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Nature Prerequisites for Zoning of Suburban Area of Krasnoyarsk City

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The suburban area is a multifunctional area that has a few problems. This area should protect the ecological city area, should solve the recreation problems of the city, should supply citizens with perishable goods, and should also have an economy and science functions for the city development. In connection with the development process of suburbanization, this territory is very important for city development. Russia's economy is going through major transitions. These transitions are rapidly changing the relationship between cities (urban areas), countryside (rural areas) and the development, growth, and popularity of suburbia. The process of suburbanization takes place in biggest cities of Russia, including Krasnoyarsk City. The modern Krasnoyarsk with a population of about 1mln people occupies the territory of 34115 ha. This article examines the analysis of functions of suburban area and connects these functions with zoning of the suburban territory. The author analyze the nature conditions of suburban area and it connection with functional zoning of territory.

Keywords: suburban area, zoning of territory, Krasnoyarsk City

Introduction

KRASNOYARSK is one of the biggest cities in Eastern Siberia, its important industrial and cultural center. The modern Krasnoyarsk with population about 1mln people occupies the territory of 34115 ha. Its length from north to south is 12 km, from west to east – 30 km.

Krasnoyarsk is a large industrial and cultural centre of East Siberia, the capital of Krasnoyarsk region, the second largest region of Russia. The location of the city is on Yenisei river, a large transport artery, makes it possible for remote regions of Central Siberia appear on the world market. The location of Krasnoyarsk at the crossing of existing and future intercontinental tracks of railway, motor, air and sea transport gives the city an opportunity to develop as the largest transport centre, connecting European countries with countries of Asian and Pacific region, North America and South Asia, North Atlantic and northern part of the Pacific Ocean. The closeness of Krasnoyarsk (in comparison with the cities of the country's European part and West Siberia) to Japan, China, South Korea and other countries of dynamically developing Asian and Pacific region makes it possible to develop economic and other potentials of the city on the basis of foreign economic activity and cooperation.

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The city was formed in 1628, but the first research and plan of suburban area begin in 20th century. In the reforming years of 19th century in Siberia as a whole, including Yenisei province, there was no sharp distinction between urban and rural areas, in both economic and socio-cultural terms. Population of petty bourgeois was still largely tied to the land (by keeping the livestock and doing a backyard farming within town's boundaries), while the peasants often engaged in fisheries within the city [1].

One of the first search for an integrated development of the city and its suburban areas was a scheme called «District plan of Krasnoyarsk», 1939. The project covered suburban territory within a radius of 20-25 km, resulting in a concentration of buildings and recreational areas near the city (areas of Udacny village, r. Bazaihi, Ovsyanka village in the West, Berezovky in the East). The complex organization of suburban territories and their clear functional zoning in the city of Krasnoyarsk, including the development perspectives, have not been finally resolved [2].

Characteristics of the urban process in Krasnoyarsk in 50-60s manifested in conjunction of new urban landscape and local conditions. If the historical part of the city's natural characteristics were increasingly dominant, in general, subjugated the overall appearance of buildings; in new residential areas of the city buildings became the means of organizing space, which revealed its own natural dominance. Picturesque landscapes near Krasnoyarsk have been replaced by faceless neighbourhoods of the city [2].

During the Soviet years of power the Homestead farming evolved significantly in Krasnoyarsk. The Siberian gardening emerged in the end of the 19th century, when immigrants from Central and southern areas of Russia settled down in Siberia and brought with them the culture of berry plant picking and planting them in their new home environments. Since the earliest days of the Soviet Republic the horticultural development became of State's significance. The Soviet way of life opened opportunities for extensive development of horticulture in Siberia. In 1938, the city had one garden and 27 gardeners, and by 1972, 160 garden settlements and 27 thousands of gardeners, to date, this number has increased by several times [3]. In the 1990th with the advent of the new government and a change in the economic and political regime, there were changes in the development of suburban areas too. The role of the government decreased in the development of horticulture and suburban settlements. Public places in the suburbs were either privatized, or just ceased to exist. This period is characterized by a decline in the development of suburban areas. But having a backyard farms helps city residents ensure continuous food security in times of crisis.

Analysis

To describe present situation in suburban area of the city the author analyze the nature condition of this area. The borders of suburban area in Krasnoyarsk City are about 20-30 km around the city. In Krasnoyarsk suburbia the main sectors are agriculture, environment, recreation, and accommodation of housing settlements. All of this sectors or functional zones need special nature condition.

