DEVELOPING THE CITY OF HELSINKI GREEN FACTOR METHOD

Report summary

English summary of the original report in Finnish Viherkerroinmenetelmän kehittäminen Helsingin kaupungille by Elina Inkiläinen (EPECC), Topi Tiihonen (EPECC) and Eeva Eitsi (FCG)

City of Helsinki Environment Centre
Helsinki 2016

This report summary in English has been produced for the project iWater – Integrated Storm Water Management, with support from the Interreg Central Balitc programme.

The original report, 'Viherkerroinmenetelmän kehittäminen Helsingin kaupungille, Oy Eero Paloheimo Ecocity Ltd, 2013', compiled in the Climate-Proof City – Tools for Planning (ILKKA) project is only available in Finnish. The ILKKA project was partly funded by the EU Regional Development Fund for the purpose of promoting climate-proof urban planning and creating tools and guidance for city planners that enable them to take climate change into account in their work.

Helsinki 2016

Interreg Central Baltic

European Union
European Regional Development Fund

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Climate-proof **city**

Summary

The prevailing report summary describes the development phases of the City of Helsinki green factor method and presents the method in more detail.

The goal of the green factor approach is to mitigate the effects of construction by maintaining a sufficient level of green infrastructure while enhancing the quality of the remaining vegetation. The significance of green surfaces in the adaptation to climate change is highlighted as the city structure becomes denser. The green factor method improves the city's prerequisites for adapting to climate change by promoting the green efficiency of the vegetation on the plots and the conservation of sufficient green structure. Vegetation mitigates the risk of flooding, reserves carbon dioxide, cools down the heat islands of built environments and increases the pleasantness and beneficial health-effects of the urban spaces.

In the green factor method, the planner sets a green factor target level for the plot that can be achieved flexibly by the garden designer using various green elements when designing the garden. The method developed for the City of Helsinki provides 43 different green elements relating to planted and maintained vegetation, various run-off water solutions and permeable surfaces, etc. The green factor is calculated as the ratio of the scored green area to lot area.

$$\text{Green factor} = \frac{\text{scored green area}}{\text{lot area}}$$

The green factor method has been developed to support the land use planning process, and it is intended particularly for city planners, landscape architects and garden designers. The green factor can, for example, be included in the zoning regulations or used for granting concessions during a construction permit application process. Similar green factor methods have been used with success in, among others, the cities of Berlin, Malmö, Seattle and Toronto, as an important tool for maintaining and increasing the ecological and social advantages of green structures.

The specific phases of developing the Helsinki Green Factor included:

1. A comprehensive literature review on relevant topics; interviews and surveys for experts and developers of previous green factor methods
2. Establishing the list of green factor elements commonly used in urban planning to be included in the tool; calculating weighted scores for each element based on its importance to ecology, functionality, landscape, and maintenance
3. Developing a land use classification for identifying the correct levels of target and minimum green factor scores; setting specific targets and minimum (required) levels for each land use class while factoring in regional and lot-specific attributes
4. Creating the Green Factor Tool, a user-friendly Excel interface guiding the user through the green factor calculation
5. Creating illustrative visualizations of specific green factor levels for the Kuninkaantammi pilot area

6. Testing the method in the Kuninkaantammi and Jätkäsaari pilot areas (residential blocks); an interactive workshop for testing the Green Factor Tool

The developed green factor method provides an excellent opportunity to improve the city's urban planning practices in the desired direction because it literally provides a means to "*assess and develop alternative ways to build an ecological, climate-proof and dense city in which the social values of urban green areas are a priority*[1]". This new method differs from previous green factor methods in that its development has involved more extensive background studies, and expert opinions have been obtained from a range of disciplines. Determining the pilot sites at the beginning of the project has meant that the focus of testing the method has been on residential blocks, which means that in order to finalise the method, extensive testing is still required in areas dedicated to trade, offices or business, services and industrial operations.

Contents

1 INTRODUCTION AND THE OBJECTIVES

This report describes the development process of the City of Helsinki Green Factor method. The objective of the method was to develop a *practical* tool for use by city planners that is based on *research data*, takes into account *local characteristics* and does not discriminate against low-budget projects by favouring expensive ecological solutions. C*ase studies, stakeholder events* and *surveys* were used to ensure the functionality of the method. The method has been developed on the basis of existing green factor scoring methods while taking into account the climatic, ecological and legislative features specific to Finland and the wishes of those responsible for land-use planning.

The specific objectives were:

1. A site-specific **green factor method** for valuing the benefits of green surfaces and elements from the viewpoint of stormwater management and other ecosystem services.
2. **Classification** based on land use and regional and site-specific attributes.
3. Appropriate **target and minimum levels** for the land use classes, intended for attaining the regional stormwater targets and maintaining the ecosystem services as part of the green infrastructure.

The steering group for the development of the green factor method comprised experts on climate change adaptation, urban ecology, urban planning, garden design, building control, landscaping, stormwater management, development and community planning.

The development of the Helsinki Green Factor was part of the project Climate-Proof City – Tools for Planning (ILKKA) with the goal of creating planning tools and best adaptation practices for urban planners and the construction and landscape industry regarding climate-proof urban planning. The ILKKA project was coordinated by the City of Helsinki, implemented during 2012-2014 and partly funded by the EU Regional Development Fund. The Helsinki Green Factor method was developed by Eero Paloheimo Ecocity Ltd (EPECC) and the Finnish Consulting Group (FCG).

2 REVIEW OF THE BASELINE DATA

2.1 Literature review

2.1.1 Ecological and social benefits of the green factor

The significance of green surfaces for various ecosystem services is emphasised as cities become more densely built. Surfaces covered by vegetation mitigate the flooding risk, sequester carbon dioxide[2], cool down "urban heat islands"[3] and increase the aesthetics, pleasantness and health effects of urban spaces[4]. The findings of several studies have also shown that urban green areas have a direct impact on lot prices[5,6].

The green factor is an ecological planning tool which, at its best, also showcases the city's identity, community spirit and landscape values. The green factor method can be applied in any given area to emphasise solutions that help preserve site-specific attributes or mitigate adverse effects.

2.1.2 Green structures in stormwater management

One of the objectives is to prepare for the increasing risk of flooding caused by climate change. With regards to lots, the green factor can be used to promote stormwater management and the prevention of floods with due consideration of national and city-level stormwater management guidelines and regulations. In Finland, the conditions concerning stormwater solutions are issued in the Water Services Act and other acts on land use, in the building regulations and in various guidelines (building guidance or transfer of ownership of land documents).

Thanks to the requirements of the EU Water Framework Directive and the Floods Directive, various stormwater management strategies and programmes, along with water management plans, have already become everyday practices in major cities. Certain general principles for stormwater management are on their way to becoming standardised, and should be prioritised in the planning of stormwater management solutions.[7]

These general principles include:

- Stormwater prevention
- Stormwater reduction, i.e., on-location treatment and utilisation
- Routing stormwater with a filtering and moderating system
- Routing stormwater to moderation and retention zones (e.g., wetlands) in public areas
- Routing stormwater to water discharges or away from the area

The key principle in site- and property-specific stormwater management should be to prevent the increase of stormwater runoff in new lots compared to their pre-construction levels. In addition to controlling stormwater runoff, the focus should be on minimising the nutrient and solid loads within lots and on the maintenance of the meeting points of lots and swales. Various incentives should be used to encourage residents to reduce the stormwater loads of their lots by setting target levels for various criteria concerning stormwater infiltration and purification.

2.1.3 Review of previous green factor methods

Berlin's green factor ("*Biotope Area Factor*", BAF)[8] expresses the ratio of the ecologically effective surface area to the total land area. Different types of surfaces are weighted according to their beneficial impact on stormwater, meaning that the same target green factor score can be obtained through very different plans. The different types of green surfaces are weighted based on, for example, their evaporative and retentive capacity, stability, connection to soil, and proportion of different habitats. The BAF has many similarities with the green factors of Malmö and Seattle (described below), which are in fact partially based on the BAF.

Malmö's green factor ("*grönytefaktor*", GYF)[9] is a calculation method based on the BAF, updated to make it applicable in the conditions of Southern Sweden. The City of Stockholm has since developed its own version with more ambitious targets for use in the pilot site of **Royal Seaport**, which is known as an ecological residential area. Stockholm's green factor is intended to take more comprehensively into account the climate impact, landscape ecology, diversity and social values of lots, which is why the method comprises more than 50 elements that affect the green factor score[10].

The **Seattle Green Factor**[11] scores the lot's vegetation and structures according to their capacity to trap and purify stormwater, for example, and achieving the minimum green factor score set by the city is now a landscape requirement for new construction projects implemented in certain areas. In Seattle, exceeding the minimum targets set for land use classification makes it possible to negotiate on the permitted building volume for the lot so that more area per floor can be built on a private lot (commercial or residential) if the amount of green surfaces in the area increases accordingly.

The objective of the **Toronto Green Standard**[12], which is based on the previous methods, is to make both the building and the surrounding lot eco-efficient. The standard has two tiers; Tier 1 is a requirement for all new construction projects, while persons who attain the voluntary Tier 2 in their lot may be eligible for a refund on their development costs based on, for example, the energy savings generated by their eco-efficiency improvement measures. A similar green factor is also in use in another city in Canada, Vancouver[13].

All the reviewed green factors use the same calculation principle: the green factor expresses the ratio of the weighted green area to the total area of the lot. However, the green elements, surfaces and structures included in the methods vary significantly, as do their weighted scores. Each of the methods described above were found to lack theoretical content.

The best practices and principles of the green factor methods were utilised in developing the Helsinki Green Factor by taking into account in the best possible manner Finland’s climate conditions, geographic characteristics, local planning conditions, and all the good and functional values and perceptions of what constitutes an urban environment. **Table 1** is a brief description of the strengths, weaknesses and future development trends that came up in the discussions with the developers of the previous green factors.

TABLE 1: ISSUES THAT CAME UP IN THE INTERVIEWS WITH THE DEVELOPERS OF PREVIOUS GREEN FACTOR METHODS

GREEN FACTOR	STRENGTHS	CHALLENGES
Berlin's green factor ("Biotope Area factor", BAF) •First ever green factor, developed in the 1980s •The ratio of the ecologically effective surface area to the total land area.	•Model for other green factors •Legally binding • Regulation has been found to be a more effective method than financial incentives	•Applied to special sites, e.g., lots with historical value (green roofs, green walls, etc.) •Costs — how is the ratio of the costs to the size of the lot calculated? Fairness?
Malmö's green factor ("grönytefaktor", GYF) •Based on BAF •Updated for the conditions of Southern Sweden	•Similar in terms of climate and species	•Too "easy" to meet the minimum requirements • Insufficient weighing of large trees/original vegetation
Housing Fair in Jyväskylä in 2014: Green efficiency •Plans for piloting in Jyväskylä in the 2014 Housing Fair area. •Allows tailor-made weighting based on local special features.	• Weighting factors based on local special features (e.g., extra points for the use of natural vegetation near important nature sites) •Idea from a monitoring study.	•The method is perhaps too fleixible/ambiguous if the weighting factors and criteria can be modified according to need.
Stockholm's green factor for Royal Seaport ("grönytefaktor", GYF) •A more ambitious version of Malmö's green factor •Also takes into account the lot's climate impact, landscape ecology, diversity and social values.	•Closest to Finland in terms of climate and species •Attention paid to, e.g., forms of climate impact.	• Perhaps even too comprehensive – spreadsheet includes more than 50 elements
Seattle Green Factor •Reaching the minimum green factor score is required in each new construction project in certain parts of Seattle •Exceeding the minimum score enables negotiations on extending the building rights for the lot.	•Application in environmental policy-making •Legally binding in certain areas	•Minimum score somewhat low – easy to reach
Toronto Green Standard (TGS) •Minimum level (Tier 1 required) •Exceeding the minimum level (voluntary Tier 2) may mean that the resident is eligible for a partial refund on development charges based on, e.g., the energy savings generated by eco-efficiency improvement measures.	•Aims for eco-efficiency in both the building and the surrounding lot. •Application in environmental policy-making •Legally binding.	•What can be required? •How to minimise the extra work arising from deployment? •Some of the elements are difficult to measure.

2.2 Survey to experts

The project included sending a survey to experts (Appendix 1), which was aimed at identifying the above issues that needed to be taken into account in the development of the Helsinki Green Factor. The survey was sent to parties selected by the green factor development steering group:

1. City planners and building control (**5**)
2. Maintenance and developers (**9**)
3. Landscape architects, garden designers, plant experts and ecologists (**9**)

The experts were sent a brief introduction of the green factor method and its background, and a survey package comprising a general questionnaire (10 questions). The responses were used to collect data on the usability of the green factor tool, the land-use classification and the weighted scores in particular. The respondents hoped that the tool will be clear and easy to use, which was taken into account as much as possible in the development of the method and during the testing phase. According to the respondents, the key ecosystem services are the capture and treatment of stormwater, the aesthetics of the cityscape and microclimate regulation (visual screen, noise barrier and protection against the wind). The respondents noted that the order of importance of the ecosystem services also depends on the land-use classification. For example, the role of stormwater is emphasised in a dense structure, whereas in less densely populated residential areas, social factors are highlighted more, such as microclimate regulation and the opportunity to engage in urban farming.

3 DEVELOPING THE CITY OF HELSINKI GREEN FACTOR

The development of the Helsinki Green Factor included the following phases: 1. defining ecology, functionality, cityscape and maintenance as the main green factor categories; 2. selecting the elements and determining their weighted scores; 3. developing a land use classification system; 4. setting the target and minimum levels and 5. creating the Green Factor Tool. The key terms used in this project are defined in **Table 2**.

TABLE 2: KEY TERMS

Term	Definition
Element	A weighted variable used in the green factor scoring process (e.g., a tree, lawn, green roof, permeable pavement or rain garden)
Criterion/definition	A requirement set for an element (e.g., the height of a preserved tree at the time of construction and when fully grown; the depth of the growing medium required by perennials)
Weighted score	A weighting factor determined for an element, used to multiply the area or quantity of the element
Class	Classification based on land use or regional/site-specific attributes
Target level	The green factor score that is recommended to attain based on a specific land-use class
Minimum level	The lowest green factor score that is required to attain in a specific land-use class

3.1 Green factor scoring categories

3.1.1 Ecology

Ecology refers to stormwater capture and treatment, carbon sequestration and storage, the diversity of species and habitats and the stability of the ecological network.

The ecological benefits of preserved vegetation are undeniable; the preservation of mature, original vegetation during construction creates continuity for all the species that rely on the vegetation to serve as their habitats[14,15] and passageways between green areas[16]. For the purpose of maximising the ecological benefits of preserved trees, groups of trees are better than individual trees.

From the viewpoint of diversity, other important characteristics of the forest ecosystem include the coverage and layers of the tree canopy, the species, size and height of the trees, and the undergrowth[17]. Natural bare rock areas (not many trees, at least partially bare rock surface[18]) are also regarded as highly important habitats[19], in addition to which they have considerable landscape value. This makes it important to preserve bare rock areas in connection with construction activities. Because rock vegetation is highly sensitive to wear and tear, the ecological significance of bare rock surfaces within urban areas is not as high as their significance for functionality and the cityscape.

Rainfall in Finland is expected to increase towards the end of the century by 10–40% in winter and 0–20% in summer (compared to the reference period 1971–2000)[20]. Preserved vegetation can help maintain the natural water conditions of a given area through transpiration and rainfall interception[21]. On average, evergreen coniferous trees have more significance for stormwater management than deciduous trees, because they do not shed their leaves during wintertime and their leaf area index is naturally higher[22]. The root systems of trees also increase soil porosity and the infiltration of water into the soil[23].

3.1.2 Functionality

One of the key objectives of developing the green factor method is to create green urban environments that have social value[24]. Also according to the survey of experts, functionality was the second most important and cityscape (or landscape value) was the third most important category in green factor scoring. The benefits of vegetation related to functionality especially stemming from the pleasantness of the environment (microclimate), recreational use and learning from nature. Vegetation reduces windiness, the sun's glare, air pollution[25] and noise annoyance both directly[26] and indirectly by acting as a visual screen between the lot and the noise source.

In the final decades of this century, the annual average temperature is predicted to be 2–6 ºC higher than in the reference period 1971–2000[27]; the temperature is expected to rise especially in the wintertime, but also the world's temperature extremes are predicted to increase. The shading and cooling effect of vegetation may also reduce the amount of energy needed to cool buildings and the emissions arising from cooling.

Vegetation also has a considerable significance for learning from nature in areas surrounding schools, for example; among other forms of impact, nature excursions have been observed to increase the environmental responsibility of children[28]. In residential areas and other densely populated areas, functionality may be in conflict with ecology.

3.1.3 Cityscape

Cityscape refers to the significance of vegetation for the visual and/or aesthetic qualities of the city (i.e., landscape value). It covers the spatial impact on the cityscape (stability, size) and the perceived visual qualities of the element types (e.g. colour, shape, seasonal variation). Some species-specific recommendations are presented in the urban plant guide of the City of Helsinki Public Works Department of the concerning which plants should be used in city parks (e.g. recommendation to add certain deciduous trees to Helsinki's cityscape[29]). However, there is no comprehensive study on the landscape value of various vegetation types in relation to each other that could be used to justify the weighted scores. Especially determining the latter is very challenging, on account of its subjectivity. Therefore, the expertise of the steering group has played a huge role in assessing this category. For example, preserved bare rock areas were deemed as a highly significant element by the steering group; their preservation can be used to highlight local characteristics of landscape value in Helsinki's cityscape.

3.1.4 Maintenance

Maintenance refers to the estimated frequency of the maintenance need of each element after the creation phase. In other words, maintenance does not refer to the duration or cost of individual maintenance measures (e.g., the cleaning of stormwater structures or mowing a meadow). It also does not include measures required by the planting or construction phases (cf. installation of a green roof), some of which can be of significance.

3.2 Selecting and defining the elements

3.2.1 Selection and definition criteria

A list of elements to be incorporated into the green factor was drawn up on the basis of previous green factor methods, including ways of building a green and ecological city – both existing ones already used in planning and new ones for meeting future needs. Certain elements that were deemed unnecessary were removed from the list and others added to it on the basis of the steering group's feedback. The goal was to develop a comprehensive yet concise set of elements that meet the planning needs. At the same time, the goal was to keep the method clear and easy to use by selecting definitions that are commonly used in planning (e.g., "small tree" vs. "large tree") and growing medium depths appropriate to each vegetation type.

If the element's area is difficult to define (e.g., the vertical area of a vine; the area of a planted tree's crown after a certain time period) or if the physical area does not match the element's significance, for example, as a habitat (e.g., a bird box; preserved dead wood), the area to be used in the green factor scoring has been separately defined for the element (e.g., 2 m² each for bird boxes and 5 m² each for preserved deadwood).

3.2.2 Element types

There are two types of elements: the “actual elements” (preserved, planted/new, pavements and stormwater solutions), for which higher points are awarded, and “bonus elements” for gaining extra points. There are 25 actual elements and 18 bonus elements; in total, there are 43 green factor elements utilised in planning.

