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INTRODUCTION

In accordance with the Environmental Consulting Services Agreement for the “New Ring Road” project (Contract No. 25/02 dated March 13, 2025) and the Terms of Reference for Project Implementation (Order No. A/720 dated June 19, 2024), “New Hydro Project” LLC completed the preparation of the Environmental Baseline Report, which constitutes the initial phase of the Environmental Impact Assessment (EIA), in March 2025.

To assess the environmental baseline of the project site, field surveys and measurements were conducted along the selected alignment of the proposed ring road, covering the districts potentially impacted by the project’s activities. In addition, previously conducted studies within the project area were reviewed and integrated into the current assessment.

The Environmental Baseline Report was developed in accordance with the Law on Environmental Protection, the Law on Specially Protected Areas, the Law on Buffer Zones of Specially Protected Areas, the Law on Protection of Cultural Heritage, and the Law on Environmental Impact Assessment. The methodology followed was based on Section 2 of the “Procedure for Environmental Impact Assessment” as stated in Annex 2 of Government Resolution No. 374 (2013), and Section 1 of Annex 2 of Ministerial Order A-117 dated April 10, 2014, issued by the Minister of Environment and Green Development.

The main objective of this Environmental Baseline Report is to determine the current environmental status of the area where the project will be implemented. This includes an assessment of the geographical setting, geological structure, climate, air quality, surface and groundwater conditions, soil cover, vegetation, and fauna. The report also considers the current socioeconomic development status of the districts and sub-districts likely to be affected by the project. The assessment was conducted by qualified specialists and researchers using scientific methods and methodologies.

Within the scope of the environmental baseline study, previously conducted research materials were collected, and the final project alignment was selected by the project implementation team. Detailed field surveys and route inspections were carried out along the finalized alignment of the proposed ring road.

The research team conducted data collection activities along the alignment of the proposed road, including the compilation of recent meteorological and air quality data in Ulaanbaatar, socioeconomic data for 30 sub-districts within five districts, land use assessments, collection of agrochemical and pollution-related soil samples, surface water sampling, and botanical surveys at relevant locations.

The information presented in this report reflects the current environmental status of the project site and will serve as baseline data for the subsequent Environmental and Social Impact Assessment (ESIA) for the proposed development.

Researchers and Specialists Involved in the Baseline Study:

1. **Team Leader** – Dr. Ts. Sosorbaram, Director of “New Hydro Project” LLC
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4. **Soil Scientist** – Sh. Odbaatar
5. **Botanist (PhD Candidate)** – Ch. Mungunchimeg
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7. **Land Use Planner** – B. Oyuuntuya
8. **Ecologist** – E. Nandin-Erdene
9. **Geographer** – D. Munkh-Ulzii
10. **GIS Specialist** – D. Ochgerel
11. **Driver** – M. Enkhbayar

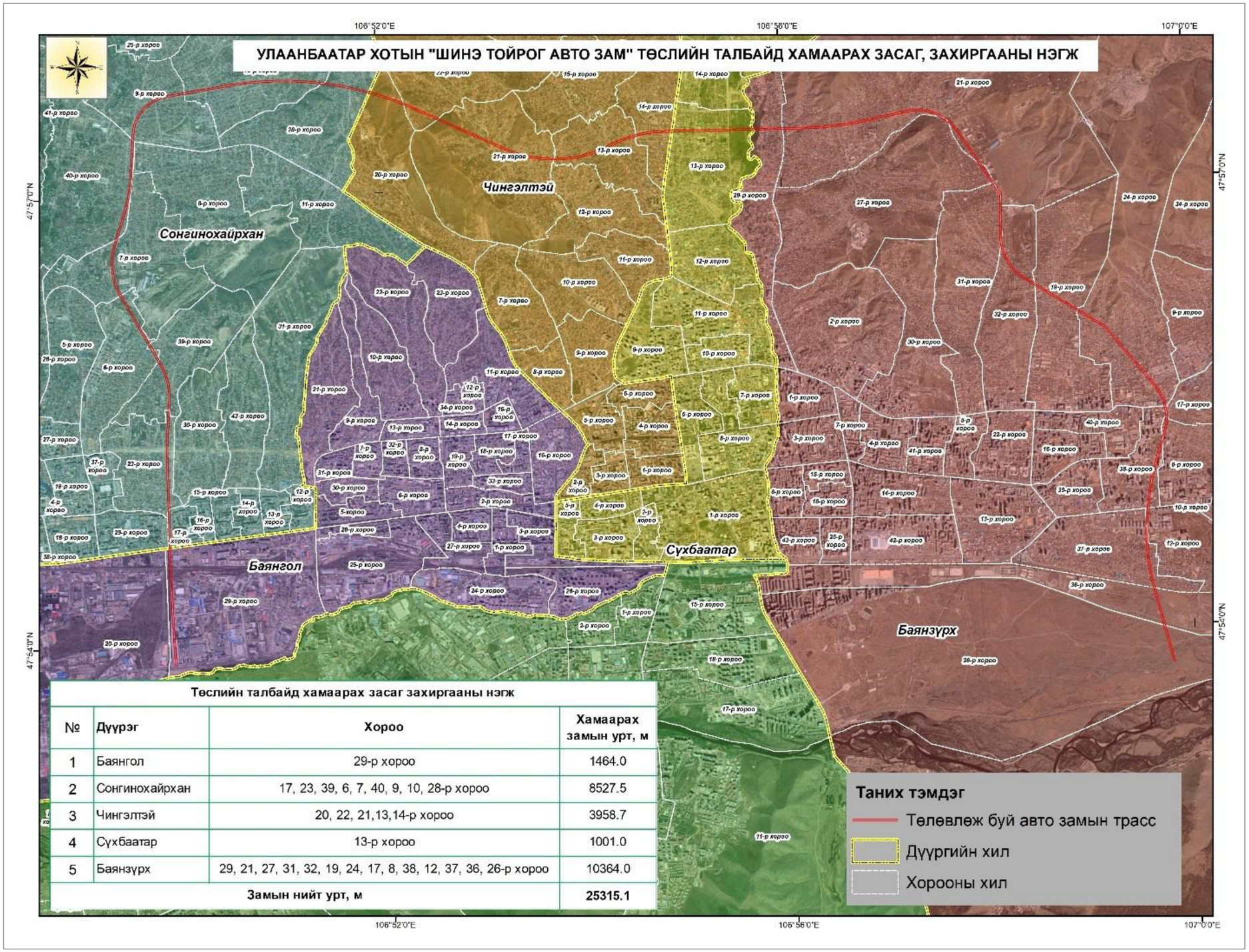
ONE. SITE LOCATION AND PHYSICAL GEOGRAPHICAL CONDITIONS

1.1. SITE LOCATION

The proposed New Ring Road alignment will traverse portions of 30 subdistricts (khoroos) across 5 districts of Ulaanbaatar city. The planned road will have a total length of 25.31 kilometers, a width of 50 to 60 meters, and will include 13 intersections, 5 pedestrian crossings, 3 animal crossings, and a dual carriageway with six traffic lanes.

Table 1. Administrative Units Covered by the Road Alignment and Corresponding Land Area

District	Subdistrict	Names of Streets and Subdistricts Crossed by the Road Alignment	Corresponding Road Lenght (m)
Bayangol	29th Khoroo	BGD 29th Khoroo or the section from the intersection of the Factory Circle-Energy Street to the intersection of the Onur Khoroool-Moscow Street	1464.0
Songino-Khairkhan	17, 23, 39, 6, 7, 40, 9, 10, 28th Khoroo	17th Khoroo of SHD or Onur Khoroool - from the intersection of Moscow Street to the turn to the back road of the 1st Khoroool, Chuluut-1 Street of the 23rd Khoroool, Khangai 16, 18, 19, 20, 22, 27 80, 82, 29, 37th Street, Khangai 35, 47th Street of the 39th Khoroool, Toosgony 51, 52nd Street, Khangai 49, 50, 51, 52nd Street, Toosgony 33, 34a, 24a, 24th Street of the 6th Khoroool, Bayankhoshuu 7th Street of the 7th Khoroool, Geology 1st Street section, 0119 Military Unit-2, 4 of the 40th Khoroool, Bayankhoshuu 29, It will pass through the sections of streets 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, and 40, the intersection of Baruun Salaa-Zuun Salaa-Bayankhoshuu Road, the sections of Baruun Bayan Uul-12, 13, 14, 15, and 16 of Khoroo 9, the sections of Zuun Bayan Uul-23, 16a, 15, and 14 of Khoroo 10, the sections of Oyodalyan 1 and 4, and the sections of Gogon Khulut-11 and Sansar 12 of Khoroo 28.	8527.5
Chingeltei	20, 22, 21,13,14th Khoroo	The mountain slope and top part located in the northeast of School No. 149 in the 20th Khoroo of the KhD, the mountain foot and skirt part in the south of Sogoot 90th Street in the 22nd Khoroo, the section of Bulag 19 and 20th Street in the 21st Khoroo, the section of School No. 25, 24, and 23rd Streets in the 13th Khoroo, the Hailaast Highway, School No. 33, 41, and 42nd Streets, the section of Hailaast 12 and 13th Streets in the 14th Khoroo	3958.7
Sukhbaatar	13-р хорoо	13th Khoro, Chingeltein Avenue, Doloon Khulna Road, 13th and 14th Streets of Rashaan, 2nd Street of Nogony Square, Selbe River and the riverbank area	1001.0
Bayanzurkh	29, 21, 27, 31, 32, 19, 24, 17, 8, 38, 12, 37, 36, 26th Khoroo	29th khoroo of BZD, Selbe river bank area, Selbe 39th and 40th streets, Dari Etyn road, 21st khoroo Baga Dari Et-4, 5th, 13th, 10th, 13th, 16th, 18th, 19th, 26th streets, Jamsran mountain rear 3rd, 2nd, 1st streets, Monel road, 27th khoroo Monel 52nd, 51st, 50th, 49th, 48th streets, Argal Oil gas station located along the road on Baruun Altan Uligi street of 31st khoroo, Monel 39th, 38th, 37th streets, Baruun Altan Uligi 36th khoroo, Zuun Altan Uligi street 11th, 10th, 9th, 8th streets, from the northwest intersection of Tsayz market to the end of Tsagaan pass The section of the road to Tsayz 22a, 25a, 24a, 23a, Denjiy 3, 2, Jargalantyn 12a Streets of the 19th Khoroo, Jargalant 5,4, Gazarchin 5, Ovoot 5, 3, Khorshoolol 14, 13, 9, 11, 10, 6th Streets of the 24th Khoroo, the western part of Da Khuree Market, the section of Erdene Tolgoi 6, 5, 4, 3, 2, 1st Streets, the section of the highway between Hilchin Street and Da Khuree Streets of the 17th Khoroo, the section of Edenetolgoi 36, 37, 38, 39, 40th Streets of the 8th Khoroo, the section of the road down to DHIS through Erdentolgoi, Erdene Tolgoi 40th Street of the 38th Khoroo, Ulaanhuaran 26th Street section, 1st Khilchni Street, 12th Khoroo, Police Academy Avenue Street road section, 23rd, 22nd, 21st, 20th, 19th, 29th, 28th, 26th Janjin Streets section, 37th Khoroo, section between railway and road in 36th Khoroo, section of road from Dunjingarav Shopping Center to Bayanzurkhin Bureau in 26th Khoroo	10364.0
Total length of the road, m			**25315.1**



Төслийн талбайд хамаарах засаг захиргааны нэгж

№	Дүүрэг	Хороо	Хамаарах замын урт, м
1	Баянгол	29-р хороо	1464.0
2	Сонгинохайрхан	17, 23, 39, 6, 7, 40, 9, 10, 28-р хороо	8527.5
3	Чингэлтэй	20, 22, 21,13,14-р хороо	3958.7
4	Сүхбаатар	13-р хороо	1001.0
5	Баянзүрх	29, 21, 27, 31, 32, 19, 24, 17, 8, 38, 12, 37, 36, 26-р хороо	10364.0
Замын нийт урт, м			25315.1

Figure 1. Administrative units within the study area

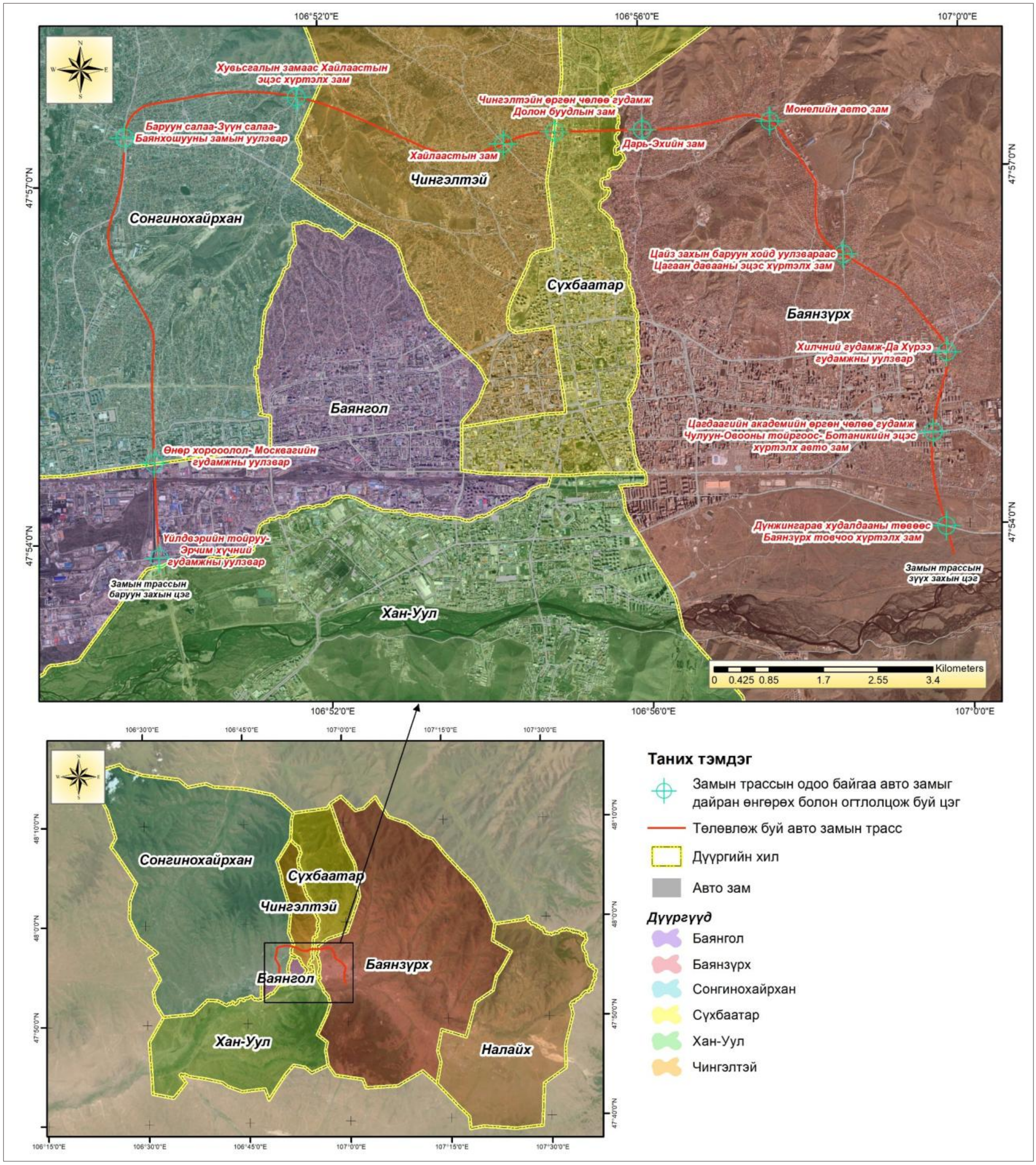


Figure 2. Alignment of the New Ring Road

1.2. PHYSICAL GEOGRAPHY AND LANDSCAPE

Physical geographical region

The territory of Ulaanbaatar city is a land with a harsh continental climate, belonging to the Khentii Sub-region of the Khentii Region, a sub-region of the Khangai-Khenti Mountainous Region in the physical geography of Mongolia.

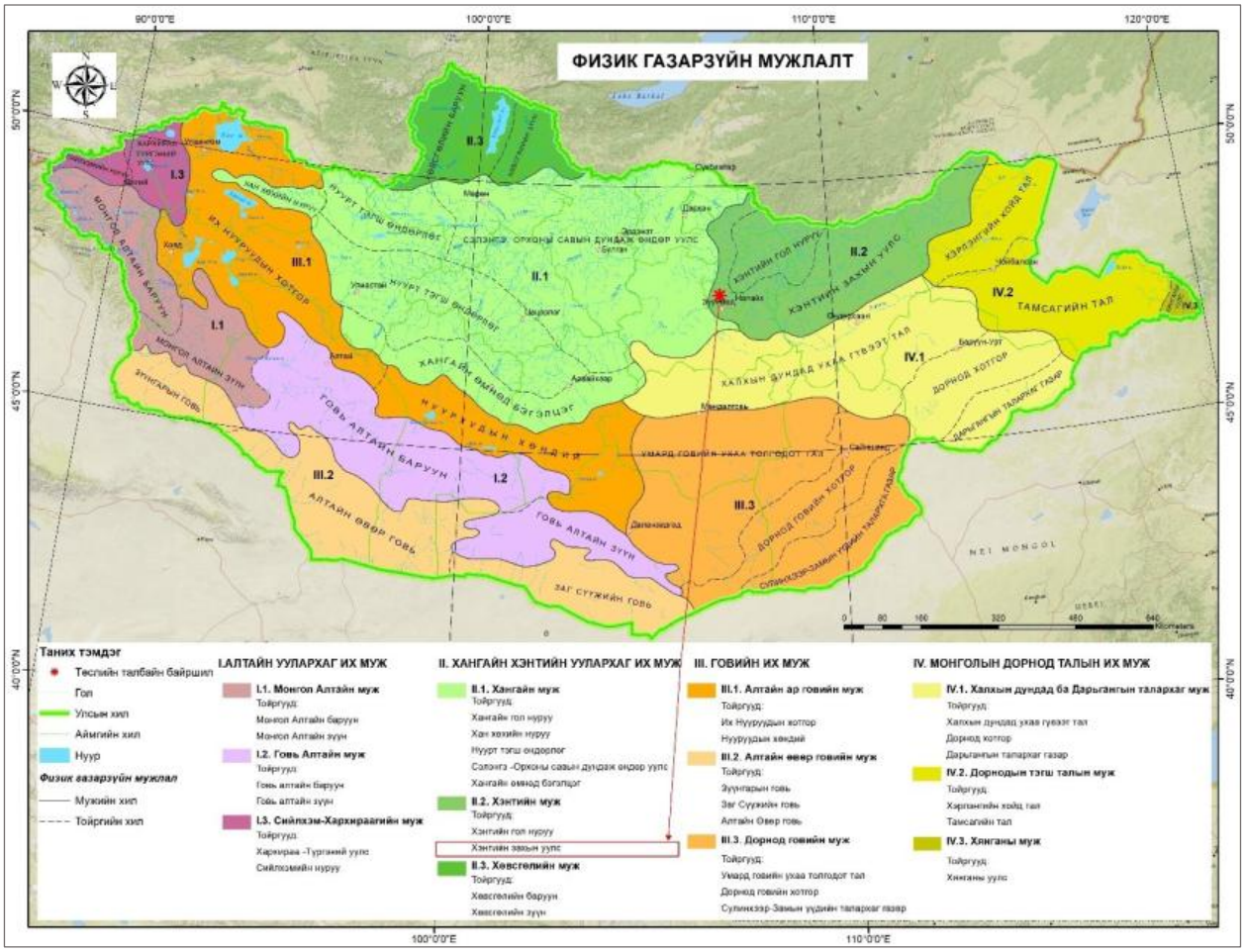


Figure 3. Physical–geographical regionalization of Mongolia (project area)

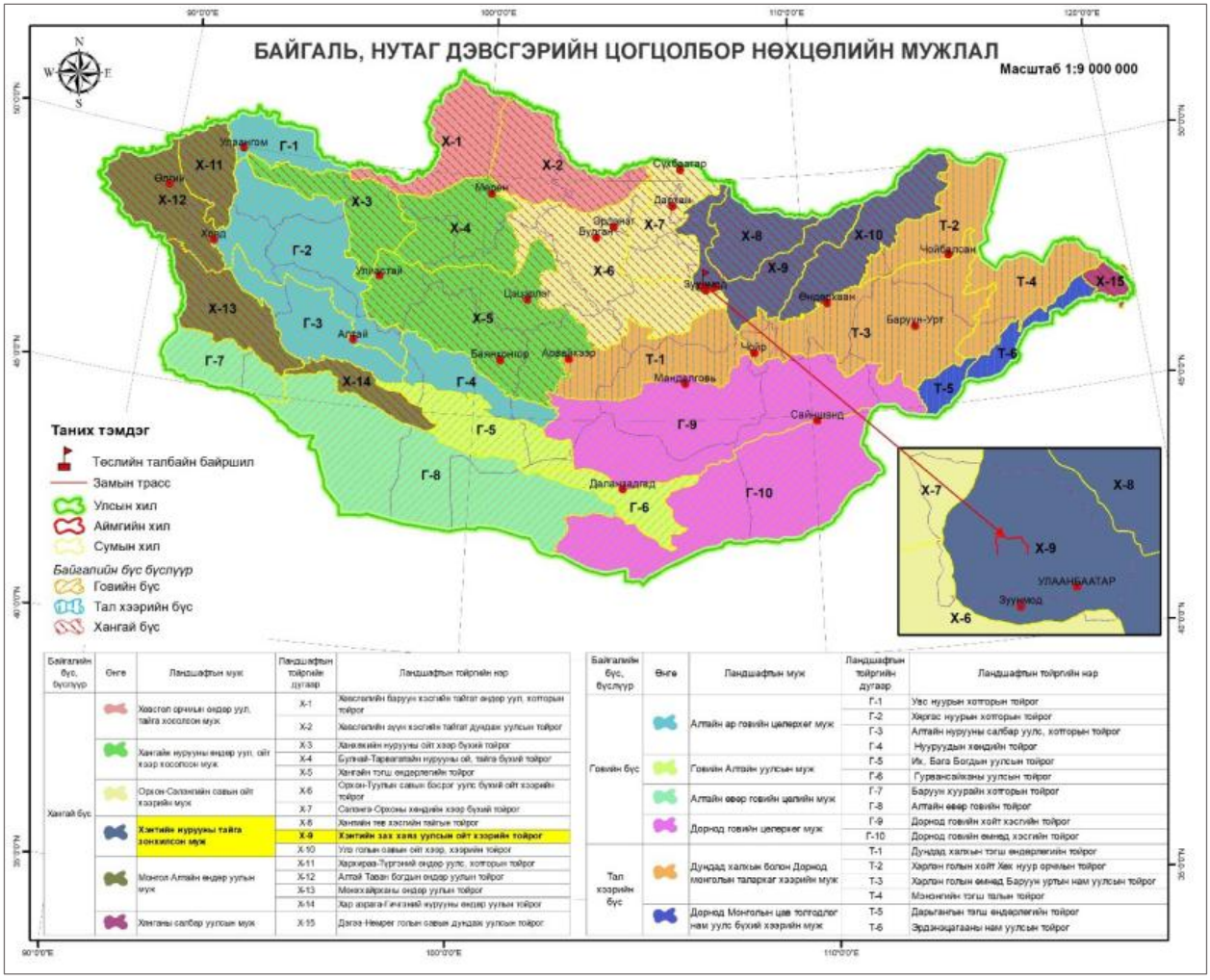


Figure 4. Regionalization of natural–territorial complexes

In the forest-steppe zone of the Khentii fringe mountains (X-9), there are widespread medium-high mountains with flat peaks separated by intermountain depressions that occur along the sides of the Khentii upland plateau. For example: on the eastern side of the Khentii upland, there are Norov gatlin mountain range (2211 m), Delgerkhaan (211 m), Khujirtyn shar ruu (1712 m), Tsorovkhaan (1868 m), on the western side of Khentii, there are Nogon ruu, Manhat, Ugtaal, Khushig, as well as mountains connected by ridges or separate from each other on the southern side, such as Yarguit (2069 m), Erdene (1830 m), Dugui (1835 m). The junction of this zone can be divided into 3 parts according to the surface appearance. These include:

1. Juniper bald mountain range

The absolute height of the mountains in this area is 2000-2500 meters and is located behind and to the northwest of the Great and Small Khentii Ranges. Here, cold weathering is intense on the mountain tops, resulting in the formation of terraces and the surface is becoming flat.

2. A large, rugged mountain range on the edge of a mountain range.

This category includes the mountains located in the western part of the Khentii Mountains in the middle reaches of the Kharaa and Yeruu rivers. The absolute height is 2000-2400 meters, the relative height is 800-1000 meters, they are mostly composed of metamorphic rocks, granite, and ancient sedimentary sediments, and they are the remnants of ancient plains. Gorkhian Mountains. They are located in the eastern part of the Khentii Mountains, and are mostly composed of granite, so they are called granite taramtsag, but there are also plains. In addition to granite, sedimentary

rocks are also distributed. The main members of the junction include mountains such as Khalzan, Altan-Olgii, Bulnai, Bogd Uul, Bayanzurkh, and valley-like depressions such as Nalaikhin Hotgor are quite common.

3. Relic Mountains

This includes the mountains located on the edge of the Khentii mountain range, such as: the Dulaankhaan and Khokhchuluut mountains along the Yeruu River, the Burgaltai mountains along the middle reaches of the Kharaa River, the Zaamar mountains along the great bend of the Tuul River, and the low mountains along the Onon and Balj rivers. The absolute height of the mountains here is 1000-2000 meters, and the relative height is 600-800 meters. The mountains are mainly composed of granite and metamorphic rocks of the Upper Paleozoic era. Between the mountains, ancient depressions filled with loose sediments of the Cretaceous, Tertiary, and Quaternary are abundant. The surface texture is highly dissected, and in some cases, local tectonic faults have formed depressions.

Landscape, terrain

Ulaanbaatar city and its surrounding area are located in the southwestern tip of the Khangai Khentii mountainous region, in the Tuul River valley, which extends 2.5-4 km, in the southwestern branch of the Ikh Khentei mountain range, and in the forest-steppe zone of its sub-region, in the independent highlands of Gorkhi, Terelj, Bogdkhan, Songinokhairkhan, Chingeltei, and Bayanzurkh, with an absolute height of 1950-2265 m above sea level. Along these branches, the Tuul River valley, which extends 2.5-4.0 km, is spread out on the slopes, foothills, and terraces of the above mountains.

The highest point in the territory of Ulaanbaatar city is the peak of Bogdhan Mountain, Tsetse Gun (2256 m), and the lowest point is the Shuvuun Factory District (1203 m) in the Tuul River Valley. The absolute height of the built-up area in the central part of Ulaanbaatar city is 1250-1345 m in the Tuul River Valley and its lower reaches. However, the absolute height of the mountains surrounding the river valley, such as Songinokhairkhan, Chingeltei, Bayanzurkh, Tolgoit, Bayankhoshuu, Bayantsogt, Khoyd Bayan, and Tsagduult, is 1515-1950 m, and the highest peak of Bogdhan Mountain is 2265 m. The average absolute height of the small mountains surrounding Ulaanbaatar city, such as Tolgoit, Bayan Khoshuu, Bayantsogt, Khoit Bayan, and Tsagduult, is 1,513-1,831 m, and the slope of the side slopes is 15-20 degrees, and in some areas it reaches 30-35 degrees.

Natural zones, belts

The area of the highway route is included in the forest-steppe zone of the Mongolian natural zone and zone N. Ulziihutag (1989). The territory of Mongolia has the characteristic of forming several vertical zones due to the change in latitude from north to south. According to this characteristic, the vegetation zone is divided into zones..

1. High mountain (taiga) zone,
2. Mountian-taiga zone,
3. **Forest-steppe zone,**
4. Steppe zone,
5. Desert-steppe zone,
6. Desert zone,

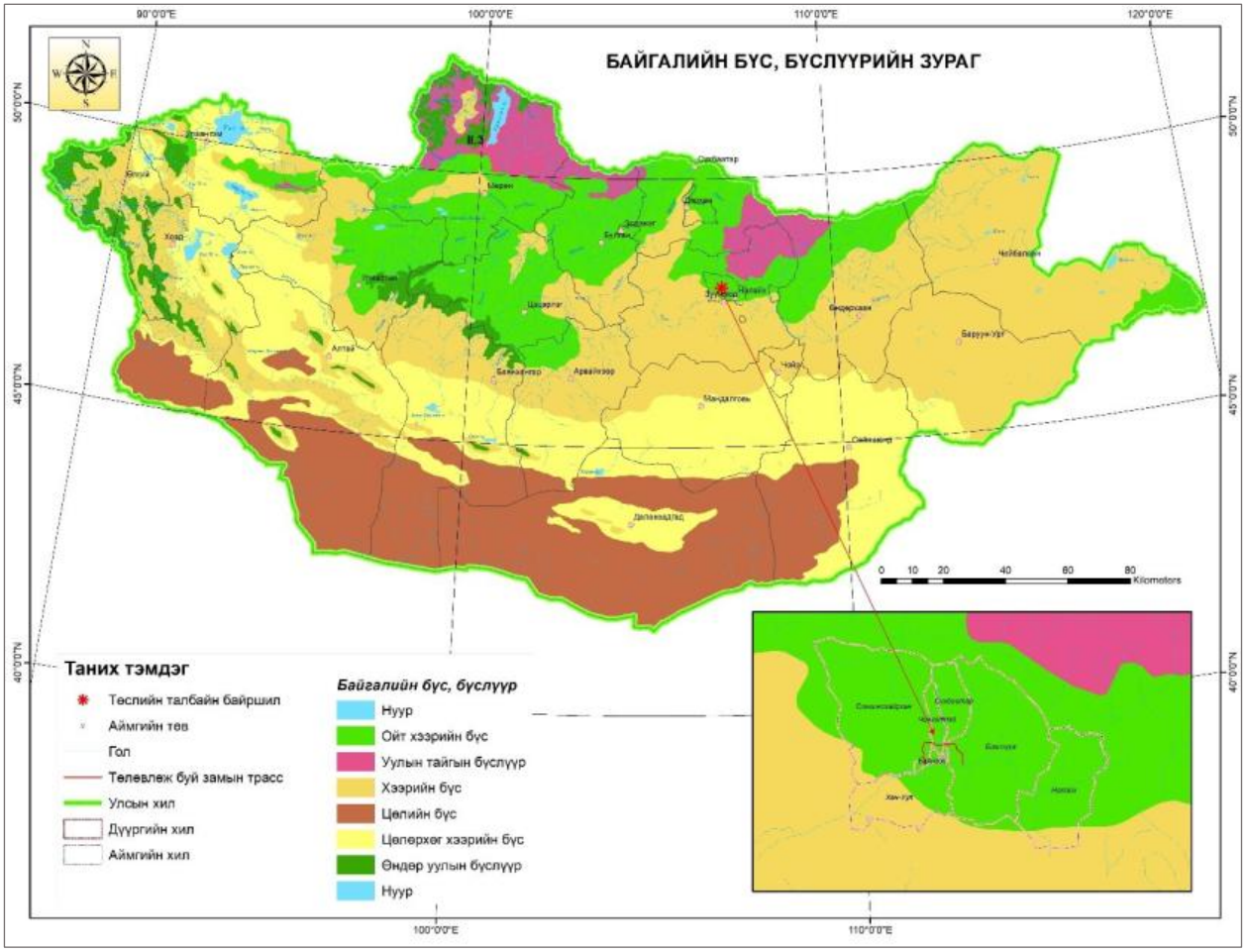


Figure 5. Natural zones and zones of Mongolia

The forest-steppe zone is the northernmost dry steppe and desert of Central Asia, the southernmost limit of the great taiga of East Siberia, the Khangai, Khentii, Altai mountain ranges, the Orkhon-Selenge basin, and the Khyangan mountain range in the easternmost part of Mongolia.

A unique feature of the forest-steppe zone is that the back of the mountains is covered with sparse forests, mainly black spruce, while the upper slopes are mountain-steppe. This feature creates a unique combination of forest and steppe flora and fauna.

In terms of vegetation, on the one hand, the Siberian taiga, on the other hand, representatives of the Mongolian steppe and Dagur species are found, and high-altitude plants of the Altai mountain range are also widespread. Mixed forests with coniferous trees grow mainly here, and variegated grasses grow abundantly.

TWO. CLIMATE

2.1. METEOROLOGICAL AND CLIMATOLOGICAL INDICATORS OF ULAANBAATAR

The Buyant-Ukhaa station in Nishat, which collects meteorological observation data in Ulaanbaatar, was first established in 1936. Currently, in addition to this station, the Ulaanbaatar station, Terelj station, and meteorological observation stations and watchdogs located in Songinokhairkhan district are continuously operating. The basic conditions and state of the regional climate are determined based on the long-term average of the climate of Ulaanbaatar city and the measurement data of the above stations for the last 5 years (2018-2022) as follows.

The climate of Ulaanbaatar is characterized by extremes that fully reflect the continental characteristics of our country's climate. In other words, it has four distinct seasons, reflecting the extreme continental characteristics of the temperate continental climate.

The project area belongs to the humid, cool, and very cold region in terms of climate. Here, winters are relatively cold and snowy, summers are cool and humid, precipitation is abundant, and wind is low. Here, autumn cools down early, spring warms up late, and snow cover lasts the longest. The main climatic conditions in this area are characterized by a continental climate with high daily, monthly, and annual temperature extremes, uneven precipitation distribution, and severe winter cold.

Table 2. Long-term climate averages, 1991-2020

Indicator	Months												Year
	1	2	3	4	5	6	7	8	9	10	11	12	
Sediment, mm	1.6	2.2	4.1	7.6	21.2	44	68.9	62	24.5	7.8	4.9	2.5	251.4
Air temperature, °C	-23.1	-18.3	8.3	2.2	9.2	15.5	17.8	15.4	8.7	-1.1	-12.1	20.7	-1.3
Wind speed, m/s	1.6	2.1	2.9	3.9	4.4	3.5	3.1	2.6	2.9	2.6	2.0	1.6	2.8

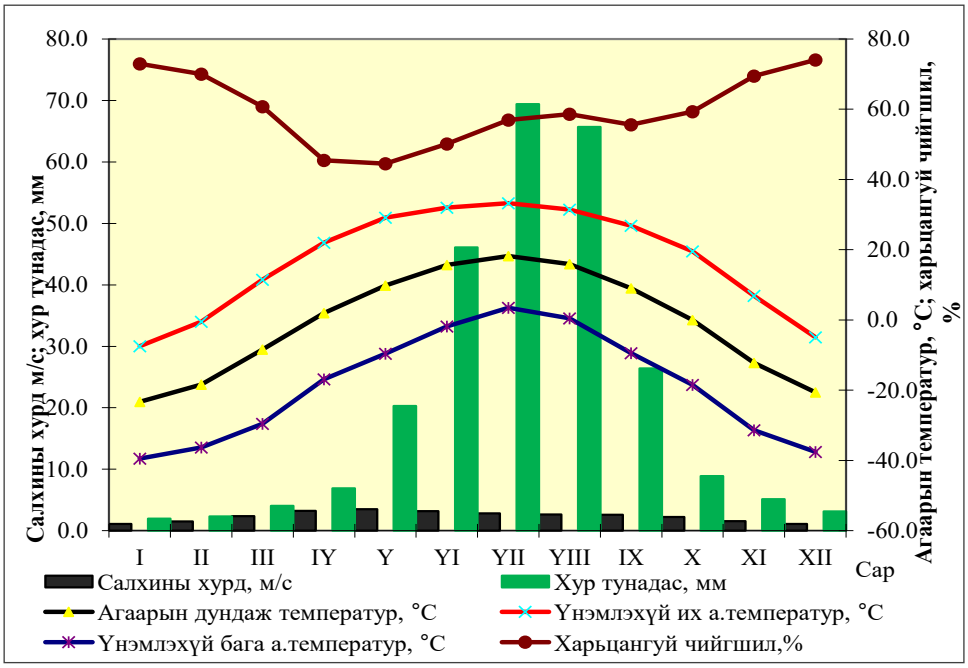


Figure 6. Climate Climatogram of the Ulaanbaatar area

2.1.1. Thermal Regime

The average monthly air temperature in the Ulaanbaatar region (Buyant-Ukhaagaar) in the cold season is -1.3...-23.5°C, in the city (Ulaanbaatar station) -3.9°..-19.2°C, in the highlands (Terelj area) -2.2...-23.5°C. The average monthly air temperature in the cold and warm seasons for July is 15.5-18.5°C.

Due to the characteristics of the continental climate, the air temperature in the cold season of the year warms up as the land surface decreases, and in the warm season it cools down as the land rises. The data on the average monthly temperatures of the stations for the last 5 years are shown in Table 3.

Table 3. Average monthly temperature, °C (2018-2022)

Station	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Ulaanbaatar	-19.2	-15.4	-3.9	4.3	10.4	16.8	18.5	15.9	11.0	1.3	-10.7	-19.3
Buyant-Ukhaa	-23.5	-18.9	-5.7	3.2	9.7	16.4	18.0	15.3	9.7	-1.3	-12.2	-23.5
Terelj	-23.5	-19.2	-8.6	1.2	6.8	12.9	15.5	13.1	6.1	-2.2	-15.2	-20.7

Source: Ministry of National Defense - Archives and Databases Department

The air temperature at the Ulaanbaatar station in recent years has decreased by 3.5-4.5°C in winter and increased by 2.9-3.7°C in summer, showing warming compared to the long-term average, compared to the long-term trend of the climate station. Due to climate warming, the duration of the cold season and the cold reserve are decreasing, while the duration of the warm season is lengthening and the heat reserve is increasing.

Table 4. Annual mean temperature (2018-2022)

Station	Year					5-year average
	2018	2019	2020	2021	2022	
Ulaanbaatar	1.0	1.7	0.0	1.4	0.9	1.0
Buyant-Ukhaa	-1.1	-0.4	-1.7	-0.7	-0.9	-1.0
Terelj	-2.9	-2.7	-3.2	-2.7	-2.6	-2.8

Source: Ministry of National Defense - Archives and Databases Department

Based on the averages of the last 5 years, the average annual temperature in Ulaanbaatar city is 0.2-1°C in the city center, and -1..-2.8°C in the suburbs of Terelj and Nisekh. Compared to the averages of previous years, the Buyant-Ukhaa area has warmed by 2°C and the city center by 0.6°C.5

2.1.2. Solar Insolation and Radiation

The annual sunshine lasts 2636 hours, which is about 60% of the available time, and is reduced by the surrounding mountains and the morning and evening sun, the surrounding clouds, and the air turbidity. The sunshine has a very clear course during the day, month, and year. The average sunshine per day is 7-8 hours, but it varies depending on the cloudiness. but in the summer months, it is 8.5-9.5 hours, and in the winter months, this period is shortened to 5.5-6.5 hours. Depending on the height of the sun, the total radiation is 4490 mJ/m2, and the direct radiation is 2500 mJ/m2 per year. The solar radiation is highest in May and June, when the sun is high and there are few clouds, and the solar altitude is lowest in December and the winter months.

2.1.3. Soil temperature

Some of the solar radiation falling on the surface of the earth is absorbed by the soil, converted from radiant energy to thermal energy, and heats the deep layers of the soil and The physical and chemical processes that support plant life in the soil are carried out under the influence of soil temperature. The amount of this heat consumed depends on the structure, properties, color, heat transfer capacity, heat capacity, humidity, and the unevenness and slope of the earth's surface.

In this environment, the average annual soil temperature at the surface is about minus 0.6°C to -1.1°C, and it warms up deeper into the earth. However, in terms of the penetration of cold and heat into the earth's depths, it is normal that it is slightly colder at 0.8-1.2 m and then warms up even deeper, and it becomes 2.0°C to -2.4°C at 1.6-3.2 meters..

Table 5. Soil climate sub-region indicators

Soil freezing			Soil thawing			0°C penetration depth, cm
Start	End	Date	Start	End	Date	
10.X	10.YI	220	20.IY	1.YII	80	400

Here, the soil freezes gradually from the surface to the depth, on average from October 10 to June 10, and remains frozen for a total of 220 days. The freezing point is 0°C at a depth of 250 cm, and the freezing point of the soil depends on the depth of penetration and the mechanical structure of the soil. The thawing of the soil occurs on average from April 20 to July for 80 days, which can cause deformations in roads and underground utilities, and in some cases, damage.

Some of the solar radiation reaching the surface of the earth is reflected back from it, some is absorbed, and the thermal regime, heating and cooling of the soil are directly dependent on the amount of solar radiation absorbed by the surface of the earth and the amount of heat lost by radiation. The energy from the solar radiation absorbed by the surface of the earth is converted into thermal energy, which heats the soil and the air around the surface of the earth, and penetrates into the soil. However, at night, since there is no radiation from the sun, the soil loses its accumulated heat by radiating it. At this time, the ambient air also cools down deep into the ground. In other words, during the day, the soil heats up when sunlight hits it, and cools down during the night. This income and expenditure of soil heat is called the soil heat balance. The soil heat balance is positive during the day, negative at night, and has a positive sign in the warm season of the year and a negative sign in the cold season. The soil heat balance regime and amount determine the soil temperature reserve, which has many useful and important purposes. Soil temperature has a significant impact on plant life, especially during the early stages of development, such as germination and rooting. The soil temperature regime depends on geographical latitude and weather conditions, as well as soil type, structure, properties, heat conductivity, heat capacity, moisture, and elevation. While air temperature is formed due to atmospheric gas movement and physical phenomena, soil temperature is the result of physical and chemical phenomena in the soil, which is a synthetic system of living organisms, organic matter, and mineral species.

2.1.4. Air pressure

The time it takes for the human body to adapt to the environment varies depending on the air pressure. Human blood pressure fluctuates, and when the weather changes, the difference between days of air pressure increases to 8 hPa or more, which negatively affects people with chronic diseases, and the air becomes uncomfortable and stuffy due to reduced oxygen supply.

The air pressure is 844 hPa (633 mm of mercury column height) per year, decreasing in the summer months (837-840 hPa) and steadily increasing in the winter months (845-847 hPa).

2.1.5. Humidity Regime

Absolute humidity is expressed as the water vapor pressure in the air. In Ulaanbaatar, the absolute humidity is 4.4-4.8 hPa on average per year. Since the water vapor pressure depends mainly on the air temperature, it is lowest in Buyant Ukhaad in winter and highest in Takhilta in summer, with its maximum value in the annual process being 11.2-12.3 hPa in summer and 0.5-1.0 hPa in winter (Table 6).

Table 6. Humidity indicators

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Absolute humidity, hPa	0.5	0.8	1.8	2.9	4.6	8.6	12.0	10.4	6.2	3.3	1.4	0.7	4.4
Relative humidity, %	75	73	66	50	47	56	65	65	64	65	72	75	64
Deficiency humidity, hPa	0.2	0.4	1.3	4.1	7.1	9.4	8.4	7.4	4.8	2.7	0.8	0.2	3.9

Source: Hydrometeorological, Environmental Research and Information Institute

Air humidity is a key climate indicator that has the greatest impact on the infrastructure sector. The annual average relative humidity around Ulaanbaatar is about 61-64%, with the lowest in Khurelthog and the highest in Buyant Ukhaad. The annual average humidity deficiency is 3.5-3.9 hPa. In winter, due to low air temperatures and close to saturation, the humidity deficiency is the lowest, around 0.2-0.5 hPa, and increases with increasing air temperature, reaching a maximum of 7.7-9.4 hPa in June. At this time, the air temperature is high, but the rainy season has not yet fully begun. However, in July and August, despite the heat, there is a lot of rain, so the humidity deficiency will decrease from June.

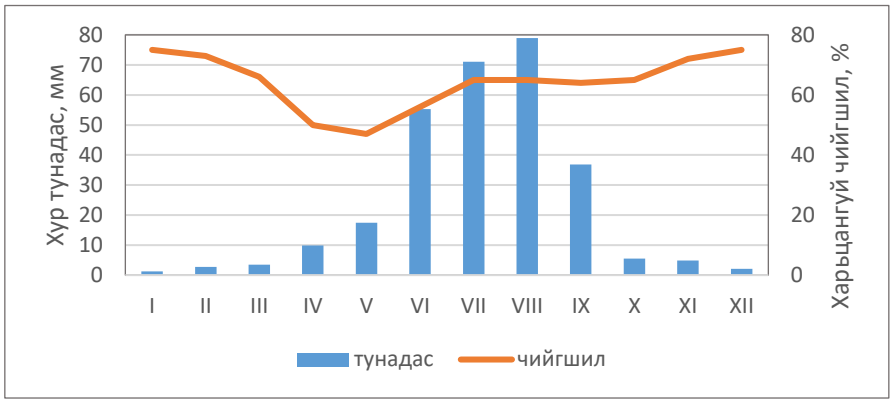


Figure 7. Annual precipitation distribution and relative humidity trends

2.1.6. Precipitation

The long-term history of precipitation in Ulaanbaatar shows a sharp decrease in recent years. For example, from 1961 to 2006, precipitation decreased by 0.399 mm/year, from 1981 to 2006 by 1.357 mm/year, and from 1990 to 2006 by 5.0 mm/year. The intensity of precipitation in this region is increasing due to climate warming. Precipitation data for 2018-2022 is shown in Table 7.

Table 7. Total monthly precipitation, in mm (2018-2022)

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual total
Ulaanbaatar	1.2	2.7	3.5	9.9	17.4	55.3	71.1	78.9	36.8	5.5	4.9	2.1	289.3
Buyant-Ukhaa	1.1	3.5	2.9	11.3	14.0	54.3	81.2	78.5	33.6	5.4	4.8	2.0	292.6
Monthly average	1.1	1.3	5.8	7.5	16.3	39.3	72.0	56.1	28.3	8.2	5.9	1.7	-

Source: Ministry of National Defense - Archives and Databases Department

Ulaanbaatar city receives 289-293 mm of precipitation, 90 percent of which falls in the warm season (April-September). Very little precipitation falls in the cold season.

2.1.7. Wind Regime

In the Ulaanbaatar region, the average annual wind speed in the city center is 1.4-1.9 m/s, and in the Buyant-Ukhaa area it is 2.9-3.1 m/s.

Table 8. Average annual wind speed

Station	2018	2019	2020	2021	2022	5-year average
Ulaanbaatar	1.7	1.9	1.4	1.9	1.8	1.7
Buyant-Ukhaa	3.1	3.0	3.0	3.0	2.9	3.0

Source: Ministry of National Defense - Archives and Databases Department

Table 9. Average monthly wind speed, m/s (2018-2022)

Station	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Ulaanbaatar	0.9	1.3	1.8	2.3	2.5	2.4	2.1	1.9	2.1	1.7	1.3	0.9
Buyant-Ukhaa	1.6	2.1	3.0	4.0	4.6	4.0	3.4	3.1	3.3	3.0	2.2	1.6

Source: Ministry of National Defense - Archives and Databases Department

The average wind speed in the windiest month of spring is 2.3-4.6 m/s. Considering the frequency of wind speeds at different speeds, it is likely that winds with speeds of 0-1 m/s are dominant in winter, and winds with speeds of 3-4 m/s become more prevalent in spring.

Table 10 Maximum wind speed, m/s

	Year	Month											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Buyant-Ukhaa	2014	14	14	19	20	19	16	16	18	21	15	14	10
	2015	14	14	15	19	24	20	23	22	22	17	13	13
	2016	12	15	19	20	19	16	15	16	15	17	14	11
	2017	13	17	15	19	20	24	17	17	17	13	13	14
	2018	11	14	18	19	22	17	17	15	17	14	16	12

Source: Ministry of National Defense - Archives and Databases Department

The highest speed at the Buyant-Ukhaa station over the past 5 years was 24 m/s in May 2015 and June 2017.

Table 11. Buyant-Ukhaa station wind direction and windless period frequency (%) for 2018-2022

Month	No wind	N	NW	E	SE	S	SW	W	NW
I	12.8	0.8	4.9	42.1	9.5	2.3	8.5	24.1	8.0
II	9.2	1.9	7.9	35.2	6.6	1.9	6.1	29.5	11.1
III	6.2	2.9	14.6	26.3	5.4	1.9	7.3	25.3	16.3
IV	6.1	5.6	14.2	18.6	5.6	3.1	6.6	25.4	20.8
V	4.8	5.3	13.6	17.0	6.0	2.5	8.5	21.6	25.4
VI	6.9	7.8	18.0	17.1	7.5	3.9	8.1	16.2	21.4
VII	9.8	6.7	19.6	20.9	10.6	4.2	7.9	13.5	16.7
VIII	6.0	4.3	18.9	23.3	7.3	4.2	8.4	14.7	18.9
IX	5.9	3.7	16.5	23.1	5.0	3.3	7.8	20.1	20.6
X	8.1	2.8	14.4	28.0	5.3	2.1	7.3	25.3	14.9
XI	9.6	1.2	9.7	42.4	8.6	2.8	5.8	19.2	10.3
XII	13.0	0.8	6.7	41.0	10.8	1.4	8.0	23.0	8.5
Annual average	8.2	3.6	13.2	27.9	7.3	2.8	7.5	21.5	16.1

Source: Ministry of National Defense - Archives and Databases Department

As can be seen from the table above, the annual average easterly wind in the Buyant-Ukhaa area is 27.9% frequent, and especially in winter, the frequency of this wind direction is clearly dominant. This is a lateral wind following the Tuul Valley. In other words, during a strong temperature

inversion, cold air flows from highlands to lowlands by gravity. The frequency of the easterly wind following the Tuul River is high.

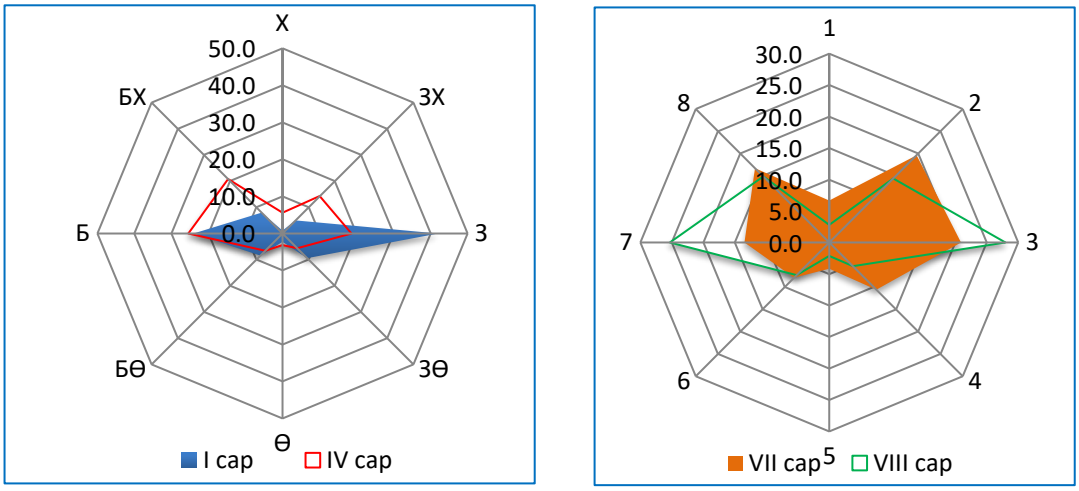


Figure 8. Буянт-Ухаа орчмын сүүлийн 5 жилийн зарим саруудын салхины чиглэлийн давтагдал, %

2.1.8. Solar Insolation and Radiation

The annual sunshine lasts 2636 hours, which is about 60% of the available time, and is reduced by the surrounding mountains and the morning and evening sun, the surrounding clouds, and the air turbidity. The sunshine has a very clear course during the day, month, and year. The average sunshine per day is 7-8 hours, but it varies depending on the cloudiness, but in the summer months it is 8.5-9.5 hours, and in the winter months this period is shortened to 5.5-6.5 hours. Depending on the height of the sun, the total radiation is 4490 mJ/m2 and the direct radiation is 2500 mJ/m2 per year. The solar radiation is highest in May and June, when the sun is high and there are few clouds, and the solar altitude is lowest in December and the winter months.

