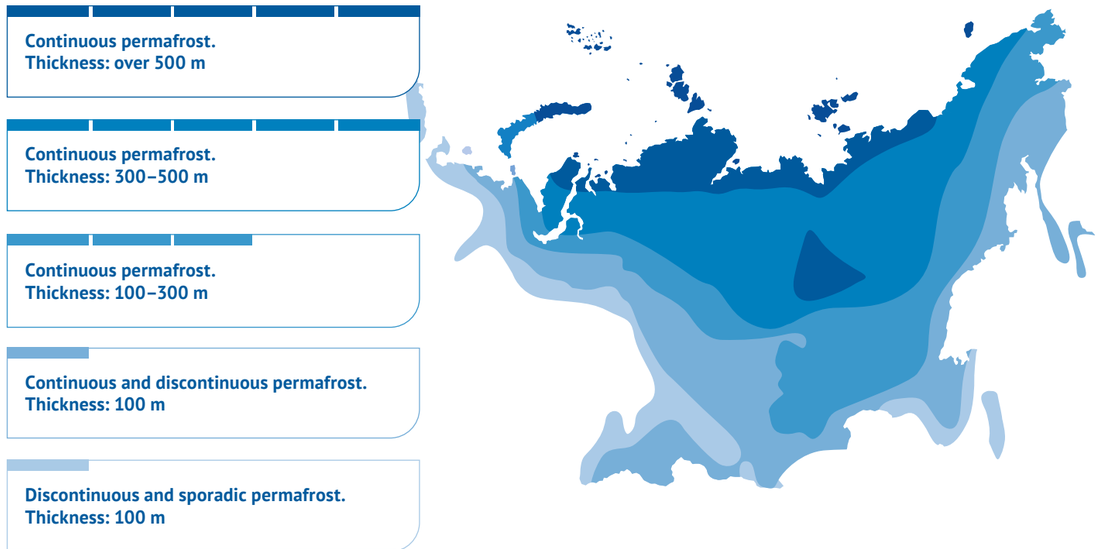
Nornickel's climate change adaptation efforts

IFRS S2 25a (v)

Permafrost monitoring

Permafrost soils in Russia cover about 11 million sq km – nearly 65% of the country's territory. These frozen layers can be hundreds of thousands of years old.