3.2.2.1 Preserved vegetation and soil

The preserved elements include the following five vegetation or soil types:

1. Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m² each)
2. Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m² each)
3. Preserved tree in good condition (1.5–3 m) or a large shrub (3 m² each)
4. Preserved natural meadow or natural ground vegetation
5. Preserved natural bare rock area (at least partially bare rock surface, not many trees)

The factors that determine whether preservation is meaningful and realistic or not include the condition of the vegetation, the size and type of the developed lot, and the timeline and resources of the construction project. In small lots, tree preservation is often impossible due to the risk of damaging the roots and/or the trunk. In bigger lots, it is also necessary for tree preservation purposes to make plans for felling and the driving routes and placement of work machines, to protect the trunks and roots, to avoid changing the soil and water conditions within the lot, etc. New vegetation must be planted to replace plants or undergrowth that have died or are in poor condition. On the other hand, the points scored for preserved vegetation reduce the need for planted vegetation, meaning that the efforts made to preserve vegetation and soil are compensated for by smaller planting and maintenance costs.

3.2.2.2 Planted/new vegetation

For the green factor method, planted or new vegetation types have been classified into 12 elements utilised in planning:

1. Large tree species, fully grown > 10 m (25 m² each)
2. Small tree species, fully grown ≤ 10 m (15 m² each)
3. Large shrubs (3 m² each)
4. Other shrubs
5. Perennials
6. Meadow or dry meadow
7. Cultivation plots
8. Lawn
9. Green roofs (> 0.3 m)
10. Green roofs (0.05 – 0.3 m)
11. Perennial vines (2 m² each)
12. Green wall, vertical area

3.2.2.3 Pavements

Two identified pavement types were included in the green factor:

1. Semipermeable pavements (e.g. grass stones)
2. Permeable pavements (e.g. gravel and sand surfaces, stone ash)

The selected pavement types enable the infiltration of stormwater into the soil. Impermeable pavements, such as asphalt, were not incorporated into the green factor.

3.2.2.4 Stormwater solutions

Stormwater management structures were classified into five different types according to their functionality and implementation method:

1. Rain garden (biofiltration area, no permanent pool of water) with a broad range of layered vegetation
2. Infiltration swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)
3. Infiltration pit (underground)
4. Wetland or water meadow with natural vegetation (permanent water surface at least part of the year; at other times the ground remains moist)
5. Retention swale covered with vegetation or aggregates (no permanent water surface, permeable soil)
6. Retention pit or tank (underground)

A stormwater solution designed for a specific lot and implemented by using vegetation may be defined as a rain garden, an infiltration or retention swale, or a wetland. The purpose of rain gardens and wetlands is to purify and slow down stormwater runoff, and letting the stormwater infiltrate into the soil. However, contrary to wetlands, the vegetation of a rain garden does not have to be natural. This gives the designer an opportunity to select the vegetation to be planted and the materials to be used (e.g., rocks) on the basis of their landscape value and from the perspective of pleasantness. With respect to diversity, this may still be less beneficial compared to a wetland comprising natural vegetation, the requirements of which also include having a permanent pool of water at least part of the year.

The abovementioned stormwater solutions differ from infiltration and retention swales in that they have more abundant vegetation, because swales can also be covered with lawn, which has much less ecological significance compared to larger, more diverse vegetation.

Underground infiltration and retention pits and tanks were also factored in although, as such, they do not make the lot any greener. Underground structures do, however, provide a way to manage stormwater problems and free up space for other functions above ground.

3.2.2.5 Bonus elements

Bonus elements provide an opportunity to collect additional points by implementing relatively small measures that increase ecology or pleasantness, such as installing bird boxes or cultivation boxes in the lot. Bonus elements may also overlap with the element types described above. For example, a certain amount of points can be scored for a planted small tree, on top of which bonus points may be scored for the same tree if it produces fruit or has an impressive bloom. For this reason, the points scored from bonus elements are lower than the points scored from the use of "actual" elements. Deadwood is a very significant element for diversity. For this reason, it was included in the bonus elements.

The total number of bonus elements in the green factor method is 18:

1. Capturing stormwater from impermeable surfaces for use in irrigation or directing it in a controlled manner to permeable vegetated areas
2. Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water
3. Hardwoods and aspen, planted or preserved large tree (25 m² each)
4. Coniferous trees, planted or preserved large tree (25 m² each)
5. Coniferous trees, planted or preserved small tree (15 m² each)
6. Shading large tree (25 m² each) on the south or southwest side of the building (especially deciduous trees)
7. Shading small tree (15 m² each) on the south or southwest side of the building (especially deciduous trees)
8. Fruit trees suitable for cultivation (15 m² each)
9. Berry bushes suitable for cultivation (3 m² each)
10. A selection of native species – at least 5 species/100 m²
11. Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m²
12. Butterfly meadows
13. Plants with pleasant scent or impressive blooming
14. Boxes for urban farming/cultivation
15. Impermeable surface designated for play or sports (e.g. sand- or gravel-covered playgrounds, sports turf)
16. Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation
17. Preserved dead wood/stump (5 m² each)
18. Bird boxes (2 m² each)

3.3 Weighting the elements

The calculation principles and the weighting of the elements are based on the survey responses ("general weighting factor") and a study on the ecological and social impact of different elements (weighted scores of the elements). If a relevant study was not available, the weighting was carried out by using the so-called direct valuation approach[30] in which the expert opinions served as baseline data.

The weighting of the elements by category was carried out as follows: ecology, functionality and cityscape were each assigned a weight on a scale of 0 to 3 (in the scale: 3 = High significance; 2 = Moderate significance; 1 = Minor significance; 0 = No significance), in which 3 indicates an element of high significance. Maintenance need was also assessed on a scale of 0 to 3 (3 = Maintenance need less than once a year; 2 = Maintenance need 1–2 times a year; 1 = Maintenance need more than 3 times a year; 0 = Maintenance need more than once a month); the higher the number, the less need for maintenance.

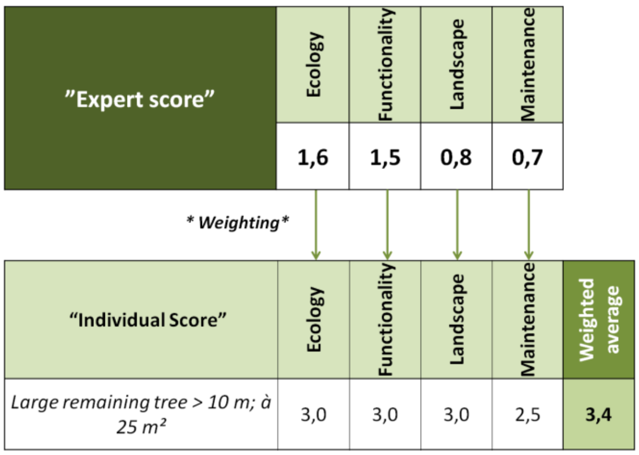

FIGURE 1: AN EXAMPLE OF THE SYSTEMATIC APPROACH FOR CALCULATING THE TOTAL SCORE (WEIGHTED AVERAGE) OF EACH ELEMENT

The significance of individual elements in each category (0–3) is weighted using the general weighting factor assigned to each category (0–3), calculated on the basis of the survey to experts. The weighted average of each element is the final total score used in the green factor scoring. The example calculation in **Figure 1** demonstrates the calculation method used. The weighting of bonus elements is carried out using the same principle as with the actual elements, but on a scale of 0 to 1. Due to the smallness of the scale, there is no differentiation between bonus elements that are of the same element type but not the same size. For example, large and small coniferous trees have the same weighted score.

Notwithstanding this, the difference in size is taken into account in the actual green factor scoring process by entering the information on small coniferous trees into a different field than large coniferous trees; this way, the spreadsheet calculates the weighted area on the basis of the estimated area of the crown of a small tree (15 m² each). The weighting factors and weighted scores determined by using this calculation method are presented in **Figure 1**.

Presented in **Table 3** are the weighted scores of the elements by category and the final total scores (weighted averages) of the elements, which are to be used in the green factor scoring and are based on the calculation principles described above. **Appendix 2** includes a more detailed account of how the category-specific weighted score of each element was determined (significance for the category, size and benchmark element).

TABLE 3: THE WEIGHTED SCORES AND AVERAGES OF EACH ELEMENT

Element groups	Elements	Ecology	Functionality	Cityscape	Maintenance	Weighted average
Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition; at least 3 m (25 m² each), preserved growing medium 25 m²	3,0	3,0	3,0	2,5	3,4
Preserved vegetation and soil	Preserved small (fully grown > 10 m) tree in good condition; at least 3 m (15m² each), preserved growing medium 15 m²	2,5	2,5	3,0	2,5	3,0
Preserved vegetation and soil	Preserved tree in good condition (1.5–3 m) or a large shrub, 3 m² each, preserved growing medium 3 m²	2,0	2,0	2,0	2,0	2,3
Preserved vegetation and soil	Preserved natural meadow or natural ground vegetation	2,0	1,5	2,0	2,0	2,1
Preserved vegetation and soil	Preserved bare rock	2,0	1,0	3,0	3,0	2,3
Planted/new vegetation	Large tree, fully grown ≤ 10 m; 25 m² each; depth of growing medium 0.8 m; dimensions of planting pit for single tree 2 x 2 m	2,5	2,0	3,0	2,0	2,7
Planted/new vegetation	Small tree, fully grown ≤ 10 m; 15 m² each; depth of growing medium 0.6 m; dimensions of planting pit for single tree 1.5 x 1.5 m	2,0	1,5	2,5	2,0	2,2
Planted/new vegetation	Large shrubs, 3 m² each; depth of growing medium 0.6 m	1,5	1,0	2,0	1,5	1,7
Planted/new vegetation	Other shrubs, 1.5 m² each; depth of growing medium 0.4 m	1,0	1,0	2,0	1,5	1,5
Planted/new vegetation	Perennials, depth of growing medium 0.4–0.6 m	1,5	1,0	2,0	1,0	1,6
Planted/new vegetation	Meadow or dry meadow, depth of growing medium 0.15–0.3 m	2,0	1,0	1,5	2,0	1,8
Planted/new vegetation	Cultivation plots (depth of growing medium depends on species, at least 0.3 m)	1,0	3,0	1,5	2,0	2,2
Planted/new vegetation	Lawn, depth of growing medium 0.15–0.2 m	0,5	1,5	1,0	0,5	1,1
Planted/new vegetation	Green roofs (> 0.3 m)	1,5	1,5	2,0	1,0	1,8
Planted/new vegetation	Green roofs (0.05 – 0.3 m)	1,0	1,0	1,5	1,0	1,3
Planted/new vegetation	Perennial vines, depth of growing medium 0.6 m, vertical area (2 m² each)	1,0	1,0	2,0	1,5	1,5
Planted/new vegetation	Green wall, vertical area	0,5	1,0	2,0	0,5	1,1
Pave-ments	Semipermeable pavements (e.g. grass stones, growing medium 0.3 m)	0,5	1,0	1,0	1,0	1,0
Pave-ments	Permeable pavements (e.g. gravel and sand surfaces, stone ash)	0,5	1,0	1,0	3,0	1,3
Stormwater solutions	Rain garden (biofiltration area, no permanent pool of water) with a broad range of layered vegetation	2,5	2,0	2,5	1,5	2,5
Stormwater solutions	Infiltration swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	2,5	1,5	1,0	1,0	1,9
Stormwater solutions	Infiltration pit (underground)	2,0	1,0	0,0	1,5	1,4
Stormwater solutions	Wetland or water meadow with natural vegetation (permanent pool of water at least part of the year; other times the ground remains moist); See: Hagelberg et al., 2009 (18).	3,0	2,0	1,5	2,0	2,6
Stormwater solutions	Retention swale covered with vegetation or aggregates (no permanent pool of water)	2,0	1,5	1,0	1,0	1,7
Stormwater solutions	Retention pit or tank (underground)	1,5	1,0	0,0	1,5	1,2
Bonus elements, max score 1/category	Directing stormwater from impermeable surfaces to permeable vegetated areas	1,0	0,5	0,0	0,5	0,7
Bonus elements, max score 1/category	Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	1,0	0,5	1,0	0,5	0,9
Bonus elements, max score 1/category	Hardwoods and aspen, planted or preserved large tree (25 m² each)	1,0	0,5	1,0	1,0	1,0
Bonus elements, max score 1/category	Coniferous trees, planted or preserved large tree (25 m² each)	0,5	1,0	1,0	1,0	1,0

	Coniferous trees, planted or preserved small tree (15 m² each)	0,5	1,0	1,0	1,0	1,0
	Shading large tree (25 m² each) on the south or southwest side of the building (especially deciduous trees)	0,5	1,0	1,0	1,0	1,0
	Shading small tree (15 m² each) on the south or southwest side of the building (especially deciduous trees)	0,5	1,0	1,0	1,0	1,0
	Fruit trees suitable for cultivation (15 m² each)	1,0	1,0	1,0	0,5	1,1
	Berry bushes suitable for cultivation (3 m² each)	1,0	1,0	1,0	0,5	1,1
	A selection of native species – at least 5 species/100 m²	1,0	0,5	1,0	1,0	1,0
	Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m²	1,0	0,5	1,0	1,0	1,0
	Butterfly meadows	1,0	1,0	1,0	0,5	1,1
	Plants with pleasant scent or impressive blooming	0,5	1,0	1,0	0,5	0,9
	Boxes for urban farming/cultivation	0,5	1,0	0,5	0,5	0,8
	Permeable surface designated for play or sports (e.g. sand or gravel covered playgrounds, sports turf)	0,5	1,0	0,0	0,0	0,6
	Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	0,5	1,0	0,5	0,0	0,7
	Preserved dead wood/stump (5 m² each)	1,0	1,0	1,0	1,0	1,2
	Bird boxes (2 m² each)	1,0	0,5	0,0	1,0	0,8

The assessment was based on the assumption that natural (e.g., a meadow) and preserved vegetation (e.g., a preserved tree) require less maintenance compared to planted decorative plants or lawns, which require repeated irrigation, fertilising and/or cutting. For example, a lawn surface requires maintenance much more frequently compared to a meadow that needs to be mowed 1–2 times in a summer; however, a lawn can be cut mechanically, whereas a meadow requires traditional, manual mowing and removal of the cutting waste. The scores for maintenance based on the frequency of maintenance need are 0.5 for a lawn and 2 for a meadow (**Table 3**).

The existing experiences with each element’s maintenance need have also been taken into account in the scoring; the scores for maintenance of lesser known elements (e.g., green walls and rain gardens) are slightly lower than the corresponding scores of elements that have been in use longer.

3.4 Land-use classification, target and minimum levels

3.4.1 Target and minimum levels for land-use classes

Land use was divided into four classes: residential, services, commercial and industrial/logistics.

The target levels for each land-use class have been set with due consideration of the opportunities and limitations of land use. The minimum level is the absolute minimum green factor requirement that – regardless of the limitations concerning the object of construction – have to be met by each lot included in the land-use class. In addition to land use, the setting of the minimum level was done with due consideration of certain lot-specific limitations that may potentially reduce the opportunities to attain the required green factor score. The proposed target and minimum levels for each land-use class are presented in **Table 4.**

TABLE 4: TARGET AND MINIMUM LEVELS FOR LAND-USE CLASSES

Land-use class		Target level	Minimum level
1	*Residential*	0.8	**0.5**
2	*Services*	0.7	**0.4**
3	*Commercial*	0.6	**0.3**
4	*Industrial/logistics*	0.5	**0.2**

In a lot for which limitations have not been specifically set, *the target level is the same as the minimum level.* This kind of situation could occur, for example, in a single-family lot that has plenty of unbuilt area and no limitations concerning soil. However, the majority of more densely built lots include factors that limit the opportunities to meet the target level set for the class, such as the share of rooftop courtyard.

3.4.2 Determining the target and minimum levels

The individual minimum level for each lot is determined on the basis of site-specific attributes and various factors related to land use in the surrounding areas and infrastructure. The following limiting questions and selections are aimed at identifying factors that reduce the required minimum level:

1) Is it a new construction project?
2) Land use:
    a. Residential
    b. Services
    c. Commercial
    d. Industrial/logistics
3) Is it a perimeter block?
4) Share of rooftop courtyard from the lot:
    a. < 25% (no impact)
    b. 25–75%
    c. 75% <
5) Can the lot be connected to separate drainage?
6) Is there a green corridor comprising a nature reserve/body of water/natural vegetation located within 50 m of the lot?
7) Is impermeable soil/groundwater located on average at least 100 cm below the ground level?
8) Are there any renewable energy production solutions that take up space in the lot (e.g., a solar panel, a small wind turbine)?

Question 2 determines the target level for the land-use class; questions 3–4 and 7–8 reduce the required minimum level (but not below the absolute minimum level), and questions 5–6 impose element-specific minimum requirements (cf. 3.4.4). The lot's required green factor minimum level is also affected by the ratio of building footprint to the total area of the lot, which is calculated by dividing the aggregate area of the buildings by the total area of the lot. The calculated ratio is divided into three classes: less than 0.4; 0.4–0.7 and more than 0.7. The impact of each limitation on the lot's individual minimum level is presented in **Table 5**.

TABLE 5: IMPACT OF LIMITATIONS ON THE MINIMUM LEVEL

	Limiting factor	Minimum level	Difference from the target level
Ratio of building footprint to the area of the lot	< 0.4 (no limitations)	0.8	0
	0.4-0.7	0.7	-0.1
	0.7 <	0.6	-0.2
Yard type	A perimeter block	0.7	-0.1
	Share of rooftop courtyard 25%–75%	0.7	-0.1
	Share of rooftop courtyard > 75%	0.6	-0.2
Separate drainage (missing)		0.8	0 *(at least 1 stormwater solution)*
Nature reserves/green corridors/bodies of water		0.8	0 *(at least 1 preserved element)*
Soil/groundwater		0.6	-0.2
Energy production		0.7	-0.1

3.4.3 Element-specific minimum requirements

Certain element-specific requirements may be set for special sites. Two special characteristics concerning the building land or the surrounding land use were taken into account in the Helsinki Green Factor, based on which it is justified to require the inclusion of certain elements in the lot. They are the lack of separate drainage and the close proximity of a nature reserve, water body or green corridor.

If the lot cannot be connected to a separate stormwater drainage system, a stormwater retention or infiltration swale must be built in the lot. Lot-specific stormwater management mitigates the load directed at the wastewater sewage system and reduces the risk of flooding by way of maintaining stormwater runoff at the pre-construction level. If a nature reserve, a body of water (e.g., a stream, pond, lake, river or ocean) or a green corridor comprising natural vegetation (e.g. a wooded area) is located in close proximity of the lot (within 50 metres), correspondingly, at least one tree or shrub or a certain share of natural ground vegetation or bare rock area should be preserved when the lot is developed.

The abovementioned elements are required in such special sites, unless they are a perimeter block or a lot of which more than 25% is covered by a rooftop courtyard, in which case the preservation of vegetation or placement of a stormwater solution in the lot would be challenging. The element-specific minimum requirements therefore do not apply to lots with factors that limit the implementation of such measures.

