

**FEATURES OF LAND USE OPTIMIZATION OF WATER PROTECTION
ZONES AND COASTAL PROTECTIVE STRIPS IN KYIV BY THE
METHOD OF LAND MANAGEMENT**

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***Abstract.** In the process of working on the article, the author considered the issue of establishing and ensuring compliance with the land use regime of water protection zones and coastal protection strips (on the example of the city of Kyiv). The urgency of considering this issue lies in the importance of optimizing land use as one of the most important tools to protect water bodies from technogenic and anthropogenic impacts and, in general, to improve the water-ecological situation of the hydrological regime. From which the purpose of the work follows, namely, to study the features of optimization of land use of water protection zones and coastal protection zones in Kyiv by the method of land management for the environmental safety of the city's population and public welfare in general.*

As a result of the research process, the theoretical basis was formed by scientific works related to the essence of the task, as well as legislative and regulatory legal acts of Ukraine on land use regulation. The information and statistical base was an extract from the scheme of planning restrictions of the General Plan of Kyiv and data of the State Service of Ukraine on Geodesy, Mapping and Cadastre, the State Statistics Service of Ukraine.

As a result of research, it was revealed that according to the legislation on the lands of cities and urban-type settlements, the size of the water protection zone, as well as the coastal protection zone, is established according to existing at the time of installation of a water protection zone concrete building conditions. Nevertheless, the example of the city of Kyiv shows that such information may be

missing. The author describes the problematic issues of the land management process of works on establishing the boundaries of water protection zones and coastal protection zones and restrictions on the use of land and other natural resources. Expertly determined the approximate possible area, taking into account the specific building conditions and possible flooding at the maximum flood water level. The model of optimization of land use of the territorial community by means of establishment of restrictions in use of the earths and other natural resources occupied by water objects is proposed. At the same time, the model combines technological, instructional and administrative tasks of land use optimization.

In addition, the optimality criteria and restrictions on the use of these criteria proposed in the model, which make it possible to unambiguously determine the location of the boundaries of water bodies and restrictions on the use of lands and other natural resources, taking into account the interests of land users and legislation.

Keywords: *land use optimization, water protection zones, coastal protection strips, land management process*

Relevance. Increasing anthropogenic and anthropogenic impact on water bodies almost everywhere leads to deterioration of their ecological state and degradation. Establishment and enforcement of land use regime of water protection zones and coastal protective strips are the most important tools for protection of water bodies from negative impact and improvement of water-environmental situation and hydrological regime.

The issues of water protection zones and coastal protection strips have been repeatedly considered by domestic scientists, in particular, they raised such issues as the formation of water protection restrictions in land use in Ukraine and abroad [1], the issue of land management problems of formation of water protection zones [2], also considered the specifics of the establishment of coastal protection strips of small rivers and streams in settlements (eg, Zakarpattia region) [3]. The status and problems of legislative regulation of water protection zones of water bodies in Ukraine were assessed [4]. A concept for the formation of water protection

restrictions in the use of land [5] and recommendations for improving the environmental condition of the coastal areas of the Dnieper reservoirs [6] have been proposed. Interesting developments are the organization of water protection zones in Ukrainian cities: methodological problems and solutions by means of landscape and environmental planning [7] and the issues of streamlining the development of coastal areas within urban settlements [8]. Despite this, under the conditions of decentralization of power, the task of optimizing the land use of water protection zones and coastal protective strips as one of the components of sustainable development of the territory has become more relevant.

The purpose of the article is to investigate the peculiarities of land use optimization of water protection zones and coastal protective strips in Kyiv by method of land management as one of the components of ecological safety of urban population and public welfare in general.

Materials and methods of research. Theoretical basis of the article was made by modern positions and principles of ecology and economics of land use, scientific works, connected with essence of the set task, and also the legislative and normative-legal acts of Ukraine concerning regulation of land use. At the same time, the information base was the data of the State Service of Ukraine on Geodesy, Mapping and Cadastre, the State Statistics Service of Ukraine and the excerpt from the scheme of planning restrictions of the General plan of Kyiv.

