

PAPER • OPEN ACCESS

## Ecological consequences of the playgrounds' reconstruction of specialized "Park-stadium Khimmash", in Yekaterinburg

To cite this article: L. Atkina *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **316** 012040

View the [article online](#) for updates and enhancements.

# Ecological consequences of the playgrounds' reconstruction of specialized "Park-stadium Khimmash", in Yekaterinburg

L Atkina<sup>1\*</sup>, O Mezenina<sup>2</sup>, M Zhukova<sup>3</sup>, D Lukin<sup>4</sup>

<sup>1,3</sup> Department of landscape construction, Ural state forest engineering university, 36 Siberian tract, Yekaterinburg, 620100, Russian Federation

<sup>2,4</sup> Department of land management and cadaster, Ural state forest engineering university, 36 Siberian tract, Yekaterinburg, 620100, Russian Federation

\*Corresponding email: [atkina@mail.ru](mailto:atkina@mail.ru)

**Abstract.** In connection with the World Cup in 2018 in the Russian Federation, including the qualifying matches of the World Championship in Yekaterinburg, the Government of the Sverdlovsk Region decided to place a training ground on the territory of the "Park-stadium Khimmash". For this purpose, a sports field reconstruction project was created and implemented. The article is devoted to the assessment of negative consequences for plantings of the "Park-stadium Khimmash" in Yekaterinburg as a result of the construction, which led to the destruction of 388 trees, 95 of them are pine trees. The park historically originated on the site of a natural pine plantation. Cutting down so many trees led to further disintegration of the stand. According to the project, the replacement of felled large park trees of pine and birch by willow and apple trees is recommended, which led to the destruction of natural landscapes that have survived in the urban environment. At the same time, not only the aesthetic perception is worsened, but the ecological criteria of the industrial area of the city are also reduced. First of all, the oxygen-producing possibilities of the plantation decreased, which is reflected in the economic assessment of the consequences.

## 1. Introduction

There is only one specialized sports park in Yekaterinburg - "Park-stadium Khimmash". Like most parks, it was created without project. In June 1947, the Khimmash stadium was opened [1], and a year later the entrance to the park was decorated with an arch. These objects were part of the social camp of Uralhimmashzavod. But the status of a park was officially acquired only on April 21, 1994, when, in accordance with the Decree of the Head of the Chkalovsky District Administration, the Yekaterinburg municipal unitary enterprise "Park-stadium Khimmash" was established. An enterprise is a commercial organization that is not endowed with the right of ownership to the property assigned to it by the owner under an agreement on the right of economic management. By the decision of the Yekaterinburg City Duma of October 27, 2009 No. 46/11 "On the formation of specially protected natural areas of local importance in the municipality "Yekaterinburg City", the status of protected areas has been established. In connection with the World Cup in 2018 in the Russian Federation, including the qualifying matches of the World Championship in Yekaterinburg, the Government of the Sverdlovsk Region, together with the Administration of the City of Yekaterinburg, decided to place a training ground on the territory of the "Park-stadium Khimmash" on one of the two plots envisaged by the outline project for placing field hockey fields (Figure 1).





**Figure 1.** Sports field for field hockey [2].

**The purpose of the work** is an environmental-economic assessment of the changes that have occurred as a result of the reconstruction of the sports ground in the park.

