Creating Water-Sensitive Cities in Israel

Project 4.1: Water-sensitive Urban Design: Best Practices and Beyond

3nd Annual Research Report, May 2018

Research team

Associate Prof. Tal Alon-Mozes, Prof. Naomi Carmon,

Assistant Prof. Michelle Portman, with Dr. Shula Goulden, Nadav Shapira

Center for Urban and Regional Studies, Faculty of Architecture and Town Planning,

Technion – Israel Institute of Technology

Technion Israel Institute of Technology

The Center for Water Sensitive Cities in Israel

המרכז לערים רגישות מים בישראל

קרן קימת לישראל K K L - J N F

Contents

Acknowledgements We would like to thank **Smadar Amir** for her great contribution in accomplishing the survey of Herzliya Park. Thanks are due to **Prof. Avital Gasith** for making the winter pool a focal point of the park and telling us its story, and to **Carmel Merhav**, whose semester project was the starting point for our evaluation work. Thanks are due to **landscape architect Barbara Aronson**, and to the **drainage engineers Shmuel Bdolah**, **Boris Levskyr** and **Amos Ro**n for their planning and design work and for sharing their knowledge with us. We are grateful to Herzliya Park manager **Vered Osher**, to **Kobi Azulay** and **Rachel Ben Gom** for their valuable contribution to our work.

Part 1:
Third Year Performance Report

During the third year, four main research tasks were accomplished, as detailed below.

1.1 Publication of an article in a refereed journal

Goulden, S., Portman, M., Carmon, N., and Alon-Mozes, T. (2018) "From Conventional Drainage to Sustainable Stormwater Management: Beyond the Technical Challenges". Journal of Environmental Management, No. 219, pp. 37-45. https://authors.elsevier.com/a/1W~e714Z6tX3hX

Abstract

Countries and cities are increasingly recognizing the value of adopting Sustainable Stormwater Management (SSWM) goals and measures. SSWM serves multiple hydrological, ecological, social and economic goals, and can replace substantial parts of conventional drainage infrastructure. Following international experience in the socio-technical nature of transitions in stormwater management, this research investigates how socio-institutional factors enable the transition from conventional to sustainable stormwater management over time. The research is based on analyzing available relevant documents, semi-structured interviews and focus groups, all in a single country case study (Israel). We found significant changes in professional awareness and discourse, some advances in professional standards of work and changes in the regulative system, supporting infiltration practices in particular. We concluded that the three-pillared socio-institutional framework, composed of cultural-cognitive, normative and regulative changes, was insightful for mapping factors supporting transition from conventional drainage to SSWM. Elements within the three pillars can work simultaneously and synergistically to achieve widespread change. At the same time, while SSWM always strives to achieve multiple goals, the order of priority of the various goals may differ from place to place and may change over time. Thus, changes within the socio-institutional pillars need to reiterate if and when the priority of goals changes. The urban and regional planning system can play a crucial role in enhancing the transition process from conventional to sustainable stormwater management. These conclusions may be relevant to other localities and countries that are struggling with such transitions to sustainability.

1.2 Thesis completed, reviewed, and accepted

Shapira, N., *A Tool for Evaluating Projects that Combine Urban Stormwater Management with Urban Landscape: The Rishon LeZion Lakes as a Case Study.* MSc thesis, submitted to the Technion – Israel Institute of Technology, March 2018. Supervisors: Alon-Mozes, T., Portman, M. and Carmon, N.

The thesis was reviewed by expert professors, received highly positive evaluations and approved.

Abstract

In recent decades, communities of planners and decision makers around the world and in Israel have come to realize that the transition from existing approaches to sustainable development requires a fundamental change in various planning approaches, including the approach to managing urban stormwater. Against this backdrop, various approaches have emerged for the sustainable management of urban stormwater, including Israel's water sensitive planning (WSP).

The present work develops a tool – BGIE (Blue-Green Infrastructure Evaluation) – for evaluating the performances before and after the implementation of water-related landscape projects that combine measures to manage urban stormwater, in accordance with the water-sensitive planning approach. By using the BGIE, decision makers, planners and stakeholders can evaluate a project's success in achieving multiple goals. As a case study, Lakes Park in Rishon Le'Zion was examined.

Overall, based on the review of the literature and the use of the tool developed to evaluate the case study project, a number of conclusions and recommendations were formulated:

All the existing tools focus on examining various aspects of projects, but do not allow assessing the success of the project based on its achievements in multiple criteria at the same time.

Since the tool allows assigning differential weighting of the various goals, it enables the evaluator to express the positions and policies he wishes to promote. At this stage, the tool may be suitable for both expert evaluation and public participation processes.

A follow-up study is recommended – one that will include evaluation of additional case studies in order to calibrate thresholds for assessment tools. Calibrating the thresholds for evaluation results will enable better cataloging of project evaluation results, as well as strengthenthe possibility of using the tool to analyze planning alternatives.

1.3 Teaching an academic course: Water-Sensitive Planning and Sustainable Stormwater Management

The course was developed by Naomi Carmon, Michelle Portman and Tal Alon Mozes, and was delivered at the Technion by Michelle Portman.

The course was offered as a graduate course in the Planning track, in the Faculty of Architecture and Town Planning, and was open to a limited number of undergraduates. The twenty-two students who took the course represented the student body of the Faculty well, coming from three study tracks: Architecture (6 students), Landscape Architecture (5 students), and Urban and Regional Planning (11 students). The overall goals of the course were: (a) providing the basic knowledge for sustainable urban development that incorporates water considerations from the outset in planning land uses and land cover; (b) promoting collaboration of urban and regional planners, architects and landscape planners with water and drainage engineers; and (c) highlight various common practices that promote the numerous goals and objectives of Water Sensitive Planning in Israel and abroad. The topics covered in the course included: Introduction to Water-Sensitive Planning; basics of land use and land cover planning and of hydrology and runoff management; water conservation and efficient use in the urban sector; rehabilitation of urban and regional streams; urban runoff management and drainage; runoff as a resource in landscape planning; progress of Water Sensitive Planning in Israel and in other countries. The course hosted several guest lecturers, and students were required each week, in turn, to present summaries of research, projects or programs reviewed from the literature (both academic and professional) before the rest of the class. Feedback on the course was generally very positive and students reported having acquired much knowledge about WSP.

1.4 Presentation of our findings in scientific and professional symposiums and conferences

July 2017	Goulden, S., Carmon, N., Portman, M. and Alon-Mozes, T. "Sustainable Stormwater Management within Urban Planning in Israel: Beyond the Technical Challenges", Israel Society for Ecology and Environmental Science conference, IDC, Israel
Oct. 2017	Carmon, N. and Alon-Mozes T. "Water Sensitive Planning in Israel and sustainable Stormwater Management", Conference on Water Sensitive Cities in Israel, Kfar HaMacabia.
Dec. 2017	Goulden, S., Carmon, N., Portman, M. and Alon-Mozes, T. "Sustainable stormwater management in Israel: changes over time and recommendations", Israeli Geographical Association conference, Ben Gurion University, Be'er Sheva.
Jan. 2018	Goulden, S. "From drainage to sustainable urban stormwater management: changes in concept and policy", Sustainability and Public Policy Seminar, Department of Public Policy, Tel Aviv University.

Part 2:

Developing an Evaluation Tool for Green-Blue Urban Projects

2.1 Introduction

In the last decade, the professional literature of Landscape Design and Stormwater Management applauds projects that convert cement drainage tunnels into living rivers, projects that reduce flood damage through creative and innovative measures, and those that celebrate the use of runoff as part of the urban landscape. At Bishan Park, Singapore, Atelier Dreiseitl "turned a 2.7 km long straight concrete drainage channel into a sinuous, natural river 3 km long, that meanders through the park. Sixty-two hectares of park space has been tastefully redesigned to accommodate the dynamic process of a river system which includes fluctuating water levels, while providing maximum benefit for park users. Three playgrounds, restaurants, a new look out point constructed using the recycled walls of the old concrete channel, and plenty of open green spaces complement the natural wonder of an ecologically restored river in the heartlands of the city." (http://worldlandscapearchitect.com/kallang-river-bishan-park-singapore-atelier-dreiseitl/#.WvgQWIiFM2w).

In Shoemaker Green at the University of Philadelphia, designed by Andropogon Assoc.,"the design has a two-pronged approach to manage the site's stormwater. The first strategy is to convey stormwater runoff to a large, two-tiered rain garden that contains designed soils and native plant species to manage, filter, store, and transpire a significant amount of stormwater. A second approach is to collect stormwater runoff from the site, as well as runoff from the roof and condensate from adjacent buildings and release the water into the soil under the main green. This water is cleaned while percolating through the designed soils as it makes its way to a large storage bed several feet below the green. A large portion of the existing tennis courts were left in-place under the main green to support a recycled aggregate storage bed. Any excess water that is not taken up by the soils and plants is captured in this bed through an underdrainage system and conveyed to a large cistern and stored for reuse. Once the entire system reaches full capacity, very large storms overflow to

the existing municipal sewer line preventing flooding."
(https://www.asla.org/2014awards/601.html).

These projects are just two examples of different scales, which demonstrate the worldwide success of integrating the design of urban parks with stormwater management (Irvine, Chua & Eikass 2014; Tan 2006; Echols & Pennypacker 2008). They reflect current changes within the field of landscape architecture, which perceive the landscape as infrastructure and highlight its performative role next to its visual role. Within the sustainable era, best practices are based on a comprehensive approach and an effort to integrate ecological, social and economic considerations. Recently, hydrological considerations became prominent in such projects, especially due to the growing frequency of floods on the one hand, and droughts on the other hand. Consequently, runoff, and mainly urban runoff, is recognized as an asset, and not only a hazard.

However, in order to advance such projects, it is necessary to promote a socio-cultural change among stakeholders and the public at large, in favor of adopting more sustainable modes of landscape projects and of drainage systems (Meyer, 2008; Goulden, et al., 2018). Demonstrating the variety of benefits from such sustainable projects, from various perspectives and for various clients, woud contribute to this process. As synergy is a key component in the sustainability discourse, measuring the various benefits of such projects and pointing to their synergetic value is a great importance.

Our research suggests a user-friendly tool for evaluating the benefits derived from projects that integrate SSWM practices into urban landscapes design. The tool, which was developed with the purpose of evaluating projects in their post-construction phase, can also contribute to the evaluation of pre-construction alternatives. This chapter is divided into three parts: The first identifies assessment frameworks for SSWM practices, using multiple criteria; the second presents the proposed tool; and the third discusses its advantages and disadvantages.

2.2 Literature review: Evaluation methods

Three main frameworks for SWM assessment were identified: Cost-benefit analyses, indexing models and case study analysis. Two cost-benefit analysis models were discussed,

where one monetizes social and environmental benefits (EPA, 2013) while the other does not; it "includes a qualitative description of social and environmental costs and benefits where quantification is not feasible" (Payne et al., 2015). Indexing models (based on sustainability indexes) comprise a second assessment model. The third model is based on a case study analysis adopted by the Landscape Architecture Foundation, called "Case Study Investigation" (CSI).

No single method appears to dominate the field of SWM evaluation or assessment. Moreover, only a few assessment methods include both quantitative and qualitative criteria, that is, hydrological, economic as well as social factors. As noted in a report of the CRC published in 2015, "Quantifying the economic value of social and environmental benefits is an area of ongoing research and projects are being undertaken, specific to WSUD technologies … However, currently there is still no accepted method for quantifying the less tangible benefits of stormwater biofilters." (Payne et al., 2015).

2.2.1 Measuring Ecosystem Services

Since the early 2000s, the concept of ecosystem services has been utilized in environmental planning and management (De Groot, 2006; Fisher et al., 2009) and has recently been applied to ecological design of human dominated landscapes (Lovell & Johnston, 2009). Moore & Hunt (2012) suggested adopting this framework in the assessment of stormwater infrastructure, and especially in constructed stormwater wetlands and ponds. Adapted from De Groot (2006) and MEA (2005), they summarized the proposed ecosystem services from Storm Control Measures (SCM) and examined the ecosystem services of 40 wetlands and ponds in North Carolina. The following table summarizes the proposed ecosystem services that they have identified:

Table 1 – Ecosystem services that are (or could be) provided, by SCMs (adapted from De Groot, 2006 and MEA, 2005).

Service	Description
Regulating services	
Hydrologic	Flooding reduced through regulating runoff volume and/or peak runoff rates. May also increase groundwater recharge.
Water quality	Sediment, excess nutrients, pathogens, and other contaminant loadings in runoff reduced through combination of physical, chemical, and biological processes.
Greenhouse gas regulation	Atmosheric CO_2 removed by SCM vegetation and is subsequently re-released through microbial respiration or stored through burial and sediment accretion. Methand and other greenhouse gases may be generated.
Air quality	Air quality may be improved through filtration and/or absorption of particulates, NO_x, and other air contaminants by SCM vegetation and soils.
Climate	More favorable microclimate may be maintained through direct shading and/or evapotranspirative heat dissipation.
Provisioning services	
Food	Many edible plants can be supported by SCMs and could be harvested as a food resource.
Raw material	Vegetation in SCMs can be harvested and used as raw material for composting, ornamental purposes, or other beneficial uses.
Cultural services	
Recreation	SCMs can be used for walking/jogging, wildlife viewing, and other recreational pursuits.
Education	Physical, chemical, and biological processes and structure of SCMs can be studied and used to enhance educational programs.
Aesthetic	Vegetation and open water areas are known to provide soothing benefits, to promote health and well-being, and to provide a sense of beauty to observers.
Biodiversity services	
	May contribute to biological and genetic diversity through habitat provision for plants, microorganisms, invertebrates, and vertebrates.

2.2.2 Rating sustainability

Another method for evaluating the performances of various sites involves using certain components of the existing rating sustainability tools. These tools measure the degree of sustainability on various scales, from the building to the neighborhood, the city and the region. They include the Israeli Standard for Green Building (5281) and NEIGHBORHOOD 360, the British BREEAM standard, the American LEED and ENVISION standards and the Australian WATER SENSITIVE CITIES INDEX. The following table summarizes the characteristics of each tool in relation to SSWM.

