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# TUUL RIVER
## MONGOLIA

## 2019 BASIN HEALTH REPORT CARD

C

# TUUL RIVER BASIN: OVERVIEW

The Tuul River headwaters begin in the Lower Khentii mountains of the Khan Khentii mountain range (48030'58.9" N, 108014'08.3" E). The river flows southwest through the capital of Mongolia, Ulaanbaatar, after which it eventually joins the Orkhon River in Orkhontuul soum where the Tuul River Basin ends (48056'55.1" N, 104047'53.2" E). The Orkhon River then joins the Selenge River to feed Lake Baikal in the Russian Federation. The catchment area is approximately 50,000 km$^2$, and the river itself is about 720 km long. Ulaanbaatar is approximately 470 km upstream from where the Tuul River meets the Orkhon River.

The Tuul River basin includes a variety of landscapes including mountain taiga and forest steppe in the upper catchment, and predominantly steppe downstream of Ulaanbaatar City. The river itself flows through 10 soums within 3 aimags including the Tuv aimag (Erdene, Altanbulag, Bayan-Unjuul, Lun, and Zaamar soums); Bulgan aimag (Bayannuur, Dashinchilen, and Buregkhangai soums); Selenge aimag (Orkhontuul soum); and 4 districts (Nalaikh, Bayanzurkh, Khan-Uul and Songinokhairkhan) within Ulaanbaatar City.

As of 2018, 1.45 million people were living within the Tuul River basin, representing 46% of Mongolia's population, and more than 60% of the country's GDP. Due to high levels of human migration into the basin, land use change within the floodplains, lack of wastewater treatment within settled areas, and gold mining in Zaamar soum of Tuv aimag and Burenkhangai soum of Bulgan aimag, the Tuul River has emerged as the most polluted river in Mongolia. These stressors, combined with a growing water demand and changes in precipitation due to global warming, have led to a scarcity of water and an interruption of river flow during the spring.

Although much research has been conducted on the water quality and quantity of the Tuul River, there is no uniform or consistent assessment on the state of the basin. Thus, this report card provides the first consolidated baseline assessment of the health of the basin inclusive of social, environmental and economic values that can be tracked over time in response to management actions and/or external pressures. Report card outputs will also contribute data and information towards meeting Mongolia's Sustainable Development Goals, and supporting implementation of the Mongolia Sustainable Development Vision – 2030.
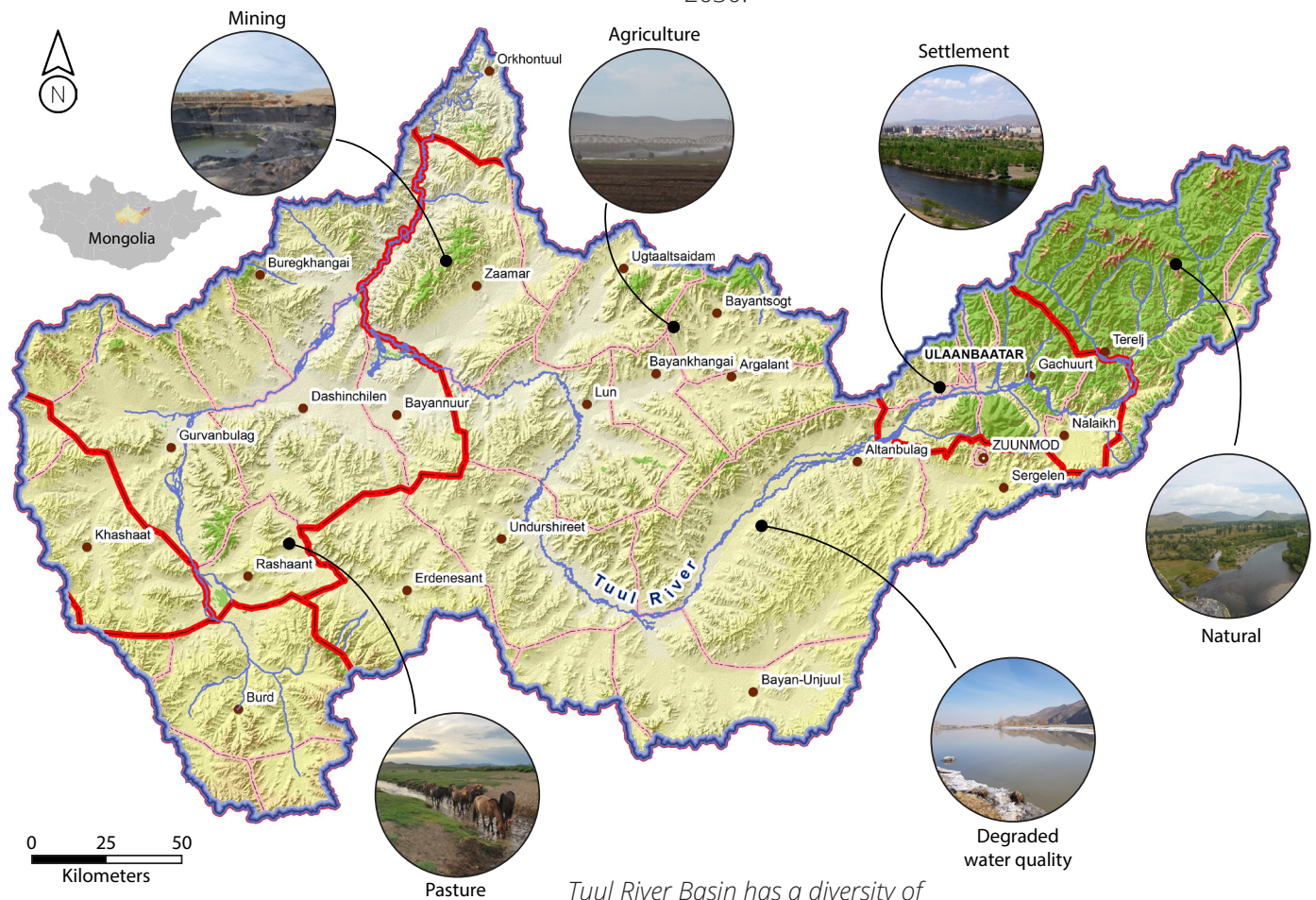


