EUROPEAN ACADEMIC RESEARCH
Vol. VI, Issue 2/ May 2018

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

# Built-up and natural environment: Ecological urbanism Framework

SALMAN ALI
PhD Student
School of Architecture and Urban Planning
Huazhong University of Science and Technology
Hubei, China

**Abstract:**

*Cities and urban areas are hardly ever built to support biodiversity as well as other habitat services; however, they have the potentials to contribute to these kinds of services. Modern methods that combine environmental investigations into the design of cities, urban infrastructures, and also buildings provide possibilities to minimize the environmental impacts of these structures on urban ecology and recover natural habitat function in urban areas. Traditionally built infrastructures in cities have substantial and varied impacts on ecology and natural ecosystems of cities. Ecological designs; enhancing local microhabitat, producing more aquatic habitat, and natural vegetation can reduce the impacts of traditionally built structures on the environment. Planning for ecological infrastructures to mitigate negative influence on the environment will also boost local ecology in urban areas. The primary purpose of the research is to create a design related connections between urban ecology and built environment. Through literature review, the concepts of ecological urbanism, eco-design, and built environment are discussed.*

**Key words:** Urban ecology, urban design, cities, urban infrastructure, eco-buildings.

## INTRODUCTION

Cities with surrounding urbanized areas are distinctive ecosystems because of human-created structures and natural elements, and they are retained and evolved by complicated ecological and social interactions. The amount and degree of ecological impacts of present human settlement are huge as compared to early times. Therefore, present cities and towns facing a variety of environmental and social problems such as pollution of air and water, energy demands, lack of food and poor waste management, which is influencing human well-being Un-habitat [1]. Furthermore, the developments and expansion of urban environments have significant impacts on native natural habitat which results in the degradation of local, regional, and global biodiversity. [2]

The urbanized world now consists of 50% of the world populations due to the rapid scale of urban expansion [3]. Despite the fact that, the built environmental feature in urbanized areas which includes all non-vegetative and human created elements for example roads, runways, and buildings are small in proportion to the earth's surface area [4]. However, the impacts of the urban area are prolonged and deep on the local and global level. Urban areas now consume 60% residential water, 75% energy and use 80% wood in industries, and also emitting 80% greenhouse gas [5]. In urban areas not only the population has been increased but also the built structures which result in the reduction of urban ecology.

In urban environments, the interaction between humans and natural processes results in changing of climate, soils, hydrology, flows of materials and energy, and also in plant and animal habitats [6].Additionally, the perception that urban areas are separated from natural environments and how it is developing created environmental problems and persistent aesthetic ugliness [7]. According to the critic author Lewis Mumford, a new sense of form will produce from architecture

an urban design when organic understanding of interactive approach of the complex relationship between cities and their surroundings, rural and urban areas is achieved [8]. In the designing of urban areas and how to maintain it, the concept that nature is everywhere is important for health, the safety of their residents. Nature and city must be viewed one entity and the surrounding areas, suburbs are transformed in the natural environment [9].

Ecological Urbanism has a long history of theories to support it, and Practice of built works that demonstrate its benefits [10]. In the twentieth century, the discussion started whether to rebuild current existing cities or to build future cities. Ebenezer Howard, in his book, Garden Cities for To-Morrow present the "Garden cities" concept for new towns while Patrick Geddes who was qualified biologist perceive city and its surroundings through his approach " Here or nowhere is our Utopia" as an organic whole [9].In the last few years, several new approaches in urban design practice have been introduced to minimize the environmental effects by making the connection between ecosystems process and their functions [11]. One approach is the ecological design which is the result of a complex relationship of different activities like human, other living creatures and natural process [9].

The prime tasks, in any ecological design endeavor, is usually to prevent further deprivation in the city environment and design to maintain it; eventually, will result in the recovery of the previous ecological conditions that was present before the existing of industrialized world [12]. Here is the problem, how it would be possible to make cities physically invisible within the natural environment. This paper elaborates the integration of urban design and ecology of urban areas with the aim of achieving beneficial and constructive interaction between human-made structures, infrastructure, and natural environment and presents a proposal that installing and designing various ecological infrastructures especially in the

urban areas enhance the quality of the urban environment and natural environment.

