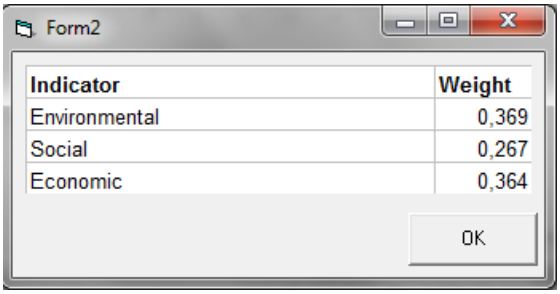
Example:

If the below sentences are true, the bars should be set the way it shown in the image:

- Environmental sustainability dimension is moderately more important (-4) than Social sustainability dimension.
- Economic sustainability dimension is weakly more important (2) than Environmental sustainability dimension.
- Social sustainability dimension is slightly more important (-1) than Economic sustainability dimension.



By clicking the Show Weights button you can see the scores assigned to each element.



To assign Indicators weight, select from the menu:

Assessment → Indicators and Weights

Click on the respective button under each group of Indicators.

You can assign the weights by scroll the side bars.

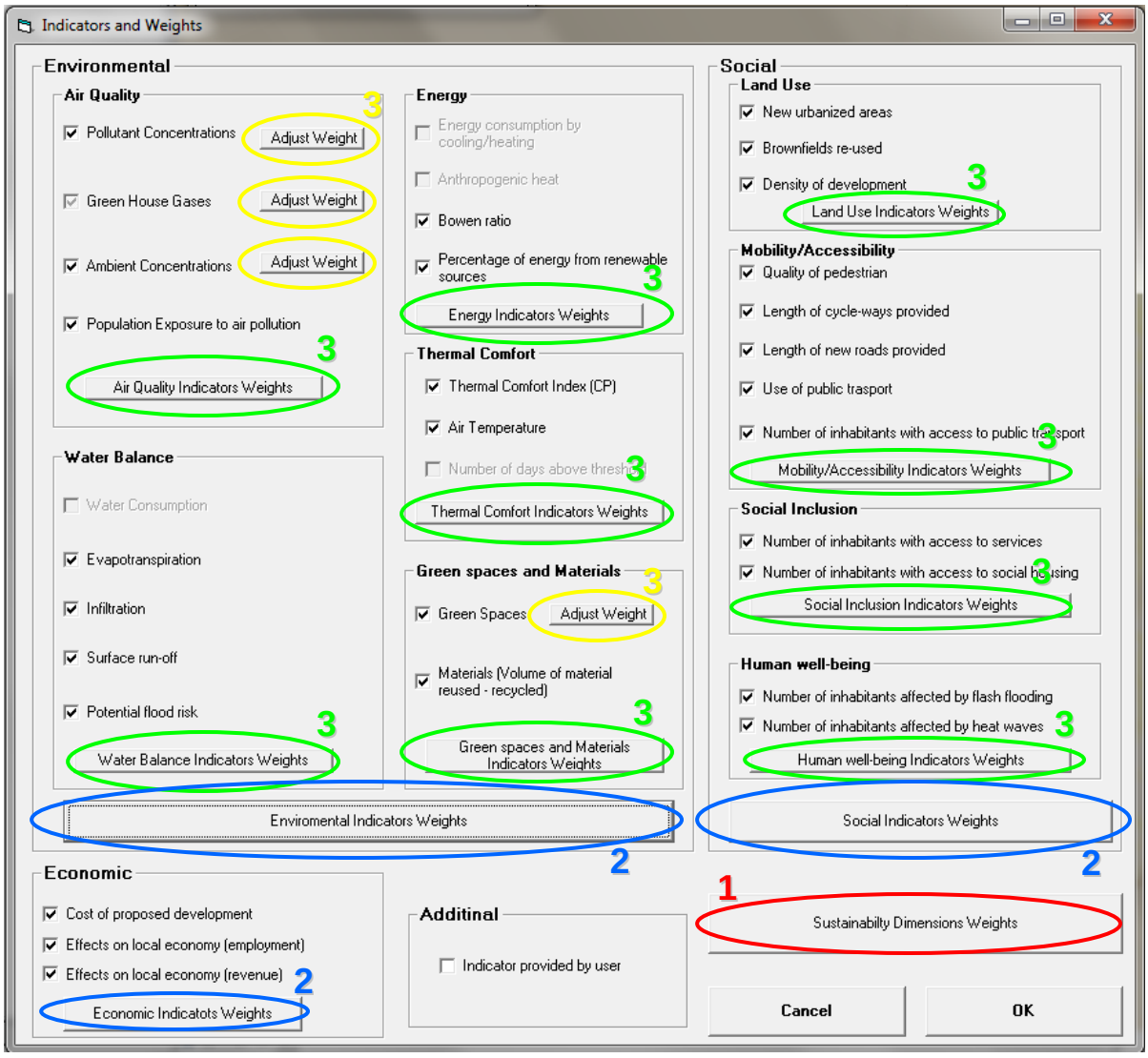
Click OK to save the results or click cancel if you want to maintain previous selection.

Warning: When weights are not assigned by the user, the selected elements are considered of *equal* importance.

Three dimensions are examined in terms of sustainability in the BRIDGE DSS (Indicators Hierarchy Level 1, see Appendix D). Weights between the three sustainability dimensions can be adjusted by pressing the **Sustainability Dimensions Weights** button.

Under the sustainability dimensions in the hierarchy lay the sustainability objectives (Indicators Hierarchy Level 2).

Weights between *Air Quality Indicators* can be adjusted by pressing the **Air Quality Indicators Weights** button.