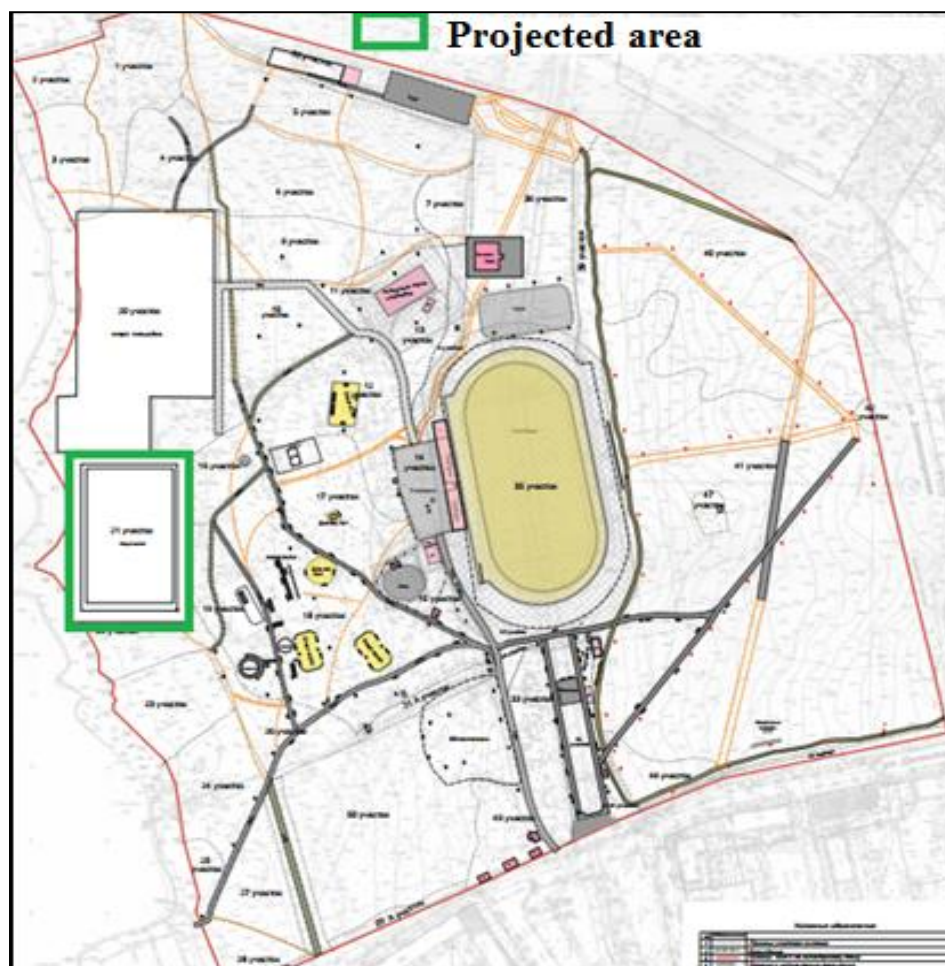
**The object of study.** The park is located in the south-eastern part of the city of Yekaterinburg, in the Chkalovsky district, has an area of 270181 m<sup>2</sup>. The shape of the park is a trapezoid of irregular shape, formed within the boundaries of the streets: from the north - the boundary of the pine massif and the territory of the gardening association "Uralkhimmash", from the west - the coastline of the Nizhne-Isetsy pond, from the south - along Dagestanskaya street from the boat station to the Zaporozhsky lane, from the east - along the border of the sections of houses on Dagestanskaya street, 1 and 1c (Figure 2).

The main function of the park is sports, the stadium is located in the center, and a large number of sports fields of various sizes. Pedestrian transits in the form of avenues formed by linden and poplar trees pass through the park. They look contrasting, as they are located among pine plantations. Also, a large number of spontaneously laid paths are noted, in connection with which the park has several entrances and exits that are actively used by visitors. The main entrances are located on the side of the Dagestanskaya st., Ingenernya st. and horticultural partnership.

Studies conducted earlier showed that the Park is an important environmental element in the structure of the district and the city as a whole, having a sports profile. The lack of a project during creation has led to the fact that one of the main requirements of sports parks is not being fulfilled - a reduction in the ways of intersecting the flow of visitors engaged in intensive physical training and those who prefer quiet rest. On the bank of the pond, children's and sports grounds are located close to each other, elderly people walk along the paths, parents walk with their children and athletes train [3-5].

## 2. Methods and Materials

The object of study is the park plantations, since they are the main component of the biogeocenosis, and, ultimately, determines the protective and aesthetic functions of the park. In the study, changes were identified in the composition of the park plantations on the basis of a tree-based tree inventory and the planning balance of the territory, which occurred as a result of the creation of a sports field [6].



**Figure 2.** The scheme of the «Park-stadium Khimash» before reconstruction with the placement of the projected playground.

The method used to assess the air regulation function, which is presented earlier in the works of Mezenina, O B, Bulatova L V and other Ural scientists [7-9].