To approach this proposal, mainly focus was on bio-integration of built and natural environment. It analyzed specific strategies and methods to get possible solutions to achieve ecological cities by providing valuable lessons and insights for designing ecological urban areas. Throughout the research analysis of the existing literature and present examples of environmental design, our research examines recent advancements in ecological design for urban areas. Key research questions addressed in this article are: Is there any particular spatial morphology that supports urban ecology? What are the implications of the Eco-Designs for projects in urban areas of big cities? Does an urban infrastructure design matter?

In answering these questions, the previous studies on urban centers, urban ecology, and guidelines for ecological urbanism are first studies and summarized. The key purpose of this article is to present ideas by integrating ecology in urbanism can provide the understanding, strategies, and indication of what the city areas could be in the future . This is achieved through addressing three objectives: (a) design importance at different levels; (b) conducting an essential review of the literature on associations between the ecology of urban areas and built-up environment; (c) bio-integrations of built and natural environment. Therefore, the article concludes by discussing the implications of ecological urbanism principles and eco-design solutions for the future urbanism.

Research Methods

The qualitative research Method was adopted to mitigates the built structures negative impacts on Urban Morphology, and the relationship found between the presumed cause: the designs of built structures in urban areas, and the Effect: the environmental deterioration of local ecologies. Additionally, the researcher analyzed the mutual relationship

of built and natural environment; because diverse range of materials has been published on the mitigation of negative impacts of urban projects.

First, the journals in urban ecosystems conservation and processes, environmental management and ecological designs were searched in the electronic journal database like Urban Ecosystem, Science Direct, Landscape Ecology and Springer. At this moment, the selections of articles were only based on reviewed publications. Main journals in the literature review were *Landscape Ecology, Urban Planning*, *the Journal of Environmental design*, Ecosystem *Health*, *Environmental management*, and *sustainability*. The relevant articles from these journals are identified by using the keywords of eco-design, urban centers, green spaces, buildings designs and conceptual models, additionally, publications of landmark books of ecological design were included in the literature review.

The evolution of the articles was based on the strengths and weakness analysis of the design study and their interpretations. The literature reviewed displayed many concepts and relationships that are related to Urban Green Infrastructure, ecosystem Urban Design, eco-design and local ecology of urban areas. These concepts, themes, relationships, and connections were used to create a conceptual framework. Since causal relationships between Green Infrastructure components and built structures are very difficult to quantify and establish, this overview of literature covered studies that focused on theories of association rather than mainly focusing on existing projects.

The conceptual framework was summarized and classified into three thematic groups. Then, the dynamic nature of relationships between ecological urbanism and city planning and designing, Green Infrastructure, and buildings design were illustrated. This was achieved by organizing the themes and relationships: cities pattern, urban infrastructure, building designs, and their impacts on ecology. The aim of the research

has been to examine; with the help of published studies, the design principles and ecology processes that underpin ecological designs as an emerging typology as discussed in selected key texts which can help identify a spectrum of approaches to ecological urban design. The issues identified and described in this study and citations of important contributions are illustrative, not exhaustive.

## BIO-INTEGRATION OF URBAN BUILT STRUCTURES AND NATURE

There are certainly various definitions of what is "urban"; therefore, a unified definition of urban ecology is nowhere to be found. Additionally, finding an accepted definition for urban or urban ecology may be neither valuable nor necessary [13]. The various ideas and perspectives in urban ecology are usually classified as either "ecology in cities" which concentrates mainly on the non-human organisms in the urban environment or "ecology of cities," which perceives the whole city as a habitat. Considering the new improvements in urban studies during the past decade, several distinct but related urban environmental approaches can be found[5]. The four of them are summarized and illustrated below.

Firstly, the human ecology-based or urban sociological approach investigates the behavior of human beings and social organization in cities depending on borrowed ecological theory and ideas (e.g., this approach deals with human ecology). Secondly, the bio-ecology approach targets the allocation of natural elements like plants and animals around urban areas (e.g., the previous European research). Thirdly, the urban mechanism method or human habitat approach both consider the urban area overall as an ecosystem comprises of natural and socioeconomic components [14],[15]. Fourthly, the city landscape approach considers city areas as multi-scaled, spatially different and dynamic parts systems based on

principles and methods of landscape ecology, this kind of approach focuses on the connection between ecological processes and urbanization patterns[14],[15],[16].

