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Itä-Lapin kuntayhtymä – The Local Federation of East Lapland

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STUDY OF KONTIOMÄKI-KEMIJÄRVI RAILWAY

NORTHERN AXIS – BARENTS LINK (NABL) KOLARCTIC CBC PROJECT KO4159

23.5.2021, final version

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STUDY OF KONTIOMÄKI- KEMIJÄRVI RAILWAY

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Project	**Northern Axis – Barents Link (NABL) Kolarctic CBC project KO4159**
Recipient	**Itä-Lapin kuntayhtymä – The Local Federation of East Lapland**
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CONTENT

1. INTRODUCTION

This project is a part of the Northern Axis – Barents Link (NABL) project, which aims to enhance transport possibilities in regional and between border areas. NABL is managed by the Regional Council of Kainuu. There are ten partners in the project from Finland, Sweden, Norway and Russia. NABL is funded by the partners and Kolarctic CBC programme.

1.1 Background

The Local Federation of East Lapland (Itä-Lapin kuntayhtymä) is leading two tasks in NABL. One of the tasks is to study the impacts of a new railway connection between Kontiomäki-Taivalkoski-Kemijärvi. The other task is to study commercial helicopter traffic between North Finland and Northwest Russia since growing demand has been identified for a new flight path on this route. This study concentrates on the new railway connection.

1.2 Project execution

The study was conducted by Traficon Oy, Ramboll Finland and OOO AvtoDoroshniiConsulting (ADC ltd) on the assignment of the Local Federation of East Lapland. The project manager was engineer Juha Hyvärinen from Traficon Oy. Ramboll's consultants were engineer Hannele Vartia, M.Sc Jyrki Rinta-Piirto, M.Eng Juha Riihiranta and M.Sc Atte Riihelä. ADC's consultant was Elena Svatkova.

1.3 Overview of the methodology

The study was conducted in the following sequence:

- analysing the information available for the current parts of the railway (Kontiomäki – Taivalkoski and Kemijärvi – Salla) and for the new railway alternatives between Taivalkoski and Kemijärvi
- producing three main railway alternatives at the regional planning (general) level
- making a preliminary assessment of the new railway alternatives
- introducing alternatives to the decision-making organ of the client
- producing technical plans of the railway alternatives between Taivalkoski and Kemijärvi
- making costs estimates for the whole railway connection including several alternatives and their combinations with two continuing railway plans, Kemijärvi – Kirkenes and Salla – Kantalahti
- assessing (modelling) passenger demand for the whole railway connection for several alternatives and their combination with two continuing railway plans, Kemijärvi – Kirkenes and Salla – Kantalahti.

Several organisations were contacted during the study, e.g. Finnish Transport Infrastructure Agency, Regional Councils of Kainuu and Lapland and Finnish Reindeer association (Paliskuntain yhdistys).

1.4 Objectives of the study

The objectives of the study were:

- to propose several alternatives to the Kontiomäki – Kemijärvi railway connection
- to assess the preliminary cost and passenger demand of the alternatives
- to preliminarily assess the Kontiomäki – Kemijärvi railway connection's impacts on two other Northern railway initiatives: Kemijärvi – Salla – Kantalahti and Kemijärvi – Kirkenes.