2.1.9. Soil temperature

Some of the solar radiation falling on the surface of the earth is absorbed by the soil, converted from radiant energy to thermal energy, and heats the deep layers of the soil, and the physical and chemical processes that support plant life in the soil are carried out under the influence of soil temperature. The amount of this heat consumed depends on the structure, properties, color, heat transfer capacity, heat capacity, humidity, and the unevenness and slope of the earth's surface. In this environment, the average annual soil temperature at the surface is about minus 0.6°C to -1.1°C, and it warms up deeper into the earth. However, in terms of the penetration of cold and heat into the earth's depths, it is normal that it is slightly colder at 0.8-1.2 m and then warms up even deeper, and it becomes 2.0°C to -2.4°C at 1.6-3.2 meters.

Table 12. Soil-climatic microzone indicators

Soil freezing			Soil thaw			0°C penetration depth, cm
Start	End	Date	Start	End	Date	
10.X	10.YI	220	20.IY	1.YII	80	400

Here, the soil freezes gradually from the surface to the depth, on average from October 10 to June 10, and is stored for a total of 220 days. Freezing occurs at a depth of 250 cm at 0°C, and the freezing of the soil depends on the depth of penetration and the mechanical structure of the soil. Soil thawing occurs on average from April 20 to July for 80 days, causing deformations and, in some cases, damage to roads and underground utilities.

Some of the solar radiation reaching the surface of the earth is reflected back from it, and some is absorbed, and the thermal regime, heating and cooling of the soil are directly dependent on the amount of solar radiation absorbed by the surface of the earth and the amount of heat lost by

radiation. The energy of the solar radiation absorbed by the surface of the earth is converted into thermal energy, which heats the soil and the air around the surface of the earth, and penetrates into the soil. However, at night, since there is no radiation from the sun, the soil loses its accumulated heat by radiation and cools down. At this time, the ambient air also cools down deep into the ground. In other words, the soil heats up during the day when solar radiation is coming, and cools down during the night when it is being radiated. This income and expenditure of soil heat is called the soil heat balance. The soil heat balance is positive during the day and negative at night, and it is positive in the warm season of the year and negative in the cold season. The soil heat balance regime and amount determine the soil temperature reserve, which is of great importance for many purposes. Soil temperature has a special effect throughout the life of plants, especially during the early stages of development, i.e. germination and rooting. The soil temperature regime depends on the geographical latitude and weather conditions, as well as on the type, structure, properties, heat conductivity, heat capacity, moisture, elevation, and slope of the soil. While air temperature is formed due to the movement of atmospheric gases and physical phenomena, soil temperature is the result of physical and chemical phenomena in the soil, which is a synthetic system of living organisms-organic matter-mineral species.

2.2. HAZARDOUS (EXTREME) PHENOMENA

A total of 42 disasters of 9 types occurred in the Tuul River basin and around Ulaanbaatar between 2001 and 2022. Of these, heavy rain and flash floods accounted for 24% of the total, and strong winds (snowstorms and dust storms) accounted for 22%. Over the years, the number of disasters has tended to decrease, while the number of disasters caused by heavy rain and flash floods has tended to increase.

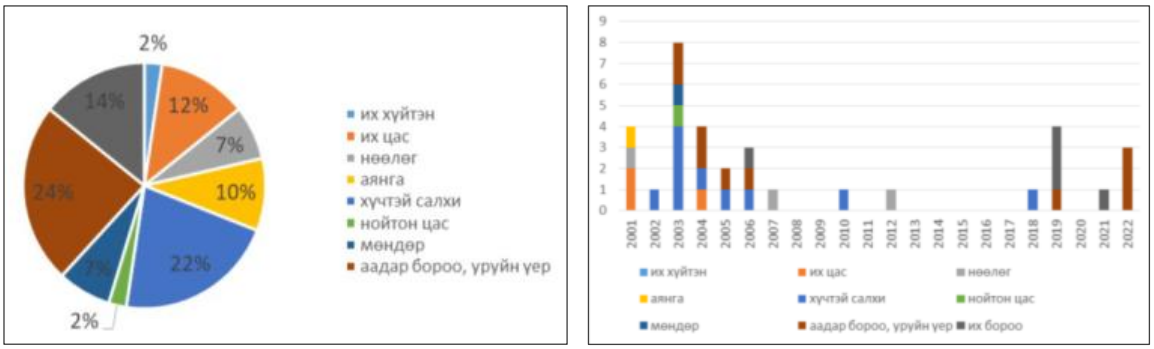


Figure 9. Occurrence of hazardous events, 2001–2022

2.3. CLIMATE CHANGES IN ULAANBAATAR CITY

In assessing climate change, data from weather stations with the longest observation series in history were used to derive the multi-year trends in average annual air temperature and total annual precipitation, and then evaluated using a linear trend method (slope coefficient).

The following figure shows the multi-year course of their deviations compared to the baseline period of 1961-1990, when the impact of climate change was relatively weak. In Ulaanbaatar, relatively warm years have continued since the 1990s, and the warming intensity has increased by 2.49°C since 1940. The total annual precipitation increased by 6.6% over the same period, which is reflected in the dry periods with low rainfall from 1995-2010 and 2013-2022, as shown in Figure 9.

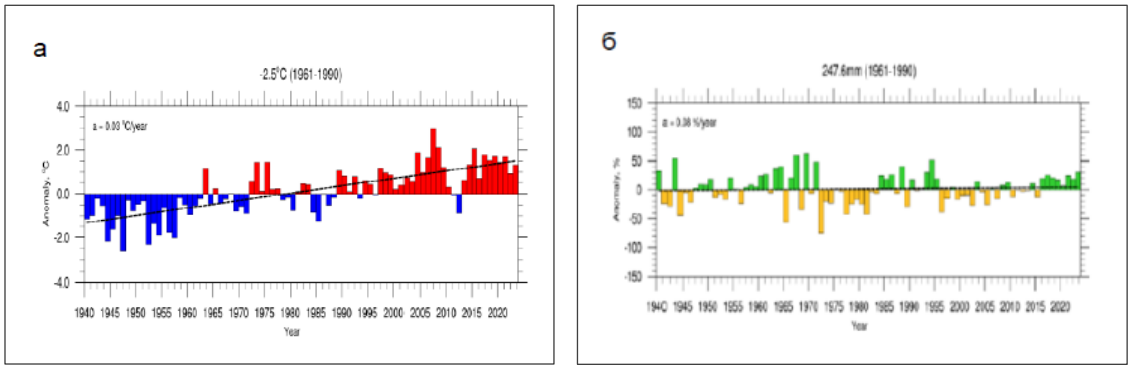


Figure 10. Buyant-Ukhaa meteorological station: (a) annual mean temperature; (b) multi-year trend of total precipitation

Table 13 shows the seasonal climate change of Ulaanbaatar city compared to the baseline period at the Buyant-Ukhaa meteorological station in terms of temperature (0C) and precipitation (%). The intensity of air temperature change is 4.10C in winter and 1.660C in summer, indicating a relatively intense warming in winter. In terms of precipitation, summer rainfall decreased by 10.8% in the middle and lower reaches of the river basin, while winter snowfall increased by 34.0% in the upper reaches of the river.

Table 13. Seasonal climate change (1941-2023)

Station name	Temperature, ^{0}C		Precipitation, mm	
	Winter	Summer	Winter	Summer
Buyant-Ukhaa	4.1 (-22.5)	1.66 (15.4)	34.0 (5.1 мм)	1.7 (183.4 мм)

THREE. AIR QUALITY AND PHYSICAL POLLUTION

Since the route of the new ring road passes through five districts of Ulaanbaatar city, the air quality data of Ulaanbaatar city was used to determine the status.

3.1. FORMATION PROCESSES AND CHARACTERISTICS OF COMMON AIR POLLUTANTS

Sulfur dioxide: Sulfur dioxide (SO2) is a harmful gas that is produced by the combustion of fuels containing sulfur. Sulfur dioxide is produced by the combustion of fuels in coal-fired power plants, factories, metallurgical and steel plants, coal-fired domestic furnaces, and vehicles. The toxicity of sulfur dioxide is manifested in symptoms such as shortness of breath and throat irritation at high concentrations, and it damages the respiratory system.

Nitrogen dioxide: Nitrogen dioxide (NO2) is a gas produced by the heat absorption reaction during high-temperature combustion and is another cause of environmental pollution. The main sources are the combustion of fuel in vehicles and thermal power plants. Ground-level ozone is a by-product of nitrogen dioxide and is a strong oxidant, so when ozone concentrations are high, it damages the outer tissues of animals and plants. Nitrogen oxides have the effect of causing acute respiratory inflammation, asthma, and bronchitis.

Carbon monoxide: Carbon monoxide (CO) is often produced as a byproduct of combustion, especially under stoichiometric conditions. However, the proportion of CO released from combustion is not as high as that of CO2. Incomplete combustion can result in significant CO emissions. Carbon monoxide causes oxygen deprivation and overloads the cardiovascular system. Inhalation of carbon monoxide can cause dizziness, headaches, and in severe cases, coma and even death.

Dust particles: Dust particles from various sources are present in urban air and have negative impacts on human health and the environment depending on their aerodynamic size, chemical composition, water solubility, light absorption and scattering, and concentration in ambient air.

Noise and vibration: Noise and vibration propagate in the surrounding environment in the form of oscillating waves and have a negative impact on humans, animals, and plants. The distribution patterns of noise and vibration are the same, and the negative impact on the natural environment (humans, animals, plants, cities, and buildings) is similar. The main sources of noise and vibration are various industrial and repair sites, as well as road, air, and rail transport.

3.2. LOCATIONS OF AIR QUALITY MONITORING STATIONS AND MEASURED INDICATORS

There are 19 air quality monitoring stations operating throughout Ulaanbaatar city. The locations of the stations are shown in the image below.

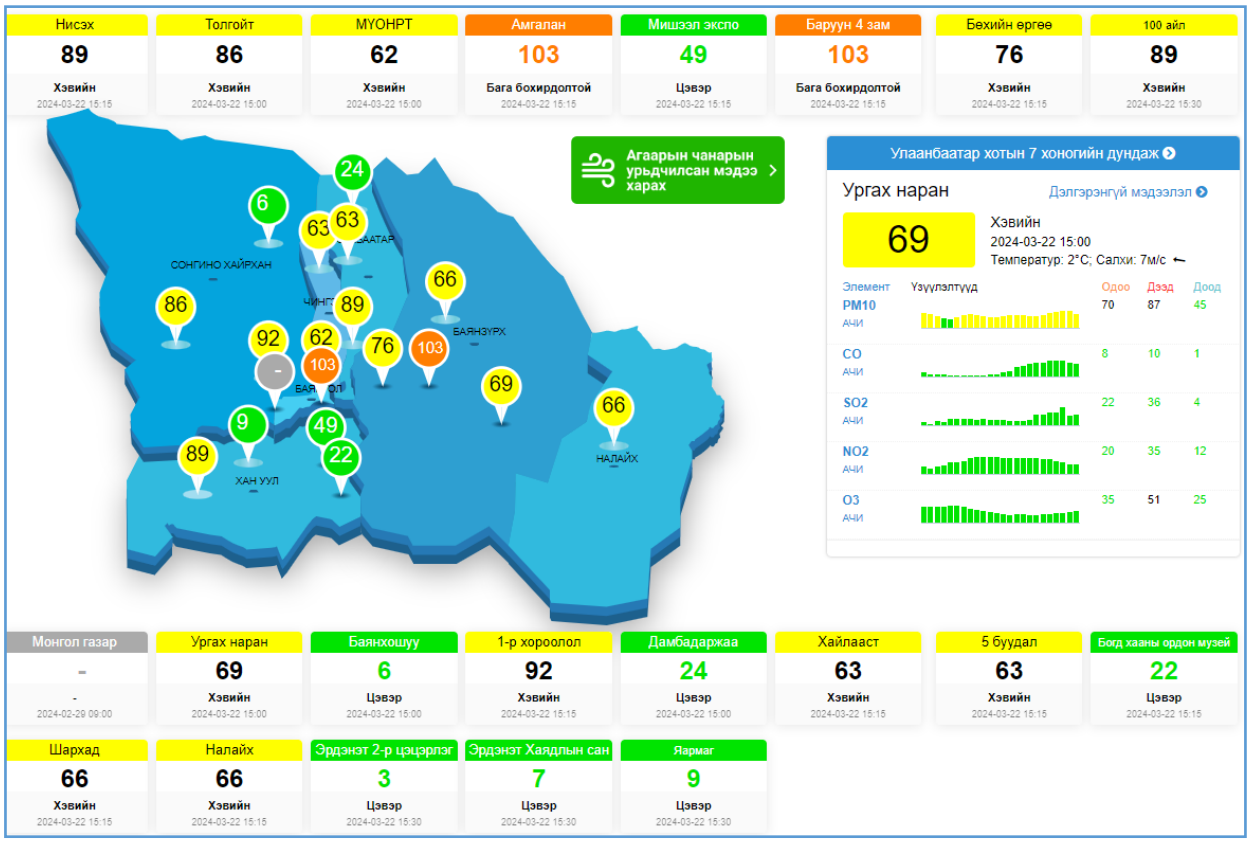


Figure 11. Location of air quality monitoring stations in UB

3.3. ANNUAL AIR QUALITY STATUS OF ULAANBAATAR IN 2023

The air quality of Ulaanbaatar city in 2023 was determined by automatic equipment at 17 points around ger districts, highways, residential areas, and industrial districts, including the concentrations of air pollutants sulfur dioxide (SO2), nitrogen dioxide (NO2), PM2.5, PM10 particles, carbon monoxide (CO), and ozone (O3).

Compared to the average annual concentration of air pollutants in 2022, PM2.5 particles were at the same level, sulfur dioxide was 7 µg/m3 or 11% lower, PM10 particles were 6 µg/m3 or 7% lower, and nitrogen dioxide was 1 µg/m3 or 2% lower (Table 14).

Table 14. Annual average concentrations of air pollutants, 2020-2023

Name of the pollutant	Air quality standard MNS 4585:2016	Annual average concentration, µg/m3			
	Tolerable concentration, µg/m3	2020 year	2021 year	2022 year	2023 year
PM2.5 particles	25	49	44	41	41
Sulfur dioxide, SO_2	20	47	66	63	56
PM10 particles	50	90	89	88	82
Nitrogen dioxide, NO_2	40	37	36	40	39

PM2.5 particulate matter

The annual average concentration of PM2.5 particles in the air of Ulaanbaatar city in 2023 is 41 µg/m3, which is the same level as in 2022.

In 2012-2023, it was 1.6-4.2 times higher than the permissible concentration in the Air Standard MNS 4585:2016, with the highest concentration in 2012 and the lowest concentration in 2022-2023.

According to the results of the last 10 years, the concentration of PM2.5 particles in 2022 and 2023 decreased compared to previous years, or 2.5 times lower than in 2012 (Figure 12).

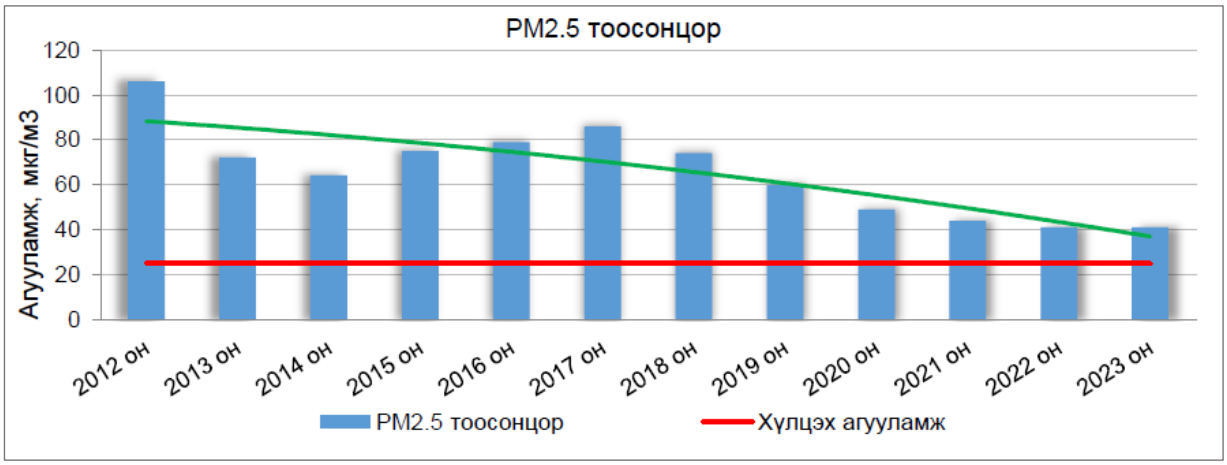


Figure 12. Annual average PM2.5 concentration in Ulaanbaatar

In the warm season, the 24-hour average concentration of PM2.5 particles exceeds the permissible concentration in the air quality standard in a few cases, while in the cold season, the pollution exceeds the permissible concentration in most points (Figure 13).

The annual average concentration of PM2.5 particles in 2023 is 1.3 times higher than the permissible concentration around Baruun 4 zam (UB-2), 2.1 times higher around 1-r khorolol (UB-3), 2.5 times higher around Hailaast (UB-11), 2.5 times higher around 5-n khola (UB-12), 1.5 times higher around Nalaikh (UB-15), 1.2 times higher around Nisekh, 1.4 times higher around Tolgoit, 1.9 times higher around Zuraat, 1.2 times higher around Amgalan, and 3.1 times higher around Bayankhoshuu.

However, the annual average concentration around District 13 (UB-4) and Bogd Khan Palace Museum (UB-13) did not exceed the permissible concentration.

PM2.5 particle monitoring in the air was conducted at a total of 13 points in 2023, and out of 3985 24-hour average measurements, the permissible concentration was exceeded in 961 times, or 24% of the total measurements, which is 85% higher than in 2022.In 2023, the maximum concentration reached 510 µg/m3 in the Bayankhoshuu area, while in 2023, it also reached 557 µg/m3 in the Bayankhoshuu area, which is 11.1 times higher than the permissible concentration, and an increase compared to the previous year.

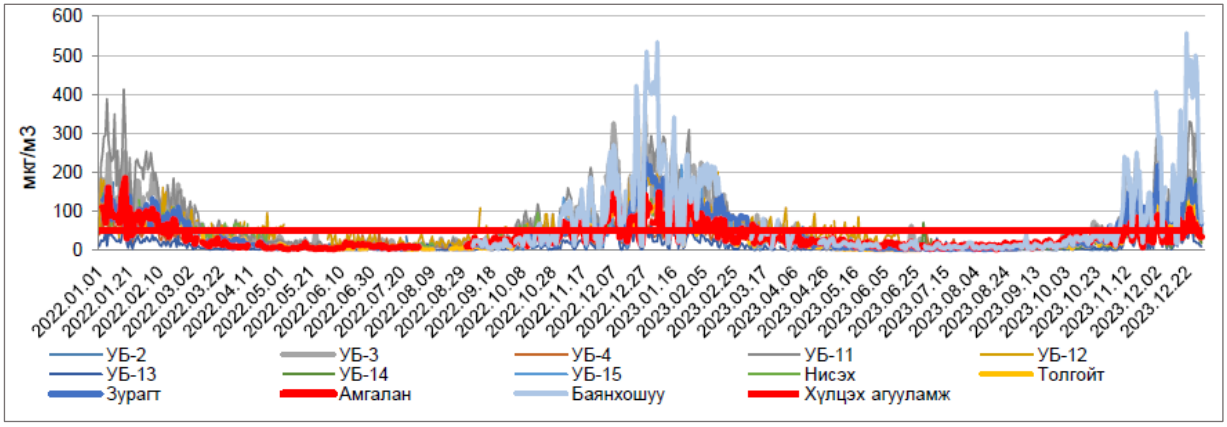


Figure 13. 24-hour average concentration of PM2.5 particles in the air of Ulaanbaatar city

Sulfur dioxide-SO_2

The annual average concentration of sulfur dioxide in the air of Ulaanbaatar city in 2023 is 56 µg/m3, which is 7 µg/m3 or 11% lower than in 2022. It was 1.1-3.3 times higher than the permissible concentration in 2000-2023, and the annual average maximum concentration was 66 µg/m3 in 2021 (Figure 14).

Figure 14. Average annual concentration of sulfur dioxide in the air of Ulaanbaatar city

The trend of the 24-hour average concentration of sulfur dioxide shows that it is lower than the permissible concentration in the air quality standard from April to October 2023, or at a clean and normal level according to the air quality index.

However, in the cold season, January-April and October-December, the permissible concentration was exceeded at all monitoring points, and air pollution increased dramatically. The highest 24-hour average concentration of sulfur dioxide was detected in December 2023 (Figure 15).

The average annual concentration of sulfur dioxide in 2023 for each air quality monitoring station is 1.3 near Misheel Expo (UB-1), 1.4 near Baruun 4-n zam (UB-2), 4.6 near 1-r khorolol (UB-3), 1.3 near Bokhin Ingyo (UB-4), 1.8 near 100-n ayl (UB-5), 1.1 near Power Plant (UB-7), 1.1 near Urgah Naran khorolol (UB-8), 2.9 near Hailaast (UB-11), 2.9 near 5-n khola (UB-12), 3.3 near Sharkhad (UB-14), 2.7 near Nalaikh (UB-15), 2.6 near Nisek, 4.8 near Tolgoit, 4.7 near Zuraat, 2.8 near Amgalan, and 6.9 near Bayankhoshuu. again, respectively, but did not exceed the acceptable concentration near Zaisan (UB-13). In 2023, out of 5,586 measurements taken at 17 points with a 24-hour average, 1,579 cases or 28% of the total measurements exceeded the

permissible concentration, which is 28% lower than in 2022. According to the overall results of the monitoring, the maximum 24-hour average concentration of sulfur gas reached 748 µg/m3 near Bayankhoshuu, which is 14.9 times higher than the permissible concentration. While the highest concentration in 2022 reached 765 µg/m3 near Tsura, the maximum concentration in 2023 was 17 µg/m3 lower.

Sulfur dioxide is mainly produced from the combustion of various types of coal containing sulfur, refined fuels, and organic fuels, such as gasoline, and increases in the coldest months of the year, January-February and November-December, in connection with the consumption of raw coal and fuel consumption by motor vehicles.

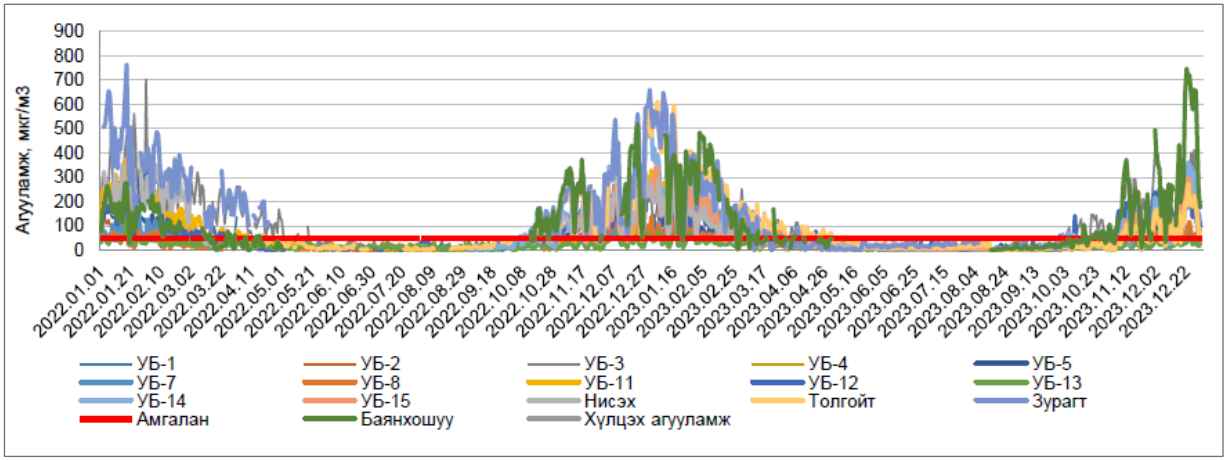


Figure 15. 24-hour average concentration of sulfur dioxide in the air of Ulaanbaatar city

PM10 particles

The annual average concentration of PM10 particles in the air of Ulaanbaatar city in 2023 is 82 µg/m3, which is 6 µg/m3 or 7% lower than in 2022. The highest concentration was in 2012 and the lowest concentration was in 2023. Based on the results of the last 13 years, the concentration of PM10 particles in 2020-2023 is 35-171 µg/m3 lower than in previous years (Figure 16).

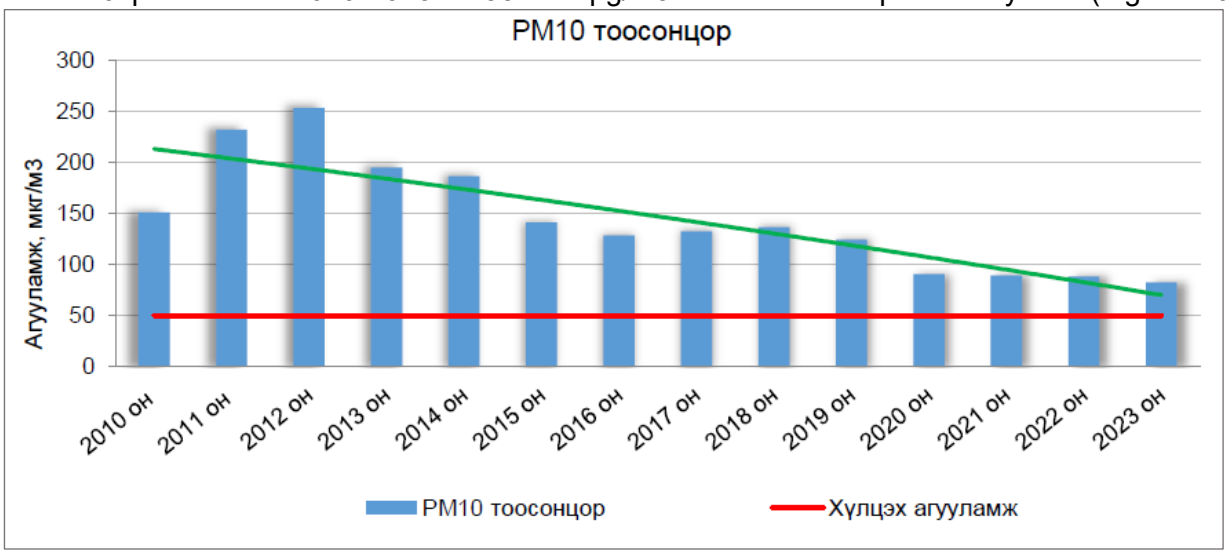


Figure 16. Average annual concentration of PM10 particles in the air of Ulaanbaatar city

The 24-hour average concentration of PM10 particles in the air of Ulaanbaatar city exceeds the air quality standard in Bayankhoshuu, Elektronsthan, Hailaast, and around 100 households in the warm season, and in Zaisan in the cold season.

In the cold season, particles emitted from coal combustion pollute the air, while in the warm season, during the dry season in spring and summer, there is a high concentration of particles generated by wind-blown dust, roads, roads, and construction work.

The daily concentration of PM10 particles in the air shows that, like PM2.5 particles and sulfur dioxide, it increases sharply in the cold season and is lower than the tolerable concentration in the warm season (Figure 17).

In the cold season, seasonal effects such as waste smoke and dryness from the combustion of raw coal and petroleum products and weather conditions such as air temperature, wind speed, inversion, and precipitation cause the concentration of particles in the air to increase.

The average annual concentration of PM10 particles in 2023 at each air quality monitoring station is 1.2 times higher than the permissible concentration around Misheel Expo (UB-1), 1.7 times higher around Baruun 4-n zam (UB-2), 2 times higher around 1-r khorolol (UB-3), 1.6 times higher around Bokhin Ingoe (UB-4), 2.2 times higher around 100-n ayl (UB-5), 2.2 times higher around Elektristanst (UB-7), 1.4 times higher around Urgah Naran khorolol (UB-8), 1.8 times higher around Hailaast (UB-11), 1.6 times higher around 5-n khola (UB-12), 1.8 times higher around Sharkhad (UB-14), 1.3 times higher around Nalaikh (UB-15), 1.2 times higher around Zuraat, 1.5 times higher around Amgalan, and 3.1 times higher around Bayankhoshuu, while Zaisan (UB-13), The air quality around Niseh and Tolgoit did not exceed the permissible concentration.

PM10 particle monitoring in the air was carried out at a total of 17 points, and out of 5714 measurements taken in 2023, the permissible concentration was exceeded in 1604 times, or 28% of the total measurements, which is 20% lower than in 2022.

In 2023, the maximum 24-hour average concentration of PM10 particles reached 607 µg/m3 in the Bayankhoshuu area, which is 6 times higher than the permissible concentration. However, the highest concentration in 2022 also reached 684 µg/m3 in the Bayankhoshuu area, while the maximum concentration in 2023 was 77 µg/m3 lower.

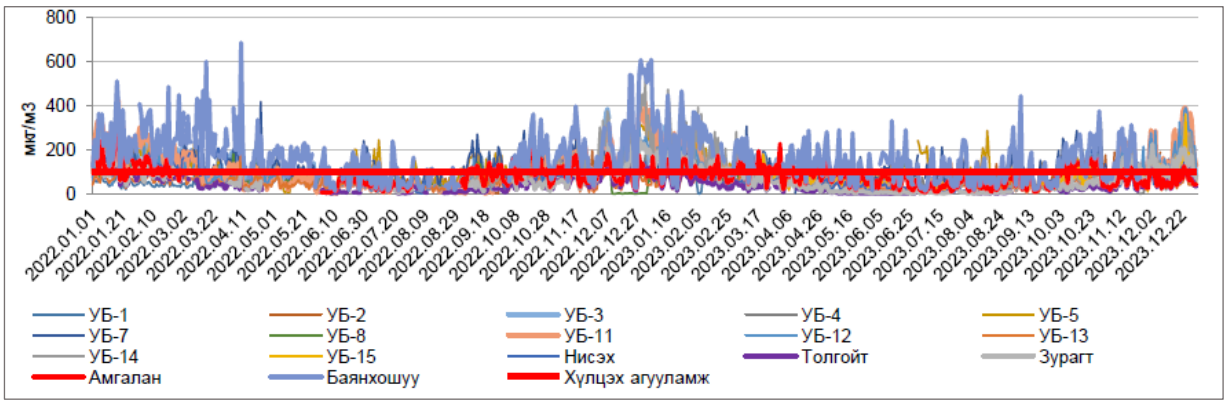


Figure 17. 24-hour average concentration of PM10 particles in the air of Ulaanbaatar city

Nitrogen dioxide, NO_2

The annual average concentration of nitrogen dioxide in the air of Ulaanbaatar city in 2023 is 39 µg/m3, which is 1 µg/m3 or 2% lower than in 2022. Over the past 23 years, the annual average concentration of nitrogen dioxide in the air of Ulaanbaatar city reached its highest level in 2013, when it was twice as high as the permissible concentration in the air quality standard, but did not exceed the permissible concentration in 2016-2023 (Figure 18).

Figure 18. Average annual concentration of nitrogen dioxide in the air of Ulaanbaatar city

The 24-hour average concentration of nitrogen dioxide in the air of Ulaanbaatar city shows that the pollution level is higher in the cold season, January-April and October-December, than in other months, and the pollution is higher near major central highways, as shown by the results of the Baruun 4 Road (UB-2), 13th District (UB-4) and Power Plant (UB-7) monitoring stations (Figure 19).

The average annual concentration of nitrogen dioxide in 2023 for each air quality monitoring station is 1.9 times higher than the permissible concentration near Baruun 4 Road (UB-2), 1.3 times higher than the permissible concentration near 1st District (UB-3), 1 time higher than the permissible concentration near Bokhin Ingyo (UB-4), 1 time higher than the permissible concentration near Power Plant (UB-7), and 1.1 times higher than the permissible concentration near Sharkhad (UB-14).

However, the air quality around Misheel Expo (UB-1), 100-n Ayl (UB-5), Urgah Naran Khorool (UB-8), Hailaast (UB-11), 5-n Kholo (UB-12), Zaisan (UB-13), Nalaikh (UB-15), Nisekh, and Zurat Amgalan did not exceed the permissible concentration.

Nitrogen dioxide monitoring was conducted 5067 times in a 24-hour average, and exceeded the permissible concentration 1333 times or 26% of the time, which is 19% less than in 2022. In December 2023, the maximum 24-hour average concentration of nitrogen dioxide reached 243 µg/m3 near 100 households, which is 4.8 times higher than the permissible concentration.

Nitrogen compounds emitted from air pollution sources are unstable and, under the influence of sunlight, undergo photochemical reactions with oxygen in the air to form ground-level or tropospheric ozone. As air temperature decreases and the weather gets colder, the concentration of nitrogen dioxide in the air increases and the concentration of ozone decreases.

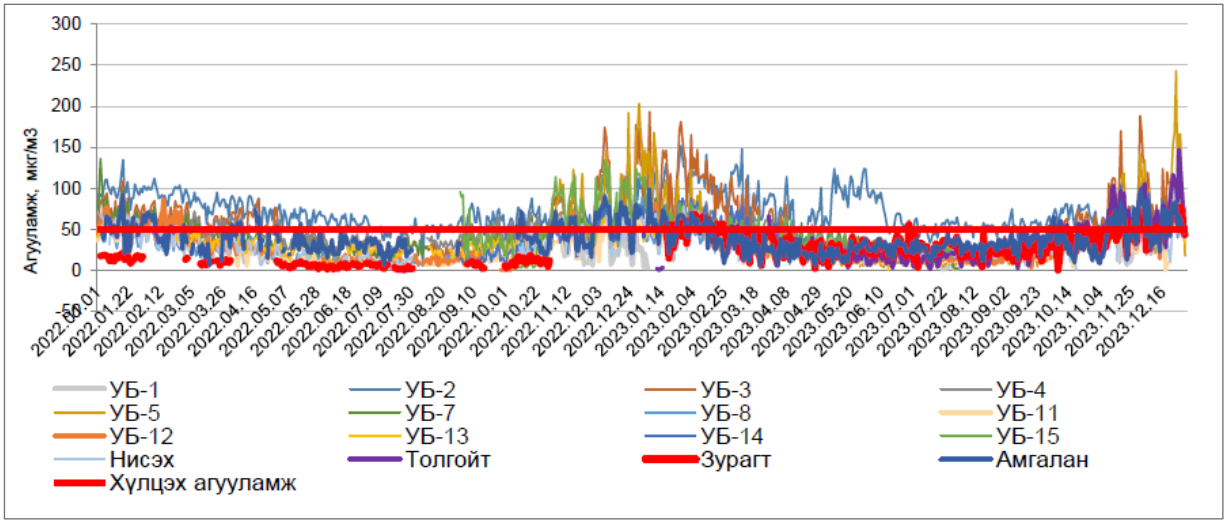


Figure 19. 24-hour average concentration of nitrogen dioxide in the air of Ulaanbaatar city

Carbon monoxide, CO

Carbon monoxide is a pollutant that is released into the air from all types of incomplete combustion and can cause serious adverse effects on human health in the short term.

The annual average concentration of carbon monoxide in the air from 2010 to 2023 was 863-1410 µg/m3, with the highest concentration in 2021 and the lowest concentration in 2013. In 2023, the annual average concentration of carbon monoxide reached 1241 µg/m3, which is 36 µg/m3 or 3% lower than in 2022.

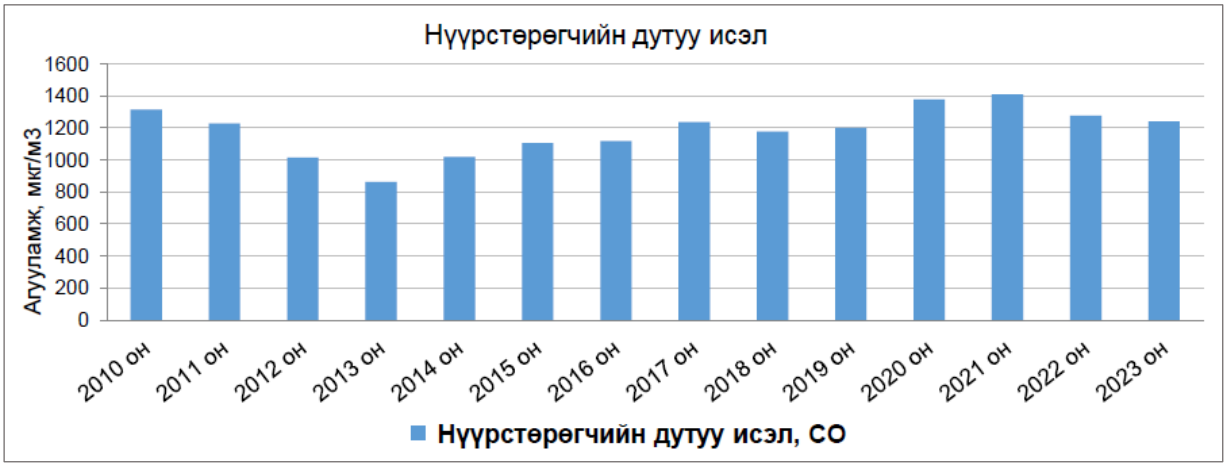


Figure 20. Average annual carbon monoxide concentration in the air of Ulaanbaatar city

In 2023, out of a total of 15,829 8-hour average measurements of carbon monoxide, the permissible concentration in the air quality standard was exceeded 3 times near West 4th Road (UB-2), 13 times near 1st District (UB-3), 1 time near 100 households (UB-5), 6 times near Hailaast (UB-11), 6 times near Sharkhad, 5 times near Nisek, 48 times near Tolgoit, and 17 times near Zuraut, for a total of 99 times or 0.6% of all measurements.

Carbon monoxide concentrations increase dramatically in the cold season, but cases of exceeding the permissible concentration in ambient air are relatively rare.

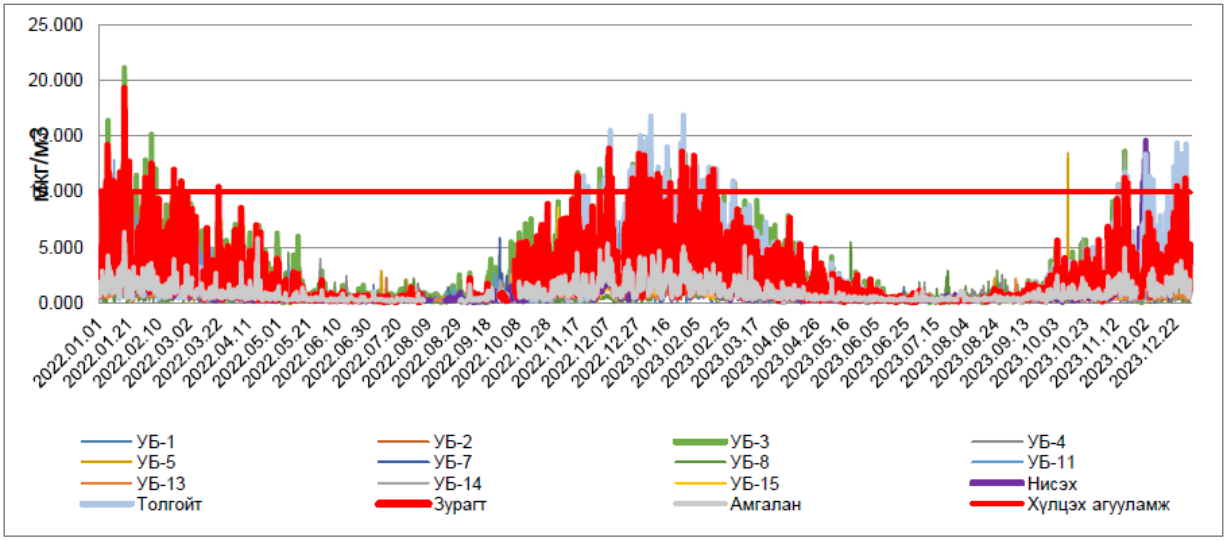


Figure 21. 8-hour average concentration of carbon monoxide in the air of Ulaanbaatar city

Ozone, O_3

Pollutants (sulfur dioxide, nitrogen oxides, and hydrocarbons) emitted directly into the air from air pollution sources react with the sun's ultraviolet rays to form ground-level ozone, and ozone concentrations in the air increase during hot, sunny summer days, which is unique among other pollutants.

Ozone, like carbon monoxide, is a pollutant that can cause serious adverse effects on human health in the short term. Therefore, air quality standards set short-term, 8-hour average, tolerable concentrations. The average annual concentration of ozone in the air from 2011 to 2023 was 19-40 µg/m3, with the highest concentration in 2017 and the lowest concentration in 2012. In 2023, the average annual concentration of ozone will reach 28 µg/m3, which is 4 µg/m3 or 12 percent lower than in 2022.

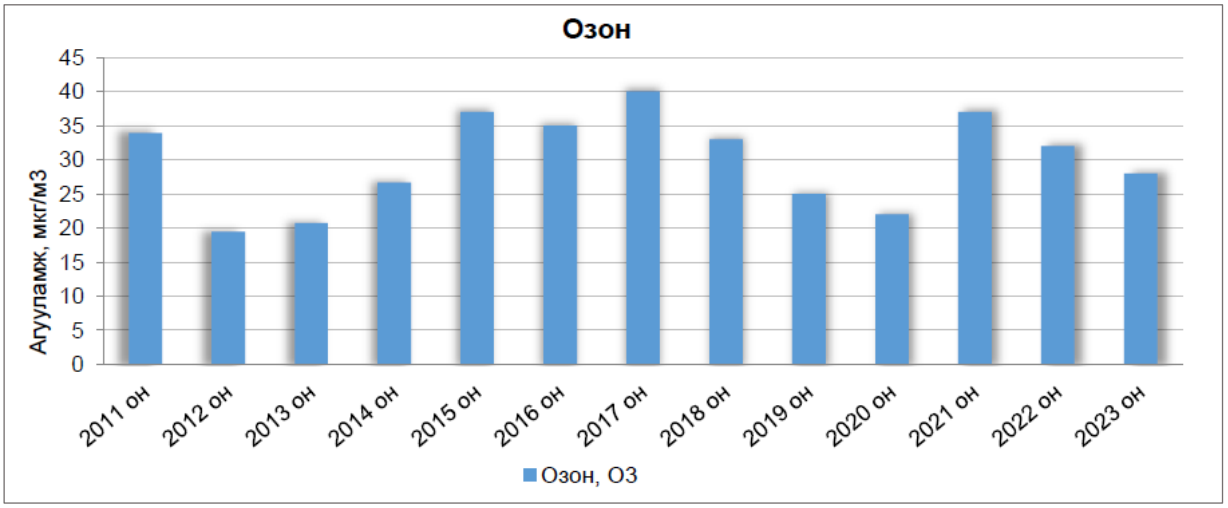


Figure 22. Average annual ozone concentration in the air of Ulaanbaatar city

Out of a total of 10,068 measurements of 8-hour average ozone levels in 2023, the permissible concentration in the air quality standards was exceeded 26 times in the Nisek area, 17 times in the Tolgoit area, 3 times in the Zuluat area, and 4 times in the Amgalan area, or a total of 50 times.

The above-mentioned monitoring results of Ulaanbaatar city show that the concentration of common pollutants in the air (except ozone) increases dramatically in the cold season due to

fires. Therefore, information on air quality during the cold season of last year, i.e. January-April and October-December of 2021-2023, has been additionally included in this report.

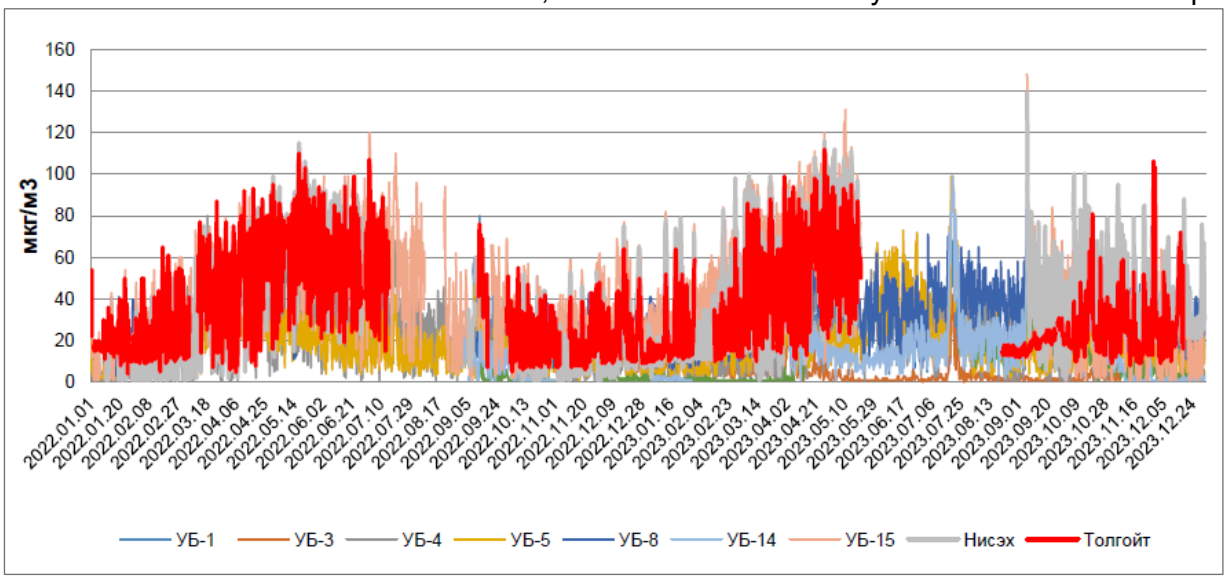


Figure 23. 8-hour average ozone concentration in the air of Ulaanbaatar city

3.4. WINTER-SEASON AIR QUALITY IN ULAANBAATAR (2021–2025)

The air quality of Ulaanbaatar city is determined by continuous automatic measurement devices at 19 points around ger districts, highways, residential areas, and industrial districts for air pollutants such as sulfur dioxide (SO2), nitrogen dioxide (NO2), PM2.5, PM10 particles, carbon monoxide (CO), ozone (O3), and meteorological parameters. Compared to the average concentration of air pollutants in Ulaanbaatar city in February 2025, nitrogen dioxide (NO2) is 12 µg/m3 or 18% lower, sulfur dioxide (SO2) is 33 µg/m3 or 28% lower, PM2.5 particles are 21 µg/m3 or 24% lower, and PM10 particles are 6 µg/m3 or 6% higher.Хүснэгт 1. Агаар дахь бохирдуулах бодисын 2024, 2025 оны 02 дугаар сарын дундаж агууламж

Name of the pollutant	Air quality standard MNS 4585:2016 Tolerable concentration, µg/m3	Monthly average concentration, µg/m3	
		February 2024	February 2025
PM10 particles	100	107	113
PM2.5 particles	50	86	65
Sulfur dioxide, SO_2	50	117	84
Nitrogen dioxide, NO_2	50	65	53

Source: www.tsag-agaar.gov.mn

The monthly average levels of each major air pollutant in Ulaanbaatar City for February 2025 are shown in the figure below (Figure 24).

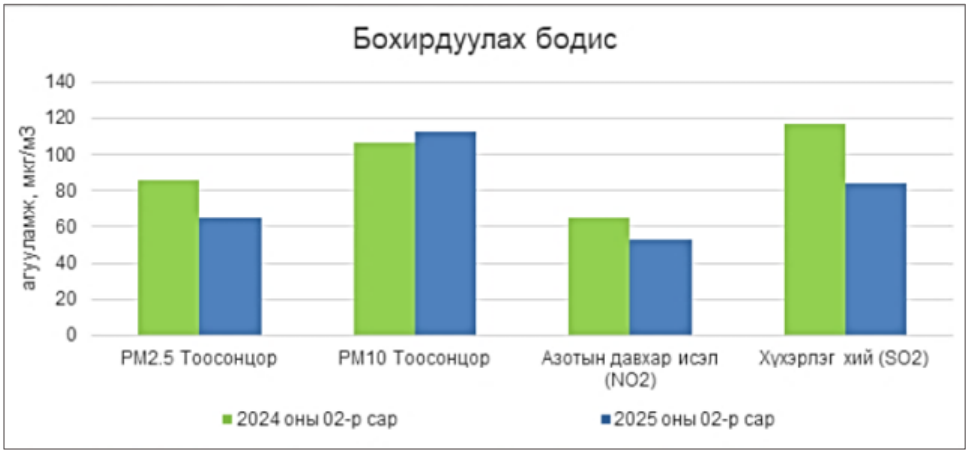


Figure 24. Average air pollutant concentrations for February 2024 and 2025

The concentrations of each major pollutant in the cold season of Ulaanbaatar city over the past 5 years are shown in the following section.

PM2.5 particles

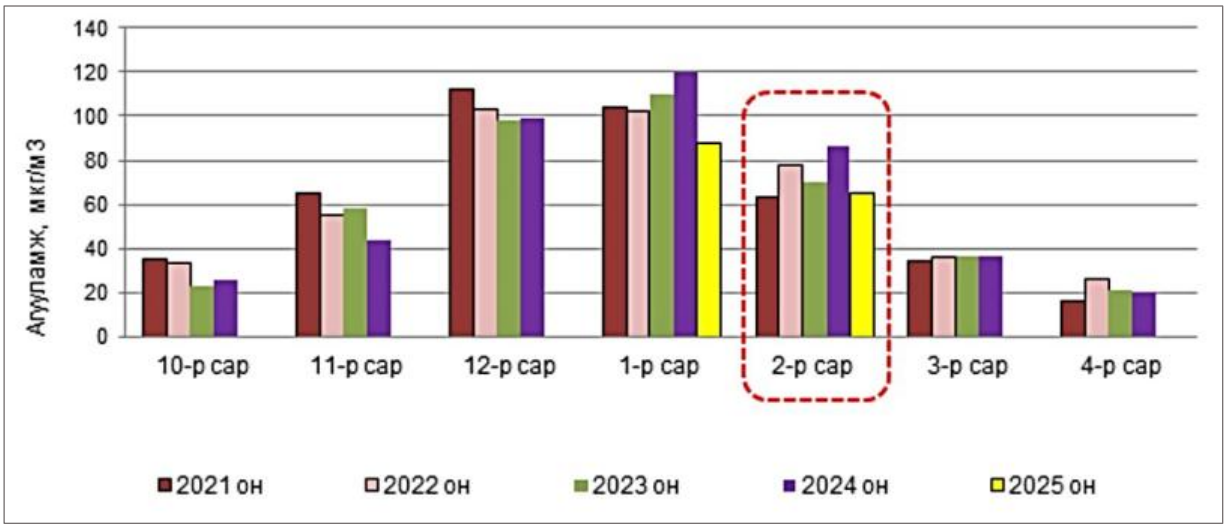


Figure 25. Average PM2.5 concentration in February, 2021-2025

The average concentration of PM2.5 particles in the air of Ulaanbaatar in February 2025 is 2 µg/m3 or 3% higher than the average concentration in February 2021, 5-13 µg/m3 or 7-17% lower than the average concentration in February 2022 and 2023, and 21 µg/m3 or 24% lower than the average concentration in February 2024. (Figure 25).

