

# HELSINKI GREEN AREA FACTOR TOOL

## Guide for modifying the Excel-based tool

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EUROPEAN UNION  
European Regional Development Fund



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# 1 BACKGROUND

## 1.1. Extent of this manual

This manual is NOT intended to introduce the user to Microsoft Excel. Good knowledge of using Excel, the Excel-specific Visual Basic for Applications (VBA) programming language and the program's terminology are required. It is therefore strongly recommended that modifications of the tool's contents, and especially its structure, are done only by an expert Excel user.

## 1.2. Protected mode

The standard version of the Green Factor Tool is protected, so that users cannot accidentally modify any cells containing essential content like default values and formulas. To apply modifications to the structure of the file, an unprotected version of the file has to be used, which can be requested from [jari.viinanen@hel.fi](mailto:jari.viinanen@hel.fi).

## 1.3. References and sections

The following guide uses references to cell ranges. References to cells, columns, rows or ranges within this manual refer to the original unprotected version of the tool only. Certain ranges within the tool are often referred to as sections and are usually marked on the corresponding figures.

Changes and adjustments to the tool should be checked in comparison to an unmodified reference file with the same setup for limitations and elements.

## 1.4. Special elements

Since the tool is Excel-based, it contains a large amount of formulas, a few controls and some macros.

### 1.4.1. Formulas

The Excel tool is largely based on the usage of formulas. The formulas' names depend on the language of the installed Excel version and are usually translated automatically. Formulas may contain flexible or static links to cells or ranges on the same or other sheets within the workbook. Generally moving or adding cells, rows or columns will adjust formulas and their references automatically. Deleting cells, rows or columns on the other hand may sometimes result in breaking some formulas, whose references were lost and therefore need to be replaced.

### 1.4.2. Macros

The tool contains a few VBA macros, which are mainly used for navigating through the sheets, while some are also needed for internal checks. They contain references to the names of the sheets and the location of specific cells. Any structural changes within the sheets or the workbook are therefore likely to result in a need to update the macros as well.

### 1.4.3. Controls

The "Limitations" sheet contains controls depending on the type of limitation. Controls in Excel are accessed via the Developer toolbar and modified by resetting their properties. The tool currently uses several radio buttons and dropdown menus. When making structural changes to this sheet, the controls might need to be adjusted.

## 2 MODIFICATIONS WITHOUT CHANGING THE STRUCTURE

### 2.1. General

This chapter applies to the modification of values in existing cells only, without any structural changes (moving, adding deleting cells, rows, columns) within the sheets.

### 2.2. Instructions

The “Instructions” sheet can be modified as long as none of the hyperlinks and buttons are deleted. This sheet does not contain any formulas.

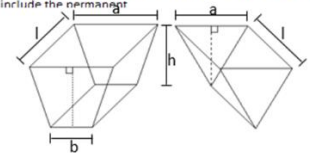
### 2.3. Target level

The target levels for the existing land use types can be changed within the “Limitations” sheet. The values are defined within the cells C41:F41 (Figure 1). The target level is set from column C for “Residential” to column F for “Industrial/Logistics”. For adding or removing land use types, please check Chapter 3.

Limitations	No.	Question	Response
Land use	1	Residential	<input type="radio"/>
		Services and Offices	<input type="radio"/>
		Commercial	<input type="radio"/>
		Industrial/logistics	<input checked="" type="radio"/>
Yard type	2	Share of rooftop courtyard over 50 %	<input checked="" type="radio"/> Yes <input type="radio"/> No
Drainage system	3	Can the site be connected to a separate drainage system?	<input type="radio"/> Yes <input checked="" type="radio"/> No
Surrounding region	4	Is there a green corridor comprising a nature reserve/body of water/natural vegetation located within ≤ 50 m of the site?	<input checked="" type="radio"/> Yes <input type="radio"/> No
Soil/groundwater	5	Is impermeable soil/groundwater located on average at least 100 cm below the ground level?	<input type="radio"/> Yes <input checked="" type="radio"/> No
Stormwater management solutions	6	What is the estimated average/effective depth <sup>21</sup> of a detention/retention element <sup>22</sup> ? (Area * Depth = estimated capacity)	0.3
	7	What is the estimated average/effective depth <sup>21</sup> of a biofiltration element? (Area * Depth = estimated capacity)	0.2
	8	If it is possible to provide a share of the necessary storm water retention capacity outside the block/lot, how big is the share (%)?	20

<sup>21</sup> Average/effective depth: average depth based on shape (e.g. trapezoidal, triangular, circular), maximum depth and embankment slopes. With sloped embankments often significantly (0,3-0,5 times) smaller than maximum depth. It is recommended to assume this parameter on the safe side (rather smaller than bigger). For retention elements (wet ponds) the average depth should not include the permanent<sup>22</sup> part.



In general the average depth (h average) equals the projected surface area on top divided by the volume of the structure.

Examples:

Trapezoidal prism: Area  $A = a * l$ , Volume  $V = (a+b)/2 * h * l \rightarrow h \text{ average} = V/A = (a+b)/(2*a) * h$

Triangular prism: Area  $A = a * l$ , Volume  $V = 0,5 * a * h * l \rightarrow h \text{ average} = V/A = 0,5 * h$

<sup>22</sup> Detention: no permanent pool of water (dry pond), good quantity but limited quality control.  
Retention: holds permanent pool of water (wet pond), permanent water level reduces detention space but increases quality control.

40				
41	Target level	0.9	0.8	0.7 0.5
43	1 Land use	4		
44	2 Yard type	1 - Share of rooftop courtyard > 50%, please add a green roof element!		
45	3 Drainage system	2 - Add at least one stormwater detention system!		
46	4 Surrounding region	1 - Nature reserve/body of water/natural vegetation located within ≤ 50 m of the site!		
47	5 Soil/groundwater	2 - Target level reduced due to groundwater level being close to surface!		

Figure 1. Modifying the target level within the marked range (a) only.

## 2.4. Weighting/Scoring

All weightings have to be modified within the sheet “New elements weights” (only visible in unprotected version), NOT within the “Green Factor” nor the “More information” sheet. This section applies to changing the weightings of existing elements only (order, type and amount of elements remain untouched). If the structure of categories and/or elements needs to be changed as well, please refer to Chapter 3.

The overall weightings were derived from expert interviews during the phase of setting up the tool’s first version. The global weighting for the Stormwater category was added during the update phase.

The overall weightings of the five categories can be changed within AY3:AY11 (a in Figure 2, note that some cells are merged).

