Строительные материалы и изделия
Construction Materials and Products

journal homepage: https://bstu-journals.ru

ISSN
2618-7183

DOI: 10.58224/2618-7183-2023-6-5-8

Circumpolar Aspect in the Development of Urban Environment Organization in Russian Cities

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Abstract. The purpose of the paper is to examine the effect of the Arctic Hectare program on the development of Russian cities in the Arctic region. In particular, the study analyzes the role of the program in changing the borders of settlements and the possibility of their regulation. The research employs a qualitative approach, including the collection of data from government documents, research literature, and electronic resources associated with urban development, regional development, and the Arctic Hectare program. Data analysis shows that most Arctic cities continue to compress: with preserved infrastructure, entire houses and areas of settlements go empty. In contrast, the Gulf of Ob shows an increase in settlements, as its mining areas actively expand. The area demonstrates a principle characteristic of circumpolar urban development, e.g., a fractal system of settlement growth with the development of the next branch of the city tree. The restart of empty suburbs outside the zone of active mining is attributed to the stage program of Arctic Hectare. As a result, the authors identify two concepts of urban planning: one that emphasizes development along outbound highways, and another that assumes the development of satellite cities. In the near future, the familiar urban landscape may change, as its outskirts may be supplemented by low-rise development. A large share of applicants use the Arctic Hectare to solve the housing problem. It becomes clear that the suburbs are a realistic way of habitation in the Arctic region. The researchers argue that the sustainability theory can allow predicting urban development in the territory based on adaptive cycles.
Keywords: Arctic Hectare, deformation resistance, transformation of landscape, reconstructiveness, city borders, urban development

Please cite this article as: Sarvut T.O. Circumpolar aspect in the development of urban environment organization in Russian cities. Construction Materials and Products. 2023. 6 (5). 8. DOI: 10.58224/2618-7183-2023-6-5-8

1. INTRODUCTION

In recent years, the Arctic region and the development of the Far North have been viewed exclusively in the context of developing production forces and using subsoil resources for the needs of the regions of central Russia [1, 2]. In the hundred years of its intensive development, the region's popula-

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Received July 8, 2023; Received in revised form August 28, 2023; Accepted October 15, 2023

tion substantially increased. Settlements for shift workers turned into cities permanently inhabited by more than half of the region's population.

Despite the period of no investment and a considerable loss of personnel, the Russian Arctic once again draws the attention of state policy, given that enterprises in this region account for 20% of Russia's budget [3]. In this connection, there appear new state projects aimed at the development of the Arctic region. In particular, the region's residents can apply for the Arctic Hectare program, which allows them to choose a land plot for free to develop. The Arctic Hectare program tasked with implementing this idea has so far remained on the sidelines of researchers' interests. However, the geography and social transformations of the Arctic Zone of the Russian Federation (AZRF) are increasingly often subjected to research, in particular, by scholars from the Moscow State University N.IU. Zamiatina and A.N. Piliasov. The legal effects of the program on the regional population are also considered by some researchers, namely O.O. Samonchik and V.M. Logunova. The territory's urban development is explored by scientists from the Moscow Architectural Institute (M.V. Shubenkov, N.A. Saprykina, S.A. Galleev, and N.N. Alekseev) and the Higher School of Economics (R.V. Goncharov).

The Council to develop the Far East, the Arctic, and Antarctica, whose meeting took place in May 2023, notes the need for a specific urban development policy and systemic development of the region. The demand for master plans and landscaping standards has only recently been formulated and has not yet been formalized [4, 5]. The aforementioned program is intended to solve one of the most crucial issues of Russia's vast territory, with its population concentrated in a large triangle of settlement – overcoming the country's reconstructiveness. The history of settlement in the circumpolar region of Russia has a distinctive feature: it is initiated by the state. Geopolitical and economic interests motivate the intensive development of the region. The established system of settlement has cities (ports) at the mouths of rivers with access to the seas and the Arctic Ocean, and cities established in the centers of mining operations. A vast territory remains undeveloped and uninhabited. It is clear that considerable land plots are allocated and reserved under the program for mining and production by big investors. However, other plots involved in the program, 1.1 mln ha in total, are planned to be provided for free use to residents. The impact of this measure on the current urban planning system raises the issue of changes in the region's structure [6]. First and foremost, this concerns cities as the centers of life in the AZRF. A number of quite specific features of the Arctic region necessitate consideration of the possible ways in which the state program can reflect on urban development.