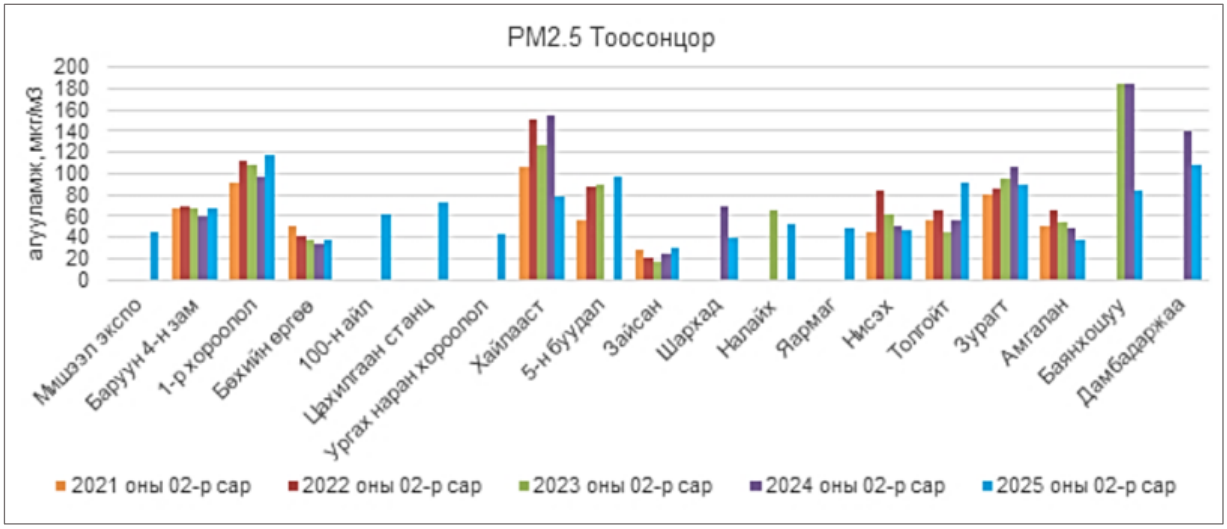


Figure 26. Average PM2.5 concentration for February by station

The monthly average PM2.5 concentration in February 2025 was 45 µg/m3 at Misheel Expo, 61 µg/m3 at 100 households, 73 µg/m3 at the Power Plant, 43 µg/m3 at Urgah Naran Khorool, 97 µg/m3 at the 5th Hotel, 53 µg/m3 at Nalaikh, and 48 µg/m3 at Yarmag. Compared to February 2024, the ASF was lower in Hailaast by 77 µg/m3, in Sharkhad by 30 µg/m3, in Nisek by 5 µg/m3, in Zulaat by 16 µg/m3, in Amgalan by 12 µg/m3, in Bayankhoshuu by 101 µg/m3, and in Dambadarjaa by 31 µg/m3, while it was higher in Baruun 4-n zam by 9 µg/m3, in Khorool 1 by 20 µg/m3, in Bokhin Uygo by 4 µg/m3, in Zaisan by 5 µg/m3, and in Tolgoit by 34 µg/m3. (Figure 26).

PM10 particles

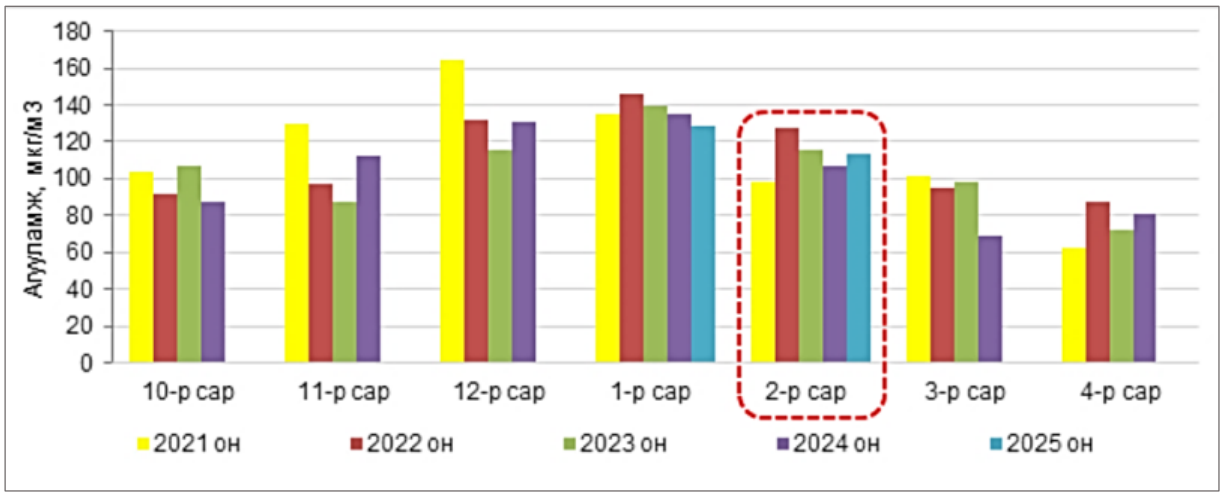


Figure 27. PM10 concentration in January, 2021-2025

The average concentration of PM10 particles in the air of Ulaanbaatar in February 2025 is 15 µg/m3, or 15% higher than the average concentration in February 2021, but 3-15 µg/m3, or 2-12% lower than the average concentration in February 2022 and 2023, and 6 µg/m3, or 6% higher than the average concentration in February 2024 (Figure 27).

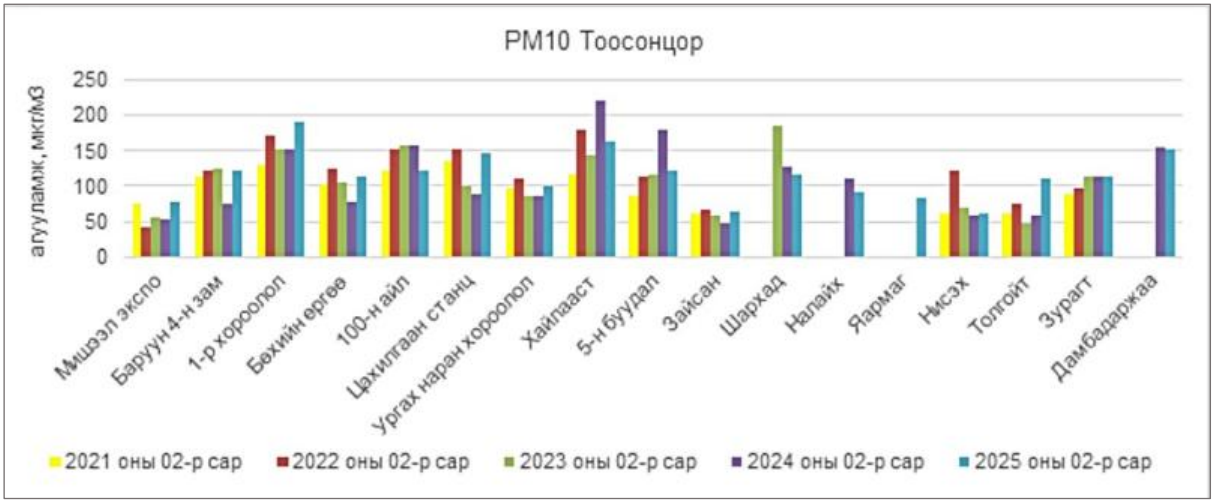


Figure 28. Average PM10 concentration for February by station

The average PM10 concentration in February 2025 in Yarmag is 82 µg/m3. Compared to the average concentration in February 2024, the levels in 100 households were 36 µg/m3, in Hailaast 59 µg/m3, in 5-n-khal 60 µg/m3, in Sharkhad 10 µg/m3, in Nalaikh 18 µg/m3, and in Dambadarjaa ASF were 2 µg/m3 lower, while in Michel Expo 25 µg/m3, in Baruun 4-n zam 45 µg/m3, in 1-r khorolol 38 µg/m3, in Bukhin Uygo 35 µg/m3, in Elektstantsk 57 µg/m3, in Urgah Naran khorolol 14 µg/m3, in Zaisan 15 µg/m3, in Nisek 2 µg/m3, in Tolgoit 52 µg/m3, and in Zuraat 2 µg/m3. The difference is large (Figure 28).

Nitrogen dioxide (NO2)

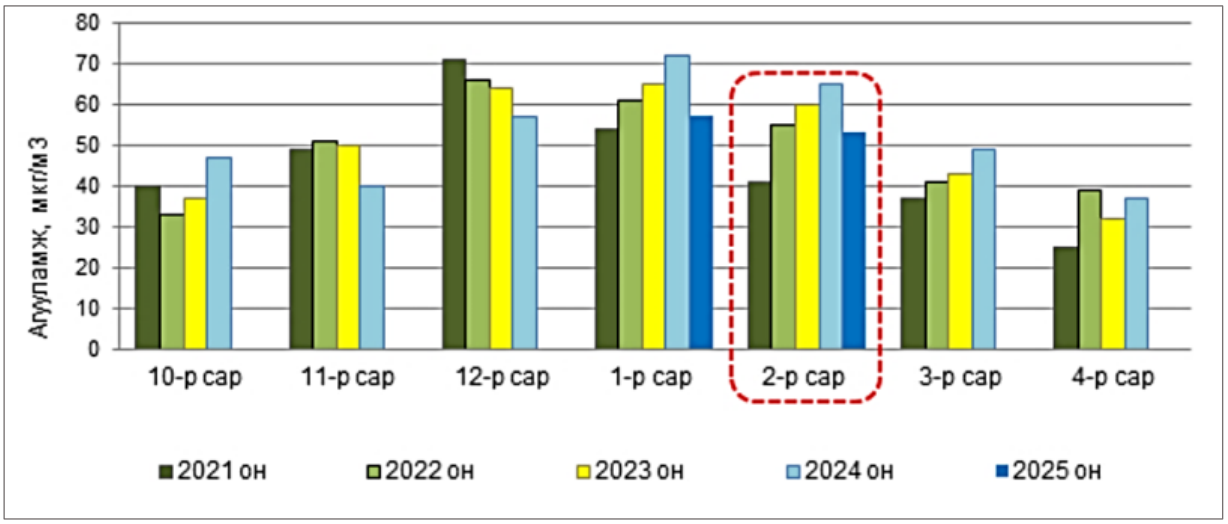


Figure 29. Average nitrogen dioxide concentration in February, 2021-2025

The average concentration of nitrogen dioxide (NO2) in February 2025 is 12 µg/m3, or 29%, higher than in February 2021. However, it is 2-7 µg/m3, or 4-12% lower than in February 2022 and 2023, and 12 µg/m3, or 18% lower than in February 2024 (Figure 29).

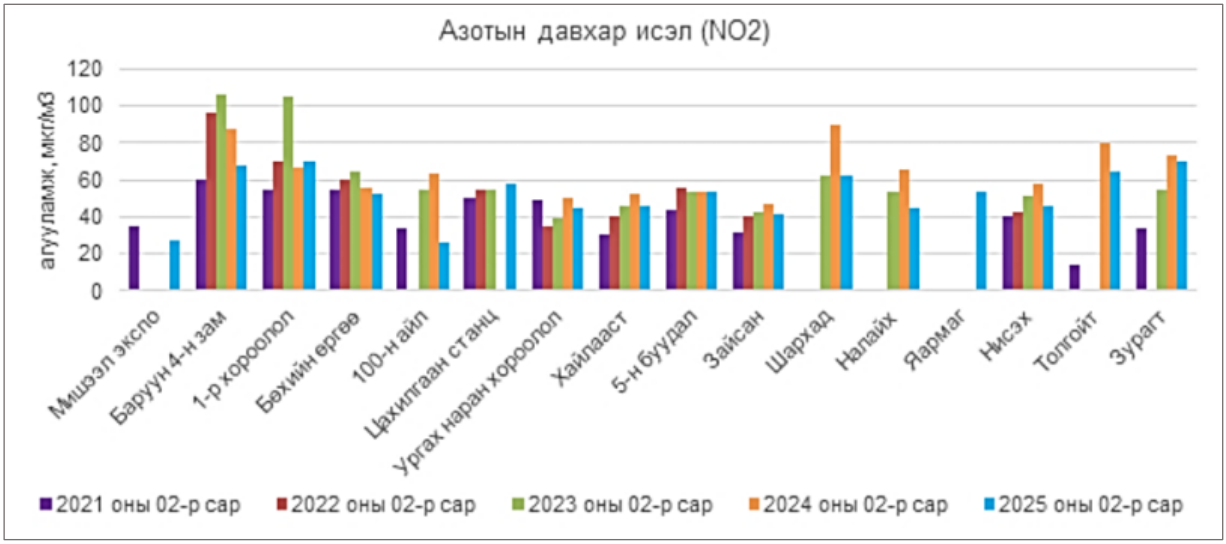


Figure 30. Азотын давхар ислийн 02 дугаар сарын дундаж агууламж харуул тус бүрээр

The average nitrogen dioxide (NO2) concentration in February 2025 at Michel Expo is 27 µg/m3, at the Power Plant 58 µg/m3, and at the Fair 54 µg/m3. Compared to February 2024, the West 4th Road is 20 µg/m3 lower than the ASF, the Bokhin Ingoe is 3 µg/m3 lower, the 100th House is 37 µg/m3 lower, the Urgah Naran District is 5 µg/m3 lower, the Hailaast is 7 µg/m3 lower, the Zaisan is 5 µg/m3 lower, the Sharkhad is 28 µg/m3 lower, the Nalaykh is 21 µg/m3 lower, the Nisek is 12 µg/m3 lower, the Tolgoit is 25 µg/m3 lower, and the Zulaat is 3 µg/m3 lower, while the 5th Station is at the same level, while the 1st District is 3 µg/m3 higher (Figure 30).

Sulfur dioxide (SO2)

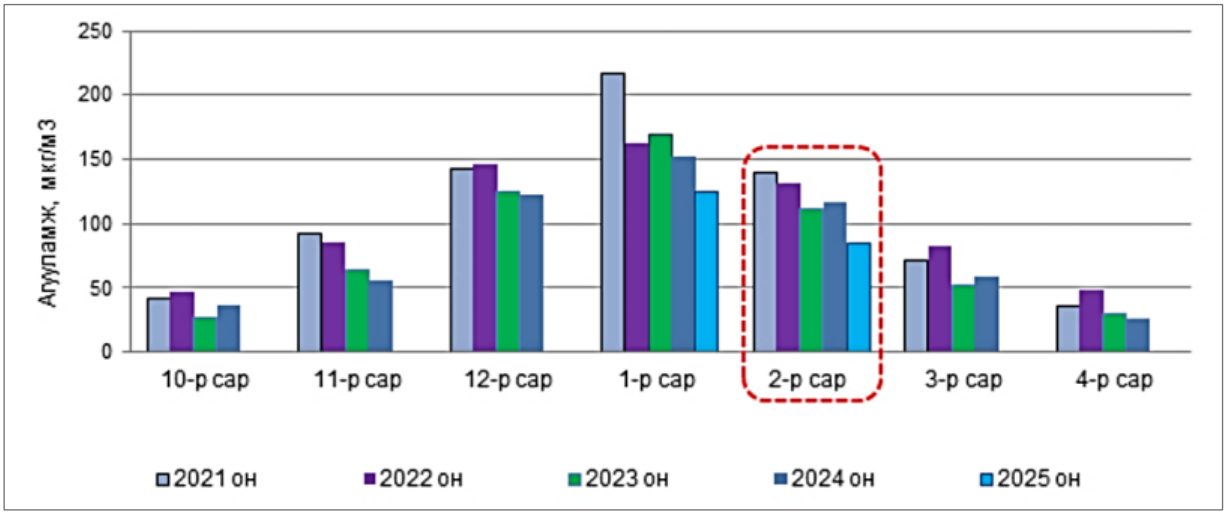


Figure 31. Average sulfur dioxide concentration in February, 2021-2025

The average concentration of sulfur dioxide (SO2) in the air in February 2025 was 27-55 µg/m3, or 24-39% lower than the average concentration in February 2021-2023, and 33 µg/m3, or 28% lower than the average concentration in February 2024, the same period of the previous year (Figure 31).

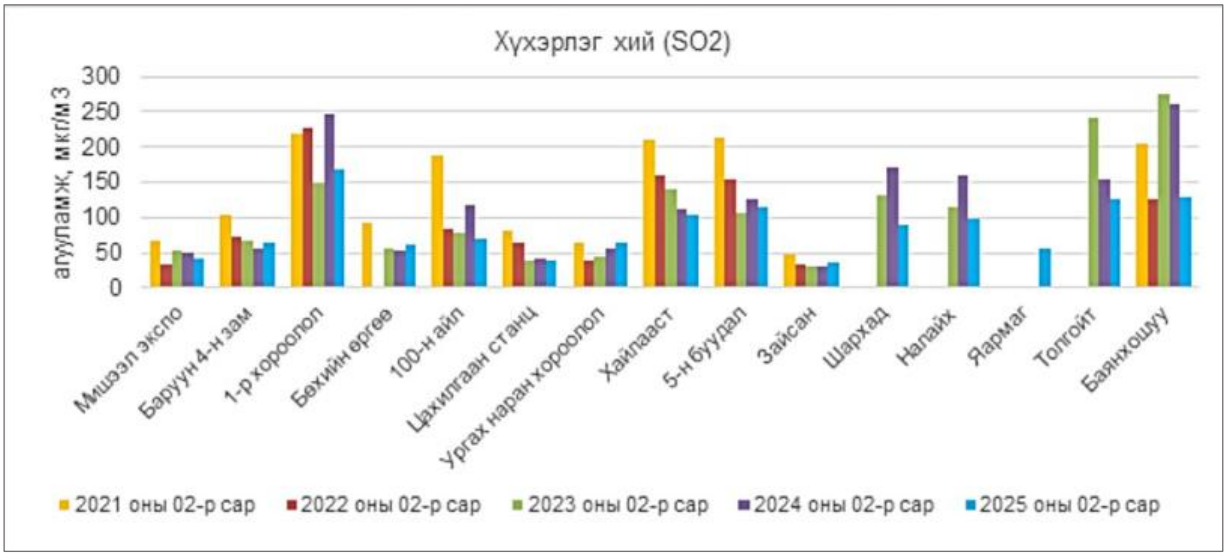


Figure 32. Average sulfur dioxide concentration for February by station

In February 2025, the average concentration of sulfur dioxide (SO2) in Yarmag was 55 µg/m3, but compared to January 2024, it was lower by 9 µg/m3 in Michel Expo, 77 µg/m3 in District 1, 47 µg/m3 in 100 households, 5 µg/m3 in Elektstantsk, 7 µg/m3 in Hailaast, 10 µg/m3 in 5-n hotel, 81 µg/m3 in Sharkhad, 62 µg/m3 in Nalaikh, 29 µg/m3 in Tolgoit, and 132 µg/m3 in Bayankhoshuu, but lower by 8 µg/m3 in Baruun 4-n zam, 8 µg/m3 in Bokhin Uygo, 9 µg/m3 in Urgah Naran Khorool, and 3 µg/m3 in Zaisan. respectively (Figure 32).

3.5. AIR QUALITY INDEX

Table 15. Air quality index and its impact on human health

Air quality index	Air quality classification	Health effects
0-50	Clean	Will not have adverse effects on human health.
51-100	Normal	Even if the air quality is satisfactory, sensitive people may be exposed to certain pollutants. For example, ozone and fine particulate matter may cause respiratory symptoms in sensitive people.
101-250	Slightly polluted	Adverse health effects will occur in highly sensitive individuals. People with chronic cardiovascular and respiratory diseases, especially bronchial asthma, are more susceptible to the effects.
251-400	Moderately polluted	Minor adverse health effects will begin to appear for the general population. Severe adverse health effects will occur for highly sensitive individuals.
401-500	Very polluted	Being outdoors for long periods of time has significant negative impacts on the health of the general population.
500<	Very polluted	Being outdoors for long periods of time has negative effects on the health of the entire population.

Source: Annex 1, Table 1, Order No. A-327 of the Minister of Environment and Green Development dated September 17, 2014

The index values of the air quality monitoring stations in Ulaanbaatar for 2016-2023 are shown in the following table and figure.

The highest numerical value of the assessment calculated for each air pollutant in a given air quality monitoring station is determined as the air quality index for that period.

The air quality index is calculated based on at least 3 main pollutants that are commonly distributed in the air of a given station. In some cases, if fewer than 3 pollutants are identified in a given station per day, the index cannot be calculated. According to the annual assessment of the air quality index, the overall index level increased in 2023 compared to 2022. However, the levels of normal and low pollution decreased. 39% of the total air quality index assessment

reached the “Low Pollution” level, which is 20% lower than in 2022 and 23-26% lower than in 2016-2019. However, compared to 2016-2022, the 2023 clean level increased, while the “Highly Polluted” and “Very Highly Polluted” levels decreased. (Table 17).

Table 16. Annual general assessment of the air quality index

Air quality classification	Annual air quality index rating, %							
	2016 year	2017 year	2018 year	2019 year	2020 year	2021 year	2022 year	2023 year
Clean	8	9	13	17	23	24	26	35
Normal	25	25	23	24	29	28	25	22
Slightly polluted	53	54	51	51	46	45	49	39
Moderately polluted	8	7	8	5	2	3	3	3
Very polluted	3	3	3	2	0	0	0	0.6
Very polluted	3	2	2	1	0	0	0	0.4

Table 17. Total number of air quality monitoring watchdog indices

Air quality classification	Annual assessment of the air quality index, 17 monitors							
	2016 Year	2017 Year	2018 Year	2019 Year	2020 Year	2021 Year	2022 Year	2023 Year
Index calculation not possible	813	595	856	344	666	570	505	79
Clean	253	289	498	695	865	1170	1277	2147
Normal	794	851	880	952	1077	1359	1241	1365
Slightly polluted	1693	1849	1916	2073	1709	2198	2395	2405
Moderately polluted	254	247	308	210	71	152	141	174
Very polluted	103	114	102	70	4	18	23	29
Very polluted	105	70	70	36	0	8	11	17

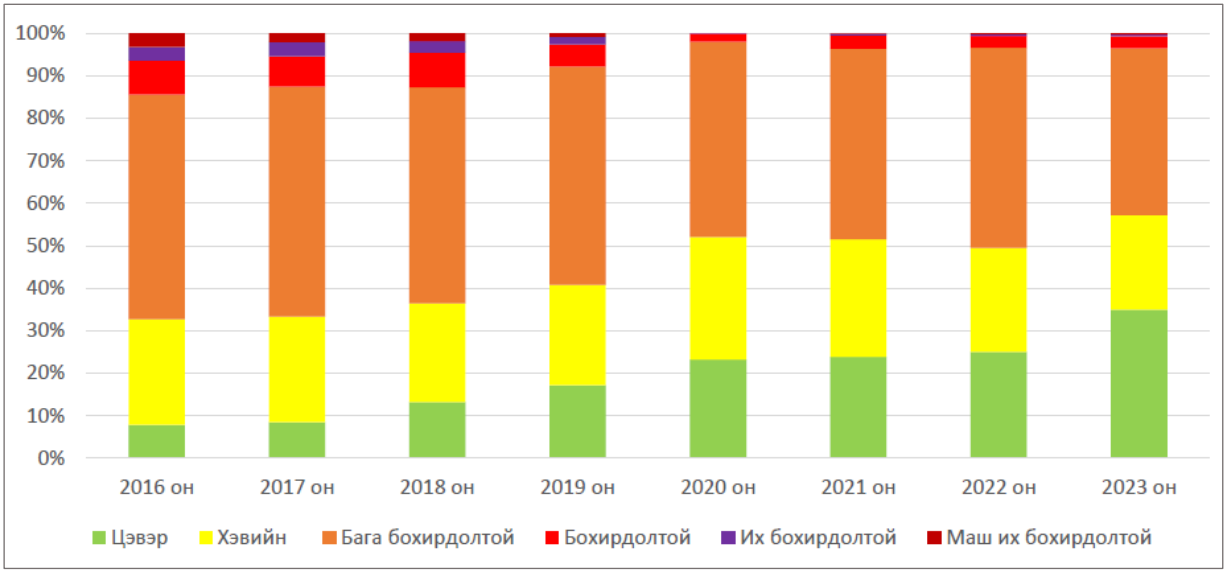


Figure 33. Annual air quality index level for 2016-2023, %

The air quality index of Ulaanbaatar in 2023 was 35% clean, 22% normal, 39% low pollution, 3% polluted, 0.6% high pollution, and 04% very polluted.

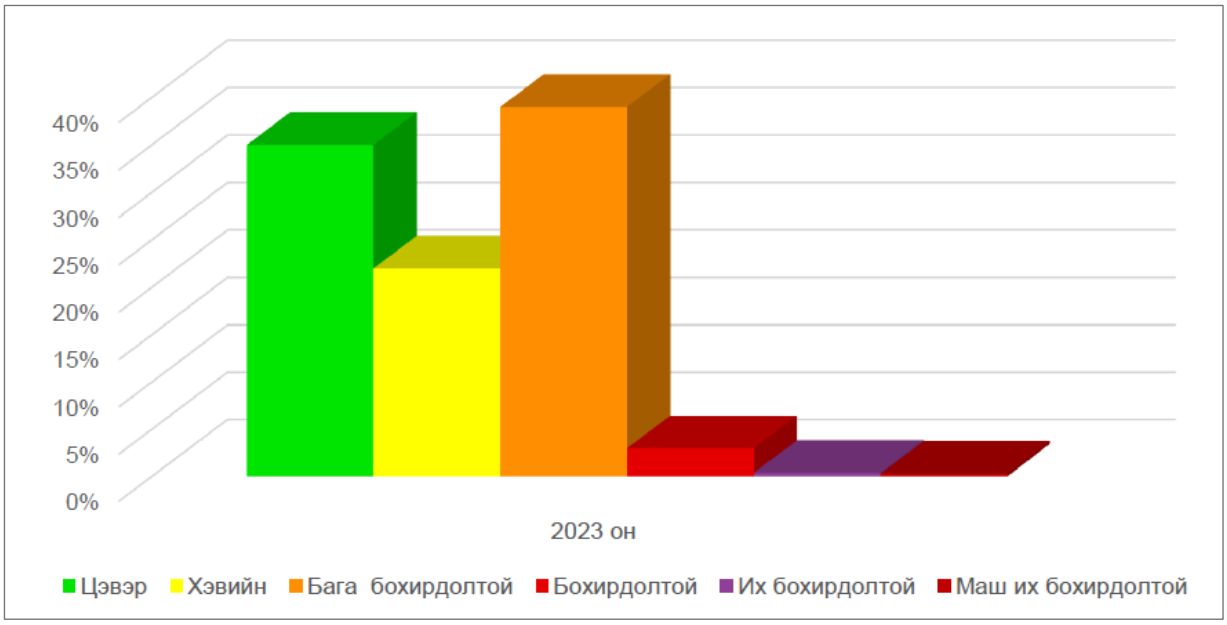


Figure 34. Air Quality Index 2023

<u>Conclusion:</u>

Compared to the average annual concentration in 2022, Ulaanbaatar city's 2023 annual concentration is at the same level for PM2.5 particles, sulfur dioxide is 7 µg/m3 or 11% lower, PM10 particles are 6 µg/m3 or 7% lower, and nitrogen dioxide is 1 µg/m3 or 2% lower.

However, the average concentration of pollutants in the air of Ulaanbaatar city during the cold season of 2022-2023, i.e. October-December 2022 and January-April 2023, was lower than the average concentration of PM2.5 particles by 4 µg/m3 or 6%, PM10 particles by 15 µg/m3 or 12%, nitrogen dioxide by 1 µg/m3 or 2%, and sulfur dioxide by 9 µg/m3 or 9%, respectively, compared to the average concentration of the same period of the previous year.

According to the annual assessment of the air quality index, the overall index level increased in 2023 compared to 2022. However, the level of normal and low pollution decreased. 39% of the total air quality index ratings reached the “Low Pollution” level, which is 20% lower than in 2022 and 23-26% lower than in 2016-2019. However, the 2023 clean level increased compared to 2016-2022, while the “Highly Polluted” and “Very Polluted” levels decreased.

According to the PM2.5 air quality index, pollution increased from “Low Pollution” to “Very Polluted” levels in the ger areas in January-March and October-December, and from “Low Pollution” to “Very Polluted” levels in the areas near major highways in January-March and November-December, and from “Low Pollution” to “Poor” levels in the areas far from ger areas in January and December.

3.6. PHYSICAL POLLUTION (NOISE)

Noise and vibration. Noise and vibration propagate in the surrounding environment in the form of oscillating waves and have a negative impact on humans, animals, and plants. The distribution patterns of noise and vibration are the same, and the negative impact on the natural environment (humans, animals, plants, cities, and buildings) is similar.

The main sources of noise and vibration in urban areas are various industrial and repair sites, as well as road, air, and rail transport.

Basic parameters of noise and vibration： When calculating and assessing the harm caused by noise to the surrounding environment, humans, animals and plants, the following parameters are taken into account:

- The loudness of noise is determined by its oscillation frequency (Hz).

- Its loudness is expressed in decibels (dB), and the normative amount of its impact on the environment is determined. The notation “dBA” is an indication of the decibel (sound meter) scale.

- Vibrations and noise propagate in the environment in the form of waves. Therefore, the propagation of sound and vibration is a process of energy transfer (diffusion) in the environment. The amount of energy corresponding to a surface of 1 m2 normal to the direction of sound propagation per unit time is called sound intensity (power). It is measured in W/m2. The minimum sound intensity at which the human ear begins to perceive sound is 10-12 W/m2, which is called the threshold of hearing, at which the center of the sound is “0” dB. When the noise intensity reaches 10W/m2, its level reaches 130 dB and can cause serious injuries and illnesses, which is called the threshold of illness.

According to the hygienic standards, the environment is classified according to the noise level as follows:

a. If the ambient noise level is higher than 80 dBA, it is considered an unfavorable environment. If it is 80-130 dBA, it is considered to be dangerous to cause injury, and if it is above 130 dBA, it is considered to be extremely dangerous to cause injury.

b. If it is 60-80 dBA, it is considered a relatively unfavorable environment. If the noise level reaches 60 dBA, it will cause irritation to people, if it reaches 70 dBA, it will obscure speech, and if it exceeds 80 dBA, it can lead to a risk.

c. If it is 40-60 dBA, it is considered a relatively favorable environment. In a normal environment, it is possible to talk in a low or normal voice.

d. If it is less than 40 dBA, it is considered a favorable environment. In a building without the influence of external noise, the noise level is 20 dBA.

Hygienic assessment of noise levels in residential areas of Ulaanbaatar city

In 2012, the National Center for Research on Working Conditions and Occupational Diseases. A. Tsengelmaa1, Ch. Onortsetseg2, and B. Tsetsegsaikhan, Ministry of Health, according to the results of the study:

Noise levels were calculated at 12 locations in 6 districts of Ulaanbaatar city, with a frequency of 3 hours, over a period of one week (a total of 637 direct measurements). When considering the average noise level in Ulaanbaatar city by district, BGD (70.6 dBA) was the highest, while HUD (62.2 dBA) was the lowest.

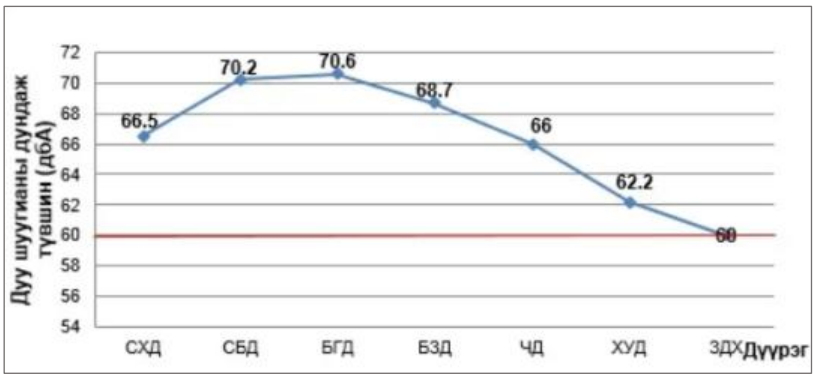


Figure 35。 Noise levels in Ulaanbaatar city districts

Table 18。Noise levels in Ulaanbaatar city districts, by day (dB)

№	Measurement date	Noise level, dBA
1	Monday	67.1
2	Tuesday	66.35
3	Wednesday	65.7
4	Thursday	67.76
5	Friday	68.28
6	Saturday	67.9
7	Sunday	68.5
8	Average	67.37

Note: Noise levels are high regardless of whether it is a weekday or a weekend.

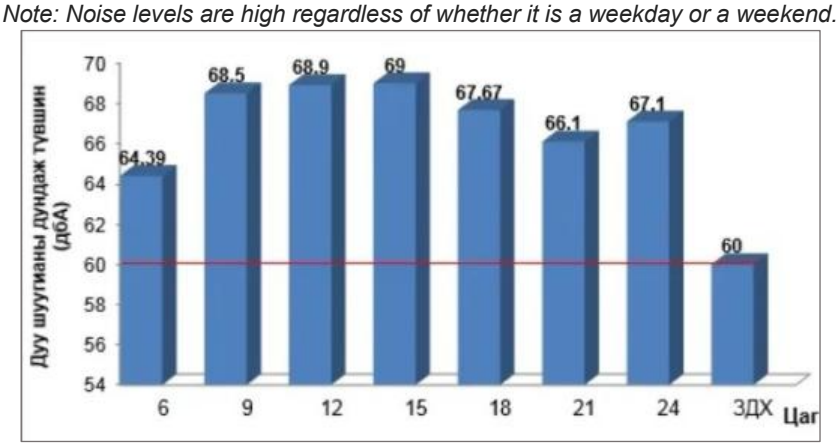


Figure 36. Average noise level, hourly average

The average noise level in Ulaanbaatar is 67.3 dBA, which is 7.3 dBA higher than the WHO recommendation and the Air Quality. General Technical Requirements MNS 4585:2001 standard (LDH 60 dBA). Excessive noise can damage human hearing and brain cells, affect the central nervous system, cause rapid fatigue, loss of concentration, and insomnia, and can lead to changes in cardiovascular function, increased blood pressure, increased risk of heart attack, and impaired metabolism and gastrointestinal function.

The average noise level in residential areas of Ulaanbaatar was highest in the BGD (70.6 dBA) and lowest in the HUD (62.2 dBA). Noise levels were also high regardless of weekdays or weekends.

• The average noise level in residential areas of Ulaanbaatar is 67.3 dBA (7.3 dBA higher than the LD 60 dBA), which does not comply with the WHO recommendations and the Air Quality. General Technical Requirements MNS 4585:2001 standard.

Noise measurements were taken at the following locations:

• Sukhbaatar Square at 6:00 PM — 70 dBA -80 dBA
• Sukhbaatar Square 4-way intersection — up to 80–105 dBA
• City Center Coffee Shop — up to 70–85 dBA
• Music Lounge — 72–85 dBA
• Jazz Club 80–88 dBA
• Mountaintops and forests 50–54 dBA
• Workplaces — 60–75 dBA

FOUR. GEOLOGICAL STRUCTURE AND GEOMORPHOLOGY

4.1. GEOLOGICAL STRUCTURE

The geological formations of our country are complex and quite complex, and are a folded system formed during various geological eras.

This folded system is located between the Siberian and North China Plateaus and gradually subsides from the north, forming a system of mountains that form an arc-shaped ridge that slopes southward. The Tokho-folded structures are rich in the remains of various ancient marine morphostructures (arcane arcs, accretionary wedges) and are very complex, so they can vary greatly even over a small area.

The appearance of these folded systems is clearly reflected in the basin scale, and the geological formation of the basin is very complex, separated from each other by deep faults, and includes the Caledonian (northern part) and Hercenian (southern part) folded systems. During the Hercenian folded system, the current deep depressions and depressions between the mountains were formed, and then sedimentary rocks of the Middle and New Age were deposited, covered with loose sediments of the Tertiary-Quaternary period.

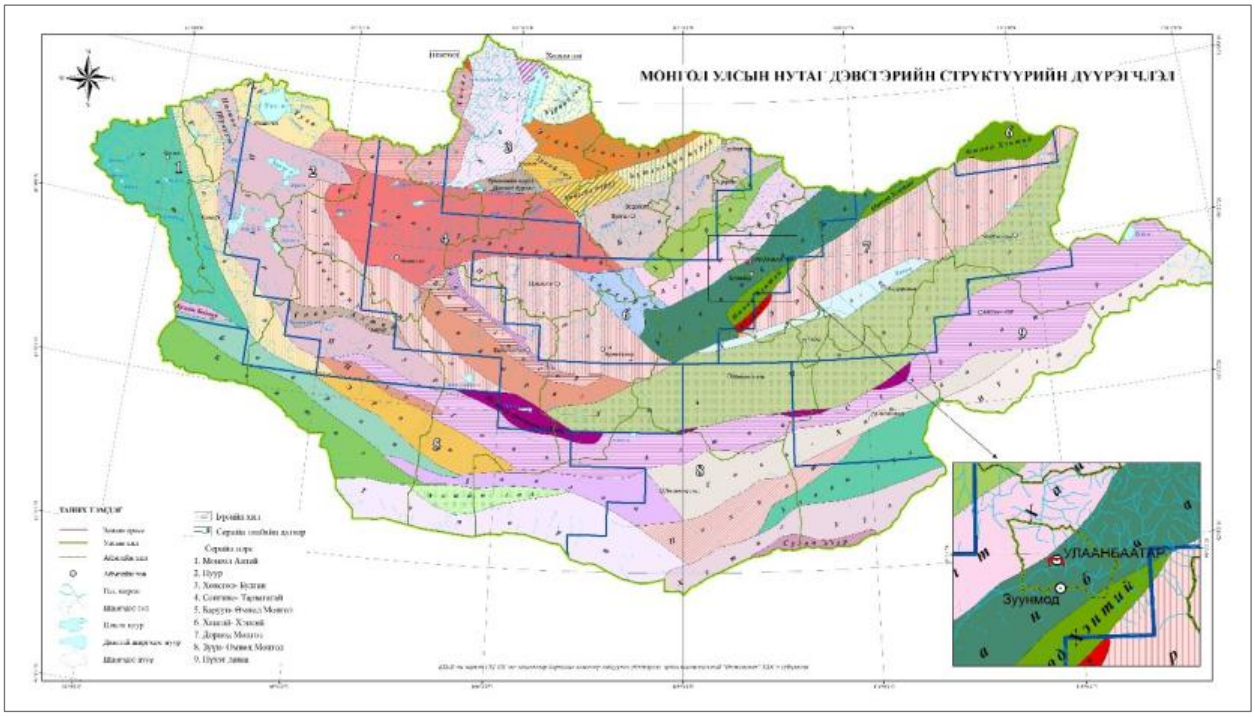


Figure 37. Geological regions of Mongolia

As can be seen from the image above, the route area of the New Ring Road project belongs to the Khangai-Khent region in terms of the territorial structure of Mongolia.

Geological formations of the area around Ulaanbaatar city

The geological formations of the area around Ulaanbaatar consist of Carboniferous, Cretaceous, and Devonian sedimentary rocks, Triassic and Jurassic intrusive rocks, and Neogene and Quaternary loose sediments.

Lower-Middle Devonian Gorkh Formation (D1-2)

In the northwest, east, and southeast of Yarma, sedimentary deposits of Lower-Middle Devonian age are widely exposed. These deposits are characterized by strong intrusion into northeast-trending, mostly vertical atria, and the Devonian and Carboniferous sedimentary layers are often separated from each other by steeply dipping tectonic faults. The Carboniferous sediments are mainly turbidites consisting of sandstones, siltstones, mudstones, clay shales, and occasionally gravelites and shale. The source of the sedimentary deposits that fed the depression was the contemporaneous marginal uplifts.

Silty shale with fine-grained interlayers, predominantly silty-sandy, and rare quartz-based effusive interlayers. The thickness of the sediments is 1500-2000 m.

Lower Carboniferous Altan Ovoo Formation (C1-2)

Lower Carboniferous rocks form the geological formations of the northern slopes of Bogd Mountain and the northern part of the Tuul River. Siltstones, sandstones, conglomerates, gravelites, and jasper-like silty rocks predominate in rocks of this age. According to the research of M.A. Anfilov and Y.S. Zhelubovsky, they are classified into two thicknesses: lower sandstone-siltstone and upper sandstone.

In the northern part of Ulaanbaatar and the back slopes of Bogd Mountain, dark-colored silty-clayey siltstone, fine-grained sandstone, jasper, and tuffite series occur in a sequential manner.

Upper and Middle Carboniferous Olgoich Mountain Formation (C2-3)

The Olgoich Mountain Formation is distributed in the eastern and northeastern parts of Yarma. It is widely distributed on both sides of the Tuul River. It consists of sandstones of various grains and is 20-30 m thick, with shale in the middle part. The lithology of the shale is similar to that of the Lower-Middle Carboniferous shales.

Lower Cretaceous rocks (K1)

The Lower Cretaceous sediments have been well studied in the past, in connection with the study of the coal deposits in the Nalaikh depression and the tuipuu mud deposits in Tolgoit. Lower Cretaceous sediments have been identified in the Nalaikh depression, Tolgoit, and Khambyn ovoon areas, and have also been newly identified in the vicinity of Takhilt Mountain in the Bokhugin River basin as a result of aerial photography and core drilling.

During the search for Tolgoit brick materials, the Lower Cretaceous rocks have been well studied and divided into two horizons, upper and lower, based on their lithological composition. Conglomerate predominates in the section of the lower horizon, which defines the characteristics of this horizon. The conglomerate consists of relatively well-grained light gray, greenish-colored fine-grained sandstone, dark gray, almost black phyllite-like shale, greenish-gray sericite-chlorite shale, quartz porphyry, hornblende, and milky-white quartz.

The conglomerates are white, light gray, and dark gray, loosely cemented by clay, and sometimes these clays are infiltrating with iron oxides, and the conglomerates form strata with large to small pebbles.

In the upper section, the conglomerate and sandstone sections are interbedded with clayey layers up to 0.2-2.0 m thick, giving the overall section a unique appearance. The clay is white, light gray, greenish gray, dark gray, and yellowish gray, very dense, argillaceous, and sometimes thinly foliated to plate-like sections. Animal and plant remains are abundant among the sandstone, siltstone, and clay within the section. The Lower Cretaceous rocks are formed by an angular unconformity on the surface of the wash of the underlying Lower Carboniferous rocks, forming a nearly latitudinal extension, dipping at an angle of about 15-20. The thickness of the Lower

Cretaceous rocks has been determined to be about 200 m through drilling and geophysical surveys.

Neogene sediments (N)

Neogene sediments are distributed over the Lower Cretaceous rocks in the Tuul River graben and are exposed at the surface in places such as Tasgan Ovoo, Naran, Maantyn Ovoo, Tolgoit, Ulaankhuaran, and Shar Khad. In these places, the distribution of Pliocene red and reddish-brown sediments is quite unique and is not usually found on the surface, but they often protrude from the Quaternary sediments in large river valleys, depressions, banks, edges, and depressions.

These sediments are sandy and clayey sediments composed of loosely bound siltstones, sandstones, and usually reddish-brown, sometimes grayish-brown clays, with siltstones always contributing more than 50%.

According to research conducted at the Tolgoit “Nairamdal” quarry, the Neogene section consists of two thicknesses. The lower layer consists of a conglomerate layer containing brownish iron oxide concretions, and above it, yellowish-gray medium-grained sandstone and light-colored silty clay layers containing thin layers of gravelite form a layer up to 16 m thick. The Neogene sediments found in Ulankhura are dominated by red clay and siltstone containing gravel and pebbles. The thickness of the sediments was determined to be 70 m by drilling and geophysical studies. The results of particle analysis of this sediment revealed that it is a lake-proluvial sediment of Neogene age.

Quaternary sediments (Q)

Quaternary sediments are quite widespread in the Yarmag area, covering the valleys of major rivers, their branches, the central parts of tributaries, and the valleys between the mountains and their flanks. In terms of age, sediments ranging from the Lower Pleistocene to the Holocene are widespread, and in terms of origin, they can be distinguished as fluvial, fluvial-flank, flank-flank, lacustrine, and aeolian, as well as technogenic sediments.

Lower Quaternary or Pleistocene

Sediments of this age are only found in some parts of the Tuul Valley as remnants and are considered to be very sparsely distributed. For example, they are largely left behind in the area where the Tuul River and Nalaikh River meet and spread out on the border of the meadow. In general, the I-III terraces of the Tuul River are relatively clearly distinguished in this area, and the I terrace (3-5m high) and II terrace (10-12m high) consist of sand and gravel riverbed sediments. These are relatively young. However, the III terrace, which belongs to the Lower Pleistocene, is located 35-40m above the river level, and sand was mined from this sediment in three places for the purpose of roads, buildings, and structures, and large deposits were created, which are still being used today. Thematic research conducted on these deposits in this area has become a key section of Pleistocene sediments not only in this region but also in Mongolia.

Upper Quaternary-Holocene sediments

The Upper Quaternary-Modern sediments are the most widespread among the loose sediments and are distributed fairly symmetrically in the center and lateral slopes of the major river valleys and their tributaries. In particular, the Tuul River valley is not only the most widely distributed but also has the thickest accumulation conditions. Depending on the conditions of origin and mutual location, sediments of this age can be classified as fluvial-flank sediments, lateral, and flank. Fluvial-flank sediments are not only widely distributed in the central part of the valleys of large and medium-sized rivers, but also fill the Tuul Valley, especially in the Ulaanbaatar Basin. The Upper Pleistocene-Holocene sediments were studied by Y. Krieger, who divided the sediments of the Ulaanbaatar Basin into upper or gravel and gravel sand layers (up to 30 m) and lower or fluvial bedrock layers (10-12 m). The PNIIIS, which has also studied the Quaternary sedimentary

watershed in the Ulaanbaatar area, has also distinguished two such suites. The sediments, which are mainly composed of gravel, pebbles, and sandstones, are widespread in the Tuul Valley, and are 3 km wide in the Uliastai area, narrowing to 1.5 km in the Amgalan area, and widening to 4.5 km in the Mahkombinat area, and 6.5 km wide in Yarmag. The total thickness of the gold sediments varies between 5-65 m, and the thickness increases from upstream to downstream in the river valley, from the sides to the center, and from the widened part of the valley to the narrower part. The lower thicket or suite is usually 1 m to 5-8 m thick, consisting of sand, sandstone, siltstone, or sand with alluvial or clay filling, boulders, gravel, and gravel.

Intrusive rocks

The distribution of intrusive rocks in Ulaanbaatar district is very small. Only in the northern part of Bogd Mountain is granite of early Mesozoic age distributed. Granite-porphyry occurs in the peripheral part of the massif, and in the central part, granite with a large and small grain grayish-gray hypidiomorphic structure occurs. This massif is formed by two dome-shaped phases of leucocratic granite. The following 3 types of sedimentary rocks are distributed in the area selected for the construction of water supply system facilities. These include:

1. Alluvial, light brown, brownish-yellow, sandy loam, containing boulders, silt and gravel soils (aQIII-IV), of the Middle-Upper Quaternary age, were deposited in the valley and lower reaches of the Tuul River, forming this type of soil layer.

2. Deluvial-proluvial, light brown, brownish-yellow, sandy and loamy loam, containing boulders, silt and gravel soils (dp-QII-IV)8 of the Middle-Upper Quaternary age, were deposited by filling the gaps between the rocks, filling the slopes, silt and gravel ravines of the uplands, forming this type of soil layer. The thickness of the sediments reaches 1.0-15.0 m.

3. Carboniferous sedimentary rocks (C1-2). Carboniferous sedimentary rocks are found under loose sediments in the Ts-1, Intermediate zone. The sediment consists of thickets of fractured, small to medium-grained, igneous sandstone and shale.

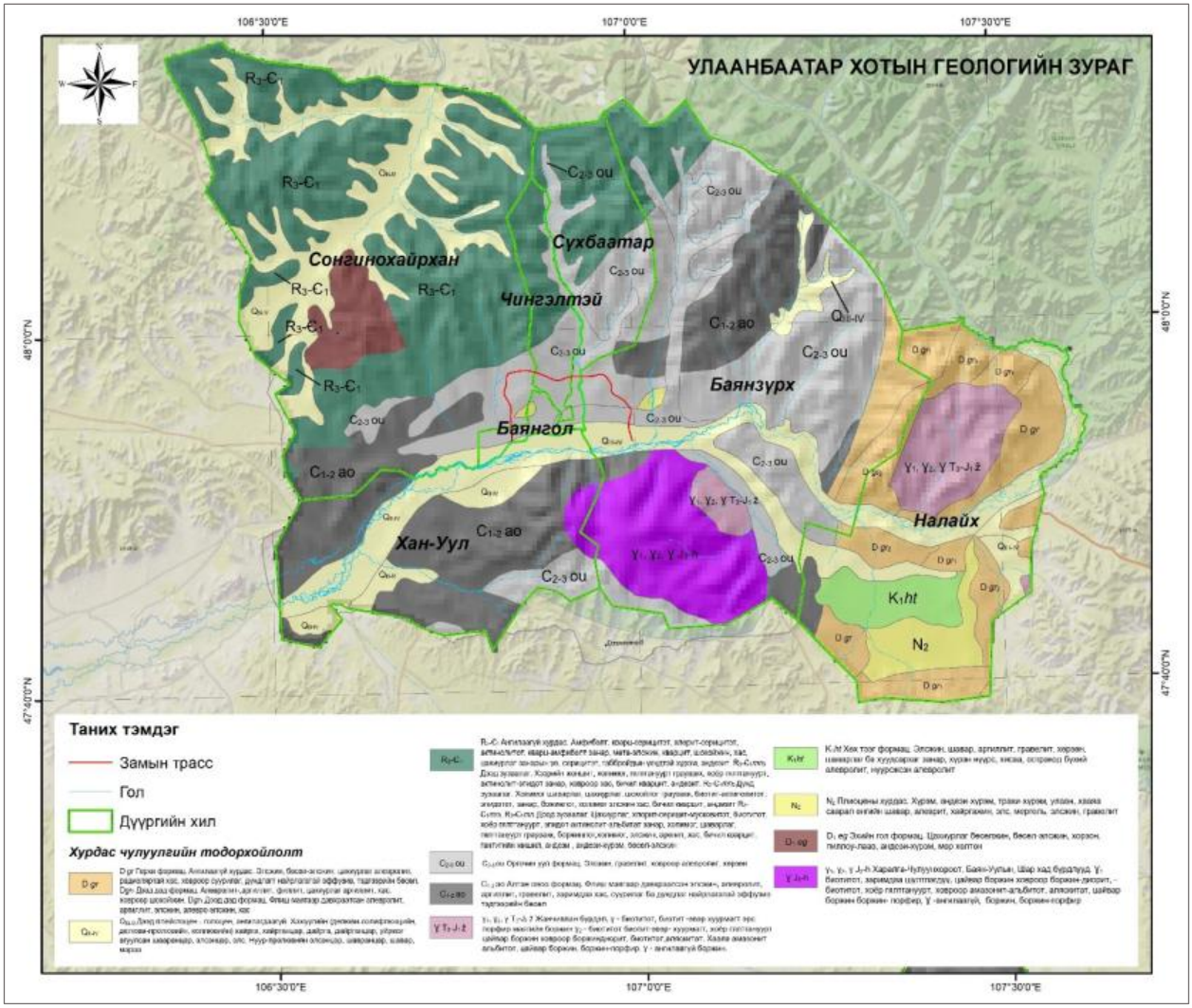


Figure 38. Geological formation

As shown in the above image, a small area at the southeastern end of the route consists of QIII-IV – Upper Pleistocene-Holocene, unclassified formations (deluvial-solifluctuation, deluvial-proluvian, colluvial), gravel, gravelly, silty, silty, clayey, sandstone, sand, lacustrine proluvian sandstone, clayey, and maraa sedimentary rocks.

However, most of the route consists of C2-3 ou Orgochin Uul Formation sandstone, gravelly, silty siltstone, and silty sedimentary rocks.

4.2. GEOMORPHOLOGY

In terms of geomorphological region, it belongs to the Khangai and Khentii mountain ranges, and the New Circle Highway area belongs to the Tuul (2) sub-region of the Orkhon Selenga mountain range (VI). The main geomorphological elements are mountain ranges, the channels between them, mouths, throats, and river valleys.

The source of the Tuul River basin is formed in the mountainous part of the Khentii Range at an absolute height of 2600 m above sea level, while in the downstream part of the river, the absolute height is about 800 m, and the river valley widens.

The mountains surrounding the basin are a groundwater recharge zone, and the Ulaanbaatar depression is a storage, transport, and foothill zone. The Tuul River valley is a series of widening and narrowing sections, with the widening section being a groundwater accumulation zone and the narrowing section being a compressed foothill zone.

Ulaanbaatar is located in the southwestern part of the Khentii mountainous region, in the Tuul River graben valley and its tributaries, surrounded by low and medium-altitude mountains. The city is bordered by the medium-altitude Bogd Mountain in the south, and its highest point is the Tsetse Gun Peak, a flat plateau formed by the remains of an ancient plain, rising 2,256.3 m above sea level. The top of Bogd Mountain is a relatively flat surface with a rocky outcrop. V-shaped mouths originate from the mountain on each side, and from these mouths, streams such as Shashin Khurakh, Tor Khurakh, Chuluut, Ikh Tenger, and Turgen flow, joining the Bokhug, Turgen, and Khuliin Gol rivers.