The authors used the following research methods in the process of work: monographic – in the process of analysis of scientific sources and normative-legal acts concerning the object of research in part of regulation of land use; analysis, synthesis – in specification of structural model of optimization of land use of territorial community by method of establishment of restrictions in use of lands and other natural resources occupied by water objects; abstract-logical – in formation of theoretical generalizations and conclusions.

Results and discussion. There are about 70 small rivers and streams within Kiev. Some of them flow directly into the Dnieper, others into its tributaries. The majority of small rivers, especially streams, are partially or completely hidden in

concrete reservoirs. All in all, there are 431 water bodies of different types in Kyiv, covering a total area of 2,347 hectares (without the Dnieper). 129 of them are lakes, 102 ponds, 43 small artificial lakes, 32 springs, 9 rivers, 27 channels, 28 streams, 2 channels and 24 bays [9]. The characteristics of individual rivers of the city, located in the right-bank part of the capital (Lybid, Syrets, Nyva and Vita) and in the left-bank part (Darnytsia) are given in Table 1.

Table 1: Main characteristics of selected rivers in Kyiv

№	Name of the river	Where the river flows into	Length, km	Watershed area, km ²
1	Vita	Dnieper	13,9	244,0
2	Darnytsia	Telbin Lake	21,1	133,0
3	Lybid	Dnieper	16,0	66,2
4	Nyvka	Irpin	19,7	94,0
5	Syrets	Opechen Lake	12,3	24,4
6	Siverka	Vita	29,2	129,0
Together			112,2	690,6

Source: [10].

Organization of rational use of the territory of the territorial community provides for a certain complex of measures, among which the main role is played by optimization of land use through allocation of zones with special conditions for use of territories. Thanks to these actions, territorial sub-types of land use within water protection zones and coastal protective strips are identified in the territorial community, for which restrictions on the use of land and other natural resources are formed in order to reduce the negative impact. At the same time, on lands of cities and towns the size of water protection zones and coastal protection strips are established in accordance with existing conditions of development at the time of establishing the water protection zone pursuant to paragraph 10 of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for Determining Sizes and Boundaries of Water Protection Zones and Regime of Business Activities in them" [11]. In particular, it would be necessary to use the materials of the master plan of

Kyiv for the period up to 2020 [12], but this master plan does not contain information about water protection zones.

In spite of the existing general legal regulation of land use planning works to establish the boundaries of water protection zones and coastal protective strips and restrictions on the use of land and other natural resources, there are some problems and difficulties in their implementation. In particular, a number of such problems were encountered when carrying out work to establish boundaries of water protection zones and coastal protective strips and restrictions on the use of land and other natural resources of water bodies within the city of Kyiv. The current land use planning process for establishing the boundaries of water protection zones and coastal protection strips is shown in Figure 1.

Elements of the land use planning process that contain problematic issues are shown in grey in Figure 1. The main problem in carrying out land use planning works to locate the borders of water protection zones and coastal protection strips and restrictions in the use of land and other natural resources is the lack of a quality mapping basis for the city area in the state land cadastre.