3.5 Presentation of the tool

An Excel-based tool was created on the basis of the green factor scoring method. A presentation of the tool is provided in **Appendix 4**.

4 PILOT SITES

The pilot sites for testing the Helsinki Green Factor are two blocks, of which one is located in Jätkäsaari and the other in Kuninkaantammi.

4.1. Jätkäsaari pilot block

The objectives of the land use plan for the Jätkäsaari area include densely built blocks, expansion of the inner city areas by the sea and provision of a wide range of housing options. The building guidance for the area includes a harbour theme, private and individual community courtyards, and the utilisation of stormwater by routing the runoff to planted areas, for example. Flood routes must be taken into account in the planning.

The Jätkäsaari model yard has been created in a community courtyard shared by several housing companies in the block. The model yard was designed by the landscape architects of Byman & Ruokonen Oy. The courtyard is on a man-made fill, which means that there is no vegetation to preserve. A large section of the yard area is a rooftop courtyard. Some soil has been left uncovered in a small section of the courtyard for planting larger trees. The courtyard is filled with groundcover shrubs and perennials, and the rescue routes and locations are partly paved with grass stones. A wide range of plant species has been planted in the courtyard and it also includes a designated section for urban farming. The Jätkäsaari pilot site is pictured in **Figure 2**.

Lists of plants and pavement specifications were used to calculate the aggregate areas and quantities for the green factor spreadsheet. The objective is that the quantities and areas to be entered into the green factor tool would be obtained from the quantity calculations used in cost estimates drawn up during the building design phase. This would make extra calculations for the tool unnecessary.

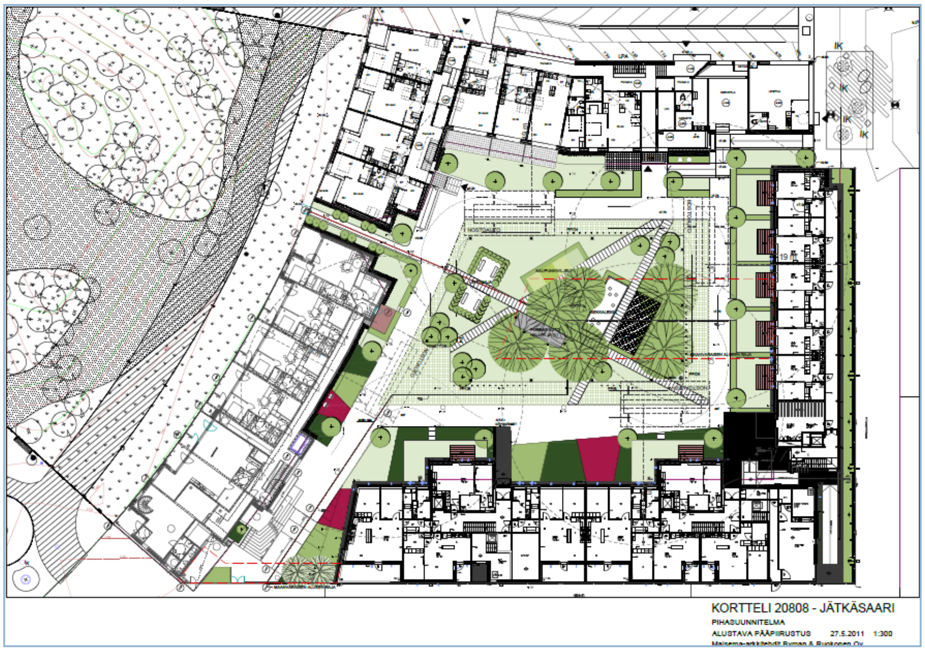

FIGURE 2: JÄTKÄSAARI PILOT BLOCK

4.2 Model yards in Kuninkaantammi

The objectives of the plan for Kuninkaantammi include increasing eco-efficiency and using natural stormwater management solutions, such as green roofs and rain gardens. All car shelters and outbuildings must have green roofs. The objectives for stormwater treatment were defined in the stormwater management report, such as utilising natural runoff routes, minimising paved routes, and stormwater retention, filtration, sedimentation and purification through plants. In the planning regulations, the space requirement for a stormwater retention solution is 0.5 m^3 per 100 m^2 of impermeable surface. This means that fairly large spaces must be reserved in the model yards since the goal is often to keep the retention swales fairly low (30 cm deep on average) and the changes in height gradual for safety and functional reasons.

The block of the model yard in Kuninkaantammi is situated on the west side of an area that will be preserved as a rocky, wooded park. Some of the parking spaces have been allocated below the rooftop courtyard (25% of the lot is underground space) and some to a dedicated parking lot (an area of the block allocated to parking spaces). The sand content of the parking lot’s soil is already gradually increasing, meaning it could potentially be used for surface water infiltration. Green roofs must be installed onto car shelters located in the parking lot. The plan’s aim has been to preserve existing pine trees.

The objectives and starting points of the plan for Kuninkaantammi are more ecological than a plan for an area that could be considered a basic block with multi-storey buildings. For this reason, the model yards used in the green factor scoring and their final green factor scores can give a false impression of how the green factor minimum and target levels are determined for the so-called basic yards of multi-storey buildings.

Three alternative model yards were designed for the lots in Kuninkaantammi: a “basic” yard (VE 1), a “more ecological than average” yard (VE 2) and an “eco-yard” (VE 3); the three model yards are presented in Figures **3–5.**

The model yards have differences in, for example, preserved tree stands. The basic yard VE 1 has less preserved trees than the other alternatives. The basic yard also has less planted trees and shrubs. The growing medium of green roofs is thinner and they have fewer species than the more ecological alternatives. The basic yard has more lawn area, whereas the more ecological model yards also include meadows. The VE 1 model of a basic yard is pictured in **Figure 3**.

FIGURE 3: KUNINKAANTAMMI MODEL YARD VE 1 (“BASIC”)

More space has been allocated to urban faming in the more ecological model yards (VE 2–3). The pavements of the more ecological model yards have relatively more permeable surfaces than the basic yard. In the basic yard, a lawn-covered retention swale has been allocated for stormwater. The retention solution in the more-ecological-than-average yard is partly water meadow and partly underground infiltration pit (e.g., rock-filled). The eco-yard has a retention basin and a rain garden with an abundance of wetland plants and a water meadow. The rain garden also includes a filtering growth medium structure. The basic yard has a few bonus elements, while the more ecological yards have more bonus elements. The VE 3 “Eco-yard” will be quite full of plants, with plenty of preserved and planted vegetation. One of the options in a VE 3 “Eco-yard” is to preserve and plant less vegetation, but then compensate for it by installing a “green roof” on top of the two-storey building in the middle of the yard. The more ecological model yards VE 2 and VE 3 are pictured in **Figures 4** and **5**.

FIGURE 4: KUNINKAANTAMMI MODEL YARD VE 2 (“MORE ECOLOGICAL THAN AVERAGE”)

FIGURE 5: KUNINKAANTAMMI MODEL YARD VE 3 ("ECO-YARD")

In addition to the pilot sites presented above, we also designed a model yard VE 0 for testing an alternative that is closer to the way that the yards of multi-storey buildings are normally built and landscaped in Helsinki. The model yard VE 0 is based on model yard VE 1 in all other respects except that preserved trees, extensive green roofs and stormwater retention solutions have been replaced with the lawn. The detailed calculations of quantities and areas for Jätkäsaari and Kuninkaantammi model yards can be found in **Appendix 3**.

4.3 Testing the green factor method

4.3.1 Testing the tool on the pilot sites

The following is a description of how the green factor tool was applied to the Jätkäsaari pilot block and the three model yards in Kuninkaantammi, as well as the fourth option, VE 0.

4.3.1.1 Jätkäsaari

The testing of the green factor tool on the Jätkäsaari pilot block began by determining the site-specific attributes and limitations in the tool's first sheet, **Limitations**. First, the block ID (20808), the site area (5,898 m²), the building footprint (2,851 m²) and the floor area (12,700 m²) were entered in the empty (white) fields on the right. The lot ID was not filled in, because the scoring concerns the whole block. The "Ratio of building footprint to site area" (0.5), which affects the minimum level, appears below the fields. The lower number, "Ratio of floor area to site area" (2.2) is also updated automatically.

The pilot block in Jätkäsaari is a perimeter block in which the share of rooftop courtyard is more than 75%. The assumption was that the site can be connected to separate drainage. In the assessment phase, detailed information was not available on the characteristics of soil; therefore, the impermeable layer of soil and groundwater at the site was assumed to be on average at a distance of more than 100 cm from the surface of the ground. In addition, the nearby coastline would provide a reason to preserve original vegetation wherever possible. However, as a rule, a rooftop courtyard prevents the construction of stormwater solutions and the preservation of vegetation at the site, while also affecting the size of the planted vegetation. This also means that the characteristics of the original soil have no material significance for the green factor. There is no knowledge of any plans to install renewable energy production solutions at the site. The limitations concerning the site-specific attributes of Jätkäsaari are presented in **Figure 6**.

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Limitations	No.	Question	Response
Building project	1	*Is it a new construction project?*	◉ Yes ○ No
Land use	2	*Residential*	◉
		Services	○
		Commercial	○
		Industrial/logistics	○
Yard type	3	*Is it a perimeter block?*	◉ Yes ○ No
	4	*Share of rooftop courtyard less than 25% (no effect)*	○
		Share of rooftop courtyard 25–75%	○
		Share of rooftop courtyard more than 75%	◉
Drainage system	5	*Can the site be connected to a separate drainage system?*	◉ Yes ○ No
Surrounding region	6	*Is there a green corridor comprising a nature reserve/body of water/natural vegetation located within ≤ 50 m of the site?*	◉ Yes ○ No
Soil/groundwater	7	*Is impermeable soil/groundwater located on average at least 100 cm below the ground level?*	◉ Yes ○ No
Energy solutions	8	*Are there any renewable energy production solutions that take up space at the site (e.g. a solar panel, a small wind turbine)?*	○ Yes ◉ No

Target level	0,8
Minimum level	0,5
Element-specific minimum requirements	- -
Block ID	20808
Lot ID	
Site area, m²	5898
Building footprint, m²	2851
Floor area, m²	12700
Ratio of building footprint to site area	0,5
Ratio of floor area to site area	2,2

FIGURE 6: LIMITATIONS CONCERNING THE SITE IN JÄTKÄSAARI

In the green factor scoring, Jätkäsaari pilot site's target level was **0.8** and its minimum level was **0.5**. As previously stated, no element-specific requirements were set for the site on account of the large share of the rooftop courtyard and the site being a perimeter block.

The green factor scoring process concerning the site in Jätkäsaari is presented in **Figure 7**.

Green Factor
0,6
Target level
0,8
Minimum level
0,5
Element-specific minimum requirements
-
-
Site area, m^2
5898
Total weighted area, m^2
3629

Element group	Element description	Unit	Area or quantity	Weighting	Weighted area, m^2
Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m^2 each)	pcs		3,4	0,0
	Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m^2 each)	pcs		3,0	0,0
	Preserved tree in good condition (1.5–3 m) or a large shrub (3 m^2 each)	pcs		2,3	0,0
	Preserved natural meadow or natural ground vegetation	m^2		2,1	0,0
More info	Preserved natural bare rock area (at least partially bare rock surface, not many trees)	m^2		2,3	0,0
Planted/new vegetation	Large tree species, fully grown > 10 m (25 m^2 each)	pcs	8	2,7	546,4
	Small tree species, fully grown ≤ 10 m (15 m^2 each)	pcs	19	2,2	638,2
	Large shrubs (3 m^2 each)	pcs	28	1,7	139,3
	Other shrubs	m^2	523	1,5	763,6
	Perennials	m^2	49	1,6	77,0
	Meadow or dry meadow	m^2		1,8	0,0
	Cultivation plots	m^2	12	2,2	26,4
	Lawn	m^2	604	1,1	643,1
	Green roofs (> 0.3 m)	m^2		1,8	0,0
	Green roofs (0.05 – 0.3 m)	m^2		1,3	0,0
	Perennial vines (2 m^2 each)	pcs	55	1,5	160,6
More info	Green wall, vertical area	m^2		1,1	0,0
Pavements	Semipermeable pavements (e.g. grass stones)	m^2	356	1,0	342,9
More info	Permeable pavements (e.g. gravel and sand surfaces, stone ash)	m^2	67	1,3	88,0
Stormwater solutions	Rain garden (biofiltration area, no permanent pool of water) with a broad range of layered vegetation	m^2		2,5	0,0
	Infiltration swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	m^2		1,9	0,0
	Infiltration pit (underground)	m^2		1,4	0,0
	Wetland or water meadow with natural vegetation (permanent water surface at least part of the year; at other times the ground remains moist)	m^2		2,6	0,0
	Retention swale covered with vegetation or aggregates (no permanent water surface, permeable soil)	m^2		1,7	0,0
More info	Retention pit or tank (underground)	m^2		1,2	0,0
Bonus elements, max score 1/category	Capturing stormwater from impermeable surfaces for use in irrigation or directing it in a controlled manner to permeable vegetated areas	m^2		0,7	0,0
	Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	m^2		0,9	0,0
	Hardwoods and aspen, planted or preserved large tree (25 m^2 each)	pcs	7	1,0	170,1
	Coniferous trees, planted or preserved large tree (25 m^2 each)	pcs		1,0	0,0
	Coniferous trees, planted or preserved small tree (15 m^2 each)	pcs		1,0	0,0
	Shading large tree (25 m^2 each) on the south or southwest side of the building (especially deciduous trees)	pcs		1,0	0,0
	Shading small tree (15 m^2 each) on the south or southwest side of the building (especially deciduous trees)	pcs		1,0	0,0
	Fruit trees suitable for cultivation (15 m^2 each)	pcs		1,1	0,0
	Berry bushes suitable for cultivation (3 m^2 each)	pcs		1,1	0,0
	A selection of native species – at least 5 species/100 m^2	m^2		1,0	0,0
	Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m^2	m^2		1,0	0,0
	Butterfly meadows	m^2		1,1	0,0
	Plants with pleasant scent or impressive blooming	m^2	22,5	0,9	19,7
	Boxes for urban farming/cultivation	m^2		0,8	0,0
	Impermeable surface designated for play or sports (e.g. sand- or gravel-covered playgrounds, sports turf)	m^2	23	0,6	13,3
	Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	m^2		0,7	0,0
	Preserved dead wood/stump (5 m^2 each)	pcs		1,2	0,0
More info	Bird boxes (2 m^2 each)	pcs		0,8	0,0

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Block ID
20808
Lot ID
-

FIGURE 7: GREEN FACTOR SCORING PROCESS CONCERNING THE SITE IN JÄTKÄSAARI

The plans for the site did not include any preserved vegetation or stormwater solutions on account of the previously stated challenges. Instead, plenty of planted vegetation and permeable surfaces were used at the site; these include trees, shrubs, grass stones and pavings with stone ash seams in particular. Bonus points were scored for planted hardwood (maple), surfaces suitable for play, and plants with impressive blooming (flowers grown from bulbs). The results of the green factor scoring concerning the site in Jätkäsaari are presented in **Figure 8.**

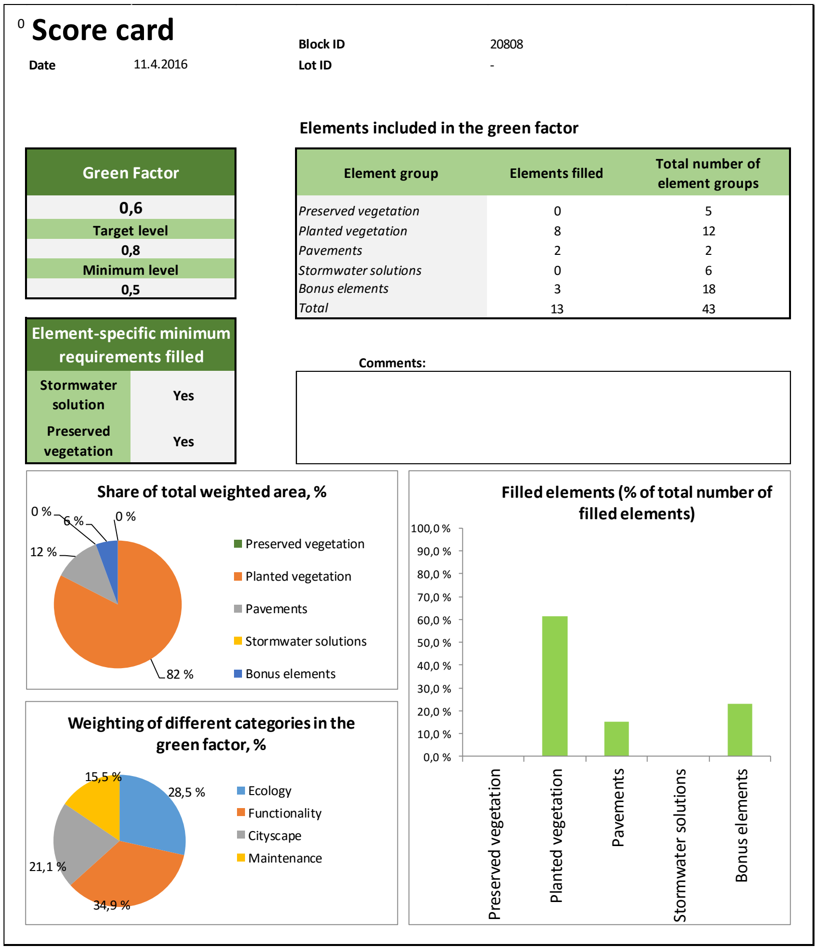

FIGURE 8: THE RESULTS OF THE GREEN FACTOR SCORING CONCERNING THE PILOT SITE IN JÄTKÄSAARI

Despite the large share of the rooftop courtyard from the total area of the yard at the Järkäsaari site, the yard's abundant vegetation meant that Jätkäsaari exceeded the minimum level set for it by achieving a green factor score of **0.6**. No element-specific requirements were set for the site; they were deemed filled. 13 different elements out of a possible 43 were used at the Jätkäsaari site, where planted vegetation comprises a considerable share (83%) of the total combined weighted green surface area. The points scored for functionality comprise the largest share of the green factor (35%), which is explained by, for example, the microclimate regulation ability of trees and shrubs and the sections of the yard suitable for urban farming, play and other activities.

4.3.1.2 Kuninkaantammi

The limitations concerning the model yards in Kuninkaantammi are the same for each yard (**Figure 9**). The Kuninkaantammi block is open on one side, which means that it cannot be deemed as a perimeter block. The share of the rooftop courtyard was less than 25%, and therefore it was not deemed to affect the minimum level. In the assessment phase, detailed information was not available on the characteristics of soil, but the bedrock was known to be at a distance of less than 100 cm from the surface of the ground in certain areas of the site. On average, however, the permeable soil was estimated to be at least 100 cm deep; additionally, filling is likely to be brought to the site.

