

Berlin: The Biotope Area Factor

Climate change impacts addressed	High temperatures Urban flooding
Spatial scale	Town or city
Response type	Regulations
Themes driving the initiative	Biodiversity conservation Quality of life and attractiveness of place
Factors of success	Internal collaboration Sound evidence base

Summary

In Berlin, plans for the development of new buildings now fall under a regulation that requires a certain proportion of the development area to be left as a green space. The proportion of green space to the entire development area is referred to as the Biotope Area Factor (BAF or BFF for *Biotopt Flächenfaktor*). The regulation is a part of a larger suite of documents relating to landscape planning, landscape design and species protection. It responds to the need to encourage more green space areas to be developed in densely built-up urban locations. An important advantage of the BAF regulation is that it allows flexibility of the site design; the developer may decide what green space measures are applied, and where, as long as the required green space ratio is achieved. The Biotope Area Factor has generated a significant international interest.

Case study location

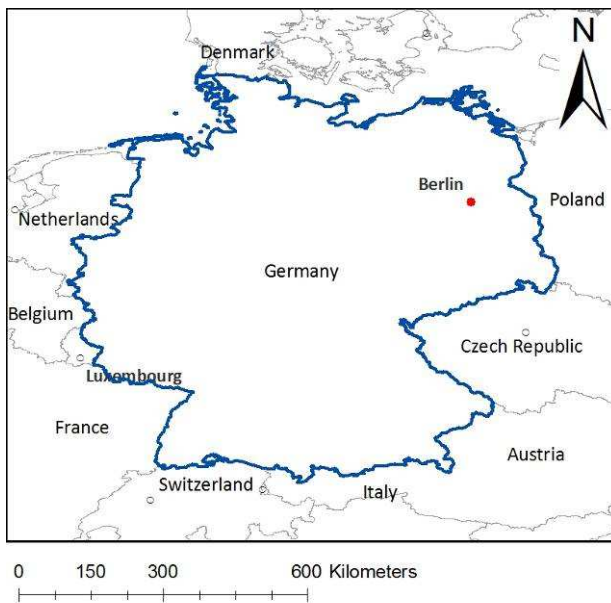


Figure 1. Location of Berlin

After the fall of the wall, Berlin became the new federal capital of Germany. The population of Berlin is almost 3.4 million. Berlin is one of three German city-states, which combine the functions of city and state. Berlin's executive body is the Senate of Berlin (Senat von Berlin), consisting of the Governing Mayor (Regierender Bürgermeister) and up to eight senators holding ministerial positions. There are 12 boroughs in Berlin, each with a mayor and six councillors ⁽¹⁾.

Berlin's city centre is characterised by high density development. This development pattern influences environmental conditions, resulting in a high degree of soil sealing, inadequate replenishment of groundwater due to the rapid runoff of rainfall into the sewage system, lack of humidity and excess warming, and biodiversity pressures due to inadequate green space cover ⁽²⁾.

Berlin has an Oceanic climate (Cfb) according to the Köppen climate classification system. The city features a temperate climate. Summers are warm with average high temperatures of 22–25°C and lows of 12–14°C. Winters are cold with average high temperatures of 4°C and lows of –2 to 0°C. Berlin's built environment creates a microclimate, with heat stored by the city's buildings. Temperatures can be 4°C higher in the city than in surrounding areas. Annual precipitation is 570 millimetres with moderate rainfall throughout the year. Light snowfall mainly occurs from December through March, but snow cover

does not usually remain for long¹. The future climate projections indicate a rise in mean annual temperature of 2.2°C by the 2080s under the medium-high emissions scenario. In the summer, precipitation is projected to decrease by around 10%, while in winter it is projected to increase by 10-30%⁽³⁾.

Development of the initiative

Key aims

In the city centre, the Biotope Area Factor (BAF) is a particular approach targeted at safeguarding and enhancing the presence of vegetation in the built environment. The key aim is to ensure that a given proportion of a particular site area is left undeveloped, i.e. covered by vegetation⁽²⁾. The BAF strategy aims to retain high densities of development, whilst also developing the city's green infrastructure⁽⁴⁾.

BAF = Ecologically-effective surface areas / total land area

Themes driving the initiative

Ecological traditions

Germany has one of the strongest ecological traditions in Europe. There is a widespread appreciation of the benefits of nature in towns and cities, particularly in respect of making cities more liveable. This is important given the preference for high density housing in Germany. Consequently, Berlin is an exemplar with its pioneering green infrastructure and community forestry projects⁽⁴⁾. The main driver behind the BAF strategy was the need to reduce the city's impact on the environment by compensating for current deficits in open space. The approach was guided by the Landscape Programme for Berlin⁽²⁾.