The economic assessment of the function of plantations in maintaining the composition of atmospheric air is made according to the formula (rub/ha):

$$E_{\text{atm}} = \sum_{i=1}^n (q_i \cdot P_i (1 + V_{1i} \cdot U_{1i} + V_{2i} \cdot U_{2i}) \cdot t_i \cdot d_i) \cdot (I_c \cdot P_c + I_o \cdot P_o)$$

where:  $q_i$  - is the current average periodical growth of stem wood in the  $i$  age group,  $\text{m}^3 / \text{ha}$ ;  $P_i$  - is the weight of absolutely dry wood of the  $i$  species;  $V_{1i}, V_{2i}$  - coefficients of measuring the growth of wood of stumps and roots, branches and branches in the  $i$  age group;  $U_{1i}, U_{2i}$  - coefficients of measuring the growth of phytomass of individual components of plantations for different age groups;  $t_i$  - duration of the  $i$  group of age, years;  $d_i$  - is the discount factor for the  $i$  age group;  $n$  - is the number of age groups (young, middle-aged, maturing, ripe);  $I_c, I_o$  - intensity of carbon dioxide absorption and oxygen evolution during the formation of 1 ton of absolutely dry wood,  $\text{tn} / \text{tn}$ ;  $P_c, P_o$  - the value of the "replacement cost" when evaluating this function of forest parks,  $\text{rub} / \text{tn}$ .

### 3. Results and Discussion

The park-stadium has existed for more than 70 years, a certain balance of the territory has developed over the years (Table 1).

It is clear from the table that the park's feature is that the majority of the planar structures before the reconstruction were sites for various purposes - almost 24%, respectively, the share of the road and path network is relatively small for such an object - 5.5%. This caused the formation of an abundance of elemental paths. After the reconstruction, only a slight increase in the share of the road and road network is planned, which will be located around the new sports ground.

The territory under plantings is heterogeneous, it includes the stand of stand-alone trees, curtains formed from shoots of deciduous trees and lawns, there are practically no flower gardens.

The park is equally represented open areas and covered with tree plantings. This reflects the specifics of the sports profile of the park. But on the other hand, the consequence of the transformation of the natural plantation is obvious, since historically the whole territory was forested.

**Table 1.** The balance of the territory of the park-stadium Himmash before (1) and after (2) reconstruction.

№	Name	Area, m <sup>2</sup>		Percentage, %	
		1	2	1	2
1	Park area by cadastral boundaries	270181	270181	100	100
2	Under green areas	201375	181219	74.5	67.1
3	Under the plane structures (roads, sidewalks and grounds)	65336	84532	24.1	31.3
	Including area under the sites	50253.7	59672.7	18.6	22
4	Buildings and constructions	3470	4430	1.3	1.6

Currently, the range of tree plantations is represented by 18 species, of which 14 are tree species and 4 species of shrubs. The territory is dominated by pine mass interspersed with plants planted at different times. The age of a pine is up to 120 years, which confirms that the park was created on a site of natural forest. 69% of the total number of woody plants in the park are represented by pine (4755 pcs.), 26% - by hanging birch (1774 pcs.). A distinctive feature of the park is a large number of rough elm trees (273 pieces) - 3%, which exceeds the balsamic poplar that is traditionally planted in parks (60 pieces) - 1%.

Greater planting density is observed in the northern part of the park. In the southern part and near the pond there are much more open spaces. Age of pine varies slightly, old pine trees have reached IV-V age classes, like birch trees often have V-VI age class. From the side of Dagestanskaya st. many ordinary landings: *Ulmus glabra* Huds., *Padus maackh* Kom., *Acer negundo* L., *Salix alba* L., *Salix caprea* L., *Salix fragilis* L.. Apparently there was an attempt to enrich the range of the park and the creation of ordinary plantings. But now everything is destroyed, overgrown, partially marshy, and turned into a structureless chaotic undergrowth. Near the cafe at the boat station, very decorative willow clumps grow (spherical shape).

A characteristic feature of the park is the presence of large open spaces where sports and children's playgrounds are located. Many of them have a natural coating. The leading position in the form of living ground cover is occupied by meadow lawn (46.1%) and natural living ground cover (38.9%). In general, the park planting is in good sanitary condition, but due to age and a significant anthropogenic load, regular work is needed to remove dry plants, pruning dry branches, etc. At the time of the survey, 69 trees (57 ordinary pine trees) required cleaning, since they are dry for more than one year. After the reconstruction of the training ground of the «Park-Stadium Khimmash», an increase in the level of recreational loads on the adjacent forest is expected.

Employees of the Committee for the improvement of the city of Yekaterinburg revealed that they should be removed: pine - 95 pieces; apple tree - 168 pcs; birch - 75 pieces; aspen - 50 pcs. The demolition of greenery is permitted with the obligatory condition of planting forest crops on a land plot of 1.5 hectares. In order to restore the recreational functions of the territory, a compensatory planting of trees should be performed from the Nizhne-Issetsky reservoir along the coastline and from North Khimmash, which, according to the designers, will help preserve a favorable environment for sports and recreation.