	AX	AY	AZ
1	<b>Overall weighting of categories calculated from specialist interviews</b>		
2	<b>Categories</b>	<b>Interview-based weighting (1-3)</b>	<b>Category functions</b>
3		<b>a</b>	<i>Capture and treatment of stormwater</i>
4	<b>Ecology</b>	1.59	<i>Carbon sequestration and storage</i>
5			<i>Biodiversity of species and habitats, the ecological network</i>
6			<i>Microclimate regulation (cooling, sequestration of air pollutants, reduction of noise and wind conditions, visual screen)</i>
7	<b>Functionality</b>	1.51	<i>Food production by urban farming, learning from nature, play</i>
8			<i>Safety</i>
9	<b>Cityscape</b>	0.84	<i>Link to the surrounding cityscape, effect on the scenery (e.g. flowers and berries)</i>
10	<b>Maintenance</b>	0.70	<i>Low-maintenance solutions</i>
11	<b>Stormwater</b>	1.25	<i>Capture and treatment of stormwater</i>

**Figure 2.** Modifying the overall weightings within the marked range (a) only.

The element-specific weightings can be modified within columns D, F, H, J and L (a in Figure 3) within the given element table of A1:N46, providing that the categories are not modified.

The average weighting in column M (b in Figure 3) is formula based. Currently the average weighting factors are not calculated as a standard arithmetic average, but as a simple multiplication of global (overall) and element-specific values divided by the number of categories. This is why the weighted average can be higher than the maximum scale of 3. If the user intends to change the calculation, the formulas in column M need to be adjusted (column O contains an example for the arithmetic average calculation).

A	B	C	D	E	F	G	H	I	J	K	L	M	N	
Element groups	Elements	Ecology	Functionality	Cityscape	Maintenance	Stormwater	Weighted average	Weighted area						
Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m²) each	The longevity and large biomass makes them highly significant for carbon sequestration and biodiversity	Bare trees that are large when fully grown (especially coniferous trees) are highly significant	The landscape value of mature trees that are large when fully grown is very high	After the construction phase, the maintenance need is once a year or less	Mature trees that are large when fully grown are highly significant	3.0	3.5	346.7					
	Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m²) each	Small trees have the same benefits as large trees, only on a smaller scale	Small trees have the same benefits as large trees, only on a smaller scale	Small trees have the same benefits as large trees, only on a smaller scale	Small trees have the same benefits as large trees, only on a smaller scale	Small trees have the same benefits as large trees, only on a smaller scale	2.5	3.0	91.0					
	Preserved tree in good condition (1.5-3 m) or a large shrub (3 m² each)	Same benefits as preserved trees taller than 3 m, only on a smaller scale. Shrubs have special benefits as a natural meadow or ground vegetation	Some benefits for functionality as with preserved trees taller than 3 m, only on a smaller scale. Shrubs have special benefits as a natural meadow or ground vegetation	Some benefits for functionality as with preserved trees taller than 3 m, only on a smaller scale. Shrubs have special benefits as a natural meadow or ground vegetation	Some benefits for functionality as with preserved trees taller than 3 m, only on a smaller scale. Shrubs have special benefits as a natural meadow or ground vegetation	Some benefits for functionality as with preserved trees taller than 3 m, only on a smaller scale. Shrubs have special benefits as a natural meadow or ground vegetation	Some benefits for functionality as with preserved trees taller than 3 m, only on a smaller scale. Shrubs have special benefits as a natural meadow or ground vegetation	2.0	2.4	0.0				
	Preserved natural meadow or natural ground vegetation	Rock areas are highly significant habitats (2). The positive effect for ecology is reduced by the negative impact of impermeable surfaces to permeable management and carbon sequestration	Rock areas are highly significant habitats (2). The positive effect for ecology is reduced by the negative impact of impermeable surfaces to permeable management and carbon sequestration	Rock areas are highly significant habitats (2). The positive effect for ecology is reduced by the negative impact of impermeable surfaces to permeable management and carbon sequestration	Rock areas are highly significant habitats (2). The positive effect for ecology is reduced by the negative impact of impermeable surfaces to permeable management and carbon sequestration	Rock areas are highly significant habitats (2). The positive effect for ecology is reduced by the negative impact of impermeable surfaces to permeable management and carbon sequestration	Rock areas are highly significant habitats (2). The positive effect for ecology is reduced by the negative impact of impermeable surfaces to permeable management and carbon sequestration	2.0	2.2	88.3				
	Preserved bare rock	Large tree, fully grown > 10 m (25 m²) each, depth of growing medium 0.8 m, dimensions of planting pit for 100 cm x 100 cm x 100 cm	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (see 9)	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (see 9)	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (see 9)	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (see 9)	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (see 9)	2.5	2.8	843.2				
Planted/new vegetation	Large shrubs, 2 m² each, depth of growing medium 0.6 m	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (see 9)	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (see 9)	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (see 9)	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (see 9)	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (see 9)	1.5	1.7	66.4					
	Other shrubs, 1.5 m² each, depth of growing medium 0.4 m	Planted smaller shrubs have the same benefits as planted large shrubs, only on a smaller scale (see 9)	Planted smaller shrubs have the same benefits as planted large shrubs, only on a smaller scale (see 9)	Planted smaller shrubs have the same benefits as planted large shrubs, only on a smaller scale (see 9)	Planted smaller shrubs have the same benefits as planted large shrubs, only on a smaller scale (see 9)	Planted smaller shrubs have the same benefits as planted large shrubs, only on a smaller scale (see 9)	1.0	1.4	588.5					
	Perennials, depth of growing medium 0.4-0.6 m	Planted perennials have the same benefits as the permanent "other shrubs", but they are usually shorter	Planted perennials have the same benefits as the permanent "other shrubs", but they are usually shorter	Planted perennials have the same benefits as the permanent "other shrubs", but they are usually shorter	Planted perennials have the same benefits as the permanent "other shrubs", but they are usually shorter	Planted perennials have the same benefits as the permanent "other shrubs", but they are usually shorter	Planted perennials have the same benefits as the permanent "other shrubs", but they are usually shorter	1.0	1.6	0.0				
	Meadow or dry meadow, depth of growing medium 0.15-0.3 m	Meadows and dry meadows are a more natural option than grass for maintenance and have a strong carbon storage capacity	The benefits of meadows to microclimates are superior to those of perennials. However, meadows are more difficult to maintain	The benefits of meadows to microclimates are superior to those of perennials. However, meadows are more difficult to maintain	The benefits of meadows to microclimates are superior to those of perennials. However, meadows are more difficult to maintain	The benefits of meadows to microclimates are superior to those of perennials. However, meadows are more difficult to maintain	The benefits of meadows to microclimates are superior to those of perennials. However, meadows are more difficult to maintain	1.0	1.4	278.3				
	Cultivation plots (depth of growing medium depends on species, at least 0.3 m)	Cultivation plots often comprise annual plants, species, meaning that their ecological significance is lower	Cultivation plots often comprise annual plants, species, meaning that their ecological significance is lower	Cultivation plots often comprise annual plants, species, meaning that their ecological significance is lower	Cultivation plots often comprise annual plants, species, meaning that their ecological significance is lower	Cultivation plots often comprise annual plants, species, meaning that their ecological significance is lower	Cultivation plots often comprise annual plants, species, meaning that their ecological significance is lower	0.5	2.0	44.2				
	Lawn, depth of growing medium 0.15-0.2 m	Lawns have significance for stormwater management and biodiversity, only on a smaller scale	Lawns have significance for stormwater management and biodiversity, only on a smaller scale	Lawns have significance for stormwater management and biodiversity, only on a smaller scale	Lawns have significance for stormwater management and biodiversity, only on a smaller scale	Lawns have significance for stormwater management and biodiversity, only on a smaller scale	Lawns have significance for stormwater management and biodiversity, only on a smaller scale	0.5	1.0	2014.0				
	Perennial vines (2 m² each)	The ecology of perennial vines is comparable to that of other perennial plants. However, when growing vertically, they have a higher impact on the microclimate and energy consumption of buildings	The ecology of perennial vines is comparable to that of other perennial plants. However, when growing vertically, they have a higher impact on the microclimate and energy consumption of buildings	The ecology of perennial vines is comparable to that of other perennial plants. However, when growing vertically, they have a higher impact on the microclimate and energy consumption of buildings	The ecology of perennial vines is comparable to that of other perennial plants. However, when growing vertically, they have a higher impact on the microclimate and energy consumption of buildings	The ecology of perennial vines is comparable to that of other perennial plants. However, when growing vertically, they have a higher impact on the microclimate and energy consumption of buildings	The ecology of perennial vines is comparable to that of other perennial plants. However, when growing vertically, they have a higher impact on the microclimate and energy consumption of buildings	1.0	0.5	7.8				
	Green wall, vertical area	Green walls have a high impact on the microclimate and energy consumption of buildings, but their maintenance needs are high	Green walls have a high impact on the microclimate and energy consumption of buildings, but their maintenance needs are high	Green walls have a high impact on the microclimate and energy consumption of buildings, but their maintenance needs are high	Green walls have a high impact on the microclimate and energy consumption of buildings, but their maintenance needs are high	Green walls have a high impact on the microclimate and energy consumption of buildings, but their maintenance needs are high	Green walls have a high impact on the microclimate and energy consumption of buildings, but their maintenance needs are high	0.5	0.1	17.7				
	Semipermeable pavements (e.g. grass stones, growing medium 0.2 m)	Semipermeable surfaces that also contain vegetation species for transpiration and carbon sequestration	Semipermeable surfaces that also contain vegetation species for transpiration and carbon sequestration	Semipermeable surfaces that also contain vegetation species for transpiration and carbon sequestration	Semipermeable surfaces that also contain vegetation species for transpiration and carbon sequestration	Semipermeable surfaces that also contain vegetation species for transpiration and carbon sequestration	Semipermeable surfaces that also contain vegetation species for transpiration and carbon sequestration	1.0	1.0	380.6				
	Permeable pavements (e.g. gravel and sand surfaces, stone ash)	Better stormwater permeability compared to grass stones, but fewer other ecological benefits	Better stormwater permeability compared to grass stones, but fewer other ecological benefits	Better stormwater permeability compared to grass stones, but fewer other ecological benefits	Better stormwater permeability compared to grass stones, but fewer other ecological benefits	Better stormwater permeability compared to grass stones, but fewer other ecological benefits	Better stormwater permeability compared to grass stones, but fewer other ecological benefits	0.5	0.1	0.35				

