BUILDING AND BIOLOGICALLY ACTIVE AREA INDICES IN DEVELOPERS' INVESTMENTS – THEORY AND PRACTICE

Agata Antczak-Stepniak
Department of Investment and Real Estate
Faculty of Economics and Sociology
University of Lodz
e-mail: agata.antczak@uni.lodz.pl

Abstract

Development activity in Poland is regulated by many legal provisions, but one of the most important acts for the implementation of developers’ projects is the Act of March 27, 2003 on spatial planning and development. The Act includes, among others, procedures for the preparation and scope of local spatial development plans. One of the parameters significant from the point of view of housing development which these plans define is the minimum and maximum intensity of development and the percentage of biologically active space that should be preserved on a property covered by the investment project. The article adopts two research goals. Firstly, it is an attempt to verify, using examples of selected developers, whether they, as profit-oriented entities, decide to develop the property as much as possible or to keep more undeveloped space, which is a more desirable phenomenon from the environmental point of view. Secondly, an attempt will be made to determine how developers in Poland create a biologically active surface in their projects. Based on desk research, it was found that, among the discussed cases, there is no evident tendency to maximize the permissible built-up areas and the created biologically active areas are sparse and not diversified.

Key words: building area index, biologically active area, development activity, spatial planning.

JEL Classification: R31, O21, Q01.

Citation: Antczak-Stepniak, A. (2022). Building and biologically active area indices in developers' investments – theory and practice. Real Estate Management and Valuation, 30(1), 53-64.

DOI: https://doi.org/10.2478/remav-2022-0005

1. Introduction

As early as the nineteenth century, Marsh (1864) noted that “Man everywhere is a disturbing agent. Wherever he plants his foot, the harmonies of nature are turned to discord” (after: Addae-Dapaahet al., 2009, p. 203). Today, when there are over 7 billion people in the world who use the Earth's surface for housing, recreation, job creation, etc., ensuring a greater quality of life necessitates finding a solution to this problem. The construction industry uses a lot of energy and water, and it is also responsible for the emission of large amounts of CO₂ as well as the consumption of natural resources (Antczak, 2014, p. 51). Awareness of human impact on the environment began to increase in the 1970s. The fuel crisis forced the development of innovations in the field of energy saving and renewable energy systems. However, it was not until the 1990s that particular attention was paid to the environmental impact of construction. At that time, numerous organizations implementing investments in the construction sector referring to the principles of sustainable development appeared (Kibert & Kibert, 2009, pp. 3–6). Developers, who currently have the largest share in the number of dwellings delivered for use in Poland, must also comply with certain regulations related to these principles. These provisions include, inter alia, the Act of March 27, 2003 on spatial planning and...
development, regulating the content of local spatial development plans, important for development activity, but also for the preservation of spatial order. One of the parameters significant from the point of view of development activity which these plans define is the minimum and maximum intensity of development and the percentage of biologically active space that should be kept on the property covered by the investment project.

Therefore, this article adopts two research goals. The first is an attempt to verify, using examples of selected developers, whether they decide to develop the property to the maximum possible extent (according to local plans), or whether they keep more undeveloped space, which is a more desirable phenomenon from the environmental point of view. The second goal is an attempt to define how developers create the biologically active area in their projects. The author adopts the research hypothesis that a significant number of developers, as profit-oriented entities, use the built-up area to the maximum extent, while contributing to the reduction of the biologically active area in the implemented investments. However, this area remains within the limits permitted by local plans, otherwise it would make it impossible for the developer to obtain a building permit.

2. The meaning of the building and biologically active area indices - literature review

Porter (2000) emphasizes that sustainable development is a two-word phrase with many meanings. In his opinion, this development means “balancing economic and social forces against the environmental imperatives of resource conservation and renewal for the world of tomorrow” (after: Addae-Dapaah et al., 2009, p. 204). A different definition was adopted by the World Commission on Environment and Development, which understands it as “development which meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987, p. 15). The need to comply with the principles of sustainable development in Poland, including its definition, is enshrined in the Act of April 27, 2001 of the Environmental Protection Law. According to this legal act, sustainable development consists in integrating political, economic and social actions, while maintaining the natural balance, so as to guarantee the possibility of satisfying the basic needs of the present inhabitants and their future generations (Act of April 24, 2001...). Reference to sustainable development, by citing the definition contained in the above-mentioned legal act, is also included in the Act of 27 March 2003 on spatial planning and development. Developers carrying out their projects, including housing projects, are required to include the provisions of local plans in their projects so that their business activity is consistent with the principles of sustainable development. Non-compliance with these documents may result in the refusal to issue a building permit by the poviat authority (starosta). The provisions of local plans, particularly important for developers, relate to the principles of designing buildings. Article 15, paragraph 2, point 6 stipulates that the local plan must specify: “the rules of spatial development and spatial planning indicators, the maximum and minimum intensity of development as an indicator of the total built-up area in relation to the building plot area, the minimum percentage of biologically active area in relation to the building plot, the maximum building height...” (Act of March 27, 2003 ...). Many local plans also specify the maximum building area, which is the ratio of the built-up area (measured along the external outline of the building) to the area of the entire investment area. Then, the number of stories is not taken into account, as is the case with the indicator of building intensity (Dąbrowska-Milewska, 2010, pp. 18-24).

