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ҚАЗАҚТЕЛЕКОМ

Guidelines for the management and conservation of Biodiversity of Kazakhtelecom JSC

Astana

Preface

1 **DEVELOPED AND INTRODUCED** by the Corporate Governance Service of Kazakhtelecom JSC on the basis of the Action Plan of Kazakhtelecom JSC on environmental protection for 2022-2023, approved by the Order of the Chairman of the Management Board of Kazakhtelecom JSC No. 98 of May 12, 2022

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1 Introduction

The production of goods and services for our global population depends on the diversity and variability of genes, species, populations, and ecosystems. Biological resources enable us to meet our needs for food and clothing as well as shelter, medicine, and spiritual food. Most of the Earth's biodiversity is found in the natural ecosystems of forests, savannahs, pastures and rangelands, deserts, tundras, rivers, lakes, and seas. Farmers' fields and gardens are also important as repositories of biodiversity; botanical gardens, zoos, and other germplasm repositories also play a modest but very important role in this matter. The current decrease in biodiversity observed is largely the result of human activity and poses a serious threat to human development.Despite increasingly intensive efforts, the loss of the planet's biodiversity, mainly through habitat destruction, overexploitation, pollution, and the harmful introduction of foreign plants and animals, continues. Biological resources are capital resources with enormous potential to provide sustainable benefits.

The conservation and protection of genetic resources, species and ecosystems is a major challenge to the sustainable management and use of biological resources.

In order to strengthen the capacity to assess, study and systematically observe and evaluate biodiversity, Kazakhtelecom JSC plans to interact with local communities, scientific institutions and authorized state bodies, and to define measurable and time-bound purposes and objectives related to biodiversity.

Kazakhtelecom JSC assesses biodiversity at the design stage of the planned activity, disclosing this information in the section "Environmental Impact Assessment" (hereinafter - EIA) to the working draft of the planned activity.

EIA is a process that contributes to making an environmentally-oriented management decision on the implementation of planned economic and other activities by identifying possible adverse impacts, assessing the environmental consequences, taking into account public opinion, developing measures to reduce and prevent the impacts. The EIA not only determines the possible negative impacts, but also develops a set of measures to minimize them.

Development of the EIA draft is a mandatory procedure for the start of economic activity of the enterprise in order to reduce or completely neutralize the negative factors manifested as a result of the operation of the enterprise. In the process of developing the EIA draft, an in-depth and comprehensive analysis of water, soil, air, and flora and fauna is conducted. In addition, the area is examined for historical and natural uniqueness. The draft undergoes a mandatory expertise in the relevant authorized state bodies.

A comprehensive biodiversity assessment will establish the percentage of impact of the Company's activities on biodiversity and prioritize areas for biodiversity mitigation and conservation in the region of operation.

2 Characteristic of the object

Kazakhstan is located in the center of the Eurasian continent and is characterized by great species, genetic, ecosystem and landscape biodiversity. Ecosystems and landscape complexes are very unique: from deserts to highlands and ecosystems of inland seas. A full range of subzonal vegetation variants of steppes, deserts and mountain belts typical of

Central Asia is represented in Kazakhstan. At the same time, more than 75% are occupied by arid and sub-humid areas. More than 40% of the species composition of all biodiversity of the country is concentrated in them. The flora of Kazakhstan includes more than 13 thousand species, including more than 5754 species of higher vascular plants, about 5000 fungi, 485 lichens, over 2000 algae, about 500 mosses. Among the plants 14% of the species are endemics. Among them there are many tertiary and quaternary relics. In Kazakhstan there are centers of endemism of flora (Karatau Mountains, Western Tien Shan), unique natural complexes - pine forests on sands (Ara- and Aman-Karagai, Naurzum); forest and steppe complexes of low mountains of Central Kazakhstan; original in floristic composition desert communities of Betpak-Dala, South Pribalkhash, Ili basin; set of forest, shrub and steppe communities of Southern Altai, Kalbinsky mountains and Tarbagatay, middle mountains of Dzungarian Alatau and Tien Shan with coniferous spruce forests and fragments of apple forests; wetland ecosystems of the lower Urals, Torgay hollow, lakes Tengiz, Alakol; floodplain forests (tugai) of Syrdarya, Ili, Charyn. The fauna of Kazakhstan is represented by 835 species of vertebrates, including mammals - 178, birds - 489 (of which 396 nesting), reptiles - 49, amphibians - 12, fish - 104 and cyclostomes - 3 species. Some species are used for commercial and economic purposes. The objects of hunting are 34 species of mammals and 59 species of birds. Genetic agro-biodiversity (hereinafter - ABD) of plants is of global importance. These are, first of all, 194 plant species of significant value both for the development of agriculture, breeding of new varieties (apple trees of Nedzvedtsky, Sivers, Kyrgyz, common apricot, pistachio, common almond, wine grapes, many floral and ornamental plants). The ABD of fauna (wild relatives of domestic animals) of Kazakhstan has a great potential, but it is not studied sufficiently and is currently practically not used in breeding work. On the territory of the republic there are species that are referred to the wild ancestors of domestic animals: mouflon, mountain sheep, wild boar, kulan, jackal, wolf, spotted cat and a number of others. Among birds, these are primarily ducks and chickens. Some wild animals are successfully bred in captivity: marals in conditions of Eastern and Central Kazakhstan, minks, sable, fox, ermine, marmot-baikal, muskrat, otter. Sturgeons in the Caspian Sea, whitefish in Northern and Eastern Kazakhstan, far-eastern herbivores (grass carp and bighead carp) mainly in the southern regions, carp (actually a mixture of wild and domestic forms of carp) are cultivated artificially. Of amphibians and reptiles are important as a genetic resource, primarily species of poisonous snakes, as well as species used in traditional oriental medicine: Semirechensk frog-toothed snake, oriental boa constrictor, etc. The peculiarity of species of herpetofauna provides an opportunity for their breeding and export as exotic.

Nevertheless, like the rest of the world, Kazakhstan faces the threat of declining biodiversity. The main document containing the totality of information about the state of rare, declining in number and endangered species of plants and animals on the territory of the republic is the Red Book of Kazakhstan. In early 1988, the "Red Book of the Kazakh SSR. Part 2. Plants." 303 rare and endangered plant species were included. Currently, approved by the Government of RK on October 31, 2006 No. 1034 "List of rare and endangered plant species" contains 387 species. Rare and endangered animal species are included in the Red Book of Kazakhstan Volume 1, Part 1 "Vertebrate Animals" (128 species and subspecies), Volume 1, Part 2 "Invertebrate Animals" (96 species). Decree of the Government of RK No. 1034 dd. 31.10.2006 approved the list of rare and endangered

species: mammals - 40, birds - 57, reptiles - 10, amphibians - 3, aquatic animals - 18, tapeworms - 2, molluscs - 6, crustaceans - 1, spiders - 2, insects - 85. The national report of the Republic of Kazakhstan on biodiversity notes the depletion of biodiversity and degradation of ecosystems on 66% of the area of the Republic. The reduction of biodiversity components is caused primarily by anthropogenic impacts. The main threats identified are: 1) desertification; 2) economic activity; 3) pollution of the natural environment; 4) natural disasters; 5) small areas of protected ecosystems, especially in the zone of deserts and steppes, with land plowing and overgrazing; 6) forest fires and illegal logging in the state forest fund.

To these reasons it is necessary to add the violation of the hydrological regime of rivers and lakes due to flow regulation, destruction of vulnerable ecosystems by spontaneous organization of tourism, uncontrolled collection of medicinal, food and ornamental plants; impact of introduced species (biological pollution), excessive withdrawal of biological resources, poaching. It is especially necessary to note for Kazakhstan, as an agrarian country, practically monoculture farming. Over 80% of all cultivated areas are occupied by several types of plants: wheat, sugar beet, sunflower, potatoes. These monocultures are grown on vast areas. This is economically profitable, but has a negative impact on biodiversity.

3 Area of application

This Guideline establishes requirements for the assessment and monitoring of biodiversity in the process of installation and operation of telecommunication equipment and highways, other activities and in the post-cultivation period.

The requirements of these Guidelines apply to Kazakhtelecom JSC (hereinafter - the Company).

4 Regulatory References

The following referenced regulatory documents are required for the application of this Guideline (these standardization recommendations). For undated references apply the latest edition of the reference regulatory document (including all its changes).

GOST 7.32-2017 System of standards on information, library and publishing. Report on research work. Structure and design rules.

ISO 14001:2015 Environmental Management Systems - Requirements and Application Guidelines.

Note - When using this standard it is advisable to check the validity of reference standards and classifiers according to the annually published information catalog "Documents on Standardization" as of the current year and the corresponding periodically published information catalog published in the current year. If the reference document is replaced (changed), the use of this standard shall be guided by the replaced (changed) document. If a reference document is repealed without replacement, the regulation in which reference is made to it shall apply insofar as it does not affect that reference.

5 Terms, definitions and abbreviations

5.1 The following terms and definitions are used in this guideline:

5.1.1 **Aboriginal species:** A naturally occurring species; a member of a natural ecosystem that originated in the area or immigrated to the area prior to the

Neolithic (synonyms: "local", "native").

5.1.2 **Amphibiotic insects:** Insects whose larvae live in water, while adult insects (imago) have wings and live on land, flying near water bodies (dragonflies, stoneflies, mayflies).

5.1.3 **Biocenosis:** A set of living organisms characteristic of a particular territory.

5.1.4 **Bioindication:** A method that allows you to judge the state of the environment by the occurrence, absence, patterns of development and condition of bio-indicator organisms.

5.1.5 **Biomonitoring of natural objects:** A system of repeated, purposeful observation, assessment and forecasting of the ecological state of natural objects using bioindication methods. In the process of biomonitoring, data on the condition of natural objects are collected, their condition is analyzed, and the causes and sources of changes in the ecological state are clarified.

5.1.6 **Biodiversity (biological diversity):** The totality of all plant and animal species inhabiting a particular area.

5.1.7 **Dominants, or dominant plant species:** Plant species predominant in plant communities (phytocenoses).

5.1.8 **Natural habitat:** An area inhabited by viable complexes of plants and animal species of exclusively or predominantly local origin, where human activities have not significantly changed the basic ecological functions and species composition.

5.1.9 **Key species:** A species for which priority shall be given to study, management, and conservation.

5.1.10 **Critical habitat:** A geographic area containing physical or biological features important to the conservation of listed species, or an area that may require special management or protection measures.

5.1.11 **Monitoring of the natural environment:** An integrated system of observations of the state of the biosphere and its individual components. The main purpose of monitoring is to assess and predict the state of the natural environment and its changes as a result of anthropogenic impacts, prevention of critical situations, harmful or hazardous to the health of people, living organisms and their communities.

5.1.12 **Psammophytes:** Plants adapted to life on the sands.

5.1.13 **Plant Association:** The basic classification unit of plant communities, is a plant community of a certain floristic composition with uniform habitat conditions and uniform physiognomy.

5.1.14 **Habitat:** A terrestrial or aquatic geographic environment or air corridor that supports the living conditions of communities of living organisms and their interactions with the non-living environment. For the purposes of this activity standard, habitats are identified and distinguished as transformed, natural, and critical.

5.1.15 **Fauna:** List of animal species inhabiting the area.

5.1.16 **Phytocenosis (plant community):** A conditionally spatially homogeneous set of plant populations organized by the influence of ecotope, mutual relations of plants and heterotrophs.

5.1.17 **Flora:** a list of plant species in a particular area.
5.1.18 **Background view:** the most characteristic species for this habitat type.
5.1.19 **An Alien Species:** species outside its historical range and appeared in the region in question at a historical time.
5.1.20 **Ecosystem:** a set of organisms and environmental conditions connected by flows of matter and energy.
5.1.21 **Endemic:** a plant or animal species is endemic to the area if it does not occur elsewhere.

5.2 The following abbreviations are used in this standard:
5.2.1 **IUCN:** International Union for Conservation of Nature.
5.2.2 **S:** Total number of species in the community (species richness).
5.2.3 **cop.: Copies.**
5.2.4 ***n*:** number of specimens examined.
5.2.5 ***L:*** total length of the fish, mm.
5.2.6 ***l:*** standard length, or length of the fish body, mm.
5.2.7 ***Q:*** total weight of fish, g.
5.2.8 ***q:*** weight of fish without entrails, g.
5.2.9 ***F:*** Fullton coefficient of fatness.
5.2.10 ***C*:** Clarke coefficient of fatness.
5.2.11 **min:** minimum value of the indicator.
5.2.12 **max:** maximum value of parameter.
5.2.13 **M:** average value of the indicator.
5.2.14 **±m:** average error.
5.2.15 **±s:** standard deviation.
5.2.16 ***CV:*** coefficient of variation.
5.2.17 **IDS:** index of disadvantaged state.

6 General regulations

6.1 According to the Environmental Code [1], biodiversity refers to the objects of environmental monitoring. Biomonitoring is based on observations and measurements made by a specialized organization. These Guidelines establish the content and procedure of observations, measurements, collection, accumulation, storage, accounting, systematization, summarization, processing and analysis of the data obtained with regard to the diversity of plants and animals during anthropogenic activities of the Company, as well as during the assessment of consequences of emergency situations at potentially hazardous facilities of Kazakhtelecom JSC. These Guidelines were developed taking into account the requirements and regulations of the Republican and international regulatory and legal documents: the Environmental Code [1], the Law on Conservation, Reproduction and Use of Wildlife [2], ISO 14001.