*Tuul River Basin has a diversity of land types and uses*

# WHAT IS A **BASIN REPORT CARD?**

Report cards are assessment and communication products that compare ecological, social, and/or economic information against predefined goals or objectives.

Similar to school report cards, river basin report cards provide performance-driven numeric grades or letters that reflect the status of a river basin on a regular basis. They effectively integrate and synthesize large, and often complex, information into simple scores that can be communicated to decision makers and the general public.
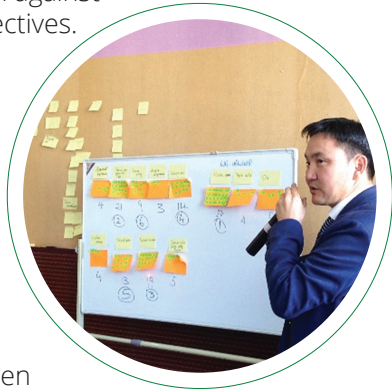
River basin report cards have been shown to be a powerful instrument to describe ecosystem status, increase public awareness, and inform and influence decision-makers to take action to improve or maintain the health of a river basin.

The process of developing report cards is highly participatory and includes the following five steps: i) identification of values and threats, ii) selection of indicators, iii) definition of thresholds, iv) calculation of scores, and v) communication of results.

The Tuul River Basin Report Card was jointly developed by the Tuul River Basin Authority, World Wildlife Fund-Mongolia Programme Office, and specialists from World Wildlife Fund-US, the University of Maryland Center for Environmental Science, with funding support from WWF-US and the Asian Development Bank.

The Tuul River Basin Report Card was created through a series of stakeholder workshops with representatives of Mongolian government agencies, academic institutions, NGO representatives, and the private sector. During the stakeholder workshops, many indicators were selected to be included in the report card. After compiling the best available data, 15 indicators were assessed by comparing each indicator with its threshold and designating a report card grade.

The Tuul River Basin was divided into 6 regions based on ecosystem condition, urbanization, socio-economic development, water use, and water pollution. The assessment was then conducted for each indicator at the region level and entire basin level.

The Tuul River Basin Report Card represents the first of its kind for the basin and can be updated and improved as needed to best represent the status of the basin.

This first report card will serve as baseline to measure change in the future in response to management actions, inform policy and planning within the basin, and assist in revising the Integrated Water Resource Management Plan of the Tuul River Basin.

# DEVELOPING THE **TUUL RIVER BASIN REPORT CARD**

Stakeholders throughout the Tuul River Basin (70 representatives from 20 organizations) identified the most important values of the basin and determined key threats to these values during a workshop held 17-19th October, 2017. The values and threats were grouped into the following categories: Water Quantity and Quality; Governance and Management; Society and Economy; Human Health; Landscapes and Eco-systems.

For each category, several indicators were determined that could be used to calculate the status of basin health. Unfortunately, data were not available for all proposed indicators.

The indicators with sufficient data were related to groundwater use, status of water bodies, spring and summer runoff, groundwater quality, surface water quality, overgrazing, non-agricultural land degradation, biotic health index, investment in water resource protection, living standard, access to safe and affordable water, access to improved sanitation facilities, air pollution, surface water monitoring, and implementation of the Integrated Water Resource Management Plan. These indicators form the basis of the Tuul River Basin Health Report Card.



*Indicators of basin health identified for the Tuul River Basin*

# INDICATORS OF TUUL RIVER BASIN HEALTH

## Water Quality & Quantity

**Groundwater use:** The amount of groundwater used in Ulaanbaatar city, 20 soums in Tuv, Bulgan, Selenge, Uvurkhangai and Arkhangai aimags was compared against the sustainable limit of groundwater exploitation.

**Status of water bodies:** Based on the hydrological inventory, the status of water bodies have been assessed by comparing the numbers of rivers, springs, lakes, marshes, and ponds that have dried out compared with baseline status.

**Spring and summer runoff:** Comparative assessment of the runoff of April, May and June against long-term average runoff during the low flow season in the Tuul, Terelj, Uliastai and Selbe rivers.

**Groundwater quality:** Concentrations of total *Escherichia coli* bacteria, ammonium, nitrates, and nitrites in well water compared to the "Standard MNS 0900:2018 – Drinking water quality and Security Assessment".

**Surface water quality:** Levels of pollutants were compared against the standards and guidelines within Standard MN4586-98, "Quality criteria of the water environment" and "Surface water cleanness degree classification".

## Society & Economy

**Investment in water resource protection:** The amount of allocated resources for water resource protection, collected from the annual water use fees, measured against the legally set benchmark of 35% .

**Living standard:** Based on comparison of the monthly average per capita earnings of the population against the poverty line.

## Health

**Access to drinking water:** Proportion of the population with access to adequate drinking water supplies, measured against the sustainable development goal.

**Access to sanitation:** Proportion of the population with access to improved sanitation facilities measured against the sustainable development goal.