Figure 3. Modifying the element-specific weightings within the marked range (a) only.

## 2.5. Runoff coefficients

The runoff coefficients for the existing set of elements can be changed in sheet "Green Factor" within range J2:J29 (a in Figure 4). This should be done only for elements that have an actual surface. For elements like, for instance "Green wall" and "Retention pit", they should be kept as "-" since they do not create any (significant) surface.

C	D	E	F	G	I	J
Element group	Element description	Unit	Area or quantity	Weighting	Weighted area, m²	Runoff coefficient C
Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m²) each	pcs	4	3.5	346.7	0.1
	Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m²) each	pcs	2	3.0	91.0	0.1
	Preserved tree in good condition (1.5-3 m) or a large shrub (3 m² each)	pcs	0	2.4	0.0	0.15
	Preserved natural meadow or natural ground vegetation	m²	40	2.2	88.3	0.1
	Preserved natural bare rock area (at least partially bare rock surface, not many trees)	m²	0	1.9	0.0	0.7
Planted/new vegetation	Large tree species, fully grown > 10 m (25 m²) each	pcs	12	2.8	843.2	0.1
	Small tree species, fully grown ≤ 10 m (15 m²) each	pcs	15	2.3	515.5	0.1
	Large shrubs (3 m² each)	pcs	13	1.7	66.4	0.1
	Other shrubs	m²	415	1.4	588.5	0.15
	Perennials	m²	0	1.6	0.0	0.2
	Meadow or dry meadow	m²	405	1.9	778.1	0.2
	Cultivation plots	m²	22	2.0	44.2	0.3
	Lawn	m²	1828	1.1	2014.0	0.25
	Perennial vines (2 m² each)	pcs	3	1.3	7.8	0.15
	Green wall, vertical area	m²	19	0.9	17.7	-
Pavements	Semipermeable pavements (e.g. grass stones, stone ash)	m²	373	1.0	380.6	0.6
	Permeable pavements (e.g. gravel and sand surfaces)	m²	286	1.8	515.1	0.35
Stormwater management solutions	Impermeable surface (calculated automatically)	m²	6168	-	-	1
	Rain garden (biofiltration area) with a broad range of layered vegetation	m²	0	2.8	0.0	0.2
	Intensive green roof / roof garden, depth of substrate 20 - 100 cm	m²	0	2.0	0.0	0.1
	Semi-intensive green roof, depth of substrate 15 - 30 cm	m²	0	1.5	0.0	0.4
	Extensive green roof, depth of substrate 6-8 cm	m²	0	1.4	0.0	0.6
	Infiltration basin or swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	m²	0	2.3	0.0	0.1
	Infiltration pit (underground)	m²	0	1.5	0.0	0.1
	Pond, wetland or water meadow with natural vegetation (permanent water surface at least part of the year; at other times the ground remains moist)	m²	0	2.8	0.0	0.1
	Retention or detention <sup>1)</sup> basin or swale covered with vegetation or aggregates (permeable soil)	m²	0	2.0	0.0	0.2
	Retention or detention <sup>1)</sup> pit, tank or cistern (underground, notice units: volumel)	m³	0	1.4	-	-
Bonus elements, max score 1 per category	Biofiltration basin or swale	m²	0	2.7	0.0	0.15
	Capturing stormwater from impermeable surfaces for use in irrigation or directing it in a controlled manner to permeable vegetated	m²	440	0.7	292.1	0.0
	Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	m²	0	0.8	0.0	0.0
	Shading large tree (25 m² each) on the south or southwest side of the building (especially deciduous trees)	pcs	6	0.9	134.3	0.0
	Shading small tree (15 m² each) on the south or southwest side of the building (especially deciduous trees)	pcs	10	0.9	134.3	0.0
	Fruit trees or berry bushes suitable for cultivation (10 m² each)	pcs	17	1.0	250.9	0.0
	A selection of native species - at least 5 species/100 m²	m²	0	0.9	0.0	0.0
	Tree species native to Helsinki and flowering trees and shrubs - at least 3 species/100 m²	m²	0	0.9	0.0	0.0
	Butterfly meadows or plants with pleasant scent or impressive blooming	m²	480	0.8	393.9	0.0
	Boxes for urban farming/cultivation	m²	11	0.6	7.1	0.0
Permeable surface designated for play or sports (e.g. sand- or gravel-covered playgrounds, sports turf)	m²	125	0.7	88.9	0.0	
Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	m²	120	0.6	73.0	0.0	
More info	Structures supporting natural and/or animal living conditions such as preserved dead wood/stumps or birdboxes (5 m² each)	pcs	2	1.2	11.6	0.0