One of the most important indicators from the point of view of sustainable development is the biologically active area. This stands for “the permeable surface able to help manage rainfall within built-up areas” (National Strategy of Regional Development 2010-2020). In legal regulations, its definitions are slightly different, indicating a method of estimating this area. And, although in many local plans the biologically active area is defined in a very general way as the percentage share of biologically active land in the area of a given building plot (compare: Uchwała nr XLVIII/1228/17 Rady Miejskiej w Łodzi...), the Regulation of the Minister of Infrastructure of April 12, 2002 on the technical conditions to be met by buildings and their location specifies this indicator as “an area with a surface arranged in a way ensuring the natural vegetation of plants and retention of rainwater, as well as 50% of the total surface of terraces and roofs, arranged as permanent lawns or flower beds on a substrate ensuring their natural vegetation, with an area of not less than 10 m²” (Regulation of the Minister of Infrastructure of April 12, 2002...). A similar approach to the biologically active area is also adopted in other European countries, e.g. in Hungary, where 40% of green roofs can be included in green areas, and the divided biologically active space cannot be smaller than 200 m² (Bakay, 2012, p. 2). In the
context of preserving the biologically active area, it is also important to plan in detail and to reliably perform work related to:

- site clearance,
- carrying out earthworks involving excavation of foundations – it is important that the developer tries to preserve the natural terrain, even if the plot is hilly,
- the presence of large stones found on the construction site that can be used as a decorative element,
- the presence of large trees that should be left in place or transplanted elsewhere (Sivadasan & Basiruddin, 2019, p. 434).

When talking about earthworks, the time of their execution is also important. The idea is that the soil is not exposed to unfavorable weather conditions, such as heavy rain or sun, which could foster soil erosion (Sivadasan & Basiruddin, 2019, p. 434).

Nevertheless, regardless of how it is defined, the biologically active area in urban space is of great importance, which has been repeatedly pointed out in the literature (see: Mądry & Słysz, 2011, pp. 93-104; Maciejewska & Krygielska, 2011, pp. 89-99; Szczepański & Mrozik, 2014, pp. 220-228; Feltynowski, 2015, pp. 128-143).

Unfortunately, there is no doubt that the biologically active area is shrinking quickly (Bożetka, 2009, p. 150). This may be partially the result of the fact that developers, as entities focused on profit, try to maximize the built-up area in their investments, keeping the biologically active area which meets only the minimum share required by the provisions of local plans. Moreover, mismanagement of public land – selling too many properties – also reduces the supply of biologically active area. Fortunately, among developers, one can find entities that, if possible, build high-rise buildings, thus trying to reduce the built-up area. However, it should be remembered that the provision of a biologically active area in developers’ investments may also take place through the implementation of green roofs or green walls (Saadatian et al., 2013, p. 156; Hulicka, 2015, pp. 79-82). Such solutions are already quite commonly used in commercial buildings (Bauer et al., 2011, pp. 34-44), and also abroad in relation to residential buildings. “Greenroofs are simply vegetated roof covers constructed atop and across a roof deck” (Velazquez, 2005, p. 75). They can reduce ambient air temperature, energy use, and utility costs, extend the life of the roof, improve aesthetics, and create greenspace for humans (Velazquez, 2005, p. 75). The issues related to green roofs and walls have already been widely recognized in the world literature (see: Friedman, 2015, pp. 57-65; Bąk & Królilikowska, 2019, pp. 1263-1278). Unfortunately, in Poland, in relation to multi-family housing, this concept still seems to be too much of a challenge for developers.

3. Data and Methods

The desk research method was used to achieve the goals set in the introduction and to verify the research hypothesis. This method has quite a long history in scientific research (cf. Starch, 1923). It is based on the use of secondary data (existing statistical data, articles, books, etc.), data from observations, surveys, interviews (Baimyrzaeva, 2018, p. 12) or Internet sources. The desk research method is most often used to conduct research on the size of markets, profiling the company, its products, and determining development trends (Hague, 1988, pp. 59-60). It is also quite commonly used abroad for analyses related to spatial planning (see: Medeiros & van der Zwet, 2020; Garel & Ramalho, 2020; Mees & Driessen, 2011, pp. 251-280). In the article, this method will be used to collect and analyze information on developers’ investments in relation to the provisions of local plans concerning indicators of building and biologically active areas.