6.2 The purpose of biomonitoring is to assess the impacts of production processes and other activities of Society on the diversity and condition of the animal and plant world, to take measures to eliminate or minimize the negative impact (if any) on biodiversity.

6.3 Objects in the assessment of biodiversity are plants and animals at sites or

facilities of telecommunication equipment, their condition and peculiarities of existence within the framework of specific environmental conditions.

6.4 The main objectives of biodiversity assessment are:

- observation of changes in plant and animal diversity before and after the installation of telecommunication equipment.
- observation of the state of dominant and background species before and after the installation of telecommunication equipment.

6.5 Assessment of the state of biodiversity is based on the results of comparing their taxonomic composition and biological indicators of the dominant groups in the initial state, before and after the installation of telecommunication equipment.

6.6 Methodologically the research is based on traditional methods for botany and zoological science and modern approaches to the study of biodiversity and analysis of the current state of plant and animal communities. General group indicators of biodiversity of plants and animals are studied. For indicator groups and species of plants and animals biological characteristics are monitored. If necessary, special research methods can be used on morphophysiological, tissue, cellular, biochemical and genetic levels.

6.7 Coordinates of places and points of inspection, sampling of environmental objects and detection of species of plants and animals included in the relevant Red Books of the Republic of Kazakhstan [3], [4] are determined using a GPS-navigator.

6.8 The description of the sites and survey sites of the project area (relief, watercourses and reservoirs, clutter, fallen, spills of productive solutions, the degree of disturbance and degradation of the soil and vegetation cover) is fulfilled.

6.9 Thematic maps are formed on the basis of stock materials, own data, using satellite images and applications.

6.10 The survey locations and the main moments of the research are documented with photographic materials.

6.11 The report document on the performed researches shall contain systematized data on the work: reflect the state of the scientific and technical problem, the materials and methods used, the results of the research and their statistical analysis, conclusion and conclusions.

6.12 The assessment of biodiversity is conducted within the framework of an initiative assessment of the impact and management of biodiversity by Company.

7 Requirements for the organization of monitoring of terrestrial and aquatic ecosystems

7.1 The collection of factual data on Critical habitats, diversity and vegetation status before and after the installation of telecommunication equipment is performed uniformly for each group of organisms: plants, terrestrial animals, aquatic animals.

7.2 The procedure for conducting vegetation diversity surveys:

- conduct a route survey of plant communities to identify characteristic sites and species included in the Red Books of the Republic of Kazakhstan at characteristic sites and

places of soil and water sampling and at places of detection of signs of anomalies in plant development, depression of vegetation cover under anthropogenic impact test sites are laid for continuous monitoring;

- geodetic coordinates are determined (gps-control), dates of sampling are recorded, photo-documentation of performed works is made.

The description of plant communities in the surveyed areas during fieldwork includes:

- characteristics of relief, soil, moisture, peculiarities of anthropogenic transformation (area, duration of impact);
- general assessment of the state of the vegetation cover of the territory with the establishment of the presence of abnormal phenotypic signs of annual plants and phenotypic abnormalities of vegetative organs of perennial plants;
- geobotanical description of each sample area with indication of peculiarities of each vegetation tier is made. The following indicators are taken into account: species composition of vascular plants, projective coverage by tiers, degree of plant oppression, vegetation changes;
- herbarium collection is conducted in accordance with Annex A;
- in the logbook of collected plant specimens are indicated: serial number, specimen code, date of collection, species, its parts, presence of physiological disorders of plants, geodetic coordinates, total projective coverage of vegetation in the collection place;
- make itinerary and complete geobotanical descriptions.

7.3 The procedure for conducting studies of the diversity of insects and aquatic animals is conducted in accordance with Annexes B and C, respectively.

7.4 The order of conducting researches on diversity of amphibians and reptiles:

- the study of these vertebrate groups begins with an inventory of species composition based on published scientific data;
- conduct local zoological survey in the places of soil, water and vegetation sampling and route survey. They describe ecological conditions (peculiarities of relief, soil, vegetation, nature of residence and anthropogenic transformation);
- when conducting studies, we use an indicator of relative abundance (e.g., the number of animals per hour of observation, etc.). Particular attention shall be paid to mass and rare species, as the former play the most important role in biogeocenoses and are easier to judge changes occurring in natural complexes, while the latter need constant monitoring due to their status;
- The following methods are used: fixation; en-route census; census along roads; census at test sites; census using trapping trenches; study of daily activity of amphibians; study of diet of amphibians and reptiles (for mass species);
- phenological observations; study of impact of grazing and recreation on herpetofauna; records of vertebrate mortality on roads (Annex D);
- to identify and measure amphibians and reptiles, capture them. Snakes are caught only by herpetologists;
- captured amphibians and reptiles shall not be held in their hands for a long time - this leads to skin damage and heat shock. Captured animals shall be placed in cloth bags. Amphibian bags shall be kept slightly moist at all times and both amphibians and reptiles in bags shall be protected from overheating by not allowing them to be exposed to direct sunlight;

– caught amphibians and reptiles, pressed lightly against a flat surface, measure with a ruler, tape measure, or caliper. measure the length of the body
(L) - from the tip of the muzzle to the cloaca opening and tail length (C) - from the cloaca opening to the tip of the tail;
– the body length of captured frogs is measured from the dorsal side by placing the index and middle fingers under the abdomen at the front and back legs respectively, and with the thumb pressing lightly on the rump so that the animal straightens up. Measurement of turtles is performed from above along the midline of the upper shield (carapace) from the anterior edge of the cervical (anterior) shield to the posterior edge of the tail guard.

7.5 Procedures for bird and mammal diversity surveys:

– to account for the diversity of birds and mammals, relative counts are used, when the results are recalculated either per kilometer of route or per hour of travel, and absolute counts, when the calculation is per unit area. Only absolute counts are used to estimate damage;
– absolute methods include route and area censuses. Route counts are less time-consuming than area counts, are less dependent on the randomness of site selection, and are therefore more suitable for work over large areas. The survey techniques are described in Annexes E and F;
– birds encountered flying shall be counted with correction for speed of movement;
– when bird nests are found, their photograph or detailed description is made: geographical coordinates, location (on the ground, deep in the bush, on a tree - on the main branches, in the fork of branches, at the ends of branches), size and shape, material (branches, ground, branches and down, etc.), presence of birds in the nest or near it. It is forbidden to approach detected nests closer than 3 m between March and August;
– if the counting is conducted from the shore in non-vegetated aquatic habitats of large size (not fully visible), then all birds encountered are recorded with a record of the range of their detection.

The calculation per 1 km^2 is based on the band width calculated for each species separately and the length of the traversed path. The width of the survey strip is determined by the maximum sustainable range of detection of the species. If it is necessary to survey a water body or a river section in full view, then all birds encountered in this habitat are counted without taking into account the range of detection. For the calculation per km^2, the number of individuals of each species encountered is divided by the area of the surveyed water body (or river section).

7.6 The following rules shall be observed during observations in the natural environment:

– the composition of the research team includes at least 3 people (in case of unforeseen circumstances, one person assists the other, the third is in charge of organizing the rescue as a whole). The most experienced among them is designated as the team leader;
– during the survey, the employee shall carefully listen to the instructions of the supervisor and strictly follow them;
– during the survey movement is made on a predetermined route. Unauthorized deviation from the route, lagging behind the main group or arbitrary stopping of the group without a valid reason is not allowed;

- it is not allowed to touch unknown animals, insects, examine nests of birds, burrows of mammals and reptiles, catch or scare away animals and insects, trample and destroy plants;
- during the survey it is forbidden to use unfamiliar plants and their parts as food (fruits, leaves, flowers) and other objects;
- during the survey it is forbidden to eat food, but in a hot period it is necessary to have a supply of drinking water and to quench thirst in a timely manner;
- after returning from an examination, be sure to wash your hands; shake your outer clothing before entering the living quarters. Examine each other, and if there are ticks or insects, remove them;
- it is not recommended to bathe in the water immediately in hot weather; you shall remember to rinse your hands and feet with cool water before bathing;
- sections of water bodies deeper than 1.2 m require the use of certified watercrafts and shall be performed only by specialists of hydrobiologists and ichthyologists; at water temperatures below 14 ° C also unprepared employees are not allowed to be in the water;
- when conducting observations and collections in water bodies, no more than 2 people can be in the water at the same time and at least one employee shall be on the shore in close proximity to the collectors;
- it is not allowed to be in the water without shoes that have thick enough soles so that they could not be cut by glass splinters, shells of mollusks, thorns and knots of trees;
- avoid contact with hazardous plants and animals.

7.7 The sites for the collection of data on the condition of aquatic ecosystems shall cover the diversity of biotopes (drains, backwaters, shallow waters, etc. for rivers, the shallow zone of lakes, ponds and channels) to the fullest extent possible. Data shall be collected in accordance with Annex G.

7.8 To select the location and number of sites and routes used for habitat survey monitoring in the study area, a route reconnaissance method is used. The survey route is selected in such a way as to cover all landscape elements (vegetation types, biotopes). In each landscape element (biotope) there shall be not less than 3 sites for monitoring. This is necessary for the fullest possible identification of diversity and statistical processing of the data obtained. Monitoring plots shall be located at a sufficient distance from each other and from the biotope boundary in order to obtain the most reliable primary data (Annex K). Next, a "test area" in the form of a square or rectangle is established and described on the territory of critically important vegetation, which is allocated in the phytocenosis so as to cover its most characteristic area, trying to avoid "distortions" present on the borders of plant communities, at animal dens, on fireplaces, and in anthropogenic territories. The size of the sample area is determined by its floristic composition. For herbaceous cover - 5x5 m, for bushes - 10x10 m, for trees - 20x20 m. The corners are marked with stakes or other clearly visible fixed marks. The plant community is described in detail on the sample site. The most important features of the community are taken into account, and a description of the habitat (topography, soil, etc.) is added.

7.9 To account for biodiversity after the installation of telecommunication equipment, plant surveys are conducted at least two or three times each season: in

spring, summer and fall. When describing the community, it is necessary to note the phenological phase of each plant species. In aquatic ecosystems, samples are taken in spring, summer and autumn. Terrestrial invertebrates are collected in late spring and early summer. Reptile and bird diversity surveys are conducted on the same time frame, from mid-phenological spring through early fall. The only limitations to reptile counts can be low temperatures or very high and dense grass, which drastically reduce the counts. In this case, reptile counts begin at a later time, when daily temperatures increase, and end after the grass has risen, if there are more frequent omissions or if undetermined reptiles leave the surveyor. In each of the designated habitats in the key area at least 5 km are cumulatively walked in each half-month period. In winter, birds are counted during February on the same routes as during the warm season. In each habitat, it is advisable to walk at least 10 km in aggregate. The counts are conducted on permanent, but not strictly fixed routes. Small mammals and amphibians are counted from mid-phenological summer to early autumn.

7.10 The expediency of repeated surveys is determined by the degree of transformation of the territory, assessed by experts and by the results of periodic spatial and temporal monitoring.

7.11 On the territory of telecommunication equipment, periodic spatial and temporal monitoring is conducted on several reference sites corresponding to typical Ecosystems.

7.12 Diseases, abnormalities and unusual phenomena in the life of animals shall be recorded and drawn up in any form. All natural factors and phenomena influencing the condition of animals in general or separate species shall be reflected. The consequences of their impact shall be described.

7.13 It is necessary to note the species of plants and animals found in the surveyed territory:

- included in the relevant Red Books of the Republic of Kazakhstan [3], [4];
- rare and endangered, Endemic species assessed as endangered by any of the IUCN categories [5];
- new alien species.

For each of them, the species name, areas and conditions of detection, numbers, and, if possible, age and sex composition are indicated. For alien species, the region of origin, source of introduction (if known) and potential economic importance are also indicated.

7.14 To assess the state of the dominant animal populations, laboratory studies are conducted in specially equipped facilities:

- in each sample taken at a particular site, the systematic belonging of organisms is determined and the number of each species is counted to identify dominant and rare species;
- in case of difficulties with the determination, one shall ask for help from narrow specialists in this group of organisms;
- for plants, diagrams are made and analyzed according to the following indicators: total projective coverage, average plant height, species diversity, density of semishrubs, density of perennial grasses. Determine the degree of anthropogenic transformation in relation to all the factors of anthropogenic impact that take place at the present time, the

abnormal development of plants.

7.15 The insects collected during field observations are processed, then collections are made of them to identify insects in controversial cases, to conduct long-term monitoring, to confirm the validity of the studies conducted.

7.16 Several methods based on the diversity and number of aquatic invertebrates are used to determine the condition of aquatic ecosystems by benthic invertebrates: by the ERT complex, the Mayer method and the Woodviss method (Annex L). Biological and morphopathological analyses of 15 to 25 specimens of each species are conducted to assess the population status of dominant fish species according to Annex M.