**Air pollution:** Levels of sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, fine and large particles ($PM_{2.5}$, $PM_{10}$), compared against air quality standard MNS4585:2016. The assessment period is limited to October to March, which corresponds to highest levels of air pollution.

## Landscapes & Ecosystems

**Overgrazing:** Assessment of the number of livestock relative to the current pasture carrying capacity.

**Non-agricultural land degradation:** The percentage of land-use for urban settlements; exploitation of forest and water resources; geological exploration and built infrastructure such as roads, transport, communications, construction and engineering networks compared to the national average of degraded land used for non-agricultural purposes.

**Biotic Index:** The biotic index is based on the presence of aquatic indicator species such as *Ephemeroptera*, *Plecoptera* and *Trichoptera*, which are susceptible to environmental stress.

## Governance & Management

**Surface water monitoring:** The number of surface water monitoring stations relative to the number needed to effectively monitor the state of surface waters.

**Implementation of Integrated Water Resource Management Plan**: The status of implementation of the Integrated Water Resource Management Plan activities for the Tuul River Basin.

# STATUS OF THE TUUL RIVER BASIN

Overall, the Tuul River Basin scored a C (49%). Indicators varied widely in their scores with *Air pollution* scoring an F, whereas *Access to safe and affordable water supply*, and *Spring and summer runoff* scored an A. Overall the categories of Water Quality and Quantity scored best and Management and Governance scored worst.

The upper part of the river basin (Region I) displayed the best health of the 6 regions scoring a B (69%), largely due to its natural state and the protection afforded by Khan Khentii Special Protected Area. This was followed by a score of C in Regions III (49%), V (45%), and VI (46%); a C- (45%) around Ulaanbaatar City (Region II); and the worst score of a D+ (39%) for Region IV that includes the mining areas around Zaamar and Buregkhangai soums.
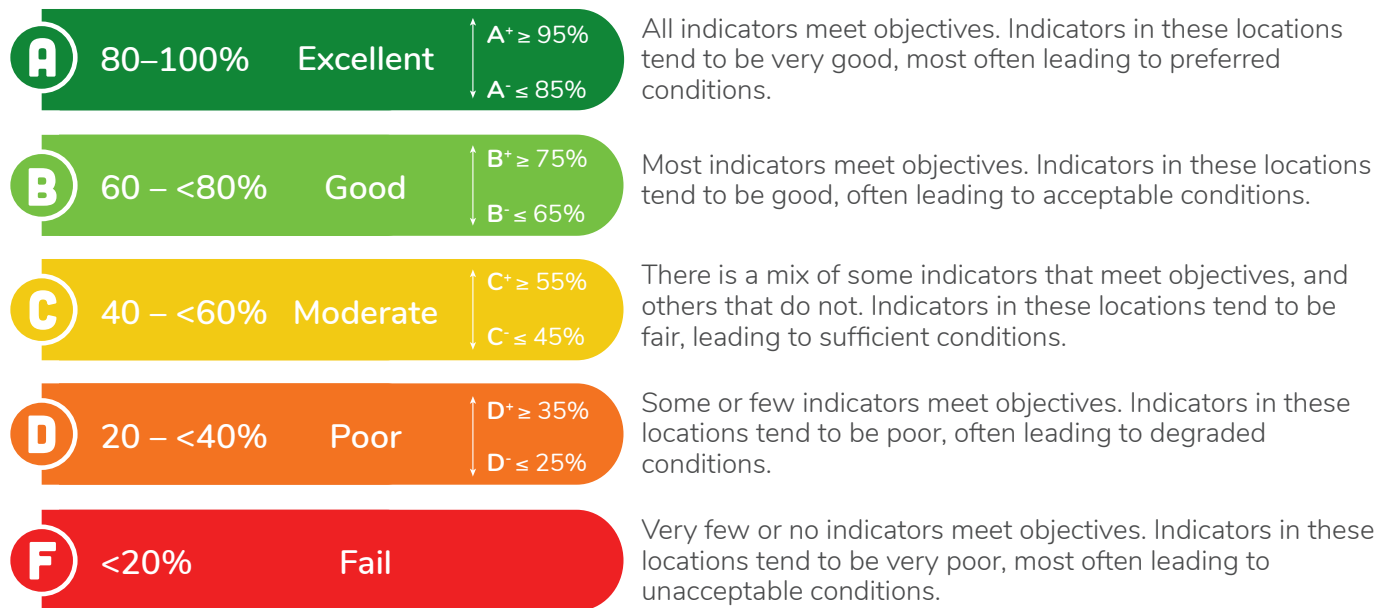
Factors affecting the health of the river basin include growing human population density, urbanization, mining, crop production, and increasing number of livestock, contributing to degradation of ecosystem status and water quality and quantity, as the assessment results show.

The surface water quality in regions II, III and IV scored low, due to the lack of a central waste water treatment facility and gold mining activities in Zaamar soum of Tuv aimag and Buregkhangai soum of Bulgan aimag.

Despite significantly higher revenue from water use fees in region IV, where gold mining activities are taking place, the amount of funds spent on water resource protection and restoration was very low, and the score of an F associated with *Non-agricultural degraded land* reflects the need for land rehabilitation and restoration. Social aspects related to *Access to safe and affordable water*, and *Access to sanitation facilities* also failed to meet desired thresholds and received an F grade, influencing the overall assessment of region IV.