To the west of the city are Songino Khairkhan (2562 m), to the east Bayanzurkh Mountain (1833 m), and to the north Chingeltei Khairkhan (1949 m). Songino Khairkhan and Bayanzurkh Mountain are bare, their slopes are relatively poorly eroded, and there are no springs. These mountains have steep sides, sharp peaks, and ridges. Chingeltei Mountain, on the other hand, has many branching mouths covered with forests in the north. The mouths are swampy, and many streams and springs originate from them.

The southwestern part of Ulaanbaatar gradually transitions to the flat-surfaced Yarma Terrace and the low-lying Morin Mountain (1513.0 m). The mountains surrounding Ulaanbaatar to the north are cut by the tectonic graben-like valleys of the Selbe, Uliastai, and Tolgoit rivers.

The Tuul River valley is located along the length of the central part of Ulaanbaatar. The valley narrows to 0.5-1 km near the Songino and Bayanzurkh mountains, becoming V-shaped, and between them it becomes a box-shaped area with a width of 5-6 km. The Tuul River valley is multi-branched and its width is 40-70 m, and in some places it reaches 100 m. The absolute elevation of the land surface in the Yarmag area is from 1321 to 1247 m, with a relative elevation difference of 74 m, and a relative elevation drop of 2.5 m/km. The area where water supply facilities (deep wells, water pipelines, pumping stations, reservoirs, etc.) are located extends from the eastern ridge of the Artsat mouth (1564.5 m) of the western branch of Yargaytyn Mountain, one of the western branches of the Bogd Mountains.

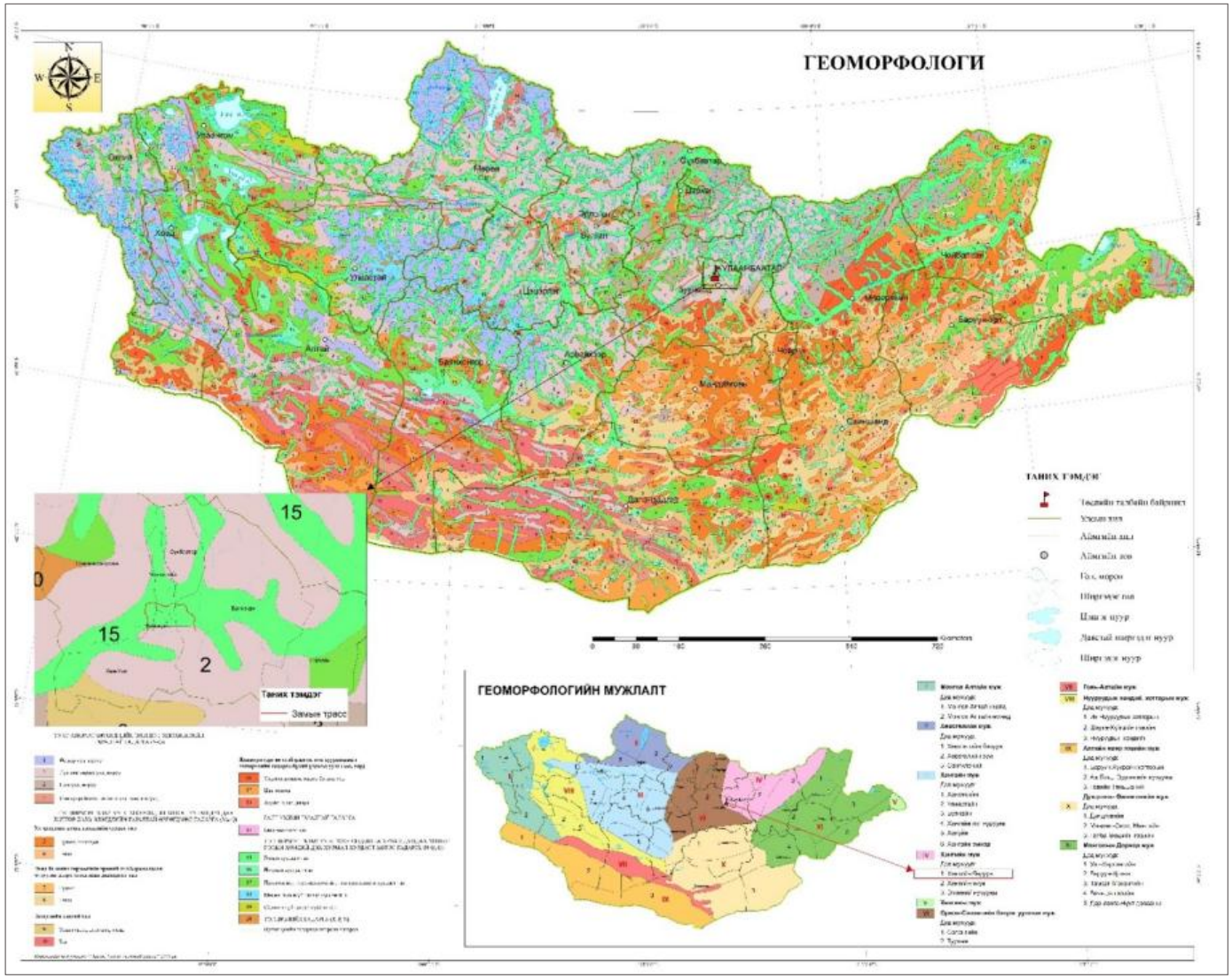


Figure 39. Geomorphological characteristics of the project area

The New Ring Road route area is a flat terrain, intermountain and intermountain depressions, river valleys with a sedimentary surface (N-Q, Q) and a river sedimentary surface (15) of the erosion-tectonic origin of the mountain-folded uplift (N-Q), with average elevations of 973-2729 m, with slopes of 0-60 in most areas along the route, and slopes of 6-100 in a small area (Figures 40, 41), and belongs to the transport-accumulation and erosion type in its origin.

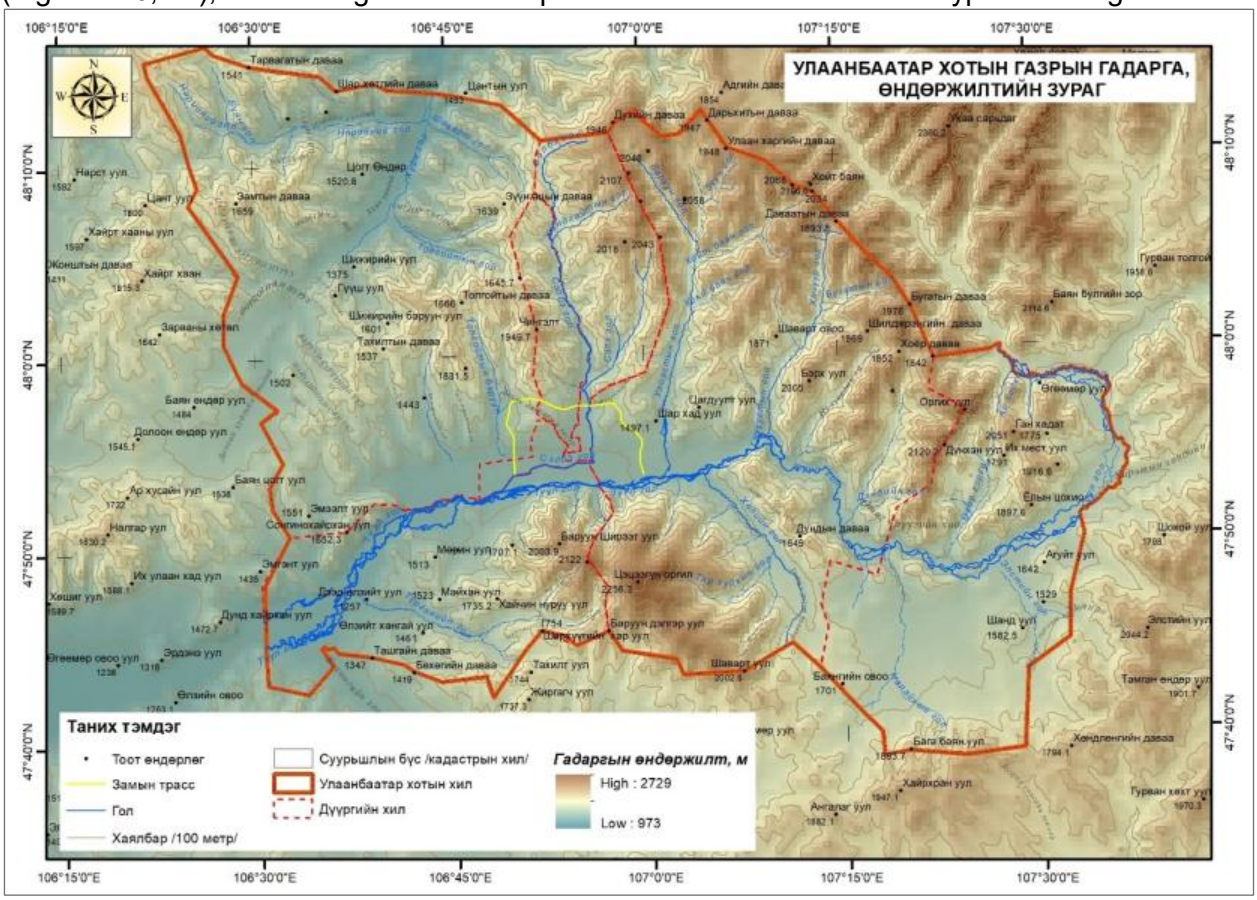


Figure 40. Elevation of the study area

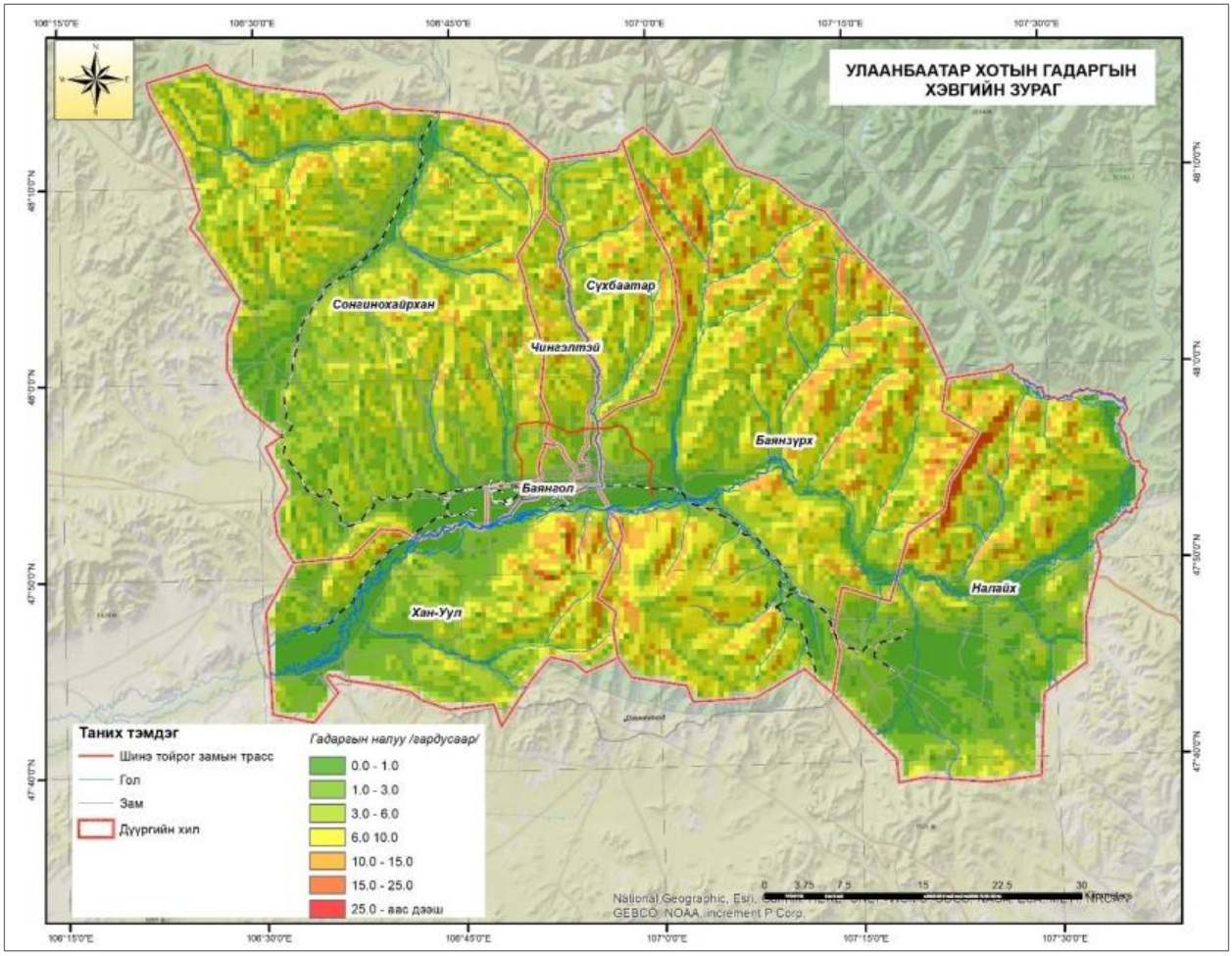


Figure 41. Slope of the study area

Earthquake

By order of the Ministry of Construction and Urban Development, the Institute of Astronomy and Geophysics produced a 1:10,000 scale seismic microregion map between 2012.11.27 and 2014.03.30, covering the areas of Ulaanbaatar city center and ger districts - 57,435 ha, Nalaikh district - 8,212 ha, Baganuur district - 6,469 ha, Bagahangai district - 3,833 ha, and Emeelt - 3,079 ha.

Researched status

Microzonation work in the Ulaanbaatar city area was carried out in 1969 and 2006 (in 2010, the boundaries of the 25,000-scale map made in 2006 were defined as 10,000), and microzonation work has not been carried out in the Nalaikh, Baganuur, Bagahangai, and Emeelt areas. A study of the faults around Ulaanbaatar was conducted jointly by Mongolian-French-Russian-Portuguese scientists with government funds in 2012.

1 9 71 o ny Ulaanbaatar city bichi I mujla I. In Ulaanbaatar city, the magnitude of the 7.5 earthquake that occurred in Mogod soum, Bulgan aimag in 1967 was reported to be 4-6 points in the city area. After the earthquake, in 1971, our scientists, together with scientists from the USSR, created a seismic micro-zonation map of Ulaanbaatar, which was used in building codes until recently. In this map, Ulaanbaatar is zoned as 8 points along the Tuul and Selbe rivers, 6 points for rocky soil, and 7 points for the rest of the city.

In 2006 (2010), the assessment of the seismic hazard of Ulaanbaatar was carried out. In 2000-2006, a study was conducted in collaboration with French scientists to assess the seismic hazard

of Ulaanbaatar. According to the results of this study, a 1:25,000 scale map was created, dividing the area of Ulaanbaatar into zones of 7-8 points. During this research, it was determined that there were active seismic faults in areas such as Khustai, Emeelt, Gunj, Avdar, Sharkhai, and Deren around Ulaanbaatar, but the fault survey was not detailed at that time. However, in 2010, the work of making the boundaries of this map detailed to a scale of 1:10,000 was commissioned by the Capital City.

Work results

Seismic activity and regime study: The study of the seismic activity of the Ulaanbaatar region identified the regions with strong earthquake epicenters and determined the main parameters of the seismic regime in these regions.

Active fault study around Ulaanbaatar city: Geophysical (seismic, GPR) and geological (route, trench) studies on active faults around Ulaanbaatar city were included in the previous study. The study of the Mungunmort fault was carried out within the framework of this project. The location, recurrence period and corresponding magnitude of the faults of Emeelt, Khustai, Gunj, Mungunmort, Sharkhai, and Avdar mountains were determined. The advantage of this study over previous studies is that it determined the age of earthquakes on active faults and mapped the active faults of the region.

Seismic wave propagation study: Since Mongolia does not have its own propagation law, the closest propagation law was selected from 17 propagation laws used internationally by comparing the data accumulated in the country's database.

Synthetic seismogram: The seismic waves generated in the event of an earthquake were calculated using the Stochastic Green's function method for every 1 km of the study area from each fault.

Earthquake hazard assessment: The earthquake hazard assessment was calculated using the deterministic and probabilistic methods to determine the maximum acceleration of seismic waves that may occur in rocky soil. The seismic force that may occur in rocky soil in Ulaanbaatar and its surrounding districts was estimated using the deterministic and probabilistic methods.

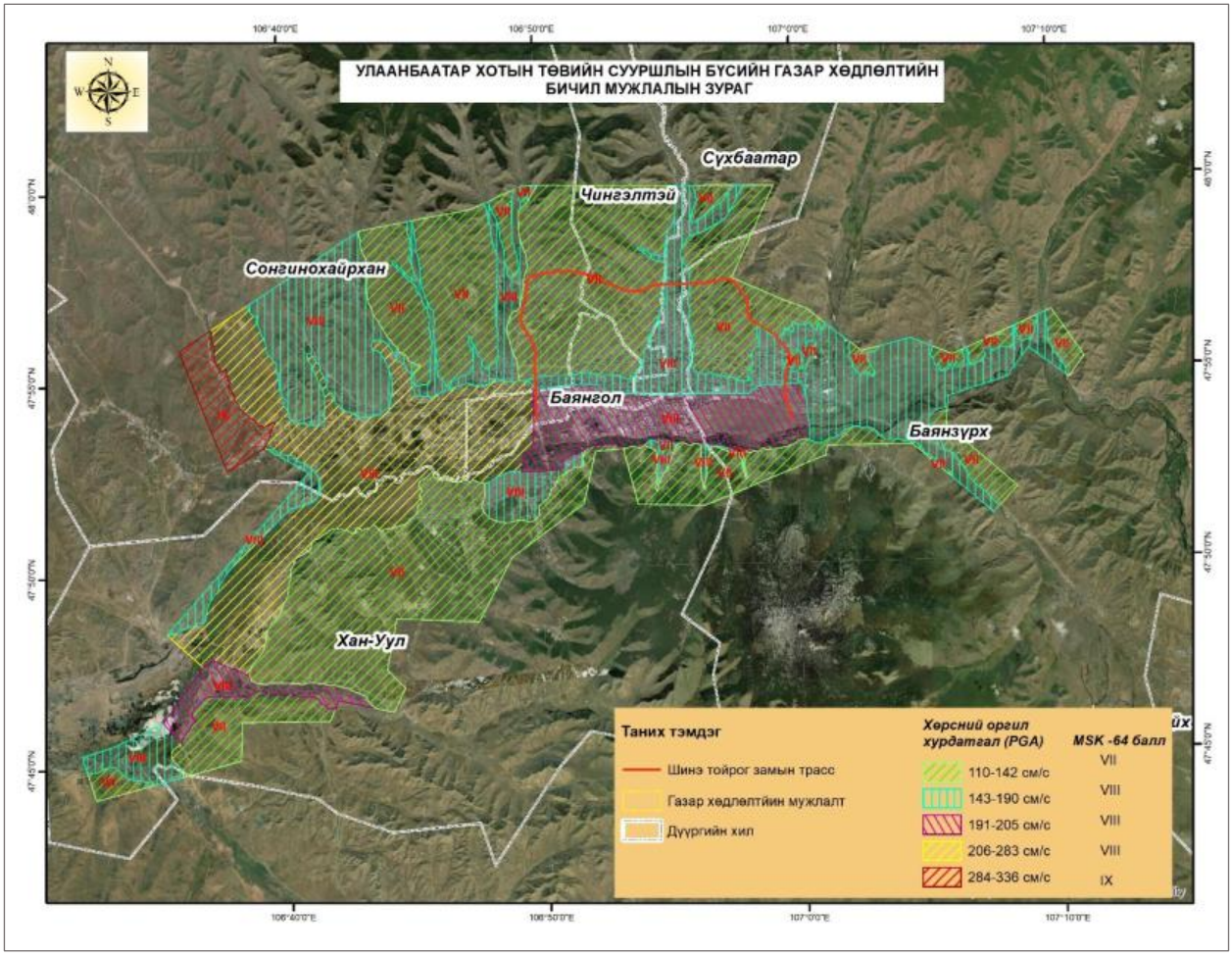


Figure 42. Earthquake microregion map

As can be seen from the seismic micro-region map (Figure 42) of the highway route, most of the area along the route falls within the VII magnitude zone, while the remaining area falls within the VIII magnitude zone.

FIVE. SURFACE WATER

The capital city of Ulaanbaatar is hydrologically part of the Tuul River basin of the Arctic Ocean. The Tuul River basin is a combination of high, medium, and low mountains, hilly plains, erosional hills, plains, intermountain depressions, and proluvial sediments, creating unique conditions for surface runoff. The Tuul River basin includes many rivers, including the Khyid, Khag, Baruun Bayan, Terelj, Galty, Khul, Gachuurt, Uliastai, Selbe, Bokhug, Guna, Khaliuch, Bad, Tarnay, and Kharbukh, and their topographic parameters, water regimes, and resources differ from each other depending on the physical geography and land cover conditions of the basin.

There are 226 first-order streams and rivers in the Tuul River basin, their average length is 2.3 km, and their average catchment area is 6.3 km2, 320 second-order streams, 64 rivers, 14 fourth-order streams, and 4 fifth-order rivers.

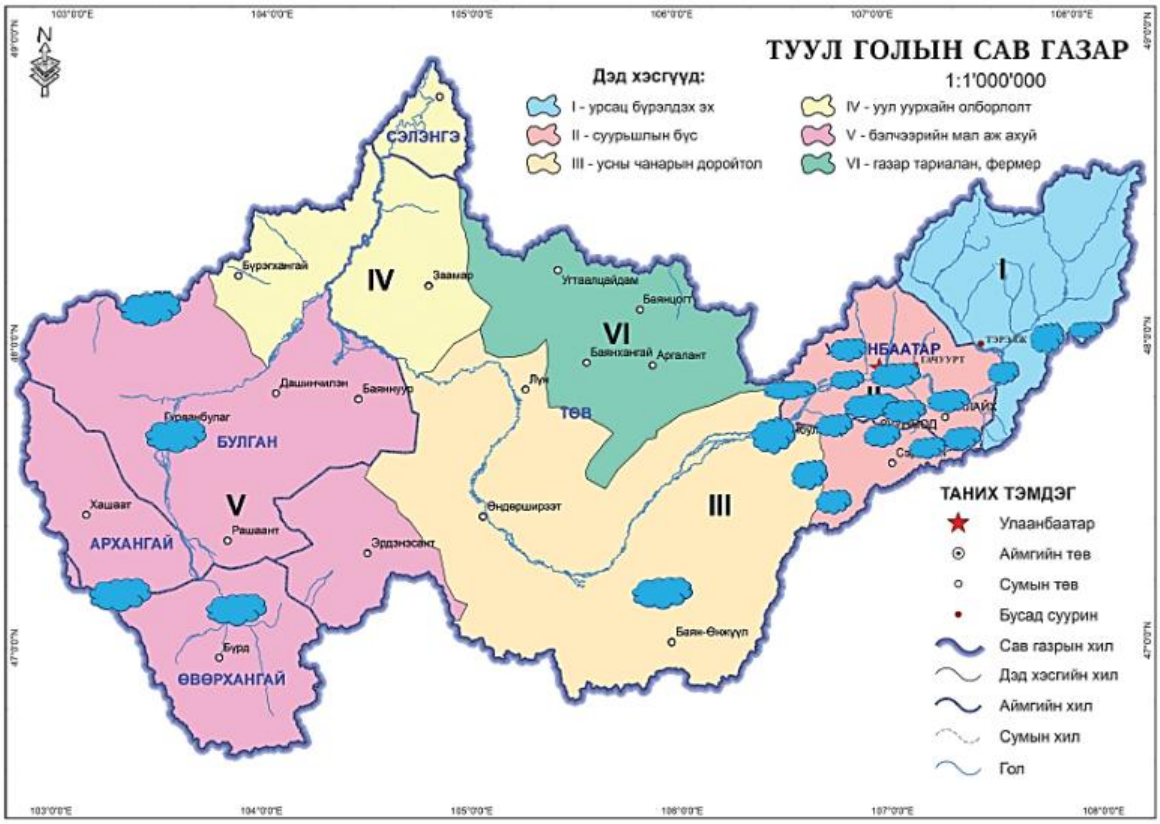


Figure 43. Tuul River Basin

5.1. TUUL RIVER

5.1.1. Water resources, regime, and quality of the Tuul River

The Tuul River is a 6th-order river. The average elevation of the Tuul River is 1,160 m, the watershed length is 2,056 km, the average elevation is 1,719 m, the density of the river network is 0.16 km/km2, the height of the catchment area is 1,300 m, the average valley depth is 559 m, the average width of the catchment area is 56.1 km, the maximum elongation degree is 16.5, the watershed curvature degree is 2.6, the minimum lateral shear is 0.58, and the ratio of the number of rivers, length, and catchment area according to the Horton-Strachler law is 4.28, 3.05, and 5.57.

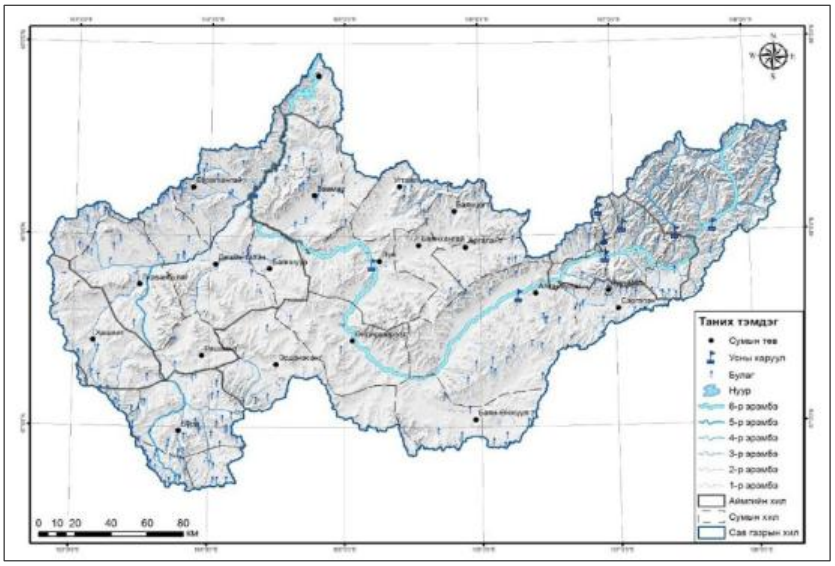


Figure 44. Hydrological network

The peculiarity of the Tuul River's water supply is that a relatively small percentage of its flow is occupied by groundwater and seasonal snow water. 25% of the river's flow is occupied by groundwater, 6% by melted snow water, and 69% by rainwater. It follows from this that the Tuul River belongs to the rivers with spring yellow water and summer rainy flood regimes in terms of its water regime. Since the main factor forming the river's flow is summer and autumn rainfall, the water level is very unstable in the warm season. Spring yellow water floods are observed in late April and early May, but their duration and flow are less than those of the rainy season. After the spring yellow water floods, a short period of summer drought is observed, and from July to September, summer and autumn rainy floods are observed, and the river has abundant water. The maximum level of the rainy season flood is 1.5-2 times higher than that of the yellow water period. After the rainy season ends, the water level gradually decreases until the ice phenomenon begins, and the drought continues.

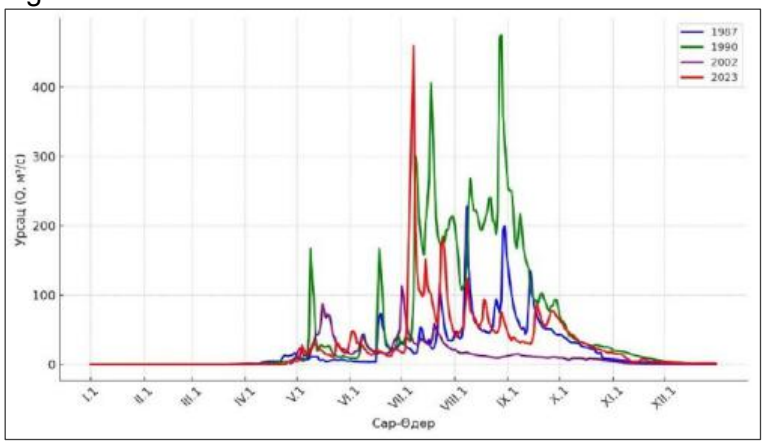


Figure 45. Annual flow hydrograph, Tuul River-Ulaanbaatar border

The average annual flow of the Tuul River is 7.44 m3/sec at the Terelj River-Terelj Recreation Area, 9.67 m3/sec at the Tuul-Bosgyn Bridge Area, 24.5 m3/sec at the Tuul River-Ulaanbaatar Area, and 23.2 m3/sec at the Tuul River-Gachuurt Area. The normal average or norm flow at the Tuul River-Ulaanbaatar Area is equal to the average annual flow.

Table 19. Average annual flow

№	River and stream name	Observation period	Water catchment		Average flow over many years			C_v	C_s
			Area, m^2	Average height, m	Q, m^3/sec	q, l/s·km^2	h, mm		
1	Terelj-Terelj Vacation	1972-2023	1281	1995	7.44	5.81	183	0.40	0.80
2	Selbe-Sanzai	1994-2023	33.1	1723	0.11	3.35	106	0.58	1.15
3	Selbe-Dambadarjaa	1995-2023	192	1650	0.37	1.94	61.3	0.49	0.98
4	Uliastai-Uliastai	1990-2023	209	1840	0.48	2.32	73.2	0.69	1.38
5	Tuul-Bosgyn Bridge	2002-2023	2192	1896	9.67	4.41	116	0.46	0.92
6	Tuul-Ulaanbaatar	1945-2023	6445	1808	24.5	3.8	120	0.58	1.17
7	Tuul-Ondorshireet	1983-1994	18427	1563	21.1	1.14	36	0.26	0.52
8	Tuul-Lkun	1998-2023	23892	1453	-				
9	Tuul-Zaamar	2014-2023	46920	1388	17.9	0.70	22.1		

The average annual flow of the Tuul River downstream of Ulaanbaatar and along its length can be represented by the results of measurements conducted by researchers from the Hydrology Sector of the Ulaanbaatar University and Kh. Badarch at additional points in 2008, 2009, 2010, and 2012. The results of the measurements from June 2008 to 2012 showed that the flow from the beginning of the Tuul River to Kharztai increased, and then, starting from a 15% decrease near the Zaisang Bridge, reaching a 30% loss at Biokombinata and a total loss of 55% when reaching Shuvuut. However, the flow from the Tuul River to Shuvuut to Altanbulag increased by 30%, confirming the relationship between flow loss and recovery along the length of the river.

Table 20. Trend of flow increase and loss between selected points and the guard, %

Selected point, view	Water reflection								
	2008		2009		2010		2012		Average, %
	m^3/s	%	m^3/s	%	m^3/s	%	m^3/s	%	
Tuul-Bosgyn Bridge	2.38		12		11.1		8.14		
Tuul-Terel Delta	2.8	18	15.7	32	20.6	85	15.1	85	55
Tuul-Kharztai	5.37	91	24.7	57	27.9	35	24.8	64	62
Tuul-Bayanzurkh	4.2	-22	23.1	-7	24.4	-13	21.7	-12	-13
Tuul-Zaisan	2.97	-29	20.2	-13	19.6	-20	20.1	-7	-17
Tuul-Biocombinat	2.46	-17	11.7	-42	17.5	-11	12.8	-46	-31
Tuul-Shuvuut	2.53	3	12.6	8	12.9	-26	9.43	-25	-10
Tuul-Altanbulag	3.63	43	15.5	23	13.4	-4	14.4	52	30

The measurement results confirm that this flow loss pattern is caused by the water consumption of Ulaanbaatar city, overexploitation of groundwater, and the influence of tributaries along the river. The drying up and loss of the Tuul River downstream of the Zaisang Bridge is largely due to human activities, which poses a serious threat to the ecosystem. Thus, although flow loss is caused by the influence of Ulaanbaatar city water supply wells along the river, the long-term average flow in the Tuul River-Altanbulag and Tuul River-Lun Gars areas at the end of the basin will not decrease significantly from the Tuul River-Ulaanbaatar Gars flow.

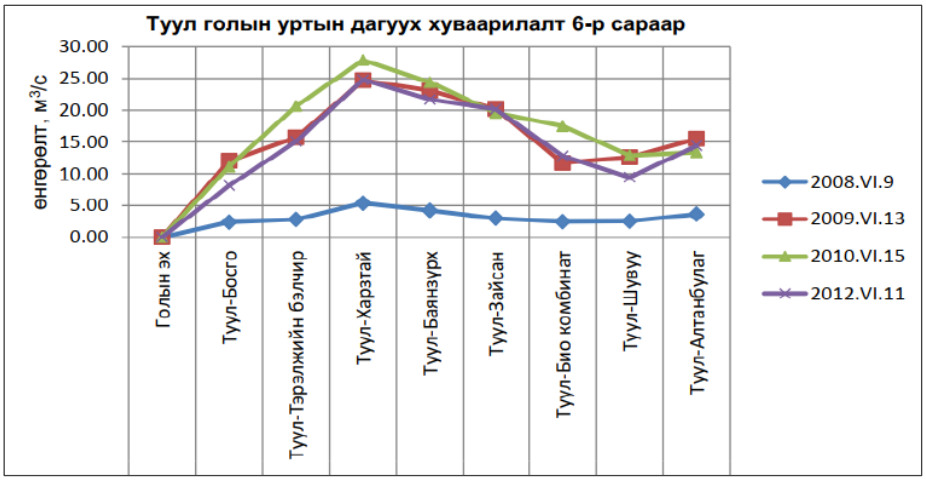


Figure 46. Flow loss along the length of the Tuul River

Table 21. Average annual flow with different levels of availability, m3/s

Name of the river and the guard	Supply R, %								
	1	5	10	25	50	75	90	95	97
Tuul-Ulaanbaatar	71.8	50.3	41.1	28.9	20.5	14.3	11.9	11.2	10.9
Tuul-Gachuurt	62.7	52.6	42.6	30.3	19.2	13.3	8.9	6.9	5.3
Tuul-Bosgyn Bridge	27.0	19.2	15.8	11.4	8.0	11.4	5.2	4.9	4.8
Terelj-Terelj	17.3	12.8	10.9	8.4	6.4	8.4	4.8	4.7	4.6

The Tuul River's 50% water availability flow is 20.5 m3/sec near Ulaanbaatar. In a year with abundant water, or 5% water availability, the flow reaches 50 m3/sec, and in dry years it drops to 10.9 m3/sec.

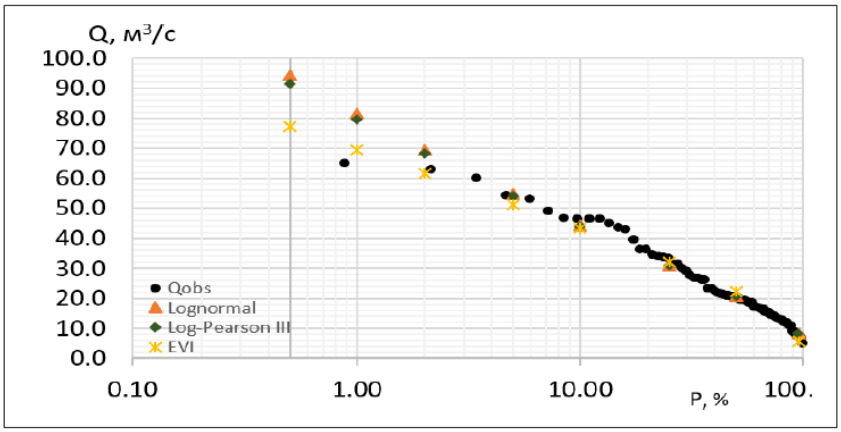


Figure 47. Average annual flow stress curve, Tuul River-Ulaanbaatar reservoir

Maximum and low-flow flows

The water regime of the rivers varies from season to season depending on the climatic conditions and geographical features of the region. High flows occur when the water level rises sharply during the rainy season and snowmelt, while conversely, during the dry season, when precipitation decreases and evaporation increases, the water level decreases, and a period of scarcity or low flow occurs.

High flows. Including the data for 2024, the maximum flood discharge of the Tuul River, which is likely to occur once in 100 years, is 1,824 m3/sec in the Tuul River and 704 m3/sec in the Terelj River, as shown in Table 23. However, the maximum flood discharge reaches its maximum near the end of the Tuul River flow zone, near Ulaanbaatar city, and decreases as the flood wave

moves downstream. This is explained by the principle that the base lengthens and spreads along the length of the flood wave.

In the Tuul River basin, especially in its tributaries such as the Selbe and Uliastai, the flood pattern is characterized by a sharp peak and a short-term pattern. Yellow water floods are observed in the rivers of the Tuul River basin. Yellow water floods, which are likely to occur once in a century, reach 480 m3/sec in the Tuul River and 140 m3/sec in the Terelj River.

Table 22. Heavy rain and flash floods

№	River-guard		Flow rate Q (m3/s), module q (l/s□km2), flow height h (cm) with different conditions					
			0.1	1	2	5	10	25
1	Tuul-Ulaanbaatar	Q	5625	1824	1300	831	592	378
		q	893	290	206	132	94	60
		h	463	150	107	68	49	31
2	Terelj-Terelj	Q	1432	704	615	498	409	292
		q	1118	549	480	388	319	228
		h	-	237	207	168	138	98
3	Selbe-Dambadarjaa	Q	125	73	62.8	49.4	39.3	25.8

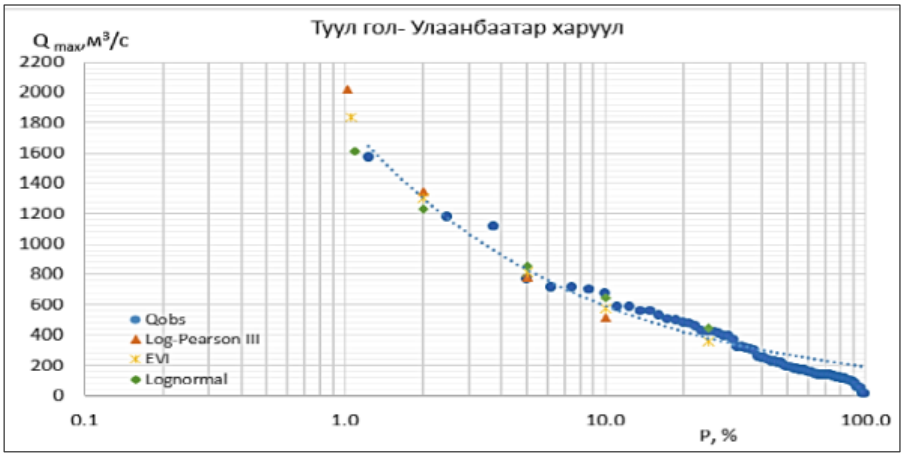


Figure 48. Tuul River rainfall peak flow stress curve, Tuul River – Ulaanbaatar

Low flow: During the observation period from 1972 to 2022, the average discharge of the 30-day minimum water flow decreased by 3.31 m3/sec, and the minimum discharge of the warm season decreased by 0.97 m3/sec. However, the decrease in low flow is more noticeable in the Ulaanbaatar reservoir. In the last 76 years, the average discharge of the 30-day minimum water flow decreased by 4.06 m3/sec, and the minimum discharge of the warm season decreased by 4.68 m3/sec, which is related to the impact of urban water supply and industrial water consumption. The trend of low flow in the Tuul-Ulaanbaatar reservoir is shown in Figure 2.6. In the area of the river's end, the low flow decreased by 11.3-13.5 m3/sec in the last 24 years, indicating that the decrease in flow is more intense due to natural and human activities.

Figure 49. Tuul River minimum flow trend, Tuul River – Ulaanbaatar

In a year with a 50 percent sufficient flow during the dry season, the flow at the head of the river fluctuates between 2.56-4.85 m3/s near Terelj Gars, 6.10-11.1 m3/s near Ulaanbaatar, and 7.90-9.60 m3/s near Lun Gars, with a decreasing trend toward the end of the river, as shown in Table 2.8.

Table 23. Low season flow, m3/s

№	River and guard	Poverty period	Supply ratio					
			50	75	80	90	95	97
1	Tuul River-Ulaanbaatar guard	Average 30-day minimum rainfall	11.0	7.43	6.85	5.19	4.00	2.80
		Minimum coverage in the warm season	6.10	4.06	3.74	2.30	1.00	0.87
2	Tuul River-Terelj guard	Average 30-day minimum rainfall	4.85	2.90	2.70	1.70	0.64	0.50
		Minimum coverage in the warm season	2.56	1.45	1.21	0.70	0.32	0.22
3	uul River-Lun guard	Average 30-day minimum rainfall	9.60	7.50	6.20	3.30	2.81	2.65
		Minimum coverage in the warm season	7.90	5.80	5.70	4.00	2.90	2.55

Hot and cold water mode

The balance of solar radiation and the thermal regime of water play an important role in the aquatic environment and its ecosystem. When the water temperature increases sharply, the number of animal and plant species and varieties decreases. For example, green plants disappear when the water temperature reaches 380C, diatoms at 450C, blue-green algae at 600C, and bacteria at 700C. Roundworms, roundworms, crustaceans, insects, and mollusks disappear at temperatures above 400C. The main factors affecting water temperature and heat balance are climate, geography, water balance, and sediments. The average annual temperature of Mongolian rivers varies by altitude from 0.3 to 0.60C per 100 m. The water temperature of the Tuul River in the last 10 days of April in spring reaches 1.20C, reaching an average of 7.00C in May, and 15.00C in the warmest month of July. The maximum water temperature will reach 23°C around July 15. After that, the water temperature will decrease along with the decrease in air temperature, which will have a cooling effect on the environment, leading to the phenomenon of autumn ice. All this will be the natural regime of the Tuul River and its tributaries.

Table 24. Water temperature

Indicator	Month and day when 0.20C is observed in spring	Monthly average							Month and day when 0.20C is observed in autumn	The most	
		IV	V	VI	VII	VIII	IX	X		Temperature	Month, Day
Tuul-Bosgyn Bridge, 1986-2022											
Medium	VI.18		5.3	11.4	13.7	12.9	8.0	2.07	X.29	18.3	VII.22
High(early)	IV.1		12.5	15.0	19.4	16.6	11.5	5.5	X.21	23.5	VI.16
Low (late)	IV.19		0.2	5.5	9.5	6.7	1.8	0.2	XI.25	13.6	VII.11
Tuul-Ulaanbaatar, 1945-2022											
Medium	IV.17	1.04	7.19	12	15	14	9	3	XI.03	20.9	VIII.08
High (early)	III.19	5.5	13.7	18	19	18	13	10	IX.28	28.9	VI.01
Low (late)	V.28	0.1	0.9	8	9	10	3	0	XII.25	14	VIII.25
Terelj-Terelj, 1970-2022											
Medium	V.03		3.7	8.49	10.5	9.89	5.75	1.78	X.28	16.4	VII.21
High (early)	IV.06		11.6	12.2	13.9	13	8.9	5.5	X.27	24.6	VI.05
Low (late)	VI.13		0.1	2.1	7.3	6.9	1.6	0.2	IX.12	11.4	VIII.22

In the Tuul River basin, the maximum water temperature decreased by an average of 0.06 degrees per year near Terelj, while it warmed by an average of 0.03 degrees near Ulaanbaatar, as can be seen in Figure 2.15.

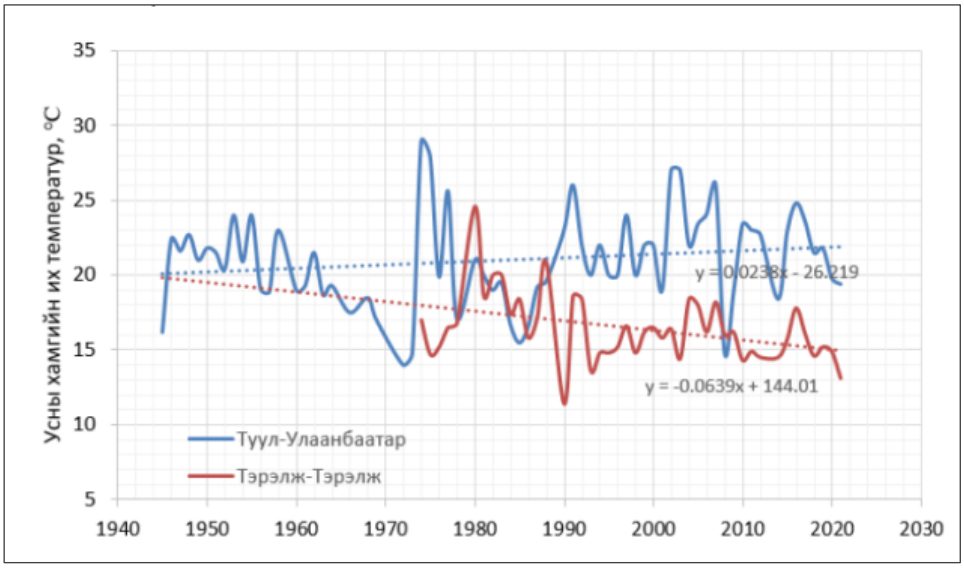


Figure 50. The maximum water temperature of the Tuul River

Depending on the river flow pattern and the influence of tributaries, ice phenomena are observed in each basin uniquely, and since the Tuul River flows mostly along the latitude, ice phenomena are observed almost simultaneously along the entire length of the river. In this basin, ice phenomena begin on average around October 20 in autumn, and after about 5 days, the ice melts, and then the ice cover is formed by mid-November. The duration of ice phenomena is 170-180 days at the average elevation of the river catchment area of 1,000-1,500 m, and 185-200 days at the headwaters of the river, which are 1,500-2,000 m high. The duration of ice cover has been

shortened by 5 days at the headwaters and 2 days at the headwaters compared to the average for 1991-2008. The duration of ice phenomena is shown in Table 2.10.

Spring ice events tend to end 10 days earlier in the Terelj River. However, the intensity of the change in the timing of spring ice events in the Tuul-Ulaanbaatar basin has increased by -0.31 days/year in the period 1990-2008, which is twice as high as the previous period 1946-1989.

Table 25. The period of observation of the ice phenomenon

Indicator	Month and day of observation					The most			
	The fall ice phenomenon begins.	Autumn festival run	Ice formation	Spring is coming soon.	The spring ice phenomenon ends	Autumn festival	Spring is coming	Ice cap	Total ice phenomenon
Tuul-Bosgyn Bridge, 1986-2023									
Medium	X/18	X/25	XI/18	IV/23	V/02	8	6	147	196
High(early)	X/01	X/14	XI/02	IV/16	IV/10	22	15	174	217
Low (late)	XI/04	XI/10	XII/01	V/01	V/24	1	1	121	165
Tuul-Ulaanbaatar, 1945-2023									
Medium	X/19	X/25	XI/13	IV/21	IV/26	14	6	154	189
High(early)	X/08	X/12	X/28	IV/01	IV/09	44	16	185	209
Low (late)	XI/10	XI/17	XII/01	V/07	V/11	1	1	114	160
Selbe-Sanzai, 1970-2023									
Medium	X/06	X/08	X/21	-	IV/23	4	-	165	199
High(early)	IX/21	X/02	X/09	-	IV/10	4	-	197	219
Low (late)	XI/01	X/11	XI/11	-	V/08	3	-	141	166

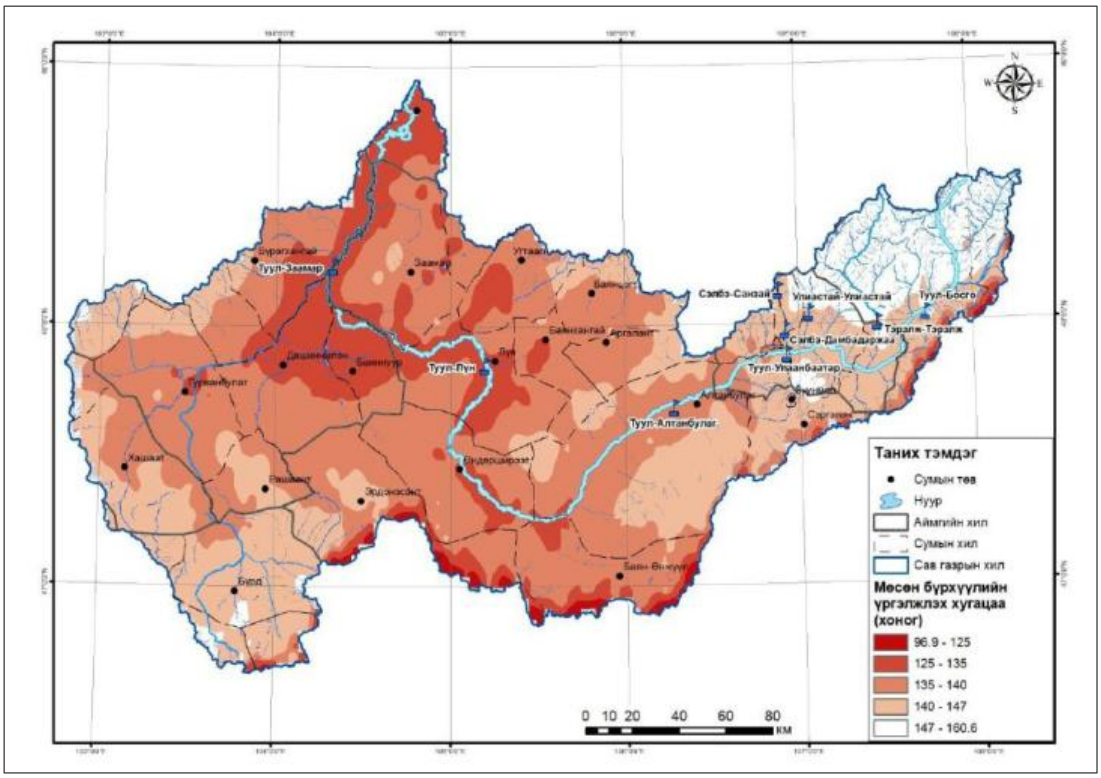


Figure 51. Number of days with ice cover on rivers in the Tuul River basin

Table 26. Ice thickness, cm

Indicator	XI			XII			I	II	III			IV	The most	
	10	20	30	10	20	30	31	28	10	20	30	10	см	Month, Day
Tuul-Bosgyn Bridge, 1986-2022														
Medium	30	35	47	60	67	73	89	98	92	86	79	167	113	II.28
High(early)	53	61	75	81	86	90	160	271	196	128	126	110	271	II.28
Low (late)	4.0	14	23	41	41	41	61	69	69	61	34	41	75	I.30
Tuul-Ulaanbaatar, 1945-2022														
Medium	17	27	38	46	56	65	86	85	83	80	72	57	98	II.15
High(early)	35	60	91	75	104	122	163	178	157	193	158	145	193	III.20
Low (late)	8.0	8.0	9.0	7.0	5.0	11	26	22	21	21	12	10	30	II.21
Selbe-Sanzai, 1994-2022														
Medium	24	28	31	33	34	34	33	33	34	34	36	37	36	I.20
High(early)	38	48	88	88	88	88	88	88	88	88	88	80	89	XII.31
Low (late)	1.0	1.0	1.0	12	13	13	13	13	13	13	13	18	13	XII.20

5.1.2. Scarcity, depletion, and quality changes of the Tuul River water resources

5.1.2.1. Water shortage and compensation of the Tuul River

The centralized water supply of the capital Ulaanbaatar city is provided by 4 sources located along the Tuul River valley. The above sources extract water from the alluvial sediments of the Tuul River valley and distribute it to consumers. The water supply source of this project is also located in the Tuul River valley.

In line with the growth of the population and industrial enterprises of the capital city, water consumption is constantly increasing, and the ability to meet this consumption only from groundwater resources is decreasing.

Currently, the capital city's drinking water consumption is estimated at 268 thousand cubic meters/day, and the water reserve is 278.4 thousand cubic meters/day. From this, it can be seen that the capital city's water resources are reaching their limits, but water consumption exceeds their limits. This is because there are many enterprises and private wells that are not connected to the water meter.

Due to deforestation in the Tuul River basin and the concentration of agriculture, especially livestock farming, the main natural components of the river basin's flow formation and regulation, such as logging, fires, pests, and soil and pasture degradation, have decreased water infiltration, resulting in increased surface runoff, and a trend toward depletion of groundwater resources. For this reason, the river's water supply was cut off in the spring of the early and mid-1990s, when water was abundant.

The main factors affecting the change in water regime are the reduction of forest resources, pasture erosion, and soil and vegetation degradation.