Date
11.4.2016

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Limitations	No.	Question	Response
Building project	1	*Is it a new construction project?*	◉ Yes ○ No
Land use	2	*Residential*	◉
		Services	○
		Commercial	○
		Industrial/logistics	○
Yard type	3	*Is it a perimeter block?*	○ Yes ◉ No
	4	*Share of rooftop courtyard less than 25% (no effect)*	◉
		Share of rooftop courtyard 25–75%	○
		Share of rooftop courtyard more than 75%	○
Drainage system	5	*Can the site be connected to a separate drainage system?*	◉ Yes ○ No
Surrounding region	6	*Is there a green corridor comprising a nature reserve/body of water/natural vegetation located within ≤ 50 m of the site?*	◉ Yes ○ No
Soil/groundwater	7	*Is impermeable soil/groundwater located on average at least 100 cm below the ground level?*	◉ Yes ○ No
Energy solutions	8	*Are there any renewable energy production solutions that take up space at the site (e.g. a solar panel, a small wind turbine)?*	○ Yes ◉ No

Target level	0,8
Minimum level	0,7
Element-specific minimum requirements	- *Vähintään 1 säilytettävä elementti*
Block ID	33397
Lot ID	
Site area, m²	9537
Building footprint, m²	4366
Floor area, m²	10800
Ratio of building footprint to site area	0,5
Ratio of floor area to site area	1,1

Green Factor	
	0,7
Target level	0,8
Minimum level	0,7
Element-specific minimum requirements	- *Vähintään 1 säilytettävä elementti*
Site area, m²	9537
Total weighted area, m²	7010

Element group	Element description	Unit	Area or quantity	Weighting	Weighted area, m²
Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m² each)	pcs	1	3,4	84,9
	Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m² each)	pcs	1	3,0	45,1
	Preserved tree in good condition (1.5–3 m) or a large shrub (3 m² each)	pcs		2,3	0,0
	Preserved natural meadow or natural ground vegetation	m²		2,1	0,0
More info	Preserved natural bare rock area (at least partially bare rock surface, not many trees)	m²		2,3	0,0
Planted/new vegetation	Large tree species, fully grown > 10 m (25 m² each)	pcs	12	2,7	819,7
	Small tree species, fully grown ≤ 10 m (15 m² each)	pcs	12	2,2	403,0
	Large shrubs (3 m² each)	pcs	12	1,7	59,7
	Other shrubs	m²	318	1,5	464,3
	Perennials	m²		1,6	0,0
	Meadow or dry meadow	m²		1,8	0,0
	Cultivation plots	m²		2,2	0,0
	Lawn	m²	2448	1,1	2606,3
	Green roofs (> 0.3 m)	m²		1,8	0,0
	Green roofs (0.05 – 0.3 m)	m²	610	1,3	772,8
	Perennial vines (2 m² each)	pcs	3	1,5	8,8
More info	Green wall, vertical area	m²		1,1	0,0
Pavements	Semipermeable pavements (e.g. grass stones)	m²	74	1,0	71,3
More info	Permeable pavements (e.g. gravel and sand surfaces, stone ash)	m²	109	1,3	143,2
Stormwater solutions	Rain garden (biofiltration area, no permanent pool of water) with a broad range of layered vegetation	m²		2,5	0,0
	Infiltration swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	m²		1,9	0,0
	Infiltration pit (underground)	m²		1,4	0,0
	Wetland or water meadow with natural vegetation (permanent water surface at least part of the year; at other times the ground remains moist)	m²		2,6	0,0
	Retention swale covered with vegetation or aggregates (no permanent water surface, permeable soil)	m²	702	1,7	1226,7
More info	Retention pit or tank (underground)	m²		1,2	0,0
Bonus elements, max score 1/category	Capturing stormwater from impermeable surfaces for use in irrigation or directing it in a controlled manner to permeable vegetated areas	m²		0,7	0,0
	Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	m²		0,9	0,0
	Hardwoods and aspen, planted or preserved large tree (25 m² each)	pcs		1,0	0,0
	Coniferous trees, planted or preserved large tree (25 m² each)	pcs	8	1,0	192,6
	Coniferous trees, planted or preserved small tree (15 m² each)	pcs		1,0	0,0
	Shading large tree (25 m² each) on the south or southwest side of the building (especially deciduous trees)	pcs		1,0	0,0
	Shading small tree (15 m² each) on the south or southwest side of the building (especially deciduous trees)	pcs		1,0	0,0
	Fruit trees suitable for cultivation (15 m² each)	pcs	3	1,1	48,3
	Berry bushes suitable for cultivation (3 m² each)	pcs		1,1	0,0
	A selection of native species – at least 5 species/100 m²	m²		1,0	0,0
	Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m²	m²		1,0	0,0
	Butterfly meadows	m²		1,1	0,0
	Plants with pleasant scent or impressive blooming	m²		0,9	0,0
	Boxes for urban farming/cultivation	m²		0,8	0,0
	Impermeable surface designated for play or sports (e.g. sand- or gravel-covered playgrounds, sports turf)	m²	109	0,6	62,9
	Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	m²		0,7	0,0
	Preserved dead wood/stump (5 m² each)	pcs		1,2	0,0
More info	Bird boxes (2 m² each)	pcs		0,8	0,0

Date
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FIGURE 9: LIMITATIONS AND SCORING PROCESS CONCERNING THE MODEL YARDS IN KUNINKAANTAMMI

In the green factor scoring, Kuninkaantammi's target level was **0.8** and minimum level **0.7**. In addition, due to the close proximity of a green corridor, at least one preserved element is required to be included in the green factor scoring.

As stated in paragraph 4.1.2, model yard VE 1 was intended to represent a green factor "basic yard". Notwithstanding this, because the plan requires preserved trees, green roofs and stormwater solutions, the yard differs from most residential blocks in Helsinki. However, less vegetation has been preserved in the basic yard compared to the more ecological alternatives VE 2 and VE 3, the growing mediums of its green roofs are thinner (0.05–0.3 m) and the stormwater solution is a lawn-covered retention swale. Most of the planted vegetation is lawn surfaces, which can be viewed as a typical situation in Helsinki. The results of model yard VE 1 are presented in **Figure 10**.

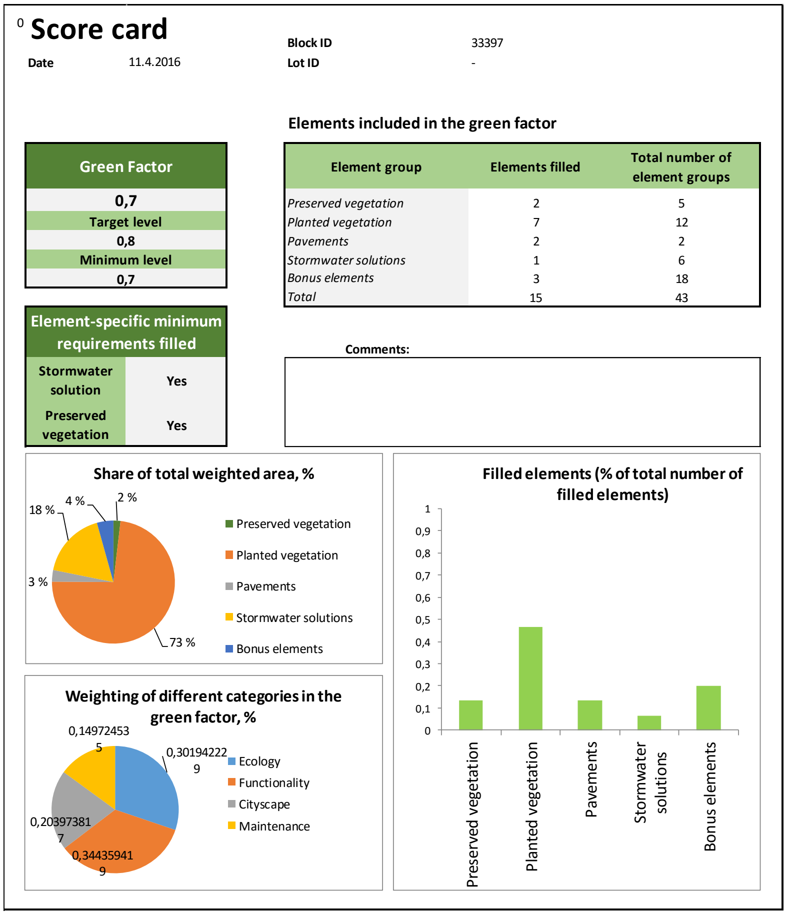

FIGURE 10: THE RESULTS OF THE GREEN FACTOR SCORING CONCERNING MODEL YARD VE 1 (“BASIC”)

The results of the green factor scoring concerning model yard VE 1 show that it is well-suited for use as a “basic yard” in Helsinki – the minimum level set for the site was attained on the nose, with **0.7.** The requirement concerning preserved vegetation was also fulfilled through preserved trees. All the element types have been used at the site (15/43), of which the largest proportion is clearly planted vegetation (73%); however, this is considerably less than the corresponding number in Jätkäsaari (83%). As a percentage from the total green factor score, the points scored for functionality (34%) are higher than the points scored for ecology (30%). The green factor scoring process and results concerning the more ecological model yards, VE 2 and 3, are presented in **Figures 11–12**.

Green Factor
0,9
Target level
0,8
Minimum level
0,7
Element-specific minimum
-
Vähintään 1 säilytettävä elementti
Site area, m²
9537
Total weighted area, m²
8373

Element group	Element description	Unit	Area or quantity	Weighting	Weighted area, m²
Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m² each)	pcs	4	3,4	339,7
	Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m² each)	pcs	2	3,0	90,3
	Preserved tree in good condition (1.5–3 m) or a large shrub (3 m² each)	pcs		2,3	0,0
	Preserved natural meadow or natural ground vegetation	m²	40	2,1	85,3
More info	Preserved natural bare rock area (at least partially bare rock surface, not many trees)	m²		2,3	0,0
Planted/new vegetation	Large tree species, fully grown > 10 m (25 m² each)	pcs	12	2,7	819,7
	Small tree species, fully grown ≤ 10 m (15 m² each)	pcs	15	2,2	503,8
	Large shrubs (3 m² each)	pcs	13	1,7	64,7
	Other shrubs	m²	415	1,5	605,9
	Perennials	m²		1,6	0,0
	Meadow or dry meadow	m²	405	1,8	744,8
	Cultivation plots	m²	22	2,2	48,4
	Lawn	m²	1828	1,1	1946,2
	Green roofs (> 0.3 m)	m²	607	1,8	1068,3
	Green roofs (0.05 – 0.3 m)	m²		1,3	0,0
	Perennial vines (2 m² each)	pcs	13	1,5	38,0
More info	Green wall, vertical area	m²		1,1	0,0
Pavements	Semipermeable pavements (e.g. grass stones)	m²	125	1,0	120,4
More info	Permeable pavements (e.g. gravel and sand surfaces, stone ash)	m²	286	1,3	375,7
Stormwater solutions	Rain garden (biofiltration area, no permanent pool of water) with a broad range of layered vegetation	m²		2,5	0,0
	Infiltration swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	m²		1,9	0,0
	Infiltration pit (underground)	m²		1,4	0,0
	Wetland or water meadow with natural vegetation (permanent water surface at least part of the year; at other times the ground remains moist)	m²		2,6	0,0
	Retention swale covered with vegetation or aggregates (no permanent water surface, permeable soil)	m²	610	1,7	1065,9
More info	Retention pit or tank (underground)	m²	15	1,2	18,5
Bonus elements, max score 1/category	Capturing stormwater from impermeable surfaces for use in irrigation or directing it in a controlled manner to permeable vegetated areas	m²		0,7	0,0
	Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	m²		0,9	0,0
	Hardwoods and aspen, planted or preserved large tree (25 m² each)	pcs		1,0	0,0
	Coniferous trees, planted or preserved large tree (25 m² each)	pcs	10	1,0	240,8
	Coniferous trees, planted or preserved small tree (15 m² each)	pcs		1,0	0,0
	Shading large tree (25 m² each) on the south or southwest side of the building (especially deciduous trees)	pcs	2	1,0	48,2
	Shading small tree (15 m² each) on the south or southwest side of the building (especially deciduous trees)	pcs		1,0	0,0
	Fruit trees suitable for cultivation (15 m² each)	pcs	2	1,1	32,2
	Berry bushes suitable for cultivation (3 m² each)	pcs		1,1	0,0
	A selection of native species – at least 5 species/100 m²	m²		1,0	0,0
	Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m²	m²		1,0	0,0
	Butterfly meadows	m²		1,1	0,0
	Plants with pleasant scent or impressive blooming	m²	75	0,9	65,7
	Boxes for urban farming/cultivation	m²		0,8	0,0
	Impermeable surface designated for play or sports (e.g. sand- or gravel-covered playgrounds, sports turf)	m²	83	0,6	47,9
	Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	m²		0,7	0,0
	Preserved dead wood/stump (5 m² each)	pcs		1,2	0,0
More info	Bird boxes (2 m² each)	pcs	2	0,8	3,0

Date
11.4.2016
Block ID
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Lot ID
-

0 Score card

Date 11.4.2016
Block ID 33397
Lot ID -

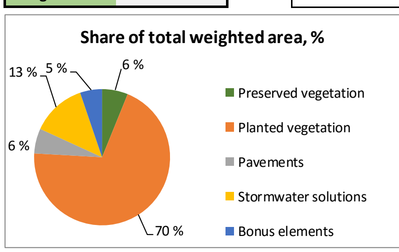
Green Factor
0,9
Target level
0,8
Minimum level
0,7

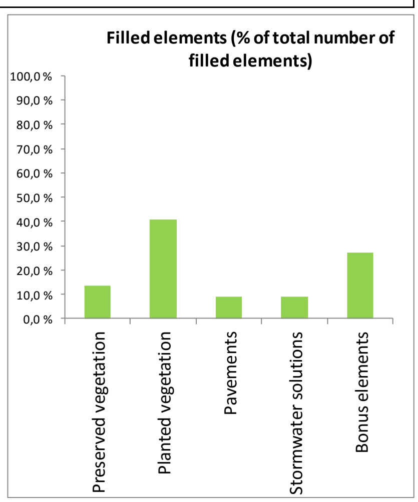
Elements included in the green factor

Element group	Elements filled	Total number of element groups
Preserved vegetation	3	5
Planted vegetation	9	12
Pavements	2	2
Stormwater solutions	2	6
Bonus elements	6	18
Total	22	43

Element-specific minimum requirements filled	
Stormwater solution	Yes
Preserved vegetation	Yes

Comments:





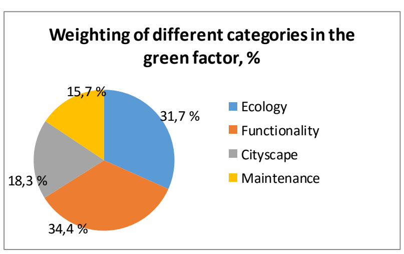


FIGURE 11: THE GREEN FACTOR SCORING PROCESS AND RESULTS CONCERNING MODEL YARD VE 2 ("MORE ECOLOGICAL THAN AVERAGE")

Green Factor
1,1
Target level
0,8
Minimum level
0,7
Element-specific minimum requirements
-
Vähintään 1 säilytettävä elementti
Site area, m²
9537
Total weighted area, m²
10270

Element group	Element description	Unit	Area or quantity	Weighting	Weighted area, m²
Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m² each)	pcs	5	3,4	424,6
	Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m² each)	pcs	3	3,0	135,4
	Preserved tree in good condition (1.5–3 m) or a large shrub (3 m² each)	pcs		2,3	0,0
	Preserved natural meadow or natural ground vegetation	m²	80	2,1	170,7
More info	Preserved natural bare rock area (at least partially bare rock surface, not many trees)	m²		2,3	0,0
Planted/new vegetation	Large tree species, fully grown > 10 m (25 m² each)	pcs	10	2,7	683,1
	Small tree species, fully grown ≤ 10 m (15 m² each)	pcs	17	2,2	571,0
	Large shrubs (3 m² each)	pcs	28	1,7	139,3
	Other shrubs	m²	325	1,5	474,5
	Perennials	m²	18	1,6	28,3
	Meadow or dry meadow	m²	232	1,8	426,6
	Cultivation plots	m²	70	2,2	153,9
	Lawn	m²	1758	1,1	1871,7
	Green roofs (> 0.3 m)	m²	610	1,8	1073,6
	Green roofs (0.05 – 0.3 m)	m²		1,3	0,0
	Perennial vines (2 m² each)	pcs	13	1,5	38,0
More info	Green wall, vertical area	m²	104	1,1	113,0
Pavements	Semipermeable pavements (e.g. grass stones)	m²	22	1,0	21,2
More info	Permeable pavements (e.g. gravel and sand surfaces, stone ash)	m²	1329	1,3	1746,0
Stormwater solutions	Rain garden (biofiltration area, no permanent pool of water) with a broad range of layered vegetation	m²	229	2,5	581,4
	Infiltration swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	m²	218	1,9	424,2
	Infiltration pit (underground)	m²		1,4	0,0
	Wetland or water meadow with natural vegetation (permanent water surface at least part of the year; at other times the ground remains moist)	m²		2,6	0,0
	Retention swale covered with vegetation or aggregates (no permanent water surface, permeable soil)	m²	343	1,7	599,4
More info	Retention pit or tank (underground)	m²		1,2	0,0
Bonus elements, max score 1/category	Capturing stormwater from impermeable surfaces for use in irrigation or directing it in a controlled manner to permeable vegetated areas	m²		0,7	0,0
	Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	m²		0,9	0,0
	Hardwoods and aspen, planted or preserved large tree (25 m² each)	pcs		1,0	0,0
	Coniferous trees, planted or preserved large tree (25 m² each)	pcs	10	1,0	240,8
	Coniferous trees, planted or preserved small tree (15 m² each)	pcs	1	1,0	14,4
	Shading large tree (25 m² each) on the south or southwest side of the building (especially deciduous trees)	pcs	2	1,0	48,2
	Shading small tree (15 m² each) on the south or southwest side of the building (especially deciduous trees)	pcs		1,0	0,0
	Fruit trees suitable for cultivation (15 m² each)	pcs	4	1,1	64,4
	Berry bushes suitable for cultivation (3 m² each)	pcs		1,1	0,0
	A selection of native species – at least 5 species/100 m²	m²		1,0	0,0
	Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m²	m²		1,0	0,0
	Butterfly meadows	m²		1,1	0,0
	Plants with pleasant scent or impressive blooming	m²	90	0,9	78,8
	Boxes for urban farming/cultivation	m²		0,8	0,0
	Impermeable surface designated for play or sports (e.g. sand- or gravel-covered playgrounds, sports turf)	m²	251	0,6	144,8
	Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	m²		0,7	0,0
	Preserved dead wood/stump (5 m² each)	pcs		1,2	0,0
More info	Bird boxes (2 m² each)	pcs	2	0,8	3,0

Date
11.4.2016
Block ID
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Lot ID
-

0 **Score card**

Date 11.4.2016
Block ID 33397
Lot ID -

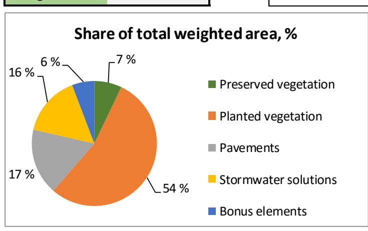
Elements included in the green factor

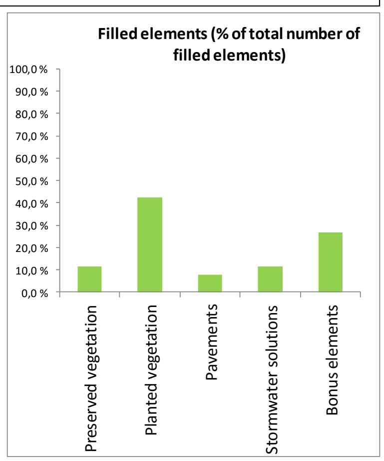
Green Factor
1,1
Target level
0,8
Minimum level
0,7

Element group	Elements filled	Total number of element groups
Preserved vegetation	3	5
Planted vegetation	11	12
Pavements	2	2
Stormwater solutions	3	6
Bonus elements	7	18
Total	26	43

Element-specific minimum requirements filled	
Stormwater solution	Yes
Preserved vegetation	Yes

Comments:





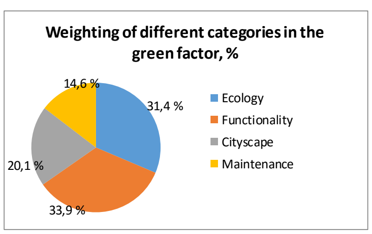


FIGURE 12: THE GREEN FACTOR SCOORING AND RESULTS CONCERNING MODEL YARD VE 3 ("ECO-YARD")

The green factor score of model yard VE 2, **0.9**, exceeds the target level 0.8 set for the class, which makes it more ecological than average. The most significant difference compared to model yard VE 1 is the higher utilisation rate of the elements (22/43). The largest share of the green surface area in

VE 2 also comprises planted vegetation (70%), and the category with the highest impact on the scoring was the same as with VE 1, functionality (34%).