Weights between *Water Balance Indicators* can be adjusted by pressing the **Water Balance Indicators Weights** button.

Weights between *Thermal Comfort Indicators* can be adjusted by pressing the **Thermal Comfort Indicators Weights** button.

Weights between *Land Use Indicators* can be adjusted by pressing the **Land Use Weights** button.

Weights between *Mobility/Accessibility Indicators* can be adjusted by pressing the ***Mobility/Accessibility* Indicators Weights** button.

Weights between *Social Inclusion Indicators* can be adjusted by pressing the **Social Inclusion Indicators Weights** button.

Weights between *Human well-being Indicators* can be adjusted by pressing the **Human well-being Indicators Weights** button.

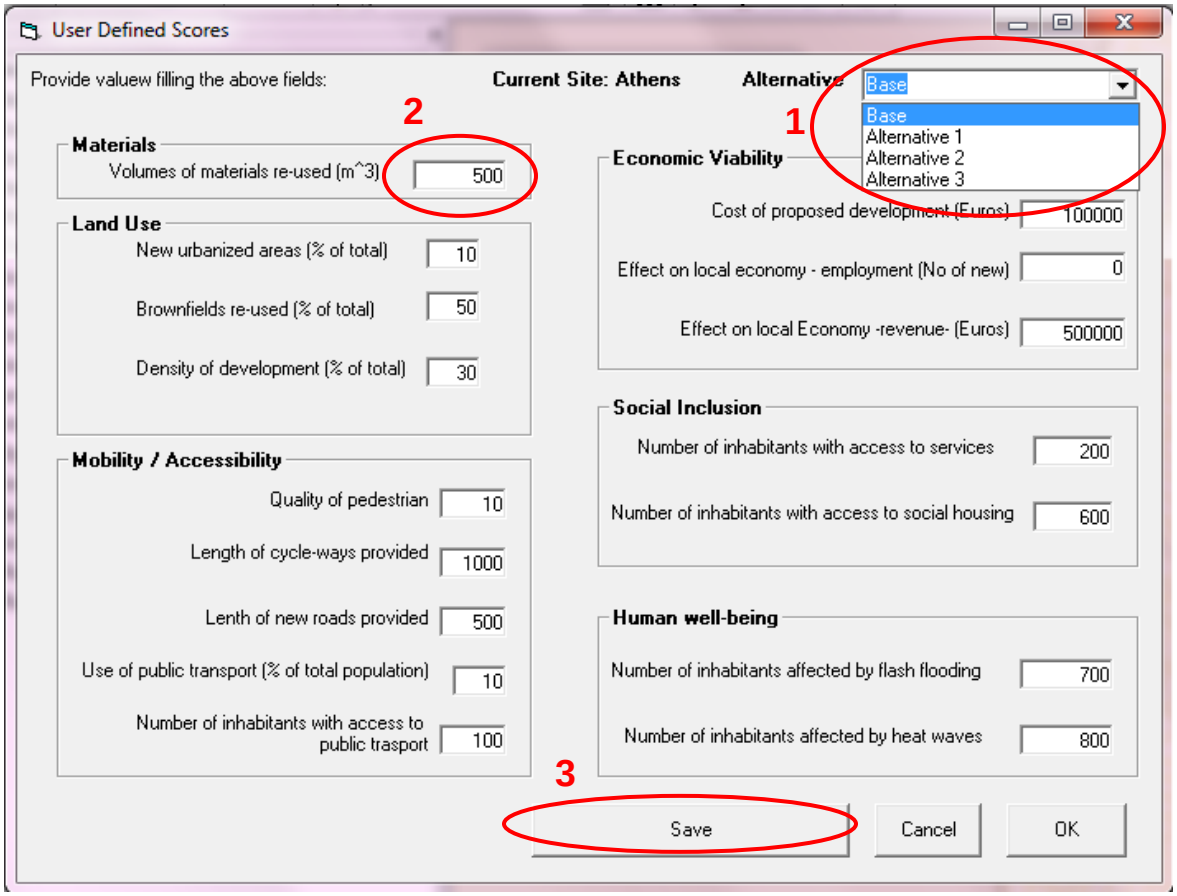
5.1.4 Provide Indicator Values

BRIDGE DSS uses indicator values for each alternative to compute the alternatives assessment scores. Some indicator values are computed using environmental model simulation results (either already available, or produced by the user. For details on running environmental models, see section 4.1.5).

Socio-economic Indicator values are not estimated using modeling and the user is required to provide their values.

To set values to indicators choose:

Assessment → Data Input



Values should be assigned to indicators for the baseline and all alternatives. To do so

- choose the alternative you want to assign values to
- assign the values and
- click “save” to update those values and move to the next alternative.

By clicking “Save” values are temporally stored so as to continue entering values for the next alternative.

By clicking “OK” all values stored for all alternatives will be saved and used for evaluation.

By clicking “Cancel” no values will be stored (even those that were previously saved using the “Save” button.