The Landscape Programme 1984/1994

The Landscape Programme for West Berlin was introduced in 1984. At that time, nature conservation was a priority for almost all political parties, which secured high level backing for the Programme. At a technical level, a great amount of effort was put into collecting the basic information needed for an inventory of West Berlin's nature and landscape, and into developing initial suitable evaluation methods and procedures. The recruitment of additional administrative staff in 1985 speeded the process up considerably, and helped to make the Programme what it is today⁽⁵⁾. The main strategies of the Landscape Programme focus on the protection of nature and wildlife, natural resources, landscape, and recreation areas⁽¹⁾. The Biotope Area Factor fits into the nature and wildlife protection strand of the Programme.

Political and financial situation in Berlin

The unique opportunity to develop the vast central area of the city after the reunification of East and West Berlin provided a testing ground for innovative large-scale green infrastructure projects⁽¹⁾. Plans highlighting Berlin's existing habitat networks have been prepared, which divide it into different character areas. These include central city (where BAF is used to secure presence of vegetation); transition areas (mixed use, where green linkages are prioritised), and landscape elements in the periphery of urban areas, where larger habitat "fingers" penetrate into the urban

¹ World Meteorological Organisation <http://www.worldweather.org/016/c00059.htm>

area ⁽⁴⁾. At the same time, planners were confronted with the challenges associated with a potential growth in the population of up to 300,000 in the city and up to 1.5 million in the region, alongside demands for 550 hectares of new building land for commercial businesses, offices and retail. A speedy decision was made to abolish allotment areas in central locations as a means of securing land in return for an agreement to protect open spaces and climatically important mitigation areas and recreation areas on the city's outskirts ⁽⁵⁾.

The greening of the urban environment in the 1980s and 1990s was mainly implemented by providing financial incentives and subsidies to developers and residents (Box 1). The city of Berlin has since suffered deficits, and the programme of direct financial incentives has been replaced by a system of fees and regulations ⁽¹⁾.

Box 1. Green courtyards and green roofs in Berlin

Berlin has a long history of planning for green spaces in densely developed areas. The Courtyard Greening Programme (1983-1996), aimed to add green space in the form of green roofs, green facades and backyard community gardens in the most densely built-up areas of the city. The aim was to improve urban climate, quality of life for residents, and the urban amenity. On average each square meter of green space was subsidized with 19.10 € of funding, which included separate amounts for construction and design. During the period of the program, 54 ha of courtyard and roofs were greened and 32.5 ha of facades were greened. This translated into subsidies worth €16.5 million. This initiative has helped the Landscape Programme to implement goals relating to increasing green space in the city ⁽⁵⁾.

Approximately 65,750 m² of extensive green roofs have been subsidized. Residents received a reimbursement for about half (25-60 €/m²), of their expenses for the cost of green roof installation ⁽¹⁾.

Details of the initiative

A fundamental objective of the Landscape Programme is to find fair planning solutions which, without losing the urban character of the city, integrate open spaces and vegetation around developments thereby making the most of the limited space available in the city. The Landscape Programme complements the process of town planning and preparation of the spatial development plan (The Land Use Plan), setting qualitative goals for urban planning. The Landscape Programme focuses on resolving land use conflicts resulting, for example, from new infrastructure developments and plans for building on land for residential use, industry, commerce and services ⁽⁵⁾.

The Biotope Area Factor (BAF) was developed in the 1980s in Berlin's western sector before reunification, and was introduced as a binding document in 1994 ⁽⁴⁾. The BAF is similar to other urban planning parameters used to regulate development planning such as the gross floor area, the site occupancy index, and the floor space index. The BAF expresses the ratio of the ecologically effective surface area (area covered in vegetation) to the total land area covered by the development.

All potential green areas, such as courtyards, roofs, walls, and fire walls, are included in the BAF. However, different types of green spaces are weighted differently according to their evapotranspiring qualities, permeability, possibility to store rain water, relationship to soil functioning and provision of habitat for plants and animals (Table 1). Figure 2 presents examples of greening of courtyards in Berlin.