Permafrost map

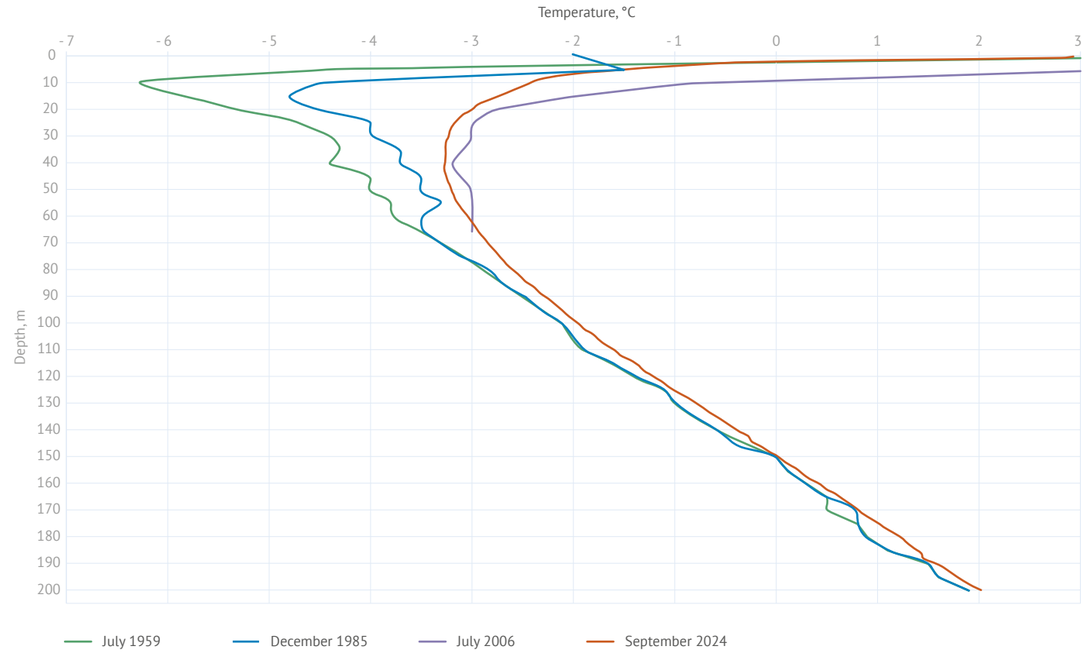


The Norilsk production site is located in the permafrost zone. Permafrost conditions in the Norilsk Industrial District are highly heterogeneous: the thickness of permafrost ranges from 5 m to over 500 m, while the average annual ground temperature varies from –7 °C to +2 °C.

Rising air temperatures result in permafrost warming, which may compromise the stability of the Company's infrastructure.

[1] Source: National Archives Catalogue, adapted map

Changes in ground temperature in central Norilsk (1959–2024)



Over the past 65 years (since 1959), ground temperature at a depth of 10 m has increased by 4.3 °C. Significant temperature fluctuations have been recorded down to a depth of 90 m, while at greater depths (up to 200 m), the average temperature change has reached 0.3 °C. To support ongoing monitoring of these processes and manage the risks associated with permafrost thawing, Nornickel is deploying a monitoring system comprising the following two interconnected components.

Geotechnical monitoring system – its main purpose is to monitor the technical condition of foundations and load-bearing structures of buildings and structures and promptly identify any operational risks. The Company has been implementing this system in-house since 2020.

Background permafrost monitoring system – this component focuses mostly on applying scientific methods to assess the state of permafrost and forecast its condition over the longer term in the natural landscapes of the Norilsk Industrial District, beyond the urban area. The system has been deployed in partnership with Fedorovsky Polar State University since 2023.

All information is stored and processed in a unified information and diagnostic system (IDS) deployed at the Company's Norilsk site, enabling the use of these data to support management decision making.

Permafrost monitoring system

IFRS S2 25a (v)

Geotechnical monitoring system

Objectives:
- ensuring the safe operation of buildings and structures (BS)
- assessment of BC current and forecasted technical condition

Geotechnical monitoring across BS

- Borehole temperature monitoring of BS
- Instrumental measurements:
  - Geodetic
  - Geothermal
  - Hydrogeological
- Visual inspections
- Groundwater level monitoring in wells
- Maintaining a digital archive of design, survey, and expert review documents
- Monitoring of ambient air temperature and other climatic parameters
- Monitoring of humidity and temperature in crawl spaces
- Monitoring changes in BS geometry

Engineering and geological surveys

Comprehensive inspections

Development and refinement of GTM programmes

Instrumental surveys

Monitoring results analysis

Risk-based approach to asset operation

Background permafrost monitoring system

Objectives:
- specification of permafrost degradation forecasts
- assessment of permafrost degradation impact on the Company's facilities outside the urban area

Background permafrost monitoring

- Determination of atmospheric meteorological parameters
- Snow cover characterisation
- Assessment of thermal insulation provided by vegetation
- Geocryological studies of permafrost soils

Study of geocryological processes

Laboratory tests

Thermometric measurements

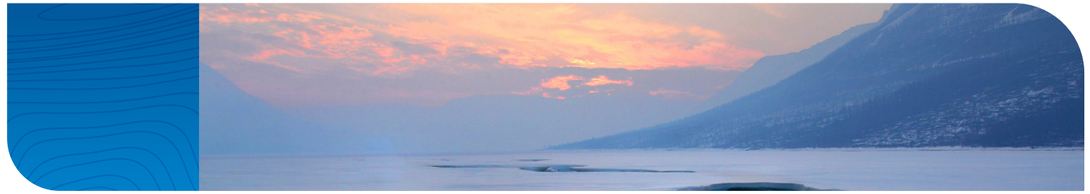
Geophysical surveys

Monitoring results analysis

Projections of climate impact on permafrost

Monitoring system's IT core: Polar Division's information and diagnostic system

Core · Analytics · Storage · Reporting



Geotechnical monitoring system

IFRS S2 14c, IFRS S2 25a (v)

The system monitors the condition of foundations and load-bearing structures of the Company's core production and infrastructure facilities.