5.1.5 Run enviromental models

(to be filled in next version)

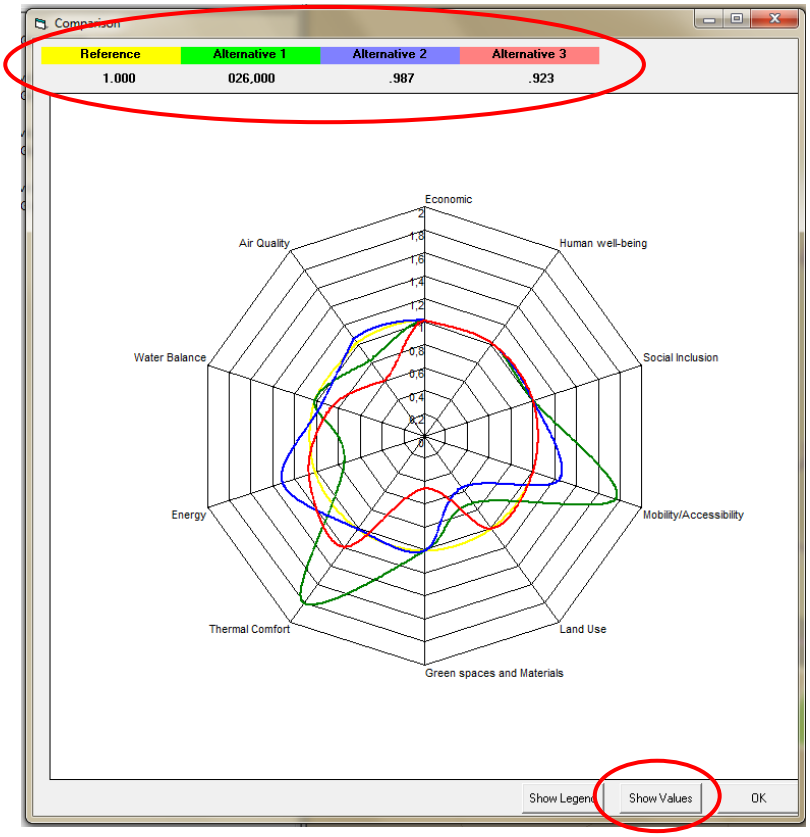
5.1.6 Run the Assessment Procedure

After all the required parameters have been set, an assessment can be run to evaluate the different planning alternatives by choosing from the menu

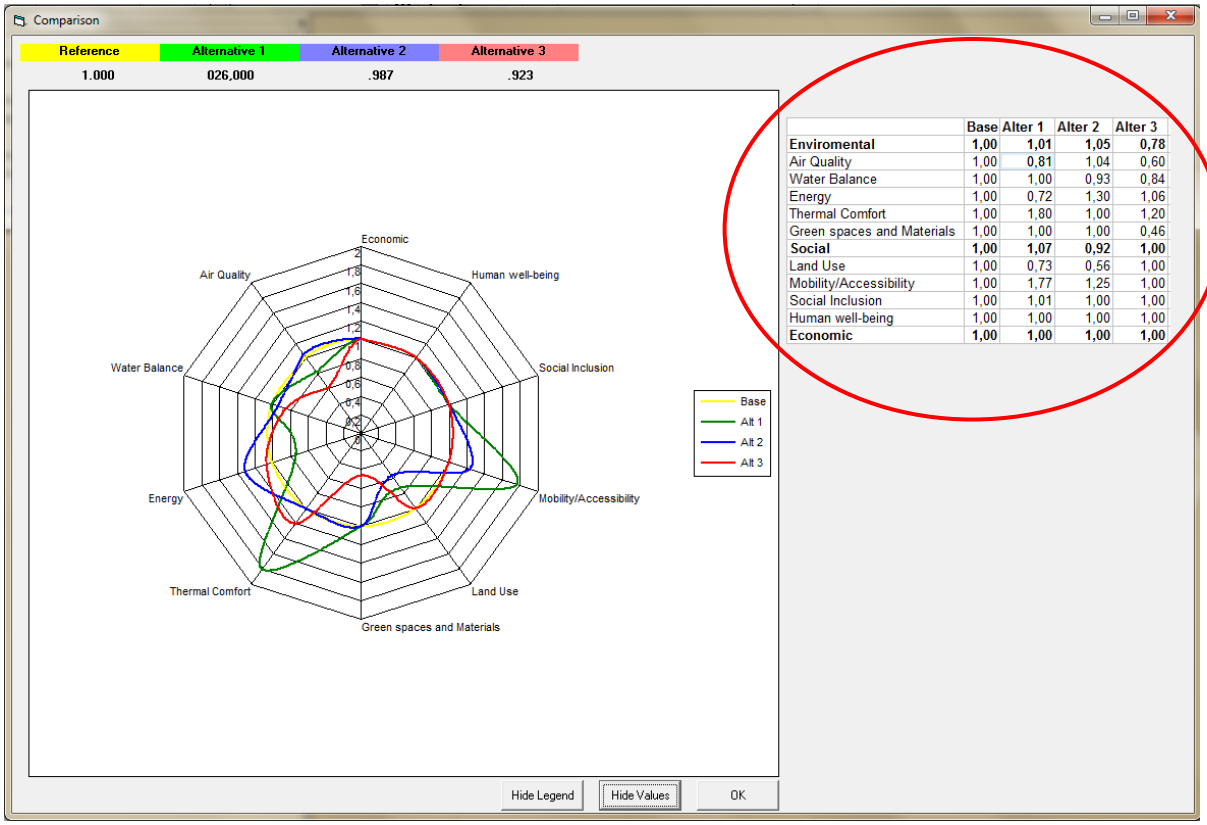
Assessment → Evaluation

The final appraisal scores computed for the alternatives are shown in the top of the Comparison window.

A break-down of the scores that were computed for the selected sustainability objectives is also presented in a form of a spider diagram.



To asses the Indicators Scores produced from the analysis you can click on the Show Values button to make the Scores matrix appear.