For the purpose of this overview, here the main focus is on the design approaches both on city level which includes city pattern, infrastructure design and also on the individual level; buildings designs. See Fig.1 Additionally, what exactly are the possibilities and potentials for integrating bio-diversity into city plans, designs and infrastructure projects as eco- design experiments? Thus Ecological urbanism can only be possible when all cities are design according to ecological design principles not only cities forms also their infrastructure design including buildings design.

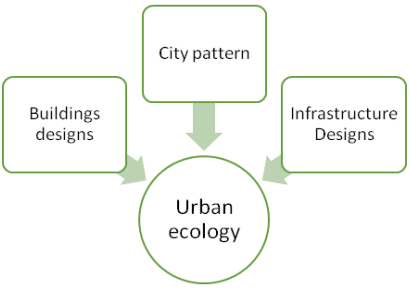


**Fig.1.The conceptual diagram illustrating the relationships among urban ecology and cities pattern, urban infrastructure and buildings designs. All these components can influence the urban ecology.**

## CITIES' FORM AND PATTERN

The history of urban ecology started in 1920 when it become part of the human ecology and in late 1940 bio-ecologist stated different version of urban ecology, in the past several similar approaches in urban ecology, progressed with little interaction but, in recent times, different perspectives integrate it. Therefore, now urban ecology becomes familiar in ecology [17]. Moreover, the idea: from an idea of the perfect city, also has a long history in western theories of urbanism. City sociology's

empiricists start using scientific research to express the impacts of urbanization on human habitat as well as city form. [18] Therefore, the research on urban ecology and urbanization cities patterns will remain important because the future of cities depends on it.

As stated in Vitruvius book, in old times when individuals need to construct a city or any other military facility, first they inspected the livers of the animals that were feed from that site. In the case of dark-color or any abnormality in their liver they continued to examine more animals to confirm that whether the fault was because of their food or disease. They started to construct military post only when the tests satisfied them that animal's livers are healthy because of food and water present on the site. In the case of any abnormality, they shifted or altered to another neighborhood, because their most important purpose was healthfulness [19]. Even in the past, the Ancient Greek physician and specialist Hippocrates discovered the impacts of ware, air, and places on the health of people and towns. Additionally, Vitruvius (Roman Architect) illustrated the layouts of streets and building can respond to natural patterns of sun and wind. Architect Leon Battista Alberti's carefully written about the adjustment of sites to natural environments in order to encourage the cities' sites, layouts of streets, and the orientation of building to enhance health, security, integrity and pleasures. [9]

Modern cities are complex in nature, integrating various sophisticated components, technologies, and processes to perform, which includes different resource distribution systems, communication systems and basic (food, water, electricity) human servicing systems. These systems have harmful impacts on natural environment because they are human-oriented. As the issue of healthy environment has increased in the world, more consideration was given to the solutions of these negative impacts. The more integrative approach is necessary between the human beings, natural environment, and in the design and

construction of built environment [20].In the pursuit of this kind of integration would be to reduce the harmful impact of human expansion on natural urban environments.

According to Ecologists Pickett and Cadenasso (2008), the integration of plant ecology into the design of cities is important because the present separation of the human and natural system is incorrect. In the shaping of the cities, natural environment researcher should take an active part with city designer instead of passive observers. This kind of approach relates urban form to natural process not only using local materials and imitating the shape of natural features. Urban designers and planners can find possibilities and can transform changes and can connect unrelated elements by focusing on the process that shape and structure the environment. [20] An ecological design approach for cities, which is not new, is a strategy for city design change and its future.

The city should be design as a whole, including its parks, buildings and urban districts and solutions to the problems should not be separated but consider it as connected through comprehensive plans of ecosystem. The individual elements can be design through this frame for multi-purpose with minimum input of energy and materials. [7]

Many progressive cities have already got active ecological sustainable plans and strategies for the greening of the city environment. However, most of those plan and procedures are simple and pragmatic, which focus on reduction of energy or on the addition of green areas. The principal question is: can such kinds of initiatives be transformed by the approach of ecological urbanism? British architecture Historian Reyner Banham, criticize that the form of city fewer matters as far as it works. [21]