The tool	General characteristics	Aspects of SWM	Measurement method
Israeli Standard for Green Building (5281) **Israeli standards institution 2016)**	Relates to various building typologies within their immediate site. The standard examines efficient use of energy, soil, **water**, materials etc.	Evaluation of outdoor spaces. Planning of a collecting system for runoff, air conditioning drainage water, and others for 50% of irrigation needs. http://www.sii.org.il/SIP_STORAGE/FILES/6/3676.pdf - p.79. Drainage and infiltration of stormwater according to TAMA 34/b/4 http://www.sii.org.il/SIP_STORAGE/FILES/6/3676.pdf - p. 89. For existing industrial areas: A stormwater management system for consecutive periods of 10 years will be constructed. Clean water will be treated in one of the following options, depending on the soil and aquifer: Infiltration (if allowed), retention, passive infiltration, another treatment preferred by the municipality. (http://www.sii.org.il/SIP_STORAGE/FILES/8/3688.pdf - p. 53.	Scores
NEIGHBORHOOD 360 **(Green Building Council 2017)**	Neighborhood scale. Examines infrastructure and building, natural and public spaces and efficient use of resources.	Above ground SWM as part of open spaces, natural and public spaces. Goals: Maximum advantages while reducing peak rates, used for irrigating, green roofs, landscape and ecological development, annual pools, infiltration and more. A comprehensive strategy for SWM for diverse advantages and less direction of runoff to the municipality drainage systems. http://www.nd360.org/wp-content/uploads/2017/09/%D7%A9%D7%9B%D7%95%D7%A0%D7%94-360_1.0_5.9.17.pdf p. 51-53.	Scores for: - Presenting the best alternative for treating runoff (quality). - Percentage of conservation of the rainfall on the neighborhood (quantity).
BREEAM Communities	Neighborhood scale	To avoid, reduce and delay the discharge of rainfall to public sewers and watercourses, thereby minimising the risk of localised flooding on and off site, watercourse pollution and other environmental harm. http://www.breeam.com/communitiesmanual/#02_step02/09_se_13_flood_risk_management.htm?Highlight=runoff To ensure that surface water runoff space is used effectively to minimize water demand. http://www.breeam.com/communitiesmanual/#03_step03/13_le_06_rainwater_harvesting.htm	1-3 credits according to level of compliance.

LEED ND (2009)	Neighborhood scale	Most popular. The intent is to to reduce pollution and hydrologic instability from stormwater, reduce flooding, promote aquifer recharge, and improve water quality by emulating natural hydrologic conditions. https://www.usgbc.org/sites/default/files/LEED%202009%20RS_ND_07.01.14_current%20version.pdf - p. 97-98. Examines 2 criteria: Location vis à vis flood plain; Percentage of conservation of rainfall on the neighborhood. SS6.1 Stormwater Design – Quantity Control 1 SS6.2 Stormwater Design – Quality Control	1-4 points
ENVISION **Zofnass (2015)**	Degree of sustainability in infrastructure projects in general, including in neighborhoods. Five main criteria: quality of life; leadership; resource management; local environment; and climate.	The following categories relate to SSWM; however, the topic is also addressed under additional subcategories. *Natural World*: 2 LAND+WATER: NW2.1 Manage Stormwater, NW2.3 Prevent Surface and Groundwater Contamination. *Resource Allocation*; 3 WATER RA3.1 Protect Fresh Water Availability RA3.3 Monitor Water Systems. https://research.gsd.harvard.edu/zofnass/files/2015/06/Envision-Manual_2015_red.pdf	No synergy measured and no preference for any criteria
Water sensitive cities index **Chesterfield et al. 2016a; Chesterfield et al. 2016b**	The success of a city in managing its urban water resources, including neighborhood. The index examines water management in the city, and not runoff. Its goals are; Improve ecological health, ensure quality urban space. 34 indicators	Part of the index not specific indicators 7 goals: Ensure good water sensitive governance, increase community capital, achieve equity of essential services, improve productivity & resource efficiency, promote adaptive infrastructure	1-5 between Water is not included in the municipal policy (1) and WM policy is fully integrated into all aspects of municipal policy and is advanced through cooperation among the various departments (5)

2.3 A New Evaluation Tool

The goal of the tool is to evaluate the level of goals achievement of designed landscape projects which integrate various practices of Sustainable Stormwater Managements (SSWM).

The results are presented in a clear and intuitive pie radar chart, which is easy to produce and to change, and therefore enables a productive process of discussion and decision making by professionals who have to work with non-professional stakeholders and municipal bureaucrats.

There are several methods to construct the list of goals to be evaluated (Alterman et al. 1984). In this research we based the selection on the over 20 years of research of WSP - Water-Sensitive Planning - at the Technion (Carmon and Shamir 1997; Shamir and Carmon 2007; Carmon 2015). The Technion researchers identified the rich area of potential goals of Sustainable Stormwater Management and divided it into four distinct fields : The hydrological; the ecological/environmental; the social; and the economic. The following table presents the distinct fields and the detailed goals/benefits related to each of them.

Hydrological goals/benefits • Mitigating urban floods • Aquifer recharge • Stormwater harvesting for various uses	**Ecological/environmental goals/benefits** • Improving stormwater quality before it reaches receiving water: aquifer, river, lake, sea. • Biodiversity support • Rehabilitation/conservation of wet ecosystems. • Soil conservation
Social goals/benefits • Place making for leisure time and recreation • Nature in the city enhancement • Aaaesthetics and landscape qualities enhancement • Education for sustainability and good citizenship • Social involvement and community promotion	**Economic goals/benefits** • Financial benefits for the municipality • Increased value of proximate real estate • Economic opportunities in proximity blue-green landscape

The level of the achievement of each goal is based on extensive data gathering from interviews with the project planners, project workers, municipal bureaucrats, and other stakeholders, as well as on information from historic and current documents on the project and its adjacent surroundings. This data collection enables the researcher to grade the level of achievement of each goal and to provide a summary evaluation of the project as a whole, presented both in a table and in a pie radar chart, as demnstrated in the next chapter (on Herzliya Park).

In addition, the tool enables presenting the findings to various stakeholders, who may be professionals or public officials, asking them to award a weight to each of the goals (or each of the four groups of goals), by the level of importance he/she ascribes to it (see the right column on the table below). Then the tool multiply the grade by its weight and provide a new easy-to-understand picture of goals achievement in a pie radar chart, a picture that takes into consideration the priorities of stakeholders.

The following table summarizes the proposed evaluation process, including the detailed goals/benefits, the scoring system and the importance of the goal/function:

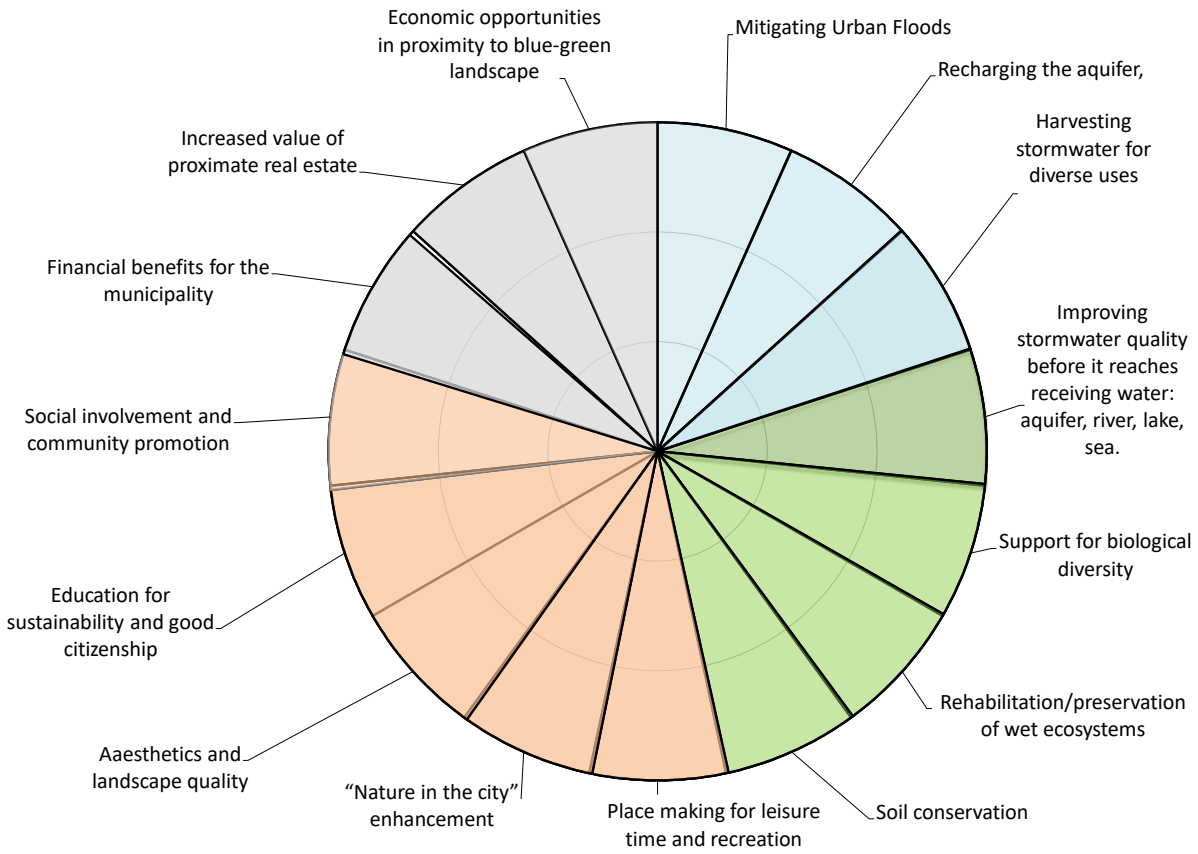
Categories of goals	**Goals/benefits**	**Degree of achievements** 0 - none 1 - low 2 - moderate 3 - high	**Importance of goals/benefits** 3 - very important 2 - important 1 - less important 0 - not important
Hydrological	Mitigating Urban Floods		
	Recharging the aquifer		
	Harvesting stormwater for diverse uses		
Ecological/environmental	Improving stormwater quality before it reaches receiving water: aquifer, river, lake, sea.		
	Support for biological diversity		
	Rehabilitation/preservation of wet ecosystems		
	Soil conservation		
Social	Place making for leisure time and recreation		
	“Nature in the city” enhancement		
	Aaesthetics and landscape quality		
	Education for sustainability and good citizenship		
	Social involvement and community promotion		

Economic	Financial benefits for the municipality		
	Increased value of proximate real estate		
	Economic opportunities in proximity to blue-green landscape		

2.4 Presentation

To present the results of the evaluation process we developed an Excel tool comprising the following components (for the case of the example, all the goals receive the same score and the same weight).

The pie radar chart presents the results:

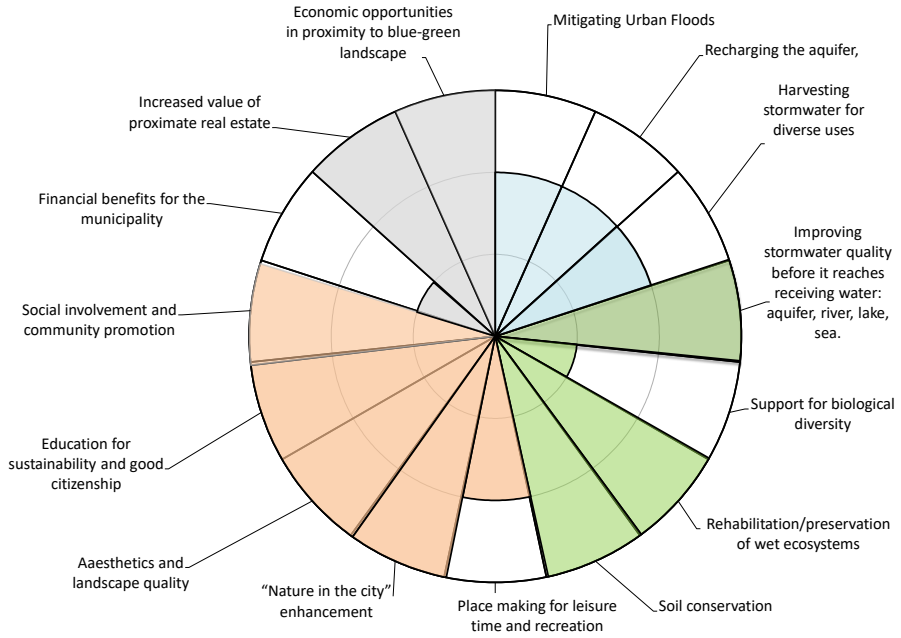


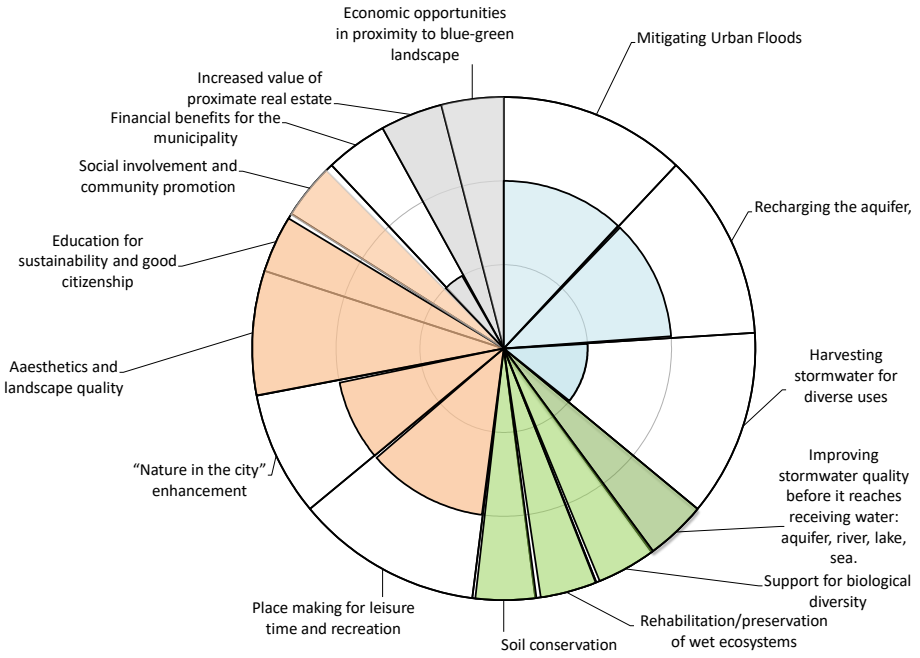
- The degree of achievement of each goal/benefit determines the relative surface cover of each segment (Grade (G) between 1-3).

- The area of each segment is determined according to its importance in relation to the other segments (weight (W) between 0 - 3).

If all the goals are equally achieved for the maximum (3) and are equally important, the chart will then appear as above.

If a stakeholder evaluates the project from a distinct perspective the chart will change accordingly. It is possible to grade each goal/benefit achievment differently, or to relate different importance (Weight) to different goals/benefits. The following charts demonstrate the various options.