For development of agricultural area important are: relief of territory, soil conditions, landscape. Environmental area of suburbia needs a vegetation of territory and the location of main pollutant of the city (main factory, main highways). The main condition for recreation zone is attractive of the area, also it better a natural area. And for development the settlements important as relief and soil conditions, as attraction of area. All of these indexes need to analyze before planning and zoning of suburban area.

A. Agricultural sector

Usually the perishable foods are produced in suburban farms. It is necessary to development and planning of suburban areas to protect agricultural function of suburbia. But currently the territories of agricultural land use to construction houses. In future planning of suburbia should to have agricultural sectors. Saturation of the farms of rural settlements should be developed gradually – from center to periphery and in the first stages in the zone of the necessary transport accessibility to the center. Active origin and development of farming movement in the process of development of agricultural areas in the first place to start in zones of influence of large cities and centers, then the system will form resettlement farms in areas of transportation routes and centers. For this case it is necessary to have program to protect agricultural sector in economy and to development farming, which will produce perishable foods for citizen. Agricultural area in suburbia should plan with accordance with the landscape. Natural and reasonable accommodation is not enough farms in the region could disrupt the ecological balance of the environment, and to the uneconomical operation of the economy.

The most favorable form of relief for agriculture are the lowlands and plains. The most gentle and flat terrain in the suburbs of Krasnoyarsk is distributed in the northern part of the city and presented to Krasnoyarsk-Kemchugskoy plain, which is part of the West Siberian Plain, and the Angara-Kan part of the Yenisei Ridge [4]. Krasnoyarsk-Kemchug plain is a piedmont, steeply-sloping plain with the majority of heights – 250-350 m. The plain is higher in the west. The heights of 400 m are more typical for surfaces which serve for dividing river systems of Yenisei and Ob. In the east Krasnoyarsk adjoins to the morphostructure of Yenisei range, particularly with its Angara-Kansk part, which consists of low-mountain (below 550 m) massifs, and which western slopes are straight line tectonic scraps with the height of about 100 m [5].

The climate of Krasnoyarsk and its surroundings is extremely continental, it is characterized by a long winter with little snow, short warm summer, short dry spring with late returns of frost, short autumn with early frost and often returns of warmth. Prevailing direction of wind in winter and autumn is south-west, in spring and summer – west [6].

For this work is more important information are about parts of the city and its suburban area, the differences in climatic regimes, and selection the most favorable areas for agriculture. To explain this is a map of climatic zoning of research area. The purpose of this zoning is characteristics depending on the climate and landforms, and climatic characteristics of the main features of the suburban area of the city of Krasnoyarsk.

Can conclude that the most favorable areas for agriculture, are confined to the lowlands, flat relief, the most favorable combination of climate is heat and moisture, and forest-steppe landscape with chernozem soil. Satisfies all the criteria are north-west and north territory, and the valley of the Yenisei River.

The tensest situation with the presence of free land for agriculture is observed in Yemelyanivsky and Berezovsky areas, due to close location to the city. Remote areas of the suburb of real estate market is unprofitable, also in this area is not a lot of housing estates. As a result represented the characteristics and analysis of factors affecting the development of agrarian sector of suburban area of Krasnoyarsk City can conclude that the most favorable zone for the placement of the agricultural sector is the northern part. Due to problems with land ownership issues and the location of the land of the agricultural sector can be removed from the city at 25-50 km, which will not affect the economic

Fig. 1. Mesoclimatic districts of Krasnoyarsk outskirts. (Type Codes/Legend – see the Table 1) [6]

Table 1. Mesoclimatic zoning of Krasnoyarsk outskirts (according to I.A. Golzberg) [6]

District (see pic.)	Natural zone	Height, m	Summer		Winter
			Period duration, days with temperature above 15 °C	Average speed of wind, July, m/sec	Period duration, days with temperature below -5 °C
I South-West (mid-mountain)	Dark-needle taiga	490-540	40-50	1,0	150-155
II East (low-mountain)	Mixed forest	340-360	50-55	1,4	140-145
III Central (foothill)	Forest-steppe	270-290	65-70	2,0	135-140
IV North (low-hill plain)		160-190	60-65	2,3	145-150
V Yenisei valley	Steppe	140-160	70-80	2,3	130-135

development component, as is located in transport availability. The most favorable areas for agriculture are the northern Yemelyanivsky region and east part of Berezovsky region.