Overall, water quality improves as the Tuul River reaches regions V and VI, however there is a lack of monitoring information on run-off, air quality and biotic indicators. Overgrazing and degradation of non-farming lands as well as lack of access to water and sanitation keep the overall grades of regions V and VI at a C (41%).
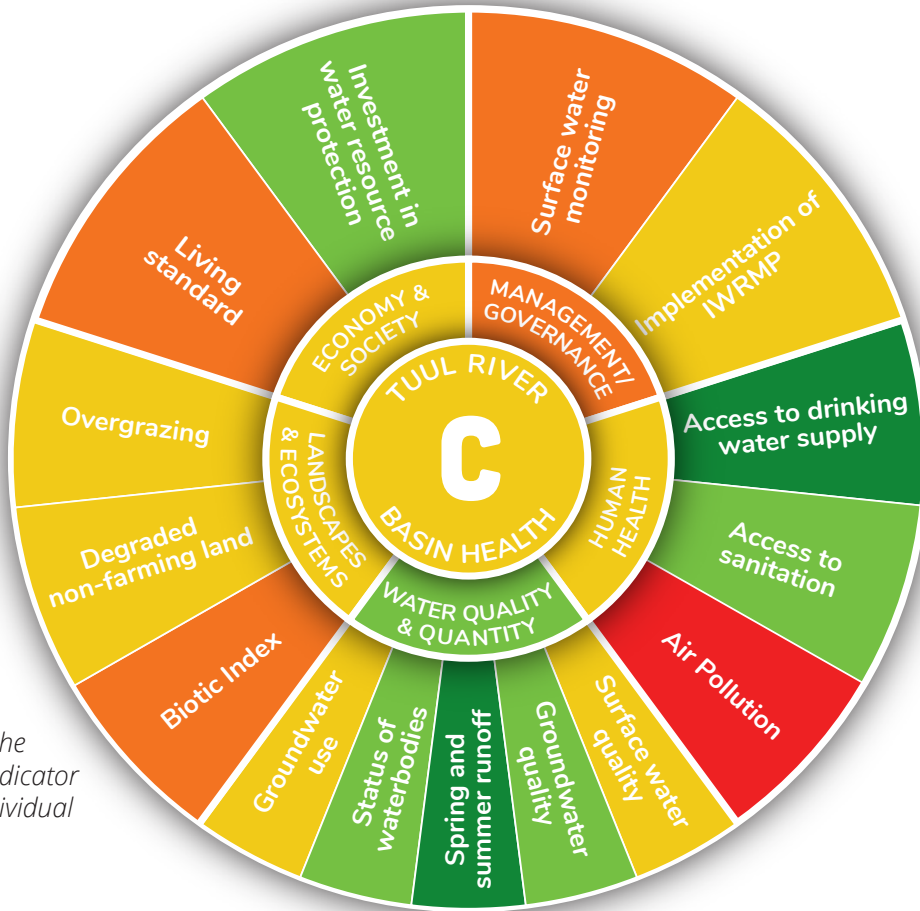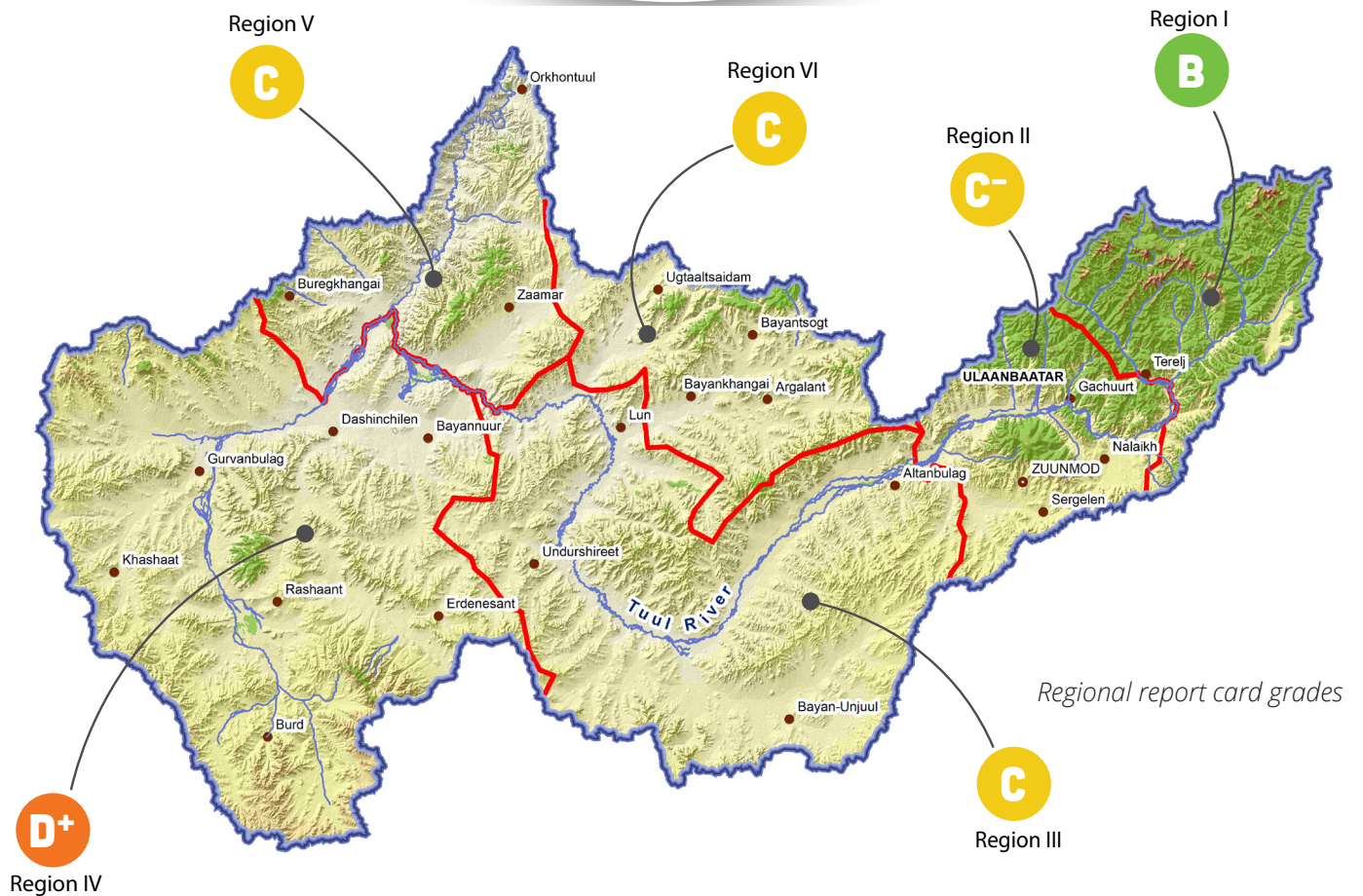
## What do the grades mean?