The research on the basis of which the conclusions in the last point were formulated was carried out in six stages:

1. First, on the basis of a review of popular real estate portals, such as rynekpierwotny.pl, gratka.pl, or noweinwestycje.pl, and the websites of individual developers, information was collected on the location of developers’ investments offered for sale in April 2020. The data were marked on the thematic map of the Municipal Geodesy Center of Łódź, containing information about the applicable local plans and those in the process of being prepared.
2. On the basis of the map, investments located in areas with applicable local plans were distinguished and chosen for further analyses.
3. Then, with the help of the InterSIT map of the Municipal Geodesy Center of Łódź, an attempt was made to determine the building area of the discussed investments. The area was calculated manually using the area calculation tools contained in the map. Unfortunately, those actions were not always possible, because not all investments in April 2020 were marked on the maps. Therefore, only those for which it was possible to estimate the built-up area were used in the further research.

4. An attempt was also made to estimate the biologically active area. Unfortunately, in most cases that part of the study was impossible to implement because, even if the investment was mapped, the fact that some of them are currently under construction (the area around the building remains undeveloped) makes it impossible to determine this index.

5. The calculated indices of building area were compared with the permissible indices specified in local plans.

6. Issues related to the biologically active area were finally discussed in a separate section, indicating the form in which Łódź developers operating in the residential market most often meet the requirements for maintaining the minimum ratio of this surface.

This study (without creating another map) was repeated in June 2021 to check whether the built-up areas and biologically active surfaces used by developers had undergone changes and what their possible nature (positive or negative) is.

The study covered the area of the city of Łódź. There were two reasons for this choice. First of all, it is the city best explored by the author of the study in previous publications. Secondly, Łódź is an example of a city with a low share of area covered by local plans. This contributes to the issuing of a large number of decisions on building conditions, which sometimes contradict the provisions of the study of conditions and directions of spatial development of the commune. The author asked herself the question whether at least the provisions of local plans were respected by the small group of developers who implemented investments in the areas covered by those plans.

Łódź is divided into five districts (Śródmieście, Bałuty, Polesie, Widzew, and Górna) and 215 registration precincts (e.g. B49), and the location of identified investments will be determined based on these divisions.

4. Empirical results

4.1. Analysis of the location of developers’ investments in Łódź

In April 2020, 113 investments on sale were identified in Łódź, and in June 2021 – 128 investment, which shows that their number is growing. Most of those projects were in progress, although several had been on offer for many years. Among those investments, multi-family housing development projects dominated. In 2020, only 17, and in 2021 - only 22 projects concerned single-family houses, usually in the form of terraced houses. Figure 1 shows the location of these investments in Łódź in April 2020 in relation to the local plans adopted and under preparation. A very positive phenomenon that can be observed on the basis of this figure is the high centralization of investments. This is a tendency that has emerged in recent years - earlier, unfortunately, many investments were carried out on the outskirts of the city, which resulted from lower land property prices and a small number of local plans (more: Antczak-Śtepiak, 2020, pp. 133-144).

Even today, Łódź remains one of the voivodeship cities with the smallest share of the area covered with local plans in Poland (20.5% in 2018 and 25.5% in 2020). Many plans are in the process of being adopted, but most of them are relatively small. In the remaining areas, decisions on building conditions are issued. These, in turn, mean that the purpose of the land is increasingly determined by the developers and land owners themselves, and not by the public authorities (Gwiazdowicz, 2010, p. 4).
Fig. 1. Location of developers’ investments in relation to local plans in Łódź (as of the first half of April 2020). Source: own elaboration based on the thematic map of Municipal Geodesy Center of Łódź, rynekpierwotny.pl and websites of individual developers.

Fig. 2. Share of the area covered by the applicable local plans in the total city area in the years 2018-2020. Source: own elaboration based on LDB.
4.2. The building area index in the developers’ investments

Out of 113 identified investments in 2020, 26 are being implemented or have been implemented in areas with the local plan in force (23%), and in June 2021, this number increased to 42 investments out of 128 identified in total (32%). However, it is difficult to say whether this is the result of a greater number of local plans in force, a greater number of investments carried out due to the increase in demand, or the growing interest of developers in areas where local plans are already in force. Ultimately, taking into account the conditions presented in the Data and Methods section, it was possible to estimate the building area index in only 21 cases in 2020 (most of them are located in the Polesie (7) and Śródmieście (6) districts), and also 21 cases in 2021 (once again mostly located in Polesie (7), Śródmieście (5) districts).

Table 1

| Characteristics of the discussed indicators, resulting from the provisions of local plans, in relation to the discussed investments in April 2020 and June 2021 |
| Minimum value in local plans | Maximum value in local plans | Average of the building area indicator in the analyzed areas |
| April 2020 | | |
| Building area | 15% | 100% | 53% |
| Biologically active area | 5% | 55% | 24% |
| June 2021 | | |
| Building area | 15% | 95% | 52% |
| Biologically active area | 0% | 60% | 24% |

Source: own elaboration.