B. Ecological sector

Suburb is “lightweight” of city, is a very important ecological role in the life of the city, so in the planning of suburban territory must abide by landscaping and create natural parks in accordance with the landscape. For balance of ecology inside the city and outside of the city in is necessary to plan green belt some line around the city. It is important to plan a persistent green area. To characterize the

current state of the environment sector of the suburbia of Krasnoyarsk City need to consider state of vegetation and naturalness.

Flora of the city and its surroundings varies: the left bank of Yenisei is a typical forest-steppe, as for the right bank – it is mountain taiga. Forest-steppes in the outskirts of the city are situated on terraces and south slopes, which face rivers Bazaikha, Laletina etc. There are several types of steppes. Stone steppes cover the tops and slopes of mountains along Kacha river, including Drokino knoll and other places. Here all the plants grow on shallow, rubbly soil. Meadow steppes with mixed herbs are typical for a piedmont part of the outskirts.

Forest area is belted the city. Its total area is 5332 ha, including: Bazaiskaya forest district (maximum height 592 m asl) 2529 ha, City forest district (maximum height 517 m asl) 2443 ha and Yesaulskiy pine wood (maximum heights 135-140 m) 360 ha. The first two are situated at foothill of East Sayan, occupying its northern part. A sharp crossing of relief at small absolute heights (200-500 m asl) and slight (not more than 150-200 m) differences in heights gives ground to consider the forest of these forest districts to low-mountain category. There prevail mostly flat slopes; and steep slopes (more than 30°) are typical only for banks. This refers, firs of all, to the slopes of southern part. Yesaulskiy pine wood makes less than 7 % of forest area, belting the city, it is situated on slightly uplifted, almost flat plateau [6].

Facilities of non-ferrous metal industry, energetic, chemical industry and construction materials industry are the main sources of air pollution in the city. A large number of carbon monoxide, nitrogen oxide, sulfur dioxide and dust are dismissed by small heating plants, which don't have purifiers. Industrial and heating plants use low-sulfur coal as fuel. Transport pollutes the atmosphere of the city immensely. The number of cars of different kinds grows every year. All major transport arteries of Krasnoyarsk are overloaded.

In the city south-west and west winds prevail, and in suburbs – west winds. (Fig. 2) Thus, the vector of pollution disperse will be correlated to the wind pattern. Also, climatic peculiarities, influencing the pollution disperse are – number of hours (days) with zero wind, which, in extremely continental climate of Krasnoyarsk is 630 (26) – 1365 (57) a year. Such periods, because of slow circulation of atmosphere, favour the concentration of polluting substances over the city, smog formation. At the same time, the majority of atmospheric pollutants are concentrated in bottom layer of air. The size of this layer differs constantly and, according to different sources, can be up to 400 metres. Thus it is possible to make a conclusion that large concentration of atmospheric pollutants will occur in those parts of the city which are located in relatively low relief features, i.e. about 8-30 m. The low location decreases the ventilation of such districts and increases the concentration of pollutants in bottom layer of air. Also for low districts it is typical to get the inflow of cold air mass from nearby territories [6, 7].

The minimum concentration of dust occurs at south-west and west winds. The maximum concentration of dust is in residential districts, next to highways and construction materials industry facilities. The maximum pollution by carbon monoxide occurs at zero wind in districts next to highways with an intensive traffic. The city is less polluted by this mix at north-east and south-east winds. The concentration of sulfur dioxide in the air reaches great amounts at zero wind and north-east and east winds. The city is most polluted by nitrogen oxide at zero wind as well and at south-east and south winds. The right bank, districts which are next to highways, and north-east part of the city are more polluted by sulfur dioxide.