## CITIES' INFRASTRUCTURE

Urbanization not only supports the industrial facilities it also needs roads, bridges, highways, and infrastructure networks. The expansion of old town center to modern city requires agriculture and green areas for infrastructure and also for new buildings. Therefore, conservation of natural landscape areas and water bodies of urban sites is necessary for the survival of natural species and natural ecology. [18]

In the planning of cities, urban ecological infrastructure enhances the green space systems because it includes spatially all natural, semi-natural and artificial networks of multifunctional ecological systems within, around and between urban areas. The idea of Ecological Infrastructure emphasizes the quality along with a quantity of urban and peri-urban green spaces, their multifunctional role, and the importance of interconnections between habitats. [22], [23] If a Green Infrastructure is proactively planned, developed, and maintained it will guide urban development through nature conservation and will support framework for economic growth. [24],[25],[26] The possibilities of interaction among urban development, conservation of urban spaces and health can be achieved through such planning. [27]

The essential elements of ecological friendly infrastructure can promote ecosystem health in a variety of ways. Urban and peri-urban habitats boost the overall vegetation cover (natural, semi-natural and artificial), thus resulting in conservation of bio-diversity which encourages ecosystem services and processes. [28],[29] Moreover, an ecological Infrastructure retains the stability of ecosystem syste ms and may provide the physical basis for ecological networks.

The improvement of ecological networks has been recommended as a way of reducing the environmental impacts of ecosystem fragmentation. This indicates that biodiversity

conservation an important part of environmentally friendly landscaping. [30]

Urban connectivity which is created through connection related features like transportation and energy distribution systems can provide ecosystem services like buffering and maintaining urban hydrology. Ecological networks, parks, river ways, and other networks like blue-green networks often contribute to urban connectivity ecosystems. Ecological landscape theory and principles are significantly applied in the planning and designing of these networks. These networks are more popular these days due to the connectivity- based functions like hydrology, transportation, and urban mobility. [31] A successful example of a multifunctional ecological network is the Emscher Park in the Rhur and Rhine valleys, where the polluted rivers of Europe are transformed into the environment-friendly and cultural corridor by providing functions like a river, habitat restoration, as well as, bicycle transportations.[32],[33]

Several cities are enthusiastically involved in "urban greening" projects intended to address urban impacts and to make urban areas healthier, attractive and bio-diverse. One example is the New York City's initiative "Designing the Edge" is a modern program that is created for rebuilding biodiversity to urban waterfronts. In this project, NYC Park's designers designed a new waterfront that is highly engaging, porous and sustainable.[34] Another example is the Houtan Park in Shanghai, China here highly contaminated river water before discharging into the same river is improved through series of treatment. This park also provides natural habitat, floodwater storage and public recreation for locals.[33]

## CITIES' BUILDINGS

The foundation of building design is to make shelter, creating a refuge, in marking the place of human beings within a natural

environment. Thus, designer become architects of the environment when making spaces for such organization that forms our interaction with one another and with nature.[35]

The importance of designing resilient or climate responsive buildings that mitigate damage to the environment and local climate should be designed for a long term with low embodied energy. In the designing of individual buildings, energy efficiency related technologies, for example, insulation materials, efficient appliances, and fixtures can minimize the negative impacts of buildings on the environment, but it is considered short term. Beside technological focused strategies, there is need to find solutions that promote connections to the environment.[20]

Many architects have been against of sustainable environment by means of technologies and written about the relationship between nature and built environment, architect Ken Yeang (2007) in his book, Eco-Skyscrapers, have also criticized the conception of technological efficiency and said that gathering enough eco-gadgetry for example photovoltaic solar collectors, insulation facades, recycling and building automation systems, will not result in ecological architecture[20].

In Green Architecture Book, Malcolm Wells (1981) said that better connection between natural environment and built environment can solve environmental problems. While searching for a more climate responsive architecture, he asked this question, "Why is it that almost every architect can identify and appreciate beauty in the natural world and yet so often fail to endow his own work with it" (p .41). He emphasized that the responsibilities of architecture have more than maintaining environment. The greater connection between buildings and natural surroundings through natural means can provide moderate climate, animal habitat, and consume building wastes.[20]

In Ecological Design book the author Van Der Ryn and Cowan present five design principles; all integrate Design with ecology, from their years of research and practice. The second principle is evaluating the criteria for ecological impact of building design on the environment. According to them, the ecological environment can be achieved by design buildings according to ecological principles [36].Designers should recognize the challenges related to project site, context, and programs to find their full impact on the ecosystems because the designer responsibility is beyond the project client's boundaries.[37]