Figure 4. Adjusting the runoff-coefficients within the marked range (a) only.

### 3 MODIFICATIONS WHICH NEED ADJUSTMENTS TO STRUCTURE AND FORMULAS

#### 3.1. General

This section applies to modifications that require changes in the sheets' structure, e.g. adding/removing cells, rows and columns. This requires ideally a trained Excel expert, who has experience in working with formulas, VBA macros and Excel controls. The following chapters briefly summarise what needs to be adjusted and checked when applying changes to basic objects such as Limitations, Elements and Categories.

#### 3.2. Limitations

Before applying changes, the user is encouraged to become familiarised with the current formulas and control settings. Modifying limitations should only be done within the cells B9:F20 (limitations section, a in Figure 5). Removing or adding rows should happen only along the full extent of columns A to F. Column F contains controls such as radio buttons and drop down lists that might be affected by structural changes and need to be checked afterwards.

After adding/removing rows within the limitations section, cells A43:D47 (response section, b in Figure 5) have to be updated and checked. These contain the reference cells of the radio buttons (column C) and the resulting comments (column D). After modifying the limitations section, those have to be verified to still work properly. Adding new limitations might result in adding new controls, which have to be added/handled within the response section. The existing ones can be taken as examples.

Limitations	No.	Question	Response
Land use	1	Residential	<input type="radio"/>
		Services and Offices	<input type="radio"/>
		Commercial	<input type="radio"/>
		Industrial/logistics	<input checked="" type="radio"/>
Yard type	2	Share of rooftop courtyard over 50 %	<input checked="" type="radio"/> Yes <input type="radio"/> No
Drainage system	3	Can the site be connected to a separate drainage system?	<input type="radio"/> Yes <input checked="" type="radio"/> No
Surrounding region	4	Is there a green corridor comprising a nature reserve/body of water/natural vegetation located within ≤ 50 m of the site?	<input type="radio"/> Yes <input checked="" type="radio"/> No
Soil/groundwater	5	Is impermeable soil/groundwater located on average at least 100 cm below the ground level?	<input type="radio"/> Yes <input checked="" type="radio"/> No
Stormwater management solutions	6	What is the estimated average/effective depth <sup>21</sup> of a detention/retention element <sup>22</sup> ? (Area * Depth = estimated capacity)	0.3
		What is the estimated average/effective depth <sup>21</sup> of a biofiltration element? (Area * Depth = estimated capacity)	0.2
		If it is possible to provide a share of the necessary storm water retention capacity outside the block/lot, how big is the share (%)?	20

Target level	0.9	0.8	0.7	0.5
1 Land use	4			
2 Yard type	1 - Share of rooftop courtyard > 50%, please add a green roof element!			
3 Drainage system	2 - Add at least one stormwater detention system!			
4 Surrounding region	1 - Nature reserve/body of water/natural vegetation located within ≤ 50 m of the site!			
5 Soil/groundwater	2 - Target level reduced due to groundwater level being close to surface!			

Figure 5. Modifying limitations.

Keep in mind that limitation no. 5 (soil/groundwater) influences directly the Target Level in cell H6. If this is changed, also the formula in H6 has to be adjusted.

If the extent of the original limitations section is changed, some of the macros need to be adjusted. Please refer to Chapter 4.

3.3. Elements

3.3.1. Simple modification

Modifying elements on the “Green Factor” sheet can be done within the boundaries of the element section (cells C1:V41, Figure 6). The existing rows can be used for modification, as long as the units are preserved (each row contains formulas depending specifically on the row’s unit defined in column E). The structure of the section should be kept as it is.

Figure 6. Modifying elements.

When modifications are made only by changing existing elements (no rows added, deleted or moved between categories and now rows are left without content) and units are kept as they are, the formulas will continue to work normally without further modification. However, within the element group section (A1:N46) of the sheet “New elements weights” the weightings and comments need to be checked and updated for the modified elements, since they will most likely change. Please refer to Chapter 3.4.1.

3.3.2. Advanced modification

If a modification based on the existing structure within the element section is not possible, any structural changes need to be closely examined concerning their influence on formulas in the same sheet as well as on the sheet “New elements weights”. This should be done only by an experienced Excel user with knowledge about the theoretical background of the Green Factor Tool.

Adding or removing rows in “Green Factor” should be done within columns C to V, since also the normally hidden columns K to V contain necessary formulas (Figure 7). The formulas have to be checked after each modification. The existing formulas can be used as examples when adding elements and adding new rows, respectively.

Important formula-containing columns to check are:

1. **Green Factor, G:** contains references to the corresponding elements (rows) in sheet “New elements weights”
2. **Green Factor, H:** calculates the areas based on the type of element
3. **Green Factor, I:** calculates the weighted areas based on contents of columns F and G
4. **Green Factor, K to V:** contain calculations for estimating the final runoff-coefficient in cell A17