Table 1. Weight of different types of surfaces ⁽²⁾


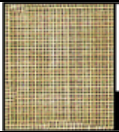







Surface type		Weighting factor
Sealed surface Impermeable to air and water and has no plant growth (concrete, asphalt, slabs with a solid subbase)		0.0
Partially sealed surfaces Permeable to water and air, but no plant growth (mosaic paving, slabs with a sand/ gravel subbase)		0.3
Semi-open surfaces Permeable to water and air, some plant growth (gravel with grass coverage, wood-block paving, honeycomb brick with grass)		0.5
Surfaces with vegetation unconnected to soil below On cellar covers or underground garages with less than 80 cm of soil covering		0.5
Surfaces with vegetation unconnected to soil below No connection to soil below but with more than 80 cm of soil covering		0.7
Surfaces with vegetation connected to soil below Vegetation connected to soil below, available for development of flora and fauna		1.0
Rainwater infiltration per m² of roof area Rainwater infiltration for replenishment of groundwater; infiltration over surfaces with existing vegetation		0.2
Vertical greenery up to 10m in height Greenery covering walls and outer walls with no windows; the actual height, up to 10 m, is taken into account		0.5
Green roofs Extensive and intensive coverage of rooftop with greenery		0.7



Figure 2. Examples of greening of courtyards ⁽⁵⁾

Implementation of the initiative

The Landscape Programme, which includes the BAF initiative, is implemented through Landscape Plans. Their binding nature as statutory instruments gives Landscape Plans a strong political, administrative and public mandate. Landscape Plans now exist for around 16% of Berlin’s urban area ⁽⁵⁾.

The BAF was formally established in as an element of Landscape Plans in 1994, and now has legally binding force in Landscape Plans for selected parts of the city ⁽²⁾. There are currently 21 BAF Landscape Plans in Berlin ⁽⁵⁾. The legally-binding elements of the BAF are described in Berlin's Handbuch der Berliner Landschaftspläne (in German only) ⁽⁶⁾. The BAF covers all forms of urban land use - residential, commercial, and infrastructure - and formulates ecological minimum standards for structural changes and new development. The objective is to achieve the BAF target values listed in Table 2 ⁽⁵⁾.

The BAF Landscape Plan is generally put into practice on the basis of building permits ⁽⁵⁾. This involves planting greenery for facades and/or on roofs, and re-opening hard surfaces in courtyards for the creation of green areas and to encourage rain water infiltration. BAF leaves the fine design details to the developer. However, common features include greening of functional spaces (e.g. bike or bin sheds); planting trees and shrubs or, in smaller areas, climbing plants; introducing green roofs; paving only on main routes and using permeable surfaces elsewhere ⁽⁷⁾. Figure 3 presents two examples of greening, which allow for achievement of the BAF standards.

Table 2. BAF targets for different types of developments ⁽²⁾

Alterations or extensions of existing development		New development
Degree of coverage	BAF	
Residential units		
up to 0.37	0.60	0.60
0.38 to 0.49	0.45	
over 0.50	0.30	
Commercial use		
N/A	0.30	0.30
Commercial enterprises and central business facilities; administrative and general use		
N/A	0.30	0.30
Public facilities		
up to 0.37	0.60	0.60
0.38 to 0.49	0.45	
over 0.50	0.30	
Schools and education complexes		
N/A	0.30	0.30
Nursery Schools and Day Care Centres		
up to 0.37	0.60	0.60
0.38 to 0.49	0.45	
over 0.50	0.30	
Technical Infrastructure		
N/A	0.30	0.30