2.5 In Conclusion

The model was preliminarily tested on several case studies, including a municipal park in Kfar Saba, the Lakes Park in Rishon LeZion and others. The next chapter discusses Herzlia Park as a detailed case study.

By way of comparison with existing tools for evaluating multi-goal blue-green projects, and following our own experience in evaluating several Israeli case studies, we conclude that the proposed evaluation tool presents several advantages, and one disadvantage:

2.5.1 advantages

- Compared with other evaluation tools, this tool is user-friendly; stakeholders with various backgrounds, not only professionals, can follow its rationale and play an active role in the evaluation. They can provide their own estimation of the level of achievement of goals and weight them according to their values. Consequently, the tool may be used to encourage democratic decision making.

- Compared with other evaluation tools, which often require years of careful data collection and analysis, this tool, which is based on available information from accessible sources and on several interviews with knowledgeable informants, may be considered very efficient: It provides extensive information plus evaluation, inexpensively in terms of both money and time.

- The evaluation appears twice in the planning process: First, ex-ante evaluation, which evaluates alternative plans before one (or a combination of several) is selected for implementation; and second, ex-post evaluation, which evaluates a project after implementation, mainly in order to draw conclusions for future projects. In the current study, the proposed tool was used for ex-post evaluation of projects, but it can also be easily adopted for use in ex-ante evaluations.

- The tool simultaneously and clearly presents the level of achievement of each goal and each category of goals, as well as of the level of success of the project as a whole.

- The tool comes with a computerized application that can be easily manipulated, enabling decision makers to see the implications of various estimations of performance and of various weights related to specific goals.

2.5.2. Disadvantage

- The main disadvantage of the proposed tool is the lack of benchmarks, to serve as a pre-defined basis for grading the level of achievement of the goals. This disadvantage may be mitigated or eliminated once greater experience is acquired in the use of the tool in a wide range of cases.

2.6 References

Alterman, R., Carmon, N. and Hill, M., "Integrated Evaluation: A Synthesis of Approaches to the Evaluation of Broad-Aim Social Programs". Socio-Economic Planning Sciences, Vol. 18, No. 6, 1984, pp. 381-389.

Bernardi E., Carlucci S., Cornaro C., André Bohne R., (2017), "An Analysis of the Most Adopted Rating Systems for Assessing the Environmental Impact of Building", Sustainability, 9, pp 1-27

Carmon, N. and Shamir, U., Water-Sensitive Urban Planning: Protecting Groundwater. Haifa: The Center for Urban and Regional Studies, Technion, 1997 (Hebrew, 227 pp),

Carmon N., Shamir U., (2010), "Water Sensitive Planning (WSP): Intergrating water consideration into urban and regional planning", Water and Environment journal, 24,3, pp 181-191.

Carmon N. (2015), Water-Sensitive Planning: 20 Years of WSP in Israel. Annual conference of Israel Water Association.

Chesterfield et al. (2016a), "A Water Sensitive Cities Index to support transitions to more liveable, sustainable, resilient and productive cities." Proceedings for Singapore International Water Week, Singapore 11-14.

Chesterfield et al. (2016b), International Low Impact Development China Conference, June, Beijing.

De Groot R.S., Alkemade L., Braat L., Hein L., Willemen L., (2010), "Challenges in Integrating the Concept of Ecosystem Services and Values in landscape planning, management and decision making", Ecological complexity, 7, pp 260-272

De Groot, R., 2006. “Function-analysis and valuation as a tool to assess land use conflicts in planning for sustainable, multifunctional landscapes”. Landscape Urban Plan. 75, 175-186.

Echols S., and Pennypacker E. (2008), “From Stormwater Management to Artful Rainwater Design” Landscape journal vol. 27 no. 2 pp. 268-290.

Fisher, B., Turner, R.K., Morling, P., (2009), “Defining and classifying ecosystem services for decision making”. Ecological Economics, 68, 643-653.

Goulden, S., Portman, M., Carmon, N., and Alon-Mozes, T. (2018) “From Conventional Drainage to Sustainable Stormwater Management: Beyond the Technical Challenges”. Journal of Environmental Management, No. 219, pp. 37-45.

Irvine, K., Chua, L., & Eikass, H, S. (2014), The four national taps of Singapore: a holistic approach to water resources management from drainage to drinking water, Journal of water management modeling, pp. 1-11.

Lovell, S.T., Johnston, D.M., (2009). “Designing landscapes for performance based on emerging principles in landscape ecology”. Ecology and Society 14 (1) online] URL:http://www.ecologyandsociety.org/vol14/iss1/art44/.

MEA (2005) Millennium Ecosystem Assessment, 2005. “Ecosystem Services and Human Well-being: Wetlands & Water: Synthesis”. Millennium Ecosystem Assessment Report to the Ramsar Convention. World Resources Institute, Washington D.C [Cited Sept 3, 2008] Available from URL: http://www.millenniumassessment.org/en/aspx.

Meyer E. (2008).” Sustaining Beauty, The Performance of Appearance”. Journal of Landscape Architecture, 1(3), 6-23.

Moore, T.L.C., Hunt, W.F., (2012) “Ecosystem service provision by stormwater wetlands and ponds A means for evaluation?” water research 46, pp. 6811- 6823.

Payne, E.G.I., Hatt, B.E., Deletic, A., Dobbie, M.F., McCarthy, D.T. and Chandrasena, G.I., (2015). Adoption Guidelines for Stormwater Biofiltration Systems, Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

Shamir U. and Carmon N., Water-Sensitive Planning: Integrating Water Considerations into Urban and Regional Planning. Haifa: Technion, The Center for Urban and Regional Studies, 2007 (Hebrew, 270 pages) (ISBN 965-409-032-5).

Tan, W. (2006), “A greenway network for Singapore”, Landscape and Urban Planning, Vol 76, Issues 1–4, 30, Pp. 45-66.

Part 3:

Herzliya Park and its Stormwater Management Practices:

Description and Evaluation

3.1 The City of Herzliya and Herzliya Park

Herzliya is a seaside city located in the southern Sharon region of Israel, approximately 10 kms north of Tel-Aviv. It was established in 1924 as a rural agricultural community, with land allocated for agriculture, recreation and urban residence. In 1960 it was formally declared a city. Its population today numbers approximately 95,000 inhabitants, and it is ranked high – 8 on a scale of 1-10 – on Israel's socio-economic scale for communities.

The city's geographic distribution is clear: Its western part is spread along the coast of the Mediterranean Sea and borders on the Ayalon highway, where Israel's railway passes as well. Most of Herzliya's residential areas are located on the eastern side of Ayalon highway. A wide strip of public spaces is situated between the western and eastern parts of the city – these include the local soccer field, the outdoor sports compound ("Sportek"), the IDC - Interdisciplinary College, several schools, and also the large municipal park, which is the object of our research.

Herzliya has a long coastline, and its altitude ranges from 0 to 66 meters above sea level. The multi-annual average rainfall in the area (the measurement station is located in the adjacent Hakfar Hayarok) is 583 mm. The city suffers from frequent flooding. We have found reports of flooding in the daily newspapers from the years 2013, 2015, 2017 and 2018; these frequently occur in the central strip, inundating main streets as well as residential buildings; however, there were no reports of fatalities resulting from these floods.

The area upon which the park was built is an historical flood plain. The flood plain was created due to drainage confined by the eolianite ("kurkar") range to its west, which prevents streams from draining to the sea, and also because of the heavy clay soil, which

impedes the infiltration of water. Already in the Roman period, attempts were made to drain the swamp to the sea using a tunnel dug in the eolianite range, in order to utilize the fertile swamplands for agriculture. Over the years the tunnel became blocked and the swamp was restored to its original size – approximately 1.5 kms long and about 0.5 km wide.

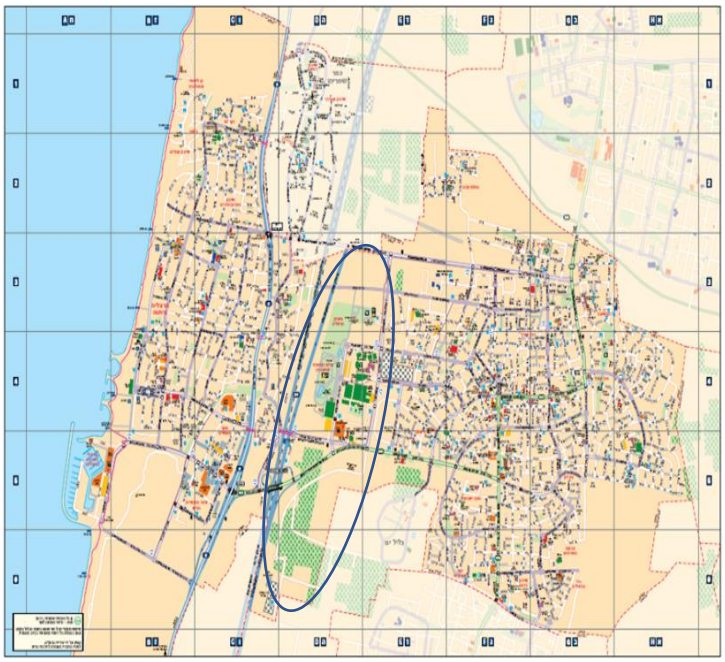


Figure 3.1: The city of Herzliya, with the broad strip of public services at its center, including the municipal park

During times when the level of the groundwater was high, the swamp was a constant presence in the area (Mendelsohn, 2016). In other times it was a seasonal pool that dried up in the summer. With the establishment of Herzliya and the opening of the Roman tunnel, the permanent swamp disappeared. The land became agricultural fields, some of which were abandoned in the 1980s, with a few areas becoming sites where building waste was dumped. Most of the area remained a seasonal pool that drains over half of the city's stormwater (Aronson, 2014), filling up with rainwater in winter and drying up in summer.

The decision to establish a park in the swamp area was met with a strong opposition of the private landowners who owned some of this land. They wanted to convert it into a residential area, and even submitted a plan for 1,400 residential units. After their appeals to the planning authorities were turned down, they took legal action. Following many years in the court system, their claims were heard by the Supreme Court, which rejected them and

ruled that construction in the park area would not be permitted. However, the standing of the park as a seasonal pool was not statutorily defined.

In the 1990's a decision was made to change the land designation in the area from agricultural land to open public land, and to establish a municipal park. The plan for the park was prepared by the office of landscape architects Lippa Yahalom and Dan Zur. It suggested a formal design, including a hard edge decorative pool, a linear stream of water and a boulevard of four rows of palm trees. The plan was rejected by the municipality which applied landscape architect Shlomo Aronson for a new proposal.

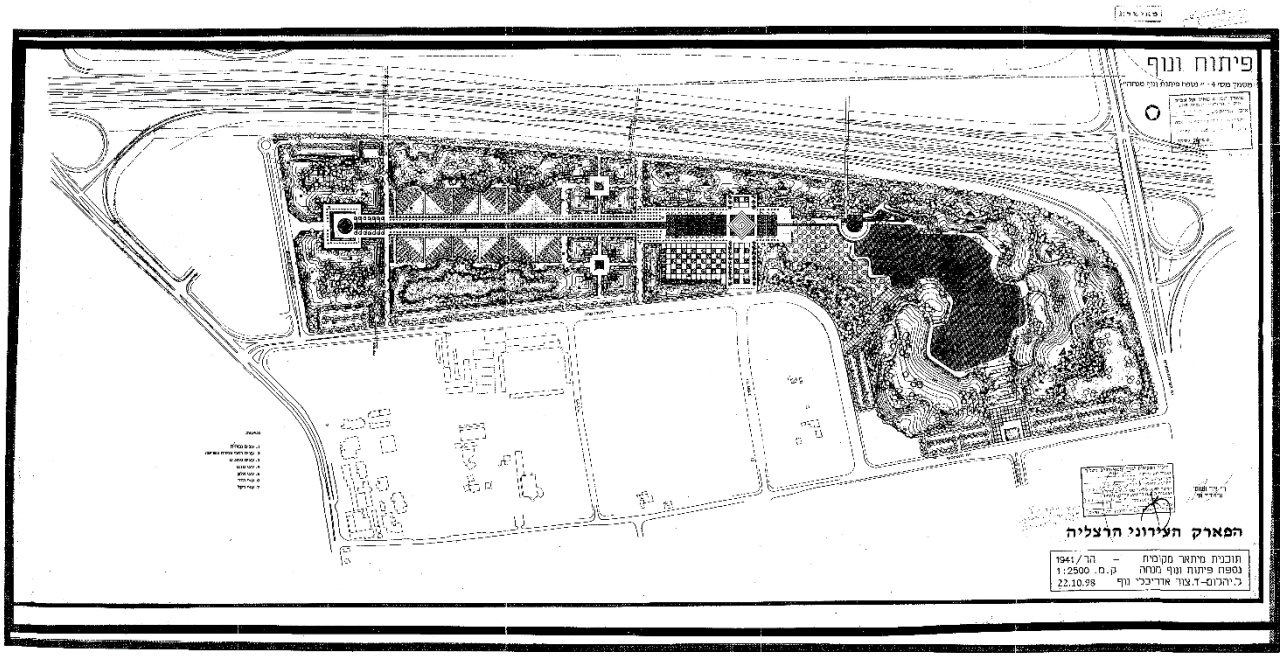


Figure 3.2: Yahalom Zur proposal for the park (Retrieved from Herzliya municipality, department of Engineering, May 2018)

At the beginning of the millennium (Carmel, 2016), Prof. Avital Gasith of Tel-Aviv University invited Herzliya's then mayor Yael German and the city council members to visit the area, intending to show them "a gem of nature", a most important natural site within their city limits. Later on, Prof. Gasith (2005) conducted an ecological survey of the swampland and the Society for Protection of Nature in Israel (2008) published a position paper supporting the resolution to conserve it. Additionally, a poll was conducted among the city's inhabitants, who supported conserving the winter pool in the park. Concurrently, in 2004, the firm Shlomo Aronson Architects was hired by the municipality of Herzliya to design a municipal park on the area of the historic swampland. At first, Aronson intended to include

a permanent lake in the park; however, following the intervention of Prof. Gasith, and later – of the mayor and of others, the landscape architects realized the importance and uniqueness of leaving a significant part of the area as a seasonal pool and incorporating it into the planned park.

Figure 3.3: The park with the winter pool is located inside the city, which can be seen on its outskirts (Photograph: Carmel Merhav)

The total area of the park is 700 Dunams, situated between Road No. 20 (Ayalon) in the west, through Menachem Begin Road in the north, Jabotinsky and Yosef Nevo Streets in the east and Shivat Hakochavim Street in the south. The developed area today - including the three first phases of development - covers less than half of the 700 Dunams. The remaining areas that have not been developed are owned partly by the municipality and partly by private owners.