8 Requirements for the interpretation and design of the results of monitoring the biodiversity of terrestrial and aquatic ecosystems

8.1 In order to analyze the possible impact of the Company's activities on biodiversity sites and their condition, baseline (background) data on the diversity and condition of plant and animal species in locations where telecommunications equipment is located shall be available.

8.2 Data on the baseline biodiversity shall be contained in the design and estimate documentation of telecommunication facilities. In case of absence of necessary data during the period of site preparation for operation, the background (natural) level of diversity is established on the basis of analysis of literature sources for the given or similar territory in the same biogeographic region.

8.3 Background data on biodiversity shall include the following indicators:

- plant species composition;
- species composition of animals;
- data on mass and background species;
- biological indicators of mass or background species;
- a list of species included in the Red Books [3], [4] or the IUCN list [5] by one of the threatened categories;
- existing anthropogenic impacts and their impact on biodiversity.

8.4 Background data on the biodiversity of sites prior to the operation of telecommunication facilities shall be used when comparing observations during biomonitoring.

8.5 Lists of all species known from literary sources are compiled for the surveyed area in comparison with those identified in the course of the surveys. Species names are given in Latin, state and Russian languages (Annex N). Separate lists are given for each group of organisms: plants, terrestrial invertebrates, terrestrial vertebrates, aquatic invertebrates, and fish. Further, quantitative indicators of diversity are given (Annex P).

8.6 When interpreting the actual results of biomonitoring, changes in biodiversity over time shall be recorded in comparison with baseline baseline indicators.

8.7 The results of the laboratory tests are presented after statistical processing of the primary data. The required statistical indicators are the minimum (min), maximum (max), mean (M) values of the indicator, error of the mean (±m), standard deviation (±s). If necessary, the value of the coefficient of variation (CV) is also given.

8.8 GIS technologies are used to process the results of field and laboratory studies.

8.9 The determination of the degree of anthropogenic disturbance is conducted in accordance with the Methodological Guidelines [6] (Annexes R, S).

9 Contents of the Terrestrial and Aquatic Biodiversity Monitoring Report

9.1 Terrestrial and aquatic ecosystems biodiversity monitoring report is a scientific and technical document that contains systematized factual data, describes the observed states of the target ecosystems and/or changes occurring in them.

9.2 The Plant and Animal Biodiversity Assessment Report shall be prepared at least once a year by the authorized unit(s) of the Company in accordance with ISO 14001 on the basis of the actual data (Annex T) with completion of tabular forms (Annex N). The report shall contain:

– a concise description of the observations made throughout the territory (start of observations, methods, number and dates of observations and counts for each group of organisms, number of samples taken for each group of organisms);
– background indicators of biodiversity;
– results of actual observations and surveys;
– results of comparative analysis (changes) of species composition for each group of organisms;
– analysis of possible influence of weather conditions of the reporting year on diversity and condition of plants and animals;
– in the case of detection of plant and animal species included in the Red Books, it is necessary to cite all the information obtained on them;
– assessment of the impact of external factors and production processes of the Company on biodiversity;
– general conclusions about the state of diversity of plants and animals and their habitats;
– recommendations for preservation of the natural diversity of plants and animals in connection with the impacts of the Company's activities.

9.3 The report on the conducted biodiversity assessment can be presented in the form of an independent document.

9.4 The format of the biodiversity assessment report shall comply with GOST 7.32.

9.5 The main part of the report shall contain:

– description of the general research methodology(s), a brief physical and geographical description of the research area, planned (established) types of impact on ecosystems;
– generalization and assessment of research results, including assessment of the reliability of the results obtained, justification of the need for additional research, proposals and justification of measures to improve the condition of disturbed ecosystems;
– establishment of the number of critical habitats and determination of their total area;
- establishing the number of habitats that have disappeared;
- establishing the number of restored habitats;
- determining the total number of red-listed species in the impact area of plants, mammals, birds, reptiles, amphibians, fish, and insects.

9.6 The report's conclusion contains:

- conclusions based on the results of the studies (a description of the degree of impact of the Company's activities on biodiversity based on the results of monitoring);
- assessment of the completeness of solutions to the tasks set;

- recommendations on management and conservation of biodiversity based on the results of monitoring and before the start of the Company's economic activity.

9.7 The appendices include record cards and protocols of meetings of rare, endemic and new alien species of plants and animals containing the following information:

- place, date of encounter;
- last name, first name, patronymic and position of the researcher (employee) who discovered the species;
- description of habitat conditions at the place of detection;
- characteristic features and/or photograph of the species.

9.8 Generalized maps of vegetation transformation, encounters and numbers of animals and plants, geobotanical map of vegetation cover are included in the annexes once a year.

9.9 Illustrations and tables of auxiliary character can also be included in the annexes.

9.10 Based on the data obtained and the results of their analysis, the number of critical habitats and their total area, the number of disappeared and restored habitats, the total diversity of rare and endangered species of plants and animals are established.

9.11 The habitat of a particular species or community can disappear temporarily or permanently. For plant and animal species, habitat is considered extinct if the species previously known to the area is not found here for more than 2 generations. For ecosystems, habitat is considered extinct if Aboriginal species make up less than half of the diversity and/or the number of Aboriginal species has declined by a factor of 10 or more.

9.12 Habitat is considered partially disturbed if no animals or plants of a certain age are found on it:

– habitat is considered unfavorable for breeding if young individuals of the relevant species are not observed in the area;
– habitat is considered unfavorable for development if no individuals of older age groups are found in the area.

9.13 Habitat is considered restored if not less than 90% of the species diversity of plants and animals, including all Key species, in the number (population density) at the level prior to the anthropogenic impact are identified in this area within 3 years.

9.14 The diversity of rare and endangered species of plants and animals is established by comparing the species identified in the area of impact of the Company with the lists of the Red Books of the Republic of Kazakhstan [3], [4] and the IUCN Red List [5].

10 List of mandatory annexes to the terrestrial and aquatic ecosystems biodiversity monitoring report

10.1 Mandatory annexes to the report on monitoring biodiversity of terrestrial and aquatic ecosystems are qualitative and quantitative indicators of diversity (Annex N), the passport of the phenological site (Annex U), the ecological passport of the

water body (Annex V), information on plant and animal species included in the relevant Red Books of the Republic of Kazakhstan [3], [4] and IUCN Red List [5] for any of the threatened categories.

10.2 Information about plant and animal species included in the relevant Red Books of the Republic of Kazakhstan is filled in in any form and shall contain all information received by the observer about the place of discovery, date, condition and abundance of the species.

Annex A
(informational)

Plant collection and research methods

Whole plants, the most characteristic of the species, with flowers and fruits, with roots if possible, are selected for the herbarium. The fruits are collected in a separate bag, which is glued to the herbarium leaf [7]. It is also necessary to collect in the herbarium abnormal (according to morphological features) specimens of plants and describe the deviations in their development.

Identification of plants goes simultaneously with the drying of the herbarium. The dried particular plant is provided with a blank label transcribed from the rough one. The label indicates: 1) latin and russian name of the family to which the species belongs; 2) latin and russian name of the species; 3) location; 4) habitat;

5) date of collection; 6) name of the collector and the person who determined the species.

Example of a blank label for herbarium plants:

Asteraceae family
Helichrysum arenarium (L.) Moench.
Almaty region, Iliysk district, right bank of Ile river, sandy desert, hilly sands

25.VI. 2022

Collected by: Barayev K.
Determined by: Isaev A.M.

Annex B
(informational)

Methods of collecting and studying invertebrates [8], [9], [10].

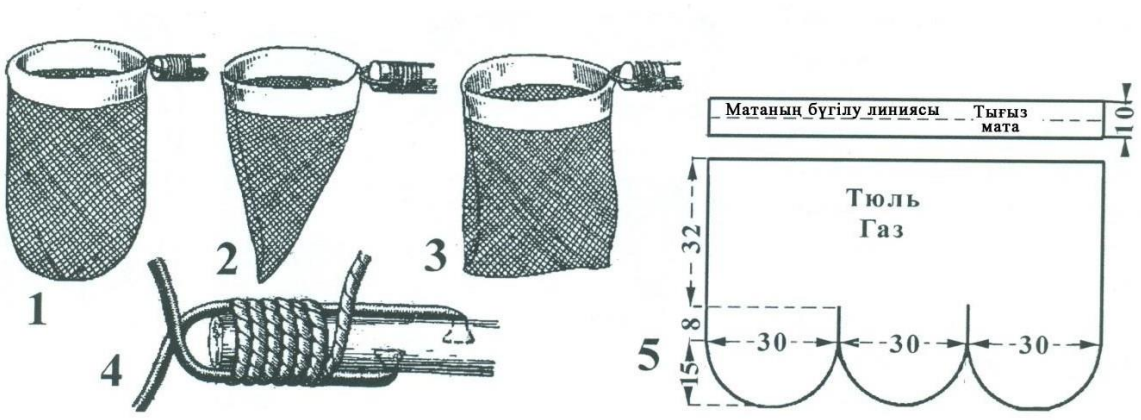
Insects are caught in warm, windless time.

Small moving insects are collected with tweezers. Entomological net is used to collect fast-moving insects (Figure B.1). For flying insects, night light trapping with a screen is also used (Figure B.2). Night trapping can be conducted in warm, dark, windless, cloudless weather.

For immobilization and subsequent dry storage the insects are collected in a stain with a special poison. A glass jar of up to 200 ml with a tightly closing lid is used for the stain (Figure B.3). To avoid injury to each other by animals, and to allow the moisture excreted by invertebrates to be absorbed, the stain containers are filled (depending on the volume of the stain) with rolled-up folds of paper. Then absorbent cotton with poison is placed in the container or a few drops of poison are dripped. The poison used is ether, chloroform, benzene, ethyl acetate, gasoline, or an insecticide spray. The stain cap shall not be left open for long periods of time to avoid evaporation of the poison.

Records of the collected material are made in the field diary and the samples themselves (containers, collection mattresses).

Labels on the samples are filled in with a simple pencil or special indelible markers. The label indicates the geographic location of the area and the date of collection of material, as well as the name of the collector.



1 - correct shape of the bag of the net; 2-3 - examples of bags of irregular shape; 4 - one of the ways of fixing the rim of the net to the handle; 5 - the pattern of the bag of the entomological net

Figure B.1 - Entomological net

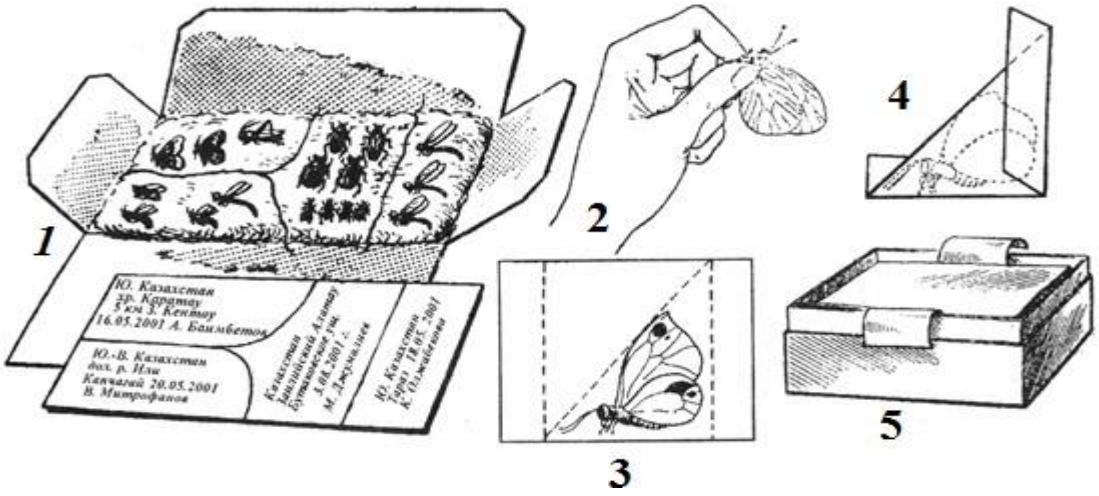
Figure B.2 - Night trapping of insects using a lamp and a white screen

Fixation (storage) of field material
The special liquid used is 70% ethyl alcohol or 4% formalin.

A B

A - Various types of stains;
B - Equipment belt
Figure B.3 - Equipment stain and belt

They are then stored dry in mattresses with cotton bedding (Figure B.4).



1 - mattress with insects and sheet with labels; 2 - way of mortification of daytime butterflies;
3,4 - making a bag for storing butterflies; 5 - box with mattresses

Figure B.4 - A cotton mattress with insects and methods of killing butterflies

Types of fixing fluids

Formalin is one of the most common fixatives. It is 40% formic acid formaldehyde, methyl alcohol and acetone mixture. For fixation of animals a 10-, 15-, 20% formalin solution is used, which corresponds to 4-, 6-, 8% formaldehyde solution. For fixation of freshwater animals formalin is mixed with tap water, and terrestrial invertebrates, vertebrates, parasites with physiological solution (for example, **Barbagallo liquid** is a solution of 3% formalin in physiological solution). Purified (distilled) water shall not be used to prepare the fixative, because animal tissues may be destroyed by the hypotonic solution.