	C	D	E	F	G	H	I	J	
	Element group	Element description	Unit	Area or quantity	Weighting	"TO HIDE" Pinta-ala, m <sup>2</sup>	Weighted area, m <sup>2</sup>	Runoff coefficient C	
2	Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m <sup>2</sup> each)	pcs	4	3.5	100.0	346.7	0.1	
3		Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m <sup>2</sup> each)	pcs	2	3.0	30.0	91.0	0.1	
4		Preserved tree in good condition (1.5–3 m) or a large shrub (3 m <sup>2</sup> each)	pcs	0	2.4	0.0	0.0	0.15	
5		Preserved natural meadow or natural ground vegetation	m <sup>2</sup>	40	2.2	40.0	88.3	0.1	
6		More info	Preserved natural bare rock area (at least partially bare rock surface, not many trees)	m <sup>2</sup>	0	1.9	0.0	0.0	0.7
7	Planted/new vegetation	Large tree species, fully grown > 10 m (25 m <sup>2</sup> each)	pcs	12	2.8	300.0	843.2	0.1	
8		Small tree species, fully grown ≤ 10 m (15 m <sup>2</sup> each)	pcs	15	2.3	225.0	515.5	0.1	
9		Large shrubs (3 m <sup>2</sup> each)	pcs	13	1.7	39.0	66.4	0.1	
10		Other shrubs	m <sup>2</sup>	415	1.4	415.0	588.5	0.15	
11		Perennials	m <sup>2</sup>	0	1.6	0.0	0.0	0.2	
12		Meadow or dry meadow	m <sup>2</sup>	405	1.9	405.0	778.1	0.2	
13		Cultivation plots	m <sup>2</sup>	22	2.0	22.0	44.2	0.3	
14		Lawn	m <sup>2</sup>	1828	1.1	1828.0	2014.0	0.25	
15		Perennial vines (2 m <sup>2</sup> each)	pcs	3	1.3	6.0	7.8	0.15	
16		More info	Green wall, vertical area	m <sup>2</sup>	19	0.9	19.0	17.7	-
17	Pavements	Semipermeable pavements (e.g. grass stones, stone ash)	m <sup>2</sup>	373	1.0	373.0	380.6	0.6	
18		Permeable pavements (e.g. gravel and sand surfaces)	m <sup>2</sup>	286	1.8	286.0	515.1	0.35	
19	More info	Impermeable surface (calculated automatically)	m <sup>2</sup>	6168	-	6168.0	-	1	
20	Stormwater management solutions	Rain garden (biofiltration area) with a broad range of layered vegetation	m <sup>2</sup>	0	2.8	0.0	0.0	0.2	
21		Intensive green roof / roof garden, depth of substrate 20–100 cm	m <sup>2</sup>	0	2.0	0.0	0.0	0.1	
22		Semi-intensive green roof, depth of substrate 15–30 cm	m <sup>2</sup>	0	1.5	0.0	0.0	0.4	
23		Extensive green roof, depth of substrate 6–8 cm	m <sup>2</sup>	0	1.4	0.0	0.0	0.6	
24		Infiltration basin or swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	m <sup>2</sup>	0	2.3	0.0	0.0	0.1	
25		Infiltration pit (underground)	m <sup>2</sup>	0	1.5	0.0	0.0	0.1	
26		Pond, wetland or water meadow with natural vegetation (permanent water surface at least part of the year; at other times the ground remains moist)	m <sup>2</sup>	0	2.8	0.0	0.0	0.1	
27		Retention or detention <sup>3</sup> basin or swale covered with vegetation or aggregates (permeable soil)	m <sup>2</sup>	0	2.0	0.0	0.0	0.2	
28		Retention or detention <sup>3</sup> pit, tank or cistern (underground, <b>notice units: volume!</b> )	m <sup>3</sup>	0	1.4	0.0	-	-	
29		More info	Biofiltration basin or swale	m <sup>2</sup>	0	2.7	0.0	0.0	0.15
30	Bonus elements, max score 1 per category	Capturing stormwater from impermeable surfaces for use in irrigation or directing it in a controlled manner to permeable vegetated	m <sup>2</sup>	440	0.7	440.0	292.1	-	
31		Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	m <sup>2</sup>	0	0.8	0.0	0.0	-	
32		Shading large tree (25 m <sup>2</sup> each) on the south or southwest side of the building (especially deciduous trees)	pcs	6	0.9	150.0	134.3	-	
33		Shading small tree (15 m <sup>2</sup> each) on the south or southwest side of the building (especially deciduous trees)	pcs	10	0.9	150.0	134.3	-	
34		Fruit trees or berry bushes suitable for cultivation (10 m <sup>2</sup> each)	pcs	17	1.0	170.0	250.9	-	
35		A selection of native species – at least 5 species/100 m <sup>2</sup>	m <sup>2</sup>	0	0.9	0.0	0.0	-	
36		Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m <sup>2</sup>	m <sup>2</sup>	0	0.9	0.0	0.0	-	
37		Butterfly meadows or plants with pleasant scent or impressive blooming	m <sup>2</sup>	480	0.8	480.0	393.9	-	
38		Boxes for urban farming/cultivation	m <sup>2</sup>	11	0.6	11.0	7.1	-	
39		Permeable surface designated for play or sports (e.g. sand- or gravel-covered playgrounds, sports turf)	m <sup>2</sup>	125	0.7	125.0	88.9	-	
40		Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	m <sup>2</sup>	120	0.6	120.0	73.0	-	
41		More info	Structures supporting natural and/or animal living conditions such as preserved dead wood/stumps or birdboxes (5 m <sup>2</sup> each)	pcs	2	1.2	11.6	11.6	-