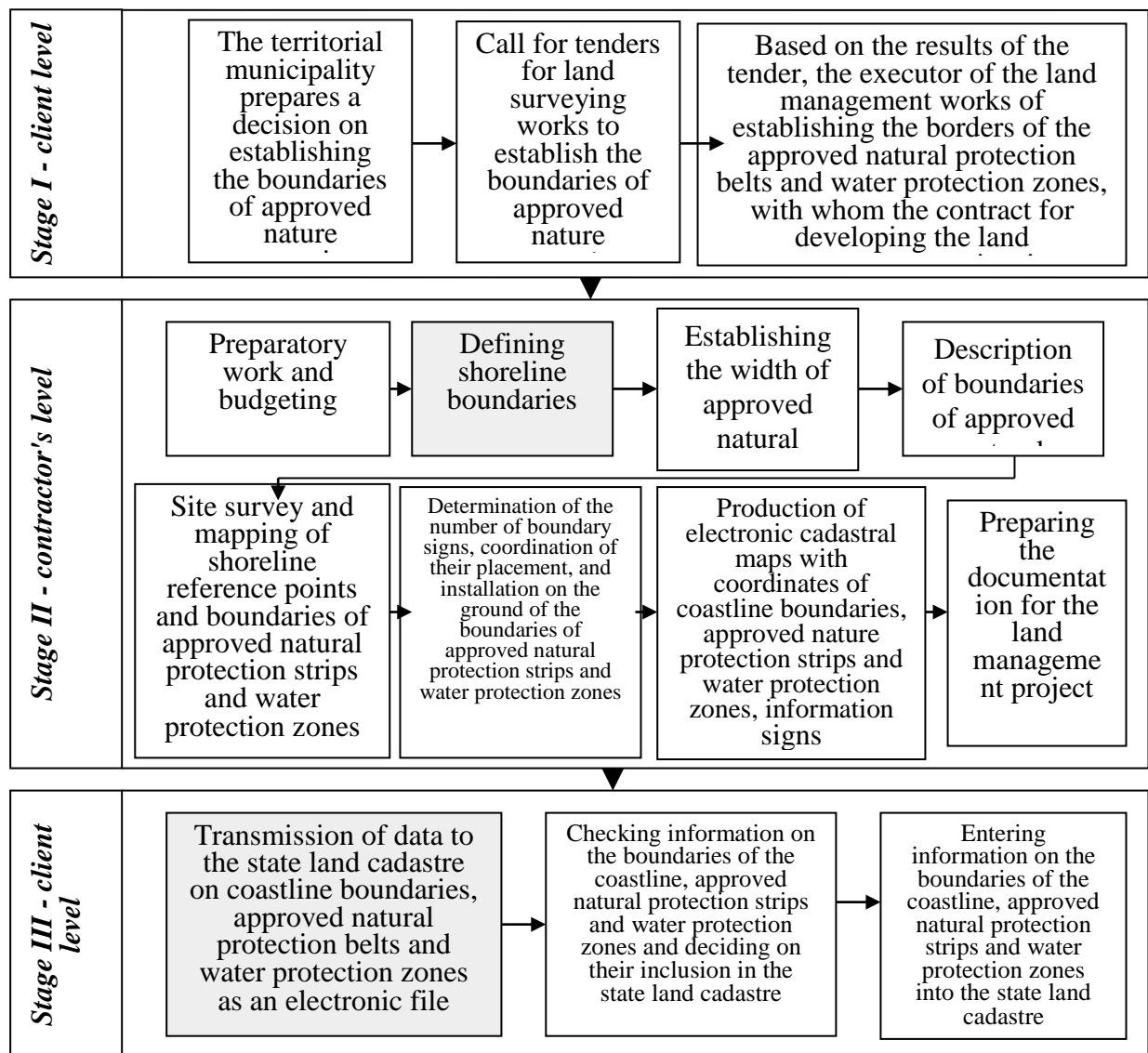


Figure 1. Logical and substantive scheme of the land use planning process for establishing the boundaries of water protection zones and coastal protection strips and restrictions on the use of land and other natural resources

A mandatory requirement of the State Service of Ukraine for Geodesy, Cartography and Cadastre for this type of work is the use of the cartometric method. For example, on the territory of Kyiv in the State Land Cadastre is a layer of "orthophotomaps (Kyiv)", which reflects orthophotomaps produced under the agreement between the Centre of the State Land Cadastre and the communal enterprise "Kiev Institute of Land Relations" dated 09.04.2014 No. 1400990100008. The layer does not contain information of the State Land Cadastre and is intended for ease of navigation on the map when searching and

viewing information. Also, the M 1: 2000 orthophotomaps with a contouring were obtained in a period that precludes the use of the cartographic method alone due to the impossibility of indisputably determining the shoreline of water bodies. The second problematic point is the current lack of an approved map (plan) form, which accumulates with regard to the zone with special conditions of land use and other natural resources. In this connection it is advisable to fill in the map (plan) made on water protection zones and coastal protective strips and restrictions in use of lands and other natural resources by analogy with the cadastral plan of the object of land management.

The problems outlined are key to resolving the issue of unambiguously establishing the location of water protection zones and coastal protection strips and restrictions on the use of land and other natural resources, as well as the state's recognition of their existence and the establishment of a special legal regime for the use of such land.