5.1.2.2. Changes in the water quality of the Tuul River

Tuul River water quality status for the first quarter of 2024

In accordance with the order of the Minister of Environment and Tourism No. A/02 of 2016, and in accordance with the approved environmental monitoring and analysis program, the Ministry of Environment and Water Resources took water samples from 4 water quality monitoring points along the Tuul River from Uubulan to Khadan Khasaa in January-March 2024 and determined the chemical composition and quality indicators.

The monthly changes in the electrical conductivity of the Tuul River water from January 2022 to March 2024 are shown in Figure 52.

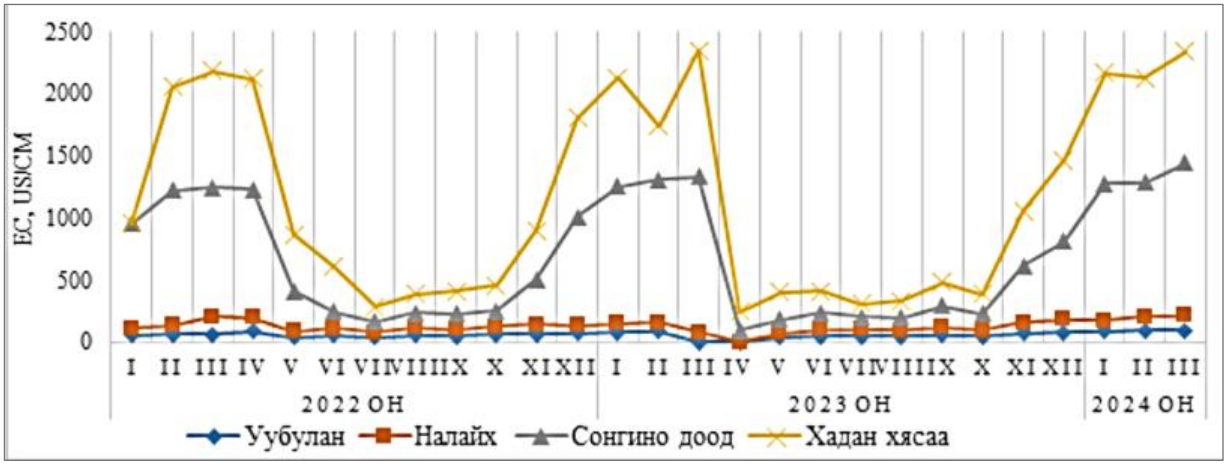


Figure 52 . Water conductivity at some points along the Tuul River

According to the analysis results, in January-March 2024, the electrical conductivity of water at points upstream of Ulaanbaatar city ranged from 91.1-99 µCi/cm, and from the Songino low point downstream of Ulaanbaatar city to the vicinity of Khadan Khasaa ranged from 1072-1228 µCi/cm.

Table 27. The concentration of major ions in water

Guard	Hardness, мг-экв/л	Ca, мг/л	Mg, мг/л	K+Na, мг/л	SO_4, мг/л	Cl, мг/л	HCO_3, мг/л	Эрдэсжилт, мг/л
Tuul-Uu Bulan	0.76	11.6	2.2	5.5	13.8	2.8	37.2	73.1
Tuul-Nalaikh	0.68	11	1.6	5.3	9.6	2.5	37.8	67.9
Tuul-bayanzurkh Bridge	0.96	14.4	2.9	3.3	14.6	3.5	42.1	80.8
Tuul-Songino Lower	3.44	42.5	16.1	184.8	80.2	94.3	396.6	814.5
Tuul-Hadan-Hasasa	3.68	41.7	19.5	142	100.1	70.2	323.4	696.9
MNS4586:98					100	300		

In the Tuul River upstream of Ulaanbaatar, no ion pollution indicators exceeding the permissible concentration in the Mongolian surface water standard MNS4586:98 were observed. The general hardness at the monitoring points, according to A.E. Posokhov's classification, ranges from 0.68-0.96 mg-eq/l or "Very soft water", and from the Songino lower point to the Khadan Khasaa point, it ranges from 3.68-3.44 mg-eq/l, which is in the "Hard water" category.

Хүснэгт 28. Major ions in water

Guard	ph	УХ, мг/л	БХХ$_5$, мг/л	ПИЧ, мг/л	NH_4, мг/л	NO_2, мг/л	NO_3, мг/л	P, мг/л
Tuul-Uu Bulan	0.2	8.62	0.5	1.5	0.01	0.001	0.60	0.002
Tuul-Nalaikh	0.4	8.32	1.4	1.4	0.02	0.001	0.37	0.005
Tuul-bayanzurkh Bridge	0.8	7.70	1.4	1.5	0.01	0.001	1.14	0.016
Tuul-Songino Lower	135	-	242.6	49.3	48.3	0.042	0.29	3.997
Tuul-Hadan-Hasasa	74	0.46	154	30.8	21.77	0.053	0.25	2.282
MNS4586:98		4<	3	10	0.50	0.020	9.0	0.100

Note: DO-Dissolved oxygen; BOD5-Biochemically available oxygen

The concentration of biogenic compounds at the monitoring points from Ulaanbaatar to the Songino Upper Point to the Khadan Khasaa point exceeded the tolerance level in the Mongolian Surface Water Standard MNS4586:98: Biochemical Oxygen Demand (BOD5) (HA-3mgO/l) 48.7-106.5 times; ammonium nitrogen (NH4) (HA-0.5mg/l) 41.2-96.6 times; nitrite nitrogen (NO2) (HA-0.02mg/l) 12.5-14.5 times; and mineral phosphorus (PO4) (HA-0.100mg/l) 22.8-39.8 times. The

dissolved oxygen regime around the Songino Lower Point and Khadan Khasaa point is lost and is at the “extremely polluted” level.

Figure 53. Biochemical oxygen demand (BOD5) content of water

Figure 54. Ammonium nitrogen content of water

Water monitoring and analysis of wastewater treatment plants in Ulaanbaatar city

In the first quarter of 2023, a total of 8 samples were taken from the wastewater inlet and outlet points of the 3 wastewater treatment plants (WWTPs) in Ulaanbaatar to determine chemical contamination. The results of the analysis of the wastewater after treatment are shown in Table 30, compared with the maximum permissible levels (MPL) of pollutants in wastewater that can be discharged into the environment as specified in the “Wastewater MNS4953:2015” standard.

Table 28. Biogenic content of 4 wastewater treatment plants in Ulaanbaatar city

Wastewater treatment plant	Sampling point	pH	J/b, mg/l	COD5, mg/l	PPE, mg/l	NH4, mg/l	NO2, mg/l	NO3, mg/l	Purity, %
central sewage treatment plant	to enter	6.57	812	904.8	1700.3	-	-	-	69.3
	to leave	6.65	164	277.2	601.8	38.72	0.45	0.072	
Nisekh treatment plant	to enter	6.87	178	261.8	897.9	-	-	-	57.1
	to leave	7.19	10	18.5	114.6	28.34	0.27	0.05	
Bio-residential treatment plant	to enter	6.55	200	346.5	726	-	-	-	-
	to leave	6.49	25	35.8	105.1	14.43	0.43	0.026	
Bio-industry treatment plant	to enter	6.92	30	42.4	66.9	-	-	-	25.1
	to leave	6.41	10	31.6	90.7	3.17	0.26	0.034	
MNS 4943:2015		6-9	30.0	20.0	50.0	15.0			

Note: B/b-Compostable substance; BOD5-Biochemical oxygen demand, BOD-Chemical oxygen demand

According to the analysis results, the water coming out of the treatment plants had a purity of 25.1-69.3%, and the wastewater treatment capacity of the Central Central Wastewater Treatment Plant was 69.3%.

When comparing the results of the analysis of the wastewater treated by the Central Central Wastewater Treatment Plant with the Wastewater Standard MNS 4943:2015, the water with a biochemical oxygen demand (BOD) content of 11.1-13.9 times, a chemical oxygen demand (COD) content of 8.7-12.0 times, a toxic substance content of 3.5-5.6 times, and a total nitrogen content of 1.6-3.0 times is supplied to the Tuul River.

The monthly changes in the purification capacity and toxic substance content of the Central Central Wastewater Treatment Plant from 2023 to March 2024 are shown in Figure 6-5.

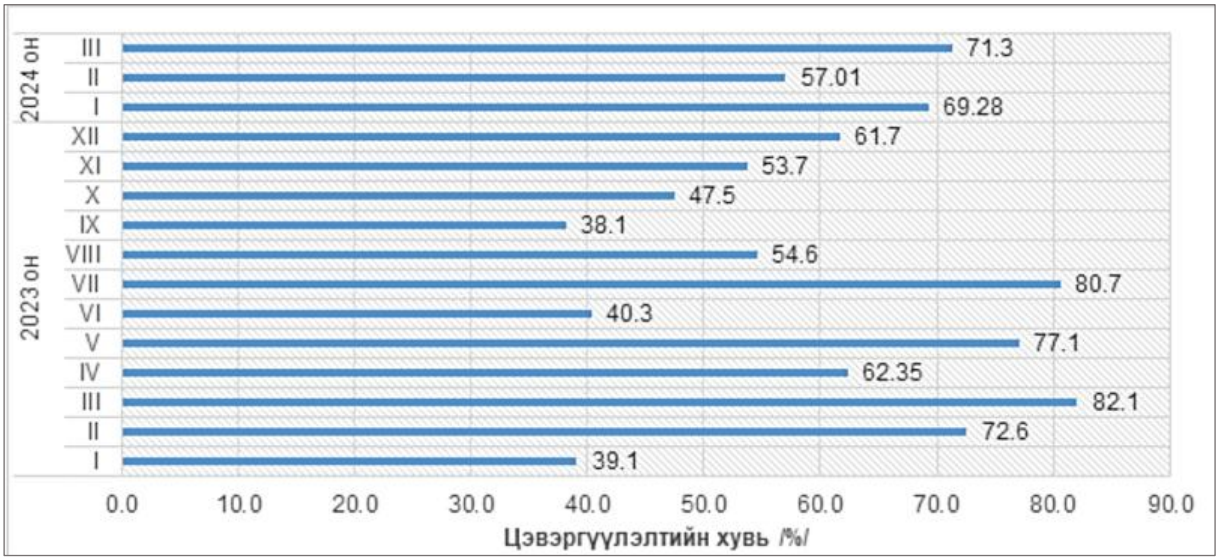


Figure 55. Treatment capacity of central treatment plants

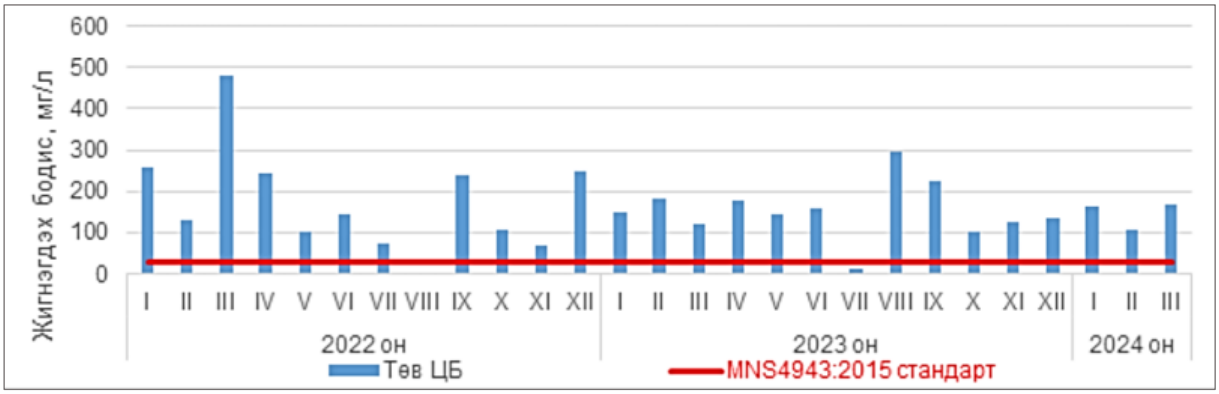


Figure 56. Weighing substances of central sewage treatment plants

Conclusion:

According to the results of monitoring conducted in the Tuul River water in January-March 2024, the overall mineralization of the river water is 73-90 mg/l (very low) upstream and near the city, and 680-1000 mg/l (high) downstream.

The water regime of the Tuul River above Ulaanbaatar was clean without any loss, but downstream from the city, near the Songino Dood and Khadan Khasaa monitoring points, the concentration of biochemical oxygen demand (BOD5) was 48-106 times higher than the

acceptable concentration (HA-3mgO/l) in the Mongolian Surface Water Standard MNS4586:98, the concentration of ammonium nitrogen (NH4-) (HA-0.5mg/l) was 41-96 times higher, the concentration of nitrite nitrogen (NO2) (HA-0.02mg/l) was 2.1-2.7 times higher, and the concentration of mineral phosphorus (P) (HA-0.100mg/l) was 22-39 times higher, and the dissolved oxygen regime was lost and observed at the “Extremely polluted” level.

However, the Central and Nisekhi wastewater treatment plants are supplying water with a total nitrogen content of 1.56-3.0 times higher than the total nitrogen content (TDN-15.0 mg/l) of the wastewater, which has a significant impact on the water quality of the Tuul River.

The wastewater treatment plants, namely the Central WWTP 57-69%, Nisekhi WWTP 92-97%, Bio-apartment WWTP 90-95%, and Bio-industrial WWTP 25%, supplied purified water to the Tuul River in January-March.

Surface water quality summary for January 2025

In January 2025, 6 samples were taken along the Tuul River to determine the chemical composition and quality parameters. Compared to the MNS4586:24 water quality standard, the ammonium nitrogen (NH4) content in the treated wastewater of the City Central Treatment Plant, near the Songino headwaters, was 895.5 times higher than the MNS, the nitrite nitrogen (NO2) content was 16.6 times higher, the mineral phosphorus (P) content was 43.4 times higher, and the biochemical oxygen demand (BOD) content was 4.5 times higher than the MNS.

From Songino Dodo to around Khadan Khasaa point, the concentration of ammonium nitrogen (NH4) was 1127-1328 times, the concentration of nitrite nitrogen (NO2) was 2.1-4.1 times, the concentration of mineral phosphorus (P) was 30.1-44.1 times, and the concentration of biochemical oxygen demand (BOD5) was 13-51 times higher than the LD. The dissolved oxygen regime was lost and it was at the “Extremely polluted level”.

5.2. SELBE RIVER

5.2.1. Water resources and regime of the Selbe River

Сэлбэ The Selbe River is one of the tributaries of the Tuul River, and its catchment area (according to the Dambadarjaa hydrological station) is located between 47º55'-48º15' north latitude and 106º50'-107º00' east longitude. The total catchment area of the river is approximately 300 km2.

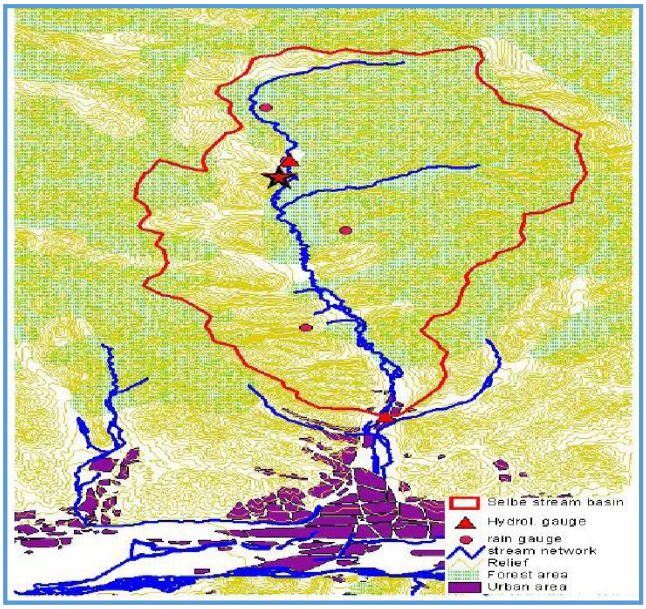


Figure 57. Selbe River Basin Map

Physical geography and hydrological parameters of the Selbe River: The Selbe River, a major tributary of the Tuul River basin, originates in the Khan Khentii mountain range and flows 35 km north-south through the center of Ulaanbaatar before flowing into the Tuul River. The Selbe River is located at an altitude of 1510-1620 m above sea level and is fed by the Khandgaitin River, Hailaast River, Chingeltei River, Sharga Moryt River, Belekhiin River, Yargaitin Gorkhi, Ar Guntiin Gorkhi, and Shadivlangiin Gorkhi (63% of the Tsutgal Rivers have dried up).

The Selbe River Valley The flow loss increases below the dam. The Selbe River is 7-15 m wide, the flow velocity is 2 m/s, the flow is 1.28 m3/s, and the level is 21.5 cm (1985).

Figure 58. Selbe and Bagabayan rivers

River water regime and feeding: The Selbe River has a spring yellow water and rainy season flood regime. 69% of the Selbe River's feeding is rain water, 5% snow and ice water, and 26% groundwater. The spring yellow water flood begins in late March and lasts until mid-April, after which the summer drought period begins. Summer rains become abundant in July, August, and September, and in autumn, the autumn drought period begins, and the river's main feeding water freezes at the end of October, so the water level, which is the river's main feeding water, is very unstable.

In terms of river regime classification, the Selbe River is included in the spring yellow water and warm season rainy season flood regime.

Permanent research on the Selbe River regime began in 1985 with the establishment of a hydrological observatory in the Dambadarjaa area. This observatory was closed in 1991 due to lack of personnel and equipment, and in 1994 a new permanent hydrological observatory was established in the Sanzai resort area, which has been operating as the main program of the hydrological network to date, measuring and observing such regime elements as water level, permeability, water temperature, ice occurrence, and thickness. Some of the graphical indicators of the above two observatories are shown in (Table 31).

According to the materials of the observed years, the maximum flow of the Selbe River reached 15.1 m3/sec in 1990 at the Dambadarjaa observatory and 3.56 m3/sec in 1994 at the Sanzai observatory.

Table 29. Some morphological characteristics of the Selbe River basin

№	River guard	Catchment area, km2	River length, km	Average height, m	The emphasis is on the form, %0	Forest area, %
1	Selb-Sanzai	34.2	8.3	1620	21.3	63.7

2	Selbe-Dambadarjaa	188	26.2	1510	12.4	54.6

Table 30. Observed annual average flow of the Selbe River, m3/s

	Month / Year	4	5	6	7	8	9	10	11
Selbe-Dambadarjaa	1987	0,8	0,21	0,27	0,42	0,65	0,34	0,22	-
	1988	0,8	1,04	0,84	0,66	0,41	0,84	0,23	0,04
	1989	0,8	0,21	0,32	0,27	0,36	0,25	0,25	0,01
	1991	2,44	2,14	0,53	1,08	0,42	1,11	0,57	0
	2000	0	0,33	0,08	0,37	1,49	0,56	0	0
	2001	1,51	1,14	0,43	0,25	0,18	0,18	0,17	0
	2003	0,37	0,96	0,17	0,28	1,96	1,1	0,65	0
	2006		1,42	2,57	1,14	0,83	0,78	0,89	0
	2007		0,97	0,94	0,63	0,73	0,75	0	0
	2008		0,31	0,64	0,59	0,12	0,3	0	0
	2009		0,25	0,32	0,43	0,44	0,33	0	0
	2010		0	0,21	0,19	0,29	0,09	0,11	0,02
	Average	0,96	0,75	0,61	0,53	0,66	0,55	0,26	0,01

Table 31. Average annual flow

№	River-Guard	Observation period	Average annual flow			C_v	C_s
			Q (m^3/s)	q ($l/s \cdot km^2$)	h (mm)		
1	Selbe-Sanzai	1994-2008	0.1	3.8	120.0	0.7	1.4
2	Selbe-Dambadarjaa	1985-2008	0.4	2.2	70.5	0.6	1.3

Table 32. Heavy rain and flash floods

№	River-Guard		Flow rate Q (m3/s), module q (l/s·km2), flow height h (cm) with different flow rates					
			0.1	1	2	5	10	25
1	Selbe-Dambadarjaa	Q	1002	350	216	113	67.4	25.8
		q	3630	1268	790	409	244	93.5
		h	-	40.0	24.6	27.0	13.5	16.0

Table 33. Average minimum flow module for 30 days of the heating season, l/s·km2

№	River-Guard	Supply ratio						C_v	C_s
		50	75	80	90	95	97		
1	Selbe-Sanzai	1.28	0.22	0.05	0.00	0.00	0.00	1.53	3.06
2	Selbe-Dambadarjaa	0.99	0.56	0.49	0.36	0.30	0.28	0.96	1.92

5.2.2. Water quality of the Selbe River

The fact that this river, which flows for just over thirty kilometers, has changed from being very clean a few years ago to being very dirty is not only a matter of concern, but also another clear example of how negative human impacts on the natural aquatic environment. The water resources of the Tuul River basin have been significantly depleted in recent years, largely due to the following factors:

- Extensive deforestation of the river's headwaters and frequent fires, which have reduced the amount of water stored in the soil and disrupted flow regulation.

- The increased population and livestock in the Tuul River basin have dramatically increased the need for water for domestic and industrial purposes.

- Climate conditions have changed, leading to aridity and warming.

- Uncontrolled use of water by the population and industrial enterprises of Ulaanbaatar city has increased.

The Selbe River is very clean at the mouth of Sanzai and above, from the mouth of Salkhit to Sharga Moryt, the pollution level increases near Dambadarjaa and Doloon Khokhlok, and the pollution reaches its peak in the area below Arslantai Bridge, and the water quality has deteriorated significantly.

On May 19, 2020, samples were taken from the headwaters of the Selbe River, the Baga Bayan River, and the area where the Selbe River flows together with the Baga Bayan River and analyzed at the Water Analysis Laboratory of the Institute of Geography and Geoecology. According to the results, the water of the headwaters of the Selbe River and the Baga Bayan River is of the hydrocarbonate class, calcium group, type 1, and is very fresh and very soft in terms of quality.

However, the water of the Selbe River where it flows together with the Baga Bayan River is of the hydrocarbonate class, sodium group, type 1, and is very fresh and very soft in terms of quality.

Compared to the analyzed indicators, the water of the Selbe River’s headwaters is classified as “Lowly polluted” in terms of ammonium nitrogen content and oxidation quality, the water of the Baga Bayan River is classified as “Polluted”, and the water of the Selbe River flowing together is classified as “Polluted” in terms of oxidation quality, and “Highly polluted” in terms of ammonium nitrogen content.

The Selbe River reaches its peak of pollution in the middle of Ulaanbaatar city, and the water level periodically decreases and is interrupted. The number of vacation homes and camps at the headwaters of the Selbe River has increased significantly, and the number of livestock households has increased, creating a major source of water pollution. This pollution tends to increase, especially in the warm season.

Chemical and biological pollution of water from this source increases further along the flow and reaches the Arslantai Bridge, reaching the same level as the most polluted part of the Tuul River, around Songino.

As a result of all the negative impacts of all industries, farms, ger districts, and residential wastewater in Ulaanbaatar, the pollution in the Songino area is very high. The pollution of the Selbe River is equivalent to the pollution in the Songino area, which is due to the fact that the river is located in the area, flows around and through the city, and therefore there are always sources of pollution in both hot and cold seasons.

5.3. MIDDLE RIVER

The Dund River is a western tributary of the Selbe River in the center of Ulaanbaatar city, where it eventually joins the Tuul River. It is approximately 20-25 km long (depending on the flow rate).

It originates at the northern foot of the Bogdhan Mountains and flows from Khan-Uul District through Bayanzurkh and Sukhbaatar Districts to the Tuul River in the western part of the city center.

River water level:

• The water level increases in the summer depending on rainfall.

• It may freeze or dry up completely in the winter.

The Dund River is one of the few rivers that flows through the city and plays the following roles in the ecosystem. These include:

- Supports surface water circulation – Part of the city’s water system.
- Habitat – Shrubs and grasses grow along the riverbanks, and birds live there.
- Flood protection – It stores excess water during the rainy season.

SIX. GROUNDWATER

6.1. GROUNDWATER RESOURCES AND STATUS

Groundwater studies in the Tuul River Basin are uneven but relatively well-conducted.

A 1:500,000 hydrogeological map has been prepared for the entire Tuul River Basin, and a 1:100,000 map has been prepared for the area around Ulaanbaatar.

The Tuul River Valley around Ulaanbaatar has been studied with high precision in terms of hydrogeology and engineering geology, and its geomorphology and geological structure have generally been clarified.

Geomorphology and geology: In terms of geomorphology, the Tuul River Basin generally belongs to a mountainous region and consists of mountain ranges, their slopes, foothills, and valleys, mouths, and channels of rivers and streams within the mountains.

The source of the Tuul River basin is located in the mountainous part of the Khentii Range at an absolute altitude of 2600 m above sea level, while the Orkhon-Tuul delta, the river's final part, has an absolute altitude of about 800 m, and the river valley widens.

The mountains surrounding the basin serve as a groundwater recharge zone, and the Ulaanbaatar depression serves as a storage, transport, and foothill zone. The Tuul River valley has alternating widening and narrowing sections, with the widening section serving as a groundwater accumulation zone and the narrowing section serving as a compressed foothill zone.

The geological formation of the basin consists of sedimentary and metamorphic rocks formed in the Cambrian, Devonian, and Carboniferous periods, Jurassic and Triassic granites that penetrate them and are frozen deep in the earth, light gray sandstones and siltstones formed in the Cretaceous period, Tertiary red and reddish yellow gravelly sandy and clayey clay, loam, and thin layers of sand, gravel, clay, and gravel formed in the Quaternary period, and sediments and rocks such as sand, gravel, clay, and gravel formed in the Quaternary period.

Tertiary (Neogene, Paleogene) sediments are on average 80 m thick and usually have an impermeable clay structure. Modern Quaternary or Holocene alluvial, lacustrine, and wind-derived sediments are distributed along the Tuul River valley, among which alluvial sediments contain relatively large reserves of groundwater.

6.2. HYDROGEOLOGY CONDITIONS

Aquifer-bearing periods, strata, and zones were distinguished based on the water-bearing characteristics of sediments and rocks distributed throughout the Tuul River basin, and the groundwater levels and distribution patterns discovered through drilling.

1. Aquifers and strata:

1.1. Aquifers in alluvial sediments. This aquifer is composed of alluvial sands, gravels, and sometimes sandstones of modern Quaternary or Holocene (qh) age, mostly in the Tuul River valley. Alluvial sediments, which are composed of sands and gravels distributed in the Tuul River valley around Ulaanbaatar, contain high-yield groundwater. The thickness of the aquifer varies from 5 meters to more than 90 meters.

1.2. Aquifers in wind-induced sediments. This aquifer is composed of wind-induced sands, gravels, and loose, porous sands of Holocene (qh) age, mostly in small areas with high yields. This layer is distributed over large areas with very low or medium yields.

1.3. Holocene alluvial aquifer. This aquifer includes alluvial aquifers with high yields in small areas or low to medium yields in large areas, composed of sand, gravel, sandstone, and clay. Most of the alluvial aquifers distributed along river valleys where groundwater use has not been explored

are included in this aquifer. Most of the wells where this type of aquifer was discovered are located in river valleys and have relatively high yields. The aquifers of Holocene alluvial aquifers, silty sands, and gravels, classified as porous aquifers with high yields in small areas or low to medium yields in large areas, have a yield of 0.2-5 l/sec.

1.4.Quaternary aquifers composed mainly of lacustrine clay, silt, and sand. The relatively small, low- or medium-yield porous layer, which is distributed over a relatively large area, was used to drain the water table by 11-13.5 m.

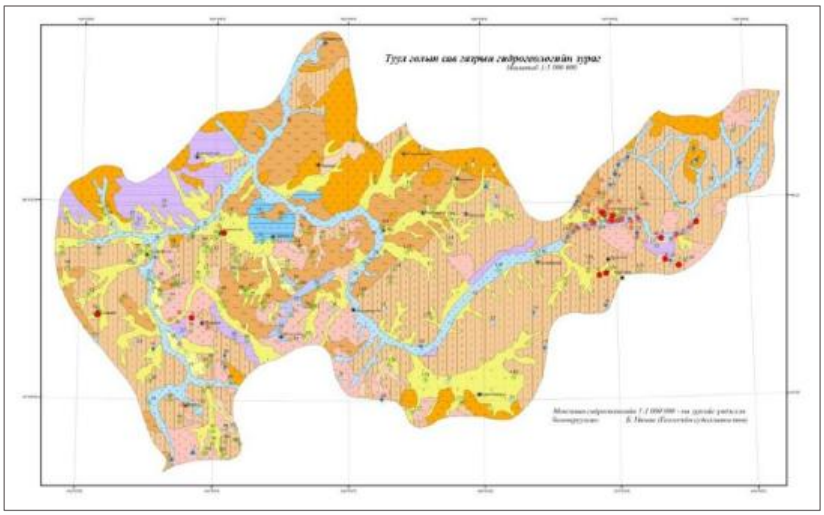
1.5. Aquifers in Pleistocene-aged, proluvial sediments. This layer consists of sand, gravel, silt, clay, and silt distributed along channels, ravines, and mountain slopes. The aquifers in Pleistocene-aged, proluvial sediments are quite widespread. The groundwater yield in the Pleistocene-aged, proluvial, limited-area, high-yield porous layer or large-area low-yield porous layer is 0.3-16 l/sec in the experimental wells, and the water table is 0.5-42 m low.

1.6. Aquifer in sediments of the Neogene (N) age. This layer consists of sandy clay, sand, and silt. Due to its low water holding capacity, its water is rarely used for concentrated water supply.

1.7. Aquifer in sediments of the Upper Cretaceous (c2) age. Upper Cretaceous aquifers are not widely distributed in this region, and it is rare to find a large source of water supply.

1.8. Aquifer in sediments of the Lower Cretaceous (c1) age, of marshy continental origin. It is common for aquifers in sediments of the Lower Cretaceous age, of marshy continental origin, to be distributed with limited depth.

1.9. Aquifer in sediments of the Jurassic, Triassic, and Permian ages, of low-lying-fractured origin. This layer is of limited distribution in this region. Jurassic, Triassic, and Permian sands and gravels are also common, containing water with a flow rate of 0.1-1.0 l/sec. The water mineralization is around 1.0 g/l.



Зураг 1.

In the Tuul River Basin, there are two types of water-bearing formations: pore (formation) and fracture (zone), and there are springs with fracture-pore water (cold springs with carbonic acid gas such as Ulaanbaatar and Ar Janchivlan). Porous formations are formed in Lower Cretaceous, Neogene, and Quaternary sediments, while fracture zones are formed in Cambrian, Devonian, Carboniferous sediments, metamorphic, or Jurassic and Triassic sedimentary rocks, respectively.

The age and lithology of sediments distributed in the Tuul River Basin are generally divided into 6 water-bearing pore-pore zones, formations, and 2 water-bearing fracture zones by N. Jadambaa et al., 2012. The basic information on the 6 water-bearing pore-pore zones and the formation and fracture zones is shown in the table below.

Table 34. Table 36. Water-bearing strata, formations and some regional hydrogeological indicators of the basin

№	Ус агуулагч үе, бүрдэл, бүсийн нэр	Өгөмжийг нь ашигласан цооногийн тоо	Усны түвшин (бага-их), м	Түвшний бууралт (бага-их), м	Ундарга, л/с	Эрдэс-жилт, гр/л
1	Голоцений аллювийн үе	300	0.2-6	0.0-23	1.0-105	0.1-0.6
2	Туул голын хөндий дагаж тархсан Плейстоцений пролюв, пролюв-аллювийн үе	200	2.0-11.5	1.9-20.5	0.5-24.1	0.5-1.5
3	Цутгал голуудын хөндий дагаж тархсан Голоцен-Плейстоцений аллюви, пролювийн үе	270	0.2-12	2-40	0.5-8.0	0.3-1.2
4	Неогений хурдас дахь бүрдэл	20	19.37-119	2-40	0.5-3.8	0.5-1.6
5	Цэрдийн хурдас дахь бүрдэл	85	1.5-80	-	0.3-10	-
6	Триас-Юрагийн давхраадаст чулуулаг дахь бүрдэл	45	3-33	1-15	1-1.3	0.2-0.3
7	Палеозойн тунамал, хувирмал, бялхмал чулуулаг дахь бүс	30	3.7-60	4.5-17	0.07-25	0.1-1.2
8	Түрмэл чулуулаг дахь бүс	115	8.6-26.5	2.7-5.1	0.1-4.3	0.1-0.7

6.3. GROUNDWATER RESOURCES

6.3.1. Renewable resources (Natural resources)

Renewable resources refer to the amount of water that can be replenished each year through precipitation infiltration, surface water infiltration, and lateral runoff.

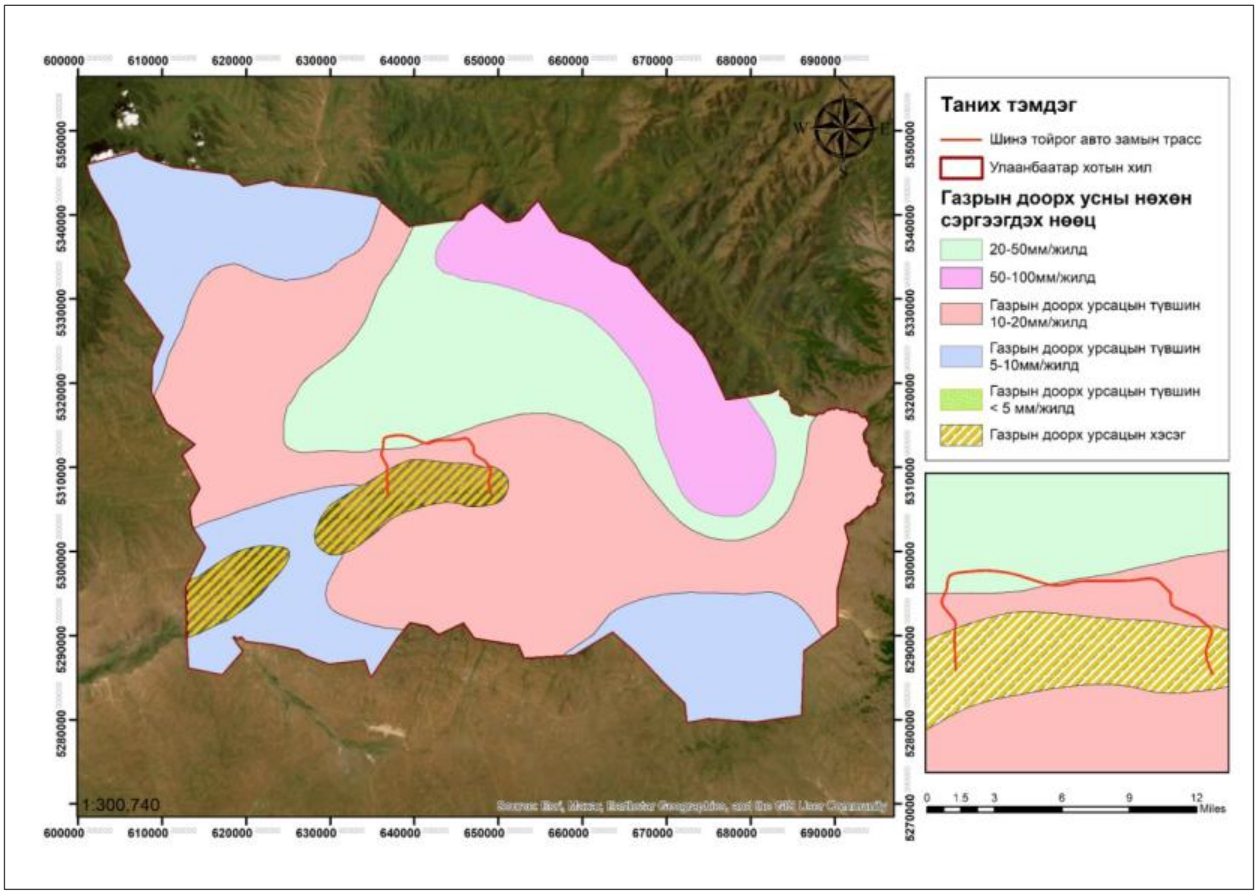


Figure 59. Renewable groundwater resources in the Tuul River Basin

The total catchment area of the Tuul River basin is 49774.0 km2, and it is estimated that 960.0 million m3 of groundwater recharge can be formed annually.

According to the groundwater recharge map (Figure 54), the area of the northwestern part of the newly constructed highway route falls into the “groundwater flow rate 10-20 mm/year” category, the northeast and northwest parts of the route fall into the “groundwater flow rate 20-50 mm/year” category, and the southeast and southwest parts of the route fall into the “groundwater flow area” category.6.3.2. Ашиглалтын баримжаат нөөц

The estimated groundwater resources are determined by the watershed, aquifer, formation, zone, and area using two main methods: mapping and balance.

The total area of the Tuul Basin is 49,774 km2, and the estimated groundwater resources are 641 million m3/year (0.641 km3/year), of which 596 million m3/year or 92.9 percent of the total resources and 20 percent of the total area are formed (Table 37).

Table 35. Туул голын сав газар дахь газрын доорх усны ашиглалтын баримжаат нөөц

Index	Classification of groundwater resources and types of water reservoirs for groundwater use	Area, km2	Reserve per unit area, l/sec/km2	Reserve per unit area, m3/year/km2	Reserves, million 3/year
1	Rich in resources (>10 l/s/1 sq km), free surface water	165.6	10	315360	52
2	Free surface water with above-average resources (3-10 l/s/1 sq km)	3705	3	94608	351
3	Free surface water with medium resources (1-3 l/s/1 sq km)	6123	1	31500	193

5	Free and pressurized surface water with lower than average resources (0.3-1 l/s/1 sq km)	246	0.65	20500	5
6	Lower than average resources (0.3-1 l/s/1 sq km), pressurized water	633	0.65	20500	13
7	Low resource (0.03-0.3 l/s/1 sq km), free and pressurized surface water from fractures and pores	1278	0.165	5203	6
8	Low resource (0.03-0.3 l/s/1 sq km), free and pressurized surface water from pores and fractures	2239	0.165	5203	12
9	Very low resource (0.003-0.03 l/s/1 sq km), free and pressurized surface water in pores	49	0.0165	520	0
12	Low resource (0.003-0.03 l/s/1 sq km), fracture pressure and free surface water	12879	0.0165	520	7
13	Very low resource (<0.003 l/s/1 cu km), fractured bedrock, permafrost-affected loose sediments, or sedimentary rocks that have not been hydrogeologically studied	22456	0.003	94.6	2
Total		49774			641

Table 36. Groundwater deposits with proven reserves in Ulaanbaatar city

№	Сум	Ордын нэр	Он	Ашиглах жил	Нийлбэр нөөц	Батлагдсан нөөц, л/сек
1	Улаанбаатар хот	Туул голын УБ доод эх үүсвэр	1979	30	7.46	
2		Туул голын УБ дунд эх үүсвэр				6.26
3		Туул голын УБ дээд эх үүсвэр				
4		Улаанбаатар хотын ДЦС-2	2020	25	108	108
5	Сонгинохайрхан	Хүй долоон худаг	1987	25	17.0	17
6		Хүй долоон худаг	2006	25	44.5	44.5
7	Сонгинохайрхан дүүрэг, 21-р хороо	361 гарам	2013	25	20	20
8	Баянзүрх	Өвөр горхийн хөндийн Туул голын савын бэлчир	2004	25	136.0	136
9	Налайх	Налайх дүүргийн - Барилгын материалын үйлдвэрлэл, технологийн парк	2015	25	30.0	30
10		Өтгөрүүгийн тохой	2020	25	85.0	85
11	Хан-Уул дүүрэг Яармаг, Нисэх	Яармаг нисэхийн эх үүсвэр	2011	25	303.3	303
12	Гавьжийн шанд, Өлзийт хороо	Өлзийт гавжийн шанд	2012	25	26.86	26.86
13	ХУД 13-хороо Биокомбинат, Шувуун фабрикт	Туул голын доод эх үүсвэр - Үнсгэний хөндий	2014	25	210.0	210
14	Хан-Уул	Улаанбаатар хотын ус хангамж (Шувуун фабрикийн хэсэг)	2019		885	885
15		Улаанбаатар хотын ус хангамж (Био комбинатын хэсэг)	2019		736	736
16		Буянт-Ухаа	2009	25	240.0	261
17		Оргилын нүүрсхүчлийн хийт хүйтэн рашаан	2022			1

Source: Water Department, 2024

6.4. CHEMICAL COMPOSITION AND QUALITY OF GROUNDWATER IN THE ULAANBAATAR CITY ENVIRONMENT

Mongolia's groundwater resources are unevenly distributed and vary in quality, with increasing mineralization from west to east and north to south. This is due to climate change, including increased precipitation, air temperature, and evaporation, as well as the basic characteristics of the water-bearing sediments.

In the integrated water resources management plan for the Tuul River Basin, groundwater around Ulaanbaatar is classified by quality and composition, and is grouped by district according to its chemical composition. For example, while the water in Sukhbaatar and Chingeltei districts has high mineralization and hardness, the water in Khan-Uul district has relatively low mineralization, or is fresh and soft water.

The long-term average of groundwater mineralization in the territory of Ulaanbaatar city is shown in the figure below, categorized by districts.

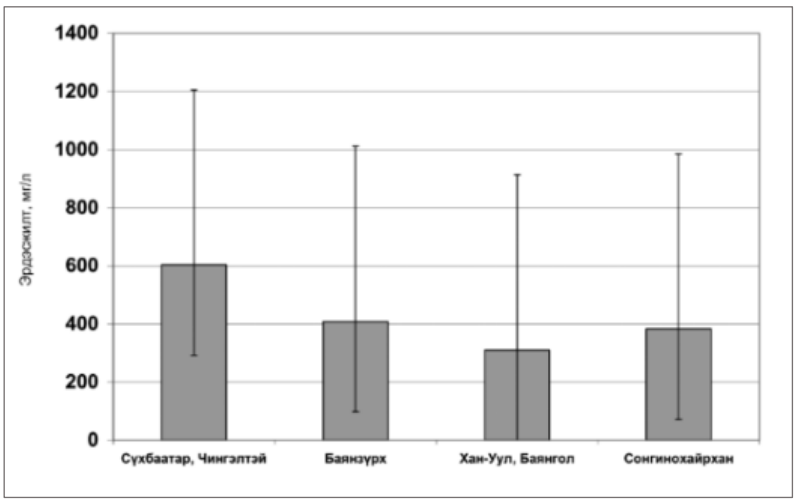


Figure 60. Average mineralization of groundwater around Ulaanbaatar city

The groundwater around Ulaanbaatar is classified as highly saline or moderately mineralized, with some areas containing saline water.

The average groundwater hardness around Ulaanbaatar is shown in Figure 60, grouped by district.

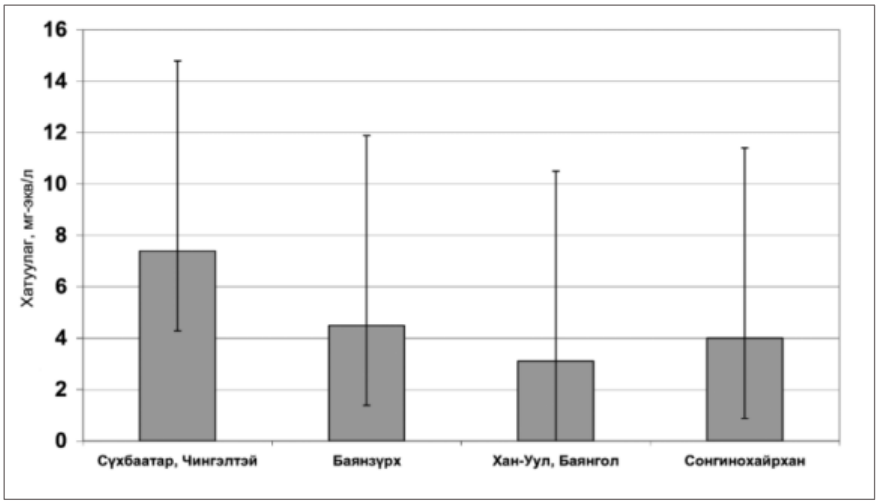


Figure 61. Average groundwater hardness around Ulaanbaatar city

The figure shows that the groundwater in most districts is soft, but in Sukhbaatar and Chingeltei districts it is relatively hard, exceeding the appropriate drinking water standard (5 mg-eq/l) and the maximum permissible limit (7 mg-eq/l).

The groundwater environment in the territory of Ulaanbaatar city is shown in Figure 61.

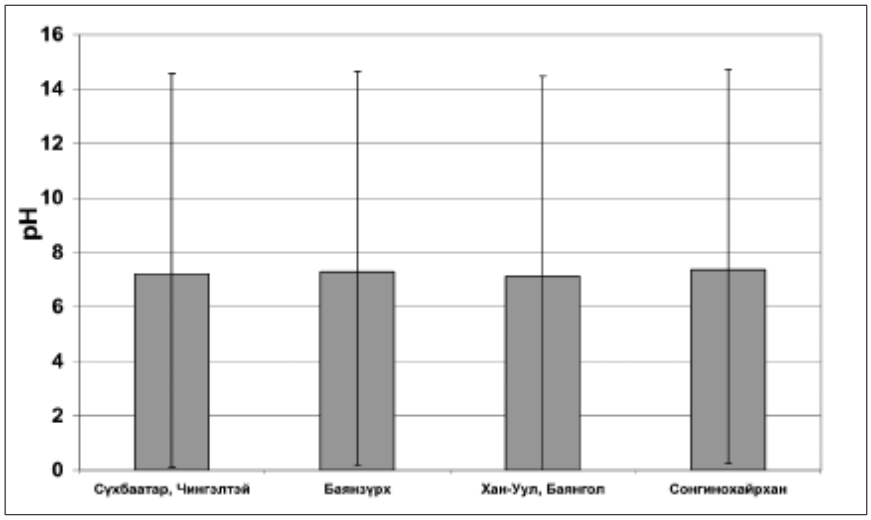


Figure 62. Groundwater pH in Ulaanbaatar city

Drinking water standards specify a pH of 6.5-8.5, and the pH of groundwater around Ulaanbaatar ranges from slightly acidic to slightly alkaline, or pH=6.5-8.5, which meets the requirements of drinking water standards.

Table 37. Heavy metal content in groundwater

Name of the place where the sample was taken	Parameters, mg/l						
	Mn	Fe	Cu	Cd	Pb	Zn	Cr
The airfield's gun well	<0.01	0.36	0.06	<0.003	<0.02	0.20	<0.01
The well of the last resort, Chingeltei	<0.01	0.13	0.07	<0.003	<0.02	0.20	<0.01
Zaisan, a children's prison well	<0.01	0.09	0.08	<0.003	<0.02	0.04	<0.01
Well of the Wounded Hospital	<0.01	0.16	0.10	<0.003	<0.02	0.03	<0.01
Dambadarjaa, deep well to the east of the temple	<0.01	0.27	0.08	<0.003	<0.02	0.04	<0.01
MNS 900:2005	0.1	0.3	1.0	0.003	0.01	5.0	0.05

Table 31 shows that the heavy metal content did not exceed the maximum permissible levels specified in the drinking water standards.

SEVEN. SOIL COVER

7.1. GENERAL SOIL CHARACTERISTICS OF ULAANBAATAR CITY

The territory of Ulaanbaatar city is located on the border of the mountain forest-taiga and steppe zones. In terms of soil geography, it is included in the pre-Khentiy district of the Khangai region of the soil-bioclimate, and Kharkhuren soil is mainly prevalent in the wide valley of the Tuul River and the slopes of the Khentii Range. In the northern part of the territory of Ulaanbaatar city, Oin Baraan and Kharshoroon soils are prevalent, in the river valleys, Alluvial peat and sandy loam soils are prevalent, while in the back of the Bogd Mountains,

Dark brown soil: This is the most common soil around Ulaanbaatar. It is stabilized under the variegated grass steppe vegetation (with 60-80% vegetation cover) and has a relatively thick (20-30 cm) dark brown humus layer. A few cm below it is a carbonate accumulation layer. Between the upper humus “A” layer and the carbonate layer, there is a 10-20 cm thick brown “B” or transition layer. The mechanical composition of the clay loam and sand is dominant, and sandy soils also occur..

Black earth soil: In the lower part of the mountain slopes, below the forest line at an altitude of 1700-1500 meters, it is stabilized under meadow-steppe vegetation with a 60-90% cover. Surface runoff from the forest creates excess soil moisture, which is soaked and moistened. Carbonate deposits form at a depth of 80-100 cm. The humus layer with a deep gray, brownish-dark gray granular structure is clearly distinguished. The thickness of the humus layer (A+AB) usually does not exceed 50-60 cm.

Alluvial soil: Spread over areas with variegated grass-grass vegetation. The humus layer is about 20-40 cm thick, with coarse humus, alternating sandy and loamy bands downwards, and the soil-forming rocks are sandy-gravelly alluvial sediments. The humus content in the upper part of the soil decreases by 5-10% as it descends. The reaction medium is neutral (pH=6.5-7.0). The gleyic character is clearly visible, and the surface has a scaly appearance of iron oxide formed by the influence of groundwater.

The residential area of Ulaanbaatar, the capital of Mongolia, has lost its natural characteristics due to population concentration, urbanization, and technogenic impacts over the past 400 years, and therefore can be considered as a Technosol soil type that has been changed by human activities. Therefore, the soils affected by technogenic impacts in the residential area of Ulaanbaatar have been divided into the following main subgroups: 1. Covered by buildings, 2. Soiled by ger districts, 3. Soiled by excavations and contamination from cemeteries, 4. Soiled by industrial areas, and 5. Soiled by mining. In addition, soils formed by human activities such as

vegetables, greenhouses, and green spaces have been mapped under the category of Antrosol.

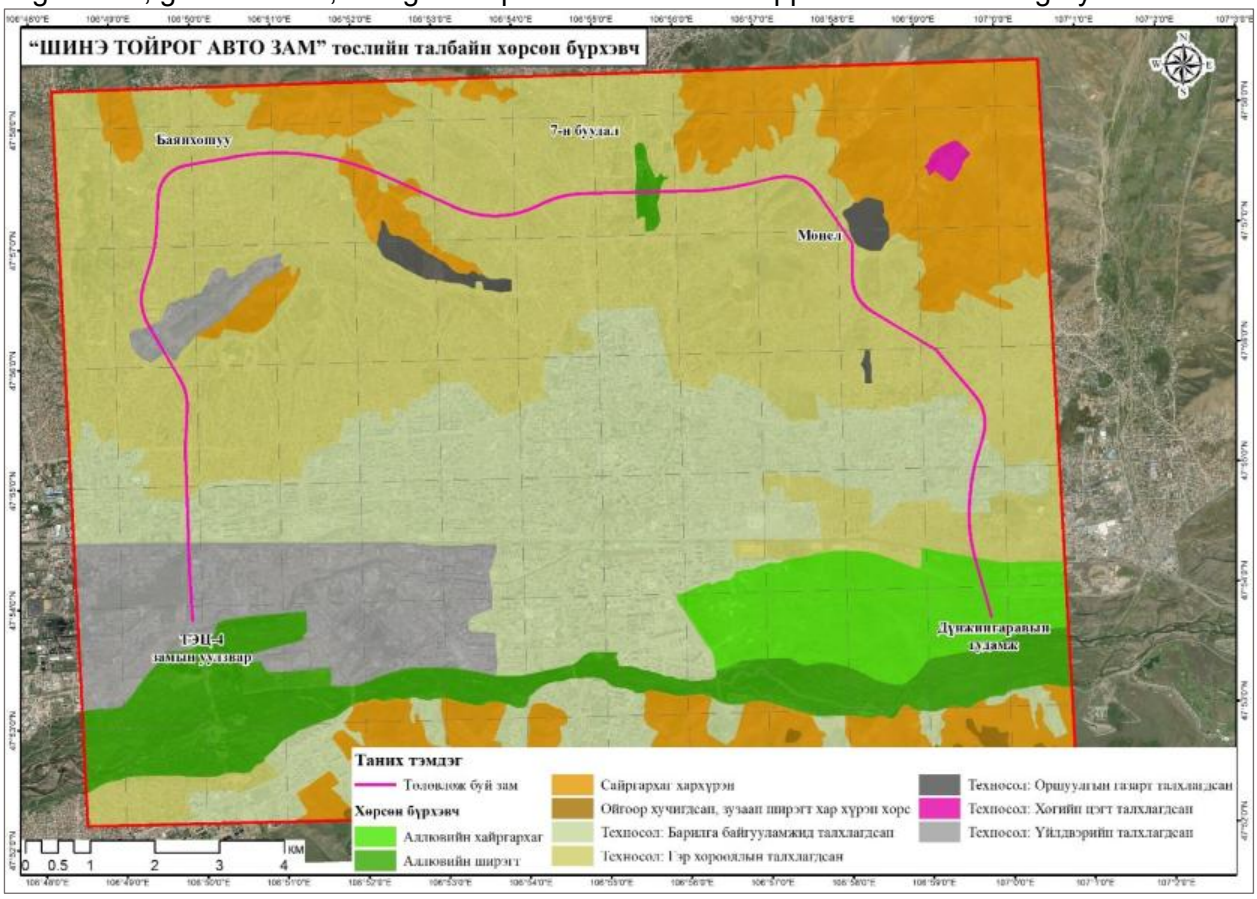


Figure 63. Soil cover of the project area

7.2. GENERAL CHEMICAL ANALYSIS OF SOILS

A general chemical analysis was performed on 242 soil samples taken from residential areas of Ulaanbaatar city. The soil reaction medium (pH) was 90.9% weakly alkaline, 4.9% alkaline, 0.8% strongly alkaline, and 3.3% weakly acidic. The humus content was 43.8% low or very low, 48.3% medium, and 7.8% very high. 44.6% of the soil was carbonate-free, 34.2% slightly carbonated, and 21% moderately carbonated. The salt content (EC) was 84.2% low, 12.3% moderate, and 3.3% saline.