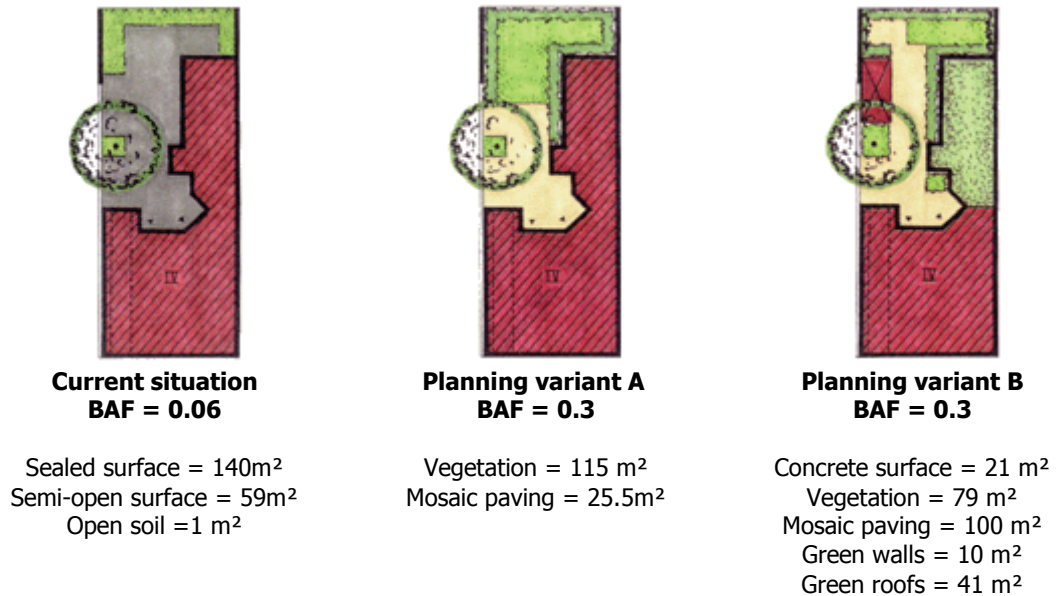


Figure 3. Example of different methods of achieving BAF of 0.3 ⁽²⁾. In this example, land area = 479 m² and the degree of development is 0.59.

Sound evidence base

The City of Berlin has an extensive database of maps presenting environmental conditions in the city and land use characteristics. The different climatic zones of the City of Berlin have also been mapped, taking into consideration air temperature, humidity and soil moisture (Figure 4). Based on this information, the BAF strategy seeks to use green infrastructure to deliver benefits in terms of air conditioning, microclimate control and flood attenuation ⁽⁷⁾. Also, the building – to – land ratio has been mapped for the City of Berlin (Figure 5). In addition, an urban structure map shows different land uses and their percentage of impervious surfaces.