Due to its abundant vegetation and extensive stormwater solutions, the green factor score attained by model yard VE 3, or “eco-yard”, was considerably high, **1.1**. The biggest differences in relation to VE 2 include the smaller proportion of planted vegetation from the total green surface area (54%), which also means more versatile utilisation of the elements (26/43). More abundant vegetation did not, however, bring significantly more or any more points for ecology for model yard VE 3 compared to VE 1 or VE 2, which had also made use of preserved elements, planted trees and stormwater solutions essential to ecology.

The implementation of an “eco-yard”, which has an abundance of preserved and planted vegetation and not much impermeable surfaces, has its own major challenges, but the model yard is an excellent example of the efficient use of green surface areas and how to create a pleasant and varying residential environment.

The results of the green factor scoring concerning model yard VE 0 are presented in **Figure 13**. VE 0 is a cut-down version of model yard VE 1, intended to reflect the current planning practices in use in Helsinki. The extensive green roofs and stormwater swales and preserved trees have been removed in VE 0. The stormwater swales were replaced with lawn.

Green Factor
0,6
Target level
0,8
Minimum level
0,7
Element-specific minimum
-
Vähintään 1 säilytettävä elementti
Site area, m^2
9537
Total weighted area, m^2
5603

Date 11.4.2016
Block ID 33397
Lot ID -

Element group	Element description	Unit	Area or quantity	Weighting	Weighted area, m^2
Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m^2 each)	pcs		3,4	0,0
	Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m^2 each)	pcs		3,0	0,0
	Preserved tree in good condition (1.5–3 m) or a large shrub (3 m^2 each)	pcs		2,3	0,0
	Preserved natural meadow or natural ground vegetation	m^2		2,1	0,0
More info	Preserved natural bare rock area (at least partially bare rock surface, not many trees)	m^2		2,3	0,0
Planted/new vegetation	Large tree species, fully grown > 10 m (25 m^2 each)	pcs	12	2,7	819,7
	Small tree species, fully grown ≤ 10 m (15 m^2 each)	pcs	12	2,2	403,0
	Large shrubs (3 m^2 each)	pcs	12	1,7	59,7
	Other shrubs	m^2	318	1,5	464,3
	Perennials	m^2		1,6	0,0
	Meadow or dry meadow	m^2		1,8	0,0
	Cultivation plots	m^2		2,2	0,0
	Lawn	m^2	3150	1,1	3353,7
	Green roofs (> 0.3 m)	m^2		1,8	0,0
	Green roofs (0.05 – 0.3 m)	m^2		1,3	0,0
	Perennial vines (2 m^2 each)	pcs	3	1,5	8,8
More info	Green wall, vertical area	m^2		1,1	0,0
Pavements	Semipermeable pavements (e.g. grass stones)	m^2	74	1,0	71,3
More info	Permeable pavements (e.g. gravel and sand surfaces, stone ash)	m^2	109	1,3	143,2
Stormwater solutions	Rain garden (biofiltration area, no permanent pool of water) with a broad range of layered vegetation	m^2		2,5	0,0
	Infiltration swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	m^2		1,9	0,0
	Infiltration pit (underground)	m^2		1,4	0,0
	Wetland or water meadow with natural vegetation (permanent water surface at least part of the year; at other times the ground remains moist)	m^2		2,6	0,0
	Retention swale covered with vegetation or aggregates (no permanent water surface, permeable soil)	m^2		1,7	0,0
More info	Retention pit or tank (underground)	m^2		1,2	0,0
Bonus elements, max score 1/category	Capturing stormwater from impermeable surfaces for use in irrigation or directing it in a controlled manner to permeable vegetated areas	m^2		0,7	0,0
	Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	m^2		0,9	0,0
	Hardwoods and aspen, planted or preserved large tree (25 m^2 each)	pcs		1,0	0,0
	Coniferous trees, planted or preserved large tree (25 m^2 each)	pcs	7	1,0	168,5
	Coniferous trees, planted or preserved small tree (15 m^2 each)	pcs		1,0	0,0
	Shading large tree (25 m^2 each) on the south or southwest side of the building (especially deciduous trees)	pcs		1,0	0,0
	Shading small tree (15 m^2 each) on the south or southwest side of the building (especially deciduous trees)	pcs		1,0	0,0
	Fruit trees suitable for cultivation (15 m^2 each)	pcs	3	1,1	48,3
	Berry bushes suitable for cultivation (3 m^2 each)	pcs		1,1	0,0
	A selection of native species – at least 5 species/100 m^2	m^2		1,0	0,0
	Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m^2	m^2		1,0	0,0
	Butterfly meadows	m^2		1,1	0,0
	Plants with pleasant scent or impressive blooming	m^2		0,9	0,0
	Boxes for urban farming/cultivation	m^2		0,8	0,0
	Impermeable surface designated for play or sports (e.g. sand- or gravel-covered playgrounds, sports turf)	m^2	109	0,6	62,9
	Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	m^2		0,7	0,0
	Preserved dead wood/stump (5 m^2 each)	pcs		1,2	0,0
More info	Bird boxes (2 m^2 each)	pcs		0,8	0,0

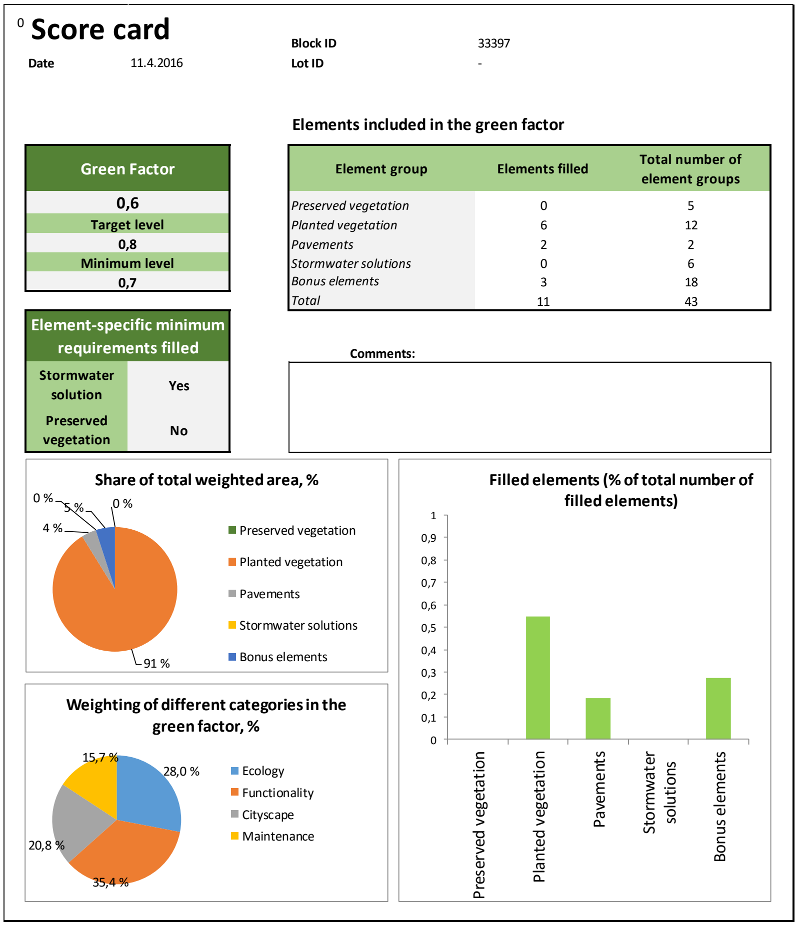


FIGURE 13: THE GREEN FACTOR SCORING PROCESS AND RESULTS CONCERNING MODEL YARD VE 0 ("ZERO")

As shown by the results presented in **Figure 13**, the green factor score for model yard VE 0, **0.6**, falls slightly below the minimum level. The element-specific requirement for preserved vegetation was also not filled. The utilisation rate of different green factor elements (11/43) is considerably lower compared to the corresponding figures of the other model yards, and nearly all of the green surface area is planted vegetation (91%). The points awarded for ecology are also lower compared to model yards VE 1–3 (28%).

The review of the results shows that, although it came close, the minimum level set for the green factor could not be met with the existing planning practices; however, with a little extra effort (compare Kuninkaantammi VE 1 and the Jätkäsaari pilot block), achieving the minimum level will be possible.

4.3.2 Testing in a workshop

In October 2013, an interactive workshop was organised for the City of Helsinki's employees to introduce how the method works, the preliminary results from the pilot sites, the model yard design plans, and other related materials. The workshop was also an opportunity to collect valuable user feedback from the method's potential future users.

For the most part, the participants felt the method was fluent and easy to use. With respect to filling in the spreadsheet, however, they said that they would prefer to enter the quantities of trees, shrubs, vines and other individual elements rather than the (estimated) areas. This was taken into account in the development of the method. The way in which construction efficiency was taken into account in the tool's limitations was also discussed at the workshop. In the participants' opinion, the larger the permitted building volume, the greater the share of impermeable surfaces within the site due to, for example, rescue routes and parking spaces. The green factor method does, however, permit the use of rather varying solutions in order to fulfil the required minimum level, which do not necessarily have to include extensive areas covered with vegetation. In the Jätkäsaari pilot block, for example, the minimum level was exceeded regardless of the relatively high construction efficiency (2.2) and share of the rooftop courtyard. Permeable surfaces can be efficiently increased by using lawn stones or pavings with stone ash seams in parking spaces, installing green roofs onto car shelters, planting vines and green walls next to the buildings, or even by constructing underground stormwater solutions.

With regards to the weighting of the elements, feedback was especially received about preserved vegetation and soil. Preservation was viewed challenging and, on the other hand, it was felt, for example, that too much weight was put on bare rock areas and that the weighting of preserved trees (3.0–3.4) was excessive in relation to that of planted trees (2.2–2.7). Further monitoring of the pilot sites and other test sites is necessary, especially with regards to preserved vegetation. If the preservation of vegetation systematically fails despite sufficient measures to promote the preservation, this must be taken into account in the further development of the method.

There was also discussion on who will be able to use the green factor method in its current form. Careful filling in of the green factor spreadsheet was viewed to be too challenging during the initial stages of the land use planning process; on the other hand, the method was felt to provide garden designers with a functional and easy-to-use-tool to assist them in the work. The overall view was that all that would be needed during the land-use planning phase was the determination of the land-use class and the target and minimum levels. In other words, the city planner would use the first stage of the green factor tool (Limitations, paragraph 3.5.3.1), while the more detailed planning would include the actual green factor scoring process (paragraph 3.5.3.2) on the basis of the limitations.

5 THE GREEN FACTOR METHOD AS PART OF LAND-USE AND CITY PLANNING PROCESS

5.1 Examples from other cities

The way that the green factor is utilised by various cities in their land use and city planning processes primarily depends on the land use planning practices and bureaucracy of different countries and cities, but it is also affected by the green factor's life cycle. The generally identified way of implementing the green factor has been to first test it on pilot sites and then iteratively develop the method further on the basis of the experiences, while also gradually increasing its use in the land use planning process. As a rule, the management of the green factor in other cities is handled by the department responsible for urban planning and/or urban development.

5.1.1 Berlin

As already mentioned, the development of Berlin's Biotope Area Factor began in the 1980s, in connection with Berlin's landscape programme, and BAFs meeting the minimum requirements have been required in certain areas (certain residential areas, and certain areas in commercial and service use) since 1994. The BAF is legally binding, and the method is administered by the Senate Department for urban development and the Environment. The inherent legally binding arrangements are described in more detail in the *Handbuch der Berliner Landschaftspläne*[31].

5.1.2 Seattle

The Seattle Green Factor (SGF) has been in use since 2006. The green factor minimum level is a mandatory requirement in connection with applying for a construction permit for specifically determined areas. In some areas of the city, the green efficiency of buildings and construction is one of the contract terms and conditions when land is being sold and developed, but in most sites it is only a recommendation. Rules on the implementation of the SGF method are set out in the *Seattle Municipal Code,* and it is administered by the Department of Planning and Development[32].

5.2 Proposal for using the green factor in Helsinki's land use and city planning process

During the drafting stage of the land-use planning process, city planners would determine which land-use class the constructed area belongs to by filling in the information in the Limitations sheet of the green factor spreadsheet. The land-use class of the constructed area is directly determined by the tool in accordance with land use. The green factor target level is linked to the land-use class and the required minimum level is determined in accordance with the land-use class and area-specific special features.

As the land-use planning process progresses, the green factor would be clarified and potential external consultants, such as architectural firms, would create block-specific plans to support the land use plan and for illustration purposes. The firms, or the landscape architects or garden designers assisting them, would calculate a preliminary green factor score in order to demonstrate that the minimum level will be achieved. The score card would be presented to the city planner in connection with the block-specific plan.

When the land is transferred to the developer/builder, who commissions detailed implementation plans regarding the garden design, the garden designer would also carry out the green factor scoring in connection with drawing up the plans by using the estimates of quantities included in cost estimates. In such an event, the green factor score card (the Results sheet) should also be submitted to building control with the garden plan. Building control will check that at least the green factor minimum level is met. The objective of this is of course that the area will be constructed as planned and to ensure the proper maintenance of the yard area.

The alternatives to testing the green factor tool on pilot sites include 1) appending the green factor to the terms of transfer of ownership of land, in which case the City of Helsinki is represented by the Real Estate Department. The green factor would be binding, i.e., when the developer makes a reservation for the lot, he would commit to maintain the green factor minimum level set for the lot and building control would also ensure that this happens; 2) making a green factor part of the plan summary, which would make it normative, not binding; or 3) presenting the green factor in the planning regulations, which would make it binding, and building control would oversee it to ensure its realisation. The proposed approaches concern the project's pilot sites; a more extensive application of the green factor method in Helsinki would require decisions to be made in high places, meaning that the approach would be different and more resources would be required for its introduction, and matters would also have to be re-prioritised in various administrative braches.

With regards to the implementation of the green factor, it must be taken into account that, after the introduction of all the green factors in the other cities, the first step in their further development has been to begin the piloting process and seek out their final form that appropriately takes into account the cities' special local features, as well as their appropriate place in the city's land-use planning and design process.

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7 APPENDICES

Appendix 1: Survey to experts

You can enter your answers directly onto the form:

- Mark your answer directly after the response option (arrange, give points, and open questions).
- When you are asked to select one of the response options, mark your answer by **highlighting it.**

Note: the scale varies according to the question type as follows:

- **Arrange:** 1 = most important
- **Give points:** 5 = most important

GENERAL QUESTIONS

1. Arrange: Put in order of importance the following reference points and objectives of the green factor (on a scale of 1 to 4 {1 = most important}):

   A. Ecology (e.g., naturalness, diversity of species and habitats)
   B. Cityscape (e.g., regional integrity, aesthetic plant selections)
   C. Functionality (e.g., versatility, adaptability, accessibility)
   D. Maintenance considerations (e.g., durability, easy care, low costs)

2. Give points: You can use the green factor to promote the preservation of ecosystem services in urban areas. How important do you think it is to take into account the following ecosystem services in the green factor (on a scale of 1 to 5 {5 = most important}; cannot say = CNS)?

   A. Stormwater capture and treatment
   B. Carbon sequestration and storage
   C. Visual screen, cover against noise and wind conditions
   D. Capture of air pollutants
   E. Cooling urban heat islands and shading
   F. Pollination
   G. Habitats for animals
   H. Food production through urban farming
   I. An aesthetic cityscape
   J. Environmental education, learning from nature
   K. Other, please specify

3.
   i. Give points: How important do you think it is to take into account current land use in the planning area in the development of the green factor (on a scale of 1 to 5 {5 = most important}; cannot say = CNS)
   ii. Open question: In what way should the characteristics of the following forms of land use be taken into account in the development of the green factor?

      A. Residential (*AK, AR, AO)*
      B. Services (*Businesses/offices, services)*
      C. Industrial/logistics
      D. Other, please specify

4. Arrange: Put in order of importance the following conditions and characteristics to be taken into account in the development of the green factor method (on a scale of 1 to 4 {1 = most important}):

   A. Soil
   B. Water conditions
   C. Climate
   D. Original vegetation

5. Open question + grounds: In your opinion, should limitations/special requirements be set for the green factor in irregular sites? On what grounds?
   - *E.g., close to sites of historical interest or other sites of importance*
   - *E.g., in the surroundings of nature conservation areas*
   - *E.g., in especially windy regions (e.g., Helsinki by the sea)?*

6. Arrange: Which of the following elements should be most heavily taken into account in the Helsinki Green Factor? Put in order of importance (on a scale of 1 to 4 {1 = most important}):

    A. Vegetation
    B. Growing mediums
    C. Stormwater purification and infiltration solutions
    D. Surfaces/pavements

7. Give points: How important do you think it is to take into account the following solutions in the green factor, e.g., by giving bonus points (on a scale of 1 to 5 {5 = most important}; cannot say = CNS)?