Table 38. Results of general soil chemical analysis

	Max	Min	Mean	SD	Variation	Median
pH (1:2.5)	9.88	6.55	8.62	0.34	0.11	7.63
EC d/sm	9.47	0.05	2.06	1.31	1.71	0.61
OM, %	19.93	0.21	3.67	2.13	4.53	2.37
$CaCO_3$, %	9.45	0.00	2.23	1.77	3.15	0.61

7.3. SOIL HEAVY METAL POLLUTION LEVELS

Soil pollution research in Ulaanbaatar began in 1989, and the research work of P. Oyuunbat, a research fellow at the Soil Science Department of the Institute of Geography and Geoecology of the Mongolian Academy of Sciences, has shown a detailed distribution of heavy metal pollution by conducting laboratory tests on about 300 soil samples.

Heavy metals, which are the main indicators of soil pollution, are not decomposed and remain in the soil for a long time, and through water and air particles, they poison animals, animals, and

humans. Since they accumulate in living organisms or humans for a long time, they poison the body at the molecular and genetic levels. Therefore, determining and evaluating the level of pollution of these elements at all stages and identifying and implementing ways to reduce pollution in the future is one of our current pressing problems.

Heavy metals in soil are classified into POWER (lead, cadmium Cd, arsenic As, chromium Cr), Toxic bioactive heavy metals (copper Cu, zinc Zn, nickel Ni, vanadium V, strontium Sr, molybdenum Mo, cobalt Cayr, Molibden Mo, koba metal Co), Na), Metals (aluminum Al, iron Fe, barium Ba, manganese Mn) according to their effects on the environment and living organisms. In this study, special and bioactive metals were emphasized.

Extremely toxic heavy metals have a high toxicity to living organisms and can cause disease and even death if ingested in large quantities. However, toxic bioactive heavy metals are less toxic than extremely toxic heavy metals and must be present in living organisms to a certain extent, but if they accumulate in large quantities in living organisms, they can cause endemic or nosocomial diseases.

According to the statistical analysis of 334 samples taken in the residential areas of Ulaanbaatar city, arsenic (As) ranged from 0.0 to 393.2 mg/kg, with an average of 9.2 mg/kg, lead (Pb) ranged from 5.7 to 1339 mg/kg, with an average of 37.2 mg/kg, chromium (Cr) ranged from 0.9 to 10000, with an average of 85.4 mg/kg, cobalt (Co) ranged from 0.0 to 16.0 mg/kg, with an average of 1.2 mg/kg, nickel (Ni) ranged from 0.0 to 70.9 mg/kg, with an average of 8.8 mg/kg, zinc (Zn) ranged from 0.0 to 441.7 mg/kg, with an average of 88.4 mg/kg, copper (Cu) ranged from 0.0 to 844.4 mg/kg, with an average of 5.8 mg/kg, molybdenum (Mo) ranges from 0.0-41.9 mg/kg with an average of 0.7 mg/kg, Vanadium (V) ranges from 0.0-110.1 mg/kg with an average of 52.3 mg/kg, and Strontium (Sr) ranges from 0.0-1013 mg/kg with an average of 294.3 mg/kg.

Soil quality. The percentage of soil contamination exceeding the maximum permissible level of pollutants in soil (MNS 5850:2019) in the total sample is: As 3.9%, Pb 2.9%, Cr 2.6%, Zn 1.9%, Cu 0.6%, Mo 1.0%, Sr 1.9%, respectively, are highly contaminated. However, the points exceeding the standards for Cobalt (Co), Nickel (Ni), and Vanadium (V) are 0% or uncontaminated. The percentage of Pb 69.7%, Co 38.1%, Zn 83.2%, Cu 12.3%, Ni 50%, Mo 42.3%, As 63.5.3%, and V 58.1% are highly contaminated.

Heavy metal content in soil in Ulaanbaatar city

Statistical indicators	Heavy metals (mg/kg)									
	As	Pb	Cr	Co	Ni	Zn	Cu	Mo	V	Sr
Count	334	334	334	334	334	334	334	334	334	334
Maximum	393.2	1339	10000	16.0	70.9	441.7	844.4	41.9	110.1	1013
Minimum	0.0	5.7	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mean	9.2	37.2	85.4	1.2	8.8	88.4	5.8	0.7	52.3	294.3
SD	24.1	103.4	544.6	2.0	11.9	58.5	47.8	2.4	18.0	116.8
CV	261.8	278.3	637.8	168.3	134.8	66.1	826.3	345.4	34.4	39.7
MNS 5850:2019	20	100	150	50	150	300	100	5	150	800
Amount exceeding the standard, %	3.9%	2.9%	2.6%	0%	0%	1.9%	0.6%	1.0%	0%	1.9%

7.3.1. Distribution of arsenic (As) in soil

Arsenic in the topsoil of Ulaanbaatar city ranges from 0.0-393.2 mg/kg, with an average of 9.2 mg/kg. The most contaminated areas are in Bayanzurkh district, around Altan-Olgii (100-939 mg/kg), Monel (60-100 mg/kg), Shar Khad (40-60 mg/kg), and Uliastai (20-40 mg/kg), which are contaminated more than the MNS 5850:2019 standard.

In Songinokhairkhan district, Orbit (80-100 mg/kg), Narangin river (60-80 mg/kg), Hanyn material (20-60 mg/kg), Sonsgolon (40-60 mg/kg) are polluted above the standard. In Khan-Uul district, there is high pollution around the industrial complex (20-60), III power plant (20-40), and Yaarmag (40-60). In Bayangol district, there is relatively high pollution around IV power plant (20-40), III and IV districts (10-20), station (10-20), and dam-building (10-20). In Chingeltei district, no pollution above the standard was detected, but in Bayan Burd and Denji 1000, it is relatively high, or 10-20 mg/kg. However, in Sukhbaatar district, the concentration is 5-10 mg/kg or lower.

In terms of the toxic effects of arsenic on living organisms, almost all arsenic compounds are carcinogenic. As(III) and AsH3 are classified as highly toxic chemicals and cause skin, lung, liver, gastrointestinal, and lymph node tumors. The greater toxicity of As(III) compared to As(V) depends on the solubility and reducing properties of the compounds they form.

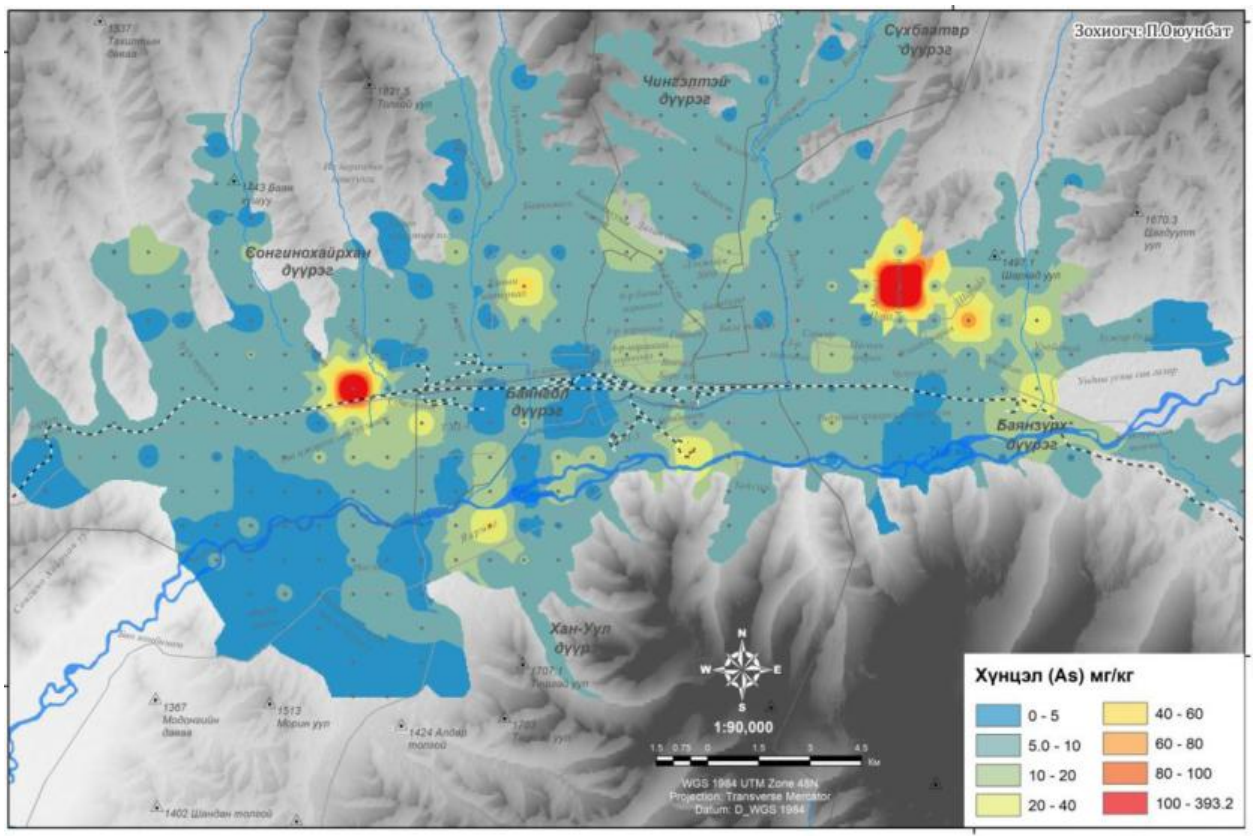


Figure 64. Arsenic content in soil in Ulaanbaatar city

Organic arsenic primarily causes severe tissue inflammation and necrosis, that is, when arsenic binds to sulfur, cell and tissue respiration and division stop. This disrupts the metabolism of fats and carbon in the body, and tissue oxidation processes decrease. Arsenic is a biologically active microelement, so it is contained in small amounts in plant and animal tissues and cells, and plays an important role in regulating the vital functions of humans and animals.

When the body lacks arsenic, hormonal regulation, enzyme activity, tissue respiration changes, and oxidation occurs. When arsenic is in excess, symptoms such as hair loss, digestive disorders, corneal clouding, nasal septum ulcers, brittle nails, and sensitivity to taste and smell appear.

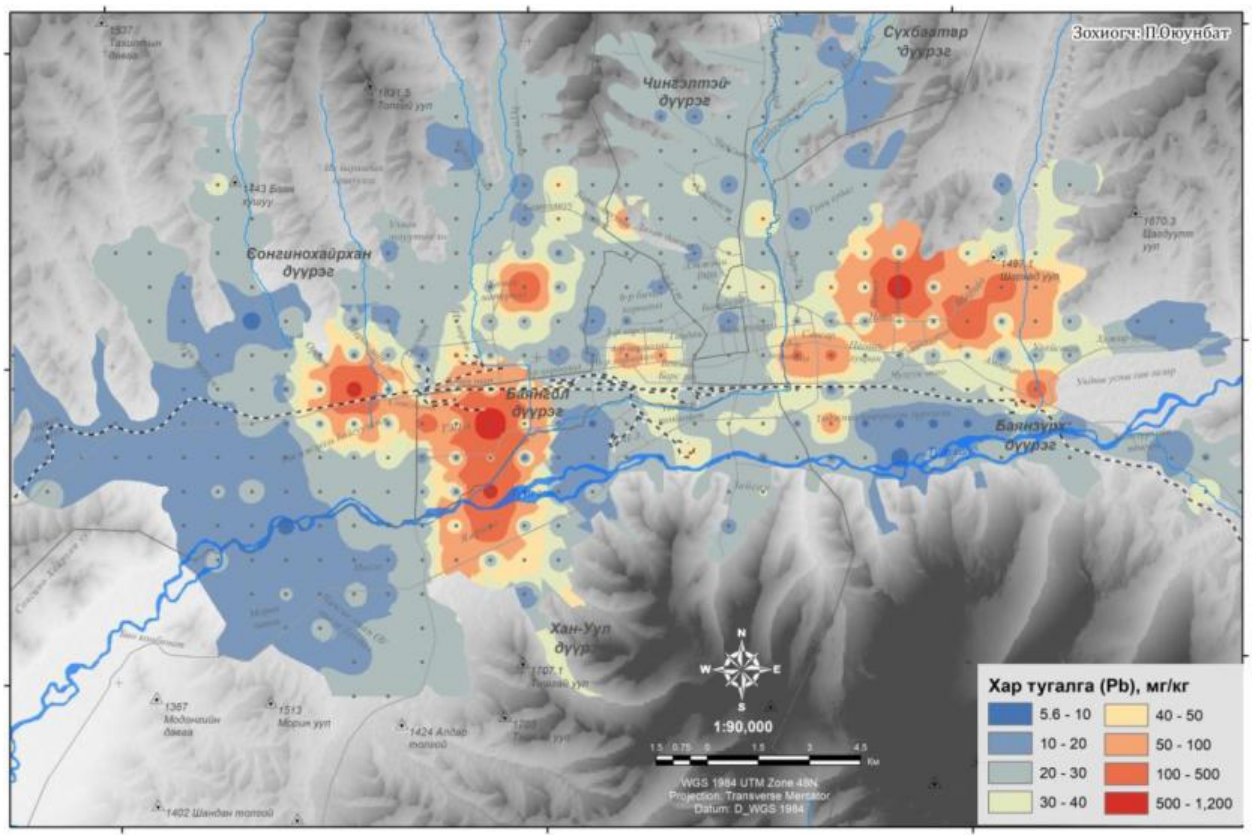
Arsenic usually enters the body through aqueous solutions, so water containing arsenic is considered the most dangerous. The permissible arsenic content in drinking water is 0.05 mg/l. Arsenic poisoning manifests itself differently depending on geographical location, lifestyle, and characteristics, and the amount contained in natural products also varies.

The amount contained in food is 0.006-1.2 mg/kg in cereals, 0.005-0.5 mg/kg in meat products, 0.01-0.2 mg/kg in vegetables and fruits, 0.005-0.01 mg/kg in dairy products, and a maximum of 0.39-3 mg/kg in seafood. The toxic dose of arsenic for humans is considered to be 0.01-0.05 g As, and the lethal dose is 0.06-0.2 g As (Voynar, 1960).

7.3.2. Distribution of lead (Pb) in soil

Arsenic in the topsoil of Ulaanbaatar city ranges from 5.7 to 1339 mg/kg, with an average of 37.2 mg/kg. The most polluted areas are in Bayanzurkh district, including Altan-Olgii (100-500 mg/kg), Monel (50-100 mg/kg), Shar Khad (100-1200 mg/kg), Amgalan (50-500 mg/kg), XIII district, Zhukov (100-500) with higher pollution than the MNS 5850:2019 standard. In Bayangol district, relatively high pollution is observed around Power Plant IV (500-1200), III and IV districts (50-100). In Songinokhairkhan district, the Orbit (100-500 mg/kg), Narang River (50-100 mg/kg), Hanyn Material (100-500 mg/kg), Sonsgolon, Central Treatment Plant (100-500 mg/kg), Bayankhoshuu Khotul (100-500) are polluted above the standard. In Khan-Uul district, the industrial complex (30-50) and Yarmag (50-100) are polluted. In Chingeltei and Sukhbaatar districts, the concentration is generally 30-50 mg/kg or less.

Sources of pollution include improper use of automotive fuels and lubricants, the sale of used spare parts, open warehouses, auto repair shops, traders, and individuals, and the negligence of individuals who directly pour oil from automobiles and spare parts into the soil, which continues to increase the concentration of heavy metals in the soil..



Зураг 2. Улаанбаатар хотын хөрсөн дэх хар тугалгын тархалт

Lead is widely used in the technical, construction, and food industries for its properties of easy melting, good permeability and compactness, protection from sun and wind erosion, long shelf life, and ease of processing. Accumulators, coal, gasoline, batteries, paints (various types, exterior paints for children's toys, toner for photocopiers and printers), etc. contain the most lead. A medium-sized accumulator contains 18-25 kg of lead and 2-3 liters of concentrated sulfuric acid, which means that this amount of toxic substance will be discarded when its service life ends.

There are more than 365,800 registered cars in Ulaanbaatar. All of them use accumulators, and if the service life is considered to be two years, it is estimated that 3,200-4,500 tons of lead waste will accumulate annually.

Mongolia's annual fuel consumption is more than 900,000 tons. Imported gasoline contains no more than 0.002 g/l of lead. The World Health Organization estimates that 5% of the lead mixed in gasoline is used to improve the engine of cars, while the remaining 95% is absorbed into the soil, air, and blood of citizens. Fingernail polish contains heavy metals that are harmful to the environment, such as mercury, lead, cadmium, and nickel, which can affect the human genome, cause mental and internal organ disorders, and are a source of cancer, and they themselves are dangerous due to improper use. Disposing of fingernail polish without any supervision causes water, soil, and air pollution.

7.3.3. Distribution of chromium (Cr) in soil

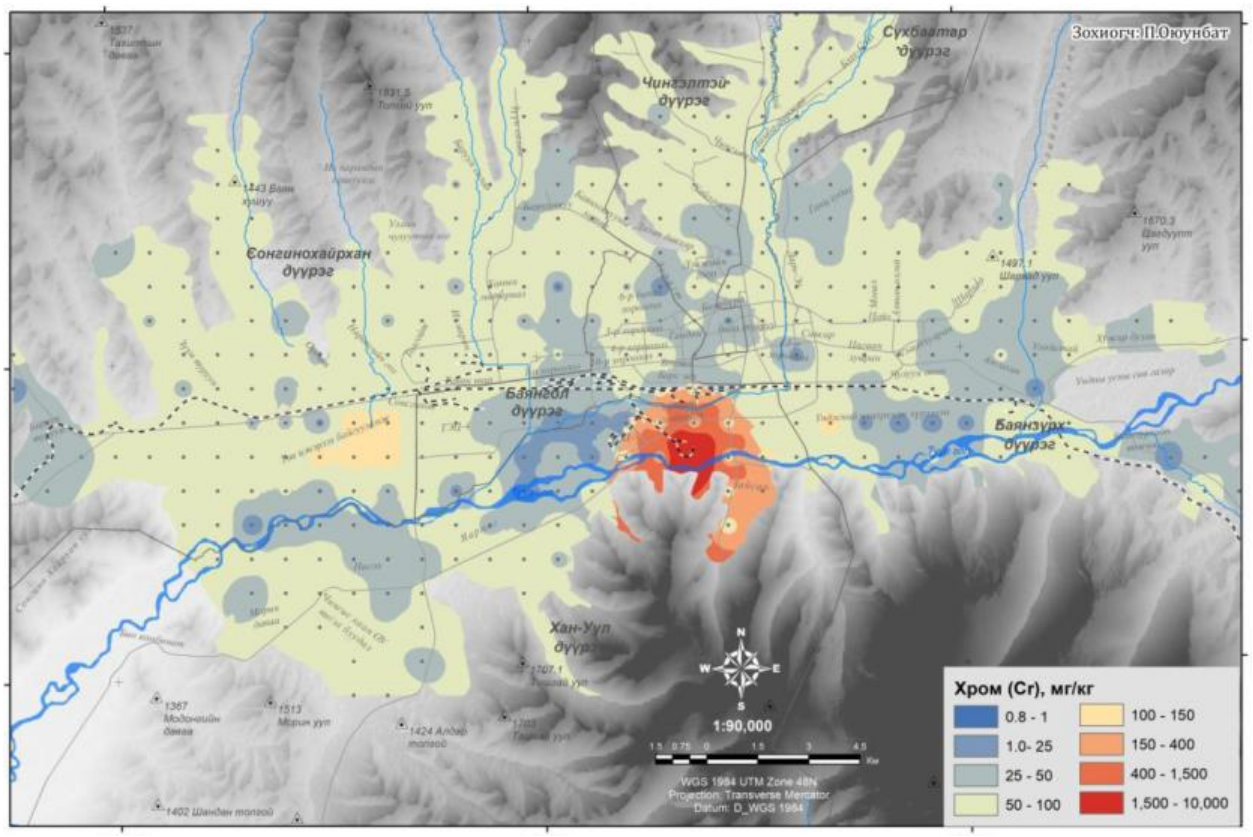
Chromium (Cr) in the topsoil of Ulaanbaatar city ranges from 0.9 to 10,000, with an average of 85.4 mg/kg. The Khan-Uul district II Khuro industrial complex, leather processing factories, and the Khargia pre-treatment plant have the highest levels of contamination (150-18,000 mg/kg), which is higher than the permissible concentration of the MNS 5850:2019 standard.

The concentration is also 100-150 mg/kg near the central treatment plant. This indicates that the “Khargia” (formerly known as the “Khargia”) treatment plant was unable to completely purify the

wastewater containing high levels of chromium salts from the leather factories and was supplied to the central treatment plant, which may have caused the chromium-containing sludge accumulated in the central treatment plant’s waste pond to dry out in the open and spread to the environment due to the wind. This is consistent with the results of a study conducted by Russian scientists in 2019 (Timofeev, A.I., Shalnova, O.I., 2019).

Chromium is distributed in the form of Cr3+ in mountain rocks, and its content is 0.0083%. However, in ultrabasic rocks such as dunite and thyroxinite, it is on average 0.2%. Chromium exhibits oxidation states from 0 to 6, but only Cr (III) and Cr (VI) are relatively stable in soil, the others are unstable. Heavy metals that pollute up to 50% of the air due to coal combustion include elements such as Cr and Ni.

Anthropogenic sources of chromium in the environment include tanneries, non-ferrous metal and steel industries, organic synthesis, paper and fiber industries, cement, fertilizers, paints and varnishes, and antifreezes. Soils are often contaminated with chromium from tanneries, textile and metal processing industries, dyestuff waste, wastewater, and industrial waste.

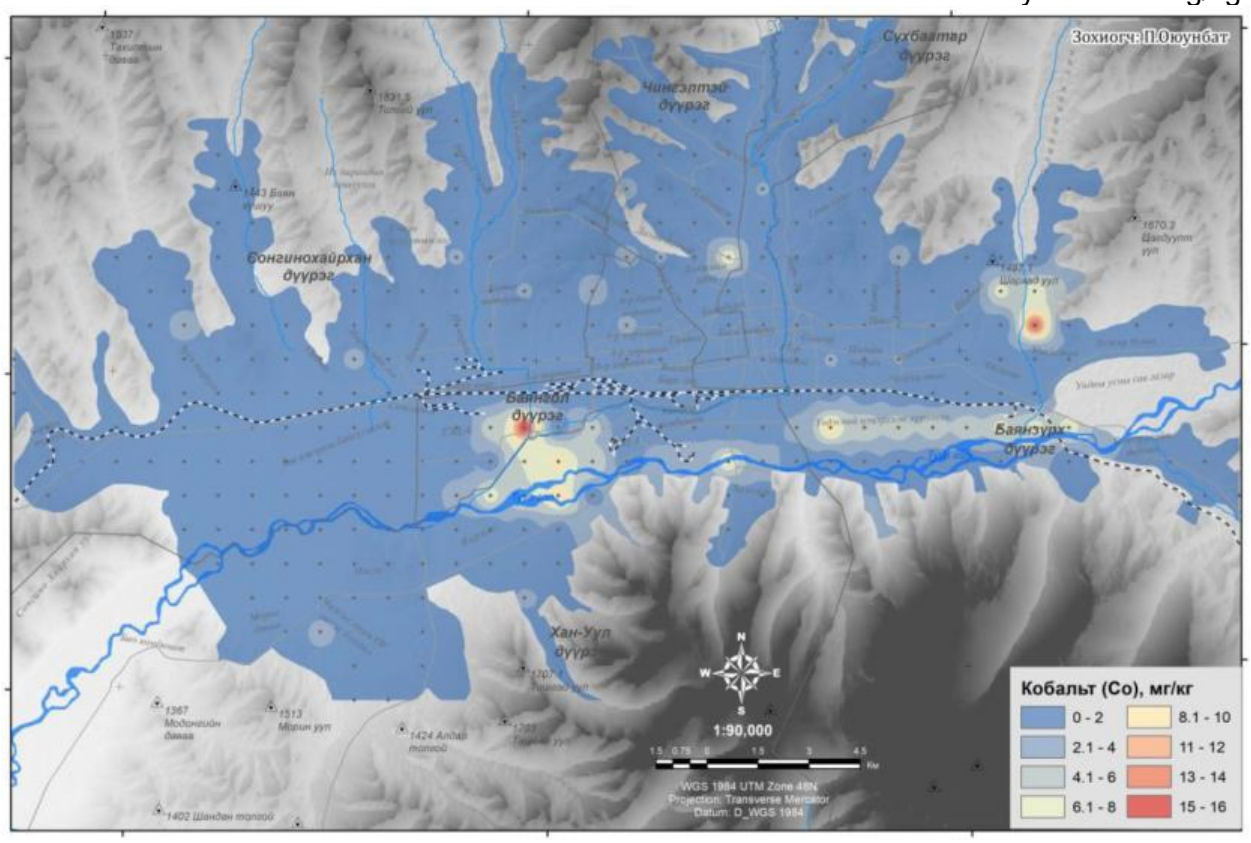


Зураг 3. Улаанбаатар хотын хөрсөн дэх хромын тархалт

7.3.4. Distribution of cobalt (Co) in soil

Cobalt (Co) in the topsoil of Ulaanbaatar city ranges from 0.0-16.0 mg/kg, with an average of 1.2 mg/kg. However, the concentration near the meat processing plant and poplar is 10-16 mg/kg, or slightly higher, but several dozen times lower than the MNS 5850:2019 standard (50 mg/kg), and

the concentration in the urban residential areas is uniformly 2-4 mg/kg.



Зураг 4. Улаанбаатар хотын хөрсөн дэх кобальтын тархалт

7.3.5. Distribution of nickel (Ni) in soil

Nickel (Ni) in the topsoil of Ulaanbaatar city ranges from 0.0-70.9 mg/kg, with an average of 8.8 mg/kg. In the urban residential area, the concentration is generally 0-10 mg/kg, and there is no significant pollution above the standard. Due to land use and technogenic effects, there is a patchy accumulation. For example, in the areas of Zuunturun, Orbit, Sharkhad, Hailaast, and Dari Eh, the concentration is 30-50 mg/kg.

Nickel is classified as a toxic heavy metal and has a negative impact on the growth and development of humans, animals, and plants, and is a source of various diseases. The main use of nickel is to improve the corrosion resistance of metal alloys. It is also used as a raw material for adding green color to glass, making electrical wires, car parts, coins, batteries, and various accumulators. The wear and tear of the above materials and the depletion of specialized industrial sites cause nickel point and field pollution in urban areas. Nickel is present in certain soil layers. However, its accumulation is caused by active industrial and agricultural activities. The most common adverse effects of this metal on human health are allergies, especially skin diseases.

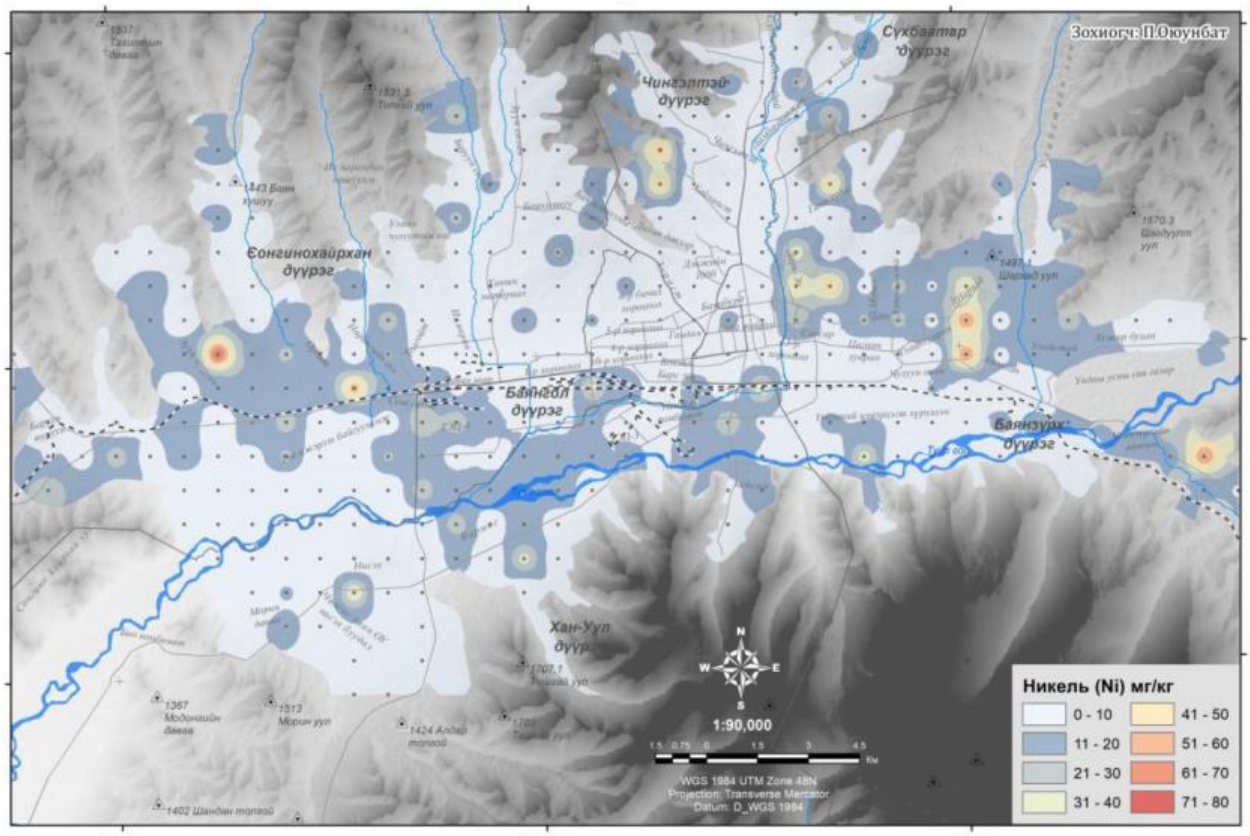


Figure 5. Nickel distribution in soil of Ulaanbaatar city

7.3.6. Distribution of zinc (Zn) in soil

Zinc (Zn) in the topsoil of Ulaanbaatar city ranges from 0.0-441.7 mg/kg, with an average of 88.4 mg/kg. The most polluted areas are Sansar, Dar-Ekh, Shar Khad, Botanik, XIII Khorool, and Zhukov in Bayanzurkh district, with pollution reaching the MNS 5850:2019 standard level of 200-400 mg/kg. In Bayangol district, the IV power plant, III, IV Khorool, and the TV area have relatively high pollution levels of 150-400 mg/kg. In Songinokhairkhan district, the concentrations are 100-200 mg/kg in the areas of Khanyn Material (200-400 mg/kg), Narangin Gol, Tolgoit, Ikh Naran, Tavan Shar, and Yuk Turun (50-100 mg/kg), and Khanyn Material, Sonsgolon, and the Central Treatment Plant. In Khan-Uul district, the concentration is 200-400 mg/kg near the industrial complex, fair, and III electric station. In the residential areas of Chingeltei and Sukhbaatar districts, the concentration is uniformly 100-150 mg/kg.

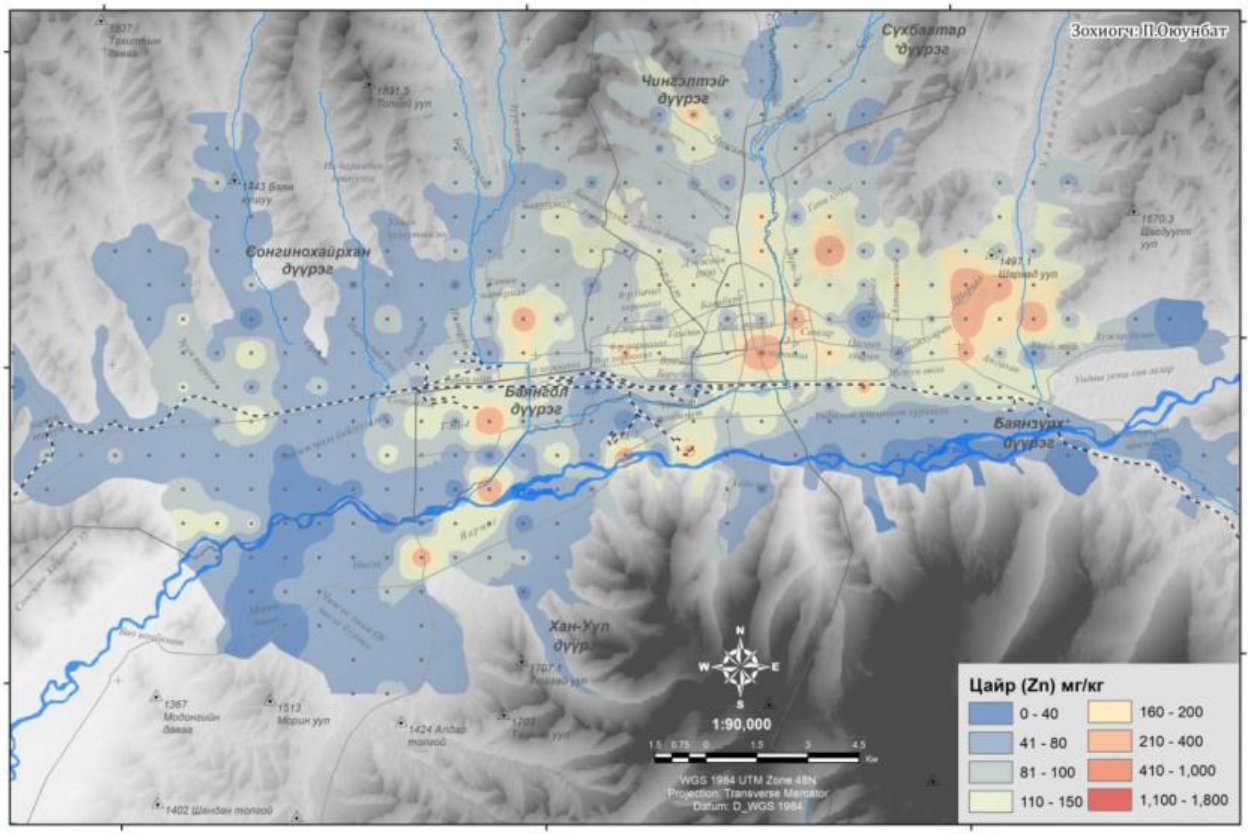


Figure 6. Distribution of zinc in soil in Ulaanbaatar city

Zinc is present in igneous rocks at a concentration of 80-120 mg/kg, in clayey sediments at a concentration of 40-80 mg/kg, and in sandstones and carbonate rocks at a concentration of 10-30 mg/kg. Zn is present in rocks as the ZnS compound. During weathering, it forms Zn+2 mobile ions in mineral solutions, especially in acidic environments. Zn is easily adsorbed as an organic compound. Therefore, its accumulation in the soil is observed at the surface. The main anthropogenic source of Zn is the non-ferrous metallurgical industry and agricultural activities. Soils contaminated with zinc can be reduced by adding organic matter and lime.

7.3.7. Distribution of copper (Cu) in soil

Copper (Cu) in the topsoil of Ulaanbaatar city ranges from 0.0-844.4 mg/kg, with an average of 5.8 mg/kg. It is uniformly 5-10 mg/kg throughout the settlement area, or generally low. The area with the highest contamination is Erdenetolgoi, with a concentration of 500-100 mg/kg. Since this is a relatively highland area, there may be anomalous contamination of the soil and sediment. Also, the XIII district, the ger district in front of Zhukov road, the industrial complex, Zaisan, and the III and IV power plants have concentrations of 25-100 mg/kg.

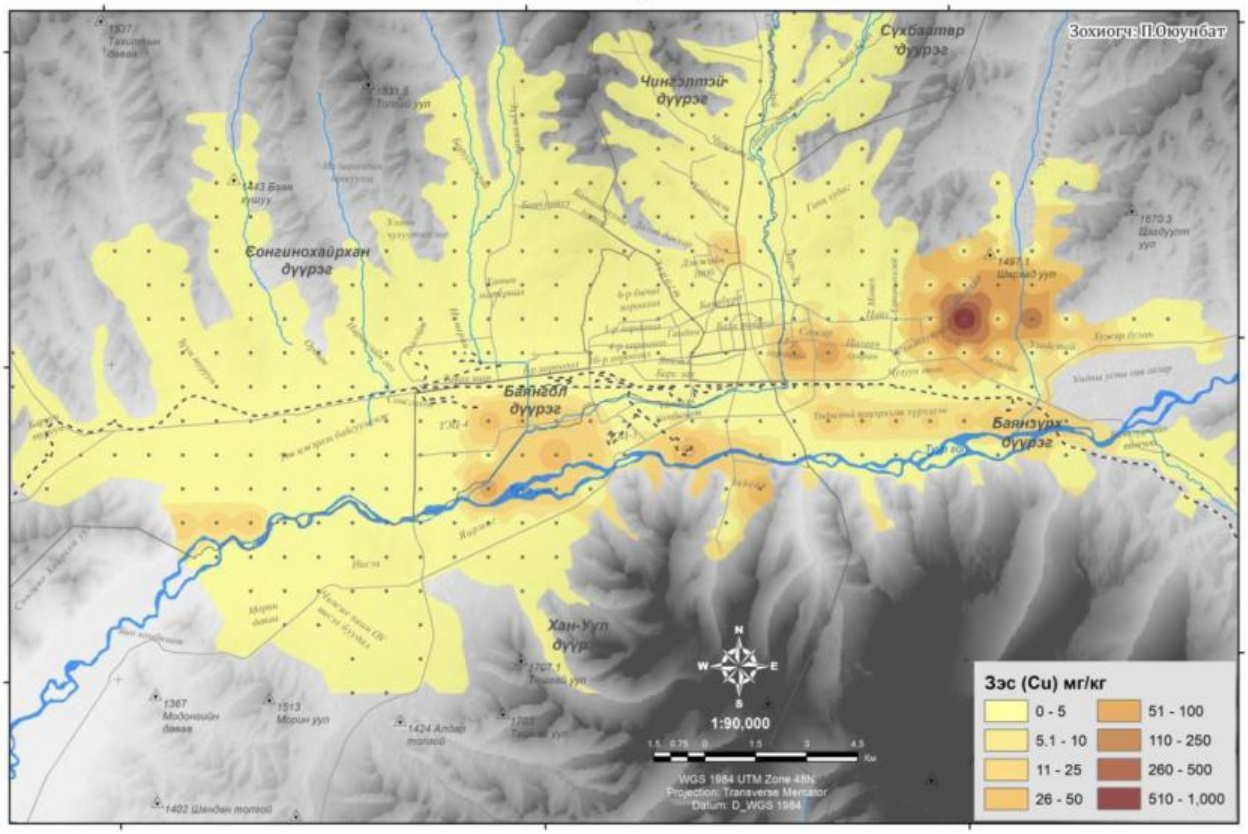


Figure 7. Distribution of copper in soil in Ulaanbaatar city

Copper and other trace elements are present in the mineral composition of the soil-forming parent rock, organic matter, and soil solution, and their amounts vary depending on soil type and land use (S. Ichinhorloo, 1990).

It is contained in large quantities in the primary copper mineral, complex sulfide. It dissolves easily during weathering, releasing Cu ions. This occurs in an acidic environment. Therefore, it is considered one of the most mobile metals in the hypergenic process of copper. Copper is most mobile in the Cu+2 state. Although copper is a very important nutrient for higher plants and animals, large amounts of copper can poison animals and plants. About 1 percent of the total copper in the soil occurs in the form of chloride, sodium, sulfate, and salts of some organic acids in water (Amgalan, Gardkhuu, Badarch, 1978).

7.3.8. Distribution of molybdenum (Mo) in soil

In the topsoil of Ulaanbaatar city, copper molybdenum (Mo) ranges from 0.0-41.9 mg/kg, with an average of 0.7 mg/kg. It is uniformly 0-1 mg/kg throughout the settlement area, or generally low. The area with the highest contamination is around Denji, with a concentration of 20-40 mg/kg, which is due to the fact that the sampling point was close to the area where secondary raw materials are obtained. Also, near the Uliastai III power plant, there is contamination of 5-10 mg/kg, or the level of the standard tolerance level.

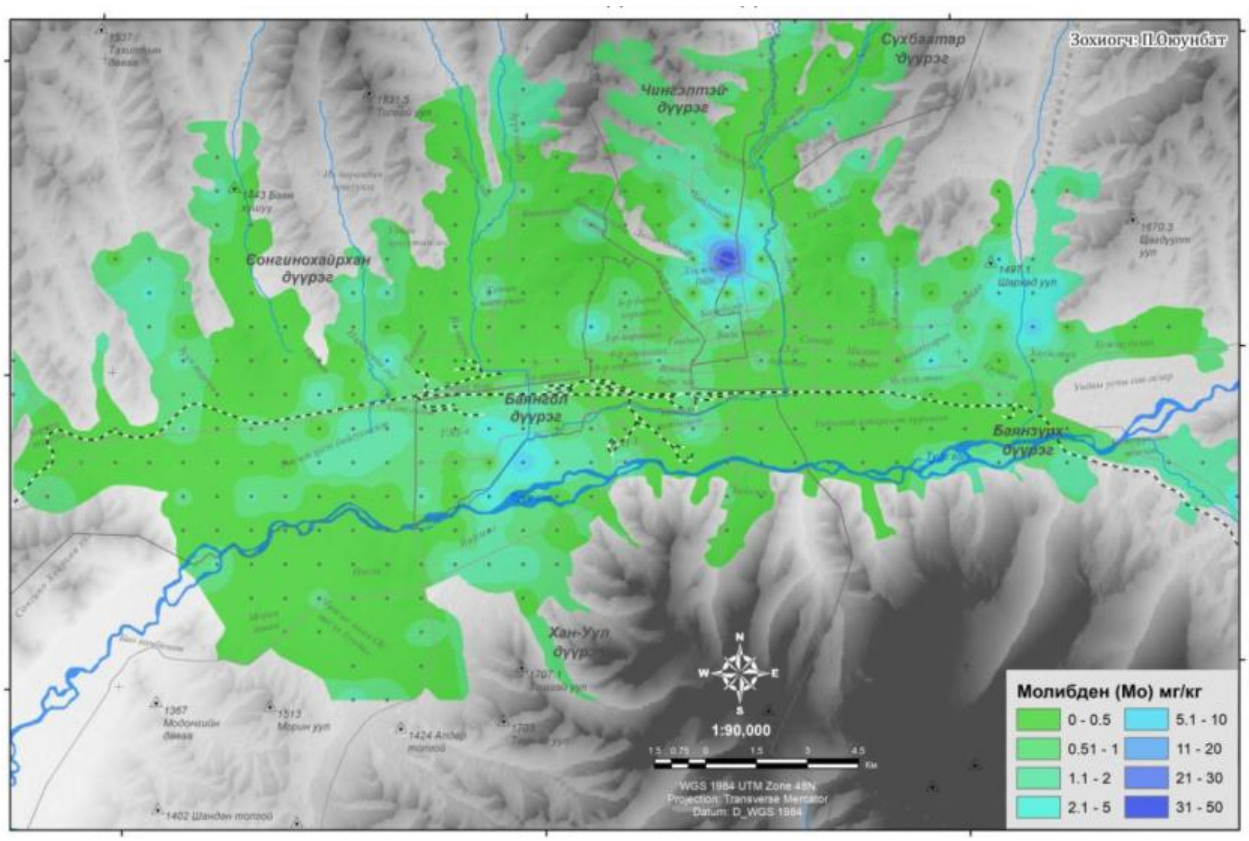


Figure 8. Distribution of molybdenum in soil of Ulaanbaatar city

7.3.9. Distribution of vanadium (V) in soil

Vanadium (V) in the topsoil of Ulaanbaatar city varied between 0.0-110.1 mg/kg, with an average of 52.3 mg/kg, or no higher than the standard, was detected. About 50 percent of the residential areas of Ulaanbaatar city had a concentration of 40-60 mg/kg, about 30 percent had a concentration of 60-80 mg/kg, and about 20 percent had a concentration of 0-40 mg/kg. The areas with the highest contamination were Baruun Turun, Tavan Tolgoi, Luk Turun, Aqartan Aqi, Denji Minya, Gan Khudag, and Altan Gulgii, with a concentration of 80-100 mg/kg.

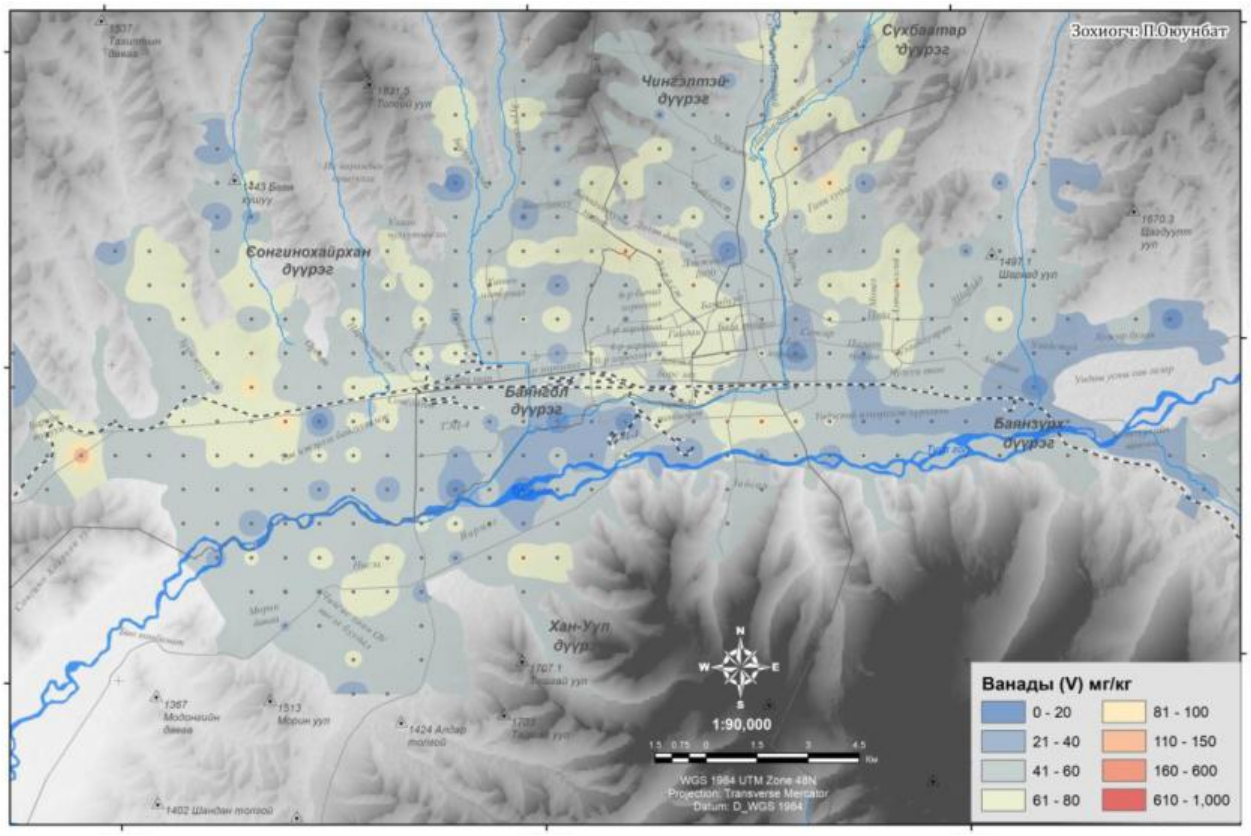


Figure 9. Distribution of vanadium in soil in Ulaanbaatar city

7.3.10. Distribution of strontium (Sr) in soil

In the topsoil of Ulaanbaatar city, the concentration of Strontium (Sr) varies between 0.0-1013 mg/kg, with an average concentration of 294.3 mg/kg. The most polluted areas are only around the central treatment plant, where the concentration is 800-1000 mg/kg, which is higher than the standard. In other areas, the concentration is evenly distributed, and the distribution is observed depending on land use. For example, the concentration is 300-500 mg/kg in the ger area, 200-300 mg/kg in the residential and public areas, and 100-200 mg/kg in the special protection area.

The concentration of strontium in soil depends on the composition of the parent rock and the climate. Strontium is mainly found in igneous rocks and is present in the form of the mobile Sr+2 ion during weathering, especially in acidic environments. The distribution of strontium in the soil creates a circulation of the soil solution. Sr solution is high in soils contaminated with Ca. It is formed by the nuclear reaction of the Sr isotope. It is easily absorbed into the soil along with Ca

and becomes a plant and biological pollutant (Undral, 2001).