Table 1 shows that the analyzed investments are located in very diverse areas: from poorly developed areas, where the permissible building area index is only 15% (in both analyzed years), to densely built-up areas in the city center, where this ratio reaches even 100% of the plot area. Then, unfortunately, the biologically active area may be very small (even 0-5%). The average built-up area index was approx. 53% in 2020 and 52% in 2021, which means that quite a significant part of investments is carried out in areas characterized by more dispersed development. On the other hand, the average biologically active area index in the analyzed areas is 24%.

Most of the investments on sale in April 2020 were characterized by built-up area indices compliant with those specified in local plans. In six cases presented in Appendix 1, this indicator was exceeded, although in two of them (Investments 4 and 7), these differences are so small that it can be assumed that they result from inaccuracies in measurements. Two investments (12 and 16) located in precinct B9 (district Baluty) have exceeded the index, but in this case the local plan was adopted after the construction of the facilities; the plan in those areas was adopted in January 2018, whereas the deadline for commissioning one investment was 2015, and the other was probably even earlier, considering that it had been started in 2007. Therefore, there are still two new investments, both in progress, the parameters of which do not agree with the provisions of the plans. The case of Investment 11 in the Widzew district (W34) may also be logically justified. Namely, the local plan was adopted in November 2015. However, the investment has a multi-stage character, so it is possible that the building permit for the entire investment was issued before the plan was adopted (the register of building permits issued from 2012 is available on the website of the City of Łódź Office – the investment was not found there). Moreover, it is possible that the building permit for the entire investment was issued before the plan was adopted (the register of building permits issued from 2012 is available on the website of the City of Łódź Office – the investment was not found there).

In June 2021, there were 5 such investments with the exceeded building area index, which, taking into account the overall increase in the number of developer investments in the residential market at that time, seems to be a positive phenomenon. Three of them are investments already discussed in the case of 2020. Out of the remaining two investments, one concerns existing buildings involving their modernization. Therefore, there is one case where the building area index was slightly exceeded, but it should be noted here that this investment has a problem with the building permit - it was issued on
October 18, 2017, in 2019 the procedure for changing the permit was discontinued, and, in 2020, the decision on the building permit has been repealed.

Therefore, it should be stated that developers in the residential market in Łódź operate in accordance with the local plans in force at a given date. One can only wonder if the long-term procedure of adopting local plans does not leave room for abuse. Being aware of what will be included in the plan, do developers not try to obtain building permits earlier in order to bypass their provisions? However, seeing as how this problem requires more extensive analysis and does not constitute the basis for inference in this article, it will not be developed further.

4.3. The biologically active area in the discussed investments

Unfortunately, it was not possible to estimate the biologically active area which has been discussed in this article several times. This is due to several reasons. First of all, some of the investments are still in the implementation phase, so they do not have developed land around the buildings. Second, the orthophotos included in the Łódź Area Information System are not updated on a regular basis. This means that, even if the investments have already been physically completed, including land development, this cannot always be stated on their basis. Sometimes the way of placing objects on maps causes problems, as is illustrated by the case of Investment 1 in 2020, where most buildings are visible on the map. However, despite a rather complex design of the building (in an atrial form), a “rectangle” appears on the map, which does not allow us to determine the biological active area located “inside” the buildings – in the inner courtyard.

Although it is difficult to say whether the minimum biologically active area indices in the discussed investments have been maintained, one can at least consider the form of biologically active area implementation. Unfortunately, most often it is simply in the form of lawns located around buildings, with individual trees and shrubs. Few investments, especially those located in the suburbs of Łódź, where the minimum rate of biologically active area specified in local plans is higher and the area of the property is larger, can boast playgrounds, playing fields and footpaths.

Green investments in the field of multi-family housing in Łódź are practically not being created. In 2020, only in the Wiszące Ogrody investment, located in the center of Łódź (in an area with applicable local plan), were green terraces used to increase the biologically active area. In 2021, another investment by the same developer in which green terraces will be built appeared; however, it is located in an area where the local plan is not yet in force. These investments should be considered as good practices of popularizing the idea of green construction among developers, which is conducive to the sustainable development of urban spaces.

It should be remembered that investments using green roofs, terraces, and walls implemented in densely built-up areas are necessary. Natural vegetation absorbs excess rainwater. In the central parts of densely built-up cities, buildings are often flooded during heavy rainfalls, precisely because the biologically active area is small. Therefore, developers could support the activities of municipal authorities in creating such an area, thus contributing to reducing the costs of maintaining cities and improving the quality of life of residents. However, attention should be paid to the fact that local government authorities themselves often contribute to limiting biologically active areas by selling too much real estate for further investments. These areas could be used for squares or playgrounds, which are missing in city centers.