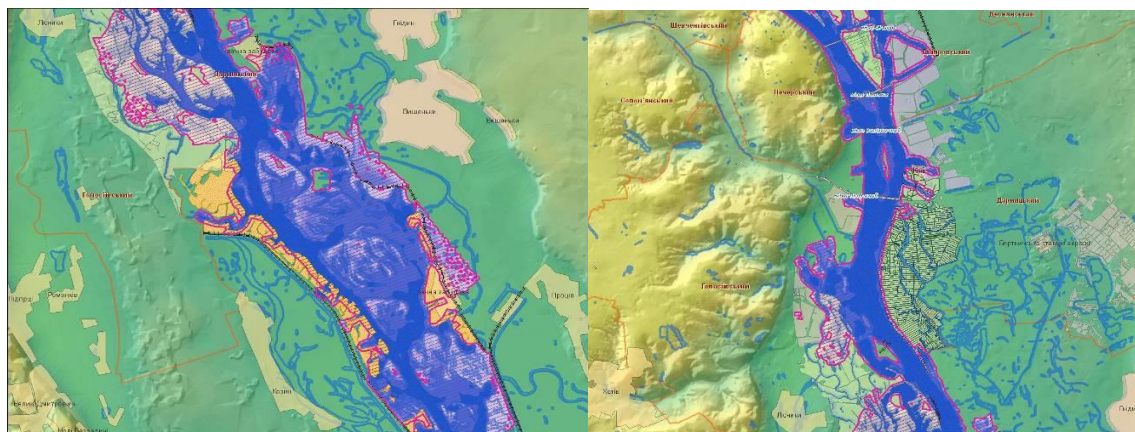
In view of the above and the fact that in Kyiv. Kyiv land use records of water protection zones and coastal protective strips are not kept, by expert means of topographic maps their approximate possible area is determined (Table 2), at that it is taken into account that the size of water protection zone, as well as coastal protective strip, is established taking into account specific conditions of development and possible flooding at the maximum flood level, repeated once in ten years (Fig. 2). As the analysis of Table 2 shows the share of water protection zones in the total area within the city districts varies from 3.6% to 36.8% with different population densities.

Table 2. Characteristics of water protection zone land use by district in Kyiv

№ п/п	Districts	Population, thousands of people	Population density, persons/ hectare	Total area, hectare	including	
					water protection zones*, hectares	%
1	Holosiiivskiyi	251, 0	16	16052	2210	13,7
2	Darnytskyi	332,23	25	12907	4750	36,8
3	Desnianskyi	368,4	25	14734	1530	10,4
4	Dniprovskiyi	354,7	53	6665	1970	29,6
5	Obolonskyi	320,3	29	10864	3730	34,3
6	Pecherskyi	152,0	56	1956	450	23,0
7	Podilskyi	191,3	56	3405	410	12,0
8	Sviatoshynskiyi	340,7	31	10255	370	3,6
9	Solomyanskyi	364,8	91	4051	360	8,8
10	Shevchenkivskiyi	231,0	86	2661	230	8,6
<i>Together</i>		<i>2906,3</i>	<i>38</i>	<i>83550</i>	<i>16010</i>	<i>19,1</i>

* is determined by the author using an expert mapping method

Source: Developed by the author with the usage of the source [13].



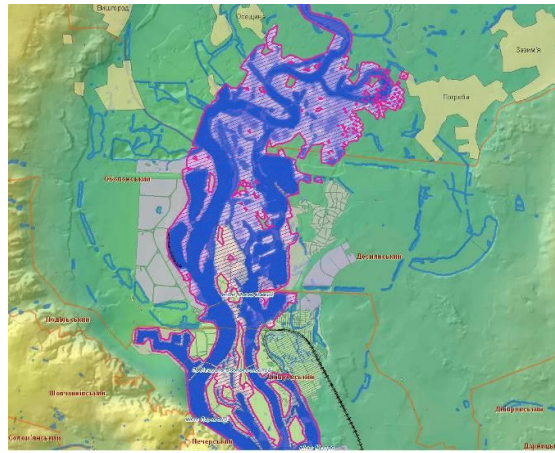


Figure 2. Fragment of the map of possible land flooding in Kyiv

Source: [14].