Thus, this study aims to examine the spatial organization of the circumpolar city and its change due to the introduction of the Arctic Hectare program as a new settlement factor.

2. METHODS AND MATERIALS

The study was conducted in 2022 in National Research University Moscow State University of Civil Engineering. The research process employed the methods of literature review, data analysis, and comparative analysis, and involved formulation of urban planning conceptions based on historical and contemporary experience.

Data for the study were collected from various sources, including government documents, official reports, research papers, and electronic sources dealing with urban development, urban planning, regional development, and the Arctic Hectare program. However, analysis of documents of government and local self-government bodies and electronic resources did not provide exhaustive information on the availability of programs for the regulation and planning of "Arctic hectare" territories.

Comparative analysis of the quality of life within the borders of Russian circumpolar cities allowed us to identify distinctive characteristics and differences in the organization of the living environment and revealed directions for spatial development. Its resistance to deformation is defined by the ability of the system to accept changes while preserving its basic structure and shifting to a new alternatively stable state through transitions, change of regimes, adaptive cycles, and transformability [7].

Proceeding from the data acquired in the course of the study, we identified two urban planning conceptions of the change and transformations of city borders. Both conceptions assume the value of specific assets, which are hectares of land. The specificity of these approaches relates to location relative to the city and transportation routes, to specialization, and to form.

3. RESULTS AND DISCUSSION

At present, there is a situation of transition to a new adaptive state characterized by high potential and connectedness [8, 9]. The high potential is ensured by a group of factors represented by a large number of proactive participants and a vast territory. Connectedness is provided by the state initiative, regulation, and funding. According to C. Holling's theory, an adaptive cycle includes the periods (zones) of exploitation, conservation, release, and reorganization. In the adaptive cycle of the period [10], characterized by the maximum adaptive property, evolving systems can move to a breakthrough and subsequent renewal. This refers to the potential of cities as sustainable systems and their evolutionary capacities [7]. However, if we consider the architectural and spatial organization of an Arctic city as a system of fractal (nested) structures, both individual households and settlements have evolutionary capabilities [11].

More than 5 thousand people have received a plot in the Arctic zone of Russia, with over 11 thousand applications submitted (Table 1). The law also permits activities unrelated to the development of settlements, such as reindeer breeding (pastures), fishing, and woodworking [12]. In addition, the project provides for the development of roadside services and starting trading or processing enterprises. There are also some proposals to organize a private kindergarten or school. If the above activities are carried out within five years, the plot for gratuitous use can be registered as property or leased.

Table 1. Distribution of land plots under the Arctic Hectare program.

Region	Number of plots provided under the Arctic Hectare program
Murmansk Oblast	3,026
Republic of Karelia	698
Arkhangelsk Oblast	503
Yamalo-Nenets Autonomous Okrug	426

Reviewing the site allocation map, we clearly observe two directions: plots near cities and those located far away from settlements. As the distribution and assignment progress, the list of plots offered changes. Yet the approximate composition remains the same. For instance, in June 2023, there was the following distribution of plots across the territory (Fig. 1):

- land plots with a city or settlement: Novy Urengoy, Vorkuta, Inta, Usinsk, Novodvinsk, Arkhangelsk, Severodvinsk, Kostomuksha;
- far from populated areas: 40 km from Krivoy Porog, 4 km from Luusalmi, 30 km from Sosnovoye (the Republic of Karelia), 40 km from Khorey-Ver (the Nenets Autonomous Okrug), 80 km from Srednee Bugayevo (Ust-Tsilemsky District, the Republic of Komi), 15 km from Vizenga, 5 km from Bereznik, 10 km from Losevo, 10 km from Igsha, 10 km from Kosmogorodsky, 2 km from Letneye Ozero, 40 km from Izhmozero (Arkhangelsk Oblast), 40 km from Lovozero (Murmansk Oblast) [11].