**A** 80–100% Excellent
A⁺ ≥ 95%
A⁻ ≤ 85%

All indicators meet objectives. Indicators in these locations tend to be very good, most often leading to preferred conditions.

**B** 60 – <80% Good
B⁺ ≥ 75%
B⁻ ≤ 65%

Most indicators meet objectives. Indicators in these locations tend to be good, often leading to acceptable conditions.

**C** 40 – <60% Moderate
C⁺ ≥ 55%
C⁻ ≤ 45%

There is a mix of some indicators that meet objectives, and others that do not. Indicators in these locations tend to be fair, leading to sufficient conditions.

**D** 20 – <40% Poor
D⁺ ≥ 35%
D⁻ ≤ 25%

Some or few indicators meet objectives. Indicators in these locations tend to be poor, often leading to degraded conditions.

**F** <20% Fail

Very few or no indicators meet objectives. Indicators in these locations tend to be very poor, most often leading to unacceptable conditions.

Score based solely on regions with available data.

# MODERATE HEALTH, BUT ACTION NEEDED NOW!



Wheel diagram showing overall results for the Tuul River Basin. Center: **TUUL RIVER BASIN HEALTH — C**.

Inner ring categories: ECONOMY & SOCIETY, MANAGEMENT/GOVERNANCE, HUMAN HEALTH, WATER QUALITY & QUANTITY, LANDSCAPES & ECOSYSTEMS.

Outer ring indicators: Investment in water resource protection, Surface water monitoring, Implementation of IWRMP, Access to drinking water supply, Access to sanitation, Air Pollution, Surface water quality, Groundwater quality, Spring and summer runoff, Status of waterbodies, Groundwater use, Biotic Index, Degraded non-farming land, Overgrazing, Living standard.

*Overall results for the Tuul River Basin, indicator categories, and individual categories.*



Map of the Tuul River Basin with regional report card grades:

- Region V — C
- Region VI — C
- Region I — B
- Region II — C⁻
- Region IV — D⁺
- Region III — C

*Regional report card grades*

# REGIONAL RESULTS

## Region I

Region I contains the headwaters of the Tuul River, Khan Khentii Protected Area, 51% of Erdene soum of Tuv aimag, and 13% of Bayandelger soum, covering a total area of 4,423 km² (9% of the total basin area) and 152 km of the length of the Tuul River from its source to where the tributary, Terelj River, joins it.
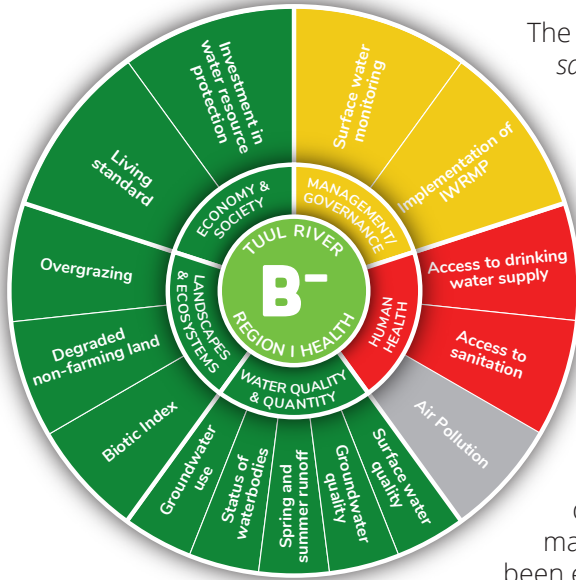


The scores for *Access to safe and affordable water* and *Access to sanitation facilitie*s were very low, however this region does have a relatively small human population. The land is not overgrazed, and there is little infrastructure, industry and services besides tourism. Indicators for Economy and Society, Landscapes and Ecosystems, and Water Quality and Quantity, were evaluated as "excellent". However, there is a need for greater surface water monitoring stations and greater implementation of the IWRMP, as both Management & Governance indicators were evaluated as "moderate".

Due to lack of an air quality monitoring station in this region, it was not possible to evaluate *Air pollution*.

Given the excellent condition of much of the region, and despite several low scores related to human health and management and governance, the overall status of Region I has been evaluated as "good" or B-.