It has been deployed in five phases.
1. A network of observation thermometric wells was restored, and engineering and geological surveys were conducted.
2. Inspections of foundations of buildings and structures were carried out.
3. Some buildings and structures were equipped with automated measurement systems.
4. The results of these measurements were integrated into the information and diagnostic system.
5. Geotechnical monitoring data were incorporated into the processes for planning and carrying out repairs.

The information and diagnostic system is used at 17 of the Company's enterprises. Around 1 thousand facilities are connected to it, with automated monitoring in place at 222 of them; data for the remaining facilities are entered manually. The total budget for the project is approximately RUB 3 billion.

The Building and Structure Monitoring System project has been repeatedly recognised by the expert community as a breakthrough solution that leverages advanced technologies and has the potential to be scaled across the entire Russian Arctic.

Project awards:

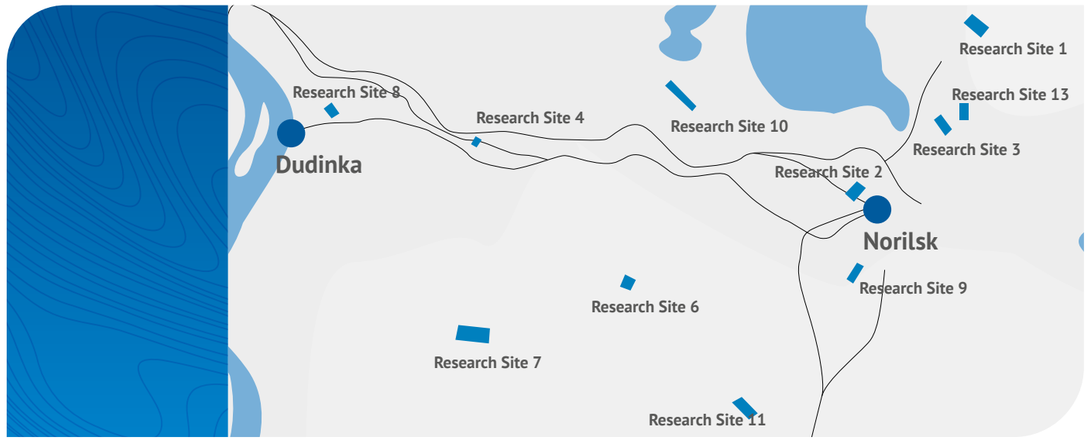
- ComNews Awards 2022, in the Best Digital Solution in Industrial Safety category
- Global CIO's Project of the Year award, in the Best IT Project in the Urals, Siberian, and Far Eastern Federal Districts category
- Silver award, MINEX 2022, in the Technical Innovation for the Metals and Mining Sector category
- 10th International Professional Competition held by the National Association of Members Performing Engineering Surveys and Design Documentation for the Best Project 2023, in the Best Project in Engineering Surveys, Including Methodological and Technical Works (Implemented) category
- 2nd National Award in Information Technology Priority: Digital 2024, in the Digital Transformation category
- Included in the Best Practices Register, BRICS Solutions Awards 2024

Background permafrost monitoring system

IFRS S2 25a (v)

Background permafrost monitoring enables the assessment of permafrost degradation trends in natural landscapes outside urban areas.

The system has been deployed in five phases.
1. An approach to background monitoring was developed, and representative locations were selected for permafrost research sites.
2. Laboratory analyses of soils from the permafrost research sites were conducted.
3. The research sites were equipped with measuring instruments.
4. Systems were put in place to collect and store measurement data.
5. Soil models for the research sites were created, and projected changes in temperature patterns were calculated through 2100.

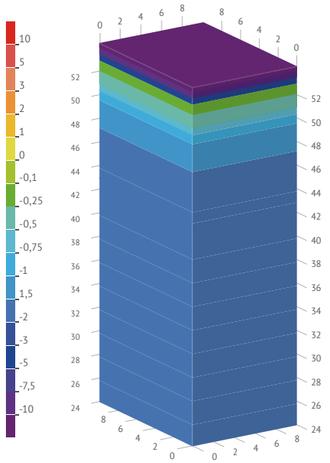


The approach to background monitoring was developed in collaboration with Fedorovsky Polar State University. Nornickel carried out engineering and geological surveys at the permafrost research sites, drilling 20 monitoring wells 10–20 m deep and three additional wells to a depth of 200 m.