Phase 1 of the park, which covers approximately 115 Dunames, was opened to the public in 2009 as an intensive park with the primary goal of creating a quality space for leisure activities for the city's inhabitants. Large lawns were planned and planted; an artificial lake with goldfish and ducks was established, with an adjacent coffee shop, as well as walking trails, jogging trails and bicycle tracks, a shaded playground for toddlers, an "extreme sports" play area for children, with rope bridges, a zip-line, climbing walls, slides, nets and more (Mendelsohn, 2016). The design was based on a motif simulating a tree that extends its branches toward the future directions of the park and simulates a "natural flow", which is associated with the site's natural history as a drainage basin (Aronson, 2016). In this

phase, two practices for managing stormwater were included in the park: Open stormwaer channels that simulate flowing streams, and large concave lawns.

The public success of Phase 1 and the court ruling allowed implementing Phase 2: The restoration of the winter pool, which was guided by environmental values. The planners' goal was to conserve and cultivate the natural activity already taking place in the pool, with minimal intervantion. They carefully kept a balance between the desire to expose the abundant natural phenomena to the public, and the need to conserve the ecological systems that autonomously exist in it (Aronson, 2014). This phase included 65 dunams of cautious development; the approximately 120 dunams of the winter pool were left as an extensive, undeveloped area.

The third and last phase, which has since been executed, covers some 40 dunams south of the area developed in Phase 1 (see the map below). It conserves the values guiding the previous phases, and particularly the movement continuum and the connection to water elements. It includes two spacious concave lawns for short-term stormwater retention, with the water accumulated in it flowing in an open channel to the channel developed in Phase 1. The area includes diverse intimate gathering spaces, catering structures and new services.

The design of the park is considered highly successful and it won sevral excellence awards (see below 3.2.5.4). In addition to the items mentioned above, the park includes a bird-watching center, a forested picnic area, a plant shelter, two coffee shops, an area set aside for outdoor grills (barbecue), an open amphitheater, diverse installations for children, a train for children and more. Various activities, for both children and adults, take place in the park. A group of volunteers, inhabitants of Herzliya, operate in the park and in the adjacent Keinan House Community Center. A footbridge connecting the park with the neighborhood Herzliya B, which lies west of Ayalon highway, is presently being built.

Figure 3.4: The three-phase plan of Herzliya Park (Source: Power Point presentation by landscape architect Barbara Aronson)

3.2 Stormwater Management Practices in Herzliya Park and their Evaluation

Herzliya Park is a green-blue project, i.e., a landscape project that includes stormwater management practices. The most prominent of these practices is the winter pond, with a sedimentation basin established before it. Additional practices include small Eucalyptus forests in topographical depressions (similar to limans), large concave lawns and stream-like open channels. All these will be presented below.

3.2.1 The Winter Pool and the Sedimentation Basin

A winter pool is a seasonal body of water that is usually fed by stormwater (and at times, by shallow groundwater as well). Such pools exist along the Israeli coastal plain in areas with depressions in clay soil, where there is little, if any, water infiltration, and most of the water loss is caused by evaporation (Shalem & Gasith, 2018). Winter pools in Israel remain wet throughout the winter, as well as during part of springtime, and dry up in the summer, as dictated by the Mediterranean climate of the country. Thanks to their seasonal regime, winter pools are populated by unique flora and fauna. The organisms populating the winter pools utilize distinctive life strategies to enable a complete life cycle within a wet period lasting only several months, after which they must survive throughout the long dry season, until the next winter (Rothschild & Perlman, 2010).

Figure 3.5: The northern part of the winter pool (photograph: Smadar Amir, April 2018)

The winter pool in Herzliya Park receives stormwater from the drainage pipe of Yosef Nevo Street, which flows to a sedimentation basin. The basin is used for coarse cleansing of the stormwater arriving from the city's neighborhoods. The water goes through a grated barrier at the pipe's opening, and when arriving to the sedimentation basin the heavy particles settle. The slope between the pipe's opening and the canal through which water flows out of the sedimentation basin enables additional retention and the settling. In the dry season, water from excess irrigation, car washing, etc. arrives the sedimentation basin; therefore, in contrast to the winter pool, it remains wet throughout the year. In recent years, a decision was made to dry up the sedimentation basin at the end of summer, in order to avoid the transfer of polluted sediment that has accumulated in it into the winter pool, when the basin fills up and overflows.

Figure 3.6: The canal from the sedimentation basin to the winter pool (photograph: Smadar Amir, April 2018)

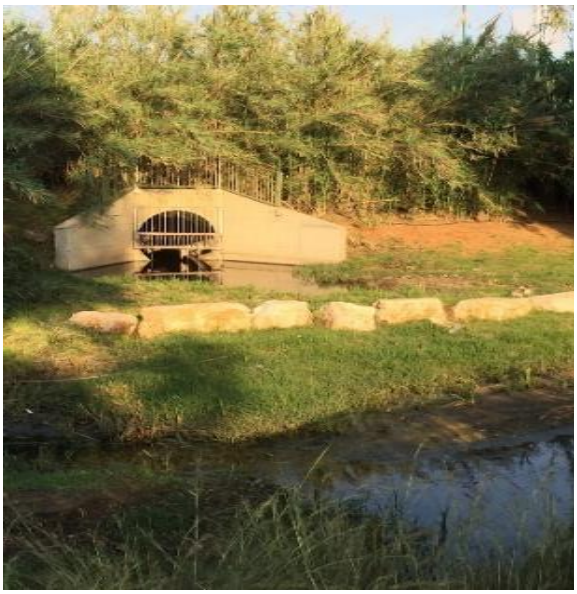


Figure 3.7: The opening of the channel leading to the sedimentation basin (photograph: Smadar Amir, April 2018)

The water flows from the sedimentation basin westward in an open channel that is full of vegetation, and splits into two at its end: One part reaches the southwestern part of the pool, and the other part continues to the northwestern part. The pool fills with water after the first significant rain (usually in October-November) and dries up completely in the summer months (starting May-June). The pool is home to an abundant ecological variety of flora and fauna, as detailed later in this report. During the dry period, some of the flora and fauna survive, thanks to special survival strategies, including winter hibernation, sustainable eggs, sustainable seeds, etc. In order to avoid disrupting these processes, human interference in the pool area must be avoided, also in the dry season.

The planning of the winter pool (Phase 2 of the park's development) is intended to enable its existence as a natural area, in which human activity is strictly restricted, to minimize interference with local nature. The planning enables the public to access the pool and witness the wealth of phenomena occurring in it by means of a floating deck that connects the sedimentation basin with the southwestern winter pool. The path is closed off with gates at night and has no nighttime illumination. Along the path, there are concealed birdwatching points that allow quiet, non-invasive observation of the water birds.

Figure 3.8: Entrance to the wooden path, with a sign providing information about the winter pool and the activities forbidden in it (photograph: Smadar Amir, April 2018)

The area of the winter pool is divided into three sections: The southwestern pool, the northwestern pool and the eastern pool (see above the map of the three phases of the park). The "main path", which is located between the northwestern and the eastern sections, and includes jogging, walking and bicycle trails, and reaches the small forests of Phase 2. Tall reeds separate the path and the pool; these were planted to avoid disrupting the activity of the fauna in the pool. The northwestern section of the pool covers a large area (including area of the future park) and at present is actually an open area, a continuation of the natural winter pool.

Figure 3.9: The "main path", including jogging, walking and bicycle trails (photograph: Smadar Amir, April 2018)

3.2.2 Eucalyptus Forests

There is a number of small Eucalyptus forests in the park. These small forests and their surrounding area were left in the natural state they were found before the park's development. They do not require irrigation; the rain falling on them and the runoff reaching them are sufficient to sustain the forests. They function similarly to the limans found in Israel's Negev desert. Most of them are situated in areas that are topographically lower than their surroundings, therefore the runoff reaching them is captured and detained for a short period of time, and thus, sustains the trees and contributes to stormwater management..

Figure 3.10: Part of a small Eucalyptus forest in the park, on a rainy day (photograph: Smadar Amir, April 2018)

3.2.3 Stream-like Open Channels

Four drainage pipes lead runoff from eastern Herzliya to the park. The northern pipe arrives directly to the northern section of the winter pool. The second pipe leads runoff into the sedimentation basin, which then flows into the winter pool. The two channels found further to the south reach the park area (the part that was planned in Phase 1) and have been designed to simulate two stream-like open channels with low vegetation. The two connect and drain to a channel in the western part of the park, and from there, the water flows to the large drainage tunnel near the train station, which drains the excess water westward.

The role of the open channels in stormwater management is to lead the water and to produce short-term retention. The two channels were designed at a slope of 0.5% from the

entry threshold of the city's pipes to the western drainage tunnel. Yet, at the time of the park's planning the person in charge of drainage was not certain that the channels would be able to drain the water, and therefore, he added a closed drainage pipe (40") that passes underneath one of the channels and drains the summer flows and some of the runoff during major storms.

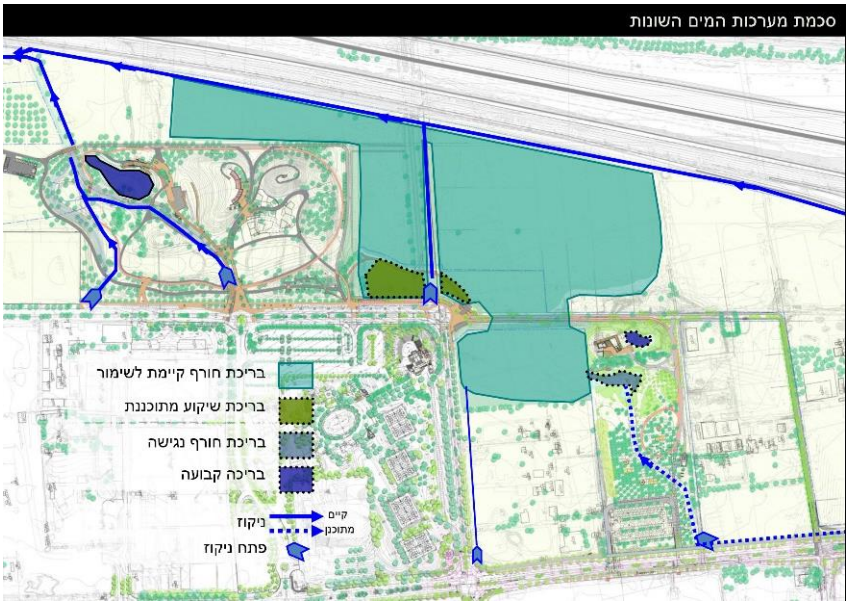


Figure 3.11: Drainage scheme (Source: Aronson's Power Point presntation, 2014)

Figure 3.12: the meeting point of the open channels, on a summer day and after significant rainfall (photograph: Smadar Amir, April 2018)

.

3.2.4 Concave Lawns

Four expansive lawns are found in the areas of the park developed in Phases 1 and 3. They were planned as concave lawns so that runoff from broad areas of the park would flow to them and accumulate in them for a short period of time. The lawns serve as an area for leisure activities, with a large playground at their center.The slopes of the lawns in Phase 1 are planned so that when they fill with runoff during significant rainfall events, the runoff flows from them to the open channels.

Figure 3.13: playground at the heart of a concave lawn (photograph: Smadar Amir, April 2018)

3.2.5 Evaluation of Herzliya Park and Practices of Stormwater Management in the Park

This section of the research uses the evaluation tool that was presented in part 2 of this report. The evaluation is based on a list of goals that was developed within the framework of the series of studies on Water-Sensitive Planning, conducted at the Technion during the last 25 years (Carmon 2015) and includes four groups: Hydrological goals, ecological-environmental goals, social goals, and economic goals. Following a presentation of the sources of data used for evaluating Herzliya park, our findings regarding the level of achievement of each goup of goals will be detailed.

3.2.5.1 Sources of information for the evaluation of Herzliya park

The sources of information that we relied upon when assessing the extent to which the park in its entirety, and the stormwater management practices in it, achieve the diverse goals of this green-blue project, may be classified into three categories: (1) Relevant scientific-professional literature; (2) Available documents relating to the seasonal pool in Herzliya and to the municipal park; and (3) Interviews with relevant informers.

The scientific-professional literature that we used in our work deals with Water-Sensitive Planning (WSP) and its objectives, as well as with the appropriate practices for managing runoff based on the WSP approach (Carmon & Shamir, 1997; Shamir & Carmon, 2007; USEPA, 2010; Carmon & Shamir, 2010; WSUD,2013; Marcus, Gasith & Carmon, 2014). A key document that we based our work on was a semester paper dealing with Herzliya Park, written by a landscape architecture student (Merhav, 2016), within the framework of the course "Water-sensitive Planning", which was developed and delivered for the first time at the Technion in 2016 by the three researchers who authored this research report. Several documents provided information on the winter pool as a central element of Herzliya Park (Gasith, 2006; The Society for the Protection of Nature in Israel, 2008; Rothschild & Perlman, 2010). We also drew information from the site of Herzliya city engineer and from articles about Herzliya Park which were published online (for example, Mendelsohn, 2016).

Interviews, conversations and e-mail communication held with "relevant informers" – those who were, and still are involved in the park's planning and maintenance - comprise a source of information of primary importance. The interviews were conducted face to face, aided by a semi-structured questionnaire and an assessment table with scores indicating the extent to which the defined goals were achieved (0 – not at all; 1 – somewhat; 2 – moderately; 3 – fairly well; and 4 – very well) . Main interviewees were Prof. Avital Gasith of Tel-Aviv University, who initiated the conservation of the winter pool to leverage the establishment of a municipal park at the site, provided valuable input during the planning process and continues to be involved through his students; Drainage Engineer Shmuel Bedolah of the firm H.G.M Civil, Water and Environmental Engineering and two of the engineers of the Union of Water Engineers - who handled, and continue to handle the issues pertaining to the stormwater and drainage at the site; Landscape Architect Barbara Aronson from Shlomo

Aronson Architects, the firm that has been responsible to the planning of the park in all its phases; Rachel Ben Gom, who was responsible for the environmental issues at the office of Herzliya's City Engineer; Landscape Architect Vered Osher, the manager of Herzliya Park; and Koby Azulay, director of water and environment at the park.

Below we present findings concerning the level of achievement of each of the goals in the four groups which were examined – the hydrological, ecological-environmental, social, and economic. Finally, a comprehensive evaluation of the entire park will be presented in a table and in a pie assessment chart, as described in part 2 above.