## Region II

Region II covers a total of 4,246 km² (9% of the total river basin) including Zuunmod and Sergelen soums of Tuv aimag, as well as the most heavily populated region with the Tuul River basin - Ulaanbaatar City. This 93 km section of the Tuul River flows from the from the confluence of Tuul-Terelj down to Altanbulag soum.
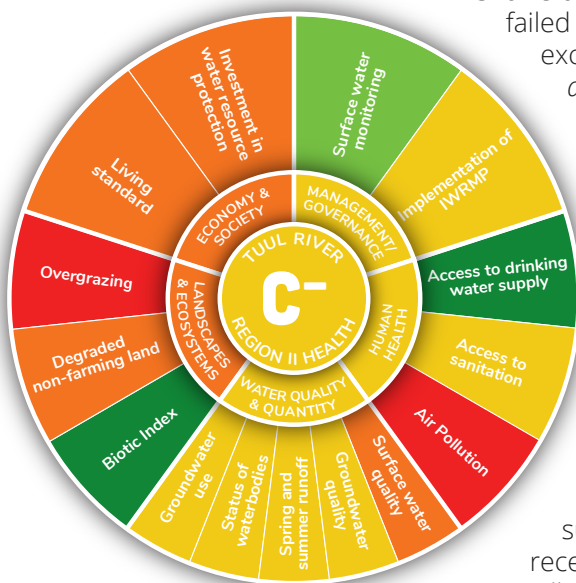


As for Ulaanbaatar, the most pressing issues are *Air pollution* which failed to meet minimum threshold conditions, and *Overgrazing* that exceeded carrying capacity by 5.7 times. *Surface water quality*, *Non-agriculture land degradation*, *Living standard*, *Investment in water resource restoration* were all scored as "Poor".

Region II also uses the most groundwater of the all the regions in the basin due to extraction for Ulaanbaatar City, reaching 44.7% of the total exploitable resources, and receiving a "moderate" grade.

*Groundwater quality*, *Spring and summer runoff*, *Status of water bodies*, *Access of the sanitation facilities*, and *Implementation of the IWRMP* received a "moderate" score, whereas *Surface water monitoring* received a "good" score.

As Ulaanbaatar and Zuunmod has access to a central water supply network, the indicator *Access to safe and affordable water* received a "excellent score". The *Biotic Health Index* also scored as "excellent" in Region II.

The overall status of Region II has been evaluated as "moderate" or C-.

## Region III

Region III contains the area of Altanbulag, Bayan-Unjuul, Undurshireet and Lun soums of Tuv aimag, located downstream of the capital city Ulaanbaatar, covering a total area of 15,658 km² (31.5% of the total river basin) and 283 km of the Tuul River.
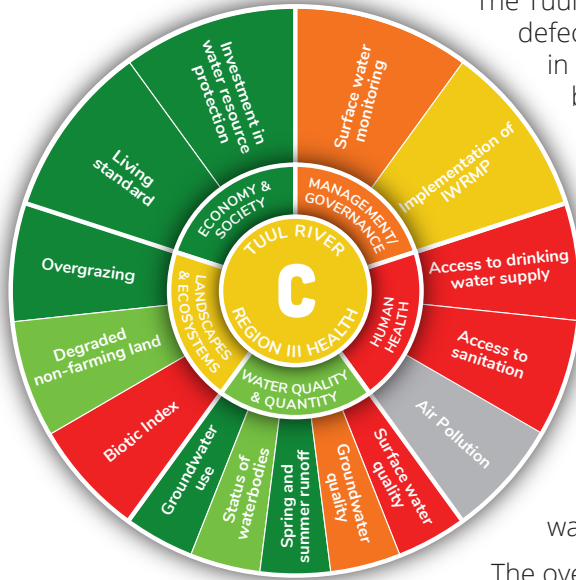


The Tuul River is most polluted in this region due to an aging and defective wastewater treatment plant located immediately upstream in Ulaanbaatar. S*urface water quality* and the *Biotic Health Index* both failed to meet minimum threshold conditions. Additionally, *Access to safe and affordable water* and *Access to sanitation facilities,* also failed to meet minimum threshold conditions.

*Groundwater quality*, likely for similar reasons as *Surface water quality*, was also rated "poor". There are very few monitoring stations and thus *Surface water monitoring* was also evaluated as "poor", whereas implementation of the IWRMP was rated as "moderate'.

*Status of water bodies* and *Non-agricultural degraded land* were evaluated as "good", with remaining indicators evaluated as in "excellent" condition.

Due to lack of an air quality monitoring station in this region, it was not possible to evaluate *Air pollution*.

The overall status of Region III has been evaluated as "moderate" or C.

## Region IV

Region IV contains the area of Zaamar soum of Tuv aimag, Buregkhangai soum of Bulgan aimag, Orkhontuul soum of Selenge aimag, covering a total area of 5,646 km² (11.3% of the total basin area) and 189 km of the Tuul River. This region features intensive mining activities.

As of 2018, 35 companies were licensed to mine gold within the Tuul River Protection Zone, which has resulted in river diversions and significant damage to soil, plant and pasture in this region, and pollution to the Tuul River.



*Degraded non-farming land*, *Investments in water resource protection*, *Access to safe and affordable water*, and *Access to sanitation facilities* failed to meet minimum threshold conditions.

Indicators for *Surface water quality*, *Access of surface water monitoring*, and *Implementation of the IWRMP* were evaluated as "poor", and the Biotic health Index evaluated as "moderate".

However, the indicators for *Groundwater quality*, *Status of water bodies* and *Overgrazing* were evaluated as in "good" condition; while the remaining indicators were assessed as "very good".

Due to lack of an air quality monitoring station in this region, it was not possible to evaluate *Air pollution*.

The overall status of Region IV has been evaluated as "poor" or D+.