Fixing the material goes for 24-48 hours, after which they can be stored for a long time. And for further work, they shall be kept in running water for 1-2 days.

The advantages of formalin fixation are as follows: 1- quick and uniform absorption of formalin by tissues; 2 - strong fixative and possibility of re-freezing the material; 3 - great possibilities of use in field conditions. Disadvantages - dye color deteriorates when staining tissues.

Ethyl alcohol (ethanol) is a well preservative liquid. 96% and absolute (100%) ethanol are used as a fixative. For fixation of small arthropods, helminths 70% ethanol is used. Advantages of ethanol over formalin: 1 - animal tissues retain their elasticity; 2 - smell of ethanol is not harmful to humans; 3 - ethanol freezes at very low temperatures; 4 - samples do not lose color when stored in a dark place, etc. In addition, alcohol is a good preservative for fixed objects, and in the future, no changes in the tissues do not affect the process of staining.

As a rule, fixation is performed at room temperature. Increasing the temperature, on the one hand, accelerates the fixation process, and on the other hand, destroys the tissue structure. In this regard, the temperature regime is chosen by experiment. The table can be used to prepare the necessary alcohol concentration.

Table B.1 - Methods of alcohol dilution to the required concentration

To obtain 100 ml (n %) of alcohol	Alcohol to water ratio, ml			
	96%	90%	80%	70%
40%	42:58	44:56	50:50	57:43
45%	47:53	50:50	56:44	64:36
50%	52:48	56:44	63:37	71:29
60%	63:37	67:33	75:25	86:14
70%	73:27	78:22	88:12	-
80%	83:17	89:11	-	-
90%	94:6	-	-	-

If the collected material is not processed immediately after fixation, it is best stored in 70% ethanol.

General rules shall be followed when preparing to use fixatives:

1 - clean glassware is used for fixation;

2 - do not wash the fixative material before placing it in the solution. Blood samples taken from mucous membranes and other contaminated sources shall be placed in warm physiological solution;

3 - the volume of the fixation solution shall be 20-40 times the volume of the material to be fixed;

4 - if after loading the material, the color of the fixing solution changes or becomes turbid, it shall be replaced immediately;

5 - fixing solution shall not be used repeatedly;

6 - when working with poisonous luting solutions, such as formalin, do not inhale the fumes of luting agent and make sure that luting agents do not get on your skin or into your food.

Annex C
(informational)

Procedure for conducting research on the diversity of aquatic animals

Sampling of aquatic invertebrates is performed with a bucket, scraper or dredge in accordance with the guidelines for hydrobiological sampling [4], [11]. Animals are placed in a jar with a label on which the sampling location and date are recorded, and fixed with 4% formalin. Additional data - ground temperature, depth, and bottom sediment type, date and time of sampling - are recorded in the field log.

To catch fish according to the size of the reservoir, a rectangular fishing net of 700 x 500 mm with a mesh size of 3 mm, a fry dragger, a fish net and a hook tackle are used.

In the case of catching fish listed in the Red Book of the Republic of Kazakhstan [3] or assessed as rare (endangered) according to any of the IUCN criteria [5], they are photographed and immediately released back into the pond. The total time of fish staying in the air shall not exceed 1.5 minutes. When photographing fish, a ruler shall be placed on the picture, or if there is no ruler, an object of known size shall be placed on the picture. The fish shall be positioned so that all parts of its body (fins, antennae, scales, etc.) are visible.

Fish destined for laboratory tests are placed immediately after capture in a container with a 4% formalin solution and labeled with the place, date, fishing gear and the area where the fish were caught. Further processing is performed in the laboratory.

Annex D
(informational)

The card of registration of animal deaths on the roads

Date of observation_____

Place of observation_____
(administrative district, the nearest settlement, distance from it in kilometers and direction)

Route length (km)_____

Biotopes crossed by the road_____

Notes_____

Researcher's name_____

Annex E
(informational)

E.1 Techniques of bird counting

Counts are conducted during the period of greatest activity of the vast majority of bird species, i.e., from the second half of April to the middle of August from dawn to 8-10 a.m. and to 10-12 a.m. from mid-August to mid-October. At other times it is possible to count during all daylight hours, although it is preferable to count in the first half of the day. It shall be understood that these are only general recommendations and it is necessary to closely monitor the level of activity of birds during the counting. In the mountains in spring and in the first half of summer birds are often active until the middle of the day, especially in cool weather. Taking into account the exposure (following the "shadow"), it is possible to effectively conduct accounting up to 13-14 hours. At the same time, a sudden onset of heat, can immediately reduce activity to almost zero, especially in mid-summer and in the second half of it.

The enumerator shall wear overall (not bright) and have a field diary (notebook), a pencil and eraser, and 7-8x binoculars. Before the start of counting, the date, habitat name, time of counting, weather conditions (cloud cover in percentage of cloud cover on a 10-point scale), temperature in o C, wind strength (i.e. strong, weak, absent) and presence/absence of precipitation are recorded. During the count, the distance covered is recorded, then the time the count ends and, if necessary, the time for which the count was interrupted (in minutes). If the route is not fixed and its length is not measured in advance, it is most reliable to measure it in steps. It is necessary to measure the average step length in advance. To do this, the number of steps on a measured 1000 meter segment is counted and the average step length is calculated. In the diary, in order to avoid confusion when counting the distance covered, every 25 pairs of steps are recorded, counted directly during the recording. Pairs of steps are counted by the number of steps taken with one foot [12].

At the starting point of the route, it is better to make a preliminary record of all birds detected from the spot. When walking the route it is necessary to stop every 50-100 meters, look back and listen. It shall be remembered that at the beginning and at the end of the counting birds that are respectively behind or ahead of the enumerator are not included in the counting, even if they are in the same habitat.

The form of the record of birds encountered shall be concise and, at the same time, contain a maximum of information. The following form of recording and symbols is appropriate: ♂ - male; ♀ - female: j - young, if sex and age are not specified, then just a number denoting the number of birds encountered (1, 2, 3 ...); s - sat ; f - flew; f - flew. Undefined species are memorized, and their appearance is described in detail. It is better to make entries on one side of the sheet, leaving the other side blank, since experience has shown that when stored, each side is imprinted on the opposite side and makes it very difficult to process the data [13].

During movement along the route, the spotter records all birds encountered by ear and visually, recording their number, sex, age (if possible), the type of movement (sitting, flying, overflying), the distance from the spotter to the bird in the projection on the recorded surface in the numerator and to the line of sight on the perpendicular in the

denominator (if the bird is on the line of sight, the second distance is 0, if it is located behind the spotter at any angle to the route a dash is put instead of the second distance).

The number of birds in the flock shall not be determined by leaving the route (this is done by ear or visually from the line of sight). In general, it is possible to leave the route only to clarify the species of birds and if the distance and time required for this purpose are great, the counting is interrupted.

E.2 Collection rate

From mid-April to mid-October in each terrestrial habitat, the total count is 5 km for each half-month of observation. At the same time, the minimum length of a section selected as a separate habitat shall not be less than several hundred meters. On water bodies and watercourses it is necessary to survey at least 10 km of the shoreline during the same period of time. That is, if a river has a good view of both banks, that is 5 km of travel, if one, 10 km of travel. Small or medium-sized water bodies are bypassed completely along the perimeter during each survey.

Water habitats (with the exception of ice-free ones) are not surveyed in winter. In terrestrial habitats from mid-October to mid-April, 10 km of counts in each habitat during February are considered sufficient.

Birds not encountered during the main route counts are recorded during partial counts during approaches, departures from the main route, and during movements through the study area for other purposes. When a partial census is taken, the entire distance and all the time spent in the same or similar observation unit during which the bird could have been sighted, but was not encountered, is added up. Therefore, it is necessary to record the length of the route for all passages through the habitats without counting [14].

Desktop data processing

For the convenience of storage and further processing, it is better to transfer the results of records from the diary to blank bibliographic cards, filling them on both sides. It is necessary to write on the card the region, district and the nearest settlement where the registration was conducted.

The data of the main and partial counts for each half-month of observation are grouped by habitat. In order to recalculate the counts per 1 km^2, they are transferred to the following tables (it is better to draw common notebooks for this).

Options for calculating species abundance

If males, females and (or) individuals of indeterminate sex are encountered in the count and there are fewer males than others, then the calculation per 1 km^2 is based on the sum of all encountered individuals, both sitting and flying and flying (here and further see column "per 5.1 km^2").

If there are more males than other individuals in the count, double the number of males is used for the calculation. Other indicators are not taken into account.

If only females and/or males of indeterminate sex are counted, all recorded individuals are counted without doubling.

If males, females (etc.) both sitting and flying birds are recorded, and the number of males in the count is less, the calculation is made separately according to the corresponding formulas for sitting and flying birds, and the values per 1 km^2 are summed up.

If males, females (etc.) both sitting and flying are encountered in the count, but there are more males in the count, then the count is based on twice the number of males. Both sitting and flying "non-males" are not taken into account.

If according to the results of counting in the sample a part of birds is not determined to species, then in the tables of density calculations a separate line for each of the uncertain groups is initially given. That is, all precisely determined species are listed. In this case, the calculated abundance is not divided into other species, but is stored in a separate line (ideally, up to the species definition).

Since the calculation of abundance per 1 km^2 is largely coarse, it is better to round the final (after all calculations) numbers that are greater than 1 to integers, those that are less than one to the first non-zero sign (i.e. 1.51=2, and 0.56=0.6, etc.) in order to simplify further processing.

It shall be noted that solitary individuals encountered once in half a month of observations do not double (except for singing males) when recalculated per area. Singing males are doubled at any time of the year if there are more of them than females in the count. An exception may be species for which it is reliably known that the timing of males and females, and of young males in the fall, is very different (i.e., it is reliably known that only males are present in a given habitat during the counting period). The abundance of males of such species, if necessary, doubles only during the pre-breeding, nesting and early post-breeding periods.

Annex F
(informational)

Tracking mammals

Knowledge of traces of wild animals, the ability to read them is a necessary part of the knowledge of a specialist zoologist. This knowledge and skills are necessary for studying the regularities of the location of animals in different types of lands, determining the size of individual plots necessary for the normal existence of an individual. Also the knowledge of traces is necessary for determining the optimal number of wild animals in undeveloped human territory and in lands occupied by agriculture or intensive forestry. The information provided by animal tracks is necessarily used in solving issues of wildlife protection and rational use of wildlife resources.

It shall be kept in mind that the footprints depicted in the drawings may not exactly match the footprints you encounter in nature. Perfect footprints, on which all fingers and claws of the animal are visible, are quite rare. It often happens that the number of fingerprints you find will not match the pattern, or the shape or size of the print will be distorted due to uneven or loose soil (the most distinct traces remain on soft, wet soil and snow).

But the real skill and experience are usually gained by practice, when you have seen an animal or a bird "live", in the short term, or with binoculars, or with a camera trap and walked in their tracks.

Fresh and old animal tracks are also very different from each other.

Relative accounting in the territory under study is conducted in order to assess the productivity of different types of lands, i.e., the degree of their occupancy by individual species of animals and birds; to determine the ratio of various species in this territory and in its individual stations, in particular the ratio in the "predator-prey" system; to compare the occurrence of animals in the current year with the previous year as well as the occurrence of individual species in the beginning of winter and after the fishing. The technique of relative enumeration is not complicated and consists in the following. In the studied territory, routes are planned that shall cross the main existing stations: coniferous and deciduous plantations, burnt areas, clearings, marshes, floodplains, agricultural and other lands. It is desirable that the length of the routes in each type of station shall be proportional to their area in the study area. For example, if spruce forests occupy 30% of the study area, then 30% of all routes shall pass through spruce forests. Routes shall not coincide with traveled roads and cuttings. They shall be laid along unmade trails, narrow sightings, or, if they are not available, by compass. Routes shall be mapped and marked in the area so that they can be re-routed in subsequent years.

The counting is conducted when the weather has settled down, when there are no sudden changes in temperature and atmospheric pressure. In order not to be connected with powdery weather, the counting is conducted on two consecutive days. On the first day they make the so called footprint mashing, when the observer walks the route and strikethroughall the footprints with a ski stick. On the second day - the counting of fresh traces that appeared during the day. If the weather conditions make it easy to distinguish fresh tracks from old (two days old) tracks, the counting can be conducted without

mashing, i.e. during one day. A trail of animals encountered along the route is counted as 4 tracks. If the route crosses the place of animal's dwelling, where traces are very confused, it is better to avoid the dwelling and count the entrance and exit traces, like during the counting by payroll. All registration data (the route, the distance covered in steps which are subsequently recalculated in meters, the type of land, the tracks encountered) are represented graphically on the route sheet. Tracks can either be represented by symbols or the name of the animal can be written with an arrow indicating the direction of its movement.

After the end of the counting, the data obtained are processed. The number of tracks per 10 km of the route is taken as a unit of counting (count rate). The length of the route segments over similar types of land is summed up, and the count rate is calculated using the formula:

$$y = 10\,n\,/L,$$

where y – accounting rate;
n – number of traces encountered;
L – route length, km.