5. Discussion and conclusions

To sum up, this article is a contribution to the body of knowledge, especially with regard to the implementation of building and biologically active area indices in development activity on the Łódź housing market. Local plans define the maximum allowable building area and the minimum required biologically active area. The study showed that, in 2021, the share of entities implementing housing investments in Łódź in areas covered by local plans increased, although there may be several reasons for this phenomenon (these had been presented in the previous sections). Nevertheless, due to the limitations related to the presentation of graphical data on maps, a detailed study could be carried out on a group of 21 investments in both analyzed years, i.e. 2020 and 2021. Referring to the results, some developers (in 2020 -10 out of 21, and in 2021 - 9 out of 21) use almost 100% of the permissible built-up area, or this index is even exceeded. The latter situation occurs most often when the local plan come into force after the investment has been completed or the building permit issued. Therefore, the
research hypothesis assuming that most developers, as entities focused on profit, would use the built-up area to the maximum extent was verified rather negatively. In eleven investments in 2020 and twelve in 2021, the analyzed indicator is lower than permissible, and in six of them in 2020 and seven in 2021, it is even much lower than the parameters allowed by local plans (lower by 20 or more percentage points), so the situation related to the use of land for investment in Łódź seems to be slowly improving. This is not synonymous with a larger biologically active area, as the built-up area does not include, for example, ground parking lots. Nevertheless, such investments have the potential to provide a larger biologically active area, which, in some of the analyzed cases, was reflected in practice.

In addition to the above, the conducted research confirms the problems associated with increasing the biologically active area, also regarding to the implementation of green roofs or green terraces. In this respect, little has changed in the multi-family housing market in Łódź. This should be an incentive for city authorities to promote these types of solutions, especially in central parts of the city. Moreover, one should consider whether, from the point of view of sustainable development, it would not be better to develop one property as much as possible than two properties only partially, especially in the central parts of the city where many properties are in the public domain. Implementation of developers’ investments assuming the maximum building area index would allow for the creation of a more compact urban tissue, which would bring many benefits, primarily to cities. Firstly, compact development is associated with lower maintenance costs of the necessary technical, social and service infrastructure. Moreover, these “vacated” undeveloped spaces could be used to create squares, parks, and playgrounds, which are often missing in the central parts of cities. Although the biologically active area indices in Łódź investments are mostly preserved, the form of their implementation leaves much to be desired. The predominant form is simply small lawns around buildings and thuja hedges. In one of the analyzed investments, solutions in the form of green terraces were used. Playgrounds are implemented only on larger plots located in the suburbs of the city.

Therefore, it can be concluded that Łódź developers try to fulfill the provisions of local plans in terms of building and biologically active area indices to the extent that allows them to obtain a building permit. Meanwhile, more should be done to ensure the sustainable development of cities. Therefore, it is the commune that has the obligation to pay attention to the needs of future generations. Cities should be very prudent in managing city-owned land, encouraging developers to maximize the use of built-up space on a smaller number of properties, while providing the biologically active space in a form other than merely lawns.

It should be noted that, due to the limitations that appeared in the implementation of the study, i.e. a limited number of projects realized in areas where local plans are in force, problems with investments that were put into operation before the adoption of the local plan, the inability to estimate the biologically active area, it seems justified to conduct further research on the topic.

6. References

Addae-Dapaah, K., Hiang, L. K., & Sharon, N. Y. S. (2009). Sustainability of Sustainable Real Property Development. Journal of Sustainable Real Estate, 1(1), 203–225. https://doi.org/10.1080/12091781

Antczak, A. (2014). Aktywność polskich deweloperów w zakresie zielonego budownictwa na rynku mieszkaniowym (Activity of Polish developers in the field of green construction on the housing market). Zarządzanie i Finanse Journal of Management and Finance, 12(4), 51-66.

Antczak-Stępnia, A. (2020). Location tendencies in developer investments in the residential market in Łódź. Bulletin of Geography. Socio-Economic Series, 47, 133–144. https://doi.org/10.2478/bog-2020-0008

Baimyrzaeva, M. (2018). Beginners’ Guide for Applied Research Process: What Is It, and Why and How to Do It? Occasional Paper 4, University of Central Asia.

Bakay, E. (2012). The role of housing estates’ green surfaces in forming the city climate of Budapest. Applied Ecology and Environmental Research, 10(1), 1–16. https://doi.org/10.15666/aeer/1001_001016

Bąk, J., & Królikowska, J. (2019). Current Status and Possibilities of Implementing Green Walls for Adaptation to Climate Change of Urban Areas on the Example of Krakow. Rocznik Ochrona Środowiska, 21, 1263–1278.
Bauer, R., Eichholtz, P., Kok, N., & Quigley, J. M. (2011). How Green is Your Property Portfolio? The Global Real Estate Sustainability Benchmark. *Rotman International Journal of Pension Management, 4*(1), 34-44.