Bio integration of built environment with the natural environment; specifically, the manual describes to discuss exactly what needs to be done to achieve harmless bio-integration. Why very important, what the factors and aspects to be considered by designer, how this affect and influence the transforming of built forms (including their content and process) and how such built forms might look. Eco-design is useful as a set of recommendations for the designer to ensure that all those crucial aspects of our design endeavors will be taken into account in bio integration and also be realized in the process of determining its built form by design. [12]

## DISCUSSION

Ecological urbanism has grown from the concepts and actions of architecture, landscape architecture, urban planning, and urban designing as presented by theorists and professionals such as those discussed above [9]. Ecological architecture and designs are collaborative modes of working among different areas of design expertise, however, the conventional division in different fields; architecture, landscaping, urban planning, and designing are also necessary for specific discipline. Contemporary urban issues are diverse in scale, and each discipline is limited to resolving it especially in most densely populated areas where disciplinary boundaries are harder to

identify. The trans-disciplinary approach in ecological urbanism is necessary for thinking about the challenging facing our urban environment both currently and in the future [21].

Additionally, the existing standards of design practices are restricted to resolve the problems of ecology and changing the recognized thinking ways. In this background, ecological urbanism will improve the approaches in urban design and development. Ecological urbanism is not completely new approach; it is the collaborative approach towards urban designing which uses both new and old strategies, methods and techniques in different fields from ecology perspective. These kinds of approaches should retrofit the current urban conditions as well as the future cities plans [21].

The current practices in buildings industries are only focusing on technological solutions to the urban problems by reducing the harmful impacts of buildings [20].Much of the work produced as ecological and environmental friendly are poor quality and mainly focused on producing energy and recycling building wastes [21]. There is a need to modify the relationship between nature and built environment. This improved mutual connection between built and natural environment can make both cities and natural systems flourish and prosper.

## CONCLUSIONS

Ecological urbanism promotes the exchange of information in different professionals, i.e., architects, landscape architects, engineers, urban planners, land managers, and policy makers. Urban areas developed according to the ecological urbanism principles can improve the physical health of residents and can give psychological heath benefits to communities as well. Spatial morphologies and built infrastructure that encourage urban vegetations and greenery can influence city and surroundings ecosystems and services.

Three approaches of designs: city form, city infrastructure design, and building designs are proposed here to build the connection between built environment and natural environment through an ecological perspective. These approaches expand the integration of ecological urbanism and design subfields such as urban design, urban infrastructure design, and eco-building designs to further improve the urban environments and ecosystem. Much is not yet known about the connections of the urban ecosystem, built environment, and design influence on the natural environment, and certainly, there are opportunities for further research.

## REFERENCES

1. Un-habitat, *State of the world's cities 2010/2011: bridging the urban divide*. 2010: Earthscan.
2. McDonnell, M.J., *Journal of Urban Ecology: Linking and promoting research and practice in the evolving discipline of urban ecology*. Journal of Urban Ecology, 2015. **1**(1): p. juv003.
3. Wu, J.J., *Making the case for landscape ecology an effective approach to urban sustainability*. Landscape journal, 2008. **27**(1): p. 41-50.
4. Schneider, A., M.A. Friedl, and D. Potere, *Mapping global urban areas using MODIS 500-m data: New methods and datasets based on 'urban ecoregions'*. Remote Sensing of Environment, 2010. **114**(8): p. 1733-1746.
5. Grimm, N.B., et al., *Global change and the ecology of cities*. science, 2008. **319**(5864): p. 756-760.
6. McDonnell, M.J., A.K. Hahs, and J.H. Breuste, *Ecology of cities and towns: a comparative approach*. 2009: Cambridge University Press.
7. Spirn, A.W., *The granite garden: urban nature and human design*. Vol. 5135. 1985: Basic Books.