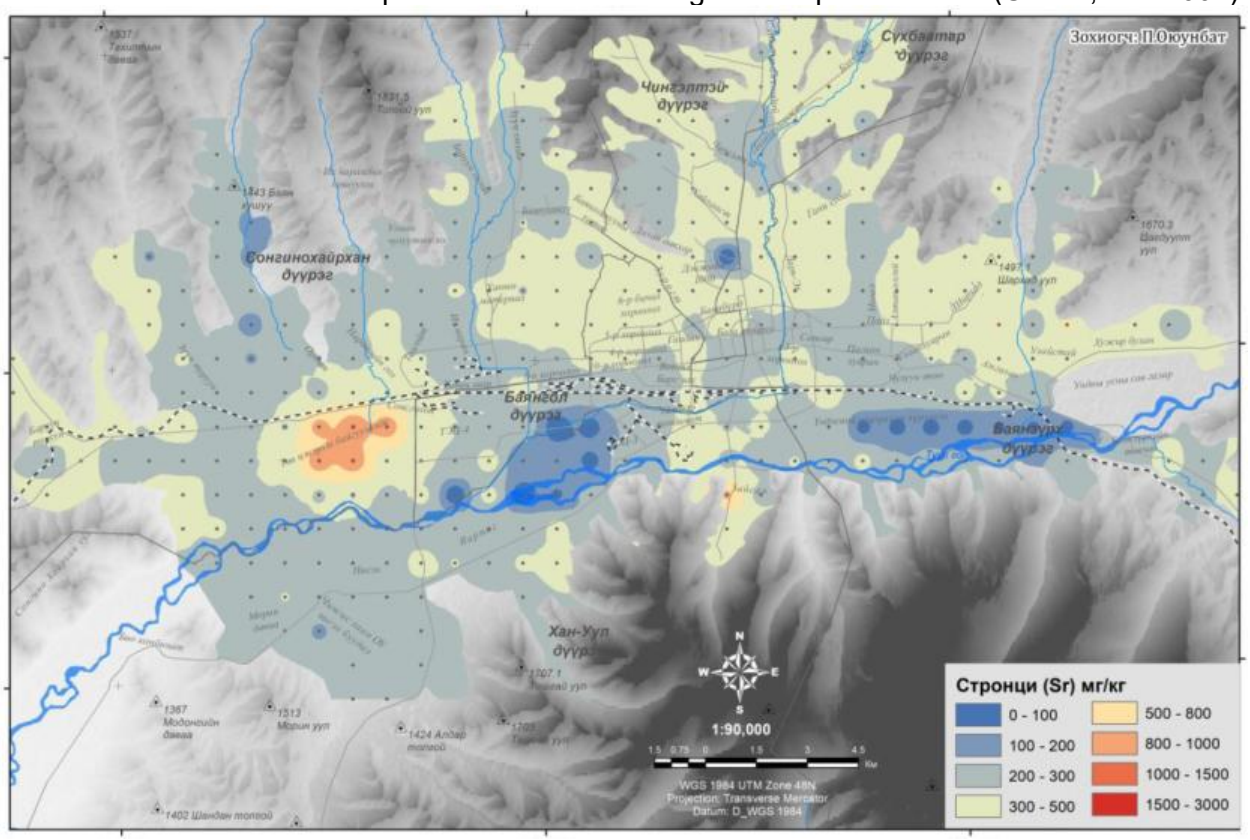


Figure 10. Distribution of Strontium in Ulaanbaatar City Soil

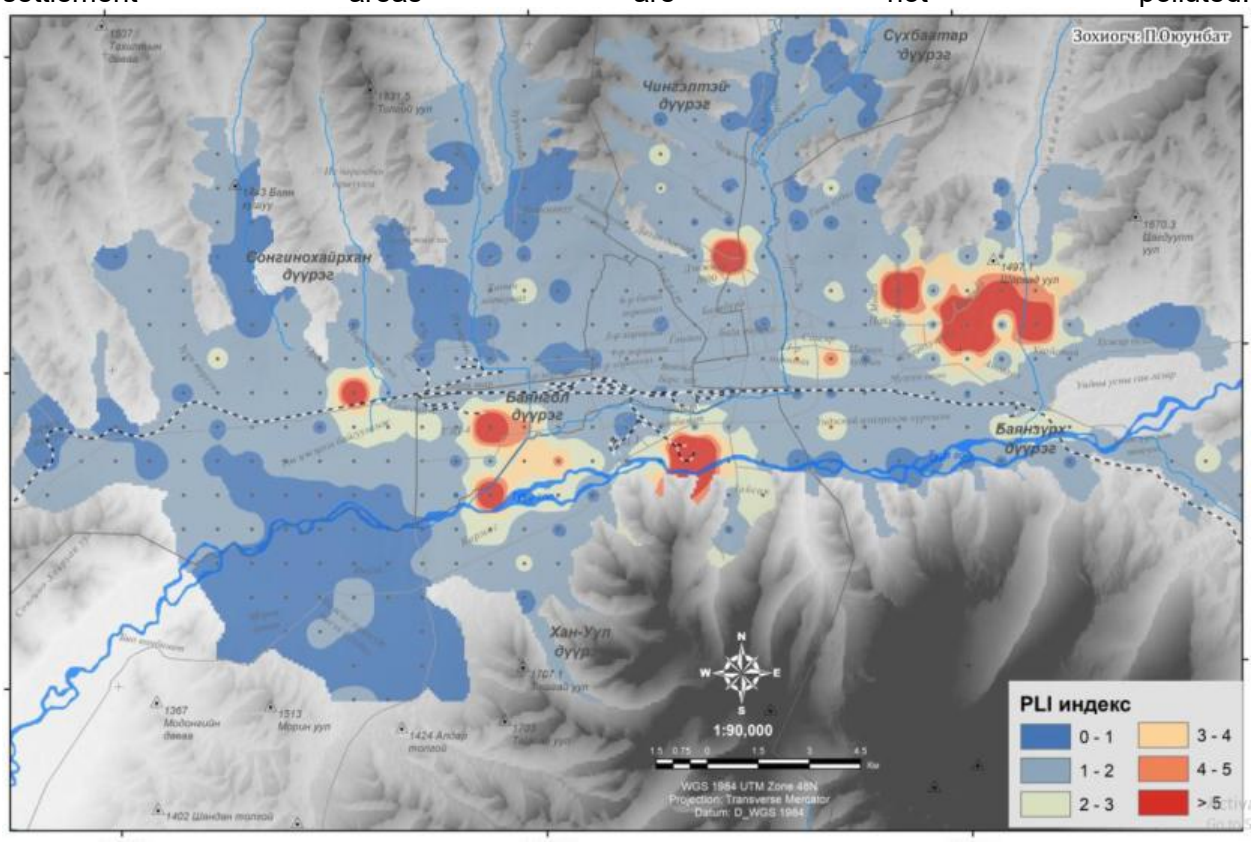
7.4. ASSESSMENT OF HEAVY METAL POLLUTION IN SOIL

The mean PI index of all metals is in descending order: Ni 2.13 > Pb 1.97 > As 1.76 > Co 1.55 > Zn 1.43 > Sr 1.15 > Cr 1.12 > V 1.06, or all elements are moderately polluted. Heavy metals such as nickel, lead, arsenic, cobalt, zinc, strontium, chromium, and vanadium have accumulated in the soil due to urbanization in the residential area of Ulaanbaatar.

The combined pollution index of heavy metals in the soil of the residential areas of Ulaanbaatar city ranges from PLI=0.6-31.8, with an average of 1.6, or slightly polluted. The combined pollution index varies depending on the characteristics of land use and technogenic impacts. For example, the areas around the industrial complex or leather processing factories, car sales and service centers around Shar Khad, Altan Ulgii, Monel, Dengji Minya, III, IV power plants, and Orbit are in the category of highly polluted areas.

The areas around the Narantuul shopping center and the ash pond of the III power plant are classified as highly polluted. The areas around the Da-khuree auto shopping center, Ulaanhuaran, 13th district, and Hos Bers are classified as moderately polluted. Amgalan, Uliastai, Zaisan, 19th district, the central treatment plant, wall materials, and the area around the sansar are classified as PLI = 2-3 or low to moderate pollution. About 60 percent of the area of the settlement area is classified as PLI = 1-2 or low pollution. Areas outside the city and without

settlement areas are not polluted.



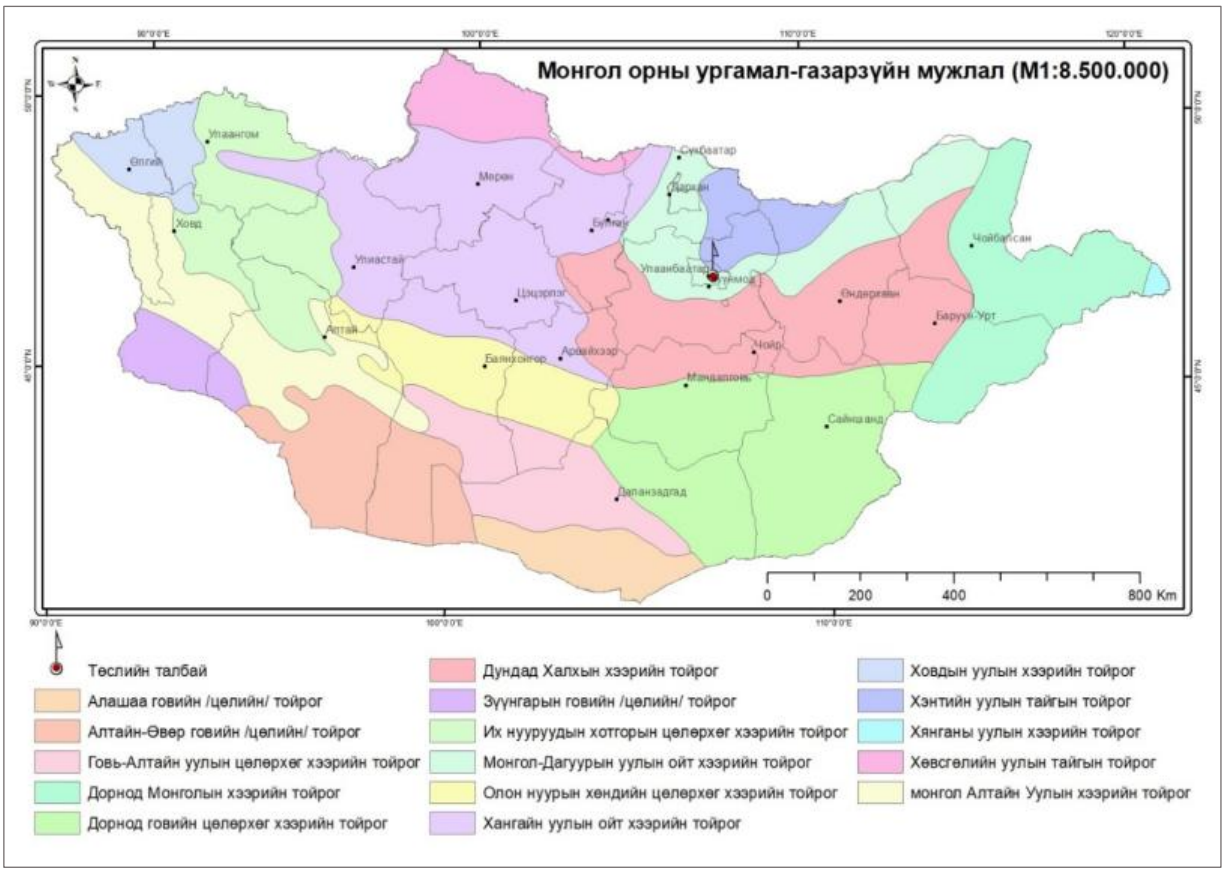
Зураг 11. Улаанбаатар хотын хөрсөн дэх хүнд металлын бохирдлын нэгдсэн үнэлгээ

EIGHT. VEGETATION

VEGETATION A field survey of the vegetation cover status of the “New Circle Highway” project area, which will pass through 5 districts of Ulaanbaatar city, was completed on March 24-29, 2025.The field survey included familiarization with the project area, field measurement, collection of basic vegetation data, and determination and verification of the current status of the vegetation cover of the affected areas.

8.1. PHYTOGEOGRAPHICAL ZONATION

The project area, located in the Ulaanbaatar city area, belongs to the Mongolian Dagur mountain steppe zone in the Mongolian phytogeographical zone (Ulziihutag N.).



Зураг 12. Phytogeographical zonation of Mongolia

8.2. RESEARCH METHODOLOGY

For the field study, a 10m x 10m area was selected, and a complete geobotanical record was made according to the vegetation survey method (Kh. Buyan-Orshikh, 2005). The species composition was determined according to V.I. Grubov (1982) “Mongolian vascular plant identification book”, the number of herbaceous plants was determined according to O. Drude’s percentage, the number of shrubs was determined by counting individuals, the cover of the plant was determined by visual inspection, the height and phenological stage were recorded, and the yield samples were taken in 6 replicates, equal to the number of plants per 1 m2 area and the soil. The obtained samples were dried, weighed, and averaged to determine the yield of the area.

8.3. STATE OF KNOWLEDGE ON VEGETATION

The vegetation in the area is characterized by the occurrence of three main vegetation zones: high mountain taiga, mountain taiga, and mountain steppe or mountain forest-steppe.

The vegetation cover of the forest-steppe and meadow type is 55.8% or 22.9 thousand hectares, of which 56.8% or 22.9 thousand hectares are forests. Of these, 56.8% are larch, 22.2% are cedar, 15.4% are spruce, 1.4% are pine, 2.6% are birch, and 1% are shrubs.

The forest zone, dominated by spruce, alder, and birch, is found on the slopes of the mountain peaks and in the gaps between the rocks. Larch, cedar, and the main forest-forming trees are spruce, pine, birch, and willow. The spruce forest that occurs here is considered a rare group in Mongolia. Steppe vegetation forms vertical zonation at the sub-typological level depending on location, elevation, and altitude.

Dry steppes are found along the foothills, slopes, and wide valleys of the mountains, meadow steppes are located along the moist slopes of the lower forest edges, and mountain steppes are located along the rocky peaks, ridges, and slopes of the mountains. In the mountain steppes, large grasses predominate in the Lena steppe and meadow steppes, while in the dry steppes, small grasses such as daagan tail, erkhok, bileg grass, and bridle grass are common. Along the river valleys, stream banks, and swamps, swampy meadows with a variety of grasses, meadows covered with turf and nettle alternate.

Siberian bird's-foot trefoil Polypodium sibiricum, Silver fern Aleuritopteris argentea, Turchaninov's sorghum Melica turczaniviniana, Mountain onion Allium altaicum, Hyena spring yellow Gagea hiensis, Corallorhiza trifida, Creeping marigold Goodyera repens, Green hyacinth Coeloglossum viride, March orchid Dactylorhiza salina, Spring grass Spiranthes amoena, Single-leaved marigold Malaxis monophyllos, Red-seeded marigold Actaea erythrocarpa, Greater celandine Chelidonium majus, Pink marigold Rhodiola rosea, Four-leaf marigold Rhodiola quadrifida, Siberian rowan Sorbus sibirica, Succulent Ortuosa Oxytropis pseudoglandulosa, Marsh marigold Astragalus uliginosus, Double-flowered violet Viola biflora, Higmel violet viola dissecta, Mongolian dogar Caryopteris mongolica, Natural banzdoo Saussurea baicalensis, Two The Bulgan plate has 23 species of rare and endangered plants, including Antennaria dioica.

Along the valleys, ravines, and swamps of the Tuul River, there are alternating meadows with a variety of grasses, meadows with sedges, irises, and other plants.

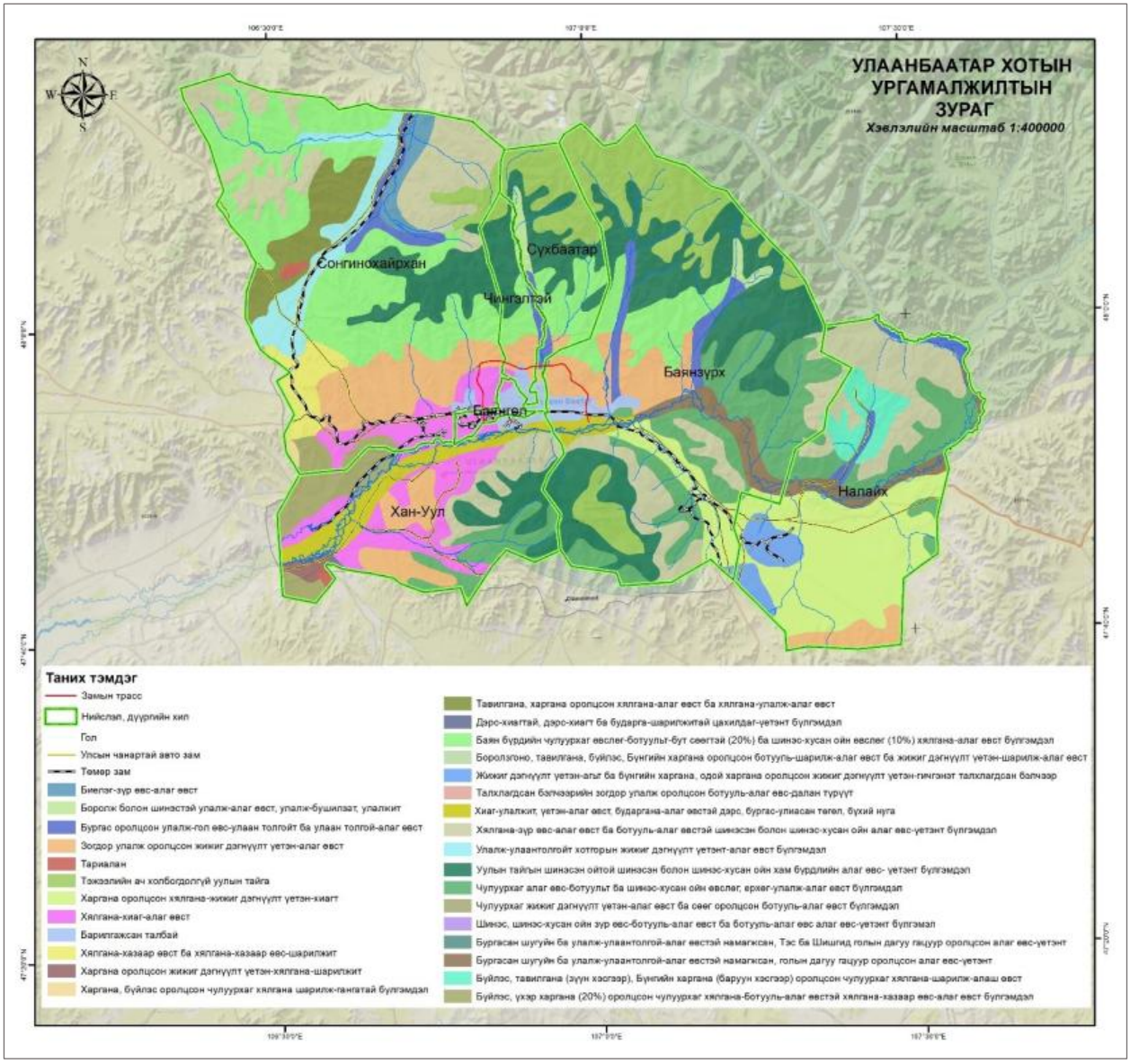


Figure 13. Vegetation of Ulaanbaatar

8.3.1. Plant groups, genera, and species composition

The plants of the Khentii taiga are classified by ecological group: 324 species of humid and humid-dry plants (33.16%), 176 species of marsh plants (18.01%), 20 species of aquatic plants (2.05%), 214 species of cold plants (21.9%), and 163 species of stony plants (16.69%). 52 species of dry plants (5.32%) and 8 species (0.82%) penetrate the taiga edge.

In the foothills of the Khentii Mountains, steppe pastures dominated by diverse grass communities such as motley grass–feather grass, motley grass–feather grass–small bunchgrass steppe, small bunchgrass steppe, motley grass–needle grass, motley grass–gramineous–needle grass, and needle grass–motley grass steppe are common in the undulating hilly terrain of the low and medium mountains.

In the undulating steppe of the intermountain valleys and depressions, pasture types such as motley grass–gramineous, motley grass–small gramineous, motley grass–needle grass, feather grass–small gramineous, motley grass–sedges–small gramineous, and motley grass–gramineous–Elymus (wild rye) pastures are distributed. In the meadow-steppe areas of river

valleys between the mountains, pastures with willow and poplar, accompanied by gramineous, motley grass–gramineous, Carex-dominated (sedgy), motley grass–Carex, motley grass, legume–gramineous, small sedge–gramineous, and gramineous–small sedge plant communities are also found.

Current status of vegetation in the project area

During the survey, the road alignment was inspected, and 5 points were fully documented to determine species composition, vegetation cover, and biomass. 90% of the project area had lost its natural vegetation and was damaged or degraded.

The project area and the surrounding area have a mountain steppe vegetation in terms of plant ecology and vegetation distribution, which has changed depending on the type of use.

Research point -1

Mountain steppe

Figure 14. Mountain steppe: sagebrush–feather-grass community

Mountain steppe agi – bridle grass community. Vegetation cover is 65%, 29 species of plants (record 1) have been recorded. Plants such as imt gichgene, shireg ullaj, agi, azaulin gichgene from the agave grasses grow, from the agave grasses, bridle grasses, shiveet xylanga, botuul, and from the agave grasses, arzgar sogsoolj, umkhi sarmilj, gelygar xylanga, tsek tuumtana grow. Yield is 3.5 t/ha. Plant height is 5-15 cm, small-leaved kharagana grows up to 40-80 cm. Pasture fertility is medium. Due to the arid climate, the mountain sarmilgan community has undergone succession and dried up, forming agri-bridle grass community.

Table 32. Legend -1

Plant species composition					
№	Latin name of the plant	Mongolian name of the plant	Cover,%	Category	Useful plants
1	Arenaria capillaris	Дэвхэргэн хурданцагаан		Бэлчээр	Элбэг
2	Artemisia adamsii	Үмхий шарилж	1	Хүмүүнсэг	Элбэг
3	Artemisia drancunculus	Гялгар шарилж	1	Хүмүүнсэг	Элбэг
4	Artemisia frigida	Агь	20	Бэлчээр	Элбэг
5	Astragalus adsurgens	Нумраа хунчир		Бэлчээр	Элбэг
6	Bassia dasyphylla	Мананхамхаг		Хүмүүнсэг	
7	Caragana microphylla	Жижиг навчит харгана		Бэлчээр	Элбэг
8	Caragana pygmeae	Алтан харгана		Бэлчээр	Элбэг
9	Carex stenophylla	Нарийн навчит улалж	3	Бэлчээр	Элбэг
10	Chamaerhodos erecta	Цэх түмэнтана	1	Хүмүүнсэг	Элбэг
11	Cleistogenes squarrosa	Дэрвээн хазааргана	25	Бэлчээр	Элбэг
12	Convovulus ammonii	Аммоний сэдэргэнэ		Бэлчээр	Элбэг
13	Heteropappus hispidus	Арзгар согсоолж	1	Хүмүүнсэг	
14	Iris tigrida	Барцоохор цахилдаг		Бэлчээр	Элбэг
15	Koeleria macrantha	Даагансүүл	3	Бэлчээр	Элбэг
16	Leymus chinensis	Нангиад түнгэ	3	Бэлчээр	Элбэг

17	Oxytropis oxyphylla	Шовх навчинцарт ортууз		Бэлчээр	Элбэг
18	Polygonum angustifolium	Нарийн навчит тарна		Бэлчээр	Элбэг
19	Potentilla bifurca	Имт гичгэнэ	1	Бэлчээр	Элбэг
20	Potentilla nivea	Цагаалин гичгэнэ	1	Бэлчээр	Элбэг
21	Pulsatilla turczaninovii	Турчаниновын яргуй		Бэлчээр	Элбэг
22	Salsola collina	Толгодын будраа		Хүмүүнсэг	Элбэг
23	Scorzonera austrica	Нарийн навчит хависгана		Бэлчээр	Элбэг
24	Sibaldiathe adpessa	Налчгар хэрээн хошуу		Бэлчээр	
25	Stelleria dichotoma	Ацан ажигана		Бэлчээр	Ховор
26	Stipa krylovii	Шивээт хялгана	5	Бэлчээр	
27	Thermopsis lancelaota	Тарваган шийр		Бэлчээр	Элбэг
28	Thymus gobicus	Говийн ганга		Бэлчээр	Элбэг
29	Tripolium lupinaster	Гурван навчит хошоонгор		Бэлчээр	

Судалгааны цэг -2

Ногоон байгууламж

Figure 79. Planted trees and shrubs along the alignment

Along the road route, there are paved areas, buildings, and household fences, and the natural native plants have been destroyed and green spaces and trees and shrubs have been planted. Here, aspen trees have adapted to grow up to 2-5m tall, and elm and willow have been planted from shrubs. Willows and poplars have spread along the Selbe River and are protected by fences. In this fence, there are 20-40cm tall plant beds, and the diversity of species has increased, and a natural native community has formed.

Судалгааны цэг -3

Сэлбэ гол

Figure 80. Selbe River floodplain

The Selbe River spreads along the floodplain meadows, with the Ulalj-galuun gichgene-paugten (Hordeum brevisubulatum, Agrostis trinii) community. The cover of the tusga is 95-100%, 33 species of plants (record-2) were recorded, and the yield was 4.3 c/ha. The dominant plants in the field are Ulaantolgoi, Nugyn Bieleg, Nangiad Hunge, and Holtsontsetseg, syreg ulalj, galuun gichgene, and tsagaan bagvaahai from the sedges. Willows are sparse along the river, reaching a height of 1.5 m - 2.4 m. The river floodplain is not affected by grazing, but has been degraded by human factors.

Table 43. Legend – 2

Plant community: Buckwheat with buckwheat-barley-grass (Hordeum brevisubulatum, Agrostis trinii)				
№	Name of the plant	Vegetation cover		Classification
1	Elymus dahuricus	1	2	бэлчээрийн ургамал
2	Medicago falcata		1	бэлчээрийн ургамал
3	Primula farinosa			бэлчээрийн ургамал
4	Odontites vulgaris			бэлчээрийн ургамал
5	Parnasia palustris	2	5	элбэг ашигт ургамал
6	Plantago major	5	5	элбэг ашигт ургамал
7	Poa pratense	10	15	бэлчээрийн ургамал
8	Polygonum aviculare	1		бэлчээрийн ургамал
9	Potentilla anserina	20		элбэг ашигт ургамал
10	Hordeum brevisubulatum	20	15	бэлчээрийн ургамал
11	Halerpestes sarmentosa	3		бэлчээрийн ургамал
12	Ranunculus grandis	1	5	бэлчээрийн ургамал
13	Sausurea salsa			бэлчээрийн ургамал
14	Taraxacum leuncanthum	1	3	бэлчээрийн ургамал
15	Carex enervis	2		бэлчээрийн ургамал
16	Triglochin maritima	1		бэлчээрийн ургамал
17	Puccinella tenuiflora	1		бэлчээрийн ургамал
18	Carex duriuscula	15	20	бэлчээрийн ургамал
19	Agrostis trinii	10		бэлчээрийн ургамал

20	Salix miyabeana			бэлчээрийн ургамал
21	Salix rhamomnifolia			бэлчээрийн ургамал
22	Sanguisorba officinalis			элбэг ашигт ургамал
23	Gentiana aquatica	1		бэлчээрийн ургамал
24	Vicia cracca	2		бэлчээрийн ургамал
25	Carum carvi			бэлчээрийн ургамал
26	Glaux martimata			бэлчээрийн ургамал
27	Cirsium arvense		1	бэлчээрийн ургамал
28	Beckmannia syzigachne			бэлчээрийн ургамал
29	Urtica cannabiana			элбэг ашигт ургамал
30	Artemisia integrifolia	4	15	бэлчээрийн ургамал
31	Astragalus melilotoides			бэлчээрийн ургамал
32	Leymus chinensis		10	бэлчээрийн ургамал

Судалгааны цэг -4

Tuul River

Figure 81. Dry meadow floodplain

The site is located in the wide valley of the Tuul River, and has a sedge-grass community with mountain dry meadow willow (Potentilla anserina, Allium senescens, Artemisia frigida), with a 52% cover of the tusga, 17 species of plants (record-3) were recorded, and the spring yield was 1.9 t/ha. The height of the vegetation cover was 5 cm and one layer was observed. The dominant plants were the sedge-grass, the sedge-grass, the nangiad hunge, the daagansul, the sedge-grass, the sedge-grass, the sedge-grass, the medicinal sod, the ag, the mangir, and the young plants. In the flooded areas, willows grew in small parts, growing to a height of 1.5-3 m. Human and technical impact is high.

Table 44. Legend – 3

Ургамлан бүлгэмдэл: алаг өвс улалжит бүлгэмдэл				
№	Ургамлын нэрс	Монгол нэр	Бүрхэц, %	Ангилаа
1	Allium senescens	Мангир	1	элбэг ашигт ургамал
2	Androsace incana	Буурал гандбадраа		элбэг ашигт ургамал
3	Artemisia frigida	Агь	1	элбэг ашигт ургамал
4	Carex duriuscula	Ширэг улалж	25	элбэг ашигт ургамал
5	Festuca lenensis	Ленийн ботуул	1	бэлчээрийн ургамал

6	Iris tigrida	Барцоохор цахилдаг		элбэг ашигт ургамал
7	Koeleria macrantha	Дааган сүүл	5	бэлчээрийн ургамал
8	Oxytropis myriophylla	Түмэннавчит ортууз		бэлчээрийн ургамал
9	Potentilla acaulis	Навтуул гичгэнэ	2	элбэг ашигт ургамал
10	Potentilla anserina	Галуун гичгэнэ	10	элбэг ашигт ургамал
11	Potentilla nivea	Цагаалин гичгэнэ		элбэг ашигт ургамал
12	Potentilla sercea	Торгон гичгэнэ	1	элбэг ашигт ургамал
13	Pulsatilla bungeana	Бүнгийн яргуй		элбэг ашигт ургамал
14	Stipa krylovii	Шивээт хялгана	1	Бэлчээрийн ургамал
15	Taraxacum officinalis	Эмийн багваахай		элбэг ашигт ургамал
16	Thalictrum simplex	Эгэл буржгар	0	элбэг ашигт ургамал
17	Veronica incana	Буурал гандбадраа	0	элбэг ашигт ургамал

Судалгааны цэг -5

Эвдэрсэн газрын ургамалжил

Зураг 15. Эвдэрсэн газрын төрх байдал

This type of vegetation is distributed in the fields that have not been used in the last 2-3 years and around the edges of household fences. It has a young age group, a canopy cover of 10-90%, 24 plant species (record-4) were recorded, and the yield was 3.6 t/ha. The dominant plants in the fields are sedge, sedge, and sedge, and the dominant plants are arzgar sogsoolj and imt gichgene. Among the young plants, goat wormwood, white-tailed sedge, hilly sedge, carvan, green sedge, small sedge, green sedge, and urvruu gagadai are growing to fill the damaged and degraded areas. There is no pasture land, and it has been degraded due to human activities and technical influences. Plants that restore their natural balance have grown between the fields and the fields.

Хүснэгт 4. Бичиглэл 4

№	Latin name of the plant	Mongolian name of the plant	In the fenced area	Classification
1	Achnatherium splendens	Гялгар дэрс	*	бэлчээрийн ургамал
2	Artemisia drancunculus	Гялгар шарилж	*	хүмүүнсэг ургамал
3	Amaranthus retroflexus	Урвуу гагдай	*	хүмүүнсэг ургамал
4	Artemisia adamsii	Үмхий шарилж	*	хүмүүнсэг ургамал
5	Artemisia anetifolia	Божмог шарилж	*	хүмүүнсэг ургамал

6	Artemisia annua	Зуны шарилж	*	хүмүүнсэг ургамал
7	Artemisia frigida	Агь	*	элбэг
8	Artemisia macrocephala	Царван	*	бэлчээрийн ургамал
9	Artemisia pectinata	Шүлхий шарилж	*	хүмүүнсэг ургамал
10	Atriplex sibirica	Сибирь шорной	*	хүмүүнсэг ургамал
11	Bassia dasyphilla	Манан хамхаг	*	хүмүүнсэг ургамал
12	Carex duriuscula	Ширэг улалж	*	бэлчээрийн ургамал
13	Chenopodium acuminatum	Шоргор лууль	*	хүмүүнсэг ургамал
14	Chenopodium aristatum	Сортой лууль	*	хүмүүнсэг ургамал
15	Chenopodium viride	Ногоон лууль	*	хүмүүнсэг ургамал
16	Chloris virgata	Сарваан сүүл	*	хүмүүнсэг ургамал
17	Heteropappus hispidus	Арзгар согсоолж	*	бэлчээрийн ургамал
18	Lappula myosotis	Дурсгалжирхуу зангуу	*	хүмүүнсэг ургамал
19	Leymus chinensis	Нангиад түнгэ	*	бэлчээрийн ургамал
20	Potentilla bifurca	Имт гичгэнэ	*	бэлчээрийн ургамал
21	Reagrostis minor	Бага хургалж	*	хүмүүнсэг ургамал
22	Salsola collina	Толгодын будраа	*	хүмүүнсэг ургамал
23	Setaria viridis	Ногоон хоног будаа	*	хүмүүнсэг ургамал
24	Urtica cannabianna	Олслог халгай	*	хүмүүнсэг ургамал

Тайлбар: * - *тохиолдоно*

8.3.2. Plant classification

The vegetation field survey was conducted in late March 2025, taking into account the previously conducted baseline survey and recording potential occurrences along the route.

The survey recorded 83 plant species from 63 genera belonging to 24 families in the project area and its vicinity. The number of species, cover and density are highly dependent on the weather characteristics of the year, so the number of plant species may vary slightly depending on the specific time of the field survey in a given year.

Хүснэгт 5. Ургамлын ангилалзүй

Species name	Type	Latin name of the species	Mongolian name of the species
Alliaceae	Allium	Allium odorum	Анхил сонгино
		Allium senescens	Мангир
Amaranthaceae	Amaranthus	Amaranthus retroflexus	Урвуу гагдай
Apiaceae	Buplerium	Buplerium bicaule	Хоёр ишт бэриш
	Sphallerocarpus	Sphallerocarpus gracillis	Үхэр гоньд
Asteraceae	Artemisia	Artemisia adamsii	Үмхий шарилж
		Artemisia annua	Зуны шарилж
		Artemisia anthifolia	Божмог шарилж
		Artemisia drancunculus	Гялгар шарилж
		Artemisia frigida	Агь
		Artemisia glauca	Саарал шарилж
		Artemisia lacinata	Салбант шарилж
		Artemisia leucophylla	Цагаалин шарилж
		Artemisia macrocephala	Царван
		Artemisia pectinata	Шүлхий шарилж
		Artemisia tanacetifolia	Маралхай шарилж
	Heteropappus	Heteropappus hispidus	Арзгар согсоолж

	Inula	Inula britanica	Британы зоосонцэцэг
	Saussurea	Saussurea salicifolia	Бургас навчит банздоо
		Saussurea sp	Банздоо
	Scorzoneria	Scorzoneria ausrtica	Австрийн хависгана
	Senecio	Senecio vulgaris	Эгэл зохимон
	Serratula	Seratula centauroides	Хонгорзулархуу хонгорзалаа
	Taraxacum	Taraxacum mongolicum	Монгол багваахай
	Youngia	Youngia tenuifolia	Нарийн ишт Юнги
Brassicaceae	Dontostemon	Dontostemon integrifolius	Бүхэлнавчит багдай
	Lepidium	Lepidium ruderale	Сүг цангуу
Chenopodiaceae	Atriplex	Atriplex sibirica	Сибирь шорной
	Chenopodium	Chenopodium acuminatum	Шоргор лууль
		Chenopodium aristratum	Сортой лууль
		Chenopodium viride	Ногоон лууль
	Salsola	Salsola collina	Толгодын будраа
Convolvulaceae	Convolvulus	Convolvulus arvense	Хөдөөгийн сэдэргэнэ
Cyperaceae	Carex	Carex duruiscula	Ширэг улалж
		Carex sp	Улалж
Euphorbiaceae	Euphorbia	Euphorbia discolor	Алаг сүүт өвс
Fabaceae	Astragalus	Astragalus adsurgens	Нумраа хунчир
	Medicaga	Medicaga falcata	Шар царгас
		Medicaga ruthenica	Орос царгас
	Thermopsis	Thermopsis dahurica	Дагуур тарваганшийр
	Trifolium	Trifolium lupinater	Шошхойлог хошоонгор
	Vicia	Vicia cracca	Яагаан гиш
Geraniaceae	Eriodium	Eriodium stephanii	Степаний заан таваг
	Geranium	Geranium pratense	Нугын шимтэглэй
		Geranium sibiricum	Сибирь Шимтэглэй
Iridaceae	Iris	Iris bungeana	Бүнгийн цахилдаг
Lamiaceae	Cymbaria	Cymbaria dahiricum	Дагуур хатны цэцэг
	Dracocephalium	Dracocephalium foetidium	Өмхий шимэлдэг
	Linaria	Linaria buriatica	Буриад хонинзажлуур
	Phlomes	Phlomes tuberosa	Туйпланцар
	Scutelleria	Scutelleria sibirica	Сибирь гүүнхөх
	Thymus	Thymus gobicus	Говийн ганга
Linaceae	Linum	Linum sibircum	Сибирь маалинга
Onagraceae	Chamaenerion	Chamaenerion angustifolium	Нарийн навчит хөвөнороойт
Plantagoceae	Plantago	Plantago major	Их тавансалаа
Poaceae	Achnatherium	Achnatherium splendens	Гялгар дэрс
	Agropyron	Agropyron cristatum	Саман ерхөг
	Bromus	Bromus inermis	Соргүй согоовор
	Cleistogenes	Cleistogenes squarrosa	Дэрвээн хазаар өвс
	Elymus	Elymus sibiricus	Сибирь хиаг
	Koeleria	Koeleria macrantha	Даагансүүл
	Leymus	Leymus chinensis	Нангиад хиаг
	Poa	Poa attenuatta	Туужууны биелэг
	Reagrostis	Reagrostis minor	Бага хургалж
	Setaria	Setaria viridis	Ногоон хоног будаа
	Silene	Silene repens	Мөлхөө шээрэнгэ
	Stipa	Stipa krylovii	Шивээт хялгана
Polygonaceae	Polygonum	Polygonum alopecuroids	Үнэгэн сүүлхэй тарна

		Polygonum convolvulus	Суман навчит тарна
	Rheum	Rheum undulatum	Намхан гишүүнэ
Primulaceae	Androsace	Androsace incana	Буурал далантовч
	Lappula	Lappula mysotis	Дурсгалжирхуу зангуу
Ranunculaceae	Ranunculus	Ranunculus japonicus	Япон хотсонцэцэг
Rosaceae	Chamaerhodes	Chamaerhodes erecta	Цэх түмэнтана
	Potentilla	Potentilla acaulis	Навтуул гичгэнэ
		Potentilla anserina	Галуун гичгэнэ
		Potentilla bifurca	Имт гичгэнэ
		Potentilla tanacetifolia	Маралзгана навчит гичгэнэ
	Sanguisorba	Sanguisorba officinalis	Эмийн сөд өвс
	Thalictrum	Thalictrum foetidium	Өмхий буржгар
Rubiaceae	Galium	Galium verum	Шар өрөмтүүл
Scrophylluriaceae	Veronica	Veronica incana	Буурал гандбадраа
Urticaceae	Urtica	Urtica cannabianna	Олсслог халгай

8.4. CURRENT STATUS OF USE, CONSERVATION AND INFLUENCE OF HERBAL RESOURCES

During the field study and development, the proportion of dominant, subdominant, general cover, heathland, and herbaceous plants in the community was considered, and pastures were classified according to the MNS 5546:2005 standard for determining the degree of degradation of vegetation cover in Mongolia, according to the classification of pastures as weakly, moderately, severely degraded, and undegraded normal pastures.

In the study area, the vegetation cover was severely degraded in areas where it was destroyed, and the main community was severely degraded.

Хүснэгт 6. Ургамлан нөмрөгийн доройтлын зэрэг

Name of the group	Grazing type	Grazing code	MNS 5546:2005
Variegated grass - perennial	Variegated grass	BT	Very
Green facilities			Strong
Broken place			Strong

8.5. CURRENT STATUS OF RARE AND NEAR-RARE PLANT PROTECTION

“The extremely rare and rare plants listed in the “Red Book of Mongolia” (2013), the “Compilation of the Red List of Mongolian Plants and Conservation Plans” (2012), the internationally unstudied plants, the regional level of endangered species, and the plants listed in the Red List (Nyambayar et al., 2012) are not recorded.

39 species with rare status included in the “List of Useful Plants” approved by the Minister of Environment and Forestry, Order No. A/603 of 2022 (Agropyron cristatum-Saman yerkhög, Allium senescens-mangir, Amaranthus retroflexus-reverse gagdai, Artemisia adamsii-Smelly wormwood, Artemisia annua-summer wormwood, Artemisia drancunculus-glossy wormwood, Artemisia frigida-Agì, Artemisia pectinata-shulkhyi wormwood, Buplerium bicaule-two-stemmed berish, Convolvulus arvense-rural bindweed, Cymbaria dahiricum-Dagur queen flower, Dracocephalium foetidium-smelly shimedeg, Galium verum-yellow burdock, Geranium sibiricum-Siberian shimteglei, Goniolemon speciosum-goo yult, Inula britanica-British zoosontsetseg, Iris bungeana-Bungi iris, Lappula mysotis-Melodious yarrow, Linaria buriatica-Buryat yarrow, Medicaga falcata-Yellow alfalfa, Plantago major-Great yarrow, Potentilla acaulis-Nattuul yarrow, Potentilla anserina-Goose yarrow, Potentilla bifurca-Spicy yarrow, Potentilla tanacetifolia-Maralzgana-leaved yarrow, Rheum undulatum-Low yarrow, Salsola collina-Hill yarrow,

Sanguisorba officinalis-Medicinal yarrow, Saussurea salicifolia-Burgas-leaved yarrow, Scorzoneria ausrtica-Austrian yarrow, Senecio vulgaris-Common yarrow, Seratula centauroides-Khongorzularhuu yarrow, Silene repens-Molkhoo sheerenge, Sphallerocarpus gracillis-Cow anise, Taraxacum mongolicum-Mongolian butterbur, Thalictrum foetidium-Smelly yarrow, Thymus gobicus (Gobi nettle), Urtica cannabianna (nettle), Veronica incana (brown ragwort), etc.

8.6. BRIEF CONCLUSION

“The route area of the “New Circle Highway” project belongs to the Mongolian Dagur Mountain Steppe Region (Ulziihutag N.) in the Mongolian phytogeographic region.

During the survey, the route was inspected and the species composition, vegetation cover, and biomass were determined at 5 points. 90% of the project area has been destroyed, damaged, and degraded by natural vegetation.

The vegetation survey was conducted at the end of March 2025, and based on the previous baseline survey conducted in the area, 83 plant species from 63 genera belonging to 24 families that may occur along the route were recorded.

According to the MNS 5546:2005 standard for determining the degree of degradation, the vegetation cover was severely degraded in the damaged areas, and the main communities were severely degraded.

There are 39 plant species with rare status included in the "List of Useful Plants" approved by the Minister of Environment and Forestry's Order No. A/603 of 2022.

NINE. ANIMAL PROVINCE

9.1. BIODIVERSITY AND SPECIES COMPOSITION OF THE PROJECT ENVIRONMENT

In the territory of Ulaanbaatar city, the fauna species have already completely lost their natural habitat and migration, and only a few mammals and birds live in urban areas.

For example, among birds, the most common are the domestic (P.domesticus) and steppe (P.montanus) sparrows, the blue pigeon (C.livia), the blind kite (Milvus migrans), the magpie (Pica pica), the red-crowned crane (Pyrrhcorax pyrrhocorax), the black crow (Corvus corone), and the raven (Corvus corax).

Among mammals, the common jay, the common jay, the white-tailed eagle, and the house mouse are found. Among insects, various beetles are mainly found.

Хүснэгт 7. Зонхилох амьтны зүйлийн жагсаалт

Insect class - INSECT

Hard-winged beetle or beetle group	*Coleoptera*
The genus of the beetle	*Carabidae*
	Taphoxenus laticollis Dej
	Taphoxenus dauricus Fish.
	Amara fodinoe Mannh
	Harpalus ampicollis Men.
	Harpalus cervus Duft.
The genus of the bearded beetle	*Sarabaeidae*
	Gymnopleurus topsus
	Sarbius sacer
Skin-eating beetle family	*Dermestidae*
	Dermestes dimidiatus Stev.
	Dermestes sibiricus Er.
The genus of the Nyasluur beetle	*Elateridae*
	Selatosomus latis F.
The genus of smooth beetles	*Buprestidae*
	Sphenoptera canaeiculata Pall.
The genus of the beetle	*Meloidae*
	Epicauta megacephala Gebl.
	Epcauta sibirica Pall.
	Mylabris frolovi Germ.
	Mylabris sibirica F.-W.
Horned beetle family	*Gerambycidae*
	Eodorcadion carinatus F.
	Eodorcadion humerale Gebl.
The genus of beetles	*Urrculionidae*
	Othiorrhynchus cribrosicollis Boh.
	Stephanocleonus oxicisus Rtt
Beloved Winged Team	*Lepidoptera*
The family of Deng's butterflies	*Pyralidae*
	Prorophora albidogilvella Roester
	Staudingoria steppicola Curadja
Batwing team	*Hymenoptera*
Ant family	*Forimidae*
	Tetramorium caespitum L
	Lasius alienus Forst.
	Cataglyphus aenescens Nyl.
The surname of the Khokhturu	*Tabonidae*
	Haemotopoto turkestanica turkistanica
	Tabonus sobulctorum sobulctorum

Ктырь ялааны овог	*Asilidae*
	Antiphrisson angustifrons Loew.
	Stenopagon maculilentus mongolicus Lher.
Дүнгэнүүр ялааны овог	*Bombylidae*
	Toxophora emeljanovi Zait.
Сирфид ялааны овог	*Syrphidae*
	Paragus haemorrhaus Mg.
Махны ялааны овог	*Sarophagidae*
	Blaesoxiphella brevicornis Vill.
	Servaisia subamericana Rohcl.
	Servaisia panfilovi (Rond. Et Varves)
	Tephromyia grisae (Mg)

Шувууны анги - *AVES*

Шонхор хэлбэртэн	*Falconiformes*
Харцгайн овог	*Accipitridae*
Сохор элээ	*Milvus migrans*
Шонхорын овог	*Falconidae*
Идлэг шонхор	*Falco cherrug Gray*
Тагтаа хэлбэртэн	*Columbiformes*
Тагтааны овог	*Columbidae*
Хадны тагтаа	*Columba rupestris Pall.*
Бор шувуу хэлбэртэн	*Pessriformes*
Болжморын овог	*Alaudidae*
Шоорон алаг болжмор	*Eremophila alpestris L.*
Харагчны овог	*Motacillidae*
Хээрийн шийхнүүхэй	*Anthus richaridii Vieill.*
Талын шийхнүүхэй	*Anthus campestris (L).*
Хэрээний овог	*Corvidae*
Хон хэрээ	*Corvis corax L.*
Турлиах	*Corvis frugilegus*
Алаг шаазгай	*Pici pica*
Жунгаа	*Pyrrhocorax pyrrhorax*
Хөөндэйн овог	*Turdidae*
Адууч чигчоохой	*Oenanyhe oenanthe L.*
Бүжимч чигчоохой	*Oenanyhe pleshanka (Lep.)*
Мяраан чигчоохой	*Oenanyhe isabellina Temm*
Бор шувууны овог	*Passeridae (Ploseidae)*
Хээрийн бор шувуу	*Passer montanus L.*
Хадны бор шувуу	*Perronia petronia L.*
Оронгийн бор шувуу	*Passer domesticus.*

Хөхтний анги - *MAMMALIA*

Орог зусаг	*Phodopus sungotus*
Хэргэлзий оготно	*Microtus gregalis*
Гэрийн хулгана	*Mus musculus*

TEN. SPECIALLY PROTECTED AREAS, HISTORICAL AND CULTURAL MONUMENTS

Specially protected areas

Specially protected areas are classified into:

- State specially protected areas.
- Local specially protected areas.

State specially protected areas are clasified into 4 categories. These:

1. Sanctuary
2. Natural parks
3. Natural reserves
4. Monuments

According to the Order No. 07 of the Minister of Environment of 2000 on the Placement of Land under Local Special Protection, “Locally Protected Areas” refer to areas protected by aimags, capital cities, soums, and districts for the purpose of protecting the natural beauty, unique formations, historical and cultural monuments, recreational, and tourism-related areas of the locality, and for the rational use of natural resources. Locally protected areas are included in the special needs area of the unified land fund, and are classified as aimags, capital cities, and soums, districts, by administrative unit.

Locally protected areas are classified according to their purpose and characteristics:

1. Forest, animal, plant and water reserves;
2. Classified as natural and historical monuments.

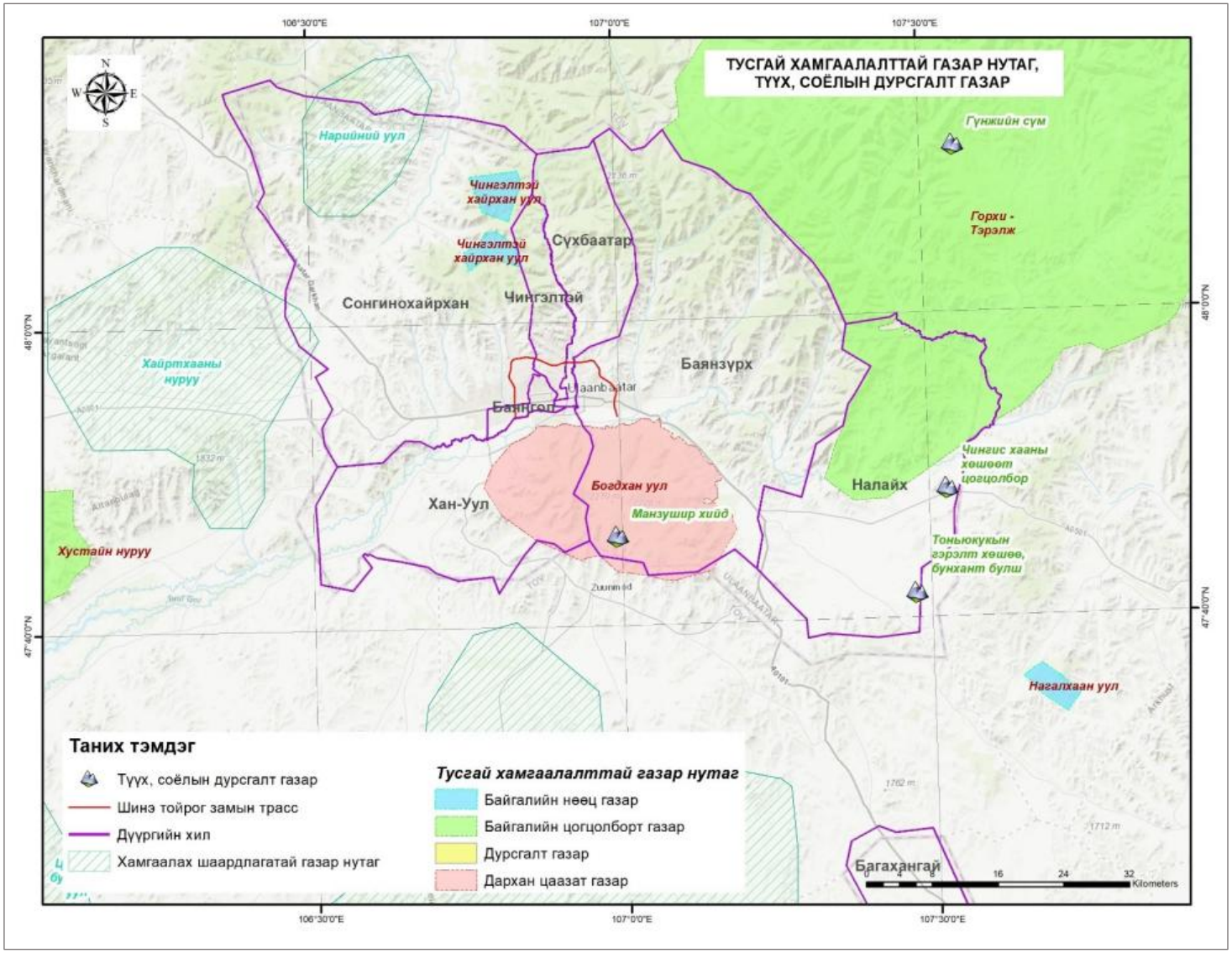
The project area or road alignment does not overlap with national or local specially protected areas (Figure 72).

Historical and cultural monuments

Archaeological research aims to determine the type, type, and number of archaeological sites in a given area, determine their scientific significance, and take measures to prevent and protect them from destruction during economic activities. In addition, the closest tombs and other ancient sites in the area are also recorded, and this material serves as the main tool for creating a unified archaeological map of Mongolia.

Archaeological research will be carried out in a simple and detailed manner based on a pre-planned methodology, and photographs of the discovered graves will be taken, a brief description will be made, and geographical coordinates will be marked on a pre-prepared background map of the area. The date of the monuments discovered during the exploration will be determined by historical comparison. Newly discovered monuments during the exploration will be included in the Unified Register of Cultural Heritage of Mongolia.

The new ring road project is being implemented in a residential area that passes through 5 districts and 30 khoroos of Ulaanbaatar city, and no historical and cultural monuments have been found in the route area.