	Base	Alter 1	Alter 2	Alter 3
Enviromental	**1,00**	**1,01**	**1,05**	**0,78**
Air Quality	1,00	0,81	1,04	0,60
Water Balance	1,00	1,00	0,93	0,84
Energy	1,00	0,72	1,30	1,06
Thermal Comfort	1,00	1,80	1,00	1,20
Green spaces and Materials	1,00	1,00	1,00	0,46
Social	**1,00**	**1,07**	**0,92**	**1,00**
Land Use	1,00	0,73	0,56	1,00
Mobility/Accessibility	1,00	1,77	1,25	1,00
Social Inclusion	1,00	1,01	1,00	1,00
Human well-being	1,00	1,00	1,00	1,00
Economic	**1,00**	**1,00**	**1,00**	**1,00**

5.2 Displaying Indicators Maps

It is possible to see the spatial distribution of data used to obtain indicator scores. Environmental model simulation results are available for the time period of 2008 in hourly basis.

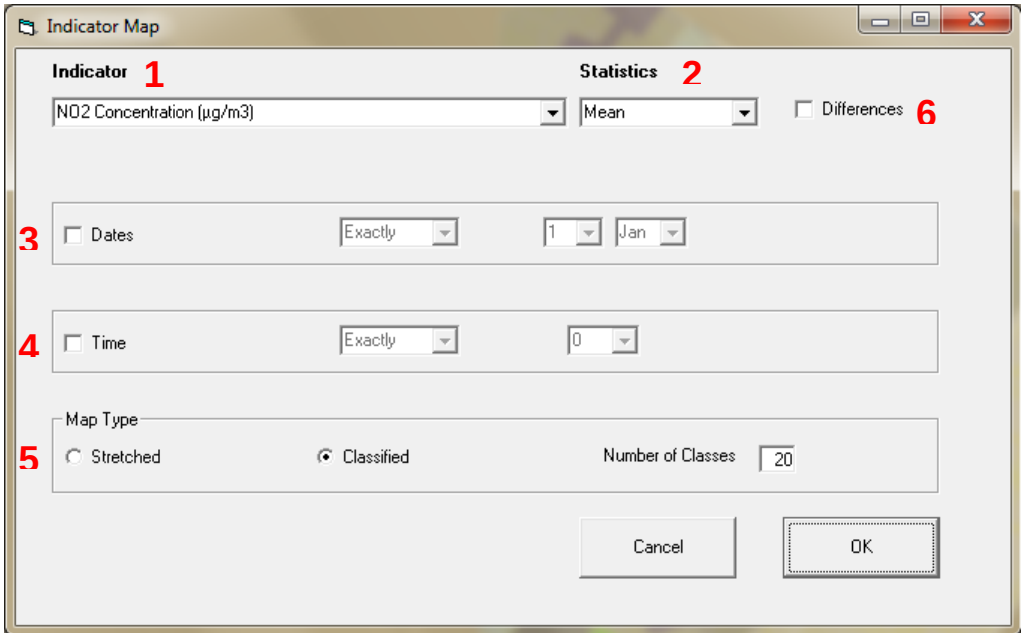
Spatial distributions are available for the Indicators shown below:

- NO_2 concentration ($\mu g/m^3$)
- PM_{10} concentration ($\mu g/m^3$)
- $PM_{2.5}$ concentration ($\mu g/m^3$)
- O_3 concentration ($\mu g/m^3$)
- SO_2 concentration ($\mu g/m^3$)
- CH_4 concentration ($\mu g/m^3$)
- Number of exceedances of NO_2
- Number of exceedances of PM_{10}
- Number of exceedances of O_3

- Number of exceedances of SO_2
- Potential population exposure to NO_2 (# of inhabitants)
- Potential population exposure to PM_{10} (# of inhabitants)
- Potential population exposure to O_3 (# of inhabitants)
- Evapotranspiration (w/m^3)
- Infiltration (w/m^3)
- Surface run-off (mm)
- Thermal Comfort Index (CP)
- Air Temperature (K)
- Number of days above thermal comfort threshold (# of days)
- Bowen Ratio
- Sensible Heat Flux (w/m^3)
- Latent Heat Flux (w/m^3)

To see the spatial distribution of data used to obtain indicator scores select:

Assessment → Display Indicator Map



You can choose the desired indicator to be displayed from the respective list of available indicators (1), then choose the type of spatial distribution to view (2), choose the date and time span (3, 4) and choose the map type (5).