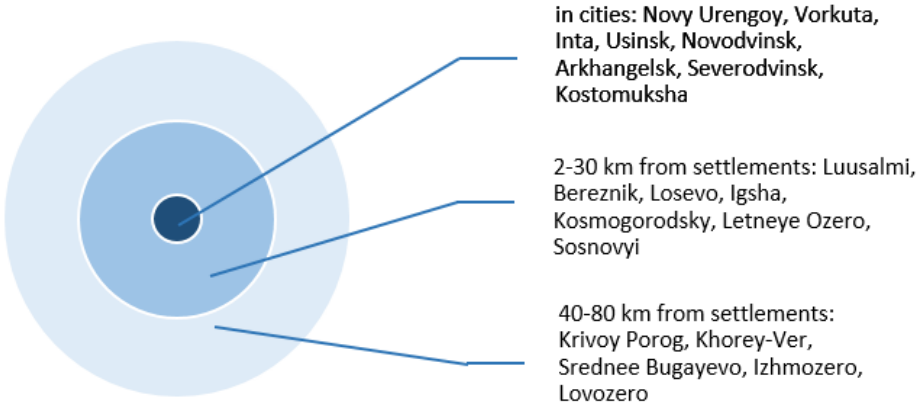


Fig. 1. Location of plots and distance from the settlement.

The remote Arctic hectares are largely intended for agricultural and commercial use, primarily for reindeer breeding and associated processing facilities [13].

The Arctic Hectare program has been in effect in the AZRF since 2021. The activities permitted on the allocated land plot include individual housing construction, tourism projects, agricultural activities, entrepreneurship, personal subsidiary farming, and other activities not permitted by law [12].

As of 2023, the State Commission for Arctic Development has the following results of two years of the program, which show the typical use of Arctic hectares: 40% are used for individual housing construction [3]. Based on collected statistics, Fig. 2 shows the leading types of activities in the allocated territories [23].

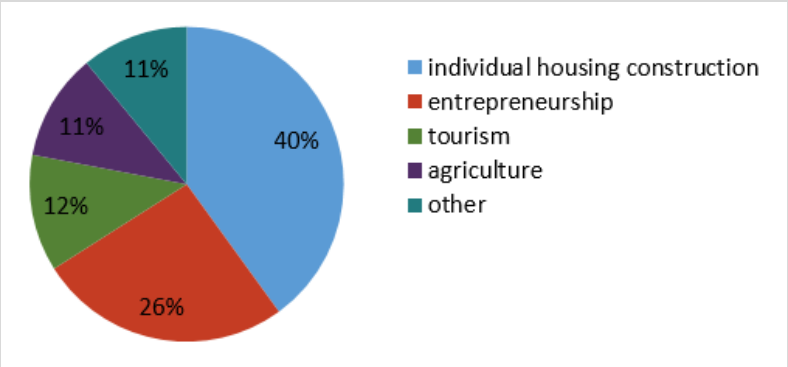


Fig. 2. Distribution of activities under the Arctic Hectare program.

Thus, the program solves the housing problem. For example, the Far Eastern Hectare program, combined with the Far Eastern Mortgage program, has resulted in an outstripping growth in housing construction (Table 2).

Table 2. Distribution of permitted land use Types under the Arctic Hectare program.

Type of permitted use of the plot	Number of plots provided under the Arctic Hectare program, %
Individual housing construction	40
Entrepreneurship	26
Agriculture	12
Other	11

The AZRF is the most urbanized region of Russia. The largest part of its population (over 2.6 mln. people) resides in 25 cities [14, 15]. In some cities (Krasnoyarsk, Yakutsk), the urban environment organization undergoes a redistribution of construction volumes from mid-rise to high-rise. Despite this, urban development in the rest of the Arctic zone mostly retains the basic organizational environmental principle of concentrated residence in mid-rise buildings [16].

The AZRF is the region most dependent on Northern delivery – the delivery of energy resources and foodstuffs that is mostly seasonal and limits the entrepreneurial capacity of the population. In these conditions, receiving free Arctic hectares allows local residents to invest money directly into the future project. However, proximity to delivery centers is the decisive factor in choosing the plot, as evidenced by the above analysis of land distribution [17].

An important aspect of site development is the compact arrangement of utilities, expensive to maintain. Clearly, the object needs to be located as close to the city as possible. Thus, despite the wide range of possible activities on the hectare, most participants in the program choose individual housing construction.

The Hectare Program offers comprehensive Business on the Hectare solutions. A resident (entrepreneur) can choose a ready-made meat shop for bakery products production, a shop for fruit and berry processing, or fish processing. It is possible to realize business projects to set up a cafe, cheese fac-

tory, boiler house, car wash, or hotel. Ready-made solutions are provided by a modular system, and their erection can be automatic.

Thus, in the short term, urban boundaries are about to expand. The scenarios of their expansion can be different. Along the highways, at the entrance to the city, the most valuable will be infrastructure facilities – driver and vehicle services, gas stations, and related services [18, 19].