3.2.5.2 Hydrological goals

Mitigating Urban Floods

The swampland upon which Herzliya Park was established served as a floodplain throughout thousands of years of settlement in the land that is now the State of Israel and is located at the geographic center of the city of Herzliya. In the Drainage and Channeling Master Plan of Herzliya (Bdolah, 2011), the park is shown at the western edge of the city's central drainage basin. This basin covers almost the entire built side on the eastern side of Ayalon highway (see Figure 3.14). Most of the basin is covered by residential buildings with several public buildings.

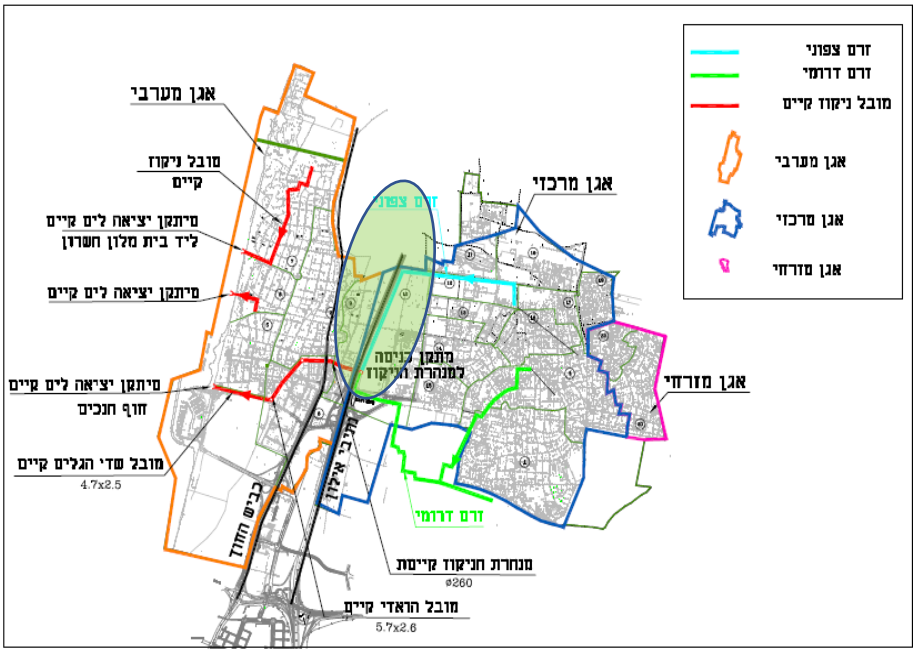


Figure 3.14: Catchment areas in the City of Herzliya (source: Bdolah 2011)

In order to understand the role of the park and the stormwater management practices implemented in it as part of the municipal drainage system, which is responsible for

protecting the city from flooding, we have collected numerous documents and have conducted interviews with the drainage engineers and landscape architects who had been involved in these issues over the last 15 years. Based on our findings, during Phase 1 of the park's planning there was limited collaboration between the landscape architects and the engineers. We were informed that a hydrological survey had been carried out at the site; however, we were unable to locate it. In Phase 1, landscape architects included two stream-like open channels to convey the stormwater, which on the eastern side of the park connect with two drainage pipes arriving from the city, to form one sloped channel inside the park, which connects with the drainage pipe system carrying the stormwater to the Mediterranean Sea on the west. However, Landscape Architect Barbara Aronson advised us that the engineers did not have confidence in the function of the open channels and installed a conventional drainage pipe underneath them.

During Phase 2, which included the planning of the winter pool, there was some level of collaboration between the engineers responsible for the drainage (in this phase only) – Union of Water Engineers, and the park's planners – Aronson Architects. This is evidenced in Figure 3.15 below.

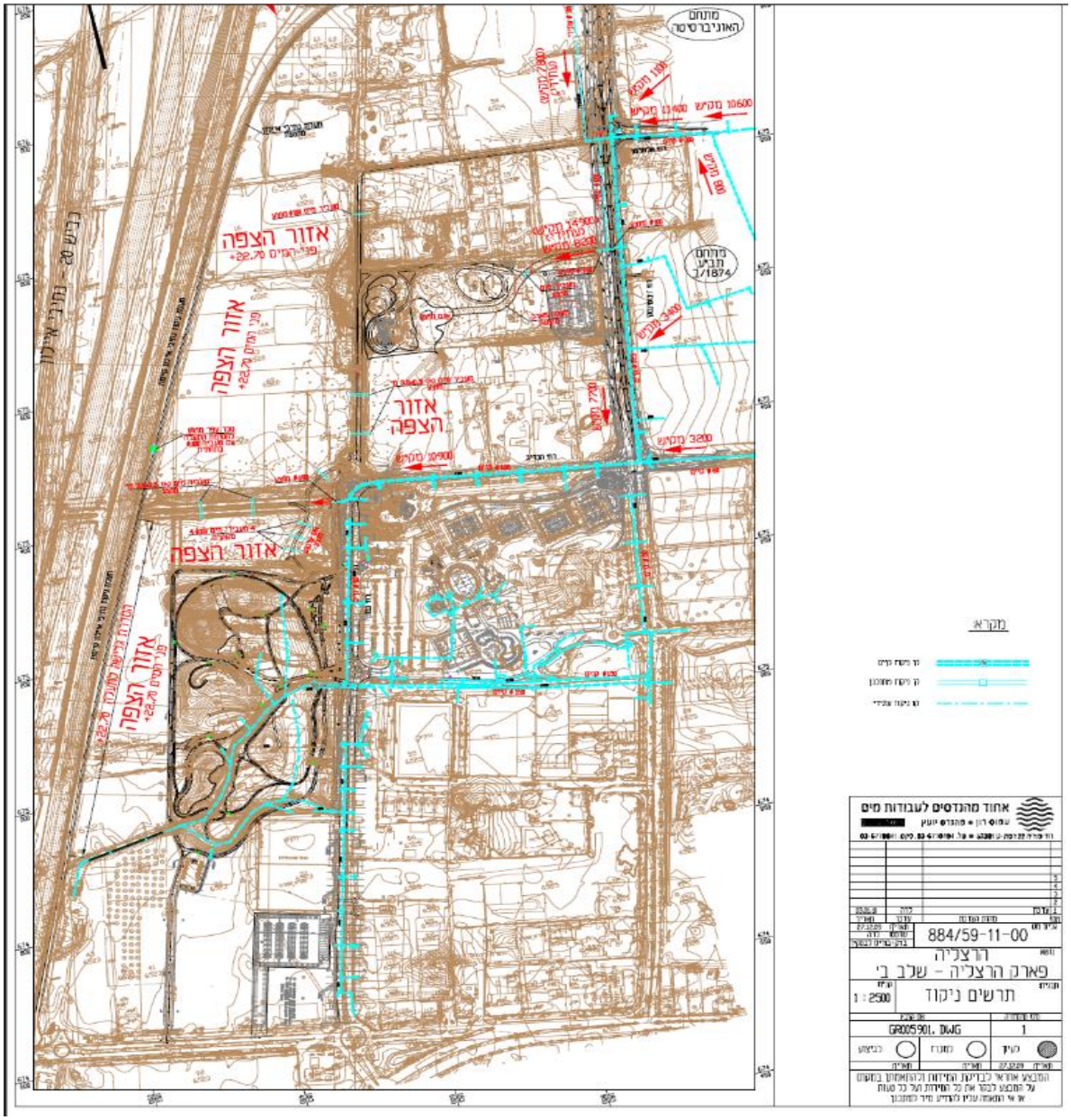


Figure 3.15: Drainage plan of Phaze 2 in Herzliya partk (source: the Union of Water Engineers, 2000)

Figure 3.15 shows the drainage pipe system (in light blue) entering the park (on the right), and indicates in words (in red) the role of the winter pool as a floodplain. The drainage engineer Boris Levskyr shared that each significant rain event results in stormwater flowing into the park; but to deal with extreme rain events, the engineers were instructed by the municipality to create a spillway throughout the areas of the winter pool at a height of 22.70 meters above sea level (the areas in the figure indicated in large red font as “floodplain”), allowing to water to collect to a height of 22.90 meters. This possibility is realized only in extreme storms (we were unable to find out their probability of occurrence), and is intended to delay the flow of the stormwater from the floodplain to the municipal drainage system

through which it flows to the sea, thus mitigating flooding and rendering redundant some of the need to significantly expand the drainage system.

Our conclusion, therefore, is that the park and the winter pool are integrated into the municipal drainage system and contribute greatly to mitigating flooding, and to some extent also to lowering the cost of the drainage system. That said, broader collaboration between the drainage engineers and the landscape architects could have increased the use of other stormwater management practices in the park (in addition to the winter pool), and to further increase the hydrological and economic benefits derived from it.

Recharging the aquifer

The soil under the park is clay, which does not allow infiltration of water; this renders spontaneous infiltration to the coastal aquifer impossible. Infiltration pits could have been included in the park, as they will be in the area that will extend the park southward; however, this idea was not raised when the park was initially planned during the first decade of the millennium.

Harvesting stormwater for diverse uses

Harvesting stormwater means directly using rainwater and runoff, before they infiltrate into the ground or reach "receiving water" (the sea, a stream, etc.). The principles of Water-Sensitive Planning determine that wherever possible, direct usage is preferable to infiltrating stormwater. One of the possible uses is "water for nature." The Israeli Water Authority's master plan (2012) formally states that the State of Israel is required to allocate a certain quantity of water each year for "water for nature". The winter pool captures the stormwater from each significant rainfall event and uses it to sustain the pool and its flora and fauna. The goal of runoff harvesting for diverse needs is thus achieved.

3.2.5.3 Ecological-environmental goals

Improving the quality of the stormwater before it reaches the "receiving water"

The stormwater that reaches the park and the winter pool originates in residential neighborhoods. Koby Azulay, who is responsible for the water in the park, reported that according to tests conducted on the stormwater, it does not flow from the adjacent airport.

Rough waste that is swept by the stormwater (such as plastic bags), is blocked by a grate installed at the opening of the pipe through which the runoff flows from eastern Herzliya. The runoff from this channel first flows down a sloped channel and then arrives at the sedimentation basin where the heavy particles settle. The quality of the water, which goes through thses relatively simple practices of cleansing, is good enogh to enable the fauna and flora in the winter pool to flourish.

The flow of water in the channel that connects the drainage pipe with the sedimentation basin continues during the summer; this is water from excess irrigation, car washing, emptying of aquariums and garden pools, etc. – water that is of lesser quality than that of winter stormwater. This water cause the sedimentation basin – in contrast to the winter pool that is dry during the summer months – to remains wet and rich with vegetation throughout the year.

The treatment of the pool and the sedimentation basin is performed under the guidance of an ecologist. In response to his professional recommendation, a decision was made in recent years to pump the water in the basin in the month of August, to allow drying it and cleaning it of the organic waste that had accumulated at its bottom. This waste, probably the part that comes from emptying aquariums, includes water snakes, eels and gambusia, which are little fish that are beneficial as they eat mosquitos, but also harm amphibia, and are therefore undesirable in the winter pool.

Support for biological diversity

The Society for the Protection of Nature in Israel was one of the organizations that fought to conserve the winter pool, arguing that it held a great significance from an ecological viewpoint, as it supports the wide biological diversity, and also since some highly endangered species have survived in it (Rothschild & Perlman, 2010). In a survey conducted at the initiative of the Municipality of Herzliya by Prof. Avital Gasith (2005), close to the time of the park's planning, the following species were detected in the swampland:

- Numerous invertebrates, including the rare species *Lepidurus apus.*

- Three species of amphibians, including indications of the presence of the rare species *syriacus Pelobates.*

- Approximately 40 species of rare flora, first and foremost the impressive species *Botomus umbellatus*, which comprises the most southern population in the world; and the species *Rumex martimus*, which was considered extinct in Israel's coastal plain.

- Approximately 64 types of birds, including a surprisingly rich population of waterfowl, some of which nest in the area. When the area is flooded, it is characterized by an abundance and high diversity of birds.

An ecological survey has not been conducted after the park's development; however, Prof. Gasith has stated (2018) that he believes that the system today is similar to the one existing when the above survey was carried out. The birdwatchers, Shlomit Lifshitz and Amir Balaban, collected information about the birds that can presently be observed in the pool, and reported about 20 waterfowl and 30 lawn birds (Municipality of Herzliya website). The following species are also mentioned in the same website, as inhabitants of the park's pool:

- *Syrian spadefoot* – an amphibian with no tail that is similar to a frog. The tadpoles develop in winter puddles; during the summer, the adults bury themselves in the ground in shallow vertical tunnels (up to 20 cm deep), in the proximity of winter puddles.

- *Lepidurus apus* – this crab disappeared from the territory of the State of Israel in the 1980s; since it is considered extinct, the Israel Nature and Parks Authority has initiated its restoration to a number of winter pools.

- Ilanit - *savignyi Hyla*– spends most of its time on trees, descends to the winter pond mainly for reproduction purposes.

- Other invertebrates that were observed in the winter pool: *Bulinus trancatus, Gerridae, Dafnia, similes Arctodiaptomus, Ostracoda, Hydrophilidae*

In addition to the important contribution to biological diversity, resulting from the cultivation of the winter pool, a garden shelter for endangered plant species was established in the park. Its purpose is to conserve these rare species that grow in this area, as well as to serve as a source for seeds and seedlings that may be restored to nature, to rehabilitate habitats and populate them. The garden shelter includes a variety of plants, including *Lotus creticus L. ,Satureja thymbra L. , Coridothymus capitatus, Globularia arabica Jaub, Scilla hyacinthoides, Salvia fruticosa Mill* and more (Municipality of Herzliya website).

Conservation of wet ecosystems

The conservation of the winter pool – a wet ecosystem of primary importance – comprises a main element in the park's planning and reputation. The conservation of wet ecosystems was adopted from the outset of the discussions on the park not only by the ecologist and by the Society for the Protection of Nature, which were intensely involved in the early stages of the planning process, but also by the city's mayor, and subsequently, by the city council and by activist inhabitants. The planners of the park wrote (Aronson, 2014) that the planning intervention in the pool area was kept to a minimum consciously and intentionally, in order to conserve its natural balance. Concealed birdwatching points were established in order to avoid disrupting the waterfowl; tall reeds were planted along the central path so that those using it would not disrupt the fauna in the pool; special hidden observation points were established to allow viewing the birds and the pool with minimal human interference; there is no illumination along the floating path at the southern end of the winter pool, and only low illumination poles at its northern end.

Interviews with Vered Osher, the park's manager, and with Koby Azulay, who is responsible for water in the park, revealed that the pool's maintenance is minimal, and follows the instructions of the ecologist who accompanys the activities in the park.