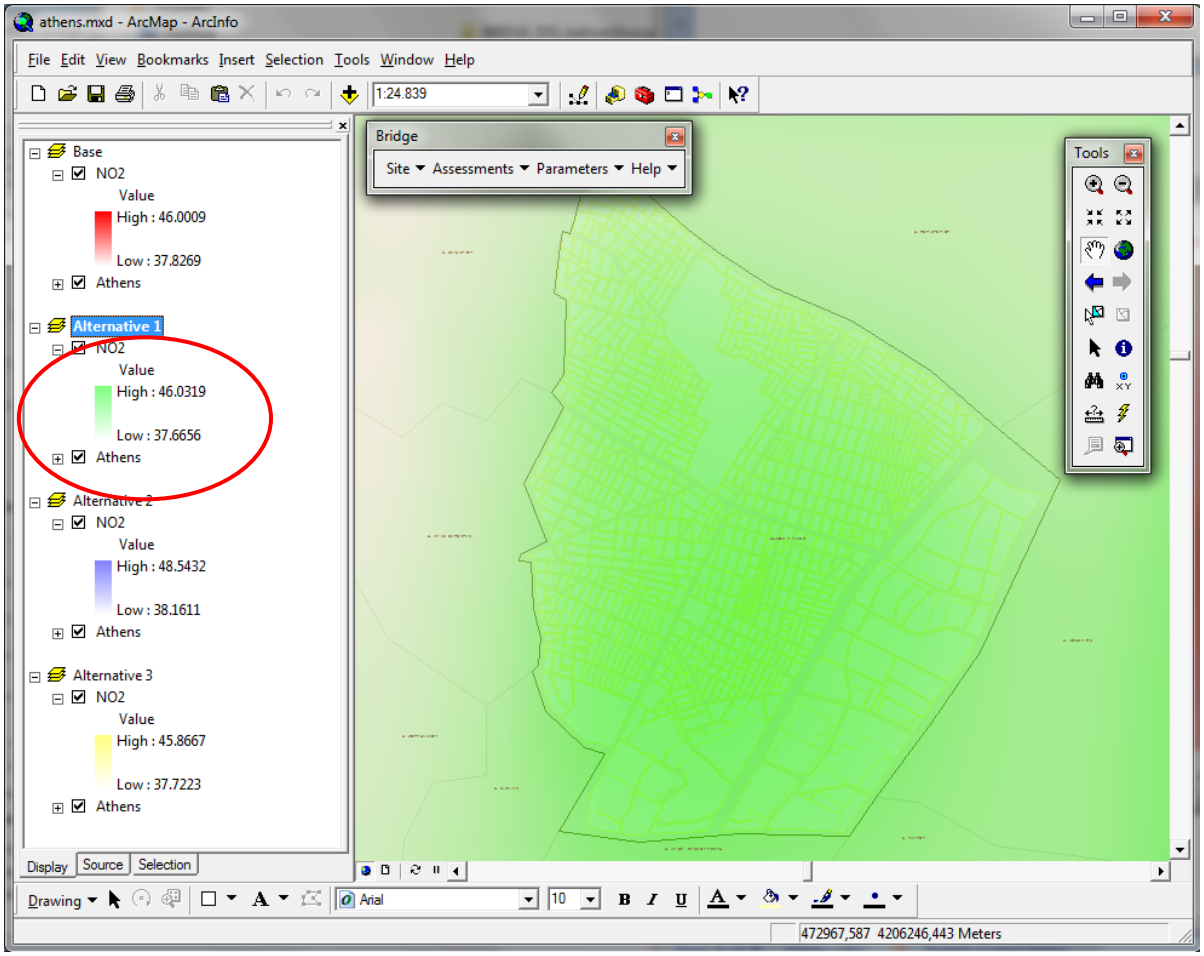
There is also the ability to choose to display 'Differences' (6). In this case, instead of spatial distributions of indicators (indicator maps), spatial distributions of differences between the

indicator values of alternatives and those of the baseline will be created (differences of indicator maps).

The Display Indicator Map menu allows the user to choose between:

- *Mean*, produces a map with the average values of the indicator in the given time span
- *Min*, produces a map with the min values of the indicator in the given time span
- *Max*, produces a map with the max values of the indicator in the given time span
- *Sum*, produces a map with the sum values of the indicator in the given time span

One map is produced for each Alternative under the respective Data Frame. You can switch between produced maps by activating the desired Data Frame.



5.3 Quick-Reference Menu Explanation

Site

Select Site → Select the case study to work with

Alternatives Description → See the description of the alternatives for the chosen case study

Create New Alternative → Create new planning alternative map

Delete Alternative → Delete a planning alternative map

Save Map as … → Save a planning alternative map

Exit → Exit the ArcGIS environment

Assessment

Indicators and Weights → Define indicators to be used in the analysis and adjust their weights

Evaluation → Run the evaluation procedure

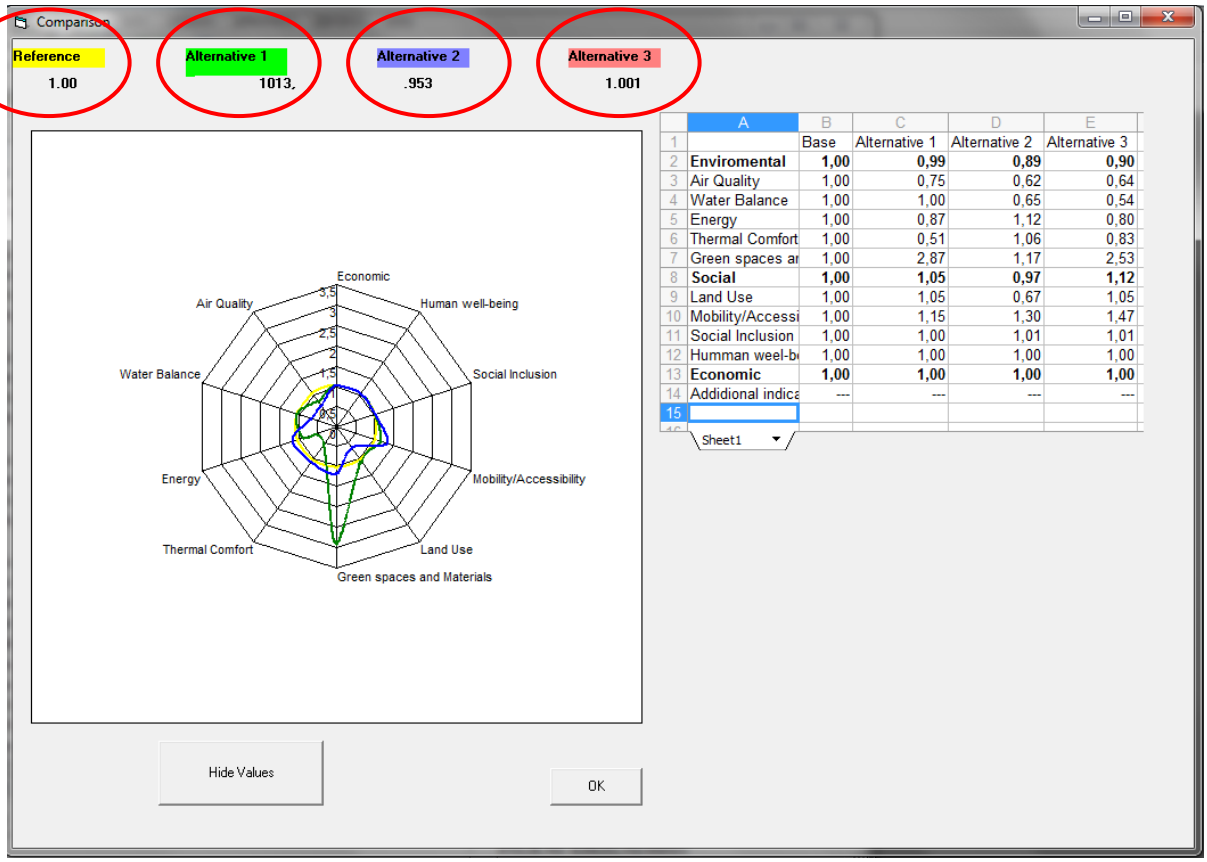
Display Indicator Map → Display Indicator's spatial distribution