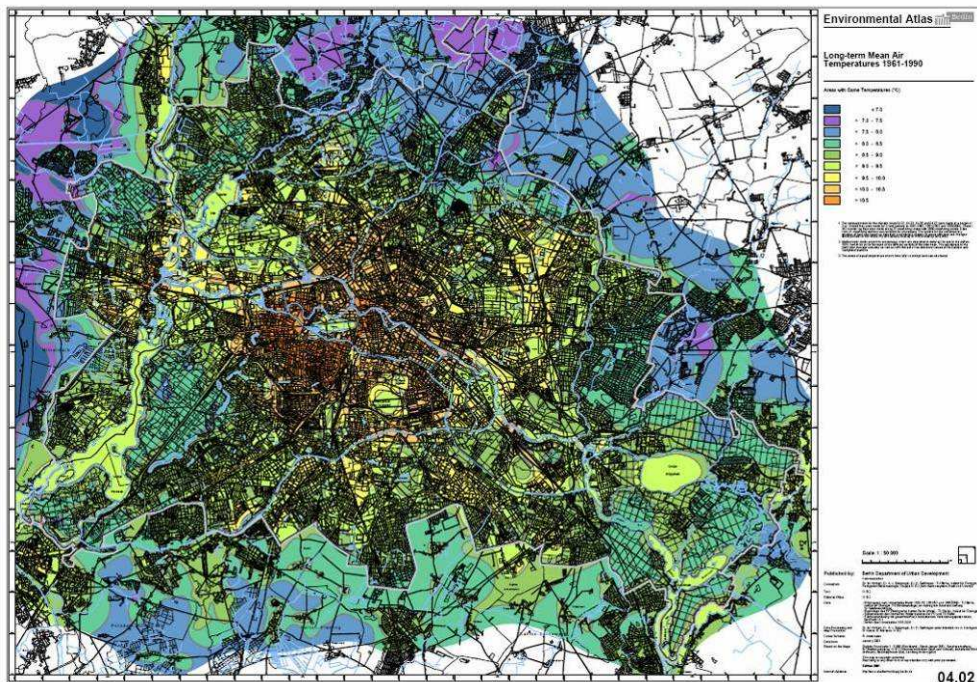


Figure 4. Climatic zones in Berlin ⁽⁸⁾

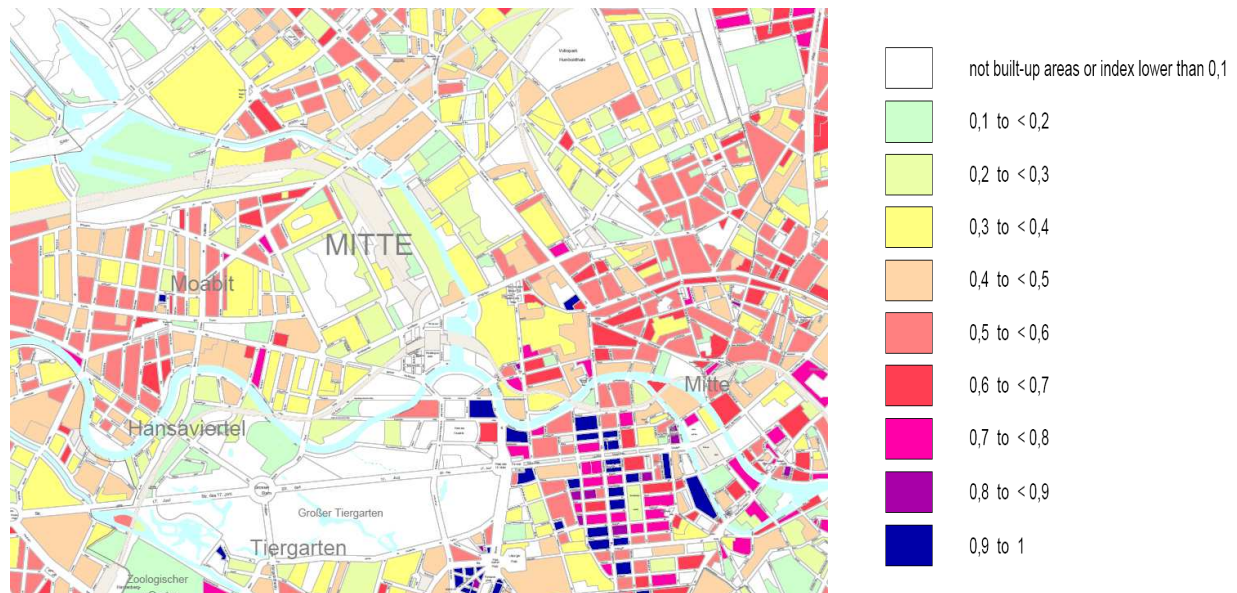


Figure 5. Building to land ratio in Berlin (fragment of the map) ⁽⁹⁾

Monitoring and evaluation

A shortage of staff has made it difficult to check the developments for compliance with the standards ⁽¹⁾. However, city planners have received positive feedback from architects and property owners about BAF, as it is easy to use and results in immediate visual improvements, as well as energy savings (in the case of green roofs). In addition, it leaves designers and property owners with room for individuality, creativity and flexibility. City planners appreciate that it is formed in the same logic as other planning indices and ratios, what also makes the training of staff easier ⁽¹⁾.

Stakeholder engagement

Collaboration with key stakeholders

The Biotope Area Factor was formulated for inner-city districts of Berlin by a large number of experts who agreed on the necessary proportion of green space areas for different development types, based on the layout of the buildings ⁽⁵⁾.

Discussions between staff from Berlin's Landscape Planning and Town Planning departments helped to develop new classifications (e.g. for environmental mitigation and replacement measures) in the Landscape Programme. Cross-departmental working also helped to develop a better mutual understanding of the various laws applicable to green spaces ⁽⁵⁾.

Engaging the public

Public consultation has always been considered highly important for landscape planning in Germany. The Landscape Programme was extensively consulted on with the public in 1986 in a targeted consultation exercise "Berlin hat Pläne (*Berlin has plans*)". The second public consultation for the Programme was held after the fall of the Berlin Wall in 1993, with the Plan finally approved in 1994 ⁽⁵⁾.

Modifications to Land Use Plans are subject to public participation and consultation phases. These are usually combined into two relatively short annual information and consultation periods. The

coordination and combination of different planning procedures, following a long-term schedule, has strengthened the consultation process with public and other statutory bodies by giving them more time and prior warning to prepare their responses ⁽¹⁰⁾.

Information on the Landscape Programme was published on the Internet for the first time in March 1998. The information is aimed at both the interested layman and the professional public, and is updated on a regular basis. With the information available in English, French, Russian and Spanish, queries are received from all over the world. The site registers up to 70,000 hits each month ⁽⁵⁾.

Can it have an impact?

Scope of adaptation

The Landscape Programme has gained in importance as time has passed. It is becoming increasingly accepted that town planning should take the Programme into account, and it is frequently commented upon and used as a basis for decisions ⁽⁵⁾.

BAF is only applied to areas where legally binding Landscape Plans are present (16% of Berlin in 21 distinct areas). Outside these areas the BAF is voluntary and can be used as a guideline for encouraging environmental measures to be incorporated when changes to the existing building structures are proposed. While this could significantly limit the applicability of BAF, due to its simplicity and the rising knowledge of environmental issues, architects, builders and property owners tend to use the BAF when it is recommended by experts ^{(1), (5)}.