Soil conservation

Soil conservation is of cardinal importance in Israel, which is lacking in soil in general, and in fertile soil in particular, and is also losing significant parts due to unawareness and insufficient allocation of resources for this purpose. A central cause of soil loss is erosion, which is mainly caused by runoff, and also by wind. The means for preventing erosion and

conserving soil can be classified into two types – agronomic, and engineering (Halperin, 1996, p. 585).

In our conversations with the persons responsible for the planning, execution and maintenance of Herzliya Park the term “soil conservation” was not mentioned. However, observation of what is taking place on the ground reveals that the park contributes greatly to this worthy cause. Soil conservation regulations (1960) stipulate that each canal, channel, strip of grass, avenue of trees, pool, etc., can be considered as a “soil conservation enterprise.” (Yaacobi, 2009) Herzliya Park was planned and built in a floodplain, with a high level of awareness to the flow of water in it, and with the intention of mitigating the flow. The winter pool stores a considerable amount of stormwater until it evaporates, and thus prevents some of the strong flow in it. There is abundant vegetation in the area of the pool; leaving uncultivated areas with local vegetation is considered a major means of soil conservation. Moderate slopes were planned throughout the park and these slow the stormwater flow, and consequently, lower the potential of soil erosion. Retention areas are scattered in the park, including the small Eucalyptus forests and the concave lawns. Fissures in the ground became stream-like open channels in with grass and other vegetation grows. All these express the significant contribution of Herzliya Park to soil conservation.

3.2.5.4 Social goals

Place making for leisure time and recreation

A visitors survey has not been conducted in the park, but based on the testimony of its manager, Vered Osher, the park is visited by persons of all ages, both individuals and families, on all days of the week and at all hours of the day. A decision was made at the outset that entry would be free of charge; this undoubtedly encourages visits.

The park offers soft rubber jogging trails, attracting joggers – both individuals and jogging groups – from around the country, who arrive to train in it. Soccer and other teams also train in the park. Private sports activities with personal trainers, including TRX (Total Body Resistence), are also seen.

In addition to Herzliya’s inhabitants who come to spend time in the park throughout the week, visitors arrive from the entire region on weekends and holidays – some use their

private vehicles, while others take the train. Lately, Israel Railways launched a campaign encouraging train usage, which lists attractive sites near train stations. The park is located a short walking distance from Herzliya train station, and is also mentioned in this campaign. Vered Osher added that during the week-long holiday of Passover, many families came to the park by train. Many youths also visit the park in the evening, arriving on their bicycles. It seems that they are requested to leave the municipal gardens at night by the police and find Herzliya Park an attractive alternative.

"Nature in the city" enhancement

"Urban nature" is a natural system located within the territory of a local authority (The Society for the Protection of Nature in Israel, 2017). Urban nature conserves the biological diversity and unique nature values, while allowing the general public to access quality natural environment and supporting community and educational activities, as well as the local economy, by helping generate revenues from tourism (ibid.).

The winter pool in Herzliya Park well meets the definition of urban nature. Much effort has been invested in its planning, and continues to be invested in its daily cultivation, in order to conserve the natural processes taking place in the pool and to minimize the impact of development on them, as well as the impact of the maintenance team and the park visitors. One can witness the annual display of the pool filling up during the winter and drying up in summer, as well as the cyclic blooming and wilting; and observe water fowl, and also birds nesting and raising their chicks from the concealed birdwatching points, without disrupting them.

According to the park's planners (Aronson 2014) and to it manager, Vered Osher, it is not only the winter pool but the entire park that allows experiencing "nature in the city". The small Eucalyptus forests have been conserved in their original state in different parts of the park. Cultured plants have not been planted in it – neither roses nor seasonal flowers; only local plants and stream vegetation, which provide a sense of nature. The plants that were chosen were those that do not require intense irrigation. Once successfully planted, they required minimal irrigation, almost like the wild vegetation that is not irrigated at all. Vered added that with the exception of the coffee shops operating in the park, there is no

commercial activity in the form of peddlers, open-air markets, etc., with the intention of preserving the sense of nature.

Aaesthetics and landscape quality

Herzliya Park provides unique landscape aesthetics, as can be seen in the images below.

Figure 3.16: Deck along the wintwr pool (photograph: Smadar Amir, April 2018)

Figure 3.17: General view

The functioning and aesthetics of the park gained professional recognition among the landscape architects' and designers' community:

- The park won the Israeli Design Excellence Award for 2010.

- The park won the Israeli Association of Landscape Architect's award for 2013. The judges declared, as part of their statement, that: "The creative and innovative design derives from the site's characteristics, and based on them succeeds to generate added value from both the ecological and architectural viewpoints. The park serves the general public in a wonderful way, and constitutes an example of planning that takes into account both the needs of the community and of the environment." (http://www.land-arch.org.il/images/inc/files_magazines/792.pdf)

- The park was awarded the Karavan prize in 2015. Aliza Braudo, chair of the landscape architects association stated: "it has both artistic and aesthetic values." (https://www.haaretz.co.il/gallery/architecture/1.2714525)

Education for sustainability and good citizenship

Herzliya Park promotes education for sustainability among children and youth, as well as among adults. This is expressed in the following:

- The park pamphlet, which enables visitors to conduct an active tour of the park, familiarize themselves with its different areas and learn about its flora and fauna.

- "Edible forest" – a small orchard was planted in the park, containing a variety of fruit and nut trees: Strawberry, pomegranate, walnut, almond, guava, feijoa, cherry, sweetsop (sugar apple), wampi (Clausena lansium), persimmon and mango. Local inhabitants cultivate this orchard.

- Keinan House – built in 1936 as a lone house at the heart of the orchards. Efraim Keinan renovated it in 1946, and his family lived there for the next 60 years. The ownership of the house was transferred to the Municipality of Herzliya in 2007, and was declared a "house of nature, the environment and the community", and is considered a part of Herzliya Park. Upon its declaration, the house was designed in conformity to the values of sustainability. The illumination system was designed through use of the poterium bushes, the benches were made of natural wood, the sculpture was built using Israel Electric Corporation waste, etc. The garden

surrounding the house was upgraded in accordance with the city's nature concept. Guided tours take place at the house and continue to the park. Keinan House currently serves as a focal point for local community activity that advance the social-environmental discourse in the city.

- Broad learning activity of children in Herzliya's schools takes place in the park. Activity for all the 4th graders, which is connected to their learning program, is carried out at the winter pool. The one-day tours begin with an explanation at Keinan House and continue with activities in the winter pool area. There are approximately thirty 4th grade classes in the city (some 1,000 children in total). This activity is now in its fourth year.

- Changing the awareness to nature of Herzliya's inhabitants – the park's manager reported a change in trend in the residents' perception: At first, they were concerned that the park and its winter pool would attract mosquitoes and voiced their objection. In contrast, today they feel a sense of pride, which is expressed in their efforts to care for the park, and in their reporting to the municipal call center of hazards, litter, vehicles driving in the park, etc.

Social involvement and communality promotion

The park's establishment was a complex process and required much community involvement. Along with the part played by the prominent persons and organizations that support the development of urban nature, the political commitment of the mayor and the city council were also required (see Appendix 2). These were supported by caring residents of Herzliya, whose help was needed to advance the process, despite the claims filed by those who owned some of the land and were interested in making a profit by constructing high-rise buildings on it. The inhabitants' support helped during the court proceedings, including at the Supreme Court, which ruled against the land owners and in favor of the public interest of conserving the winter pool and establishing a large municipal park in the area (see Appendix 1).

According to the presentation provided by Landscape architect Barbra Aronson (2014), the planning program of the park was determined following a telephone survey conducted

among the city's residents and a brainstorming workshop with local residents (referred to in the image below). Accordingly, it included the following elements: Playground facilities, lawns, an amphitheater, picnic grounds, a lake, jogging and bicycle paths, a coffee shop, public toilets and shaded areas.

Figure 3.18: Brainstorming announcment (Source: Aronson's Power Point presntation, 2014)

The community involvement in the life of the park continued, and even increased after its establishment. Some of this involvement was bottom-up, especially in the form of volunteers. It was also encouraged from above, through public entertainment sponsored by the municipality, and youth activities funded by it. The park's manager mentioned a photography project that she had initiated in recent months, which was inspired by beautiful pictures of the park and life in it, which were sent to her by visitors.

3.2.5.5 Economic goals

Financial benefits for the municipality

The municipality has gained a successful, particularly well-functioning park, with significant savings in its establishment and maintenance costs. Based on a "position paper" prepared by the Society for the Protection of Nature in Israel (2008), "the conservation of the winter pool as a natural area with minimal development will save the city's residents millions of

NIS: The cost of intensive park development (lawns, pergolas, facilities) is estimated at more than NIS 100,000 per dunam; therefore, conserving some 120 dunam of pool saved the Municipality of Herzliya approximately NIS 12 million.

Furthermore, the annual maintenance costs of an intensive park are estimated at thousands of NIS per dunam. The park's manager indicates that the maintenance of the winter pool is minimal – a day or two of mowing periodically, as per the ecologist's instructions. Consequently, the municipality saves hundreds of thousands of NIS annually.

Additional cost savings, the extent of which is unknown, is generated by the flow of a significant amount of stormwater, which is directed to the winter pool each year, a large share of which evaporates and does not reach the drainage system situated west of the park. Engineer Borris from the Union of Water Engineers told us that thanks to the calculations of the floodplain in the park, the western drainage system of the city is considerably smaller than it would have been without it. The above is joined by the stormwater that is directed to the stream-like open channels, where it flows relatively slowly, irrigating and evaporating on its way. If these large amounts of stormwater would not have been detained at the park, it would have been necessary to expand the municipal drainage system that conveys the runoff to the sea – which would have required heavy financial investment.

On the other hand, it is important to remember the municipality's expenses as well: Compensating the private landowners whose land was confiscated to establish parts of the park (a process that is ongoing and far from over), and the establishment and maintenance of the large park, which is open to the public free of charge. In addition, the municipality initiates cultural events in the park, also free of charge, including guided tours, concerts, dancing, story telling and more. Even the blue-and-white (paid) parking in the park's vicinity is free of charge for Herzliya residents; visitors from outside the city pay a parking fee, which constitutes revenue for the municipality.

Increased value of proximate real estate

The land uses in the vicinity of the park are mainly commercial or public, including the city's stadium, performing arts hall, country club, Air Force House, the Interdisciplinary College

(IDC), event halls and more. No residential areas neighbor the park, whose value would have increased thanks to the green and blue landscape visible from their buildings' windows. The "Western Green Herzliya" neighborhood lies not far from the northern (and as yet undeveloped) part of the park; it is a relatively new neighborhood that mainly attracts young families. A search on the central website for information concerning residential neighborhoods and the purchase/rental of apartments in Israel (*MADLAN*), reveals that the proximity to the park is indeed mentioned as one of this neighborhood's attributes; however, only among other attributes, such as spacious apartments; and proximity to public transportation, to schools and sports clubs, and also to open areas – the only one of which that is mentioned by name is Herzliya Park. We therefore conclude that the park's impact on real estate prices in the area is small.

Economic opportunities in proximity to blue-green landscape

The park's planners intentionally refrained, and continue to refrain from conducting commercial activity in it, which in their view is incompatible with the "nature in the city" experience that they would like the park visitors to enjoy. There are only two coffee shops, one at the southern part of the park and one at its center, near a playground. An additional coffee shop (Phase 3 of the development) is presently closed for renovation.

The main public services offered by the Municipality of Herzliya, which were mentioned above, operate in proximity to the park; however, is it reasonable to assume that their existence in this location and the activity taking place in them are not influenced by it.

The shopping mall "Shivat HaKochavim" which is situated near the park, is worth mentioning in this context, if only because there is a huge glass wall near its entrance (close to Aroma coffee shop). It is possible that observing the park, or visiting it as well, are part of the shopping experience at the mall, and therefore, positively impact on its level of attractiveness.

We have not found evidence of any plans to expand the economic activity in the park or its vicinity.

3.3 Herzliya Park as a Green-Blue Project: Comprehensive Evaluation of Goals Achievement

Herzliya Park is green-blue project – a landscape project that integrates practices/means/tools for stormwater management. In this research, it serves as a test case on an urban scale. It demonstrates that integration is possible, and that it supports the achievement of goals related to all the four groups that were examined: Hydrological, environmental-ecological, social and economic goals.

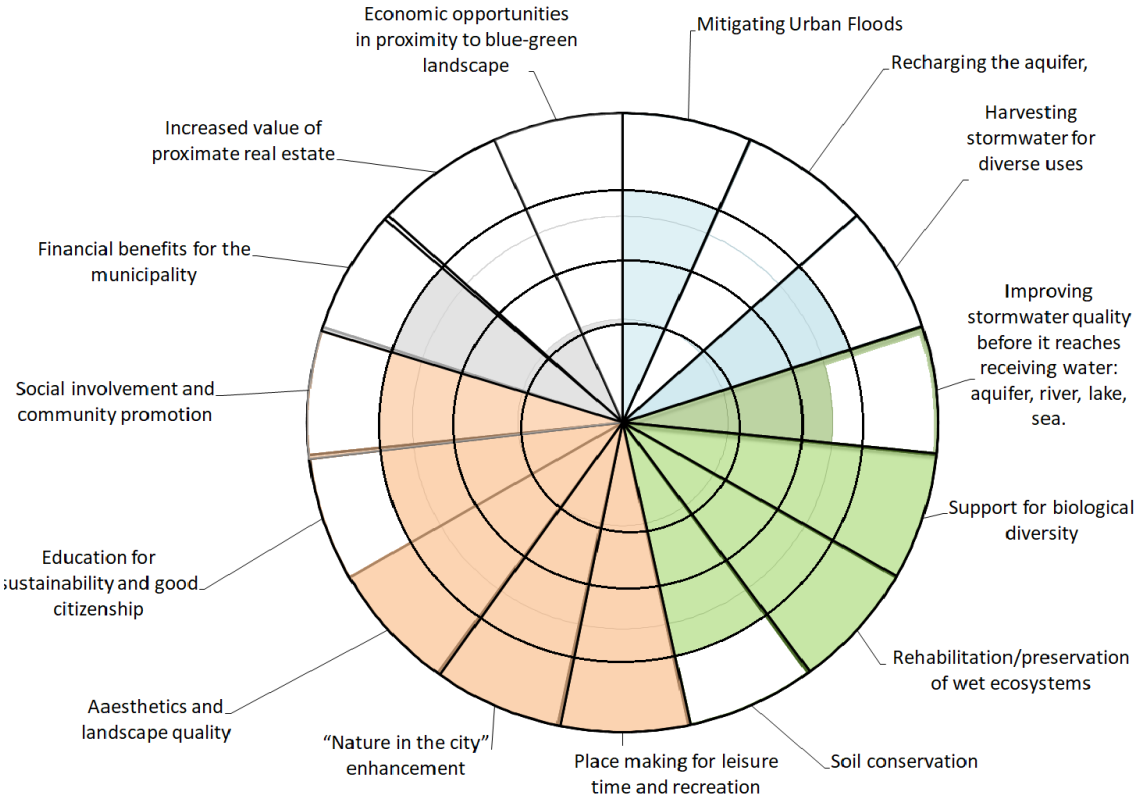
Herzliya Park as a Green-Blue Project – Overall Assessment of the Achievement of Goals