Data Input → Define indicator values manually

Run Online Models → Run environmental models

6 Guidelines for Result Interpretation

BRIDGE DSS relies on sustainability indicators to help the user make a sustainability assessment regarding different planning alternatives. Indicator values are normalized by scoring them according to their performance. The performance is set by how close the indicator value is to a reference basis. Indicator scores are computed in all levels of hierarchy (see Appendix D). Although, final appraisal scores are also computed for each planning alternative, the user is encouraged to look into the scores of the individual indicators (spider-diagram) and also their spatial representation (indicators maps).

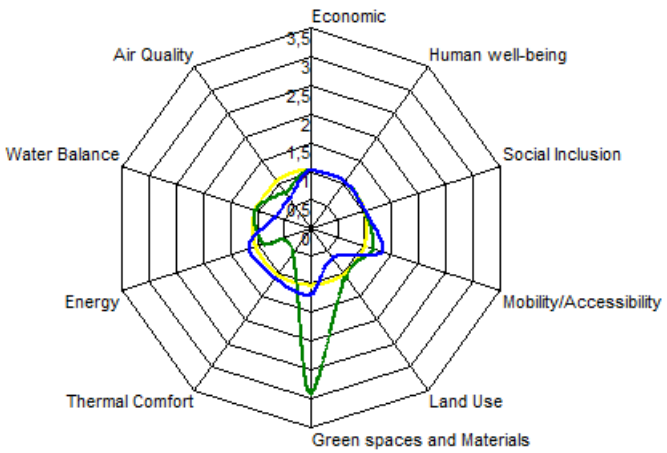


	Base	Alternative 1	Alternative 2	Alternative 3
Enviromental	**1,00**	**0,99**	**0,89**	**0,90**
Air Quality	1,00	0,75	0,62	0,64
Water Balance	1,00	1,00	0,65	0,54
Energy	1,00	0,87	1,12	0,80
Thermal Comfort	1,00	0,51	1,06	0,83
Green spaces ar	1,00	2,87	1,17	2,53
Social	**1,00**	**1,05**	**0,97**	**1,12**
Land Use	1,00	1,05	0,67	1,05
Mobility/Accessi	1,00	1,15	1,30	1,47
Social Inclusion	1,00	1,00	1,01	1,01
Humman weel-b	1,00	1,00	1,00	1,00
Economic	**1,00**	**1,00**	**1,00**	**1,00**
Addidional indica	---	---	---	---

Final appraisal scores appear in the top of the results screen. Reference refers to the baseline. The final appraisal score of Reference is always 1, because indicators scores are computed using the baseline as a reference. A final appraisal score greater than 1 indicates better performance of the alternative in question, as compared to the Reference alternative. The same applies to the underlying indicators scores.

6.1 Spider-diagram

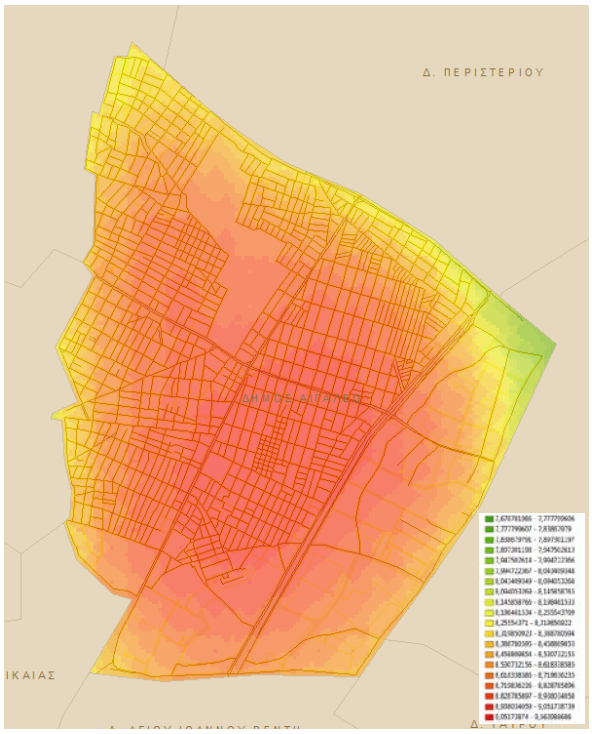
Apart from the final appraisal score, the appraisal scores of the individual indicators should be taken into account towards the decision. The appraisal scores for each alternative are computed by combining the indicators values (received using numerical modeling, or user defined) with their respective weights. The spider diagram reveals more information regarding performance of indicators in terms of comparison between alternatives.