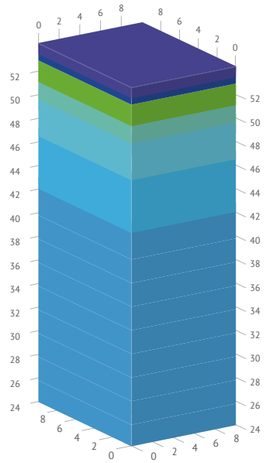
As a result, a landscape map of the Norilsk Industrial District was produced, with the characteristics, composition, and properties of the soils and vegetation identified – forming the basis for mathematical modelling. Modelling of changes in the mean annual ground temperature at a 10 m depth was based on regional climate projections under the SSP5-8.5 scenario, previously developed by the Obukhov Institute of Atmospheric Physics of the Russian Academy of Sciences.

Initial results indicate that by 2050, ground temperatures are projected to rise across the entire Norilsk Industrial District. For instance, zones with low temperatures (from –3 °C to –4 °C) at 10 m depth – covering up to 18% of the area in 2024 – are expected to vanish completely. The proportion of intermittently frozen ground with temperatures ranging from +1 °C to –0.5 °C is projected to grow from 20% to 33% of total area by 2050, with sustained thawing expected in 20% of those areas.

Example of modelling results:



Soil temperature at one of the research sites in 2024



The projected temperature in 2050

Maps of average annual soil temperature for 2024 and 2050 were used as part of the programme activities of the Yenisei Siberia scientific and educational centre under the TP-21 initiative Launch of the Yenisei Arctic Geographic Information System (GIS).

Project awards:

- National Environmental Prize named after V.I. Vernadsky, in the Science for Sustainable Development category
- Second place, International Professional Competition held by the National Association of Members Performing Engineering Surveys and Design Documentation for the Best Project, in the Best Project in Engineering Surveys, Including Methodological and Technical Works (Implemented) category
- Winner, GenerationS Innovation Award (Federal Prize for Corporate Innovation), in the Cooperation of Science and Business category
- Winner, Green Eurasia international competition, in the Monitoring and Forecasting Climate Change category
- Included in the Best Practices Register, BRICS Solutions Awards 2024

Assessment of facility vulnerability to climate impacts

In 2024, Nornickel launched the development of a methodology for assessing the vulnerability of its facilities to climate-related impacts. The assessment is driven by objective data already available within the Company, including:

- design documents
- industrial safety reviews
- results of surveys and inspections
- monitoring results
- statistics on incidents and accidents.

The methodology was tested at the Energy Division's facilities, as they are the most exposed to climate impacts in the Norilsk Industrial District. Checklists with assessment criteria on a low/medium/high vulnerability scale were developed for each type of assessed facility.

Within the Energy Division, 105 facilities were identified for assessment, of which 45 have already been assessed. Based on the results, 36 out of the 45 assessed facilities were found to be vulnerable to various climate factors to some degree. In 2025, the Company plans to complete the testing of this methodology across all its facilities.

Internal carbon price

IFRS S2 14b, IFRS S2 29f

In 2024, Nornickel continued to implement an internal carbon price. This tool is used to estimate the potential tax burden from future carbon regulation within the financial and economic models of individual projects and the Company's overall budgeting model.

The Company analysed the practices of international metals and mining companies and selected the shadow pricing approach, which involves calculating theoretical costs or expenses to be considered in investment decision making. Several carbon price forecasts are applied depending on the expected level of carbon-related payments under various economic and climate scenarios. For 2024, the base price was set at USD 49 per tonne of CO_2 equivalent.

During the year, 60 of the Company's investment projects were evaluated using this internal carbon price. Assessment results indicate that, even at its highest level, the internal carbon price does not reduce the NPV or IRR of commercial projects below predetermined thresholds.