## Region V

Region V encompasses 29.6% of the Tuul River basin (14,709 km$^2$) including the Erdenesant soum of Tuv aimag, Burd soum of Uvurkhangai aimag, Rashaant, Dashinchilen, Gurvanbulag soums of Arkhangai aimag. The population is relatively small in region V, with low levels of infrastructure and an economy dominated by pastoral livestock husbandry.
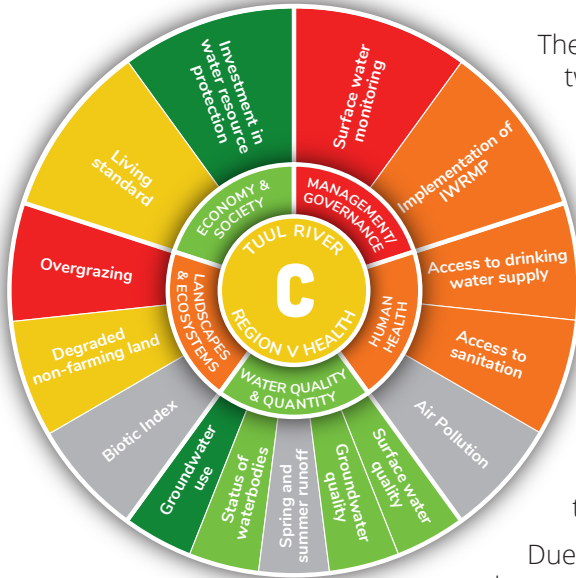


The number of livestock exceeded pasture carrying capacity twofold, thus, *Overgrazing* is an issue in this region and that indicator failed to meet minimum threshold conditions. There is also insufficient *Surface water monitoring* stations, which also resulted in a score that failed to meet minimum threshold conditions. *Implementation of the IWRMP* has been slower than anticipated and thus was rated as "poor". There is a lack adequate *Access to safe and affordable water* and *Access to sanitation facilities* such that these indicators also received a "poor" score.
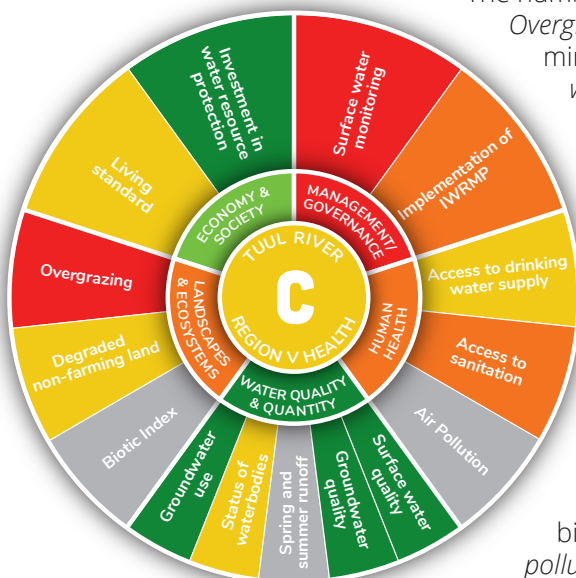
In contrast, the indicators measuring *Surface water quality* and *Groundwater quality* as well as *Status of water bodies* are assessed as "good". *Groundwater use* and *Investments in water resource protection* indicators were rated as "excellent" , while the remaining indicators are rated "moderate".

Due to lack of an air quality monitoring station in this region, biotic data, and stream gauges it was not possible to evaluate *Air pollution* or *Biotic Health Index or Spring and summer runoff*.

The overall status of Region V has been evaluated as "moderate" or C.

## Region VI

Region VI covers 5,092 km$^2$ (10.2% of total basin area) including Argalant, Bayankhangai, Bayantsogt and Ugtaaltsaidam soums of Tuv aimag. The population is relatively small in region V, with low levels of infrastructure and an economy dominated by pastoral livestock husbandry.



The number of livestock exceeded pasture carrying capacity 1.2x, thus, *Overgrazing* is an issue in this region and that indicator failed to meet minimum threshold conditions. There is also insufficient *Surface water monitoring* stations, which also resulted in a score that failed to meet minimum threshold conditions. *Implementation of the IWRMP* has been slower than anticipated and thus was rated as "poor". There is a lack adequate *Access to safe and affordable water* and *Access to sanitation facilities* such that these indicators also received a "moderate" and "poor" score, respectively.

In contrast, the indicators measuring *Surface water quality* and *Groundwater quality* as well as *Status of water bodies* are assessed as "excellent". *Groundwater use* and *Investments in water resource protection* indicators were rated as "excellent" .

Due to lack of an air quality monitoring station in this region, biotic data, and stream gauges it was not possible to evaluate *Air pollution* or *Biotic Health Index or Spring and summer runoff*.

The overall status of Region VI has been evaluated as "moderate" or C.