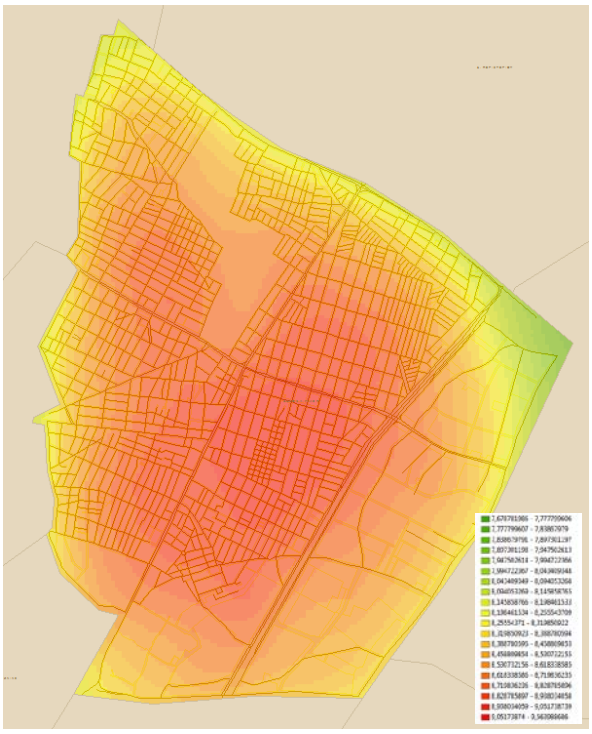
The user can examine the performance of each alternative in terms of different sustainability objectives, by comparing the indicators scores with 1.

6.2 Indicators Maps

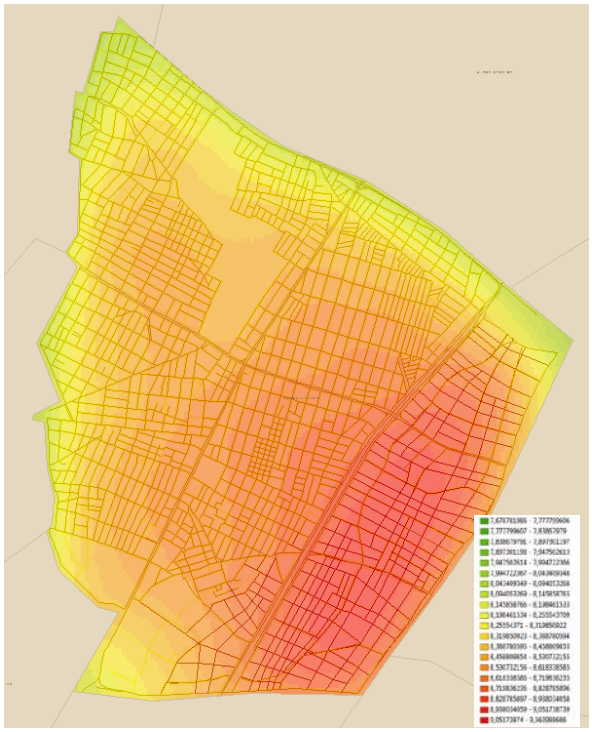
Indicator maps are spatial representations of computed indicators. For example an indicator map may represent the spatial distribution over the area of interest of pollutant concentrations. The figure below represents the spatial distribution of mean value of PM_{10} for the January of 2008 for the area of Athens.



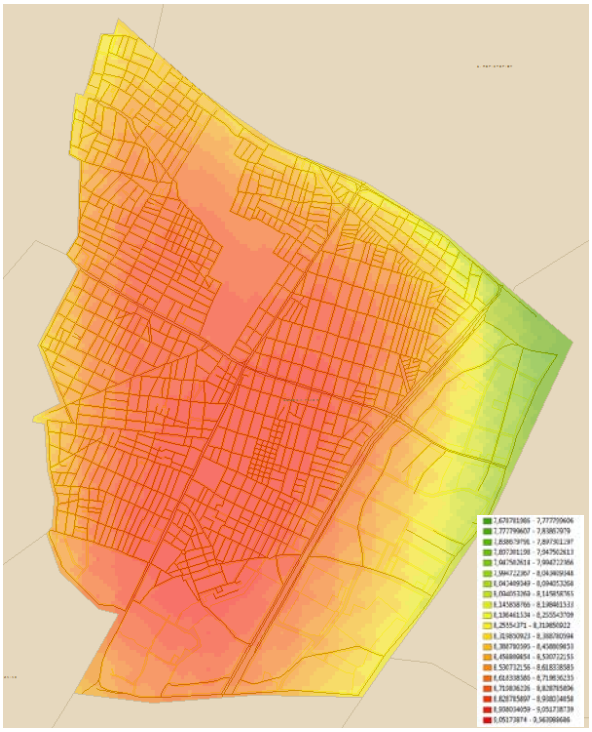
Baseline: current state



Alternative 1: apply cool materials to buildings and roads



Alternative 2: change ‘Eleonas’ from Brownfield to Urban Fabric



Alternative 3: change ‘Eleonas’ from Brownfield to Green Vegetation

7 Troubleshooting

7.1 Installation problems

Q: I have downloaded the zipped files that are required for installation, but I don't recognize the format and I cannot unzip them.

A: The files are in 7-Zip format. Many zip software packages unzip those files (e.g. WinRAR). It is suggested to download and install 7-Zip for Windows from http://www.7-zip.org/download.html. Once you have the 7-Zip software installed, right click on the file you need to extract and select *"Uncompress into the folder [folder name]"*.