Goals/Benefits	Relevant stormwater management practices	Information for evaluation (details in former sections)	Grade* (0-4)
Mitigation of urban floods	Winter pool Stream-like open channels Small eucalyptus forests Concave lawns	120 dunams retain stormwater for 6-7 months a year and serve as floodplain in extreme rainstorms; Slowing down the flow; The last two: Short-term retention.	3
Aquifer recharge	---	Clay soil does not enable infiltration; infiltration pits were not added to the park	0
Stormwater harvesting for various uses	Winter pool	The pool collects "water for nature", which is a formal water use in Israel;	3
Stormwater quality improvement before it reaches "receiving water"	River-like open channels	The sedimentation basin cleans runoff to the extent required for the pool; Slowing down the runoff flow and passing through vegetation contributes to cleansing	2
Biodiversity support	Winter pool The other practices	The natural fauna and flora in the pool and other practices contribute considerably to biodiversity	4
Rehabilitation/conservation of wet ecosystems	Winter pool	Rigorous conservation	4
Soil conservation	All the practices	Each practice and its vegetation slow down runoff flow and conserve soil	3
Place making for leisure time and recreation	Winter pool Concave lawns Eucalyptus forests	Residents of Herzliya and other visitors intensively use the park; The practices increase the park's attractiveness.	4
Nature in the city enhancement	Winter pool The other practices	Conserving nature and using local vegetation only	4
Aesthetics and landscape quality enhancement	The practices and the park as a whole	A series of professional awards confirms the unique quality	4
Education for sustainability and good citizenship	Winter pool The other practices	Plenty of educational activities; citizens alert whenever they detect hazards	3
Social involvement enhancement	Winter pool The other practices	Citizen participation in ensuring pool conservation; volunteers are active in the park	3
Financial benefits for the municipality	Winter pool	Cost savings in development and maintenance in comparison to an intensive park;	3

		Cost saving due to somewhat smaller drainage system in the western part of the city	
Increased value of proximate real estate	The park as a whole	No housing in immediate proximity; the park is considered as adding some value by *MADLAN***	1
Economic opportunities in proximity to blue-green landscape	---	---	0

*Grades: 0 – not at all; 1 – little; 2 – moderate; 3 – well; 4 – very well

** *MADLAN* is a popular real estate site



The various goals were achieved to varying extents. In two of the groups – environmental-ecological goals and social goals – the park was awarded high evaluation grades: Mostly 4's (very well) and a few 3's (well). Economic goals were moderately achieved (0,1,2). The hydrological goals, which deserve particular attention in this research, were achieved to a mixed degree: Aquifer recharge – not at all; mitigation of urban floods– well, but not very well; runoff cleansing – again, well, but not very well. Our explanation for the variance in the level of goals achievement is anchored both in the lack of sufficient awareness of the

professionals who dealt with the park's planning to the great potential for achieving the goals, and in their lack of collaboration.

The raison d'être of the park at the location where it is situated is that the site is an historic floodplain. The landscape architects, who are primarily responsible for the park's image, were aware of the 'watery' history, and stated: "The main skeleton of the park and the design of its elements are an interpretation of the basic concept of 'natural flow', a concept directly associated with the site's natural history as a drainage basin" (Aronson, 2014). However, this awareness did not encourage them to communicate with the drainage engineers and to collaborate with them from the very start of the planning process. The idea of collaboration and its potential benefits were even further away from the point of view of the drainage engineers. Moreover, the drainage plan of Phase 1 of the park reflects a lack of belief that the means existing in the park could aid drainage; this is expressed in laying a drainage pump underneath the open channels in Phase 1 of the park's development. The drainage engineers as well as the landscape architects did not think at all about recharging the aquifer, because the soil type in the area is clay, which does not infiltrate water; however, they could have considered infiltration pits, such as those planned in the park across the road, at the southern part of the researched park.

In contrast to the very little communication between the landscape architects and the drainage engineers, a close connection was maintained between the planners and the ecologists in all the stages of the parks's planning, execution and maintenance. Prof. Avital Gasith was responsible for mobilizing Herzliya's mayor and the city council to restore the water pool as a central focal point in the park, and the Society for the Protection of Nature in Israel assisted by supporting the decision to conserve the natural pool at the dimensions necessary for the continuation of the natural processes taking place in it. Ecologists provided professional support throughout the planning and execution stages and took care – among other actions – to situate the sedimentation basin in an area that had already been damaged by man, and took care not to use heavy machinery in the area of the natural pool. Additionally, the pool's maintenance specifically, and the park's maintenance in general, take place in consultation with an ecologist. Landscape Architect Barbara Aronson believes that the establishment of the park has opened up new possibilities for similar parks, which were developed in the following years, and contributed to promoting the professional

dialog between landscape architects and ecologists. The success of this collaboration is very apparent in the high to very high grades that were awarded to the achievement of the environmental-ecological goals and of the social goals, which are closely associated with the planning and design.

It is important to note that the diverse goals were not only achieved symutaneously, but that the synergy between the goals' achievement is prominently discernible. The planning and execution of the stormwater management practices, first and foremost the winter pool and the adjoining sedimentation basin, and with it the small Eucalyptus forests in shallow depressed areas, the concave lawns and the stream-like open channels, which contribute to reducing the floods and to cleansing the flowing runoff, are highly beneficial to the achievement of the environmental-ecological goals. These comprise focal points of social interest in the park, while also contributing to the reduction of the execution and maintenance costs. All these together, including, of course the design talent and the superior ability to communicate with the target audience that were demonstrated by the planners, led to the success of Herzliya Park. In a newspaper article covering the most recommended parks in central Israel, Herzliya Park was listed first (Sagi Alfasa, 2012).

Finally, we wish to add that the park's success is not guaranteed. Although the court has ruled in favor of protecting the right of this area to serve as a municipal park (and not as a land intended for residential or other uses), this has not yet been finalized statutorily. Some of the land in the park area is still privately owned. Furthermore, the water sources feeding the winter pool are under threat of building and road construction plans. There is hope that these issues will be resolved with time, due to the public and educational success of the park. It is dear to the heart of many of Herzliya's inhabitants and of its public representatives, and it is reasonable to assume that they will fight to preserve and expand it.

3.4 References

Aronson Architects, (2014), "Herzliya Park", Landscape Architecture, 50, pp 7 (Hebrew).

Aronson B., (2014), "Planning Herzliya Park 2004-2014", PowerPoint presentation, Shlomo Aronson Architects (Hebrew)

Bdolah S., (2011), “Herzliya – Drainage and Channeling Master Plan”, PowerPoint presentation, HGM Civil, Water and Environmental Engineering (Hebrew).

Burmil, S., Shamir, U., Carmon N. and Be’eri S. (2003), Urban Runoff in Residential Areas. Research report. Technion: The Center for Urban and Regional Studies and Grand Center for Water Research (Hebrew).

Carmon, N. and Shamir, U. (1997), Water-Sensitive Urban Planning: Protecting Groundwater. Research report. Technion: The Center for Urban and Regional Studies (Hebrew).

Carmon, N. and Shamir, U. (2010), "Water-Sensitive Planning: Integrating Water Considerations into Urban and Regional Planning”. Water and Environment Journal, Vol. 24, No 3, pp. 181-191. Available http://naomi.carmon.net.technion.ac.il/files/2016/12/Water-and-Envir-J-following-correction-of-titles.pdf

Carmon N. (2015), Water-Sensitive Planning: 20 Years of WSP in Israel. PowerPoint presentation at the annual conference of Israel Water Association.

Gasith, A,, (2006), Ecological Survey – Herzliya Swampland. Tel Aviv University: Faculty of life Sciences.

Halperin, (1966), “Encyclopedia for Agriculture”, Vol. 1, Fundamental Sciences (in Hebrew only)

Markus L., Gasith A. and Carmon N. (2014), Water Sensitive Design (WSD) of Inerurban Highway Corridors in Israel: Using Road Runoff for Enhancement of Ecological and Social Benefits. Tel Aviv: Porter School in Tel Aviv University and the Center for Urban and Regional Studies, Technion (Hebrew). http://naomi-carmon.net.technion.ac.il/files/2017/10/Liad-Highways-Corridors-in-Israel-2014.pdf

Markus, L., Carmon, N. and Gasith, A. (2015), “Tool Box for Water-Sensitive Planning of Inter-Urban Roads for Achieving Ecological and Social Benefits”. Adrichalut Nof, The Journal of Israel Association of Landscape Architects (Hebrew). http://naomi-carmon.net.technion.ac.il/files/2018/05/ארגז-כלים-לתכנון-רכיש-למים-של-כבישים-בינעירוניים.pdf

Mendelsohn A., (2016), Excursion Trail: Herzliya Park and the Floodplain (Hebrew). https://www.inature.info/wiki/%D7%A4%D7%90%D7%A8%D7%A7_%D7%94%D7%A8%D7%A6%D7%9C%D7%99%D7%94_%D7%95%D7%94%D7%91%D7%90%D7%A1%D7%94

Merhav, C. (2016), Ex-Post Evaluation of Practices of Water-Sensitive Planning in Herzliya Park. Term Paper for a course on Water-Sensitive Planning, Submitted to Professors Michelle Portman, Tal Alon Mozes and Naomi Carmon (Hebrew).

Herzliya Municipality website, “Herzliya Park”, http://www.herzliya.muni.il/park_herzliya (Hebrew).

Herzliya Municipality, City Engineering Department website, http://handasa.herzliya.muni.il/Pages/default.aspx (Hebrew).

Rothschild A., Perlman Y., (2010), Winter Pools in Israel: The Importance and Challenge of Conservation – Information for Policymakers and Field Managers. The Society for the Protection of Nature in Israel (Hebrew).

Sagi Alfasa E., (2012), "The Large Survey: Which Urban Park in Central Israel is the Best?", https://www.ynet.co.il/articles/0,7340,L-4232643,00.html (Hebrew).

Shalem L., Gazit A., (2018), "Winter Pools and Puddles Receive their Proper Status in the Urban Environment", Water Engineering, issue 115, pp 48-51

Shamir U. and Carmon N. (2007), Water-Sensitive Planning: Integrating Water Considerations into Urban and Regional Planning**.** Haifa: Technion, The Center for Urban and Regional Studies and Grand Center for Water Research (Hebrew). http://naomi-carmon.net.technion.ac.il/files/2017/11/-ספר-תרמ-הדפסה-שלישית-2012.pdf

The Society for the Protection of Nature in Israel, (2008), Integrating the Winter Pool into the Framework of Herzliya Park ('the Floodplain') and Conserving Nature Values. Position Paper (Hebrew).

The Society for the Protection of Nature in Israel, (2017), National Policy for Urban Nature. (Hebrew).

USEPA, (2000), Low Impact Development (LID) – A Literature Review, EPA-841-B-00-005 .

Water Authority of Israel, (2012), Long Term Master Plan for the Water Sector, Part A – Policy Document (version 4), http://www.water.gov.il/Hebrew/Planning-and-Development/Planning/MasterPlan/DocLib4/MasterPlan-en-v.4.pdf (Hebrew).

WSUD, (2013), Water Sensitive Urban Design, U-tube presentation. https://www.youtube.com/watch?v=b_DTnOzYTR4

Yaacobi B., (2009), Soil Conservation Means - an Edict that the Public Cannot Bear? Online presentation, retrieved in May 2018 http://www.geog.bgu.ac.il/fastSite/coursesFiles/confTal/beni1.pdf (Hebrew).

Part 4:

Towards the fourth and last research year

Summary of Work: Project Deliverable according to research proposal from Dec. 2012, Accomplishments, proposed work

Project Deliverables	Accomplishments	Proposed work
1. Literature review to confirm most-relevant selection criteria	Accomplished, see Part III, sent by the beginning of 2016 as app. 1-3.	
2. Survey and categorize potential case studies	Accomplished, sent by the beginning of 2016 as app. 4.	
3. Final choice of projects. Initiate in-depth survey of general information on environs of chosen case study projects	Accomplished.	
4. Development of methodology and evaluation methods	Accomplished, seepart 2 in this report.	
5. Completion of policy review of stormwater management institutional frameworks and planning and implementation processes	Accomplished, see report from July 2017.	
6. Evaluation of physical, economic and social goal achievement	Partly ccomplished, see part 3 in this report.	More case studies will be examined

The last part of the research will include:

Recommendations for improving stormwater management in Israel.

1) Discussion of desired changes/improvements in policy, based on the identification of impediments and supports.

2) Discussion of Management Practices (MPs) tailored to the Israeli context.

3) Identification/presentation of gaps in knowledge and future directions (academic and professional publications, conference presentation, meetings with planners and policymakers).

Appendices

נספח 1: פסק הדין שאיפשר הקמתו של הפארק (כתבה עיתונאית)

https://www.makorrishon.co.il/nrg/online/1/ART1/706/080.html

בית המשפט העליון פסק לטובת העירייה וקבע כי פארק הרצליה יישאר ריאה ירוקה במקום מתחם בנייני מגורים

6/3/2008 | מעריב nrg

עוד החלטה ירוקה בבית המשפט העליון, בשבוע אחד. ימים ספורים לאחר השאיר על כנו את צו המניעה להמשך העבודות בעיר הבה"דים, שוב הלם הפטיש בתום החלטה, שמותירה את הבניינים בחוץ ומשאירה את הריאות שלנו בחיים .

בית המשפט העליון קבע השבוע כי כל שטח פארק הרצליה, על 700 הדונמים שלו, יישאר ריאה ירוקה ודחה את בקשתם של משקיעים ויזמי נדל"ן לבנות 1,400 יחידות דיור ב 16 -בניינים במתחם הפארק .