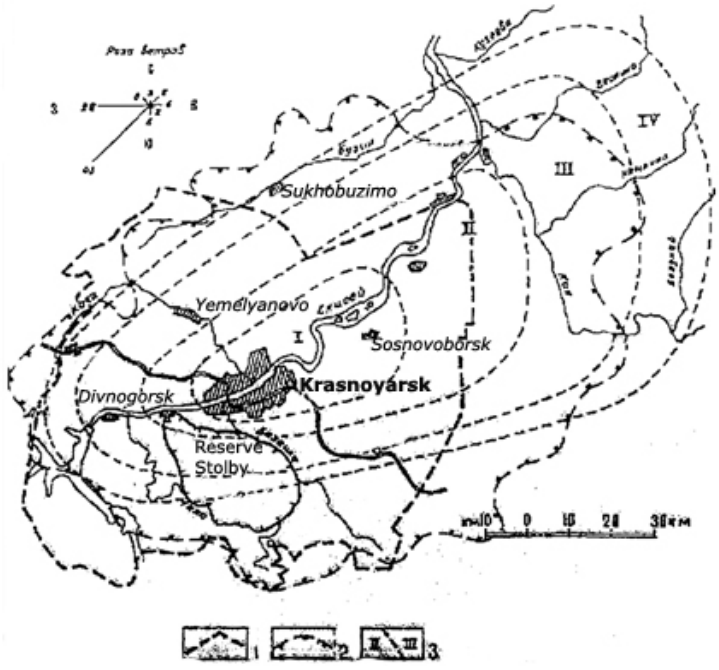

Fig. 2. Zone areole of pollution disperse in Krasnoyarsk city [4]

On the whole it is important to mention that Krasnoyarsk is located in unfavourable (because of pollution) weather conditions. Especially the conditions of mix disperse worsen during winter months, when the repetition of inverse temperature distribution, light winds and fogs increases. A big industrial city, such as Krasnoyarsk, influences the climate immensely. The air becomes less transparent and clear; air temperature in winter is higher than in suburbs. Yenisei river has a cushion impact on the microclimate of riverside districts during warm period. The analysis of data of air temperature and rainfall showed a tendency of some increase of air temperature in the city and rainfall increase.

According to the norms of urban planning for cities with populations of more than 250-1200 thousands mean radius of the green zone are advised to take from 25-40 km, the minimum width of the protective green belt – from 3.5 to 5 km. Thus, to Krasnoyarsk environmental sector should be about 15-20 km.

Ecological situation in Krasnoyarsk city is not advantageous. Because of many industrial facilities there occurs air, water and soil pollution. Some suburban districts cannot be used as residential, agricultural and recreational territory. In the consequence of a long impact of harmful substances on the territory, soils lost their fertile functions, and growing products there is dangerous for health. To improve the ecological situation in the city it is planned to locate harmful facilities outside the city limits, to improve their cleaning system. In further planning of suburban territory it is necessary to consider the geographical component of a district location. Depending on the level of pollution impact on the territory it is necessary to plan sizes and functions of the territory.

The most favorable location of the environmental sector around the city throughout a distance of 10-25 km from the city, it promotes the most efficient purification of the atmosphere and reduce the adverse effects on the population. Currently, the sought part of city is surrounded by forests, which are

on preservation. The north of the environment sector represented by fields and unused industrial lands that are not detrimental to the environmental situation.

C. Recreational sector

In connection with the socio-political changes in the country areal impact of recreation and the creation of new recreational landscape intensified in the development of Russian regions (especially near large cities) in the late 20's early 21th century. Below are shows the features of transformation recreational landscape of the suburbia – partial degradation of system of public institutions, especially the resort areas. Part of the resorts was closed and came into full desolation; others changed owners and profile, and others in more or less preserved historical features. In general, the availability of institutions "organized recreation" for the citizens greatly diminished.

There are several recreational areas in the vicinity of Krasnoyarsk city, some of them are equipped for the rest, some are in the nature of natural vegetation, but is used for recreational purposes. To characterize the recreational sector of suburban area of Krasnoyarsk City, isolate the main factors influencing of its development.

Nature is the main factor in the development of the sector of recreation. Various recreational areas require different natural conditions of vegetation and topography. In terms of attractive appeal in this situation is interesting mountainous terrain presented in Krasnoyarsk East Sayan mountains – one of Altai-Sayan region mountain systems.Another attractive for recreational side of nature is a hydrological network. The main water objects on territory of Krasnoyarsk are Yenisei river and its small tributaries (Bazaikha, Kacha, Berezovka). Yenisei is the biggest river in the country. Its length is 3487 km, the square of water collection is 2580 thous. km^2. Within Krasnoyarsk Yenisei, flowing from the West to the East, has length of 30 km. the prevailing width is 500-600 m (the biggest 750 m and the smallest 300 m). In some places the depth reaches 6 m. Below the estuary of Kacha river, it is separated by islands into channels. The biggest islands are Otdykha, Molokova, Tatysheva, Atamanova. Upstream the river is shut off by the dam of Krasnoyarsk hydro-electric power station and its flowing is fully regulated, which changed its natural hydrologic state.