	C	D	E	F	G	H	I	J	
	Element group	Element description	Unit	Area or quantity	Weighting	"TO HIDE" Pinta-ala, m <sup>2</sup>	Weighted area, m <sup>2</sup>	Runoff coefficient C	
2	Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m <sup>2</sup> each)	pcs	4	3.5	100.0	346.7	0.1	
3		Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m <sup>2</sup> each)	pcs	2	3.0	30.0	91.0	0.1	
4		Preserved tree in good condition (1.5–3 m) or a large shrub (3 m <sup>2</sup> each)	pcs	0	2.4	0.0	0.0	0.15	
5		Preserved natural meadow or natural ground vegetation	m <sup>2</sup>	40	2.2	40.0	88.3	0.1	
6		More info	Preserved natural bare rock area (at least partially bare rock surface, not many trees)	m <sup>2</sup>	0	1.9	0.0	0.0	0.7
7	Planted/new vegetation	Large tree species, fully grown > 10 m (25 m <sup>2</sup> each)	pcs	12	2.8	300.0	843.2	0.1	
8		Small tree species, fully grown ≤ 10 m (15 m <sup>2</sup> each)	pcs	15	2.3	225.0	515.5	0.1	
9		Large shrubs (3 m <sup>2</sup> each)	pcs	13	1.7	39.0	66.4	0.1	
10		Other shrubs	m <sup>2</sup>	415	1.4	415.0	588.5	0.15	
11		Perennials	m <sup>2</sup>	0	1.6	0.0	0.0	0.2	
12		Meadow or dry meadow	m <sup>2</sup>	405	1.9	405.0	778.1	0.2	
13		Cultivation plots	m <sup>2</sup>	22	2.0	22.0	44.2	0.3	
14		Lawn	m <sup>2</sup>	1828	1.1	1828.0	2014.0	0.25	
15		Perennial vines (2 m <sup>2</sup> each)	pcs	3	1.3	6.0	7.8	0.15	
16		More info	Green wall, vertical area	m <sup>2</sup>	19	0.9	19.0	17.7	-
17	Pavements	Semipermeable pavements (e.g. grass stones, stone ash)	m <sup>2</sup>	373	1.0	373.0	380.6	0.6	
18		Permeable pavements (e.g. gravel and sand surfaces)	m <sup>2</sup>	286	1.8	286.0	515.1	0.35	
19	More info	Impermeable surface (calculated automatically)	m <sup>2</sup>	6168	-	6168.0	-	1	
20	Stormwater management solutions	Rain garden (biofiltration area) with a broad range of layered vegetation	m <sup>2</sup>	0	2.8	0.0	0.0	0.2	
21		Intensive green roof / roof garden, depth of substrate 20–100 cm	m <sup>2</sup>	0	2.0	0.0	0.0	0.1	
22		Semi-intensive green roof, depth of substrate 15–30 cm	m <sup>2</sup>	0	1.5	0.0	0.0	0.4	
23		Extensive green roof, depth of substrate 6–8 cm	m <sup>2</sup>	0	1.4	0.0	0.0	0.6	
24		Infiltration basin or swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	m <sup>2</sup>	0	2.3	0.0	0.0	0.1	
25		Infiltration pit (underground)	m <sup>2</sup>	0	1.5	0.0	0.0	0.1	
26		Pond, wetland or water meadow with natural vegetation (permanent water surface at least part of the year; at other times the ground remains moist)	m <sup>2</sup>	0	2.8	0.0	0.0	0.1	
27		Retention or detention <sup>3</sup> basin or swale covered with vegetation or aggregates (permeable soil)	m <sup>2</sup>	0	2.0	0.0	0.0	0.2	
28		Retention or detention <sup>3</sup> pit, tank or cistern (underground, <b>notice units: volume!</b> )	m <sup>3</sup>	0	1.4	0.0	-	-	
29		More info	Biofiltration basin or swale	m <sup>2</sup>	0	2.7	0.0	0.0	0.15
30	Bonus elements, max score 1 per category	Capturing stormwater from impermeable surfaces for use in irrigation or directing it in a controlled manner to permeable vegetated	m <sup>2</sup>	440	0.7	440.0	292.1	-	
31		Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	m <sup>2</sup>	0	0.8	0.0	0.0	-	
32		Shading large tree (25 m <sup>2</sup> each) on the south or southwest side of the building (especially deciduous trees)	pcs	6	0.9	150.0	134.3	-	
33		Shading small tree (15 m <sup>2</sup> each) on the south or southwest side of the building (especially deciduous trees)	pcs	10	0.9	150.0	134.3	-	
34		Fruit trees or berry bushes suitable for cultivation (10 m <sup>2</sup> each)	pcs	17	1.0	170.0	250.9	-	
35		A selection of native species – at least 5 species/100 m <sup>2</sup>	m <sup>2</sup>	0	0.9	0.0	0.0	-	
36		Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m <sup>2</sup>	m <sup>2</sup>	0	0.9	0.0	0.0	-	
37		Butterfly meadows or plants with pleasant scent or impressive blooming	m <sup>2</sup>	480	0.8	480.0	393.9	-	
38		Boxes for urban farming/cultivation	m <sup>2</sup>	11	0.6	11.0	7.1	-	
39		Permeable surface designated for play or sports (e.g. sand- or gravel-covered playgrounds, sports turf)	m <sup>2</sup>	125	0.7	125.0	88.9	-	
40		Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	m <sup>2</sup>	120	0.6	120.0	73.0	-	
41		More info	Structures supporting natural and/or animal living conditions such as preserved dead wood/stumps or birdboxes (5 m <sup>2</sup> each)	pcs	2	1.2	11.6	11.6	-

Figure 7. The two parts of the element section: main table with columns C–J (top) and additional calculations within columns K–V (bottom).

When elements are added/removed in sheet “Green Factor”, also sheet “New elements weights” needs to be updated. A list of important formulas that need checking are listed in Chapter 3.4.2. If the extent of the original element section is changed, some of the macros need to be adjusted. Please refer to Chapter 4.

## 3.4. Categories

### 3.4.1. Simple modification

Modifying categories in sheet “New elements weights” can be done within the boundaries of the element group section (A1:N46). The existing rows and columns can be used for modification, as long as element- and category-specific weightings are updated correspondingly. The structure of the section should then be kept as it is.

When modifications are made only by changing existing elements (no columns added or deleted and no columns left without content), the formulas will continue to work normally without further modification. However, if categories are changed, their overall weightings most likely need to be adjusted. This can be done by modifying the contents within the global weightings section (AX2:AZ11, Figure 2), and the weightings in range AY2:AY11 in particular (a in Figure 2, note that some of cells are merged). Also, the weightings and comments within the element group section (A1:N46) should be revised.

### 3.4.2. Advanced modification

If categories need to be added or removed, this means a structural change of the sheet (adding/deleting columns within the element group section) and requires adjustments to the formulas. The same applies, if elements have been added, removed or shifted.

The “New elements weights” sheet consists of two different sections: the element group section and results calculation section within cell range AJ1:BF46 (Figure 8). Structural changes usually affect both sections and both of their contents need to be revised.

Important formula-containing columns to check are:

5. **“New elements weights”, D, F, H, J, L:** contain the element-specific weightings for each category
6. **“New elements weights”, M:** contains element-specific average weightings (note that in the current version this is not the arithmetic average)
7. **“New elements weights”, O:** contains alternative element-specific average weightings based on building the arithmetic average for each element, that can be used as a replacement for the formulas in column M
8. **“New elements weights”, AJ to AV:** contain element-specific calculation of the shares concerning the overall categories. Note: these need to be particularly cross-checked, when adding/removing categories (columns AO and AV should always sum up to 100% or remain stay zero when the element is not in use)
9. **“New elements weights”, BF:** contains calculation of the amount of used elements

Additionally, the “Green Factor” sheet needs to be adjusted to match the new categories. Please refer to Section 3.3.2 for advanced modification on this sheet.