מדובר במאבקה של עיריית הרצליה נגד משקיעים ויזמי נדל"ן, שרכשו קרקע חקלאית אך "התארגנו בסיוע משפטי כדי שיותר להם לבנות בשטח הפארק מגדלי דירות". עיריית הרצליה טוענת כי אותם רוכשים ידעו כי השטח אינו מיועד לבנייה, אך בית המשפט המחוזי בתל-אביב קבע כי עליה לדון בתוכנית הרוכשים .

"משמעותו של דיון כזה", טענו בעירייה, "היה עיכוב של כמה עשורים בהקמת הפארק העירוני ובעיקר - גניזת חלומו הלגיטימי של הציבור להקים פארק - ריאה ירוקה רצופה - בעיר". העירייה, באמצעות עו"ד אילנה בראף-שניר ועורך דין רענן הר-זהב, ערערה לבית המשפט העליון וכאמור קיבלו השופטים חשין, לוי וחיות את עמדתה .

תכנית פארק הרצליה מקודמת על-ידי עיריית הרצליה החל משנת 1974. התכנית כוללת פיתוח פארק בן 700 דונם לרווחת תושבי הרצליה בשטח שבין הרצליה ה"מערבית" להרצליה ה"מזרחית" באזור ה"באסה" – שלולית החורף ההיסטורית של הרצליה .

התכנית כוללת שימור של ה"באסה" והקמת נקודות תצפית ושבילי גישה אליה, מדשאות, מתקני משחק, אזור פיקניק, אזור אירועים, אגם נוי ועוד .

חשוב לציין כי לתושבי הרצליה אין כיום פארק גדול בעיר. שטח הפארק המתוכנן, הכולל כ- 700 דונם של פארק פתוח, הינו שטח מינימלי לפארק עירוני לאוכלוסיית הרצליה בשנים הקרובות (כ- 120,000 איש .(

בשטח הפארק קיימת בריכת הבאסה, ובה מיני חי וצומח נדירים כדוגמת הצפרדע חפרית מצויה, צמחים נדירים כבוציץ סוככני וסרטנים נדירים כתריסן הקשקש .

מעבר לחשיבותן האסתטית והטבעית, יש לבריכות חורף חשיבות חינוכית- היא מרכז חינוכי ללימודי טבע ונוף, מילדי גן ועד לסטודנטים באוניברסיטה, המבקרים במקום, עורכים עבודות ביוטופים וכו'. וכך גם ילדים עירוניים מגלים שיש להם טבע מתחת לאף .
בחברה להגנת הטבע שמחו על הידיעה ומסרו בתגובה :
"אנחנו מברכים על החלטת בית המשפט העליון לשמור על הריאה הירוקה של הרצליה נקיה מבנייה .

"החברה להגנת הטבע, שפעלה בשיתוף העירייה לביטול תוכניות הבנייה, קוראת לעיריית הרצליה לשמור על ערכי הטבע הייחודיים של פארק הרצליה ולקדם את נושא שימור בריכת החורף –"בריכת הבאסה", אחת מבריכות החורף האחרונות שנותרו בישראל, כאתר טבע עירוני .

"שטח הבריכה, הכולל כ-100 ד' משטח הפארק, הוא משאב אקולוגי, ציבורי וחינוכי ממדרגה ראשונה, ומצויים בו ערכי טבע נדירים בסכנת הכחדה. פיתוח הפארק חייב להיעשות תוך התחשבות ושימור ערכי הטבע המיוחדים, בכדי שגם תושבי הרצליה והאיזור כולו יוכלו ליהנות מטבע במרחק נגיעה ."

"מתנה לדורות הבאים"

"הפקעת מקרקעין פוגעת קשות בזכות הקניין של הפרט, אלא שהיא רע הכרחי. הפקעת מקרקעין נדרשת במקרים רבים כדי לענות על הצורך הציבורי בדרכים, בפארקים, וכיוצא באלה .

"תכנית הר/1941 מבקשת להפקיע את כל המקרקעין הפרטיים המצויים בתחומה לצורך הקמתו של פארק עירוני בהרצליה .

"לכל אלה, נטען, תהיה גם השפעה על האטרקטיביות של הפארק. יש לזכור, כי התכנית שהוצגה בפני המועצה הארצית היתה לבניית שכונת מגורים בהיקף של כ-1,400 יחידות דיור, ב-16 בניינים בני 15 קומות... באופן שתיווצר חומה, לטענת המערערות, בשטחו הצפון-מזרחי של הפארק .

"החלטתם זו של מוסדות התכנון, ככל שהיא פוגעת בקניינם של בעלי המקרקעין, איננה יכולה להיחשב מבחינת תוכנה כהחלטה בלתי סבירה, ובוודאי שלא בלתי סבירה באורח קיצוני ."

את הניצחון רושמת לעצמה ראש עיריית הרצליה, יעל גרמן, שמסרה: "אני מאושרת מהחלטתו של בית המשפט העליון, שהיא מתנה לדורות הבאים וניצחון של שוחרי הטבע ואיכות הסביבה. בית המשפט העליון קבע סופית שהרצליה תזכה בריאה הירוקה, לה היא ראויה ."

מהחברה להגנת הטבע נמסרי כי היא "מברכת על החלטת בית המשפט העליון לשמור על הריאה הירוקה של הרצליה נקיה מבנייה .

"החברה להגנת הטבע, שפעלה בשיתוף העירייה לביטול תוכניות הבנייה, קוראת לעיריית הרצליה לשמור על ערכי הטבע הייחודיים של פארק הרצליה ולקדם את נושא שימור בריכת החורף –"בריכת הבאסה", אחת מבריכות החורף האחרונות שנותרו בישראל, כאתר טבע עירוני .

"שטח הבריכה, הכולל כ-100 ד' משטח הפארק, הוא משאב אקולוגי, ציבורי וחינוכי ממדרגה ראשונה, ומצויים בו ערכי טבע נדירים בסכנת הכחדה. פיתוח הפארק חייב להיעשות תוך התחשבות ושימור ערכי הטבע המיוחדים, בכדי שגם תושבי הרצליה והאיזור כולו יוכלו ליהנות מטבע במרחק נגיעה ."

נספח 2:

גם גרמן והתושבים ראויים לפרס על פארק הרצליה, ולא רק אדריכלי הנוף

https://xnet.ynet.co.il/architecture/articles/0,14710,L-3110289,00.html

גיא נרדי

פארק הרצליה זכה בפרס אברהם קרוון לאדריכלות גנים ונוף לשנת 2015. הפרס מוענק מדי שנתיים שהטביע את חותמו בגנים לפרויקט ישראלי מצטיין, לזכרו של אדריכל הגנים והנוף אברהם קרוון הבולטים של תל אביב: גן מאיר, גן העצמאות, גן הפסגה ואחרים. הפרס, בסך 18 אלף שקלים, יוענק בסוף נובמבר לאדריכלית הנוף ברברה אהרונסון בשיתוף האדריכל איתי אהרונסון, שניהם ממשרד "שלמה אהרונסון אדריכלים".

בראש חבר השופטים השנה עמדה פרופ' נורית ליסובסקי, כשלצדה אדריכלית הנוף עליזה ברוידא, האמנית דרורה דומיני ואדריכלי הנוף ליאור לוינגר וליטל סמוק-פביאן. פרס קרוון מוענק מאז 1971, מטעם קרן שייסדה רשות הטבע והגנים, המועצה לארץ ישראל יפה, מרכז השלטון המקומי, עיריית ת"א-יפו, משפחת האדריכל יעקב רכטר ומשפחת קרוון. מאז 2001 מופקדת הקרן בידי עיריית תל אביב-יפו, שמחלקת אותו מדי שנתיים לאדריכל נוף על הצטיינות בתכנון פרוייקט נופי.

פארק הרצליה, שחנוכתו הראשונית הייתה ב-2008, המשכו נחנך לפני שנתיים והשלב השלישי שלו טרם הסתיים. התכנון עוקב אחר הרעיון של זרימה טבעית של בריכת החורף, כעץ השולח זרועות (צילום: RonAlmog, cc)

תכנון הפארק כולל אזורי מדשאות, במה, אמפיתיאטרון, מתקני כושר, בריכת נוי ובריכת חורף. הוא משתרע על פני כ-700 דונם, שחלקם היו אדמות פרטיות והסבתן לשטח ציבורי עוררה התנגדות עזה - שהסתיימה בפיצויים גבוהים (צילום: RonAlmog, cc)

דיירי הפארק. ערכי הטבע של הבאסה (ביצה) עשירים ותועדו בעשור שעבר (צילום: RonAlmog, cc)

התנגדויות של בעלי הקרקע

הפארק משתרע על פני כ-700 דונם, בין מסילת הרכבת (תל אביב-חיפה) לעיר הוותיקה, ליד קניון שבעת הכוכבים וספורטק הרצליה. זהו חלק משטח מרזבה (עמק), הנמצאת בין צירי גבעות הכורכר הראשון והשני של מישור החוף באזור השרון, ולכן נקוו בו, מאז ומעולם, מי גשמים ונוצרו ביצות - או בשמן העדכני "בריכות חורף". התכנון של הפארק עוקב אחר הרעיון של "זרימה טבעית", כמעין עץ השולח זרועות. תכנון הפארק כולל אזורי מדשאות, במה, אמפיתיאטרון, מתקני כושר, בריכת נוי ובריכת חורף. הפארק נפתח לציבור כבר

ב-2008, כעבור שלוש שנים הסתיימו עבודות ההרחבה של שלב ב', ב-2011 הושלם שלב ב' וב-2013 שלב ג'. הצד הצפוני של הפארק תוכנן, אך טרם הושלם.

מהלך עיקש של יעל גרמן, שעלה לעירייה הרבה כסף. התושבים מצביעים ברגליים (צילום: פרס קרוון הוענק אמנם למשרד האדריכלים, אך למימוש וגיבוש רעיון הפארק היו שותפים רבים, והעיתוי הוא הזדמנות טובה להזכירם. ההחלטה על הקמת הפארק התקבלה כבר בשנות ה-90 של המאה הקודמת, בשטח שהוגדר כשטח חקלאי בתוכניות מתאר ישנות. הכוונה להסב את ייעוד השטח לשצ"פ (שטח ציבורי פתוח) עוררה התנגדויות עזות של בעלי קרקעות פרטיים, שחלק מהשטח היה בבעלותם והם רצו לקדם בו בנייה למגורים. מאבקם היה עיקש: לאחר שפניותיהם למוסדות התכנון נדחו, הם פנו לבית המשפט העליון, שדחה את טענותיהם וקבע שלא תהיה בנייה בפארק, ומכאן נפתח מאבק ממושך על גובה הפיצויים שיינתנו להם.

יעל גרמן, שכיהנה באותה תקופה כראש עיריית הרצליה, הייתה גורם מרכזי בהגשמת הרעיון. אף שהפארק נחנך ב-2009, רק אשתקד - אחרי שגרמן כבר עזבה את העירייה לטובת הכנסת ומשרד הבריאות - פסק בית המשפט המחוזי בתל אביב את גובה הפיצויים שתשלם העירייה לבעלי הקרקעות: 15 מיליון דולר עבור 200 דונם, כולל דמי שימוש בשטח ושכר טירחה של עורכי הדין. בית המשפט כינה את התנהלותה של גרמן כלפי בעלי הקרקע "עוינת". הסגנון של גרמן היה אולי בעייתי, אך את הגנאי ניתן לפרש גם כשבח על מסירות למען הגשמת אידאל שגרמן מאמינה בו.

החברה להגנת הטבע. אגף שמירת טבע בחברה להגנת הטבע לא ממהר להירתם למאבקים על נושאים הקשורים לסביבה העירונית, אך בפארק הרצליה הוא חרג ממנהגו. הוא חבר לרשות העירונית כשזיהה שהבאסה, או הביצה, היא אחת מבריכות החורף הבודדות ששרדו את תנופת הפיתוח של אזור תל אביב. החברה להגנת הטבע הייתה בעלת ברית למאבק, כחלק מתפקידה כמייצגת ארגוני הסביבה בועדות התכנון ובשותפה בפעילויות שקריבו את הציבור לערכי הטבע הייחודיים. הדוח שהכין ב-2008 רכז אגף שמירת טבע, אלון רוטשילד, כאשר נשקפה סכנה לבריכת החורף בגלל העיצוב האינטנסיבי של הפארק, תרם להכרה בערכן האקולוגי והנופי של בריכות החורף בכלל, וזו של הרצליה בפרט.
אביטל גזית. הסקר האקולוגי שערך הפרופסור מאוניברסיטת תל אביב ב-2006 בעבור היחידה הסביבתית של עיריית הרצליה, היה תיעוד ראשון של ערכי הטבע של הבאסה: צומח (דמסון כוככבני, אגמון ימי, אצה חוטית קלדופורה ועוד), עופות (דוחל שחור גרון, פיפיון מים, מגלן, ברווז היאורית ועוד) ומאכלסי מים (סרטני דפניה, תריסן הקשקש, חפרית, קרפדות,טריטונים ועוד).

עיריית הרצליה והתושבים. פארק הרצליה הוא אחת הדוגמאות הראשונות בישראל לשיתוף ציבור: התושבים השתתפו בקביעת אופי הפארק ותמהיל השימושים הרצויים. למפגשי שיתוף הציבור, שנערכו ביוזמת מינהל ההנדסה העירוני לקראת תכנון השלב הראשון והשלישי, הגיעו מאות תושבים - צעירים ומבוגרים כאחד.

בעלי חיים וצמחים שנצפו בשלולית החורף בפארק הרצליה:

ציפורים:

אגמית מצויה
אדום חזה
אנפה אפורה
אנפית בקר
בולבול
בז מצוי
ביצנית לבנת כנף
ברווז חד זנב
ברכיה
דוחל שחור כיפה
דרור הבית
דררה
חנקן אדום ראש
חרטומית ביצות
טבלן גמדי
ירגזי
ירקון
לבן חזה
לבנית גדולה
לבנית קטנה
מאינה מצויה
מגלן
מרית צפונית
נחליאלי לבן
סופית מצויה
סיס חומות
סיקסק
סנונית רפתות
עורב אפור
עיט צפרדעים
פרוש מצוי
פרפור עקוד
פשוש
צופית
צוצלת
שחפי אגמים
שחפים צהובי רגל
שיקשק
שלדג לבן חזה
שרשיר

בעלי חוליות אחרים:

1. אילנית

חסרי חוליות

1. חלזון בולית
2. חלזון בועית (קונכיה)
3. פשפש חותר
4. דפניה (כמה מינים)
5. ציקלופס
6. שט רגל אדמדם
7. צדפונית
8. מושבת חד תאיים (פעמוניות)
9. חיפושית חובבת מים
10. זחל יתוש

צמחים

1. אגמון ימי
2. בצעוני
3. קנה
4. עב קנה