Thus, our calculations show that the total area of all types of established water protection zones with special conditions of land and other natural resources use within the land fund of the city does not exceed 20% of the total area. Despite the relatively small territorial expenditures of the territorial community, for the establishment of borders of water protection zones and coastal protective strips and restrictions in the use of land and other natural resources which brings in the long term a very tangible environmental and economic effect of land use optimization, manifested in the rehabilitation of water bodies as components of nature and sources of water supply.

Rehabilitation (as land improvements) of urban land use occupied by water bodies entails an overall increase in the value of urban development, is in the zone of influence of natural water bodies as pricing factors. Contribution of natural objects to the cost of land and capital construction objects in Kyiv reaches 15-20%, abroad – 30-40%. Taking into account all presented above, the structural model – optimization of land use of territorial community by means of establishment of restrictions in use of lands and other natural resources occupied by water objects (Table 3) for the purpose of optimization of land use within settlements was developed.

This model provides an algorithm that combines technological, instructional and administrative tasks of land use optimisation. It defines the optimality criteria and limitations of the use of these criteria to enable unambiguous determination of

the location of water body boundaries and, accordingly, boundaries of water protection zones and riparian protection strips and restrictions in land and other natural resources use, and proposes criteria for optimised land use in allocated zones, taking into account the interests of land users and legislation.

Table 3: Model flowchart – an optimising the land use of a territorial community by setting restrictions on the use of land and other natural resources occupied by water bodies

The challenge of optimising land use	Optimisation criteria	Limits	Optimization results
Optimisation of the area of approved natural protection strips and water protection zones	To ensure that the allocated area of approved natural protection strips and water protection zones meets the target of reducing the anthropogenic impact on water bodies	A land use regime and regulations for determining the width of approved nature protection strips and water protection zones have been established by law	Reducing human impact on land, water and other natural resources and biodiversity
Optimisation of the location of approved natural protection belts and water protection zones	Ensuring that the boundaries of approved nature protection strips and water protection zones are placed in and adjacent to the water protection zones	Legislative requirements for locating the boundaries of approved nature protection strips and water protection zones and fixing them on the area	Respect for the interests of land users, the state and the territorial community
Optimisation of the way in which the boundaries of approved nature protection strips and water protection zones	Ensure that the location of the shoreline of a water body and its derived boundaries of approved natural	Legislative requirements for the method of locating the boundaries of approved nature protection strips and	Specific location of boundaries and area of approved natural protection strips and water protection zones

are defined	protection belts and water protection zones is accurate	water protection zones	
Optimisation land use of the area of medium protection strips and water protection zones	Providing a structure for the intended and functional use of land and other natural resources in approved nature protection strips and water protection zones, while respecting the possible economic return	Legislated legal regime for land use	Establishment of an ecologically optimal land-use structure for approved nature protection strips and water protection zones

Conclusions and prospects for further research. On average, the total area of water protection zones and coastal protection strips and restrictions on the use of land and other natural resources in the land fund in Kyiv does not exceed 20% of the total area. Despite the existing general regulatory and technological regulation of land use planning for establishing the boundaries of water protection zones and coastal protective strips and restrictions on the use of lands and other natural resources, there are two key problems, without solving which it is impossible to uniquely identify the location of water protection zones and coastal protective strips and restrictions on land use and other natural resources: lack of quality mapping basis in the state land cadastre and absence of the approved form of the cadastral plan, which accumulates in relation to zones with special conditions of land and other natural resources use. We propose a structural model for land use optimisation through the establishment of restrictions in the use of land and other natural resources occupied by water bodies, including solutions to the set objectives of land use optimisation taking into account the developed optimality criteria and its restrictions (encumbrances) in order to optimise land use within settlements.