# REPORT CARD SCORES AND ASSIGNED GRADES

| Category | No. | Indicator name | Region | | | | | | Indicator score | Indicator grade | Category score | Category grade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | I | II | III | IV | V | VI | | | | |
| Water Quality & Quantity | 1 | Groundwater use | 90 | 55 | 93 | 90 | 88 | 91 | 57 | C+ | 64 | B- |
| | 2 | Status of water bodies | 100 | 51 | 67 | 77 | 66 | 58 | 68 | B | | |
| | 3 | Spring and summer runoff | 100 | 40 | 100 | No data | | | 80 | A- | | |
| | 4 | Groundwater quality | 100 | 53 | 38 | 72 | 77 | 93 | 66 | B | | |
| | 5 | Surface water quality | 100 | 36 | 12 | 38 | 75 | 85 | 51 | C | | |
| Human Health | 6 | Access to drinking water supply | 0 | 83 | 1 | 9 | 37 | 41 | 89 | A | 59 | C+ |
| | 7 | Access to sanitation | 0 | 45 | 3 | 13 | 20 | 26 | 73 | B | | |
| | 8 | Air pollution | No data | 17 | No data | | | | 17 | F | | |
| Governance & Management | 9 | Surface water monitoring | 50 | 73 | 29 | 33 | 0 | 0 | 26 | D | 34 | D |
| | 10 | Implementation of IWRMP | 56 | 41 | 40 | 35 | 38 | 36 | 41 | C- | | |
| Society & Economy | 11 | Investment in water resource protection | 100 | 34 | 100 | 1 | 100 | 100 | 72 | B | 51 | C |
| | 12 | Living standard | 100 | 28 | 100 | 81 | 55 | 50 | 29 | D | | |
| Landscapes & Ecosystems | 13 | Overgrazing | 100 | 0 | 82 | 75 | 0 | 0 | 46 | C | 40 | C- |
| | 14 | Non-agricultural degraded land | 98 | 34 | 63 | 0 | 49 | 41 | 54 | C | | |
| | 15 | Biotic Health Index | 90 | 83 | 0 | 54 | No data | | 21 | D- | | |
| Regional score | | | 69 | 45 | 49 | 39 | 45 | 46 | | | | |
| Regional grade | | | B | C- | C | D+ | C | C | | | | |
| Overall Tuul River Score | | | 49 | | | | | | | | | |
| Overall Tuul River Grade | | | C | | | | | | | | | |

# CONCLUSIONS

Following a methodology and approach that has been used in several other basins around the world, the Tuul River Basin Report Card has been developed for the first time to assess the current status of the basin and to develop recommendations for improving its health; as well as supporting implementation of the Mongolia Sustainable Development Vision-2030 and Integrated Water Resource Management Plan (IWRMP) of the Tuul River Basin.

Indicators were selected based on the most important issues within the Tuul River Basin and harmonized with the SDG targets as well as indicators from the IWRMP of the Tuul River Basin. The data and results provide a baseline for measuring basin health into the future as well as the effects of any measures taken to improve or maintain basin Health. Hence, the Tuul river Basin Report Card has relevance to policy actions at local, regional and national levels.

The Tuul River Basin has been evaluated in this assessment as "moderate" health or 'C'. The results indicate parts of the basin are in relatively good health, particularly Region I. Certain indicators also perform well across many regions including *Groundwater use* (except in Region II), S*tatus of water bodies* in Region I, III, IV and V, and *Investment in water resource protection* (except in Region II and IV)

The results indicate urgent management interventions are required to address the following findings:

· Excessive groundwater extraction in Region II
· Degraded surface and groundwater quality in Regions II, III, and IV
· Hazardous winter air quality in Region II, and a lack of monitoring stations in all other regions
· Poor access to clean and affordable water and sanitation facilities in most regions
· Less than adequate surface water monitoring stations in Regions III, IV, V, and VI
· Grazing beyond carrying capacity in Regions II, V and VI
· Poor living standards in Region II
· Moderate to poor implementation of the IWRMP across all regions
· Degraded health of macroinvertebrates in Region III and IV, and insufficient data for in Regions V and VI

A detailed report documenting the methods and the results for each of the 15 indicators has been developed separately. It covers the five categories of indicators: Water Quantity and Quality; Human Health; Governance and Management; Society and Economy; and Landscape and Ecosystems. This methodology report describes the purpose and justification of each indicator; source of the data used, score calculation methods, thresholds, results, and recommendations.



*Tuul river watershed faced multiple stresses such as over-concentration, urbanization, water and air pollution, mining and pasture degradation. Photo: Simon Costanzo*

# RECOMMENDATIONS

Recommendations to improve the current health of the Tuul River are:

1.  Reduce dependence on groundwater supplies through wastewater recycling at the central wastewater treatment plant of Ulaanbaatar City.

2.  Make a plan for a sustainable water supply for Ulaanbaatar City, ensuring sustainable abstraction of surface and groundwater resources, and maintenance of dry season flows in the river near Ulaanbaatar City.

3.  Improve monitoring, reporting, and data management of surface and groundwater quality and quantity in order to ensure future sustainability of water resources.

4.  Improve enforcement of regulations prohibiting mining and development activities in protected zones adjacent to the Tuul River and other water bodies (as specified in the Water Law).

5.  Incentivize upgrades in water treatment and increased water efficiency of industries (e.g. leather manufacturers) to reduce soil and water pollution and over-abstraction.

6.  Encourage sustainable population growth outside of Ulaanbaatar City, through improved access to drinking water and sanitation (e.g. bio-latrines) in other soum centers, settlements and rural settlements.

7.  Reduce air pollution in Ulaanbaatar City through government subsidies and incentives for alternate energy sources for household consumption, particularly in the Ger district.

8.  Increase spending on water resource protection and restoration to the level of 35% of the water utilization fee, as designated in the Water Law.

9.  Expand aquatic biological monitoring (Region V and VI), air quality monitoring (install air quality stations in regions I, III, IV, V and VI) and expand water quality and quantity assessments of surface waters in Region II.

10. Limit the number of livestock to within rangeland carrying capacity and promote intensive farming in remote areas with high productivity and quality.

11. Encourage participation of different government agencies and stakeholders in the implementation of, and future revisions of the Integrated Water Resources Management Plan of the Tuul River Basin.

# ACKNOWLEDGEMENTS

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