Bożtyka, B. (2009). Remarks on Contemporary anthropogenic Threats for Urban Greenery in Poland. *Contemporary Problems of Management and Environmental Protection, 3*, 143-162.

Dąbrowska-Milewska, G. (2010). Standardy urbanistyczne jako narzędzie racjonalnej gospodarki terenami w mieście (Urban standards as a tool for rational land management in the city). *Czasopismo Techniczne: Architektura, 107*(14), 17-24.

Feltnowski, M. (2015). Land-Use Planning and Satellite Imagery Used for Green Areas Protection – Case Study of the City of Łódź, Poland. *Folia Oeconomica Stetinensia, 15*(2), 128-143, https://doi.org/10.1515/foli-2015-0040

Friedman, A. (2015). Design strategies for Integration of Green Roofs in Sustainable Housing. *VITRUVIO - International Journal of Architectural Technology and Sustainability, 1*, 57-65. https://doi.org/10.4995/vitruvio-ijats.2015.4475.

Garel, L., & Ramalho, T. (2020). Participatory Incremental Urban Planning. A Toolbox to support local governments in developing countries to implement the New Urban Agenda and the Sustainable Development Goals. United Nations Human Settlements Programme.

Gwiazdowicz, M. (2010). Kryzys gospodarki przestrzennej (The crisis of the spatial economy). *Biuro Analiz Sejmowych, 3* (73).

Hague, P. (1988). *A Practical Guide to Market Research*, on: https://www.b2binternational.com/publications/practical-market-research/, (accessed: 10.04.2020).

Hulicka, A. (2015). Miasto zielone. Miasto zrównoważone. Sposoby kształtowania miejskich terenów zielonych w nawiązaniu do idei Green city (Green city. A sustainable city. Ways of shaping urban green areas in relation to the idea of Green city). *Prace Geograficzne, 141*, 73-85. https://doi.org/10.4467/20833113PG.15.010.4062

Kibert, N., & Kibert, Ch. (2009). History and Status of Sustainable Development. In J. E. Furr, (Eds.), *Green Building and Sustainable Development: The Practical Legal Guide*. American Bar Association.

Maciejewska, A., & Krygielska, B. (2011). Rola i znaczenie przestrzeni biologicznie czynnych (przykład Miasta Stołecznego Warszawy) (The role and importance of biologically active spaces (example of the City of Warsaw)). *Studia Komitetu Przestrzennego Zagospodarowania Kraju, 142*, 89-99.

Małdy, T., & Słysz, K. (2011). Powierzchnie biologicznie czynne w planowaniu przestrzennym miast (Biologically active areas in urban spatial planning). *Problemy Rozwoju Miast, 3-4*, 93-104.

Medeiros, E., & van der Zwet, A. (2020). Sustainable and Integrated Urban Planning and Governance in Metropolitan and Medium-Sized Cities. *Sustainability 12*(15), 5976. https://doi.org/10.3390/su12155976

Mees, H.-L. P., & Driessen, P. P. J. (2011). Adaptation to climate change in urban areas: Climate-greening London, Rotterdam, and Toronto. *Climate Law, 2*, 251-280. https://doi.org/10.1163/CL-2011-036

National Strategy of Regional Development 2010-2020, after: Jopek, D. (2018). Water in the city. The development of permeable surfaces in urban areas.E3S Web of Conferences 45, 00109, 3.

Rozporządzenie Ministra Infrastruktury z dnia 12 kwietnia 2002 roku w sprawie warunków technicznych, jakim powinny odpowiadać budynki i ich usytuowanie, Dz. U. z 2015 roku, poz. 1422. (Regulation of the Minister of Infrastructure of 12 April 2002 on technical conditions to be met by buildings and their location, Journal of Laws, 2015, item 1422).

Sivadasan, R., & Basiruddin, R. (2019). Green Housing Development: Is it Really Sustainable? *International Journal of Academic Research in Business & Social Sciences, 9*(12), 431-444.

Starch, D. (1923). Research Methods in Advertising. *The Annals of the American Academy of Political and Social Science, 110*, 139-143. https://doi.org/10.1177/000271622311000114

Szczepeński, P., & Mroziak, K. (2014). Wskaźnik powierzchni biologicznie czynnej jako narzędzie równoważenia struktury przestrzennej gminy miejskiej Łuboń (Biologically active area index as a tool for balancing the spatial structure of the municipal commune of Łuboń). *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, 339*, 220-228.DOI: 10.15611/pn.2014.339.20.
Uchwała nr XLVIII/1228/17 Rady Miejskiej w Łodzi z dnia 10 maja 2017 r. w sprawie uchwalenia miejscowego planu zagospodarowania przestrzennego dla części obszaru miasta Łodzi położonej w rejonie alei: Tadeusz Kościuszki i Adama Mickiewicza oraz ulic: Andrzeja Struga i Piotrkowskiej (Resolution No. XLVIII/1228/17 of the City Council in Łódź of May 10, 2017 on the adoption of a local spatial development plan for the part of the city of Łódź located in the area of Tadeusz Kościuszko and Adam Mickiewicz avenues and Andrzeja Struga and Piotrkowska streets)

Ustawa z dnia 27 marca 2003 roku o planowaniu i zagospodarowaniu przestrzennym, Dz.U. z 2020, poz. 1086. (Act of 27 March 2003 on spatial planning and development, Journal of Laws, 2020, item 1086).