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ОСОБЛИВОСТІ ОПТИМІЗАЦІЇ ЗЕМЛЕКОРИСТУВАННЯ ВОДОХОРОННИХ ЗОН ТА ПРИБЕРЕЖНИХ ЗАХИСНИХ СМУГ В М. КИЇВ МЕТОДОМ ЗЕМЛЕВПОРЯДКУВАННЯ

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***Анотація.** В процесі роботи над статтею автором розглянуто питання встановлення та забезпечення дотримання режиму землекористування водоохоронних зон і прибережних захисних смуг (на прикладі міста Київ). В результаті дослідження виявлено, що відповідно до законодавства на землях міст і селищ міського типу розмір водоохоронної зони, як і прибережної захисної смуги, встановлюється відповідно до існуючих на час встановлення водоохоронної зони конкретних умов забудови. Попри це, на прикладі міста Києва виявлено, що така інформація може бути відсутня. Автором зображено проблемні питання землевпорядного процесу виконання робіт з встановлення меж водоохоронних зон та прибережних захисних смуг і обмежень у використанні земель та інших природних ресурсів. Експертним шляхом визначено орієнтовну можливу площу із врахуванням конкретних умов забудови та можливого затоплення при максимальному повеневому (наводковому) рівні води. Запропоновано модель оптимізації землекористування територіальної громади за*

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допомогою встановлення обмежень у використанні земель та інших природних ресурсів, зайнятих водними об'єктами. При цьому, модель поєднує у собі технологічні, інструктивні і адміністративно-управлінські завдання оптимізації землекористування. Крім того, запропоновані в моделі критерії оптимальності та обмеження використання цих критеріїв, дозволяють провести однозначне визначення місцеположення меж водних об'єктів і обмежень у використанні земель та інших природних ресурсів з урахуванням дотримання інтересів землекористувачів та законодавства.

***Ключові слова:** оптимізація землекористування, водоохоронні зони, прибережні захисні смуги, землевпорядний процес.*

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Особенности оптимизации землепользования водоохраных зон и прибрежных защитных полос в г. Киев методом землеустройства

Аннотация. В процессе работы над статьей автором рассмотрены вопросы установления и обеспечения соблюдения режима землепользования водоохраных зон и прибрежных защитных полос (на примере города Киева). Актуальность рассмотрения этого вопроса заключается в важности оптимизации землепользования, как одного из важнейших инструментов защиты водных объектов от техногенного и антропогенного воздействия и в целом улучшение водно-экологической обстановки гидрологического режима. Из чего и вытекает цель работы, а именно исследовать особенности оптимизации землепользования водоохраных зон и прибрежных защитных полос в г. Киев методом землеустройства для экологической безопасности населения города и в целом общественного благосостояния.

В результате процесса исследования теоретическую основу составили научные труды, связанные с сущностью поставленной задачи, а также законодательные и нормативно-правовые акты Украины относительно регулирования землепользования. Информационной и статистической базой

стали выписка из схемы планировочных ограничений Генерального плана г. Киев и данные Государственной службы Украины по вопросам геодезии, картографирования и кадастра, Государственной службы статистики Украины.

В результате исследования выявлено, что в соответствии с законодательством на землях городов и поселков городского типа размер водоохранной зоны, как и прибрежной защитной полосы устанавливается в соответствии с существующими на время установления водоохранной зоны конкретными условиями застройки. Несмотря на это, на примере города Киева обнаружено, что такая информация может отсутствовать. Автором изображено проблемные вопросы землеустроительного процесса выполнения работ по установлению границ водоохранных зон и прибрежных защитных полос и ограничений в использовании земель и других природных ресурсов. Экспертным путем определено ориентировочную возможную площадь с учетом конкретных условий застройки и возможного затопления при максимальном паводковом уровне воды. Предложена модель оптимизации землепользования территориальной общины посредством установления ограничений в использовании земель и других природных ресурсов, занятых водными объектами. При этом, модель сочетает в себе технологические, инструктивные и административно-управленческие задачи оптимизации землепользования. Кроме того, предложенные в модели критерии оптимальности и ограничения использования этих критериев, позволяющих провести однозначное определение местоположения границ водных объектов и ограничений в использовании земель и других природных ресурсов с учетом соблюдения интересов землепользователей и законодательства.

Ключевые слова: оптимизация землепользования, водоохранные зоны, прибрежные защитные полосы, землеустроительный процесс.