Q: I am trying to install a new version of the software, but when I add the .dll I get the message "No objects added".

A: This is a problem of privileges of Windows 7 Operating System. To resolve it you have to start the ArcGIS software by right-clicking the shortcut and choose "Run as Administrator" option.

Q: I am trying to install a new version of the software, but although I have added the toolbar in customize menu, the BRIDGE menu does not appear.

A: If you are trying to install a new version of the software and you have problems with the menu, do the following:

1. Remove all previous versions from your computer (erase files)
2. Install again the new dll (from tools-> customize)
3. To start the ArcGIS applications double-click on the athens.mxd file found in the root install directory.

7.2 Functionality not working

Q: What can I do if the BRIDGE toolbar disapears?

A: BRIDGE DSS appears as a toolbar in ArcGIS environment, so if for any reason disappears, you need to

1. Go to **Tools** menu, click on **Customize…**
2. In the list of available toolbars make sure that **Bridge** is selected

Q: I have made all the neccesary parametrization to run an assessment, but the *Run Assessment* button does not work.

A: This problem is caused by incompatibilities of Microsoft Windows and Office installed on your computer with those used by the BRIDGE DSS. To resolve this issue please do following:

1. Erase any previous version of BRIDGE DSS and unzip again the files you have downloaded
2. Download http://www.iacm.forth.gr/BRIDGE/DSS/BRIDGE_DSS_Setup.zip
2. Unzip BRIDGE_DSS_Setup.zip in a local disk
3. Run …\BRIDGE_DSS_Setup\setup.exe and follow the instructions
4. Re-install BRIDGE DSS (see page 8).

Q: I have installed the DSS, used it any without problem and exit ArcGIS. When I opened it again, after starting ArcMap, I am not able to select anything in the Bridge toolbar and most options appear disable (grey). How can I enable them?

A: The options are disabled because the system is not linked to the database. In order to link the system to the database you will need to select:

Parameters → Options

click on *Main Database* and then point to the bridge.mdb file found in the root folder.

If none of the above answers to your questions, please contact Mitraka Zina (mitraka@iacm.foth.gr)

Appendix A – Reference Documents

González, A., Donnelly, A. and Jones, M. (2010): Report on the Impact Assessment Model for Urban Metabolism. BRIDGE Project Deliverable D.5.2.

Mitraka, Z, Diamantakis, M and Chrysoulakis, N (2010) DSS Design Report. BRIDGE Project Deliverable D.6.1.

Saaty, T. L. (1980). The analytic hierarchy process. New York: McGraw-Hill

Appendix B – Glossary of Terms

Term	Meaning
Alternative	refers to a planning intervention in a site. The scope of the BRIDGE DSS is to evaluate different planning interventions, thus planning alternatives.
Indicators	refer to indicators that are used in BRIDGE to assess urban metabolism (see the list in Appendix D)
Indicator Map	is a spatial distributions of an indicator that was derived using environmental numerical models.
Indicator score	is the appraisal score that computed for one indicator, given the model output or the user-defined value.
Indicator value	is the value of an indicator whether it is derived in space (using environmental modeling) or it is defined by the user as a single value.
Spider diagram	is a kind of diagram that includes all indicator scores computed for all alternatives in one diagram to facilitate comparison between alternatives in terms of environmental and socio-economic aspects

Appendix C – Acronyms

Acronym	Explanation
BRIDGE	SustainaBle uRban planning Decision support accountinG for Urban mEtabolism
DSS	Decision Support System
GIS	Geographic Information System

Appendix D – Indicators Hierarchy

Sustainability indicators used in BRIDGE are organized in the hierarchy that is presented below. Numbers indicate the level in the hierarchy.

1 Environmental

- 2 Air Quality
  - 3 Pollutant Concentrations
    - 4 NO_2, PM_{10}, $PM_{2.5}$, O_3, CO, SO_2
  - 3 Green House Gases
    - 4 CO_2EMIS, CO_2FLUX, CH_4EMIS
  - 3 Ambient Concentrations
    - 4 NO_2, PM_{10}, O_3, SO_2
  - 3 Population Exposure to air pollution
- 2 Water Balance
  - 3 Water consumption
  - 3 Evapotranspiration
  - 3 Infiltration
  - 3 Surface run-off
  - 3 Potential flood risk
- 2 Energy
  - 3 Energy consumption by cooling/heating
  - 3 Anthropogenic heat
  - 3 Bowen ratio
  - 3 Percentage of energy from renewable sources
- 2 Thermal Comfort
  - 3 Thermal Comfort Index (CP)
  - 3 Air Temperature
  - 3 Number of days above threshold
- 2 Discretionary Indicators
  - 3 Green Spaces
    - 4 Number of inhabitants per green area
    - 4 Newly created canopy surface or green area
    - 4 Number of inhabitants with access to green areas
  - 3 Materials (Volume of material re-used (recycled)

1 **Social**

- 2 Land Use
  - 3 New urbanized areas
  - 3 Brownfields re-used
  - 3 Density of development
- 2 Mobility/Accessibility
  - 3 Quality of pedestrian
  - 3 Length of cycle-ways provided
  - 3 Length of new roads provided
  - 3 Use of public transport
  - 3 Number of inhabitants with access to public transport
- 2 Social Inclusion
  - 3 Number of inhabitants with access to services
  - 3 Number of inhabitants with access to social housing
- 2 Human well-being
  - 3 Number of inhabitants affected by flash flooding
  - 3 Number of inhabitants affected by heat waves

1 **Economic**

- 2 Cost of proposed development
- 2 Effects on local economy (employment)
- 2 Effects on local economy (revenue)