    A. Replacing cut trees with new ones
    B. Using forest floor mat transplants in certain areas of yards where doing so is possible, e.g., complementary construction projects in wooded suburbs
    C. Starting a meadow
    D. Low-maintenance solutions
    E. Solutions that required plenty of maintenance
    F. High-quality solutions

8. Give points: How important do you think it is to take into account the following future needs (on a scale of 1 to 5 {5 = most important}; cannot say = CNS)?

    A. Greywater treatment and utilisation in yards
    B. Cooling elements (shade from the trees, green walls, etc.)
    C. Flood preparedness
    D. Climate-adaptive species
    E. Other, please specify

9. Open question: What do you think, does filling in the green factor spreadsheet mean much more work for the planners?

10. Select: How should the new green factor method be deployed?

    A. In stages
    B. In connection with pilot sites
    C. Other; please specify.

DIRECTED QUESTIONS

City planners and building control

1. Select: Should the green factor requirements

    A. depend on the lot’s building efficiency rate? (in other words, more efficient land use means lower green factor criteria/target levels)
    B. be equal regardless of the lot (in relation to available yard space)?

2. Select + justify: Who do you think is the main user of the green factor spreadsheet when plans are made for a lot and why?
    A. City planner
    B. Party responsible for the specifics of urban block design
    C. Both
    D. Someone else; who?

3. Select: Should the green factor minimum level/target level be incorporated

    A. into the planning regulation as binding
    B. into the general regulations, as a recommendation (normative)
    C. into the building guidance
    D. Other; please specify.

4. Select: If the green factor is incorporated into the planning regulation as binding, would it be a good idea to set a green factor

    A. minimum level?
    B. range?
    C. target level?
    D. Other, please specify

5. Open question + grounds: What should be most heavily taken into account in the green factor with respect to the following construction projects, and why?

   A. New construction
   B. Complementary construction
   C. Renovation

      - *E.g., Increasing the density of a wooded suburb; partial preservation of tree stands, taking into account the temporal strata and 'the spirit of the time'*
      - *E.g., Replacement/compensatory measures; new activities and routes, social priorities? Etc.*

6. Open question + grounds: In your opinion, could some form of concrete compensation be granted to a building permit applicant if they voluntarily exceed the minimum requirements, such as extending the permitted building volume? On what grounds?

7. Let us know what other thoughts you have on the green factor method.

Maintenance and developers

1. Give points: How important do you think it is to incorporate the following criteria into the green factor (on a scale of 1 to 5 {5 = most important}; cannot say = CNS)?
   A. Replacing swings and sandpits, which are often referred to as mandatory, with a water playground in the stormwater swale
   B. Replacing a lawn area allocated for recreational use or sports partially with a clover lawn
   C. Replacing the edges of lawns allocated for recreational use of sports with a meadow (less maitenance; no continuous need for mowing the lawn, a meadow only needs to be mowed once in a summer)
   D. Planting groundcover plants in less used areas of the yard without losing visibility?
   E. Utilising permeable surface materials, such as stone ash or grass stones, where applicable, in areas where the carrying capacity of the structural layers is sufficient?
      - *Parking lots (lanes + spaces)*
      - *Service vehicles only*
      - *Snow plowing*
      - *Rescue routes*
      - *Rescue locations*
      - *Waste management*
      - *Bicycle parking*

2. Open question: If you have experience with stormwater basins and swales, tell us your views on their:

   A. Safety:
   B. Maintenance:

   and any other issues that need to be taken into account.

3. Select: Would you recommend using a stormwater wetland/water meadow that has no permanent pool of water in residential yards rather than a basin or a swale?
   A. Yes
   B. No
   C. Cannot say

4. Open question: How do you feel about combining the yards of different lots into one large courtyard for the whole block?
   - *Is it challenging? Benefits/challenges?*

5. Open question: What challenges could arise from taking the green factor into account in rooftop structures?

   - *What can presumably be done in a rooftop courtyard regarding vegetation, growing medium, stormwater, structures and costs?*
   - *In terms of compensation, could the assumption be more green roofs, for example?*
   - *Could additional compensation be granted for eco-efficiency (e.g., solar panels)?*

6. Let us know what other thoughts you have on the green factor method.

Landscape architects, architects, plant experts and ecologists

1. Open question: With regards to the green factor, how should the following quality-related characteristics of vegetation be measured?

   A. Multi-species vegetation
      - *E.g., number of different species of trees, shrubs and perennials, 0–3, 3–10, more than 10, etc.*

B. Layered vegetation
    - *E.g. number of species of different heights in a given area, 0–3, 3–10, etc.*
    - *E.g., visual estimation of the proportion covered by vegetation in an area measuring 3x3x3 metres, repeated for the total length of the crown (calculating the 'canopy's diversity index' by using the Shannon-Wiener formula)*

2. Select: How to estimate the size of a planted tree (as well as the benefits it brings and the volume of growing medium it requires)?

    A. Size of tree at planting (width/height)
    B. Target size of tree after certain time from planting, e.g., five years (width/height)
    C. Target size of tree when fully grown (width/height)

3. Give points: How important do you think that the following vegetation-related characteristics are in the Helsinki Green Factor (on a scale of 1 to 5 {5 = most important}; cannot say = CNS)?

    A. Suitable for the conditions of the growth environment
    B. Durable and easy to care for
    C. Trees and shrubs that produce flowers and berries at different times
    D. Plants that serve as habitats for animals
    E. Edible plants
    F. Natural green areas (meadows, wetland)
    G. Domestic seedlings and seeds
    H. Coniferous tree species (evergreens, more capacity to capture rainfall and air pollution compared to deciduous trees)

4. Give points: How important do you think it is to favour the following species when designing courtyards (on a scale of 1 to 5 {5 = most important}; cannot say = CNS)
    A. Finnish species
    B. Foreign species that are likely to adapt to the changing climate
    C. Local plant species
    D. Plants selected based on the Santamour rule (planted vegetation is selected from as many genera as possible > diversity)

5. Give points: How important do you think it is that the lot is connected (on a scale of 1 to 5 {5 = most important}; cannot say = CNS)

    A. to an ecological network as part of it (e.g., natural vegetation close to nature conservation areas)?
    B. to the surrounding cityscape?

6. Open question: What kind of conditions would you impose on the utilisation of infiltration structures with regards to:

    A. Soil?
    B. Groundwater height?
    C. Distance of infiltration structures in relation to buildings?
    D. Care/maintenance?

7. Open question: How should animals be taken into account when determining the weighted scores for the green factor?

8. Open question: What is your attitude towards invasive or non-native species?

9. Let us know what other thoughts you have on the green factor method.

Appendix 2: Determining the weighted scores for each element

Note: The numbers in brackets refer to the source; the sources are listed below the table

Element groups	Elements	Ecology		Functionality		Cityscape		Maintenance		Weighted average
Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition; at least 3 m (25 m² each), preserved growing medium 25 m²	Mature trees that are large when fully grown are highly significant for stormwater management with their ability to trap soil water in their roots and to intercept rainwater in their crown (interception evaporation) (11). Their longevity and large biomass also makes them highly significant for carbon sequestration and storage. Especially dominant, large single trees and groups of trees within an open landscape are important habitats (4, 13). In forestry, tree retention has been identified as an effective method of preserving habitats between fellings (6–8); however, it must be taken into consideration that only certain species have the capacity to benefit from this practice. Note: Forest-grown trees with deep roots (e.g. pine) are better suited to individual planting than trees with above-ground roots (e.g. spruce), which often perish if moved to different growth conditions.	**3,0**	Mature trees that are large when fully grown (especially coniferous trees) are highly significant for microclimate regulation and act as visual screens (11). To some degree, stands can also act as a noise barrier (1), although the effect is mostly psychological (visual screen reduces noise annoyance). The is also an important functional aspect, such as recreational use and learning from nature (9). When a tree is in good condition, tree retention does not pose any safety risks if the tree's roots and trunk are protected during the construction phase. Note: Forest-grown trees with deep roots (e.g. pine) are better suited to individual planting than trees with above-ground roots (e.g. spruce), which often perish if moved to different growth conditions.	**3,0**	The landscape value of mature trees that are large when fully grown is very high due to the facilitating effect on the transition from undeveloped land to a built environment. Urban forests have been found to have a positive effect on lot prices (3). Preserved vegetation is often a more significant landscape element compared to planted vegetation, which can take years to establish itself and reach the corresponding size. The landscape value is significantly influenced by the condition of the preserved vegetation. Forest-grown trees with deep roots (e.g. pine) are better suited to individual planting than trees with above-ground roots (e.g. spruce), which often perish if moved to different growth conditions.	**3,0**	After the construction phase, the maintenance need is once a year or less frequently. Fertilising (about once a year), monitoring the tree's condition and removing dangerous branches is necessary in areas where a falling tree may be a safety risk. Typical signs of weakened condition include the tree's crown turning yellow and becoming thinner, and decreased leaf size. Hardwoods are typically more resilient to rot, unlike e.g. birches.	**2,5**	**3,4**

	Preserved small (fully grown > 10 m) tree in good condition; at least 3 m (15m² each), preserved growing medium 15 m²	Mature small trees have the same benefits as large trees, only on a smaller scale. Note: Forest-grown trees with deep roots (e.g. pine) are better suited to individual planting than trees with above-ground roots (e.g. spruce), which often perish if moved to different growth conditions.	**2,5**	Mature small trees have the same benefits as large trees, only on a smaller scale. A tree may also have significance for urban farming, meaning a fruit tree. Tree retention does not pose any safety risks when the tree is in good condition, if the tree's roots and trunk are protected during the construction phase. Note: Forest-grown trees with deep roots (e.g. pine) are better suited to individual planting than trees with above-ground roots (e.g. spruce), which often perish if moved to different growth conditions.	**2,5**	In terms of landscape value, mature trees that are small when fully grown have the same benefits as large trees. Size is a secondary factor, because tree retention itself is valuable. The landscape value is significantly influenced by the species and condition of the preserved vegetation. Forest-grown trees with deep roots (e.g. pine) are better suited to individual planting than trees with above-ground roots (e.g. spruce), which often perish if moved to different growth conditions.	**3,0**	Same maintenance need as with large preserved trees.	**2,5**	**3,0**
	Preserved tree in good condition (1.5–3 m) or a large shrub, 3 m² each, preserved growing medium 3 m²	Same benefits as with preserved trees taller than 3 m, only on a smaller scale. Shrubs have special significance as habitats and places of shelter for many small animals.	**2,0**	Same benefits for functionality as with preserved trees taller than 3 m, only on a smaller scale. A shrub may also have significance for urban farming, meaning e.g. a berry bush.	**2,0**	Same benefits for the landscape value as with preserved trees taller than 3 m, only on a smaller scale. Landscape value is significantly influenced by the condition of the preserved vegetation.	**2,0**	Maintenance need is the same as with preserved trees taller than 3 m, except that shrubs need more fertilising and cutting.	**2,0**	**2,3**
	Preserved natural meadow or natural ground vegetation	Mature natural meadows or ground vegetation have the same benefits as preserved trees and shrubs, only on a smaller scale. Meadows and natural ground vegetation have special significance as sources of food, habitats and places of shelter for many small animals. The preservation of ground vegetation is often challenging, because the vegetation is used to specific growth conditions (cf. forest vegetation).	**2,0**	Same benefits for functionality as with preserved trees and shrubs, only on a smaller scale.	**1,5**	Preserved meadows or ground vegetation have the same benefits for the landscape value as preserved shrubs. Landscape value is significantly influenced by the condition of the preserved vegetation.	**2,0**	Mowing the meadow 1–2 times a year; the maintenance need of preserved ground vegetation requires further research.	**2,0**	**2,1**
	Preserved bare rock	Rock areas are highly significant habitats (4). The points scored for ecology are reduced by the negative impact of impermeable surfaces to stormwater management and carbon sequestration and storage. Rock vegetation is also highly sensitive to wear and tear, which reduces its ecological value unless access to the rock is limited.	**2,0**	A positive functional aspect is the opportunity for recreational use and learning from nature. A negative functional aspect is the sensitivity to wear and tear, which may require protection or access control (e.g. through stairs) to limit erosion and improve safety.	**1,0**	The landscape value of bare rock areas is considerable. The landscape value of rock areas cannot be reproduced artificially afterwards, which is why it should be preserved wherever possible.	**3,0**	Maintenance need is less than once a year. Potential protection or access control (e.g. stairs) is necessary to limit erosion and improve safety.	**3,0**	**2,3**

Planted/new vegetation	Large tree, fully grown ≤ 10 m; 25 m² each; depth of growing medium 0.8 m; dimensions of planting pit for single tree 2 x 2 m	A large planted tree has the same benefits as a corresponding preserved tree, but the benefits are often realised after several years. A large growing medium has significance to stormwater management. The significance of woody plants with long life cycles to carbon sequestration and storage is especially high.	**2,5**	A large planted tree has the same benefits as a corresponding preserved tree, but the benefits are often realised after several years. However, the benefits of a planted tree to microclimate regulation are increased by the opportunity to decide the tree species and place of planting in relation to the building, which is not possible with preserved vegetation.	**2,0**	A large planted tree has the same benefits as a corresponding preserved tree, but the benefits are often realised after several years. However, the landscape value of a planted tree is increased by the opportunity to decide the tree species and place of planting in relation to the building, which is not possible with preserved vegetation.	**3,0**	Maintenance need 1–2 times a year. Fertilising needed once a year; also cutting and protection of trunk against herbivores may be necessary.	**2,0**	**2,7**
	Small tree, fully grown ≤ 10 m; 15 m² each; depth of growing medium 0.6 m; dimensions of planting pit for single tree 1.5 x 1.5 m	Planted small trees have the same benefits as planted large trees, only on a smaller scale (size of the plant and growing medium).	**2,0**	Planted small trees have the same benefits as planted large trees, only on a smaller scale (plant size). A tree may also have significance for urban farming, meaning a fruit tree.	**1,5**	Planted small trees have the same benefits as planted large trees, only on a smaller scale.	**2,5**	Same maintenance needs as with large trees.	**2,0**	**2,2**
	Large shrubs, 3 m² each; depth of growing medium 0.6 m	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (size of the plant and growing medium). Shrubs have special significance as habitats and places of shelter for many small animals.	**1,5**	Planted large shrubs have the same benefits as planted trees, only on a smaller scale (plant size). Shrubs may also have significance for urban farming and act as dividers between various functions in the yard.	**1,0**	Planted large shrubs have the same benefits as planted small trees, only on a smaller scale (plant size). Shrubs are well suited for use as dividers between various functions in the yard.	**2,0**	Slightly more need for maintenance compared to trees. Estimated maintenance need (trimming and fertilising) 2–3 times a year. Protecting the trunk and foliage from herbivores may also be necessary.	**1,5**	**1,7**
	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 (size of the plant and growing medium). Shrubs have special significance as habitats and places of shelter for many small animals.	**1,0**	Planted smaller-sized shrubs have same benefits as large shrubs. Shrubs may also have significance for urban farming.	**1,0**	Smaller-sized planted shrubs have the same benefits as the larger ones. The landscape value is affected equally by the plant size and the choice of species, and the benefit is, therefore, estimated to be the same.	**2,0**	Same maintenance needs as with larger shrubs.	**1,5**	**1,5**

	Perennials, depth of growing medium 0.4–0.6 m	Planted perennials have the same benefits as the element "Other shrubs", but they are usually associated with a larger-sized growing medium (stormwater management). Perennials offer nutrition, habitats and places of shelter for many small animals.	**1,5**	Planted perennials have the same benefits as smaller-sized planted shrubs.	**1,0**	The landscape value of perennials is equal to shrubs: despite being typically smaller in size, perennials often have more lasting and more impressive inflorescences.	**2,0**	Well-planned vegetation does not require maintenance more than once a month. However, the need for maintenance and irrigation varies considerably depending on the species, place of planting and rainfall. On average, the estimated maintenance need is more than 3 times a year. Fertilisation and potential protection from herbivores is necessary.	**1,0**	**1,6**
	Meadow or dry meadow, depth of growing medium 0.15–0.3 m	Meadows and dry meadows are a more natural option (less need for maintenance) and have a more diverse range of species compared to, for example, perennials. However, meadows require a thinner layer of growing medium, which is why they have less significance in stormwater management than perennials. On the whole, they have the same ecological significance. Meadows have special significance for biodiversity e.g. due to flowering plants that attract pollinators (13).	**2,0**	The benefits of meadows to microclimates are comparable to those of perennials. However, a meadow can offer better opportunities to learn from nature.	**1,0**	The opinion on the perceived landscape value is divided. Flowering increases the landscape value of meadows and dry meadows; however, a state of "controlled neglect" is not suitable in all land-use categories.	**1,5**	After taking root (mowed a few times during the summer), needs maintenance 1–2 times per summer, dry meadows even less frequently. Meadows and grass fields require less maintenance than perennials, for example.	**2,0**	**1,8**
	Cultivation plots (depth of growing medium depends on species, at least 0.3 m)	Cultivation plots often comprise annual plant species, meaning that their ecological significance is the highest in the growing season, during which they have major significance for pollinators and the biodiversity of species and moderate significance for stormwater management. Have less significance than e.g. perennials.	**1,0**	Cultivation plots are very significant for functionality due to providing the opportunity for urban farming and learning from nature.	**3,0**	Potential flowering, berries and fruit increase landscape value and variation; the seasonal nature of cultivation and potential untidiness due to neglect reduce landscape value (e.g. in relation to perennials).	**1,5**	Areas suitable for cultivation often require frequent maintenance, but it is the responsibility of the residents. The housing company has less responsibility for maintenance than with e.g. lawns.	**2,0**	**2,2**
	Lawn, depth of growing medium 0.15–0.2 m	Lawns have significance for stormwater management and biodiversity, only on a smaller scale compared to e.g. perennials (size of the plant and growing medium). Typically require regular maintenance, which makes it less significant for biodiversity.	**0,5**	Lawns provide excellent opportunities for play. However, lawns play a minor role in microclimate regulation (size).	**1,5**	A manicured lawn is tidy; landscape value reduces significantly if maintenance is neglected. A one-dimensional element compared to other low vegetation.	**1,0**	Maintenance need more than once a month. Lawns typically require regular cutting and fertilising, as well as irrigation during dry seasons.	**0,5**	**1,1**