At present public places of resort in Krasnoyarsk are suburban territories, such as: state nature reserve 'Stolby', fun-park 'Bobroviy log', zoo 'Roev ruchey', botanic garden of Siberian Federal University, forest area of Akademgorodok, birch wood of Studgorodok, mountain skiing complex 'Kashtak', mountain skiing complex 'Nikolayevskaya sopka', ski stadium 'Vetluzhanka', biathlon stadium 'Dinamo'. These areas are used both as sport objects and places of mass rest (Fig. 3).

A conclusion is that in suburban area of Krasnoyarsk city there is a lack of recreational zones. The reason can be the absence of the necessary development of recreational infrastructure, insufficient financing of already existing recreational objects. As a result of this analysis can identify the most suitable location for the recreational sector: the south-western part of Berezovsky district.

D. Sector of suburban settlements

The history of suburbia in Krasnoyarsk started with a few planned communities. The early suburbia in Krasnoyarsk was unplanned and sporadic. Now the process of suburbanization is part of the total urbanization process, with urban planning and development now and in the future (Fig. 4). At present, there are two areas for suburban housing development in Krasnoyarsk. The first area is near

Fig. 3. Map of recreational centers in Krasnoyarsk City (Google map, Shaporova Liubov)

the federal highway M-53 from city to airport. The majority of this area near the federal highway will be changed into family-housing for community. This area once was farmland, but it became private property after privatization. The second one is near the Yenisei River in the east of the city. These areas are very clean and have a good view. The other suburban areas of Krasnoyarsk City are farmland, summer housing and nature reservation. The mountains in the western and southern part of the city are regarded as the natural borders for development.

As the process of privatization take place in Krasnoyarsk city the need of urban planning and the need for development of suburbia become more and more important. The focus of the discussion will be on urban planning and suburban area in Krasnoyarsk city. It is important that territorial government, region government and city governments need to have organized growth for agglomeration and the development of suburban areas. Since the beginning of Soviet Union surrounding area in Krasnoyarsk city was state owned farmland. This area is been utilized for the development for the Krasnoyarsk city suburban area [8]. The plans for this territory include low-rise, residential, business and commercial buildings. Immediate plans call for 24 different communities with using low-rise construction [6]. This plan has a few reasons, said Nicolay Glushkov, the Minister of Construction and Architecture of the Krasnoyarsk Region: the first two thirds of citizen lived outside the city, the second that this type of building is economical and quick to build, and the third is this type of construction is good for healthy lifestyle for the residents [9].

All of these conditions began to emerge after the collapse of the Soviet Union, and the characteristic of the new Russia. Suburban housing is formed in Moscow, and extends for 50 km around the city. For the Siberian cities of the end of 90 th was the beginning of suburbanization. Therefore, the process is to continue, which contributes to the development of suburban housing.