For example, if along the boron 16 km were passed and 20 squirrel tracks were found, and 18 tracks were found in the spruce forest at 8 km, then the index of the squirrel population accounting will be equal for the boron: (20 - 10)/16 = 12,5; for the spruce forest: (18 - 10)/8 = 22,5, and for the coniferous forests as a whole: 20 + (18 - 10)/(16 + 8) = 15,8.

If a comprehensive census is conducted (i.e., more than one species is counted), the census rate for other animals whose tracks are found along the route is determined in the same way. Relative census, although it does not give exact data on the number of animals living in a certain area, but allows you to compare different areas, districts and even regions in terms of the abundance of a particular commercial animal in them.

Quantitative or approximate-accurate accounting makes it possible to determine the number of animals inhabiting the area under study, their density (number per unit area), i.e. to calculate the stock index. Approximate-accurate counting is more complicated than relative counting, more labor-intensive, and requires more trained specialists - biologists-hunters. The fact is that, in addition to counting tracks on the routes, it is necessary to determine the average length of the daily legacy of the species taken into account. For this purpose it is necessary to conduct several daily trails of different individuals, i.e. to go by traces of the entire hunting or foraging path of the animal from one rookery-days to another [15].

The route and trace counting for quantitative counting are done in the same way as for relative counting. Then, having the data on the route traveled, the number of fresh animal tracks crossed, and the length of its daily legacy, it is possible to approximately determine the number of animals of the considered species per 1 km^2 of the territory. The following formula was proposed for such a calculation [16]:

$$S = n\,/(Ld),$$

where S – number of animals per km^2;

n – number of intersections of the route line with animal tracks;
L – route length, km;
d – average length of daily legacy, km.

The data obtained by the above method cannot claim to be absolutely accurate, but when carefully conducted accounting work is very close to the truth.

Small mammal and amphibian census methods

Small mammals. The methods of census of this group of animals, which includes representatives of the order of Rodents (families of Rats, Mice, Fieldflies and representatives of some other families) and the order of Insectivores (families of Moles and Moles) are by now no less diverse than the methods of census of birds. There are a number of methods of relative indirect counting: by biological indicators [17] and by traces of small mammals [18]. The group of methods of direct relative census is even more diverse and includes: counting the number of small mammals on trap lines, area trapping, and census with the help of trap grooves [19]. Methods for absolute counting of the number of animals have also been developed: marking of animals in order to study their individual plots and determine their population density, complete trapping of animals on isolated plots, visual counting of active animals on plots. A variety of other methods are also used, but mainly for the counts of single species or small groups of species. The obtained data are recorded in the logbook according to the table.

Table F.1 - Sample rubric and log maintenance

№	Type	Gender, age.	Date of capture	Number of spent c/s (k/s)*	Habitat	Note
1	2	3	4	5	6	7
1	Small mammals		20.07.2021	20 k/s	Rubbly desert	
2	- ” -		- ” -	- ” -	- ” -	
3	Amphibians		- ” -	- ” -	Sarysu River -	
4	- ” -		- ” -	- ” -	- ” -	
5	- ” -		- ” -	- ” -	- ” -	
6	Small mammals		22.07.2021	30 c/s	Saxaulnicks	
7	- ” -		- ” -	- ” -	- ” -	
8	- ” -		- ” -	- ” -	- ” -	
9	- ” -		- ” -	- ” -	- ” -	
10	Amphibians		- ” -	- ” -	- ” -	
11	- ” -		- ” -	- ” -	- ” -	
* Note: c/k (k/s) - cylinder-(cone-)-day						

Timing of work and collection rate

Since this method of counting involves the removal of captured animals from habitats, it is conducted in the II half of summer (from July 16 to August 31), so as not to undermine the number of adults before the breeding period. This allows a more complete assessment of the abundance and species composition inhabiting the study area. At least one counting trench or fence is established in each habitat allocated for the bird population survey.

Desktop data processing

Once the counts are completed, the species of captured animals are determined (clarified), and the data is completely documented in the logbook, the results are summarized in a table with information on the total number of captured animals and the number of cylinder-days worked in order to obtain the counts in standard recalculation per 100 c/s sufficient for further calculations. For amphibians, in addition to total indicators, we need indicators of accounting for each age group, because the calculation of energy consumed by this group of animals is made taking into account their size.

Thus, we obtain information on the abundance of small mammals and amphibians in relative counts. To convert relative indices into absolute ones (per 1 km^2) by the method proposed by L.P. Nikiforov [20] for small mammals and by the method proposed by Yu.S. Ravkin [21] for amphibians, average conversion factors were calculated in the laboratory of zoological monitoring of the Institute of Animal Systematics and Ecology of the Siberian Branch of the Russian Academy of Sciences based on extensive factual material:

for rodents - 145; for insectivores - 115;

amphibians - 300.

i.e., rodent abundance per km^2 is 145 times greater than per 100 c/s, and further similarly for other groups. So, by multiplying the species abundance counts per 100 c/s by the coefficient corresponding to that group, we get approximate counts per km^2. Calculation of indices for cone-nights, assuming that cones are filled with formalin, is identical. Body length and division into size-age groups are given according to Yu.S. Ravkin, I.V. Lukyanova [22].

Annex G
(informational)

Sampling in aquatic ecosystems

Sampling in water bodies is conducted in the areas before and after the sources of impact. It shall be taken into account that the impact of industrial and domestic effluents on aquatic invertebrates can be reflected in 2-3 days. Besides, it is necessary to take into account flow velocity, water temperature [11], [23]. Separate accounting is conducted in natural sections of water bodies, canals, reservoirs where more than 50% of the area has been changed as a result of human activity and in areas with significant anthropogenic transformation: near bridges, fords and crossings, large stones and concrete structures, in places of stripping works, in places with transformed channel and/or banks, etc.

For each biotope physical and chemical indicators of water are recorded: color, odor, transparency, presence of flow, temperature at the surface and at a depth of 1 m, hydrogen index (pH), total mineralization or electrical conductivity, soil type (muddy, sandy, pebbly, stony). Color, smell of water, soil type are determined by the observers' senses (organoleptically). Since individual differences in perception are possible, the data of each of 3 (or more) observers are recorded in the logbook. To measure water transparency, a Secchi disk is used: a white disk with a black painted radius on a rope is submerged in water (the plane of the disk is parallel to the water surface) until a black stripe is visible. This depth is then recorded in the logbook. Measurements of temperature, pH and total salinity (and/or conductivity) of water are made with appropriate instruments. It is convenient to conduct measurements with a combined instrument that combines all these indicators. Measurements are conducted at least 3 times at each site and in each biotope, all measurement results are recorded in the logbook.

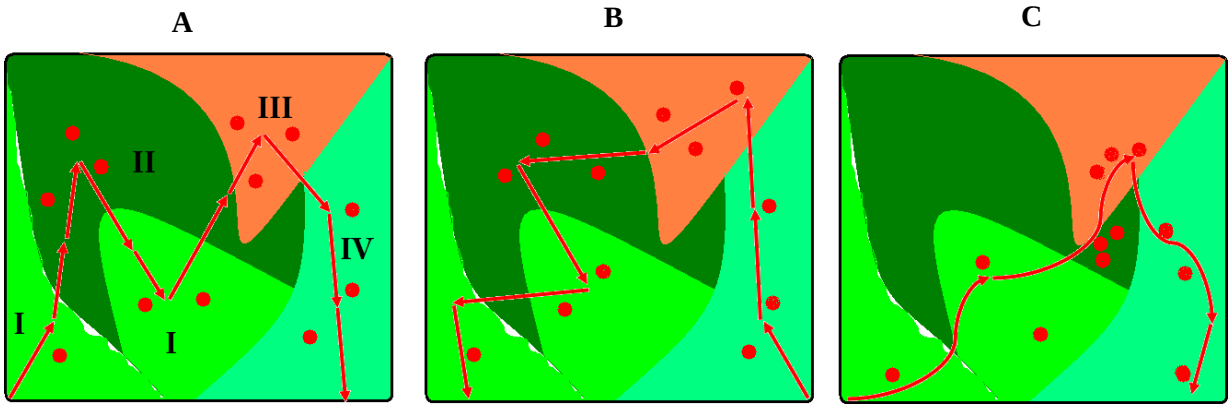
Then aquatic invertebrates and fish are collected in each biotope. In accordance with the objectives of a particular study, collections are used: 1) without removal and 2) with removal of animals from the natural environment. In the first case the captured animals are kept for a short time in a big enough container to provide their vital activity. The captured animals are identified. They are counted and photographed extensively, then released into the natural environment. In the second case, water bodies, timing, fishing gear and the number of animals to be seized shall be preliminarily agreed with the authorized bodies in accordance with the current legislation [2].

Aquatic invertebrates are collected at least 3 times (samples) in each biotope. It is desirable that the number of organisms in each sample is not less than 50 copies. At the same time it is necessary to take into account the area of collection each time. Each sample is labeled with the water body, site, date, time and area of collection.

Annex K
(informational)

Selection of routes and sites for monitoring

The figure shows the possible locations of routes and monitoring sites [23], [24]. The errors in the route in figure K.1 (B) are insufficient coverage of the territory in zones II and III and too close to each other sites for monitoring.



Roman numerals indicate different zones (landscape types, vegetation).
The red dots indicate areas to be monitored. A and B are correct, C is incorrect.

Figure K.1 - Selection of routes and location of sites for monitoring

Annex L
(informational)

Methods for determining the state of aquatic ecosystems [11], [23], [25]

Method for determining water quality by ERT complex.

Amphibiotic insects are those whose larvae live in the water, while adult insects (adults) have wings and live on land, flying near bodies of water. Among insects the most important are mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera), because they are the most sensitive to pollution benthos organisms, they are indicators of clean water. These three groups are briefly referred to as the "ERT complex". It is very important to learn how to identify these particular groups, because if they are present in a body of water and are diverse, it means the aquatic ecosystem is in good health. The maggot larvae are well distinguished by living in tube houses made of sand grains and/or plants, which they attach to rocks and other objects in the water. Water quality is evaluated according to 4 categories: I - very clean water (excellent quality), II - relatively clean water (satisfactory quality), III - polluted water, unfit for drinking (unsatisfactory quality), IV - dirty water (very poor quality). By studying the composition of aquatic invertebrates and the relative diversity and abundance of the ERT complex it is possible to determine the water quality in the studied area.

Water quality category I - "very clean water":

All three groups of ERT (mayflies, stoneflies and caddisflies) are present in the river, their representatives are very diverse (in total you can identify more than 20 ERT morphotypes); the number of ERT organisms is very high; in addition, other invertebrate groups are present and diverse in the benthos, such as the crustacean gammarus (numerous), higher crayfish, bivalve mollusks and other groups.

Water quality category II - "relatively clean water":

All three ERT groups are present, but their diversity is relatively low, especially the stoneflies (no more than 1-2 morphotypes) and mayflies (4-5 morphotypes), the total number of ERT morphotypes can reach 10-14; the number of ERT is low, as is the number of crustaceans - gammarids, but the number of oligochaetes, chironomids, and gastropod mollusks is relatively increased.

Water quality category III - "polluted water"

The Plecoptera are absent, Ephemeroptera are rare (no more than 1-2 morphotypes), Trichoptera are represented by 1-2 morphotypes and their numbers are low; Gammarus crustaceans are rare or absent; there is an increase in numbers of leeches, dragonflies, water bugs; total numbers of oligochaetes and chironomids (oligochaete-chironomid complex) may be over 50% of total invertebrate numbers.

Water quality category IV - "very dirty water"

Complete absence of ERT complex, presence of other groups of insects tolerant to moderate pollution - dragonflies, bedbugs with their small numbers; there is a sharp increase in the relative abundance of oligochaete-chironomid complex (over 50%; in acute cases it reaches 90% and more); tolerant to pollution two-wings (chironomids of Chironomus genus, larvae of blood-sucking mosquitoes, syrphid flies and other two-wings) are developing.

The Mayer method is the simplest method. To calculate the Mayer pollution coefficient, it is not necessary to identify invertebrates to the exact species. The method is

based on the fact that different groups of aquatic invertebrates are confined to habitats with different degrees of pollution. It is necessary to note which of the groups given in Table L.1 are found. Each organism in column 1 is multiplied by 3 (3x). Each organism in column 2 is multiplied by 2 (2u). Each organism in column 3 is multiplied by 1 (Z). The result is:

$$3x+2y+Z=\sum.$$

According to the value of the sum, the degree of pollution of water bodies is assessed: more than 21 points - very clean water, I class;

17-21 points - clean water, II class;

11-16 - moderately polluted water, III class; less than 11 points - dirty water, IY-YII class.