	Green roofs (> 0.3 m)	In stormwater management, green roofs are comparable to low vegetation such as lawns. However, green roofs with a growing medium deeper than 0.3 m have more significance for stormwater management compared to lawns (0.05–0.2 m growing medium). Green roofs also reduce the energy consumption of buildings and thus also GHG emissions.	**1,5**	The functionality aspect of green roofs is comparable to low vegetation such as lawns. Green roofs e.g. provide an opportunity for urban farming and reduce the energy consumption of buildings.	**1,5**	Green roofs have significance for the cityscape, because they add greenery to areas normally covered by impermeable surfaces. Furthermore, green roofs can often be seen from longer distances than e.g. low perennial plants. Multi-species and e.g. sedum-covered green roofs are also multi-coloured and create a sense of seasonal variation. The thicker the growing medium on the green roof, the greater the variation in the planted vegetation. The landscape value is estimated to correspond to that of perennials.	**2,0**	Maintenance need more than 3 times a year. Maintenance of the drainage systems and vegetation, and the removal of debris, tree seedlings and snow are required (10). Post-construction installation of a green roof to a building often requires structural changes to increase carrying capacity.	**1,0**	**1,8**
	Green roofs (0.05 – 0.3 m)	A green roof with a 0.05 – 0.3 m deep growing medium has the same ecological benefits as a green roof with a > 0.3 m deep growing medium, only on a smaller scale.	**1,0**	A green roof with a 0.05 – 0.3 m deep growing medium has the same functional benefits as a green roof with a > 0.3 m deep growing medium, only on a smaller scale.	**1,0**	The landscape value is the same as with a thicker green roof, only on a smaller scale, because such a variety of species cannot be planted on a thinner growing medium.	**1,5**	Maintenance need is the same as with a thicker green roof.	**1,0**	**1,3**
	Perennial vines, depth of growing medium 0.6 m, vertical area (2 m² each)	The ecology of perennial vines is comparable to that of other perennial plants. However, when growing vertically, the canopy cover limits the ability to capture stormwater. Therefore, increased vertical area is not directly proportional to the benefits of stormwater management -> lower weighting compared to groundcover perennials.	**1,0**	The benefits of vines to the microclimate and the energy consumption of buildings are similar to those of green roofs.	**1,0**	Vines add greenery to areas normally covered by impermeable surfaces. Flowering/autumn colour vines add colour to a green structure. The landscape value is estimated to be at least corresponding to that of large shrubs.	**2,0**	The estimated maintenance need corresponds to that of shrubs. Certain vines can damage the façade and increase the need for maintenance if they grow against the building.	**1,5**	**1,5**
	Green wall, vertical area	The ecological value of a green wall depends on its location and implementation method. A green wall not connected to the growing medium has less significance for stormwater management compared to vines. Requires further research.	**0,5**	Same estimated benefit as from vines.	**1,0**	A well-planned green wall has the same estimated benefit as vines.	**2,0**	Experiences with the functionality of green walls in Finland are not sufficient for evaluating the maintenance need. However, the need for maintenance measures in order to maintain functionality could be significant. Requires further research. A lawn requiring plenty of maintenance has been used as a point of reference in the comparison.	**0,5**	**1,1**

Pavements	Semipermeable pavements (e.g. grass stones, growing medium 0.3 m)	A semipermeable surface that also contains vegetation capable of transpiration and carbon sequestration is fairly suitable for stormwater management (10). The growing medium is thicker than with normal lawns. Estimated ecological value is equal to that of lawns.	**0,5**	Same functionality as with lawns, with less possibility to regulate the microclimate -> lower weighting.	**1,0**	A semipermeable grass stone pavement is tidy – its landscape value is comparable to that of a lawn.	**1,0**	Maintenance need more than 3 times a year. The winter maintenance of semipermeable pavements is challenging (10). Large amounts of a solid or debris weakens the permeability of the pavement.	**1,0**	**1,0**
	Permeable pavements (e.g. gravel and sand surfaces, stone ash)	Better stormwater permeability compared to grass stones, but fewer other ecological benefits.	**0,5**	Same functionality as with lawns, without the possibility to regulate the microclimate -> lower weighting	**1,0**	Permeable sand, gravel or stone ash surfaces look crisp and clean, and not much maintenance is required to keep them looking tidy. However, these are an unbeneficial element to green structures because they reduce the share of greenery at the site.	**1,0**	Maintenance need is less than once a year.	**3,0**	**1,3**
Stormwater solutions	Rain garden (biofiltration area, no permanent pool of water) with a broad range of layered vegetation	Highly significant for stormwater management and the biodiversity of species; well suited to stormwater management (10). Due to abundant vegetation there is also significance for carbon sequestration. More ecological due to the opportunity to use stormwater for gardening purposes. Note: Avoid invasive species and other aggressively spreading species.	**2,5**	Significance for microclimate regulation and learning from nature due to abundant vegetation. The opportunity for gardening increases functionality.	**2,0**	A well-planned rain garden can be a presentable landscape element whose landscape value is not reduced by occasional dryness. This must be the starting point when selecting the species.	**2,5**	A well-planned rain garden does not suffer from occasional dryness. The estimated maintenance need of vegetation and other surfaces is 1–2 times a year (maintenance need requires further research) (10).	**1,5**	**2,5**
	Infiltration swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	Highly significant for the quantitative and qualitative management of stormwater (10). Less significance for biodiversity and carbon sequestration compared to a rain garden.	**2,5**	Less significance for microclimate regulation compared to a rain garden. For the most part, enables the same functions as lawn and permeable pavements.	**1,5**	Landscape value depends on the way the swale is constructed. Typically, a swale covered with gravel and grass is comparable to the landscape value of such elements.	**1,0**	Maintenance need depends on the construction method. Grass surface is comparable to lawn (0.5), aggregate surfaces require maintenance less frequently. Average maintenance need (1–2 times a year/once a month) = 1. Requires removal of debris and solids, maintenance of the filtering layer, emptying of the pit's sludge chamber (once a year) (10).	**1,0**	**1,9**
	Infiltration pit (underground)	Less significance for the flow equalisation of small water bodies and the prevention of erosion compared to an infiltration swale. No significance for biodiversity and carbon sequestration. On the other hand, frees up space for vegetation or other land use above ground.	**2,0**	No significance for microclimate regulation. The opportunity to place other functions on top of the pit increases functionality.	**1,0**	No significance for the cityscape.	**0,0**	Less maintenance need compared to a structure covered with vegetation. Requires removal of debris and solids, maintenance of the filtering layer, emptying of the pit's sludge chamber (once a year) (10).	**1,5**	**1,4**

	Wetland or water meadow with natural vegetation (permanent pool of water at least part of the year; other times the ground remains moist); See: Hagelberg et al., 2009 (18).	Natural vegetation is important for biodiversity, habitats and the ecological network. Significance for stormwater management comparable to an infiltration swale (10). Due to abundant vegetation there is also significance for carbon sequestration. Note: Avoid invasive species and other aggressively spreading species.	**3,0**	Significance for microclimate regulation and learning from nature due to abundant vegetation.	**2,0**	The opinion on the perceived landscape value is divided. Suitable for use in an open community structure favouring a more natural type of vegetation.	**1,5**	Wetland vegetation requires some maintenance in order to preserve a versatile plant selection, prevent it from becoming overgrown and to ensure functionality. E.g. Ensuring that the equalisation basin and the discharge bed or pipes are cleaned. Estimated need for maintaining the vegetation and ensuring the functionality of the structures is 1–2 times a year; dredging at 10–15 year intervals. (10)	**2,0**	**2,6**
	Retention swale covered with vegetation or aggregates (no permanent pool of water)	Same functions as in a wetland, but less quantitative and qualitative significance for stormwater management. Less significance for biodiversity and carbon sequestration.	**2,0**	Functionality comparable to that of an infiltration swale.	**1,5**	Landscape value depends on the way the swale is constructed. Typically, a swale covered with gravel and grass is comparable to the landscape value of such elements.	**1,0**	Maintenance need comparable to that of an infiltration swale. Includes: maintaining the covering vegetation or aggregates, monitoring the fuctionality of the discharge pipe or soil dam, and removing debris and solids whenever necessary (10)	**1,0**	**1,7**
	Retention pit or tank (underground)	Same functions as in a retention swale, but less significance in qualitative stormwater management. No significance to biodiversity and carbon sequestration. On the other hand, frees up space for vegetation or other land use above ground.	**1,5**	No significance for microclimate regulation. The opportunity to place other functions on top of the pit increases functionality.	**1,0**	No significance for the cityscape.	**0,0**	Maintenance need comparable to that of an infiltration pit. Includes e.g. rinsing the subsoil drain and removing the solids using a suction method (10).	**1,5**	**1,2**
Bonus elements, max score 1/category	Directing stormwater from impermeable surfaces to permeable vegetated areas	Significance for stormwater management in particular. Ecology increases also through reducing tap water use in irrigation.	**1,0**	Functionality increases through the opportunity to utilise stormwater in the maintenance of vegetation.	**0,5**	No significance for the cityscape.	**0,0**	Maintenance need depends on the structure. Probably requires debris removal and cleaning of water pipes 1–2 times a year or more frequently. (10)	**0,5**	**0,7**

	Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	Significance especially for stormwater management and biodiversity, but also to carbon sequestration.	**1,0**	Opportunity for water games and learning from nature. Functionality is reduced by safety aspects, and insects such as mosquitoes are often associated with water features.	**0,5**	Water features have considerable significance for the cityscape.	**1,0**	Estimated maintenance need 1–2 times a year or more frequently; depends on the type of water feature. Often requires debris removal and cleaning the water pipes leading to the water feature. (10)	**0,5**	**0,9**
	Hardwoods and aspen, planted or preserved large tree (25 m² each)	Hardwoods and aspen are highly significant for the preservation of endangered species. They are keystone species (12), meaning that many other species are dependent on their existence. Hardwood stands are very significant habitats (4). Individually planted trees naturally are not comparable to natural forests; however, individual trees in parks, for example, have been noted to act as habitats for many rare polypores (5) and insects. Deciduous trees also improve the soil with their leaf litter, which is more nutritious compared to the litter of coniferous trees (11).	**1,0**	Deciduous trees have less significance for microclimate regulation in relation to deciduous trees (smaller leaf area index, leafless in winter) (11).	**0,5**	Hardwoods are very popular landscape trees in Helsinki.	**1,0**	Hardwoods often need to be protected against herbivores at the seedling stage. After taking root, not much need for maintenance (Note: Avoid using elms (Ulmus) exclusively on account of the elm disease)	**1,0**	**1,0**
	Coniferous trees, planted or preserved large tree (25 m² each)	Due to being evergreen and having a greater leaf area index (LAI), coniferous trees have more significance for stormwater management compared to hardwoods (11).	**0,5**	Hardwoods are highly significant for microclimate regulation due to their great leaf area and evergreen nature – protection against noise, wind and air pollution.	**1,0**	The significance hardwoods have for the cityscape is emphasised especially during winter when there is less coverage by other vegetation (with leaves).	**1,0**	After taking root, not much need for maintenance. However, coniferous trees are often more sensitive to air pollution than deciduous trees (defoliation) (15).	**1,0**	**1,0**
	Coniferous trees, planted or preserved small tree (15 m² each)	Due to being evergreen and having a greater leaf area index (LAI), coniferous trees have more significance for stormwater management compared to hardwoods (11).	**0,5**	Hardwoods are highly significant for microclimate regulation due to their great leaf area and evergreen nature - protection against noise, wind and air pollution.	**1,0**	The significance hardwoods have for the cityscape is emphasised especially during winter when there is less coverage by other vegetation (with leaves).	**1,0**	After taking root, not much need for maintenance. However, coniferous trees are often more sensitive to air pollution than deciduous trees (defoliation) (15).	**1,0**	**1,0**

	Shading large tree (25 m² each) on the south or southwest side of the building (especially deciduous trees)	Significance for stormwater management, carbon sequestration and biodiversity.	**0,5**	Shading trees blocking the sunlight reduce the cooling need of buildings in the summer.	**1,0**	Trees have significance for the cityscape.	**1,0**	No significant need for maintenance.	**1,0**	**1,0**
	Shading small tree (15 m² each) on the south or southwest side of the building (especially deciduous trees)	Significance for stormwater management, carbon sequestration and biodiversity.	**0,5**	Shading trees blocking the sunlight reduce the cooling need of buildings in the summer.	**1,0**	Trees have significance for the cityscape.	**1,0**	No significant need for maintenance.	**1,0**	**1,0**
	Fruit trees suitable for cultivation (15 m² each)	Perennial fruit trees are important for biodiversity (pollination, acting as food plants), carbon sequestration and stormwater management.	**1,0**	Significance for recreational use (e.g. urban farming) and learning from nature.	**1,0**	Trees that flower at the beginning of the growing season and later produce fruit are often highly significant for the cityscape.	**1,0**	Fruit trees require maintenance at least twice a year (fertilising, cutting), and they also often need to be protected against herbivores.	**0,5**	**1,1**
	Berry bushes suitable for cultivation (3 m² each)	Perennial berry bushes are important for biodiversity (pollination, acting as food plants), carbon sequestration and stormwater management.	**1,0**	Significance for recreational use (e.g. urban farming) and learning from nature.	**1,0**	Berry-producing bushes are highly significant for the cityscape.	**1,0**	Berry bushes require maintenance at least twice a year (fertilising, cutting), and they also often need protection against herbivores.	**0,5**	**1,1**
	A selection of native species – at least 5 species/100 m²	Natural vegetation is important for biodiversity, habitats and the ecological network. Regionally appropriate vegetation also reduces the need for maintenance, meaning it is more ecological.	**1,0**	Significance for the microclimate and learning from nature.	**0,5**	Regionally appropriate species increase the landscape value.	**1,0**	After taking root, not much need for maintenance. Regionally suitable vegetation significantly reduces the need for maintenance.	**1,0**	**1,0**
	Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m²	Important for biodiversity, habitats and the ecological network. Regionally appropriate vegetation also reduces the need for maintenance, meaning it is more ecological.	**1,0**	Significance for the microclimate and learning from nature.	**0,5**	Regionally appropriate species increase the landscape value. Flowering species especially are significant for the cityscape.	**1,0**	After taking root, not much need for maintenance. Regionally suitable vegetation significantly reduces the need for maintenance.	**1,0**	**1,0**

Butterfly meadows	The composition of butterfly meadows especially comprises food plants favoured by butterflies (16, 17). Important for biodiversity, habitats and the ecological network.	**1,0**	Significance for learning from nature and nature observations in particular.	**1,0**	Flowering and colourful plants are especially significant for the cityscape.	**1,0**	Maintenance 1–2 times a year, or more frequently if perennials are planted in the butterfly meadow.	**0,5**	**1,1**
Plants with pleasant scent or impressi	Flowering and fragrant plants often also have significance for pollinators (13) – significance for biodiversity.	**0,5**	Significance for learning from nature in particular.	**1,0**	Flowering and colourful plants are especially significant for the cityscape.	**1,0**	Flowering plants often have greater need for maintenance.	**0,5**	**0,9**
Boxes for urban farming/cultivation	The ecological value of boxes for urban farming/cultivation is estimated to be equal to that of plantings with a pleasant scent and impressive blooming. However, the significance of boxes for urban farming/cultivation with regards to stormwater is limited.	**0,5**	Significance for recreational use (e.g. urban farming) and learning from nature.	**1,0**	Boxes for urban farming/cultivation can increase the cityscape's biodiversity e.g. through flowering plants. The seasonal nature of cultivation and potential untidiness due to neglect reduce it.	**0,5**	Areas suitable for cultivation usually have a great need for maintenance, but it is the responsibility of the residents. The housing company probably bears the responsibility for maintaining the boxes.	**0,5**	**0,8**
Permeable surface designated for play or sports (e.g. sand or gravel covered playgrounds, sports turf)	Permeable surfaces are significant for stormwater management.	**0,5**	Multipurpose surfaces increase functionality.	**1,0**	No significant landscape value.	**0,0**	The wear and tear on green surfaces and the requirements posed by multipurpose use increase the need for maintenance.	**0,0**	**0,6**
Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	Potential significance for biodiversity and carbon sequestration.	**0,5**	Significance for urban farming, communality and learning from nature.	**1,0**	Landscape value is created by increasing green surfaces.	**0,5**	Growing plants in pots increases the need for maintenance of vegetation.	**0,0**	**0,7**
Preserved dead wood/stump (5 m² each)	A tree left to rot provides habitats and nutrition to a large portion of endangered forest species. Especially a robust rotted tree is highly significant for the biodiversity of the species and habitats and to the ecological network (4) (6-8).	**1,0**	Functionality is increased by the opportunity to learn from nature. Dead wood can also act as a divider (access control e.g. on the edges of paths) and as play environments.	**1,0**	The landscape value of a dead tree is very subjective. Especially a robust tree can be (and is) utilised as a divider at the site; on the other hand, a rotting tree can be perceived as untidy, particularly if located in an environment used for representation purposes.	**1,0**	No maintenance required. Rotting and decaying occur naturally in dead wood.	**1,0**	**1,2**

		Bird boxes (2 m² each)	Significance for biodiversity and the ecological network.	**1,0**	Significance for learning from nature and nature observations.	**0,5**	No significant landscape value.	**0,0**	No significant need for maintenance.	**1,0**	**0,8**

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Appendix 3. Quantity calculations

		Unit	VE1	VE2	VE3	Jätkäsaari
General	Total area of the lot	m²	9,537	9,537	9,537	5,898
	Building footprint, total	m²	4,366	4,366	4,366	2,851
	Permitted building volume	m² (gross floor area)	10,800	10,800	10,800	12,700
Preserved vegetation/soil	Large tree, deciduous	Pcs	0	0	0	0
	Large tree, coniferous	Pcs	1	4	5	0
	Small tree, deciduous	Pcs	1	2	2	0
	Small tree, coniferous	pcs	0	0	1	0
	Forest floor	m²	0	40	80	0
Planted/new vegetation	Large tree, deciduous	pcs	4	4	4	8
	Large tree, coniferous	pcs	5	6	4	0
	Small tree	pcs	9	8	7	19
	Small tree, blooming	pcs	0	5	6	0
	Small tree, fruit	pcs	3	2	4	0
	Large/single shrub	pcs	12	13	25	28
	Other shrubs	m²	291	371	281	522.5
	Vine, at the base of a tree	pcs	3	3	3	55
	Vine, on a lattice (height x rm x 2 m)	m²	0	19	19	0
	Vine, green wall (height x rm x 3 m)	m²	0	0	78	0
	Vine, green wall, ground area	m²	0	0	26	0
	Perennials, groundcover	m²	0	0	18	49
	Lawn	m²	2,301	1,700	1,633	604
	Reinforced lawn	m²	0	0	125	0
	Meadow	m²	0	405	0	0
	Forest floor mat transplant or a meadow	m²	0	0	232	0
	Cultivation plots	m²	0	22	70	12
	Green roof, minor diversity	m²	117	0	0	0
	Green roof, moderate diversity	m²	0	117	0	0
	Green roof, great diversity	m²	0	0	117	0
	Flowers grown from bulbs	pcs	0	0	0	1000
Pavements	Asphalt	m²	849	700	611	715
	Concrete slabs	m²	262	248	187	230.5
	Concrete stone	m²	0	0	0	93
	Grass stone	m²	74	125	0	258
	Slate	m²	0	0	22	0
	Cobblestone pavement, stone ash seam	m²	0	0	0	97.5
	Safety platform, cast	m²	0	0	0	31
	Play sand/safety gravel	m²	109	83	126	23
	Stone ash	m²	0	142	388	13
	Laying gravel/lake gravel	m²	0	0	0	31
	Stone wall	m²	0	0	11	0
Stormwater solutions	Rain garden	m²	0	0	101	0
	Retention swale	m²	499	407	140	0
	Infiltration swale	m²	0	0	218	0
	Rock-filled infiltration pit	m²	0	15	0	0
	Channel	m²	183	183	183	64
Total area of the lot	Surfaces	m²	4,186	4,111	4,105	2,765
	Buildings	m²	3,602	3,602	3,602	2,851
	Shelter	m²	271	271	271	0
	Area of the lot (measured)	m²	8,057	8,057	8,057	5,898
Parking lot	Large tree, deciduous	pcs	1	2	1	0
	Large tree, coniferous	pcs	2	0	1	0
	Large/single shrub	pcs	0	0	3	0
	Other shrubs	m²	27	44	44	0
	Lawn	m²	147	128	0	0
	Rain garden	m²	0	0	128	0
	Asphalt	m²	754	754	0	0
	Concrete slabs	m²	58	0	0	0
	Stone ash	m²	0	61	815	0
	Green roof, minor diversity	m²	493	0	0	0
	Green roof, moderate diversity	m²	0	490	0	0
	Green roof, great diversity	m²	0	0	493	0
	Swale	m²	20	20	20	0
Total, parking lot	Surfaces	m²	1,479	1,477	1,480	0
	Car shelter	m²	493	493	493	0
	Area of the lot (measured)	m²	1,480	1,480	1,480	0

Appendix 4. User Instructions for the City of Helsinki Green Factor tool

1 Taking the tool into use

An Excel-based user interface uses Visual Basic macros. Using macros enables, for example switching between sheets easily with a click of a button. To ensure that the tool functions properly, macros must be enabled on opening the tool. In the 2007 version of Microsoft Office Excel, macros are enabled by clicking the "Settings" button in the "Security Warning" bar. From the menu that opens, select "*Enable this content*". **Figure 1** demonstrates the process in the English-language version of Microsoft Office Excel 2007.