8. Mumford, L., *The urban prospect: essays*. 1968: New York; Harcourt, Brace & World.
9. Spirn, A.W., *Ecological urbanism: a framework for the design of resilient cities*. 2011.
10. Spirn, A.W., *Urban nature and human design: renewing the great tradition*. Journal of Planning Education and Research, 1985. **5**(1): p. 39-51.
11. Dyson, K. and K. Yocom, *Ecological design for urban waterfronts*. Urban Ecosystems, 2015. **18**(1): p. 189-208.
12. Yeang, K., *Ecodesign: A manual for ecological design*. 2006.
13. Wu, J., *Urban ecology and sustainability: The state-of-the-science and future directions*. Landscape and Urban Planning, 2014. **125**: p. 209-221.
14. Odum, H.T., *Systems Ecology; an introduction*. 1983.
15. McDonnell, M.J. and S.T. Pickett, *Ecosystem structure and function along urban-rural gradients: an unexploited opportunity for ecology*. Ecology, 1990. **71**(4): p. 1232-1237.
16. Grimm, N.B., et al., *Integrated Approaches to Long-Term Studies of Urban Ecological Systems Urban ecological systems present multiple challenges to ecologists—pervasive human impact and extreme heterogeneity of cities, and the need to integrate social and ecological approaches, concepts, and theory*. BioScience, 2000. **50**(7): p. 571-584.
17. McDonnell, M.J., *The history of urban ecology: an ecologist's perspective*. Urban Ecology: Patterns, Processes and Applications. Niemelä J., Breuste J., Elmqvist T., Guntenspergen G., James P., McIntyre NE (eds). Oxford University Press, Oxford, 2011: p. 5-13.
18. Haar, S., *The ecological city: metaphor versus metabolism*. 2007, Citeseer.
19. Morgan, M.H., *Vitruvius*, in *The ten books on architecture*. 1960, Dover New York.

20. Ozer, E., *Mutualistic relationships versus hyper-efficiencies in the sustainable building and city.* Urban Ecosystems, 2014. **17**(1): p. 195-204.
21. Mostafavi, M. and G. Doherty, *Ecological Urbanism. Harvard University Graduate School of Design*. 2010, Lars Müller Publishers, Baden.
22. Sandstro¨ m, U.G., *Green infrastructure planning in urban Sweden.* Planning Practice and Research, 2002. **17**(4): p. 373-385.
23. TURNER, T., *City as landscape: a post-Postmodern view of planning and design.* London, Spon, 1996.
24. Walmsley, A., *Greenways: multiplying and diversifying in the 21st century.* Landscape and urban planning, 2006. **76**(1): p. 252-290.
25. Schrijnen, P.M., *Infrastructure networks and red–green patterns in city regions.* Landscape and Urban Planning, 2000. **48**(3): p. 191-204.
26. Vander Ryn, S. and S. Cowan, *Ecological Design Island Press Washington*. 1996, DC.
27. Tzoulas, K., et al., *Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review.* Landscape and urban planning, 2007. **81**(3): p. 167-178.
28. Costanza, R., B.G. Norton, and B.D. Haskell, *Ecosystem health: new goals for environmental management*. 1992: Island Press.
29. Flores, A., et al., *Adopting a modern ecological view of the metropolitan landscape: the case of a greenspace system for the New York City region.* Landscape and urban planning, 1998. **39**(4): p. 295-308.
30. Opdam, P., E. Steingröver, and S. Van Rooij, *Ecological networks: a spatial concept for multi-actor planning of sustainable landscapes.* Landscape and urban planning, 2006. **75**(3): p. 322-332.

31. Bryant, M.M., *Urban landscape conservation and the role of ecological greenways at local and metropolitan scales.* Landscape and urban planning, 2006. **76**(1): p. 23-44.
32. Ruhr, R., *Unter freiem Himmel/Under the Open Sky: Emscher Landschaftspark/Emscher Landscape Park*. 2010: Walter de Gruyter.
33. Rottle, N. and K. Yocom, *Basics Landscape Architecture 02: Ecological Design*. Vol. 2. 2011: A&C Black.
34. Ahern, J., *Urban landscape sustainability and resilience: the promise and challenges of integrating ecology with urban planning and design.* Landscape Ecology, 2013. **28**(6): p. 1203-1212.
35. Spirn, A.W., *Toward A Unified Vision: Architecture In The Landscape.* Landscape Architecture, 1990. **80**(8): p. 36-41.
36. Cowan, S. and S. Van Der Ryn, *Ecological design.* Washington: DC-Covelo, 1996.
37. Berger, A., *Drosscape: wasting land urban America*. 2007: Princeton Architectural Press.