Table L.1 - Definition of the Mayer index

Inhabitants of clear waters (X)	Inhabitants of moderately polluted waters (У)	Inhabitants of heavily polluted waters (Z)
1	2	3
Stoneflies larvae	Hemlock	Chime mosquito larvae
Mayfly larvae	River crayfish	Water donkey
Copepod larvae	Dragonfly larvae	Leeches
Lousefly larvae	Mollusks of the coil and livebearers	Gnat larvae
Bivalve mollusks		Oligochaetes
		Pondworms

Woodiwiss method. It combines the principles of the indicator value of individual species and the principle of changes in the diversity of fauna under pollution conditions. The method is based on simplification of the Biocenosis taxonomic structure as the level of water pollution increases due to the loss of indicator taxa when their tolerance limit is reached against the background of a decrease in the total diversity of organisms, united in the so-called Woodiwiss groups. As indicator groups were selected groups of stoneflies, mayflies, copepods, two crustacean genera (Gammarus, Asellus), as well as oligochaetes of family Tubificidae and chironomids of genus Chironomus.

The initial point of work with the scale when determining the biotic index is to find the initial position in the first column while moving from the top line of this column downwards as there are no indicative organisms in the sample being determined, reaching the indicative group present in the sample, while taking into account the number of species in it. Based on this, the biotic index is determined in accordance with Table L.2. All determined species are entered into the zoobenthos primary treatment card.

Table L.2 - Working scale for determining the biotic index by the presence of Woodiwiss group

Show organisms	Species diversity	Biotic index by the presence of the total number of groups present				
		0-1	2-5	6-10	11-15	>16

1	2	3	4	5	6	7
Stoneflies larvae	only 1 species	no	6	7	8	9
	2 or more species	no	7	8	9	10
Mayfly larvae	only 1 species	no	5	6	7	8
	2 or more species	no	6	7	8	9
Copepod larvae	only 1 species	no	4	5	6	7
	2 or more species	no	5	6	7	8
Gammarus	all of the species listed above are absent	3	4	5	6	7
Oligochaetes and/or red chironomid larvae ("moths")	all of the species listed above are absent	1	2	3	4	no
All of the species listed above are absent		0	1	2	no	no

The accuracy of determining the above methods is insufficient, but if you conduct water quality studies regularly, that is, monitor for a long time, even using these simple methods, you can determine in what direction the ecological condition of the reservoir is changing.

Annex M
(informational)

Assessment of the state of populations of dominant fish species

To assess the state of fish populations, important indicators are the size, weight, and fatness of fish, as well as the sex ratio [26], [27]. The total length (L) and body length (l) of each fish are measured (figure K1). If possible in the field, the total weight of the fish (Q) is determined. Length is measured in millimeters and weight is measured in grams to the nearest 100 mg. Then an external inspection of the fish is conducted, scales are taken to determine age. After that, the fish is opened as shown in figure M.1.

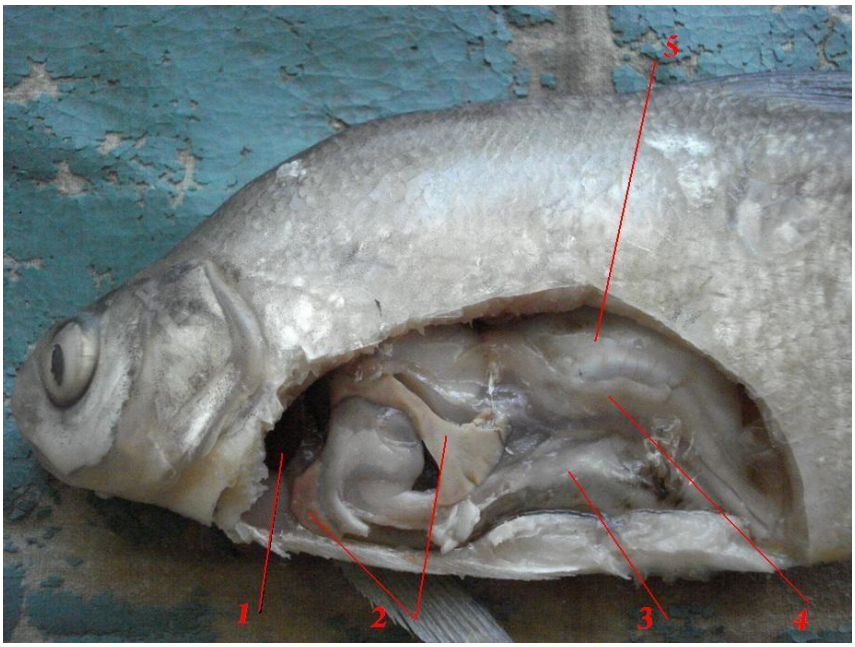
Figure M.1 - Measurement of total length (L) and body length (l) in fish.

Order of entries:

- location. Name the body of water (river, river, pond, lake, canal, other) from which the fish was taken. For insignificant and little-known water bodies, it is desirable to indicate the basin to which the water body belongs, for example: Mashat River, tributary of Aksu River (Syr Darya basin);
- time of location. Date, month, year. Surname, first name, patronymic of the collector and measurer. Scientific and local name;
- The numbering of studied specimens is conducted sequentially by fish species and sections (but not by individual sheets). It is not necessary to keep records of measurements of fish of different taxonomic forms on the same sheet, so as not to create inconvenience in further processing of the numbers of measurements;
- biological analysis of fish is conducted according to the schemes generally accepted in ichthyology: L, l, Q are measured. In addition, after opening the fish, the sex of the fish is determined, the fatness (from 0 to 5) and the degree of filling of the digestive system (from 0 to 5) are evaluated in points. The mass without entrails (q) is weighed. Based on the obtained measurements of length and weight, calculate the fatness of fish according to Fullton (F) and Clark (C) according to the formulas:

$$F = \frac{Q \times 100.000}{l^3} \quad ; \quad C = \frac{q \times 100.000}{l^3}$$

The age of fish is determined according to N.I. Chugunova's guideline [28], using scales and vertebrae as recording structures.



1 - heart, 2 - liver, 3 - intestine with a layer of cavitary fat, 4 - sex gland (male), 5 - swim bladder

Figure M.2 - Opened fish

Sex determination is mandatory in the study of all fish. Only in a few fish species are males and females differentiated externally. Therefore the abdominal cavity shall be opened to determine sex (figure M.2). The male is denoted by ♂ the female by ♀. If the fish is young and the sex cannot be determined with the naked eye, then juv (i.e., abbreviated juvenalis) is written in the appropriate box.

For adult fish, sex is determined by the point system of the state (degree of maturity) of sexual products. For example, ♀ IV, i.e. female, whose degree of maturity of sexual products is expressed by the score four (1V). The weight of sex glands - gonads is indicated (g).

Fish weight (g or kg). When comparing fish from different water bodies, their weight, which is in close relation to the growth rate, is one of the best indicators of the ecological condition of the water body and the well-being of the population. In addition, weight readings are necessary to determine the fatness of fish. Age is also essential. But age values have to be entered after the fish age materials have been processed. When measuring fish the main body length is the distance from the end of the snout to the end of the scale (beginning of the caudal fin). The length of the whole fish is also indicated.

A variety of types of anthropogenic load, their different intensity and duration, different physical and geographical conditions of water bodies, a combination of different types of impact made chemical analysis of pollution of ecosystems extremely expensive and often ineffective. One of the most effective is the method proposed by Reshetnikov Yu.S. and others [29] for the ball evaluation of pathologies and the calculation of the index of unfavorable condition (IUC) on its basis. IUC is calculated as the sum of all indicators according to the table [30].

The absence of pathology is scored as zero. IUC is not normalized, and can vary from 0 to 24. Depending on the resulting IUC value, three states of aquatic ecosystems

are distinguished:

I - zone of relative ecological well-being (IUC for peaceful fish species is not more than 4, but only if summed up by 3 or more indicators. If the IUC is greater than 2 for any of the indicators, this indicates habitat disturbance);

II - zone of ecological disaster (IUC for peaceful fish species from 5 to 8); III - zone of ecological crisis (IUC for peaceful fish species greater than 8).

Table M.3 - Ball rating system of fish condition

Organ system, presence of parasites, fatty degeneration	Signs	Score in points *
1	*2*	*3*
Skin	Lack of black pigment (depigmentation) Appearance of blue or green "Ruffling" of scales Appearance of ulcers on the body	1 2 3 4
Jaws	Slight shortening of both or one Underdevelopment, pug-like mouth	2 3
Gills	Pale, lots of mucus Anemic ring on gills weak Anemic ring on gills strongly pronounced	1 2 3
Muscles	Turgor is weak, the body sags. They are squeezed under the fingers. Divided into myoseptes there are cavities.	1 2 3
Spine	Vertebrae without abnormalities, spine mildly curved Severely curved spine (scoliosis) Vertebral fusion and fracture (lordosis)	1 2 3
Liver	Paler than usual, more often pale, normal in shape and size Very pale, mosaic, weakly reduced Reddish, strongly mosaic, granular in structure, reduced by more than 2 times	1 2 3
Parasites	Available in more than 2 bodies Numerous, more than 3 organs Very abundant, all organs affected	1 2 3
Fatty overgrowth.	Change in the color of hollow fat Obesity of individual organs.	1 2
* Note - The IUC is calculated as the sum of all scores. The absence of pathology is scored as zero.		

Annex N
(mandatory)

Qualitative and quantitative indicators of diversity

Qualitative indicators of diversity are filled according to the table.

Table N.1 - Taxonomic composition of plant diversity

Latin (scientific name)	Name in the state language	Name in russian	Known for the area (indicating the source of information)	Detected (indication of the timing of research)	Quantity
1	2	3	4	5	6
* Note: + - species detected; 0 - species not detected					

Table N.2 - Taxonomic Composition of Terrestrial Invertebrate Diversity

Latin (scientific name)	Name in the state language	Name in russian	Known for the area (indicating the source of information)	Detected (indication of the timing of research)	Quantity
1	2	3	4	5	6
* Note: + - species detected; 0 - species not detected					

Table N.3 - Taxonomic composition of terrestrial vertebrate diversity

Latin (scientific name)	Name in the state language	Name in russian	Known for the area (indicating the source of information)	Detected (indication of the timing of research)	Quantity
1	2	3	4	5	6
* Note: + - species detected; 0 - species not detected					

Table N.4 - Taxonomic composition of the diversity of aquatic invertebrates and fish

Latin (scientific name)	Name in the state language	Name in russian	Known for the area (indicating the source of information)	Detected (indication of the timing of research)	Quantity
1	2	3	4	5	6
* Note: + - species detected; 0 - species not detected					

Annex P
(informational)

Calculation of Community Diversity Indices

Indices used in community diversity analysis shall meet the following requirements [30], [31].

- the greater the diversity of a community, the greater the number of species in it;
- the greater the diversity of a community, the greater its levelness.

Most of the differences between indices that measure biodiversity are in the importance they place on equalization and species richness.

Species richness is an important measure of diversity for a spatially and temporally limited community for which the number of its constituent species and individuals is known precisely.

Various combinations of S (the number of species detected) and N (the total number of individuals of all S species) form the basis of a simple measure of species diversity: the Margalef index of species richness:

$$Dmg = (S\text{-}1) / lnN$$

where lnN – the natural logarithm of the number of individuals.

The *Dmg* index takes a maximum value when all individuals belong to different species ($S = n$) and equals zero when all individuals belong to the same species ($S = 1$).

Menhinik Species Richness Index:

$$D_{mn} = \frac{S}{\sqrt{N}}$$

For example, the excursion resulted in a sample of 17 plant species represented by 149 individuals. The diversity will be: by the Margalef index - *DMg* = 3.2, by the Menchinik index - *DMn* = 1.4. The advantage of these indices is the ease of calculation. A greater index value corresponds to greater diversity.

The main potential applications of diversity indices are conservation and monitoring. The use of diversity assessments in these areas is based on two regulations:

- species-rich communities are more resilient than species-poor ones;
- pollution levels are associated with decreased diversity and altered species abundance patterns.

In this case, conservation usually uses indicators of species richness.

Degree of impoverishment and indices of equalization. When studying this or that influence (pollution) it is necessary to calculate the degree of impoverishment of species according to the formula:

$$f = ((S1–S2)/S1) \times 100\%,$$

where *S1* – number of species in the background (or comparison site);
S2 – the same at the contaminated (or site located below).

An important characteristic of the state of communities are the indices of equalization. Let us imagine two communities: both consist of 100 individuals belonging to 10 species, but the distribution of 100 individuals among the 10 species is not the same. In one case: 91-1-1-1-1-1- 1-1-1-1-1, and in the other: 10-10-10-10-10-10-10-10-10-10. These are two examples of extreme cases of equalization: in the first one, it is minimal, and in the second one, it is perfect. Thus, it appears that the number of dominant species varies. It is known that the number of dominant species is smaller the more extreme the ecosystem or community is. For example, forests in northern conditions consist of 1-2 tree species by 90%, while a tropical forest by the same criteria of dominance (% of total number or biomass of any species) may have more than a dozen dominant species. Here, too, 1-2 species of organisms dominate in polluted waters.

The Berger-Parker index is the easiest way to calculate the levelness (a measure of the dominance of one species):

$$d = N/Nimax,$$

where *N* – total population;
Nimax – abundance of the most abundant species.

An increase in the index shows an increase in diversity and a decrease in the dominance of one species, i.e., a better condition of the community.

The Simpson index and the Shannon-Weaver index are indices that take into account both components of species diversity - both the number of species and the nature of their distribution in abundance (equalization):

Simpson index:

$$C = \sum [\, ni\ (ni-1)\ N(N-1)\ ],$$

where *N* – number of species;
n_i– number of individuals of the i-th species.