Ustawa z dnia 27 kwietnia 2001 roku Prawo ochrony środowiska, Dz.U. z 2020, poz. 1219. (Act of 27 April 2001 Environmental Protection Law, Journal of Laws, 2020, item 1219).

VELAZQUEZ, L.S. (2005): Organic Greenroof Architecture: Sustainable Design for the New Millennium, Environmental Quality Management, 14(4), 73-85. https://doi.org/10.1002/tqem.20059.

World Commission on Environment and Development (1987): Our Common Future, Report United Nations.

**Appendix 1.** Building and biologically active area indexes in selected developer investments in areas covered by local plans in April 2020 in Łódź

| Investments | District and precinct | Estimate area plots | Estimated built-up area | Date of adoption of the local plan | Indicated indicator of the building area (range for individual plots) | Indicated indicator of building area allowed by local plans | Minimal biologically active area according to local plans | Identified date of issue of the building permit |
|-------------|-----------------------|---------------------|-------------------------|-------------------------------|---------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------|
| 1 Investment 1 | Polesie (precinct P1) | 35245 | 13032 | 07.07.2011 | 37% (34%-39.5%) | 40% | 30% | 30.12.2013 stage II, changed 10.07.2015, changed 6.10.2016 (plot no. 128/6), 27.12.2017 (plot no. 128/5), transfer 12.06.2018 |
| 2 Investment 2 | Górna (precinct G3) | 680 | 345 | 04.06.2014 | 50.70% | 60% | 10% | 19.12.2019 |
| 3 Investment 3 | Śródmieście (precinct S1, S6) | 1172 | 780 | 29.12.2014 | 66.50% | 80% | 5% | nd |
| 4 Investment 4 | Śródmieście (precinct S6) | 12307 | 7496 | 16.10.2019 | 61% | 60% | 15% | 12.02.2016, changed 24.04.2018, changed 8.05.2019 |
| 5 Investment 5 | Polesie (precinct P1) | 3526 | 1330 | 07.07.2011 | 37.70% | 40% | 20% | 25.10.2017, transfer 5.06.2018 |
| 6 Investment 6 | Polesie (precinct P19) | 3429 | 1968 | 06.03.2019 | 57.40% | 65% | 15% | nd |
| 7 Investment 7 | Bialuty (precinct B47) | 1299 | 550 | 16.10.2019 | 42.30% | 40% | 25% | 20.12.2017, changed 23.12.2019 |
| 8 Investment 8 | Śródmieście (precinct S6) | 1842 | 835 | 25.01.2018 | 45.30% | 70% | 10% | 26.06.2018 |
| 9 Investment 9 | Polesie (precinct 20) | 726 | 554 | 06.03.2019 | 76.30% | 80% | 5% | remission 4.11.2019 |
| 10 Investment 10 | Śródmieście (precinct S6) | 1255 | 620 | 29.12.2014 | 49.40% | 80% | 10% | 02.06.2016 |
| No. | Investment | District and precinct | Estimated area of plots | Estimated built-up area | Date of adoption of the local plan | Estimated indicator of the building area (range for individual plots) | Indicator of building area allowed by local plans | Minimal biologically active area according to local plans | Identified date of issue of the building permit |
|-----|------------|-----------------------|--------------------------|-------------------------|-----------------------------------|-------------------------------------------------|----------------------------------|-----------------------------------------------|-----------------------------------------------|
| 11  | Investment 11 Widzew (precinct W34) | 4565 | 1400 | 18.11.2015 | 31.00% | 20% | 30% | nd |
| 12  | Investment 12 Baluty (precinct B9) | 3701 | 1100 | 25.01.2018 | 29.70% | 15% | 50% | nd |
| 13  | Investment 13 Polesie (precinct P12) | 50079 | 7410 | 21.01.2015 | 14.80% | 35% | 55% | 10.03.2015, 2.05.2017 expansion, changed 20.05.2019 |
| 14  | Investment 14 Widzew (precinct W9) | 19895 | 4156 | 12.02.2014 | 20.90% | 40% | 40% | transfer 7.06.2016 |
| 15  | Investment 15 Baluty (precinct B12) | 10521 | 1145 | 30.03.2016 | 10.90% | 20% | 50% | 20.02.2018 |
| 16  | Investment 16 Baluty (precinct B9) | 2269 | 930 | 25.01.2018 | 40.99% | 25% | 40% | 24.07.2013 |
| 17  | Investment 17 Polesie (precinct P9) | 5213 | 1800 | 06.03.2019 | 34.50% | 65% | 20% | II stage - 18.02.2019 (change 23.12.2019) |
| 18  | Investment 18 Polesie (precinct P20) | 1687 | 533 | 06.03.2019 | 31.60% | 65% | 20% | Transfer 14.03.2018 |
| 19  | Investment 19 Śródmieście (precinct S6) | 1701 | 1261 | 29.12.2014 | 74.10% | 80% | 10% | 12.03.2019 |
| 20  | Investment 20 Górna (precinct G52) | 4028 | 1525 | 25.01.2018 | 37.90% | 25% | 40% | Change 15.07.2019 |
| 21  | Investment 21 Śródmieście (precinct S1) | 3665 | 2102 | 11.05.2016 | 57.40% | 100% | 5% | 26.11.2019 |