FIGURE 1: ENABLING MACROS

2 Usage and structure of the tool

The first sheet of the tool, **Instructions,** contains brief instructions on how to use the tool. It is recommended to read the instructions before starting the scoring, but the instructions can also be read mid-process by clicking on the "Instructions" button. To start the scoring, click on the "Start" button in the **Instructions** sheet or the **Limitations** tab at the bottom of the screen.

The analysis process of the Green Factor tool has three stages, to be completed in the following order: 1) Limitations, 2) Green Factor, and 3) Results. Use the "Previous" and "Next" buttons or the tabs at the bottom of the screen to move between the stages.

The **Green Factor** sheet contains "More info" buttons for each element group. Clicking them will take you to a separate (otherwise hidden) **More Info** sheet, which contains more information on the weighting of each element. Click the "Back" button to leave the **More Info** sheet and go back to the **Green Factor** sheet.

3 The three-stages of Green Factor scoring

3.1 Stage 1: Limitations

Start the scoring by defining the site-specific characteristics and limitations in the tool's second sheet, **Limitations** (**Figure 2**). First, fill in the block ID, lot ID, the site area (m^2), the building footprint (m^2) and the floor area (m^2) in the empty (white) fields on the right. The ratios affecting the minimum level, "Ratio of building footprint to site area" and "Ratio of floor area to site area" will be shown in the fields below. The latter, which is based on the floor area, is calculated for use by the designer. In the green factor scoring of a block, it is usually only necessary to enter the block ID, but with individual sites it is recommended to enter both the block ID and the lot ID. The block ID and lot ID and the date of the analysis will be updated automatically in the **Green Factor** and **Results** sheets.

Next, select the appropriate response to eight yes or no and multiple choice questions about site-specific attributes. In this version of the tool, the response to **Question 1** "*Is this a new construction project?*" does not yet have any effect on the target and minimum levels, because the response is by default "yes". The question is included in the limitations for the purpose of future updates to the green factor tool, meaning the possibility to also take into account complementary construction projects.

Multiple choice question 2 regarding land use is for determining the green factor target level for the site, which is updated automatically according to the selections in the "Target level" field on the right.

Question 3 asks whether the site is a perimeter block, meaning that it has a closed yard where none of the sides are (fully) open to the surrounding areas. If the answer is "yes", the figure in the "Minimum level" field will be updated accordingly. In **multiple choice question 4,** select the most appropriate yard type based on the share of the rooftop courtyard: "Share of rooftop courtyard less than 25%", "Share of rooftop courtyard 25-75%" or "Share of rooftop courtyard more than 75%". The two latter options will have an effect on the minimum level required in the site, and the figure in the "Minimum level" field on the right will be updated accordingly.

Question 5, "Can the site be connected to a separate drainage system?" is for mapping the stormwater management solutions necessary for the site. If the answer is "no", meaning that the lot's stormwater cannot be directed to an existing stormwater drain or one under-construction, at least one new stormwater management structure must be constructed at the site. The requirement will be updated in the "Element-specific minimum requirements" field on the right. The element-specific requirement does not apply if the site is a perimeter block or if the share of the rooftop courtyard at the site is more than 25%.

Question 6 is for mapping nearby (within 50 metres of the lot) nature conservation areas, bodies of water and green corridors comprising natural vegetation, the existence of which means that original vegetation or soil at the site should be preserved as far as possible in order to mitigate the adverse environmental effects of construction. If fulfilled, the requirement concerning a preserved element will be updated in the “Element-specific minimum requirements” field on the right. As with the previous question, the element-specific requirement does not apply if the site is a perimeter block or if the share of the rooftop courtyard at the site is more than 25%.

Question 7 is for determining whether there are any soil-related restrictions. If the site has impermeable soil or groundwater within an average distance of less than 100 cm from ground level, it presents considerable restrictions on the planted vegetation and stormwater solutions, which will also be taken into account in the required minimum level. In such a case, the change to the minimum level will be updated in the “Minimum level” field.

Lastly, **question 8** takes into account any space-taking renewable energy production solutions situated at the site, such as small wind turbines and solar panels. Such solutions can take up space from green surfaces and elements, which is taken into account in the minimum level.

Note. *The minimum level cannot fall below the absolute minimum level set for land use* ([target level] – 0.3). In residential areas, for example, the target level is 0.8, and the absolute minimum level is 0.5. If the absolute minimum level has been achieved, the figure in the “Minimum level” field will not be affected by additional selections that would otherwise have an effect on the minimum level.

After all the questions regarding the limitations have been answered and the target and minimum levels for the site have been determined, you can move to the next stage by clicking the “Next” button or by using the tabs at the bottom of the screen.

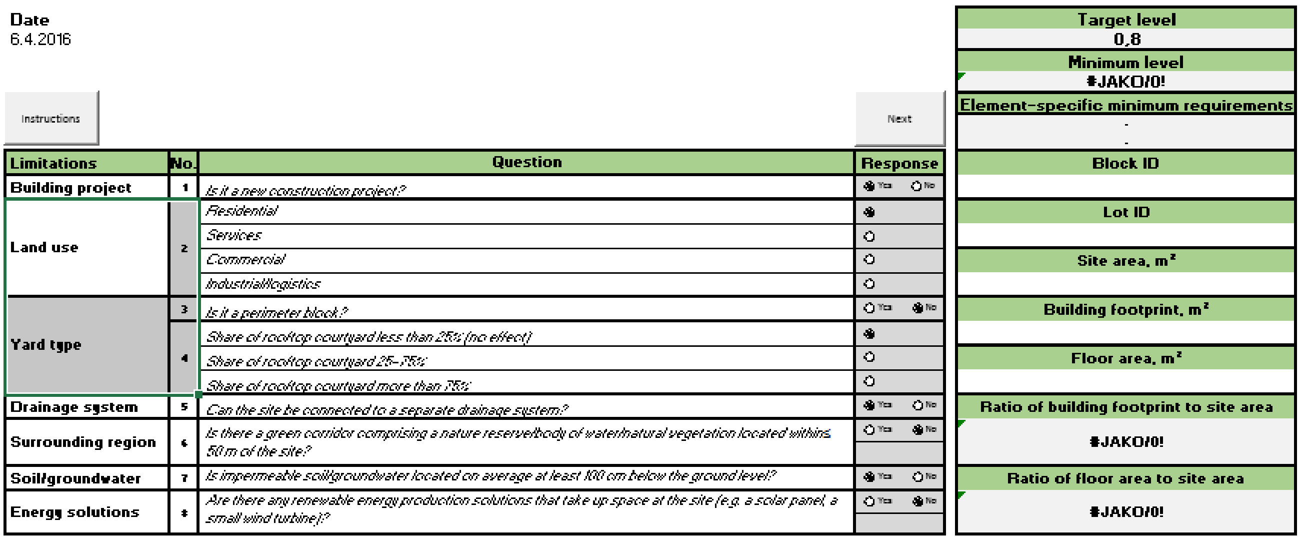


FIGURE 2: THE LIMITATIONS SHEET

3.2 Stage 2: Green Factor scoring

In the tool's third sheet, **Green Factor**, the areas or quantities of the green factor elements used are entered in the "Area or quantity" column for the calculation of the green factor score. Other columns do not need to be modified. The unit of measure for each piece of information (m^2/pcs) is shown in the "Unit" column (**Figure 3**).

Green Factor
#JAKO/0!
Target level
0,8
Minimum level
#JAKO/0!
Element-specific minimum
-
-
Site area, m^2
0
Total weighted area, m^2
0

Element group	Element description	Unit	Area or quantity	Weighting	Weighted area, m^2
Preserved vegetation and soil	Preserved large (fully grown > 10 m) tree in good condition, at least 3 m (25 m^2 each)	pcs		3,4	0,0
	Preserved small (fully grown ≤ 10 m) tree in good condition, at least 3 m (15 m^2 each)	pcs		3,0	0,0
	Preserved tree in good condition (1.5–3 m) or a large shrub (3 m^2 each)	pcs		2,3	0,0
	Preserved natural meadow or natural ground vegetation	m^2		2,1	0,0
More info	Preserved natural bare rock area (at least partially bare rock surface, not many trees)	m^2		2,3	0,0
Planted/new vegetation	Large tree species, fully grown > 10 m (25 m^2 each)	pcs		2,7	0,0
	Small tree species, fully grown ≤ 10 m (15 m^2 each)	pcs		2,2	0,0
	Large shrubs (3 m^2 each)	pcs		1,7	0,0
	Other shrubs	m^2		1,5	0,0
	Perennials	m^2		1,6	0,0
	Meadow or dry meadow	m^2		1,8	0,0
	Cultivation plots	m^2		2,2	0,0
	Lawn	m^2		1,1	0,0
	Green roofs (> 0.3 m)	m^2		1,8	0,0
	Green roofs (0.05 – 0.3 m)	m^2		1,3	0,0
	Perennial vines (2 m^2 each)	pcs		1,5	0,0
More info	Green wall, vertical area	m^2		1,1	0,0
Pavements	Semipermeable pavements (e.g. grass stones)	m^2		1,0	0,0
More info	Permeable pavements (e.g. gravel and sand surfaces, stone ash)	m^2		1,3	0,0
Stormwater solutions	Rain garden (biofiltration area, no permanent pool of water) with a broad range of layered vegetation	m^2		2,5	0,0
	Infiltration swale covered with vegetation or aggregates (no permanent pool of water, permeable soil)	m^2		1,9	0,0
	Infiltration pit (underground)	m^2		1,4	0,0
	Wetland or water meadow with natural vegetation (permanent water surface at least part of the year; at other times the ground remains	m^2		2,6	0,0
	Retention swale covered with vegetation or aggregates (no permanent water surface, permeable soil)	m^2		1,7	0,0
More info	Retention pit or tank (underground)	m^2		1,2	0,0
Bonus elements, max score 1/category	Capturing stormwater from impermeable surfaces for use in irrigation or directing it in a controlled manner to permeable vegetated areas	m^2		0,7	0,0
	Directing stormwater from impermeable surfaces to constructed water features, such as ponds and streams, with flowing water	m^2		0,9	0,0
	Hardwoods and aspen, planted or preserved large tree (25 m^2 each)	pcs		1,0	0,0
	Coniferous trees, planted or preserved large tree (25 m^2 each)	pcs		1,0	0,0
	Coniferous trees, planted or preserved small tree (15 m^2 each)	pcs		1,0	0,0
	Shading large tree (25 m^2 each) on the south or southwest side of the building (especially deciduous trees)	pcs		1,0	0,0
	Shading small tree (15 m^2 each) on the south or southwest side of the building (especially deciduous trees)	pcs		1,0	0,0
	Fruit trees suitable for cultivation (15 m^2 each)	pcs		1,1	0,0
	Berry bushes suitable for cultivation (3 m^2 each)	pcs		1,1	0,0
	A selection of native species – at least 5 species/100 m^2	m^2		1,0	0,0
	Tree species native to Helsinki and flowering trees and shrubs – at least 3 species/100 m^2	m^2		1,0	0,0
	Butterfly meadows	m^2		1,1	0,0
	Plants with pleasant scent or impressive blooming	m^2		0,9	0,0
	Boxes for urban farming/cultivation	m^2		0,8	0,0
	Impermeable surface designated for play or sports (e.g. sand- or gravel-covered playgrounds, sports turf)	m^2		0,6	0,0
	Communal rooftop gardens or balconies with at least 10% of the total area covered by vegetation	m^2		0,7	0,0
	Preserved dead wood/stump (5 m^2 each)	pcs		1,2	0,0
More info	Bird boxes (2 m^2 each)	pcs		0,8	0,0

Date
6.4.2016
Block ID
-
Lot ID
-

Instructions Previous Clear Next

FIGURE 3: THE GREEN FACTOR SHEET

Use the "More info" buttons to open separate **More Info** sheets that contain more information on the weighting of the elements. To go back to the **Green Factor** sheet, click on the "Back" button.

After all the area information has been entered into the table, the green factor score achieved for the site will appear automatically in the upper left corner, and the target and minimum levels, as well as the element-specific minimum requirements (if any), will be given as reference below.

To improve usability, the **Green Factor** sheet has a “Clear” button, for clearing all the area information entered in the table. The information will be deleted permanently and cannot be retrieved later. Before the information is cleared, a dialogue box will open to confirm that you really wish to clear all the information (**Figure 4**).

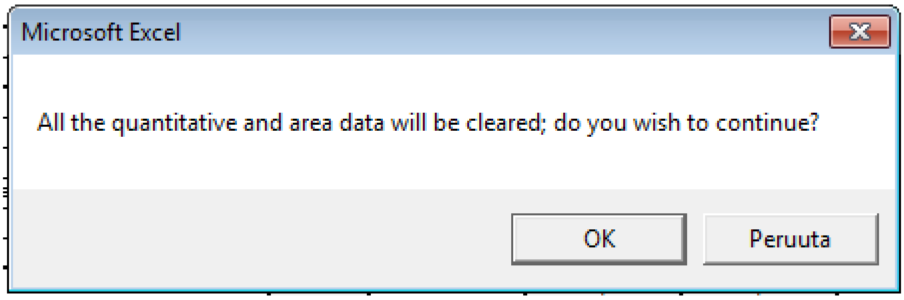


FIGURE 4: CLEARING INFORMATION IN THE GREEN FACTOR SHEET

After the scoring is complete, the results can be viewed by clicking the “Next” button or the tab of the Results sheet.

3.3 Stage 3: Results

The results are shown in a separate **Results** sheet (**Figure 5**). The date (updated automatically when the table is opened) and the block ID and lot ID defined in the **Limitations** sheet appear automatically at the top of the Score card. The results shown in the Score card include the lot’s green factor score, the target and minimum levels, the fulfilment of element-specific minimum requirements, the share of the elements used from the total amount of elements used, and the effect on the green factor score. The person who filled in the tables of the Green Factor tool can leave comments in the “User comments” field for future reference to others viewing the results. Such comments may include, for example, regional special targets, assumptions used in the scoring, or any uncertainties that may have risen during the analysis process.

If you wish to modify the information you have entered, the “Previous” button will take you back to the **Green Factor** sheet.

Score card

Date 6.4.2016

Block ID -
Lot ID -

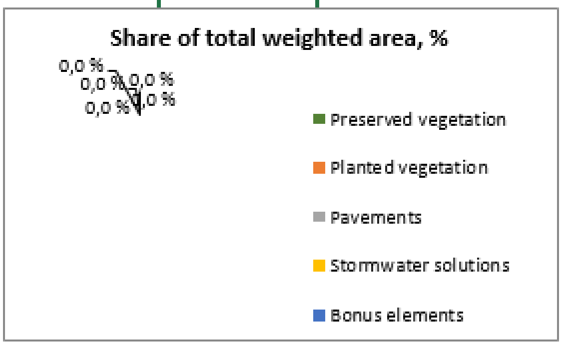
Green Factor
#JAKO/0!
Target level
0,8
Minimum level
#JAKO/0!

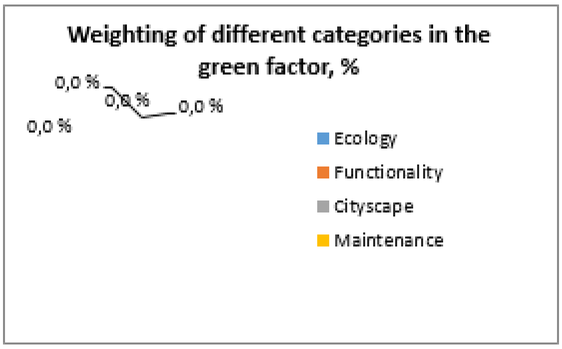
Elements included in the green factor

Element group	Elements filled	Total number of element groups
Preserved vegetation	0	5
Planted vegetation	0	12
Pavements	0	2
Stormwater solutions	0	6
Bonus elements	0	18
Total	0	43

Element-specific minimum requirements filled	
Stormwater solution	Yes
Preserved vegetation	Yes

Comments:





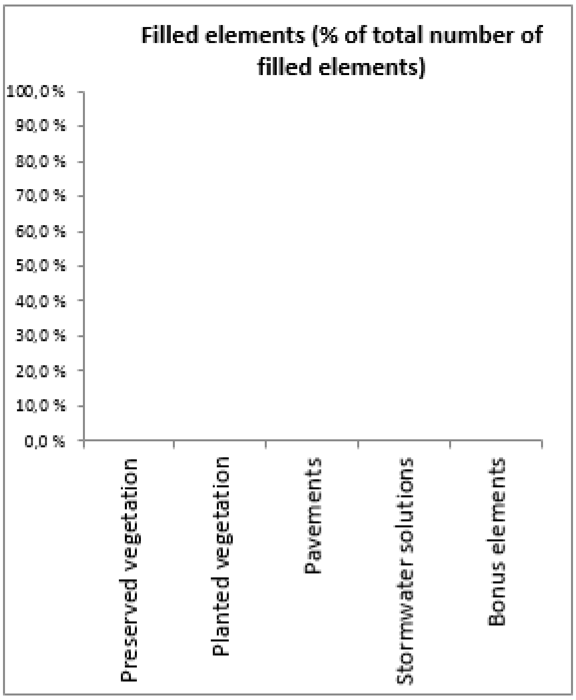


FIGURE 5: THE RESULTS SHEET