Here, the higher the index value, the lower the species diversity.

Shannon index:

$$H = -\sum(ni /N) log (ni /N)$$

where n_i – number or biomass of the i-th species in the community;
N - total number or biomass of the community.

The Simpson index is more sensitive to changes in the abundance of the most abundant species, the Shannon index, on the contrary, to changes in the abundance of rare species. Therefore, the former is preferable if researchers are primarily interested in characterizing the community by the dominant group of species. Therefore, it is referred to the so-called dominance indices. Among the latter, the inverse Berger-Parker index, which is the ratio of the total abundance of species in a community to the abundance of the most numerous species, seems to be the most convenient:

$$Ibp = N/Nmax$$

where N_{max} – the number of individuals of the most abundant species.

An increase in the Berger-Parker index, as well as the Simpson index, means a decrease in diversity and an increase in the dominance of one species.

The Sorensen similarity index is used to compare fish communities:

$$S = 2C/(A+B),$$

where A – number of species in the sample
A; B – number of species in sample B;
C – the number of species common to both samples.

The value of the indicator ranges from 0 (complete difference) to 1 (complete similarity).

Annex R
(informational)

Assessment of anthropogenic disturbance of vegetation

In order to establish the degree of anthropogenic disturbance of plant communities, comparisons are made with "background" communities (conventionally selected as similar anthropogenic-disturbed communities) located outside the mining area [32]. Such descriptions shall represent typical phytocenoses of different landscape conditions. Comparison of the structure and floristic composition of undisturbed communities with communities subjected to anthropogenic impact in similar ecotopes will give an idea of the degree of anthropogenic transformation. Assessment of biodiversity includes the following indicators: total species richness, species saturation of phytocenoses, taxonomic diversity (alpha diversity). Also indicators of biodiversity and ecological condition of the territory are the share of undisturbed and undisturbed communities (according to the map), the share of rare and protected species in the total floristic list, the share of imported species.

Moreover, it is necessary to assess the impact on the biota of various species in the broad sense of anthropogenic and in a narrower sense of anthropogenic impact. Within the territory under study these are road degradation, soil erosion and deflation, construction works (disturbance of habitats near construction sites, roads, overpasses), pollution (fuel dumping, garbage dumps, etc.). Anthropogenic impact on the vegetation cover inevitably leads to a violation of the stability of indigenous communities, a change in the floristic composition, the formation of derivative communities.

To assess anthropogenic transformation of vegetation the following indicators are used: degree of projective coverage of grass-bush and moss tiers, floristic composition of phytocenoses, presence of rare species, share of imported species. In order to determine imported species, it is necessary to make as complete a floristic list of the territory as possible and compare it with the materials of previous studies, literary and stock data. During the geobotanical descriptions, the status of the imported species, their viability and cenotic behavior are recorded. Particular attention is paid to the detection of places of growth of rare and specially protected species of flora (in the study area - these are species from the Red Book of Kazakhstan [4]. The detected places of growth of rare species are recorded with the indication of coordinates.

When assessing the degree of anthropogenic disturbance of vegetation, we described conditionally "background" undisturbed or weakly disturbed areas that preserved biodiversity and community structure, and their anthropogenic modifications in each type of ecosystem.

The anthropogenic character of disturbances was established based on the presence of clearly anthropogenic objects (roads, buildings, etc.), the presence of anthropogenic meso- and microforms of relief, or by the type of land use.

When assessing the current state of vegetation for each specific area, all the factors of influence that have taken place at present, as well as the residual effects of past influences, were considered. This approach makes it possible to isolate the effects, processes and trends of vegetation development and to develop methods and criteria for

the assessment and monitoring of vegetation in relation to a particular factor.

Some criteria are common for all types of vegetation, some are applicable only for specific factors of impact, for example, grazing, road degradation, chemical pollution, etc., specific criteria are used only for specific types of vegetation.

The general criteria include the following:

- depression of the vital state of plants (changes in the ratio of vegetative and generative individuals; changes in the morphological parameters of habitus; disruption of the ratio of the cycle and the passage of phenological phases);
- changes in the ratio and phytocoenotic role of species in communities (changes in projective cover; change of dominants and co-dominants or an increase in the phytocoenotic role of weed species);
- changes in the qualitative composition of communities (invasion of new species, including weedy species; loss of economically valuable species; changes in the vertical and horizontal structure of communities; changes in the ecological and biomorphological composition of species in communities; changes in the ratio of ecomorphs; replacement of native species by weedy species).

Identification of the stages of vegetation transformation was conducted by describing the ecological-dynamic series of communities from heavily disturbed to conditionally background. Communities of the same type were organized according to the decreasing intensity of the impact factor. Special attention was paid to the fixation of species-indicators of transformation.

When assessing the state of vegetation, the following criteria of the degree (gradation) of vegetation disturbance were used (according to the 6-point system):

Background (unchanged) vegetation (0 points) is characteristic of indigenous (climax) or conditionally indigenous (quasi-climax) zonal communities and subclimax intrazonal communities, which are derivatives of a given climax vegetation and benchmarks of biodiversity and structure. This category also includes communities of little changed (conditionally background), year to year dynamics of which corresponds to the range of natural cyclic fluctuations.

Weakly disturbed vegetation (1 point). Weak external manifestations of changes in the state of habitus of individual species, disappearance of rare or particularly sensitive species, reduction in the amount of rags and sediment. Plant communities are characterized by relative completeness of floristic composition and structure, good vital state of most species, normal generativity of dominants. The dynamics has the character of natural fluctuations, the ability to self-regenerate under the existing loads is preserved.

Moderately disturbed vegetation (2 points). The composition of dominant species is preserved, but some structural and physionomic characteristics of communities change, species viability deteriorates, morphological changes of plant organs occur. Communities are incompletely floristic, with participation of weedy species, sparse grass cover. Dynamics has character of directed successions.

Strongly disturbed vegetation (3 points). There are changes in species composition of dominants and subdominants. The species composition of communities is strongly changed and impoverished, the number of minor and synanthropic species increases up to 50%. The disappearance of indigenous and appearance of derivative communities is observed. Communities are characterized by sparse herbage and reduced sodding of soil by more than 50%. The dynamics is characterized by catastrophic successions.

Very badly disturbed vegetation (4 points). Complete destruction of native communities. Communities are characterized by completely changed floristic composition and structure, with insignificant participation of species of aboriginal flora, highly fragmented. The dynamics has a chaotic character.

Complete destruction of vegetation (5 points). Vegetation cover is absent. Projective coverage of the soil with plants does not exceed 1 %. Only ruderal plants are found among species.

When selecting criteria for evaluating anthropogenic transformation of vegetation, it is important to determine the type of impact. In the vast majority of cases, vegetation experiences a simultaneous impact from several factors, in which case the leading factor was identified, with an indication of the associated factors of vegetation transformation.

Annex S
(informational)

Standard description of the Phytocenosis

To simplify the description and unify the described parameters of the physical environment and the Phytocenosis itself, we have developed a vegetation description form (see sample), i.e. a table with pre-drawn graphs for each environmental description parameter. The forms are filled in directly in the field - at the place of description. Before going to the route it is necessary to prepare forms in necessary quantity, and during work only to fill them [33].

In the plains, it is possible to create larger sampling areas, in the mountains smaller ones are often necessary, because here the heterogeneity of environmental conditions creates a rapid change of plant communities in space. A list of plants shall be compiled very carefully in order to include all species that are both mature and in the form of young plants and even sprouts. It is recommended to arrange the plants in the list according to their life forms, for example: trees first, then shrubs, bushes, semi-bushes, perennial grasses, annual grasses, mosses, lichens,

The sample area is established in the typical plot of Phytocenosis by closeness of vegetation cover, longitudinal and mosaic structure, composition of dominant and indicator species. The floristic composition of vascular plants and mosses with evaluation of abundance according to the Drude scale is taken into account, the projective coverage of the herb-shrub layer and moss cover is given as a percentage, the height of the layers is indicated. Coordinates of description points are fixed by GPS device. Photos of described cenoses and individual plant species (background, rare, imported, etc.) are taken. A herbarium of higher vascular plants and mosses is collected both during the descriptions and along the route for the precise identification of species and the compilation of a complete floristic list of the study area.

The name of the association is given by the dominant species. The name of a forest association is compiled according to the dominant species of each tier, starting with the tree tier. If there is more than one dominant species in a tier, they are hyphenated in the name of the association and the dominant species is placed last.

The names of herbaceous associations usually do not take into account whether the dominants belong to a particular tier. The dominant species are hyphenated in the order in which the dominant with the highest abundance is placed last. For example, a meadow association with the dominant species pike, buttercup and sedge with a clear predominance of pike may be called: sedge-mulberry-pike. If the grass is dominated by one grass, for example, meadow bluegrass, sedges are absent, there are few representatives of legumes, there are no dominant species among herbs, but together they play an important role in the Phytocenosis, then such Phytocenosis shall be referred to the mixed grass-meadow association.

A very important stage is to identify the floristic composition, i.e. to make a list of plant species. Herbaceous plants are usually found in the sample area in large numbers compared to trees and shrubs, so for the herbaceous layer the list was compiled in the order in which the species were found when walking around it. In order not to miss species growing in the sample area, plants are entered into the description form as

follows:

- include all the plants found in the first corner plot;
- moving along the borders of the trial area, gradually adding new species to the list;
- crossing the area diagonally in order to include the plant species that have not yet been included in the list.

This method of compiling the floristic list makes it possible to make it as complete as possible and to save the area from trampling for further vegetation characterization.

To assess the role of a species in a Phytocenosis, it is important to determine its abundance, i.e. its quantity in a sample area. Abundance is determined by various indicators. The most available are eye-based methods of counting, expressed in conditional points; less often numerical methods of counting the number of individuals of each species are used.

Physical and chemical effects on plants in the early stages are not visually diagnosable and in some cases, in later stages can even have a positive effect, because some chemical elements and compounds in certain doses can stimulate plant development. They also in large doses stop the development of plants.

During reconnaissance surveys to identify chemical pollution in parallel with deterioration sampling, the following criteria are used:

- deterioration of phytocenometric characteristics of species (general habitus);
- deterioration of generativity - underdevelopment of generative organs (flowers, fruits) or their absence in adults;
- changes in the horizontal structure of the community (mosaicism, character of placement of individuals);
- appearance of teratological abnormalities (deformities);
- appearance of physiological abnormalities (necrosis and chlorosis of leaves, weakening of pigmentation).

The degree of leaf damage is set on a 5-point Guderian scale:

1 – very mild necrosis or chlorosis (up to 20% leaf damage);

2 – mild necrosis or chlorosis (21-40%); 3 – moderate necrosis or chlorosis (41-60%);4 – severe necrosis or chlorosis (61-80%);

5 – very severe necrosis or chlorosis (81-100%).

The impact on vegetation can be expressed in 3 main ways:

a) physical impact. Transformation of the vegetation cover. Vegetation forms heterogeneous areas and usually has a mosaic character. Various stages of vegetation recovery are observed in such areas, from primary weed-grass groupings, to full-member zonal communities. Dusting of plants leads to disturbances in the photosynthetic device and photosynthetic processes, which, in turn, is reflected in a decrease in productivity. At the level of phytocenoses, it leads to their structural rearrangements. Sensitive, low abundant species (mainly motley grasses) drop off of the cover, and the vegetation acquires a more xerophytic appearance;

b) chemical effects. As a result, the plant cover experiences a whole set of indicators that manifest themselves in changes in physiological and biochemical processes and can be diagnosed at the anatomical level during complex studies;

c) fires. Fires burn the dry parts of plants, litter, and rags. In the case of strong and repeated fires, the underground parts of plants burn, and the upper soil horizon burns.

This leads to changes in ecological conditions of biota formation. After fires, the structure of phytocenoses is significantly transformed (the growth of green mass decreases, the ratio of different species changes, and the role of vegetatively mobile species increases).

Annex T
(mandatory)

Leaflet for employees on accounting for biodiversity in areas of telecommunications equipment, production facilities and surrounding areas

1. The main purpose of accounting for plant and animal diversity is to assess the state of the environment, so the focus shall be on:
- characteristic (most frequent and/or numerous) species;
- keystone species;
- species listed in the Red Book.
2. To register the presence of a particular plant or animal species on the territory of telecommunication equipment, production facilities and adjacent territories, it is necessary:
- take a good quality photograph, a short video recording, or a written description of the characteristic features;
- indicate the supposed systematic position (name) of this organism (for example, "beetle", "cabbage moth", "house sparrow", "wormwood", "dandelion", etc.);
- make a note in a notebook, field diary or electronic media, where you shall specify: date and time of detection; place of detection (established by using GPS coordinates or indicating the approximate distance and direction to the nearest settlement); information about the state of the detected organism (eg, "flowering tulip", "withering branches on willow", "singing starling", "running adult urchin with 2 babies"); his last name, first name, middle name and position.
3. In the nearest time after the observations you shall check your own opinion about the systematic position (name) of this organism with the descriptions and photographs available in the Internet and available literature sources. In any case (if the systematic position of the organism is the same or different) the original record is not erased or deleted, but the name of the organism is added to it with an indication of the source of information used.
4. All other organisms are registered in the same way:
- a photograph (short video);
- indication of the place, date, time and their surname, first name, patronymic and position;
- an indication of the reason why the organism shall be recorded: rare species, obvious deviations from the normal (healthy) species or condition, unknown species, previously unseen species; previously unrecorded species, etc.
5. All materials collected by employees are handed over to the person responsible for conducting biodiversity surveys in the area.
6. In order to accurately establish the systematic position of a particular species, you shall contact qualified specialists of the Company or, in agreement with the Administration, specialists from the relevant institutions.
7. After the systematic position of a particular species of organisms is established, it is entered in the general list of biodiversity with the primary data (date, place, name of the observer) and the name, position, place of work of the specialist who conducted the

determination.