**Source:** own study.

**Appendix 2.** Building and biologically active area indexes in selected developer investments in areas covered by local plans in June 2021 in Łódź

| Investment | District and precinct | Estimated area of plots | Estimated built-up area | Date of adoption of the local plan | Estimated indicator of the building area (range for individual plots) | Indicator of building area allowed by local plans | Minimal biologically active area according to local plans | Identified date of issue of the building permit |
|------------|-----------------------|--------------------------|-------------------------|-----------------------------------|-------------------------------------------------|----------------------------------|-----------------------------------------------|-----------------------------------------------|
| 1 | Investment 1 Polesie (precinct P1) | 9473 | 1822 | 07.07.2011 | 19.23% | 40% | 20% | 09.08.2019 |
| 2 | Investment 2 Śródmieście (precinct S6) | 12307 | 5826 | 16.10.2019 | 47.34% | 60% | 15% | 12.02.2016; 24.04.2018 - change; 15.02.2019 - change |
| 3 | Investment 3 Widzew (precinct W25) | 6597 | 4084 | 04.07.2018 | 61.91% | 95% | 0% | nd |
| 4 | Investment 4 Polesie (precinct P1) | 3526 | 1380 | 07.07.2011 | 39.14% | 40% | 20% | 25.10.2017, transfer 5.06.2018 |
| 5 | Investment 5 Polesie (precinct P19) | 3429 | 1968 | 06.03.2019 | 57.40% | 65% | 15% | nd |
| No. | Investment  | Location | Value | Date    | Percentage | Status   | Date       |
|-----|-------------|----------|-------|---------|------------|----------|------------|
| 6   | Baluty      | precinct B47 | 1299  | 509     | 16.10.2019 | 39.18%   | 20.12.2017, change 23.12.2019 |
| 7   | Śródmieście | precinct S6 | 1842  | 835     | 25.01.2018 | 45.30%   | 26.06.2018 |
| 8   | Polesie     | precinct P20 | 726   | 554     | 06.03.2019 | 76.30%   | remission 4.11.2019 |
| 9   | Widzew      | precinct W34 | 4565  | 1400    | 18.11.2015 | 31.00%   | nd         |
| 10  | Baluty      | precinct B9  | 3701  | 1100    | 25.01.2018 | 29.70%   | nd         |
| 11  | Polesie     | precinct P12 | 50079 | 7410    | 21.01.2015 | 14.80%   | 10.03.2015, 2.05.2017 expansion, change 20.05.2019 |
| 12  | Widzew      | precinct W9  | 19895 | 4156    | 12.02.2014 | 20.90%   | transfer 7.06.2016 |
| 13  | Baluty      | precinct B12 | 13049 | 950     | 30.03.2016 | 7.28%    | 14.05.2021 - transfer |
| 14  | Baluty      | precinct B9  | 2269  | 930     | 25.01.2018 | 40.99%   | 24.07.2013 |
| 15  | Śródmieście | precinct S2  | 5549  | 3780    | 29.12.2014/2.12.2020 | 68.12%   | 29.01.2018 |
| 16  | Polesie     | precinct P20 | 1687  | 830     | 06.03.2019 | 49.20%   | 17.05.2021 |
| 17  | Śródmieście | precinct S6  | 1701  | 1261    | 29.12.2014 | 74.10%   | 12.03.2019 |
| 18  | Polesie     | precinct P20 | 1927  | 1241    | 06.03.2019 | 64.40%   | 25.02.2021 |
| 19  | Górna       | precinct G40 | 1031  | 300     | 25.01.2018 | 29.10%   | 27.02.2019 - remission; 18.08.2020 - repeal |
| 20  | Widzew      | precinct W25 | 4843  | 1456    | 27.12.2018 | 30.06%   | 8.05.2017; 26.04.2019 - change |
| 21  | Śródmieście | precinct S1  | 1161  | 1073    | 18.10.2017 | 92.42%   | 7.03.2019; 9.10.2020 - remission |

*Source: own study.*