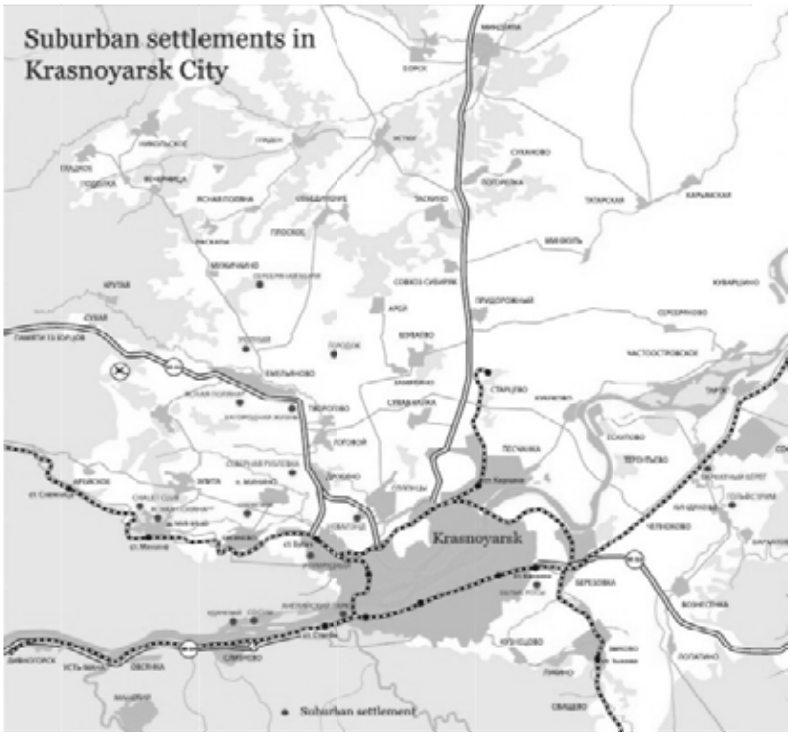

Fig. 4. Map of suburban settlements (http://www.dela.ru/articles/maloetazniy-krasnoyarsk/)

For the development of housing one of the most influencing factors is natural. The difference from the city apartments and suburban house is in location closed to nature. Therefore, for the placement of housing in the suburbs of the attractiveness of the territory is important. As with any construction plays an important role topography and geology, environmental condition of the area.

The plain area, with solid rock is the most favorable location of housing settlements. If we consider the vicinity of Krasnoyarsk on the availability of such relief, the gentle is the western part of the left bank, dedicated to the West Siberian Plain. According to the administrative division, the territory is in Yemelyanovsky area. The northeastern part of the suburb is also flat, but the location in the area of a large steel plant which affects the environment. In this case, the environmental factor plays a crucial role in the distribution of housing in the area.

The southwestern part of the relief expressed by the spurs of Eastern Sayan an elevation of 450-550 meters and dark coniferous taiga. The area is attractive and environmentally friendly disposition of its nature reserve, but the terrain is not favorable for construction. In this zone, very few areas suitable for development of housing, only a small strip along the shore of the Yenisei River.

As a result represented by the analysis of the situation that exists in housing suburbs of Krasnoyarsk, there are several key points. First, there is for now the two centers of the housing sector. In accordance with natural and economic indicators rational distribution of suburban settlements is in the north-west Yemelyanovsky area at a distance of 510 km from the city. In this area there is already incorporated several towns of building sites for future settlements.

Conclusions

So, it was the characteristic of suburban development to all sectors of the city of Krasnoyarsk in connection with nature case. As mentioned above, each sector is characterized in accordance with the proposed criteria for analysis. The main reasons of research this area is transitional changes in Russia and its influence in suburban development. The result of analysis is the location of all functional sectors in connection with a variety of natural and economic conditions.

By analyze the nature condition in suburban area of Krasnoyarsk city author concluded that:

1. The most favorable areas for agriculture are the northern Yemelyanovsky region and east part of Berezovsky region.
2. The most favorable location of the environmental sector around the city throughout a distance of 10-25 km from the city
3. The most suitable location for the recreational sector: the south-western part of Berezovsky district.
4. Rational distribution of suburban settlements is in the north-west Yemelyanovsky area at a distance of 5-10 km from the city.

This conclusions based on principles of urban planning, geographical characteristics of the area, landscape features. In future author continue to research suburban development in other cases, with also have influence in this area.

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Природные предпосылки зонирования пригородной территории города Красноярска

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Пригородная зона как многофункциональная территория решает несколько проблем города. Эта зона способствует экологической защите города, отдыху горожан, обеспечивает их необходимыми продуктами питания, а также сочетает в себе функции экономического и научного роста и развития города. Пригородная зона крайне важна в исследовании вопросов развития территорий городов и стран, особенно с учетом набирающего популярность процесса субурбанизации. Российская экономика в настоящий момент находится в переходной фазе развития. В результате экономических и политических реформ изменились отношения между городом и деревней, городом и его пригородной территорией. Процесс субурбанизации получил свое развитие в крупнейших городах России, в том числе и в Красноярске. Современный Красноярск – это город с населением более 1 млн чел., расположенный на площади в 34115 га. В данной статье представлен анализ функций современной пригородной зоны и их зависимость от природного компонента. В соответствии с полученными данными авторы предлагают функциональное зонирование территории пригорода Красноярска.

Ключевые слова: пригородная зона, Красноярск, функциональное зонирование.