Another essential factor in the organization of the urban environment is rest and recreation. Arctic cities have plenty of recreational areas, but organized recreation outside the cities is largely undeveloped. The example of Krasnoyarsk with its 11 ski slopes demonstrates the demand for and popularity of this type of recreation. A ski base is a plausible facility for an Arctic hectare, coupled with road infrastructure. Most of the roads in the Arctic are winter roads – rolled and compacted snow (ice). If points of attraction are established along one or several hectares, it becomes possible to develop the necessary infrastructure along the route, including waste disposal. Furthermore, in any object in the Arctic, it is necessary to provide for a maximally closed and autonomous mode of functioning as a prerequisite for sustainability [20]. The next in line are tourism facilities. The development of domestic tourism is gaining popularity in Russia. Even watching the aurora borealis assumes a full set of services for rest, food, communication, etc. Importantly, the northern lights cannot be seen in cities with bright night lighting. Thus, tourist sites are already being developed: the Yamshchitskoe Podvorye ethnographic complex attracts tourists despite being 250 km away from Yakutsk.

Thus, there is an environmental complex on the Arctic hectare, adjacent to the city: road facility – recreation center – tourist base [20, 21]. As an environmental complex, it should contain all the attribute patterns necessary for its operation, including environmental, functional, metabolic, and communicative, i.e., several support objects [22]. Since 2021, the largest number of Arctic hectares have been provided to the Murmansk Oblast (3,026), the Republic of Karelia (698), the Arkhangelsk Oblast (503), and the Yamalo-Nenets Autonomous Okrug (424).

various regions have been allocated Arctic hectares, with the highest numbers going to the Murmansk Oblast, the Republic of Karelia, the Arkhangelsk Oblast, and the Yamalo-Nenets Autonomous Okrug (Fig. 3). New facilities directly adjacent to the city generate their own spatial locations, changing the city's borders. The island-like character of the city will therefore change physically and visually.

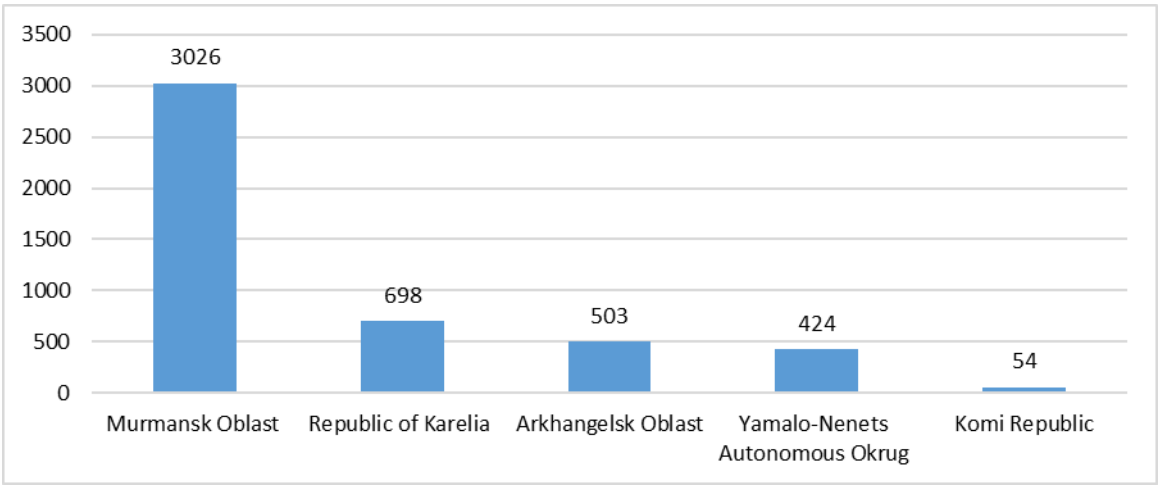


Fig. 3. Allocation of Arctic Hectares to Different Regions.