# Score card

Date 17.11.2017

Block ID  
Lot ID

XYZ  
ABC

## Green Factor calculation

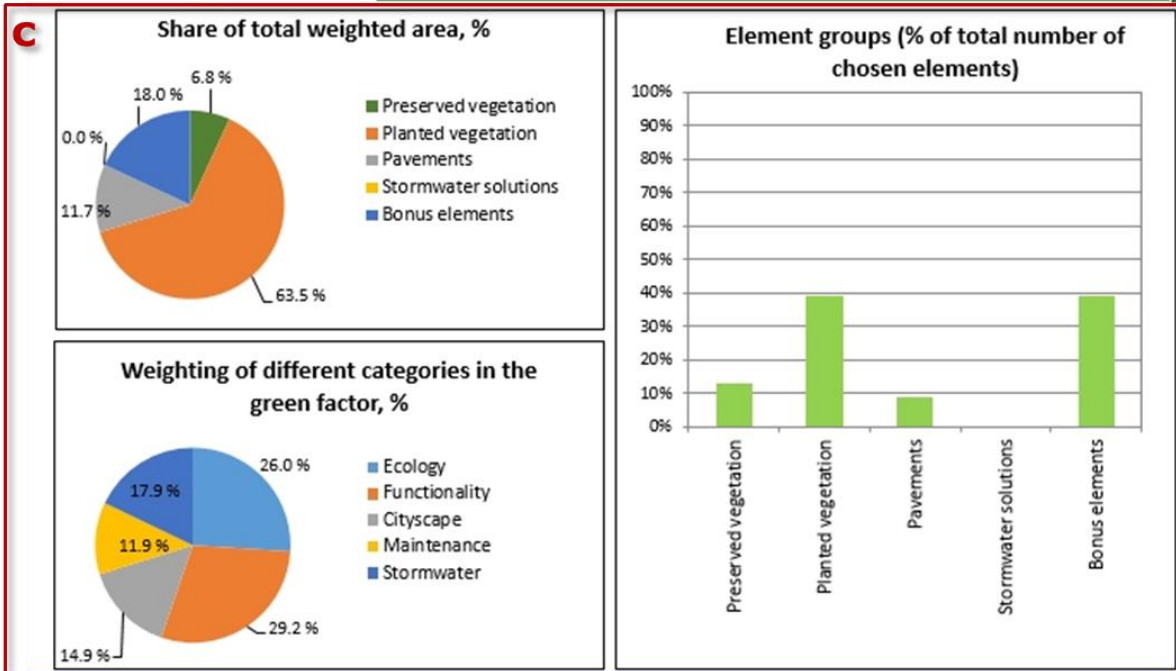
<b>Green Factor is below target level!</b>	<b>0.81</b>
Target level	0.90
<b>Stormwater volume m<sup>3</sup></b>	
66.7	
Average runoff coefficient C	Possibility to retain stormwater outside block/lot
0.7	Yes
Necessary retention vol. m <sup>3</sup> on the	
53.4	
Retention volume of chosen elements m <sup>3</sup>	Remaining retention demand m <sup>3</sup>
0.0	53.4
Share of total impermeable surface	
65 %	

## Elements included in the green factor

Element group	Elements filled	Total number of elements in group
Preserved vegetation	3	5
Planted vegetation	9	10
Pavements	2	2
Stormwater solutions	no elements!	9
Bonus elements	9	12
<b>Total</b>	<b>23</b>	<b>38</b>

### Comments

- Share of rooftop courtyard > 50%, please add a green roof element!
- Add at least one stormwater detention system!
- Nature reserve/body of water/natural vegetation located within ≤ 50 m of the site!



**Figure 9.** The two parts of the “New elements weights” sheet: element group section (top) and results calculation section (bottom).

Size and design of the sheet are roughly scaled for an A4 printout, which should be kept in mind when adjusting extent and font sizes.