On the territory of the enterprise, special attention shall be paid to the identification of places of growth of rare and specially protected species of flora (these are species from the Red Book of Kazakhstan (2014). Identified places of growth of rare species are recorded with a photograph of the plant, indicating the coordinates of the place of finding, date, phenological phase, the abundance of the species (Table). Tearing, digging up the plants is not allowed under any circumstances.

Table of records of rare and specially protected species of flora

Table T.1.

№	Coordinates of the discovery site	Date	Abundance (in the field of view), pcs				Phenophase			
			1-3 (rarely)	3-5 (medium)	6 -10 (much)	10 - can't count (abundantly)	vegetation	budding	blooming	fruiting

The following early spring beautifully flowering and at the same time reddish bulbous and tuberous plants will be interesting and most noticeable:

Rhinopetalum karelinii, Lily family.

An early flowering perennial with a white globular bulb up to 2 cm in diameter. Stem 5-15 cm tall, grayish from short pubescence. The two lower leaves are almost opposite, broad, while the upper ones are alternate, narrower, transforming into paired bractal leaves. Flowers 1-10, zygomorphic, broadly bell-shaped, drooping, the lower ones are monopolar, the upper ones staminate, aggregated in a brush-like inflorescence. Perianth leaflets are dull pinkish-purple, with a chess-like pattern of darker spots. Fruit is a rounded, dry ribbed capsule up to 2 cm long, without distinctly expressed wings. Blossoms from late March to May; bears fruit in May or June. It grows on sandy, clayey, less often on pebbly soils in deserts, semi-deserts and along plumes of desert mountains.

Occurs in the south of the steppe and practically throughout the desert zone - from the Caspian Sea and Ustyurt to the Alakol hollow and the foothills of the Tien Shan and the Dzungarian Alatau. Ornamental and feathered plant. **A monitoring species, an indicator of the onset of spring in the desert.**

Tulipa alberti, Lily family.

A herbaceous perennial with an early spring development cycle. Bulb ovate, up to 3-4 cm in diameter, with leathery dark brown, slightly extended scales. The stem is stout, squat, up to 20 cm tall. Leaves, 3-4 bluish, wavy along the edge, gradually descending toward the top. Flower is cup-shaped, up to 7 cm tall. It varies in color from yellow to crimson-red. The base of the flower is often black on the inside. The fruit is a dry, triangular capsule, up to 6 cm long and 2.5 cm wide. Blossoms from early April to the end of the first decade of May; bears fruit in May-June. It grows in deserts and intermountain valleys, foothills

and low mountains, on dry, often stony slopes, on clay and rubbly plains with thinned vegetation.
It is endemic of Kazakhstan with the broken area. Occurs in Syr Darya Karatau, the Chu Ili Mountains and across the southern part of the Betpakdala Desert. It is an ornamental, feathered and fodder plant. Listed in the Red Book of Kazakhstan.

***Tulipa borszczowii*, Lily family**.

A bulbous perennial 25 cm tall. The flower is up to 6 cm tall, broad-bottomed, yellow, orange or orange-red with a purple or purplish-brown spot in the center, which is strongly translucent from inside the petals and clearly visible on both sides. The fruit is a bluntly rounded capsule up to 4.5 cm long and 2 cm wide. Blossoms in late April or May; bears fruit in late May or June. It grows in sandy and clay-sandy, less often weakly boggy deserts, on loess slopes of low hills and chinks. Endemic of Kazakhstan, distributed in Prearalie, Kyzylkum and western part of Betpakdala.
In the east, it reaches the northern slopes of the Syr Darya Karatau. (vicinity of lakes Kyzykol and Akkol). It is an ornamental, feathered and fodder plant. **Included in the Red Book of Kazakhstan. Key species.**

***Tulipa buhseana*, Lily family**.

Bulbous perennial, 15-30 cm tall. Bulb up to 1-1.5 cm in diameter with brown, leathery, internally thinly hairy scales at apex. Stem 15-40 cm tall, usually glabrous, with 2 strongly spaced linear narrow leaves that do not reach the flower. Flowers range in number from 1 to 6-8 and droop after blossoming. Perianth petals are white, with a distinctly limited yellow spot at the base. Outer ones are dirty violet or pinkish-brown along the back, a little longer and almost twice as narrow as the inner ones. The fruit is an oblong, sometimes almost globular capsule, up to 2 cm long and about 1 cm wide.

Blossoms in late March-April and bears fruit in late May-June. It grows on sands and clayey, less often on pebbly soils. Widespread from Priaralie to Balkhash-Alakol hollow and Zhetysu Alatau. A spectacular early flowering species.

***Leontice incerta*, Barberry family**.

Original desert plant. Widely distributed in the zone of deserts and semi-deserts from the Caspian Sea to the Balkhash-Zaisan Depression, often found on saline soils and in saxaul thickets. The stem is short, up to 20 cm, with two almost opposite leaves. Leaves are glaucous, repeatedly divided into ellipsoid whole-edged lobules. Flowers aggregated at the apex in a cystic inflorescence. Sepals are bright yellow in color. The underground organ is a large (up to 4 cm) globular tuber. It blooms at the end of March or beginning of April, becoming especially conspicuous in May, during the fruiting period.

The fruits of the plant are very large, up to 4.5 cm in diameter, and are globular, bubble-shaped, bloated bolls that do not open until fully ripe.

In addition to beautiful flowering herbaceous plants, of great interest is a shrub, which is a relic and endemic of Kazakhstan - **Spiraeanthus schrenkianus, Rosaceae family**. It is found in the Betpakdala desert in small thickets on rubbly soils on the edges of takyrs and in the Karatau mountains on the steppe slats of mountains and in gorges. This is a low shrub up to 2.5 m, with a dense broad crown of scattered branches with gray-yellow bark. Leaves are narrow-linear, pinnate, with 15-80 pairs of small thick lobes on each. Inflorescences are oblong, sparse panicles at the ends of one-year shoots. Flowers are white or pale pink, fragrant. Blossoms in June; fruits ripen in August. Fruits are compound, consisting of 2-5 oblong pubescent leaflets. **It is the rarest plant, listed in the Red Book of Kazakhstan.**

Note - The following may be used as guidelines for the initial identification of plants and birds:

1. Ivashchenko A.A. Flowering plants of the south-east of Kazakhstan. - Almaty: Association for the Conservation of Biodiversity of Kazakhstan, 2008. - 184 p.
2. Khrokov V.V., Sklyarenko S.L. Short guideline to birds of Kazakhstan. - Almaty: Association for the Conservation of Biodiversity of Kazakhstan, 2009. - 156 p.
3. http: www.birds.kz

Annex U
(mandatory)

Passport of the phenological site [34]

Phenological site of the plot _____

Coordinates of the phenological site according to GPS data, altitude above sea level:

_____

Description: The site is located_____

Distance from (object)_____m, size_____m.

Date of laying the site: _____

List of plant species:_____.

Methodology for phenological observation of plants

Visits to permanent phenological sites are made in spring, during the beginning of active plant vegetation, at least once a week.

In autumn time - after the leaves have fallen off the trees. A small number of leaves may remain on the tops and ends of branches, but they are not taken into account.

For herbaceous plants, the following phases shall be noted: emergence of seedlings, budding, beginning of flowering, mass flowering, end of flowering, beginning of seed ripening, full seed ripening. Signs of the phases coincide with the descriptions for trees and shrubs.

It is necessary to mark the beginning of the phenological phase when at least a few plants at a phenological site have the phenomenon. The same phenomena are observed at other round-up sites and are recorded in the observation diary of the specialist of the environmental protection department.

For the plant species selected for phenological observations (indicator species) are filled inaccording to Tables U.1 and U.2.

Table U.1 - Indicator tree and shrub species

Latin name	Kazakh name	Russian name of the species
1	2	3

Table U.2 - Indicator species of herbaceous plants

Latin name	Kazakh name	Russian name of the species
1	2	3

Note - Phenological observations are made for each phenological site and Tables U.3 and U.4 are filled

inseparately.

Table U.3 - Phenological phases of trees and shrubs in 20_____.

Phenoplot _____
Observer_____

Species	Date	Swelling of the buds	Blossoming buds	Leaf unfurling	Flowering, the beginning	Flowering, mass	Flowering, the end	Maturation, beginning	Maturation, full	Autumn coloring, the beginning	Autumn coloring is complete	Leaf fall, the beginning	Leaf fall, mass	Leaf fall, the end
1	2	3	4	5	5	6	7	8	9	10	11	12	13	14

Table U.4. - Phenological phases of herbaceous plants in 20___.

Phenoplot _____
Observer_____

Species	Emergence of seedlings	Budding	Flowering, the beginning	Flowering, mass	Flowering, the end	Seed maturation, the beginning	Seed maturation, complete
1	2	3	4	5	6	7	8

To assess the yield of trees and shrubs, a few easily distinguishable species are selected, the yield of which is amenable to eyeball evaluation. Evaluation of seed and fruit yield is conducted according to the 6-point system (based on the scale of V.G. Kapper and A.N. Formozov) [33].

Yields of trees and shrubs are given in Table U.5.

Table U.5 - Yield of trees and shrubs (in points) in 20_____.

Species	Inspection area 1		Inspection area 2	
	Yield in points at the phenological site	Yield in points on the plot as a whole	Yield in points at the phenological site	Yield in points on the plot as a whole
1	2	3	4	5

Annex V
(mandatory)

Ecological passport of the reservoir

I. General information about the reservoir
1. The name_____
2. River system (which watershed the water body belongs to) _____
3. Main river or tributary (what order) _____
4. Where the river begins (source) _____
5. Where it flows in (mouth)_____
6. Approximate area of the water body or length of the river _____
7. Located in the territory (districts, nearby settlements) _____
8. What tributaries does it take: the right_____the left_____
9. Are there dams, weirs, where are_____
10. For man-made waterways (canals, ditches):
Nature of watercourse (digged, concrete banks, etc.) _____
When was it created?_____Why was it created?_____

II. Characteristics of the reservoir/river and its valley at the study site
1. Description of the location of the study area of the river (upstream/closer to the source, middle, downstream/closer to the mouth)_____
2. Location of the observation sampling station_____
3. Features of the river valley: width and shape_____
   The presence of terraces, their number, what rocks are formed_____
   Vegetation on the banks and slopes of the valley_____
   River floodplain: width_____vegetation_____
   composing rocks_____
4. Springs in the river valley (number, location)

_____
5. Riverbed: width_____depth: maximum_____middle_____
Presence of islands, fords, channels, rifts and their location_____
Bottom soil features_____
Current velocity_____Water consumption_____
6. Water quality assessment (you can use the tables from Chapter 4 for convenience):
turbidity_____color_____
sediment_____transparence_____
smell_____temperature _____

III. Life in and near a body of water
1. Coastal vegetation (indicate prevailing and rare species)

   _____
2. Aquatic and benthic vegetation (predominant and rare species)

_____
degree of channel overgrowth (% of area) _____
3. Fish: common species_____
   rare species_____
4. Crayfish (availability and quantity) _____
5. Bottom organisms_____

6. Animals, birds, their tracks_____
7. Invertebrate animals on the banks of the reservoir_____

IV. Use of the reservoir and its valley and its ecological consequences

1. What settlements are located in the valley of the reservoir and along its banks, at what distance from the reservoir? _____
2. Industrial and agricultural enterprises, their location in relation to the water body

_____

3. What agricultural land (seeded fields, meadows for cattle grazing)?
   What area do they occupy? _____
4. How the reservoir and the valley are used for recreation (vacation homes, children's camps, beaches, etc.)

_____

5. Is the water body used for industrial or agricultural purposes?

_____

6. Is the body of water used for fishing? What methods are used to catch fish? _____
7. Is the pond used for water supply and other domestic needs?

_____

V.Sources of river pollution, water protection measures

1. Natural sources and causes of changes in water quality

_____

2. Anthropogenic sources of water body pollution _____
3. Where are the locations of untreated water discharges? _____
4. Where are the places where treated wastewater is discharged? What measures are taken to treat them? _____
5. What is the width of the environmental protection zone of the reservoir _____ What is the condition _____
6. Your proposals for the protection and rational use of the reservoir and the surrounding area

_____

7. What has been done to clean up the reservoir and its banks_____

Who compiled the passport (last name, first name, patronymic, age, occupation) _____

_____

Date of completion

_____

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