Arctic cities, whose population has shrunk in the post-Soviet period, are gradually replenishing their population. Nevertheless, there is an urgent need to preserve the local population and to provide local residents with education and jobs. While jobs will be created in the first phase of use of the Arctic hectares allocated by now, educational opportunities will be offered in the second phase. Permitted educational activities on the Arctic hectare include schools, kindergartens, and so on. By developing jobs, offering proper recreation, and developing tourism, it is possible to create an attractive and comfortable environment for youth and families. However, in this case, the construction of preschool

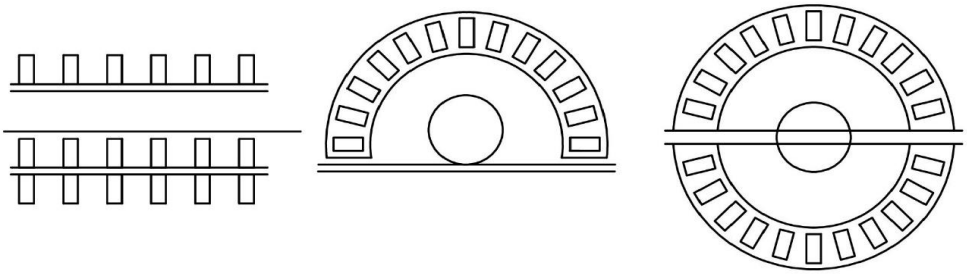
(school) institutions in the Arctic hectare requires immediate proximity to residential areas. A peculiarity of the Arctic region is that the children of reindeer breeders study in boarding school, while their parents lead herds from pasture to pasture. Once the number of reindeer herders increases with hectares for pastures, there can be a rise in demand for children's educational institutions located compactly closer to these pastures [24]. The internal watch system of work in the Arctic region is the predominant one: workers tend to work in the same region they live in. Their children can stay in boarding schools while their parents are on the watch. The incorporation of various educational institutions into the Arctic Hectare program will lead to the expansion of settlement borders [25]. Global experience demonstrates that Arctic cities are revived once the educational function is introduced in them (Fairbanks, Tromsø).

Based on the acquired data, we specify two urban development conceptions for the change and transformation of city borders.

The first approach assumes the development of the city along outbound highways, i.e., roads leading from the city towards the points of concentration (distribution) of Arctic Hectare plots. This option requires regulation of the specialization of plots, since industrial facilities, even small ones, cannot be allowed near residential areas [26]. It is also necessary to specify the allowed proximity of various technological sites to the borders of plots. Regulation is also needed to ensure the even distribution of functional zones for services to the population, which are also introduced on the Arctic hectares. This new formation can be similar to suburbs with some social and business facilities.

The second concept assumes the development of satellite cities. The distributed plots are located close to each other, within 2-20 km away from the central city (following the 15-minute city concept). At the core of the satellite city, there have to be several enterprises since there is a need to establish a market foundation of the residents' lives, i.e., jobs. The remaining plots in this scenario provide housing, utilities, and other demanded functions [27].

Given the scale of the plots, dense housing does not appear feasible. Only by adjusting the shape to an elongated one (trapezoid, rectangle, etc.) is it possible to distribute them along a line (road). This implies that there must be a road to every section. However, the region's difficult climatic and weather conditions make it challenging to build many quality roads. The previously described winter roads exist only in the winter (for around 7-8 months), and for the remainder of the year, there is a vital need for a hard road surface, which is extremely expensive in the described conditions [28].



1. 2. 3.

Fig. 4. Options for grouping plots of the Arctic Hectare: 1 – linear, 2 – incomplete centric, 3 – centric.

An obvious way to distribute the plots is by both sides of the road (which fits the first conception, suburbs). The experience of urban development has examples of minimal lengths of the road to a settlement associated with its shape. In this case, the road leads to the center of the settlement, a square outlined by the smaller sides of the plots. Thus, the shape of the settlement is close to a circle, with land plots as its segments. Such a parcel can be blocked by other ones along any trajectory. The centric version of parcels' composition is appropriate for satellite cities, although it can also be implemented in suburbs (Fig. 4).

The proposed concept of redistributing the borders of cities and settlements from the point of the circumpolar aspect of organizing the habitat can be realized with established planning, management, and funding mechanisms. These are provided by the actively operating public and business support programs. Nevertheless, it is necessary to develop a development plan for the territory and coordinate

the provision of each particular Arctic hectare on its basis and under administrative control. Without spatial planning of the territory, based solely on personal initiative, people risk using money, and the region risks not achieving the desired development [29]. Yet strict planning is also not recommended. Participation in the gradual development of the territory needs to be among the prerequisites for receiving a land plot. The area plots allocated in the first two years of the program, 5 ths km^2, are minuscule compared to the entire AZRF – 5 mln km^2. We can only hope that the previous manner of distribution, chaotic from the standpoint of urban construction, has not created the associated problems and that it is still possible to direct the development according to plan. In the past 30 years, there has been no official planning of cities. However, the major increase in settlements near the Gulf of Ob shows the opposite (Fig. 5). For instance, the Sabbeta village is factually a city, having a population of 22 ths people [30].