Table 2 presents data on planted crops and the breakdown of lawns on the basis of design solutions for the improvement of the territory of specially protected natural territories.

**Table 2.** Statement of elements of gardening.

Species Name	Age, years	Quantity, pieces
<i>Salix fragilis</i> L (f. spherical)	5	80
<i>Malus baccata</i> (L.) Borkh	5	85
<i>Crataegus sanguinea</i> Pall	5	212

As a result, 165 trees and 212 shrubs will be planted on the territory of almost 3.7 hectares, which is almost three times lower than in the recommendations for greening park areas [10].

The assessment of the air regulation function is based on the cost of O<sub>2</sub> emission and CO<sub>2</sub> absorption per unit area. According to the project, the area allocated for the removal of plantations was 37.321 m<sup>2</sup>, based on the proportion of participation of the removed species, based on the growing area under conifers, an area of 0.9 hectares was withdrawn, and deciduous - 2.8 hectares.

In monetary terms, calculated on the basis of the Mezenina O B method, this will amount to 85.5 thousand rubles for conifers in 2010 prices, and 127.7 thousand rubles for hardwoods, totaling 213.2 thousand rubles, or taking into account the inflation rate to the prices of 2019 year [11] - coniferous 156.9 thousand rubles, deciduous 234.3 thousand rubles and total - 391.2 thousand rubles.

The project provides for compensatory landscaping - the creation of forest crops on an area of 1.5 hectares in the suburban forest zone. This is another inconsistency. In the practice of compensatory landscaping, when designing urban areas, it is recommended to plant trees at the cutting site, and only if this is not possible, compensatory greening is carried out in another area. On the territory of the park, measures are needed to preserve the pine plantations, where there is practically no undergrowth of pine trees, however, the project does not provide for this.

#### 4. Conclusion

During the reconstruction of the sports ground of the park there is a clear decrease in the number of growing trees. Although the territory has a lot of free sites, where compensatory landscaping is not provided. Instead of a pine, trees that are less ecologically valuable will be planted, which will reduce the aesthetic perception of park landscapes and worsen its ecological role. In economic terms, a reduction in the air regulation function can be estimated as a loss of 391200 rubles when calculating environmental damage from the changes made in the park.

#### References

- [1] Summer holiday workers 1947 *The newspaper "Martin"* **9 (4540)** p 3
- [2] UralInformBureau [Electronic resource], available at: <https://www.uralinform.ru/news/sport/279872-uchastnikam-chm-2018-obespechili-komphortnye-trenirovki-na-himmashe/>
- [3] Atkina L I, Vishnyakova S V, Zhukova M V, Luganskaya S N and Suslova N G 2017 The current state of green spaces of the Khimmash Park-stadium in Yekaterinburg *The Perm agrarian Bulletin* [Permskiy agrarnyy vestnik] **18** pp. 6-12
- [4] Burgess J, Harrison C M and Limb M 1988. People, parks and the urban green: a study of popular meanings and values for open spaces in the city *Urban Stud.* **25** pp. 455-473

- [5] Nicks S 2003 Designing The Interface: The Role of Urban Design In Reconstructing Apartheid Villages, Towns and Cities. *Urban Design International* **8** pp. 179-205
- [6] Methods of inventory of urban greenery. Ministry of Construction of Russia: entry into force [Electronic resource], available at: <http://files.stroyinf.ru/Index2/1/4294815/4294815098.htm>
- [7] Mezenina O B and Bulatova L V 2015 Definition of evaluation criteria for calculating the cost of a forest-park area in a megacity Forests of Russia and their economy **4 (55)** *Ural. state forest engin. un-ty* pp. 79–85
- [8] William H S 1981 New York. Air Pollution and Forests: Interactions Between Air Contaminants and Forest Ecosystems. *Springer Series on Environmental Management* p.388
- [9] Williams M R W 1988 Decision-Making in Forest Management. *Research Studies Press Ltd. Letchworth, Hertfordshire, England.* p.128
- [10] Order of December 15, 1999 **153** On approval of the Rules for the creation, protection and maintenance of green spaces in cities of the Russian Federation. *State Committee of the Russian Federation for Construction and Housing and Communal Services* [Electronic resource], available at : [http://www.consultant.ru/document/cons\\_doc\\_LAW\\_98762/](http://www.consultant.ru/document/cons_doc_LAW_98762/)
- [11] Inflation rate in the Russian Federation [Electronic resource], available at: <http://xn----ctbjnaatncev9av3a8f8b.xn--p1ai/>