Зураг 16. Тусгай хамгаалалттай газар нутгийн байршил

ELEVEN. LAND USE

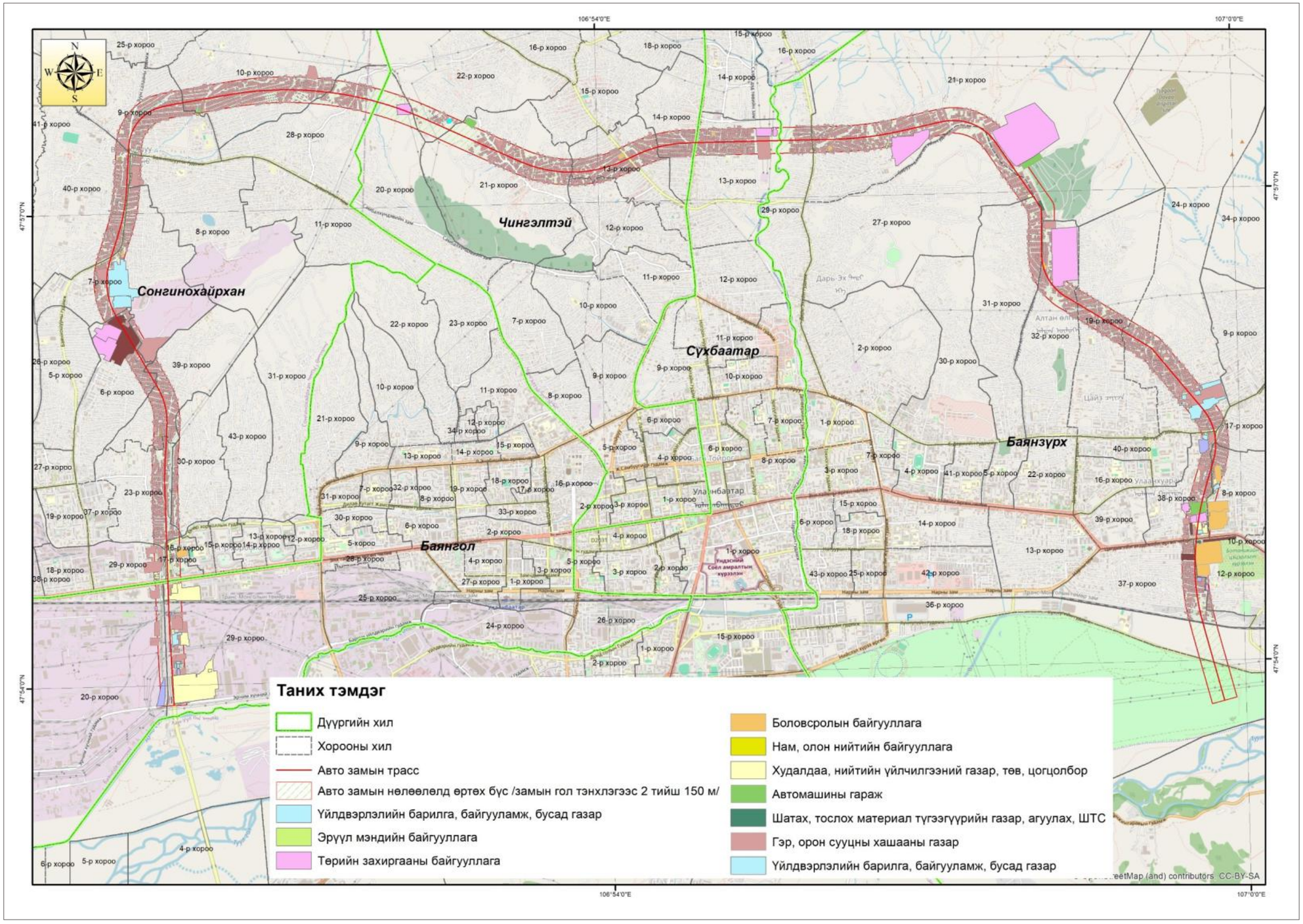
The main objective of the land use survey is to conduct field measurements in the study areas of Songinokhairkhan, Bayangol, Chingeltei, Sukhbaatar, and Bayanzurkh districts of Ulaanbaatar city and to present the results in figures and figures based on the results of field and field surveys. The survey was carried out in the following stages. Including:

- **Preparation:** During the preparation, familiarize yourself with the map and location of the route of the field survey area.
- **Field survey:** During the field survey, familiarize yourself with the types of land use in the area along the project route, and measure at the necessary points to determine the intersection.

Хүснэгт 8. Зургийн проекцийн өгөгдөл

PROJECTION:	Universal Transverse Mercator
SPHEROID:	WGS 84
DATUM:	WGS 84
UNITS:	Meters
ZONE	48
FALSE EASTING /Meters/:	500000
FALSE NORTHING /Meters/:	0
SCALE FACTOR	0.9996

- **Material processing and mapping:** Based on the results of the field survey and previous survey data, a land use map of the study area was developed using ArcGIS 10.5 ArcMap using an Esri Map 0.8 m raster map, Sentinel 10 m resolution raster map, and 1:100000 topographic map. The projection data of the image was calculated and mapped as follows. Including:
  - Geographic location or coordinates were recorded using GPS in WGS84 units in degrees°, minutes, seconds format. The land use map of the districts covered by the road alignment was developed by processing the 2022 data on land use coordinates obtained from the study area and related databases.



Зураг 17.Шинэ тойрог автозамын трассын дагуух дүүргүүдийн газар ашиглалтын төрлүүдийн байршил

The table shows the types of land use located 150 m in each direction from the centerline of the highway, or a total of 300 m, for each of the 5 districts, and the number of units per area.

Хүснэгт 9. Автозамын трассын дагуу байрлах нэгж талбарын тоо

Land use type	Bayangol	Songino-Khairkhan	Chingeltei	Sukhbaatar	Bayanzurkh
State administrative organization	-	15	2	2	11
Educational institution	2	6	1	1	7
Health care organization	7	-	-	-	2
Parties and public organizations	-	5	-	-	
Commercial and public service facilities, centers, and complexes	-	30	1	-	13
Car garage	-	104	1	-	2
Fuel and lubricant distribution points, warehouses, gas stations	-	1	-	-	2
Public housing with 9 or more floors	-	1	-	-	5
House and apartment yard land	35	2986	1179	720	3014
Industrial buildings, facilities, and other places	4	2			9
Total number of units	48	3150	1184	723	3065

Автозамын трассын дагуу хоёр тал руу тус бүр 150 м газар хамруулан газар ашиглалтын судалгаагаар нийт 8170 нэгж талбар хамрагдаж байна. Үүнээс Сонгинохайрхан дүүргийн нутаг дэвсгэрт хамгийн олон буюу 3150 нэгж талбар, Баянзүрх дүүрэгт 3065 нэгж талбар хамрагдсан (хүнэгт 50, зураг 84).

TWELVE. GENERAL SOCIAL AND ECONOMIC INDICATIONS

This chapter presents the socio-economic conditions of the 5 districts and 30 khoroos included in the study area. These include:

- 17th, 23rd, 39th, 6th, 7th, 40th, 9th, 10th, 28th Khoroos of Songinokhairkhan District
- 20th, 22nd, 21st, 13th, 14th Khoroos of Chingeltei District
- 13th Khoroo of Sukhbaatar District
- 29th, 21st, 27th, 31st, 32nd, 19th, 24th, 17th, 8th, 38th, 12th, 37th, 36th, 26th Khoroos of Bayanzurkh District were included.
- 29th Khoroo of Sukhbaatar District

12.1. BAYANZURKH DISTRICT

Territory and environment

Bayanzurkh District is one of the four oldest districts of the capital city, which was first established as Nairamdly Rayon by Decree No. 79 of the Presidium of the Supreme Soviet of the Mongolian People's Republic on April 14, 1965. Located on the east side of Ulaanbaatar, Bayanzurkh District is the largest district of the capital city and covers a total area of 124.4 thousand hectares, including beautiful natural landscapes such as Baga Tenger, Bogino Chukhree, Chuluut, Bumbat, Zalaat, Tor Khurakh Am, and Khar Usan Tokhoi.

Population and administration

As of 2023, 434,976 people (209,223 males, 2,125,753 females) live in 127,339 households, with a population density of 351.1 people per km2 in Ulaanbaatar city. There are 43 administrative districts. 104,764 households live in ger districts and 80,037 households live in byr districts.

Population employment

Дүүргийн хөдөлмөрийн хэлтэст бүртгэлтэй, ажил идэвхтэй хайж байгаа ажилгүй иргэдийн тоо 2023 оны 8 сард 301 бүртгэгдэж, өмнөх оны мөн үеэс 71 хүнээр (30.9 хувь) өссөн байна. Нийт ажилгүйчүүдийн 76 (25.2 хувь) нь эмэгтэйчүүд байна.

Health

In August 2023, 4912 children were born in the district hospital, an increase of 160 children (3.4%) compared to the same period of the previous year. 1112 deaths were recorded, a decrease of 8 people (0.7%) compared to the same period of the previous year. The number of people suffering from infectious diseases was 4332, a decrease of 36462 people (89.4%) compared to the same period of the previous year. In Bayanzurkh district, the number of infectious diseases per 10,000 population in August 2023 was 109.3, a decrease of 976.3 percent compared to the same period of the previous year. Among sexually transmitted diseases, 215 syphilis, 64 gonorrhea, and 116 trichomoniasis were registered.

Social insurance and welfare

As of 2023, the Social Insurance Fund's revenue amounted to 336.9 billion tugriks, an increase of 154.3 billion tugriks (84.5%) from the same period of the previous year. 78.3 percent of the Social Insurance Fund's revenue was generated by the Pension Insurance Fund, 11.9 percent by health insurance, 5.1 percent by pension insurance, 3.7 percent by NHI insurance, and 1.0 percent by the Unemployment Insurance Fund. In August 2023, the Social Insurance Fund's expenditure was 12.3 billion tugriks more than the planned 273.1 billion tugriks, or 285.4 billion tugriks.

Social Welfare: In August 2023, 73.6 percent of the total expenditure of the social welfare fund was spent on child benefits, 8.6 percent on welfare pensions, 4.0 percent on childcare benefits for children aged 0-3, 7.8 percent on care benefits, 2.3 percent on livelihood support benefits, 1.9 percent on assistance and discounts for the elderly, 0.6 percent on food and nutrition programs, 0.5 percent on maternity benefits, and 0.7 percent on other benefits.

Enterprise

In addition to the Mongolian Academy of Sciences, its 6 affiliated institutes, and the Russian Cultural and Scientific Center, the Mongolian Military Museum, Zhukov Museum, and the Museum of Intellectuals are located in Bayanzurkh District, where children and young people can travel along the original historical path.

Also, major health institutions such as the National Medical Center, National Medical Center, Second Hospital, Military Hospital, Amgalan Maternity Hospital, and Mongolian-Japanese Hospital of the Mongolian State Medical University are located in Bayanzurkh District, providing specialized, basic, and primary care services to citizens. In addition to the 10 main departments of state services in the District Governor's Office, the administration operates as a territorial unit with 43 khoroos, which are primary administrative units, and 29 district administrative departments.

More than 180 thousand enterprises and organizations operate, including the Narantuul International Trade Center, Ugeumur, Da-Khurei Auto Trade and Technical Market, Bayanzurkh, and Amgalan Markets.

Industry

The district's industrial sector produced 1,427.3 billion tugriks worth of products and sold 1,704.1 billion tugriks worth of products in the first eight months of 2023, an increase of 587.5 billion tugriks (69.9%) and 653.3 billion tugriks (62.5%) in production and sales, respectively, compared to the same period of the previous year.

Of the total output, 846.2 billion tugriks (59.3%) were accounted for by the mining sector, including crude oil and fluorspar, fluorspar concentrate, iron ore, iron ore concentrate, gold, sand, gravel, and soil mining, 409.4 billion tugriks (28.7%) by food and beverages, 95.9 billion tugriks (6.7%) by clothing, footwear, textiles, wool, cashmere processing, and other manufacturing, 1.2 billion tugriks (0.1%) by electricity, gas, steam, and ventilation, and the remaining 74.6 billion tugriks (5.2%) by wastewater treatment systems, waste management, and cleaning activities. The growth in manufacturing production was driven by food production, textile production, basic pharmaceuticals and pharmaceuticals, non-ferrous metal products, leather, and other manufacturing industries.

Agriculture

In Bayanzurkh district, as of 2023, potatoes were grown on 0.0354 hectares and vegetables on 1.7768 hectares, and in the first eight months of 2023, 0.474 tons of potatoes and 27.73 tons of vegetables were harvested.

Economy

According to the preliminary budget execution for August 2023, the district budget revenue was 131.9 billion tugriks, budget expenditure was 74.8 billion tugriks, and the budget balance was in surplus by 57.1 billion tugriks.

Budget revenue: According to the preliminary budget execution data for August 2023, tax revenue accounted for 127.6 billion tugriks (96.7%), non-tax revenue accounted for 1.6 billion tugriks (1.2%), and local development fund revenue accounted for 2.8 billion tugriks (2.1%). Budget revenue execution was 33.0 billion tugriks short of the plan. This was mainly due to the 33.3 billion tugriks (20.7%) shortfall in tax revenue.

Budget expenditure: According to the preliminary budget execution data for August 2023, 40.3 percent (74.8 billion tugriks) of the planned operating expenses of district budget organizations were financed. In other words, budget organizations have not spent 59.7 percent of their total operating expenses (110.8 billion tugriks) on time. Considering the structure of budget expenditures, 13.4 percent are salaries, wages and additional incentives, 2.2 percent are contributions paid by employers to the social insurance fund, 9.8 percent are fixed expenses related to the use of premises, 11.8 percent are expenses for supplies and inventory, 13.7 percent are payments and fees for services performed by others, 30.2 percent are current transfers, and 18.9 percent are other expenses.

Livestock and agriculture

According to the year-end livestock and domestic animals census of 2024, 55,470 animals were counted. Of these, 14,410 were horses, 17,180 were cattle, 14,160 were sheep, and 9,720 were goats.

Usage price

The consumer price index increased by 10.0 percent in August 2023 compared to the same period of the previous year, due to an increase in the prices of food, beverages, and water by 15.5 percent, alcoholic beverages, and tobacco by 5.8 percent, clothing, footwear, and textiles by 9.6 percent, household goods, and furniture by 8.7 percent, pharmaceuticals, and medical services by 8.4 percent, communication services by 2.1 percent, recreation, leisure, and cultural goods by 7.3 percent, educational services by 21.2 percent, hotels, public catering, and dormitories by 18.7 percent, other goods, and services by 2.8 percent, housing, water, electricity, and fuel by 5.1 percent, and a decrease in transportation services by 0.3 percent.

Bayanzurkh district subdistricts

29th Khoroo

The khoroo was first established in 2022. It has an area of 128.275 hectares. As of December 7, 2023, the khoroo has a population of 6665. According to a study, 9 percent of the total population lives in apartments and 91 percent in ger areas.

29 khoroos have general education school No. 102 and Dayankhuu kindergarten. There are shopping centers such as Dar Ekh market, Yu Kombini, and Shine hotel.

21th Khoroo

The khoroo is located in the northern part of Ulaanbaatar city, northwest of the central part of Bayanzurkh district. It has an area of 450 hectares. As of 2023, it has a population of 8,117. Small businesses, shopping centers, and other commercial and service centers operate around the khoroo center and residential areas.

37th Khoroo

The khoroo is located in the eastern part of Ulaanbaatar city, east of the central part of Bayanzurkh district. It has an area of approximately 500 hectares. The 27th khoroo borders the 26th khoroo to the west, the 28th khoroo to the south, and the 10th khoroo of the district to the north. As of 2023, it has a population of 11,210. The population density of the khoroo is relatively high, and residents live in residential areas, ger areas, and small business areas. Small businesses, shopping centers, and markets, such as markets, are operating in the vicinity of the khoroo center and residential areas.

31st Khoroo

By the resolution of the meeting of citizens' representatives of Bayanzurkh district of the capital dated October 18, 2021 “On the establishment and change of committees”, 15 new khoroos were established based on the proposals submitted by the district governor, in accordance with Article 4, Sections 4.1 and 4.2, Article 25, Sections 25.1 and 25.2 of the Law on the Administration and Territorial Units of Mongolia and their Management. Bayanzurkh district 31 was established on

April 1, 2021. It has an area of 164 hectares. The khoroo has a population of 10,599 as of January 1, 2023. 95 percent of the total population lives in ger districts.

32nd

It is a khoroo located in the northwest of Ulaanbaatar city, northwest of the central part of Bayanzurkh district. It covers an area of 450 hectares. The khoroo has a population of 8,953 as of 2023.

The 32nd khoroo of Bayanzurkh district borders the 31st khoroo of the district to the east, the 33rd khoroo to the southwest, and the 20th khoroo to the north. Small businesses, shopping centers, and other commercial and service centers operate in the vicinity of the khoroo center and residential areas.

19th Khoroo

The khoroo is a khoroo located in the western part of Ulaanbaatar city, northwest of the central part of Bayanzurkh district. The khoroo contains residential, ger neighborhoods, and medium-sized business areas, and is located close to the city center. It has an area of approximately 500 hectares. The khoroo borders Bayanzurkh district's 18th khoroo in the northwest, 20th khoroo in the northeast, and 21st khoroo in the southwest.

As of 2023, it has a population of 12,887. The population density of the khoroo is relatively high, with residents living in residential, ger neighborhoods, and small business areas.

24th Khoroo

The khoroo was newly organized by the Resolution No. 27 of the City Council of the Kyrgyz Republic dated February 28, 2007, after being divided from the 19th khoroo of the BZD. It borders khoroos 9,17,19 of Bayanzurkh district and has an area of 26.8 hectares, a population of 9035 people in 2382 households, and 14 sections. There are 90 enterprises and organizations engaged in production, service, and trade activities in the territory of the khoroo, there are no public or private schools, and there is 1 public kindergarten. It is a khoroo consisting exclusively of ger khoroos.

17th Khoroo

The khoroo was newly organized by Resolution No. 27 of the City Council of the Kyrgyz Republic dated February 28, 2007, after being divided from the 19th khoroo of the BZD. It borders khoroos 9,17,19 of Bayanzurkh district and has an area of 26.8 hectares, a population of 9035 people in 2382 households, and 14 sections. There are 90 enterprises and organizations engaged in production, service, and trade activities in the territory of the khoroo, there are no public or private schools, and there is 1 public kindergarten. It is a khoroo consisting exclusively of ger khoroos.

8th Khoroo

The district was first established in the 1960s as a military unit and unit, and as a result of the concentration of military services and garment factories, a ger district called Ulaanhuaran began to be established, and was officially established as Khuroo No. 8 of the Nairamdliy district in 1968. On January 13, 1992, Mongolia adopted a new Constitution and transitioned to a free democratic society, changing the administrative structure and expanding it to Khuroo No. 8 of the BZD, and it has been providing public services to citizens to this day.

According to Resolution No. 12/36 of the City Council of Mongolia dated December 24, 2021, Khuroo No. 8 was divided into 3 Khuroo No. 38 and 39, reducing the area to 96 hectares, with a total household size of 3,297 and a population of 11,471.

The 8th khoroo is home to the Amgalan Complex Secondary School, School No. 92, the private Turk Empathy Secondary School, the State Head Kindergarten No. 32, Kindergarten No. 301, and the Railway Kindergarten No. 177.

38th Khoroo

The khoroo is located in the western part of Ulaanbaatar city, southwest of the center of Bayanzurkh district. It was formed by dividing khoroo No. 8 in 2019, and has a total of 1011 households, 3033 people, and 5 sections. The number of enterprises located in the territory of the khoroo is 73, of which 3 are government organizations, 65 are business services, 3 are universities, 1 is a private kindergarten, and 3 are CHPs.

12nd Khoroo

The khoroo was first established in 1985 and covers an area of 140 hectares. As of January 1, 2023, it has a population of 7,063. 36.2 percent of the total population lives in apartments and 63.8 percent in ger neighborhoods.

In the khoroo, in the 12th khoroo, there are 147th General Education School, 20th Kindergarten, and Ehrenhem Amad Kindergarten. There are also large shopping centers such as Wellmart Supermarket, Orgil Hypermarket, and Orgil Jade Food Market.

37th Khoroo

The khoroo is a khoroo located in the northwest of Ulaanbaatar city, northwest of the center of Bayanzurkh district. This khoroo contains residential areas, ger areas, and businesses, and is one of the most mixed and developed areas in the region. It borders khoroos 38, 36, and 39 of Bayanzurkh district and covers an area of 520 hectares. As of 2023, the khoroo has a population of 10,431.

36th Khoroo

Khoroo 36 of Bayanzurkh District is located in the northwest of Ulaanbaatar city, relatively far from the center of Ulaanbaatar. This khoroo contains residential areas, ger areas, and businesses, and is one of the most mixed and developed areas in terms of living environment. It borders Khoroo 37, 38, and 35 of Bayanzurkh District, and covers an area of approximately 550 hectares. As of 2023, the khoroo has a population of 15,574.

26th Khoroo

By the resolution of the People's Assembly of the capital city No. 6/48 dated December 24, 2010, the 12th khoroo of Bayanzurkh district was established as the 26th khoroo with 536 households and 1456 population.

As of January 1, 2023, the 36th khoroo was newly established from the 26th khoroo by the resolution of the People's Assembly of the capital city No. 12/36 dated December 24, 2021. The 26th khoroo has a population of 22767 and 6754 households. It is a residential khoroo.

Starting from the northern axis of the Marshal Bridge, go north along Hunnu Street to the north axis of the Marshal Bridge. The western boundary of the committee extends to the Home Plaza shopping center, the eastern boundary extends to the Bayanzurkh Bridge, the southern boundary extends to the banks of the Tuul River, and the northern boundary extends to Hunnu Street. The area of the land is 934 hectares.

12.2. CHINGELTEI DISTRICT

Territory and environment

Chingeltei District was first established by Resolution No. 18 of the Mongolian State Great Khural on August 18, 1992. Subsequently, by Resolution No. 31 of the Ulaanbaatar City People's Deputies' Khural on September 1, 1992, it was organized into 18 khoroos, which are the primary administrative and territorial units. The district has a total area of 8.93 thousand hectares. Of this, forest land accounts for 37.1%, agricultural land for 30.3%, towns, villages, roads, and settlements for 27.0%, and water bodies for 4.5%.

Population and administration

As of 2023, 140,264 people (67,326 males, 72,938 females) live in 37,736 households, and there is a density of 1,526 people per km2 in Ulaanbaatar city. There are 19 administrative units. 28,486 households (104,264 people) live in ger districts, and 9,250 households (36,000 people) live in byr districts.

Health

According to the District Health Center, in the first nine months of 2024, 1,439 mothers gave birth and 1,458 children were born, which is a decrease of 292 (16.9%) in the number of mothers and 283 (16.3%) in the number of children born compared to the same period of the previous year. In the first nine months of 2024, 590,267 people underwent medical examinations, which is an increase of 39,815 (7.2%) compared to the same period of the previous year. The number of people hospitalized decreased by 1,445 (21.4%) to 5,323. There were 235 sexually transmitted diseases, accounting for 25.6 percent of all infectious diseases. There were no cases of Covid-19.

Social insurance and welfare

The income of the Social Insurance Fund reached 435.4 million tugriks in the first 9 months of this year, an increase of 47.2 (12.1%) million tugriks from the same period of the previous year, and the fund's expenditure reached 189.8 million tugriks, an increase of 56.5 (42.4%) million tugriks from the same period of the previous year. By funds, the income of the Pension Insurance Fund increased by 32.7 (10.4%) million tugriks from the same period of the previous year, the income of the Unemployment Insurance Fund by 1.2 (19.1%) million tugriks, the income of the Pension Insurance Fund by 5.8 (18.3%) million tugriks, and the income of the Social Security Insurance Fund by 7.4 (21.4%) million tugriks. Expenditures of the funds increased by 59.9 (52.5%) million tugriks from the same period of the previous year, while expenditures of the Pension Insurance Fund increased by 0.2 (23.4%) million tugriks,

expenditures of the Social Insurance Fund increased by 0.8 (19.6%) million tugriks, and expenditures of the Pension Insurance Fund decreased by 4.4 (32.0%) million tugriks.

The Social Welfare Fund provided 75.0 billion tugriks in pensions and benefits to 113.9 thousand people in September 2024, which is an increase of 1028 (0.9%) thousand people covered and 6100.7 (8.8%) million tugriks granted, respectively, compared to the same period of the previous year.

Social Welfare: As of September 2024, 2,459 people were covered by social welfare pensions and 7,478.9 million tugriks were paid, which is a decrease of 20 (0.8%) in the number of covered persons compared to the same period of the previous year, while the cash pension paid increased by 1,405.7 (23.1%) million tugriks. 70,704 people were covered by social welfare benefits and 53,942.7 million tugriks were paid, which is an increase of 514 (0.7%) people and 1,304.1 (2.5%) million tugriks in the number of covered persons compared to the same period of the previous year.

Education

The number of students in general education schools in the district for the 2023-2024 school year increased by 543 (1.8%) children compared to the same period last year to 30,229. A total of 10,251 children were enrolled in preschool education in the 2023-2024 school year.

Enterprise

There are 36 kindergartens in Chingeltei district, 23 state-owned and 13 private-owned, and more than 25 thousand children study in 22 general education schools, 13 state-owned and 9 private-owned, with 1,167 teachers and employees working in the education sector. There are also Labor Institute, Ulaanbaatar Erdem-Oyu, Ulaanbaatar Erdem-Sudlal, Culture College, and Culture and Arts Universities. There are historical and cultural entertainment facilities such as the National History Museum, the Natural History Museum, the Zanabazar Museum of Fine Arts, and the Tengis Cinema in the district.

Industry

The total production of the industrial sector increased by 35.0 percent from the previous month. The total production of the industrial sector amounted to 119364.9 million tugriks as of September 2024, an increase of 26711.6 (28.8%) million tugriks from the same period of the previous year. Of which: The mining and extractive industries sector increased by 36106.0 (2.2 times) million tugriks, and the water supply, sewerage systems, waste disposal and environmental restoration activities sector increased by 1080.8 (16.4%) million tugriks.

The total production of the processing sector amounted to 46088.3 million tugriks as of September 2024, a decrease of 10475.2 (18.5%) million tugriks from the same period of the previous year. The industrial sector's sales in September 2024 amounted to 122,069.1 million tugriks, an increase of 42,442.4 (53.3%) million tugriks from the same period last year, driven by an increase of 26,711.6 (28.8%) in mining and quarrying.

Agriculture

In Chingeltei district, as of 2024, potatoes were grown on 0.04 hectares and vegetables on 0.15 hectares, and as of 2024, 0.71 tons of potatoes and 3.55 tons of vegetables were harvested.

Economy

The district budget balance was 2.7 billion tugriks in September 2024. The total district budget revenue was 159.0 billion tugriks in September 2024, which was 9.7 billion tugriks (5.8%) less than planned. Tax revenue accounted for 95.2 percent of the total budget revenue, non-tax revenue for 4.1 percent, and aid revenue for 0.7 percent. In September 2024, the district's tax revenue reached 151.4 billion tugriks, which was 13.6 million tugriks or 8.2 percent less than planned, and non-tax revenue reached 6.5 billion tugriks, which was 4.0 billion tugriks, 2.6 times less than planned.

The total local budget expenditure and repayments decreased by 29.7 billion tugriks (15.5%) from the planned amount to 161.7 billion tugriks in September 2024. Wages and salaries and bonuses account for 5.7 percent of total budget expenditures, social insurance contributions paid by employers account for 0.6 percent, other goods and services expenditures account for 24.1 percent, and current transfer expenditures account for 59.5 percent.

Usage price

The consumer price index increased by 6.5 percent year-on-year. The consumer price index for September 2024 increased by 5.2 percent compared to the end of 2023 and increased by 0.1 percent compared to the previous month. The consumer price index increased by 5.2 percent in September 2024 compared to the end of the previous year due to increases in the prices of food and non-alcoholic beverages by 6.0 percent, clothing and footwear by 6.2 percent, housing, water, electricity, gas and other fuels by 4.7 percent, household furniture and household goods by 7.8 percent, medicines and medical services by 3.8 percent, recreation, leisure and cultural goods

and services by 4.9 percent, educational services by 19.7 percent, and other goods and services by 8.2 percent.

Chingeltei District Subdistricts

20th Khoroo

The khoroo was separated from khoroo 7 of Chingeltei district in April 2022 and is currently located in class 204 of school 149. The khoroo borders khoroo 28 of SHD to the north, khoroo 22 of CHD to the east, khoroo 11 of BGD to the southwest, and khoroo 7 of CHD to the southeast. It has a population of 5223 in 1392 households with an area of 157 hectares.

Within the khoroo, there are 149 public schools, 224 kindergartens, 291 kindergartens, private Aavudun kindergartens, 1 Service Center infrastructure center, 5 6-brand grocery stores, 12 8-brand grocery stores, 3 churches, 4 wells, 6 car washes and repairs, and 3 public buildings, a total of 36 business entities and organizations operating.

The district is densely populated, sparsely populated, with a high number of rural migrants and migrants, and a large number of households with incomes below the subsistence level and vulnerable groups. It is expected to become more populated in the future.

22nd Khoroo

The khoroo was separated from khoroo number 16 and was newly established on January 16, 2023. The khoroo has a population of 4021 in 1039 households.

It borders on khoroo number 16 of the Khural of the Kyrgyz Republic in the east and northeast, khoroo number 15 of the Khural of the Kyrgyz Republic in the southeast, khoroo number 21 of the Khural of the Kyrgyz Republic in the south, khoroo number 20 of the Khural of the Kyrgyz Republic in the southwest, and khoroo number 6 of the Khural of the Kyrgyz Republic in the northwest. There are also 14 business entities and organizations in the territory of the khoroo, providing drinking water through 6 wells.

21st Khoroo

The khoroo was separated from the territory of khoroo number 12 in 2022 and formed khoroo number 21. It is located 5 km from the city center and the district administrative center. It borders khoroo number 7 of the district to the west, khoroo number 16 to the north, and khoroo number 12 to the south. The khoroo has a population of 6,957 in 827 households on an area of 178.6 hectares.

A total of 6,541 people live in 176 households in rural areas and temporary residents of Ulaanbaatar city.

The khoroo number 21 has 95 streets numbered 18-22, 1,397 courtyards, EB primary school number 138 and kindergartens 220 and 154, Mon Kara LLC, Zam-gu-ri auto base, 17 boutique shops, 6 boutique shops, 5 public buildings, 4, etc., and has a total of 28 business entities.

13th khoroo

The khoroo was first established in 1970 as the 21st khoroo of Sukhbaatar district, and in 1992, due to the geographical location, population density and concentration, it was established as the 13th khoroo of Chingeltei district.

The territory of the khoroo borders the 12th khoroo of Chingeltei district to the south and west, and the 14th and 15th khoroos of Chingeltei district to the north or east. The khoroo has an area of 72 hectares and a population of 6983 in 1761 households. It is a large ger khoroo with 13% of the total population being elderly, 37% aged 0-18, and 50% aged 19-55/60. More than 60 private

sector enterprises, organizations, and citizens operate in the khoroo, including the Bagachuud Food Production Unit, Batseju Footwear Factory, Ub-17, Telmen Impex, and grocery stores. There are also 7 government organizations.

14th Khoroo

The khoroo was known as the 21st khoroo of the current Sukhbaatar district from 1965 to 1972, the 24th khoroo from 1972 to 1978, the 18th khoroo from 1978 to 1992, and the 14th khoroo of Chingeltei district after the administrative reorganization in August 1992. The khoroo has a land area of 9 hectares.

It borders the 18th khoroo of Chingeltei district to the north, the 15th khoroo of Chingeltei district to the west, the 13th khoroo of Sukhbaatar district to the east, and the 13th khoroo of Chingeltei district to the south. According to the 2022 population statistics, the khoroo has 1674 households and a population of 6461, of which 3238 are women and 3223 are men. It is a peaceful community, located in a lowland area, not mountainous, with a large population, relatively low crime rates, and 1 public school, 2 public kindergartens, 1 private kindergarten, 1 family health center, 53 business entities, and 8 water distribution facilities.

12.3. SONGINO-KHAIRKHAN DISTRICT

Territory and environment

As of December 31, 2023, Songinokhairkhan District has an area of 124.3 thousand hectares, 77 percent of which is agricultural land, 20 percent is forest, and 3 percent is land with roads and utility lines. Songinokhairkhan District is home to 20.8 percent of the total population of Ulaanbaatar City and about 25.50 percent of the land area, making it the largest in terms of population and area in the capital. 254.6 km of paved roads and 174 km of pedestrian paths have been laid. The number of lighting is 22,978, and the number of monuments is 13. Green spaces have been established on 124.7 hectares of the total area of the district.

Population and administration

As of 2023, 341,390 people (168,593 males, 172,797 females) live in 95,895 households, with a population density of 369.1 people per km2 in Ulaanbaatar city. There are 43 administrative units.

237,370 people live in 66,830 households in ger districts, and 104,020 people live in 29,065 households in byr districts.

The working-age population increased by 1,101 (0.5%) from 227,434 in 2019 to 228,535 in 2023. The number of employees increased by 11,111 (10.5%) from 105,850 in 2019 to 116,961 in 2023. The number of job seekers decreased from 3,000 in 2019 to 669 in 2023, a decrease of 2,331 (77.7%) people. In 2023, the working-age population increased by 2.6 (1.1%) thousand people to 238.2, compared to the same period of the previous year. The employment rate decreased by 1.3 (2.6%) points to 49.0 from 2019.

Enterprises and organizations

The district is one of the largest districts with more than 27 thousand business entities and organizations operating. The number of registered business entities and organizations increased by 4084 (17.5%) from 2019 to 27371 in 2023. Of the total business entities and organizations registered in 2023, 23623 (86.3%) were enterprises, and 3748 (13.7%) were budget and non-governmental organizations. The number of limited liability companies in 2023 was 22697, which is an increase of 4659 (25.8%) from 2019.

Among these, major factories producing bread, sweets, meat, dairy products, and dairy products, such as Altan Tari, Suu, Oguj, Mah Impex, Gan Khaits, Talkh Sukur, Monos, and Savan Trade, as well as major road transport organizations such as Elektar Hukur JSC, Autobus-2 JSC, Auto-5 JSC, and Mongol Teeh are located and serve the population of the capital city.

Education

In the 2023 academic year, 3,771 students graduated from 3 higher education institutions, 25,304 children from 115 secondary education institutions (67 state-owned, 48 private), and 66,428 students from 34 secondary schools (27 state-owned, 7 private).

Health

In 2023, there are 4 state hospitals, 26 family hospitals, and 843 beds. The number of hospital employees is 354, which is a decrease of 48 (11.9%) from 2019. As of 2023, 24.6 percent of the total hospital employees are general practitioners, which is a decrease of 22 (20.2%) from 2019.

In the district, 6,376 infants were born to 6,342 mothers in 2023, which is a decrease of 903 (12.5%) from 2019.

In 2023, the number of people who underwent early screening for arterial hypertension for the first time decreased by 4,792 (4.2%) from 2022, the number of people who underwent early screening for type 2 diabetes for the first time decreased by 15,912 (16.2%), and the number of people who underwent early screening for liver cancer increased by 1,897 (13.6%).

In outpatient examinations, 93,321 non-communicable diseases were registered in 2023, a decrease of 36,882 (28.3%) from 2022, and 57,940 (62.1%) of the total diseases were newly registered. The number of infectious diseases was 2,560.

Economy

In 2019, the district's local budget revenue was 32916.4 million tugriks, while in 2023 it was 109201.2 million tugriks, an increase of 3.3 times. 82.8 percent of the total local budget revenue was made up of tax revenue. Local budget expenditure in 2023 is 93383.7 million tugriks, an increase of 3.2 times from 2019. 13896.2 (14.8%) million tugriks of the total expenditure in 2023 are salaries, bonuses, and additional expenses. This is an increase of 8936.8 million tugriks, or 2.8 times, from 2019.

According to the results of industrial enterprises covered by official statistical data, in 2022, 1216440.1 million tugriks worth of products were produced, while in 2023 it increased to 1717920.3 (41.2%) million tugriks. Sales of industrial products increased from 1517911.7 million tugriks in 2022 to 2178349.5 (43%) million tugriks in 2023. Food industries produced products worth 696982.9 million tugriks in 2022, increasing to 1191996.7 million tugriks in 2023, or 71.0 percent, while the production of non-food products increased from 519457.2 million tugriks in 2022 to 525923.6 million tugriks in 2023, or 0.01 percent.

Employment

In 2019, the number of job seekers was 3,000, of which 1,546 (51.5%) were women. In 2019, 63 citizens were employed, while in 2023, 1,261 citizens were employed. Of the job seekers, 578 (2.6%) were immigrants, 109 (2.9%) were graduates, 3 (0.4%) were discharged from the military, 13 (0.5%) were dropouts, 661 (22.0%) were unemployed, 175 (5.8%) were looking for a job to increase their income, 185 (6.2%) wanted to change their current job, and 68 (2.3%) were looking for work because their household or personal businesses were no longer profitable.

Of the registered unemployed in 2023, 8 (1.2%) were retired, 108 (16.1%) were unemployed due to staff reductions, 121 (18%) were unemployed due to health reasons, and 45 (6.7%) were unemployed due to the liquidation of the organization.

Livestock and agriculture

The year-end livestock and domestic animal census for 2023 counted 73,824 livestock. This is an increase of 3,056 (4.1%) livestock from 2019.

Agriculture

As of 2024, in Songinokhairkhan district, potatoes were grown on 81.0 hectares, fodder crops on 415.0 hectares, green fodder on 365.0 hectares, silage crops on 50 hectares, corn on 50 hectares, and vegetables on 101.7 hectares. As of 2024, 992 tons of potatoes and 897.3 tons of vegetables were harvested.

Infrastructure

Of the 43 khoroos, 12 are single-family residential khoroos, and there are 66,830 households in ger khoroos using portable water. This is a decrease of 67 (0.1%) households from 2019. The number of water distribution points increased by 44 (18.5%) points from 243 in 2019.

In the construction sector, construction and major repairs worth 161,281.1 million tugriks were completed in 2019, while in 2023, work worth 188,094.5 million tugriks was completed. This is an increase of 26,813.4 (16.6%) tugriks from 2019.

In 2023, there were 86 gas stations in the district. This is an increase of 24 (38.7%) points from 2019, and the number of cars in the district is 84,850 in 2023, an increase of 23,817 (39%) from 2019.

There are 275 service establishments operating in the field of public catering, an increase of 18 (6.1%) from 2019.

The number of small and medium-sized food enterprises in Songinokhairkhan district is 146, an increase of 60 (69.7%) from 2019, 57 meat and meat product factories are 26 (83.8%) from 2019, and 18 bakeries are 5 (21.7%) from 2019..

Songino-Khairkhan district subdistricts

17th Khoroo

The khoroo is located in the central part of Songinokhairkhan district. The khoroo has residential areas, service areas, and shopping centers. The khoroo has a population of 5,809.

The khoroo has many residential areas, and in total there are 4-5 residential areas (for example, Songinokhairkhan-1, Songinokhairkhan-2, etc.), where more than 2,000 families live. The khoroo covers an area of approximately 300 hectares and includes housing, small farms, and service areas. There is more than 5 km of main road in the khoroo, which connects residential areas and shopping centers.

There are 2 general education schools in khoroo 17, with about 1,500 students studying in these schools. There are 4 kindergartens, with a total of more than 600 children enrolled in kindergartens. There is 1 family clinic and 1 private clinic in the khoroo. 300-500 people use them daily for health services.

There are 3 large shopping centers in the district and 20-30 small and large businesses operating there.

23th Khoroo

The khoroo is located in the northwestern part of Songinokhairkhan district, bordering Gachuurt and Bayanzurkh districts, and has a population of 5,776.

Khoroo 23 is located not far from the center, and a 5-7 km road facilitates access to public and private transport, as well as connecting it to major roads. 2-3 bus routes run through the khoroo, transporting more than 1,000 people per day.

The khoroo has 1-2 secondary schools, with a total of more than 1,000 students. 3 kindergartens accommodate a total of 300-400 children. There is 1 family clinic and a private clinic in the khoroo. 200-300 people receive health services per day. There are 3-4 large shopping centers in the khoroo area, as well as small and medium-sized business centers and 20-30 small trade and service establishments.

39th Khoroo

The khoroo is located in the western part of the district. The territory of the khoroo borders the West 4th road, Gachuurt and Bayanzurkh districts. The khoroo is located 10-15 km from the center of the capital and is connected to the main road and public transport. Approximately 2,000 people travel by public transport per day. Khoroo 39 has a population of about 12,000-15,000. It has several residential neighborhoods and a total of about 3,000 families live there. There are about 7-8 km of main roads in the khoroo and 3 bus routes for public transport. 1,000-1,500 people travel by public transport per day.

There is 1 general education school in the khoroo with 800-1,000 students. There are also 2 kindergartens, which accept and educate 250-300 children. Khoroo 39 has 1 family clinic and a private clinic. 200-300 people can receive health services per day.

The district has 2 large shopping centers and small retail stores. About 20 small businesses operate.

6th Khoroo

The khoroo is located in the western part of Ulaanbaatar city, west of the center of Songinokhairkhan district. This khoroo has an area containing residential areas, ger districts, and service centers. It is located in the central part of Songinokhairkhan district, about 5 km west of the center of Ulaanbaatar city. It has an area of approximately 760 hectares. The khoroo is one of the largest khoroos in the Songinokhairkhan district, with a population of about 10,227. The population density of the khoroo is relatively high, and residents live in residential and ger districts. There are commercial centers such as Harsh and Kharkhorin market, as well as small and medium-sized businesses, as well as chemical and food industries and construction materials factories.

7th Khoroo

The khoroo is located in the western part of Ulaanbaatar city, west of the central part of Songinokhairkhan district. It is located about 3-4 km west of the central part of Songinokhairkhan district. It has an area of approximately 650 hectares. The khoroo is one of the medium-sized khoroos in the population of Songinokhairkhan district, with a population of about 9597. The population density of the khoroo is relatively high, and residents live in residential and ger areas. Kharkhorin market and small shopping centers are operating.

40th Khoroo

The khoroo is located in the western part of Ulaanbaatar city, west of the city center. It covers an area of approximately 920 hectares. Khoroo 40 is one of the largest khoroos in Songinokhairkhan district, with a population of approximately 8,325. The population density of the khoroo is relatively

high, with residents living in residential and ger areas. Business areas are expanding, and markets and shops are operating.

9th Khoroo

The khoroo is located in the western part of Ulaanbaatar city, about 4-5 km west of the center of Songinokhairkhan district. It has an area of approximately 680 hectares. Khoroo 9 is one of the medium-sized khoroos in Songinokhairkhan district, with a population of about 6,632. The population density of the khoroo is relatively high, and residents live in residential and ger areas. Markets, shops and small shopping centers are operating.

10th Khoroo

The khoroo is located in the western part of Ulaanbaatar city, approximately 5-6 km northwest of the center of Songinokhairkhan district. With an area of approximately 670 hectares, the khoroo is one of the largest khoroos in Songinokhairkhan district, with a population of approximately 10,012. The population density of the khoroo is relatively high, with residents living in apartments, ger areas, and small business areas.

28th Khoroo

The khoroo is located in the western part of Ulaanbaatar city, about 6-7 km northwest of the center of Songinokhairkhan district. It has an area of approximately 750 hectares. Khoroo 28 is one of the medium-sized khoroos in Songinokhairkhan district, with a population of about 7,367. The population density of the khoroo is relatively high, and residents live in apartments, ger areas and small business areas. Businesses such as markets, shops and small shopping centers operate.

12.4. BAYANGOL DISTRICT

Territory and environment

In 1965, four districts were established as the main administrative units of Ulaanbaatar city: Sukhbaatar, Oktyabr, Nairamdal, and Ajilchin. The development of Bayangol district began with the name Oktyabr district. Bayangol district of the capital is one of the six districts of the center of Ulaanbaatar, the capital of Mongolia, and covers an area of 2,949 hectares. It borders Chingeltei and Sukhbaatar to the east, Khan-Uul to the south, and Songinokhairkhan to the west and north. It is a small but densely populated district.

Population and administration

As of 2023, 252,979 people (123,959 males and 129,020 females) live in 69,519 households, and the population density in Ulaanbaatar city is 8,578.5 people per km2. There are 34 administrative units.

Also, 82.7 percent of the total households in the district live in residential areas and 17.3 percent in ger areas.

Enterprises and organizations

Bayangol District Public Security Bureau has 11 units and 25 subordinate departments, including the State Registration Department, Tax Department, Labor and Welfare Services Department, Professional Inspection Department, Health Center, Police Department I and II, Traffic Police Department, Land Management Department, Social Insurance Department, Procurement Department, Family, Child and Youth Development Department, Children and Youth Cultural Center, Family and Ceremonial House, Non-Formal-Lifelong Education Center, Elderly

Committee, Physical Education and Sports Committee, Internal Audit Department, Small and Medium Enterprise Support Center, Emergency Department, Statistics Department, Red Zalgam Committee, “Water Sports Training Center” ONOTUG, Children's Camp, “Bayangol Park” ONOTUG, “Bayangol Shine Uingo” ONOTUG.

The territory of Bayangol district is home to Mongolia's largest power plant, the DTS-4 TPP, the Dulaany Second Power Plant, the Mongolian-Russian Joint Stock Company "UBTZ", which is the backbone of Mongolia's economic development, major state-owned hospitals, the State Central Hospital, the Third State Central Hospital, and the State Central Hospital. In addition, media organizations such as MONRT and UBS, as well as major art and cultural organizations such as MUSTO and the Railway Song and Dance Ensemble, and the Gandantegchenlin Monastery, the center of Mongolian Buddhism, are located in Bayangol district. In addition, Bayangol district is a district with a concentration of trade and service establishments, and the "Kharkhorin" and "Bars" markets, as well as shopping centers along the 3rd and 4th districts, are located.

Education

In the 2021-2022 academic year, 20 state-owned schools and 28 non-state-owned schools are operating in Bayangol district, with a total of 48 schools, with 56,868 students enrolled in 1,733 groups. Of these, 30,814 are at the primary education level, 18,090 are at the basic education level, and 7,964 are at the secondary education level. There are also 2,113 state-owned schools and 508 non-state-owned schools, with a total of 2,621 main teachers.

Health

Bayangol District has large state-level hospitals, such as the State Central Hospital, the Third Central Hospital, the Children's Central Hospital, and the Narcology Hospital.

The Bayangol District Health Center also implements, coordinates, and monitors the policies, orders, and decisions of the Ministry of Health, the National Health Service, the Department of Health, and the District Health Service, and provides public health and secondary medical care to the population, as well as medical and public health care to the population of the district in the form of outpatient and inpatient treatment.

In addition, the Health Center operates in 34 khoroos, which are the primary administrative units, and provides primary health care to citizens in a timely manner.

Agriculture

Баянгол дүүргийн хэмжээнд 2024 оны байдлаар 2.0 га талбайд төмс, 6.5 га талбайд хүнсний ногоо тариалсан бөгөөд 2024 оны байдлаар 28.2 тонн төмс, 406.8 тонн хүнсний ногоо хураан авсан байна.

Bayangol district 19th Khoroo

Bayangol District 29 is located in the western part of Ulaanbaatar city and covers the Tolgoit area. This khoroo was established in 2022 and combines various areas of the city, including the industrial zone, ger districts, and new residential areas. The khoroo is located in the western part of Tamir Bridge, Sonsgolon, and Tolgoit areas. It has an area of approximately 850 hectares and a population of approximately 7,817 as of 2023.

The industrial sector is concentrated in the central part of the khoroo. Chemical and food factories, construction materials companies, small businesses, and the "Kharkhorin Market", "Shine Sunday", and "Bars 2" shopping centers operate.

The western part of the khoroo includes the ger district and new residential areas (Onur khoroo, Erin khoroo). There are 3-4 state and private kindergartens.

12.5. SUKHBAATAR DISTRICT

Territory and environment

By Decree No. 79 of the Presidium of the People's Great Khural of the Mongolian People's Republic of April 14, 1965, the administrative units of Ulaanbaatar city were divided into 10 khoroos and organized into 4 districts (called rayons in the decree), one of which is Sukhbaatar district (rayon). The district today has an area of 21.8 thousand hectares. It borders Bayanzurkh in the east, Khan-Uul in the south, and Songinokhairkhan, Bayangol, and Chingeltei districts in the west.

Population and administration

As of 2023, 141,990 people (69,575 males, 72,415 females) live in 39,984 households, and the population density in Ulaanbaatar city is 679.2 people per km2. There are 20 administrative units.

Also, 54.0 percent of the total households in the district live in residential areas and 44.0 percent in ger areas.

Education

Сүхбаатар дүүрэгт Монгол Улсын анхны ерөнхий боловсролын 1,2,3 дугаар сургууль, 1,2 дугаар цэцэрлэг, улсын анхны их дээд сургууль Монгол Улсын Их сургууль, Боловсролын их сургууль, Шинжлэх ухаан технологийн их сургууль, Эрүүл мэндийн шинжлэх ухааны их сургуулиуд байрлаж үйл ажиллагаагаа явуулдаг Өнөөдөр дүүргийн хэмжээнд боловсролын байгууллагууд өргөжин хөгжиж ерөнхий боловсролын төрийн өмчийн 22, төрийн бус өмчийн 30 сургуульд 32138 хүүхэд, төрийн өмчийн 26, төрийн бус өмчийн 39 цэцэрлэгт 10064 хүүхэд багачууд сурч хүмүүжиж байна. Мөн их дээд сургууль, коллеж мэргэжлийн боловсролын сургуулиуд олноор байгуулагдаж 60000 оюутан залуус суралцаж байна.

Health

The district health center, along with a general hospital and 18 family hospitals, provides primary and secondary healthcare services to citizens. In Sukhbaatar district, Mongolia's first healthcare institutions, the State Clinical General Hospital, and the first and second maternity hospitals, are located, while in the central district of the capital, more than 100 public and private healthcare institutions and pharmacies provide healthcare services to citizens.

Unemployment

According to administrative statistics from the Department of Labor and Welfare Services, the number of registered unemployed citizens who are actively looking for work decreased by 134 people, or 47.6 percent, in 2022 compared to the previous year. Of the unregistered unemployed citizens, 637 citizens were employed by the end of 2022, which is a decrease of 403 or 38.8 percent from the same period in the previous year.

Industry

Registered and stable industrial enterprises in Sukhbaatar District produced a total of 4075.9 billion tugriks worth of products and made sales of 10964.9 billion tugriks in 2022. This was mainly due to an increase in mining and quarrying production by 18.5 percent, processing production by 13.5 percent, and electricity, heat, energy, and water supply production by 65.2 percent.

Budget

The total budget revenue of the district amounted to 297.8 billion tugriks as of the end of 2022, and the revenue plan was fulfilled by 100.3 percent. Current revenue accounted for 96.7 percent of the centralized revenue, and current budget financing revenue accounted for 3.3 percent. However, tax revenue accounted for 99.0 percent of the current revenue, and non-tax revenue

accounted for 1.0 percent. Total budget expenditure: As of December 2022, 98.7 percent of the centralized revenue was spent on current expenses. The majority of current expenses, or 99.7 percent, was spent on goods and services, and 0.3 percent on other expenses. The majority of goods and services expenses, or 76.2 percent, were spent on revenues concentrated in the capital, 2.0 percent on salary increases and bonuses, 0.2 percent on employer contributions to social insurance, and 21.6 percent on other goods and services expenses.

Agriculture

In Sukhbaatar district, as of 2024, potatoes were grown on 0.2 hectares and vegetables on 0.7 hectares, and as of 2024, 2.9 tons of potatoes and 11.5 tons of vegetables were harvested.

Sukhbaatar district 13th Khoroo

By Decree No. 79 of the Presidium of the People's Great Khural of the Mongolian People's Republic of Mongolia dated April 14, 1965, the territory under the jurisdiction of the Executive Administration of the Ulaanbaatar City Administrative District was divided into 4 districts. At that time, the khoroo was established under the name of Oronup Street Khoroo No. 23. At that time, the school streets of the current 13th khoroo of Chingeltei District belonged to the khoroo, and there were more than 50 streets in total.

By Resolution No. 06 of the Khoroo Citizens' Public Khural of the khoroo dated December 16, 2005, the numbering of household yards was reorganized, and there were a total of 25 streets in 11 districts (Khangayin 23, 24, Rashaani 1-16, Nogony 1-7). It borders the 14th khoroo of the SBD in the north, the 2nd khoroo of the BZD in the east, the 12th khoroo of the district in the south, and the 13th and 14th khoroos of the ChD in the west. It has an area of 148 hectares, and at the end of 2014, it had a population of 8636 in 2241 households. The khoroo, as it is popularly called, is located along the 1.6 km road from the 32nd bus station to the Zasvsryn station. Most of the territory of the khoroo is marshy. The khoroo has 51 organizations and enterprises, including kindergarten No. 150, Sankoll family hospital, Jasiun center, Max-Khuns LLC branch, Tod Oyms LLC, Badruun center, and Altdyn gol LLC. Most of the enterprises are engaged in commercial activities.

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