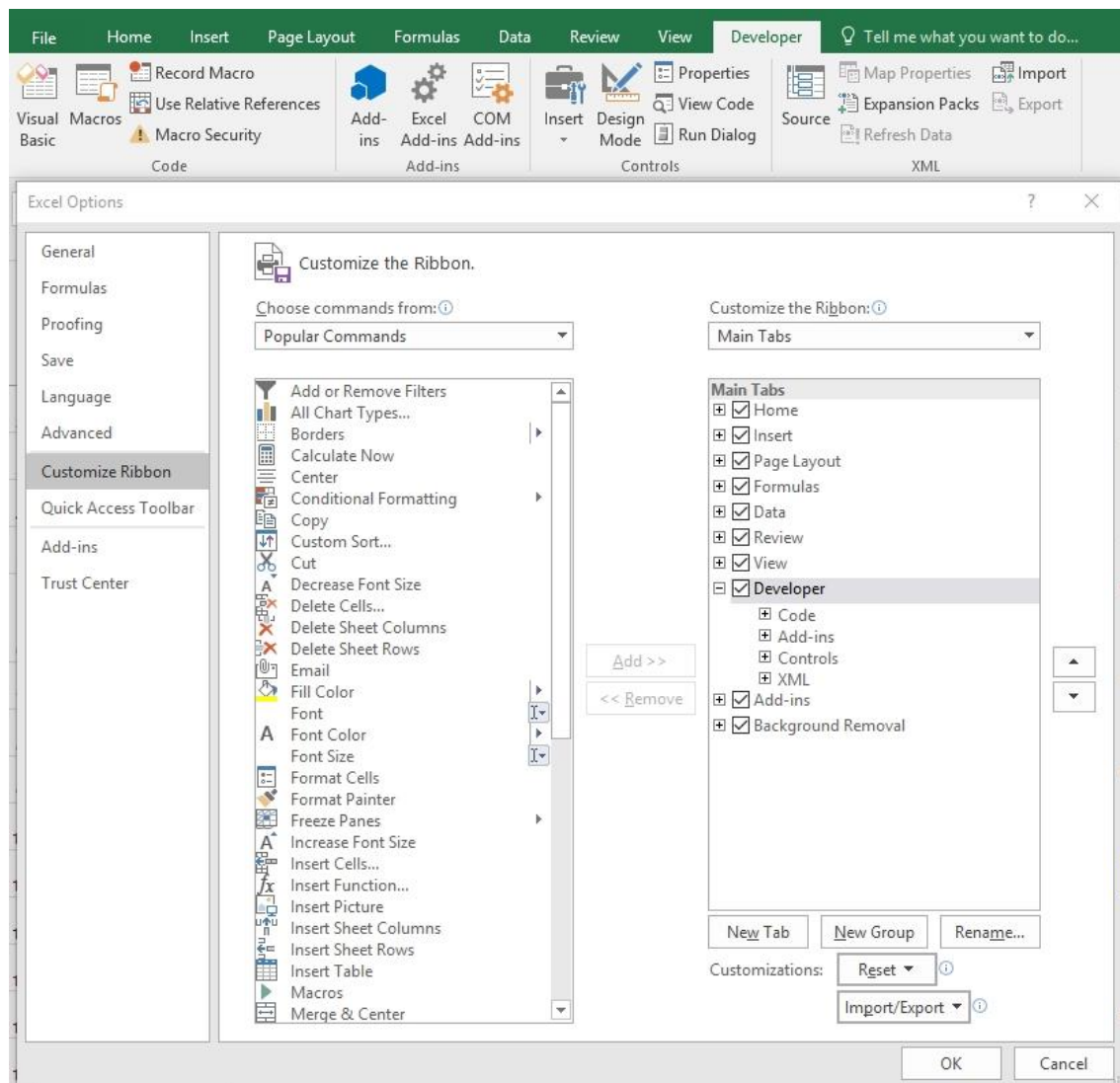
## 4 MODIFYING MACROS

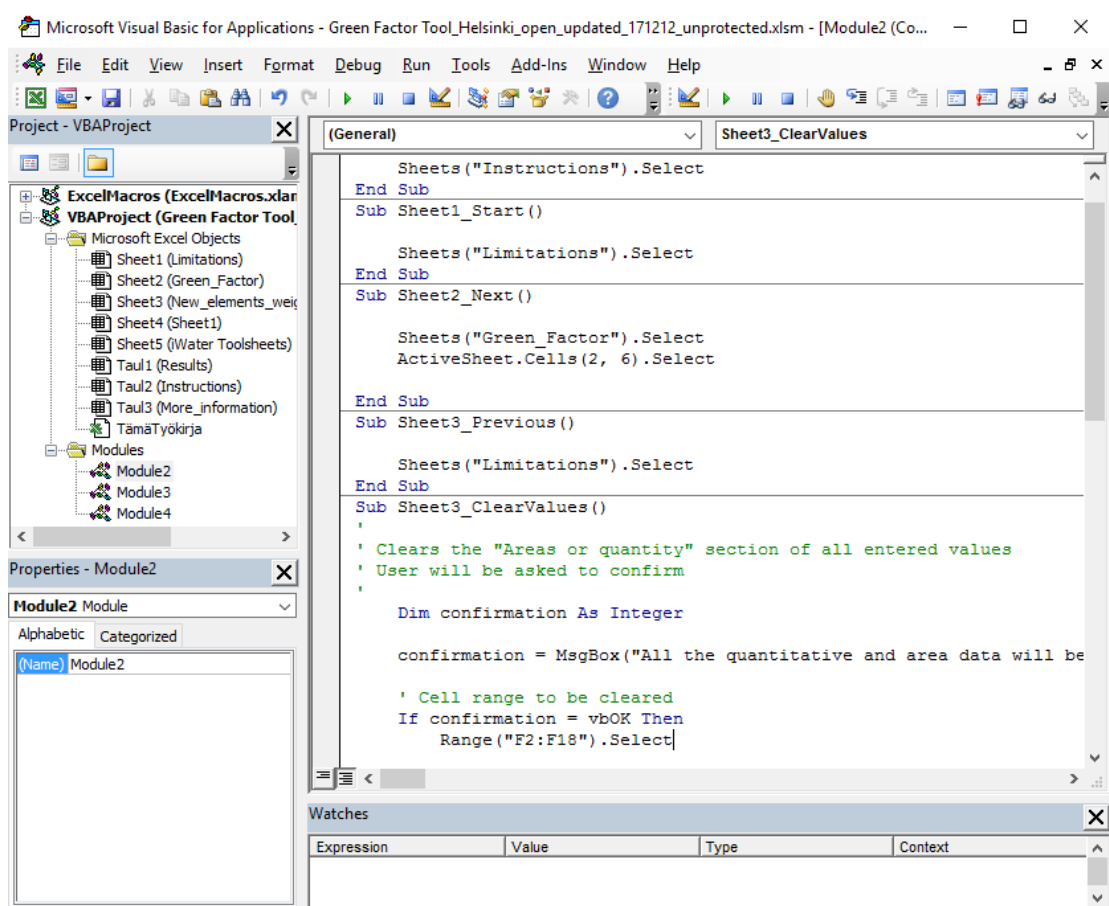
### 4.1. General

To modify macros, the “Developer” tab in Excel’s Ribbon bar needs to be activated. Open the Visual Basic for Applications window and check the “Modules” folder for “Module2”, “Module3” and “Module4” containing all the tool’s custom macros (Figure 10). To apply changes the user requires good knowledge about using VBA within Excel.

If adjustment is necessary, it is recommended not to use any country-specific letters/vowels (like the Finnish ö or ä), since this will likely cause problems in systems with different language settings.

For adjustments, it is recommended to open a version of the original Excel tool at the same time and to compare the original and modified structure.





**Figure 10.** Activating the Developer Toolbar in Excel (top), Visual Basic for Applications (VBA) window showing the sheets and modules included in the tool (bottom).

## 4.2. Renaming sheets

If sheets are renamed, the corresponding names have to be updated in all macros. This can be done quickly and easily with the built-in Replace feature from the Edit Menu of the VBA window.

## 4.3. Structural changes to selected sheets

### 4.3.1. Limitations sheet

The macro “Sheet3\_Next” in “Module2” contains a reference to the share of rooftop area on the lot. In case of structural changes within the sheet, it needs to be checked, if the reference for the variable “kansipiha” (rooftop area) is still pointing to the correct cell.

### 4.3.2. Green Factor sheet

The macro “Sheet3\_ClearValues” in “Module2” contains a reference to two different cell ranges that will be cleared. If the structure of the elements section has changed, these ranges need to be adjusted to match the new updated range(s).

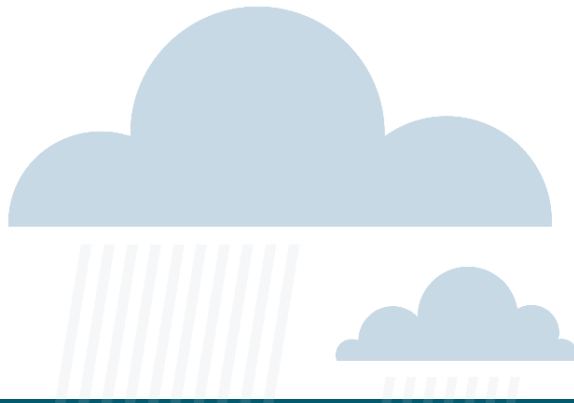
The macro “Sheet3\_Next” in “Module2” contains references to several cells for calculating sums of green roof area (“viherkatto\_m2”) and storage volume (“sailio\_m2”) as well as the amount of existing or planted trees (“puita”). If the structure of the elements section has changed, these cell references need to be adjusted.

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Executor of the Helsinki Green Area Factor Excel-based tool:

FCG DESIGN AND ENGINEERING LTD  
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 Landscape architect, MARK

**Eric Wehner**  
 Special planning engineer, DI



## **This manual was developed within the iWater - Integrated Storm Water Management project (2015–2018).**

iWater aims at improving the urban planning in the cities of the Baltic Sea Region through development of integrated storm water management system. Project provides new approaches and tools for urban planning – for greener, safer, more sustainable and attractive cities.

For more details please visit project website at [www.integratedstormwater.eu](http://www.integratedstormwater.eu)

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