In addition, provision of green spaces is supported by national legislation. In the German constitution, there is a clause about private property owners having responsibilities for promoting social good. This means that property owners have a responsibility to the greater community to provide green space ⁽¹⁾.

Whilst the BAF has been introduced into spatial planning as a nature conservation measure securing presence of habitats, the provision of vegetation in densely-developed areas has a significant potential to attenuate impacts of climate change such as occurrence of heat waves and the risk of flooding from intense precipitation events.

Additional benefits

The BAF contributes to standardizing and putting into practice the following environmental quality goals:

- Safeguarding and improving the microclimate and atmospheric hygiene,
- Safeguarding and developing soil function and water balance,
- Creating and enhancing the quality of plant and animal habitats,
- Improving the residential environment ⁽²⁾.

Information on the Biotope Area Factor is also available on the Internet, with worked examples in English and French. Since its inception, information on this method has been requested from abroad from countries such as Canada, Italy, Denmark, Finland and Puerto Rico, where it has been adopted unchanged or modified for use in their spatial planning systems ⁽⁵⁾. Based on BAF, the Greenspace Factor was implemented in an urban development in Malmö, Sweden in 2001. In 2007, the City of Seattle, USA, developed its own Green Factor (<http://www.seattle.gov/dpd/Permits/GreenFactor/Overview/>) ⁽¹¹⁾.

Key messages

- Use of regulations rather than financial incentives has proven to be an effective means of increasing green cover in Berlin.
- Flexibility of the approach provides significant advantages. Developers can choose between a number of different options for greening or creating permeable surfaces, and pick those that are the most beneficial for themselves and the users of the development.
- Collaboration between the departments of landscape planning and land use planning ensured that the two planning instruments central to the implementation of the BAF are working in a coordinated way.

Contact information

Senate Department for Urban Development in Berlin
Sabine Kopetzki
sabine.kopetzki@senstadt.berlin.de

References

- (1) Ngan, G. (2004) Green roof policies: Tools for encouraging sustainable design. Available at: <http://www.gnla.ca/assets/Policy%20report.pdf>.
- (2) City of Berlin (no date) Biotope Area Factor. Available at: http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/bff/index_en.shtml
- (3) UBA (2007) Neue Ergebnisse zu regionalen Klimaänderungen. Umweltbundesamt Available at: <http://www.umweltbundesamt.de/uba-info-presse/hintergrund/Regionale-Klimaaenderungen.pdf>.
- (4) TCPA (2004) Biodiversity by Design. Town and Country Planning Association, London.
- (5) Cloos, I. (2009) A project celebrates its 25th birthday. The Landscape Programme including Nature Conservation for the City of Berlin. Available at: http://www.google.co.uk/url?sa=t&source=web&ct=res&cd=2&ved=0CAkQFjAB&url=http%3A%2F%2Fwww.stadtentwicklung.berlin.de%2Fumwelt%2Flandschaftsplanung%2Fapro%2Fdownload%2Fapro-25jahre_englisch.pdf&rct=j&q=biotope+area+factor+public+consultation&ei=tsSLS52VB5S7jAf5_qHYDA&usq=AFQjCNGX3ml8Wcg3ai7fEeu8rAeA8MXiYQ
- (6) City of Berlin (2006) Handbuch der Berliner Landschaftspläne. Available at: <http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/handbuch/index.shtml>
- (7) Sundseth, K. and Raeymaekers, G. (2006) Biodiversity and Natura 2000 in urban areas. Available at: http://www.eukn.org/binaries/eukn/eukn/research/2007/7/biodiversity_natura2000_www.pdf.
- (8) <http://www.stadtentwicklung.berlin.de/umwelt/umweltatlas/eia402.htm>
- (9) <http://www.stadtentwicklung.berlin.de/umwelt/umweltatlas/ei609.htm>
- (10) City of Berlin (no date) Explanatory comments on the Land Use Plan and the involvement of the public: Coordination of planning procedures. Available at: http://www.stadtentwicklung.berlin.de/planen/fnp/en/erlaeuterungen_fnp/abb2_g.shtml
- (11) Roehr, D. and Laurenz, J. (2008) Living envelopes. Environmental benefits achieved by living envelope interventions in cities. Available at: <http://www.biotope-city.net/artikelen%20editie1/english/Roehr.Laurenz-eng.html>