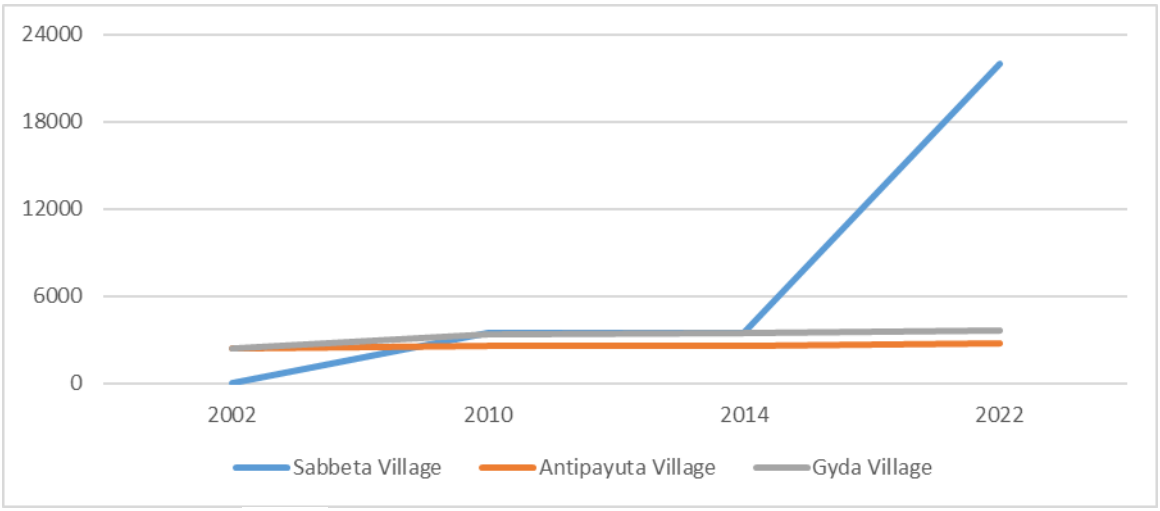


Fig. 5. Population growth in villages near the Gulf of Ob.

This growth is mostly attributed to a confluence of factors such as strategic economic activities, job growth, resource exploitation, improved living conditions and that have collectively spurred urbanization and community expansion in this particular region.

It appears that the time has come for a new stage in Russian urban development practice to expand the borders of old cities and design new ones in view of today's conditions and circumstances.

4. CONCLUSION

At present, the landscape of the Arctic zone is undergoing a major transformation mainly due to the introduction of innovation programs and state initiatives, as well as unique regional dynamics.

The circumpolar aspect in the development of the spatial organization of Russian cities assumes changing the borders of Arctic cities due to the development of territories under the Arctic Hectare program. The borders of cities and settlements will expand towards points of attraction, such as tourism and recreation facilities and workplaces. The trend towards the centralization of objects is explained by the need for them to be connected with cities and with one another. Objects located far away from cities are at risk due to their shared peculiarity: in case their exploitation proves impossible due to the lack of communication (roads, resources, connection), both residents and the state will bear the costs.

The reconstructivity of the region is viewed as a means of expanding the boundaries of civilization in the vast northern territory of Russia. The redistribution of population through settlement on the Arctic hectares will change the established pattern of densely and sparsely populated areas. However, with respect to population density and the development of infrastructure and roads, there is a clear predominance of the European part of the Arctic zone. In contrast, the coverage of the Asian part of the region is minimal. We can hope that the positive experience of the Murmansk Oblast will be utilized in the

Siberian part. The issue of reconstructivity in Russia can be resolved only if the territories of Siberian port cities on the Northern Sea Route are developed.

The expansion of the region's development needs to rely on forward-looking spatial planning. The state must take on the function of not only providing plots but also of reasonably grouping them and combining them with centers for the distribution of resources and services.

In our view, the process of chaotic change to the borders of Arctic cities is a novel phenomenon in Russian urban development, which calls for research and exploration considering the features of organizing living environments in the Arctic zone.

5. ACKNOWLEDGMENTS

The paper was written under Project No. 23 "City borders in the diversity of typologies, architectural images, and meanings. Historical transformations and new proposals" as part of fundamental and applied scientific research (research and development) by research teams in the Moscow State University of Civil Engineering (Order of March 23, 2023 No. 258/130)

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