2. STATE OF THE CURRENT RAILWAYS AND IMPROVEMENT PLANS

2.1 Current railway between Kontiomäki and Taivalkoski (157 km)

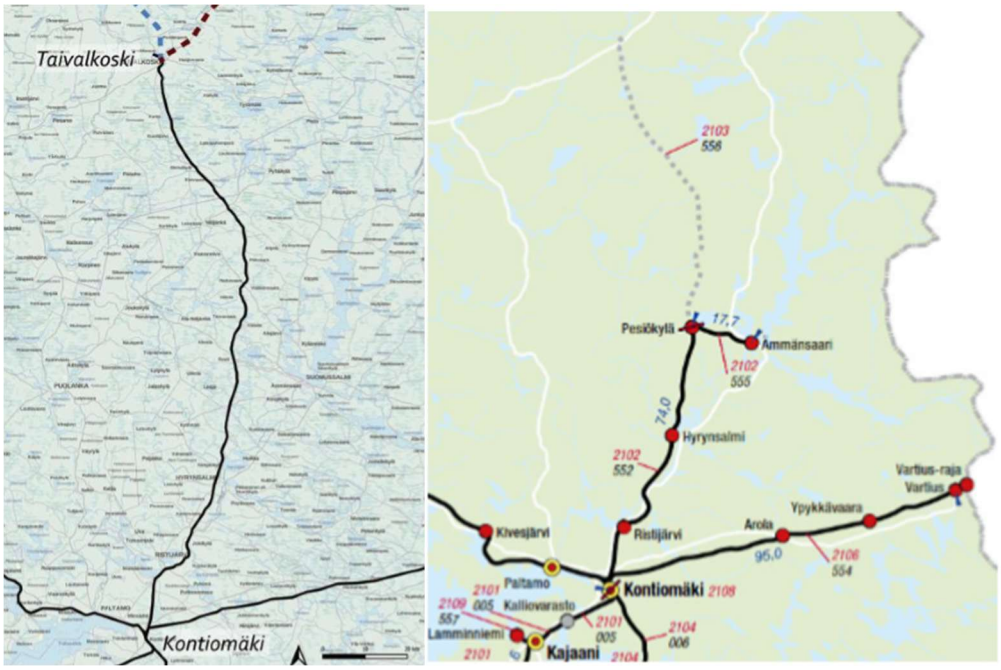

Figure 1. Current railway Kontiomäki – Pesiökylä – Ämmänsaari and closed railway section Pesiökylä-Taivalkoski. Image source: Finnish Transport Infrastructure Agency publication 26/2019.

The Finnish Transport Infrastructure Agency evaluated the Kontiomäki – Taivalkoski railway (Publication 26/2019). Based on that, in 2020 the Finnish government reserved 81 M€ for the rehabilitation of the Kontiomäki and Pesiökylä railway. In the rehabilitation works, railway support structures will be renewed, safety equipment installed and crossings with roads arranged. Additionally, Pesiökylä will receive a new timber loading terminal. It is anticipated that after these works, the current Ämmänsaari timber loading terminal and the Pesiökylä – Ämmänsaari railway section will be closed. Rehabilitation works are anticipated to start between 2020–2022.

The following information is mostly based on information from Väylä 26/2019 – publication (Väylä, 2019).

The basic costs for rehabilitation of the whole Kontiomäki – Taivalkoski railway section would be 135 M€. The two new timber terminals (Pesiökylä and Taivalkoski) would add 6 M€ and the main road (no. 8950) improvements 8 M€. Electrification of the railway line would cost additional 54 M€ (Finnish earth works index MAKU 130, when 2010=100).

2.1.1 Current railway between Kontiomäki and Pesiökylä (75 km)

This 75 km freight non-electrified railway section (with continuation to Ämmänsaari 18 km) is in use at a speed of about 40 km/h. The section does not have automatic blocking nor track control systems. It is managed by Oulu railway traffic control centre. The last section of the railway was constructed in 1939.

The railway section has only timber transport loaded from Hyrynsalmi or Ämmänsaari timber terminals. In 2018, the freight volumes between Kontiomäki and Hyrynsalmi were about 0.5 million tonnes and about 0.3 million tonnes between Hyrynsalmi and Ämmänsaari.

The technical condition of the railway is poor, leading to speed and weight limitations. It has K30-rails and wooden sleepers laid on a gravel foundation, which is more than 40 years old. The maximum allowed axel weight is 20 tonnes at 40 km/h. This limits utilisation of modern timber wagons that have 22.5 axel weight. The speed limits the volumes as only one train can visit the timber terminals daily. In addition, the modern Dr- class diesel locomotives cannot be used in this section.

Because of the lack of track control, only one train at a time can use this railway section. Some small and quick traffic management improvements are being planned to increase its capacity.

The level of rehabilitation planned for this railway would allow 80 km/h for freight traffic and a maximum of 100 km/h for passenger trains.

2.1.2 Current railway between Pesiökylä and Taivalkoski (82 km)

This 82 km non-electrified railway section has not been used since 2004. The last section was constructed in 1961. The railway was used before closing for timber transport and between 1977–1984 for ore transport created by the Mustavaara mine at Taivalkoski. Permanent passenger transport was closed in 1982. After that, passenger trains ran briefly from 1988 to 1991.

The planned level of improvement would allow a maximum speed of 80 km/h for freight trains and 100 km/h for passenger trains.

2.1.3 Current railway Kontiomäki - Taivalkoski and Natura 2000 areas

The current railway goes through two (8 km) and touches three (2.7 km) Natura 2000 areas. In the 2019 study, the Finnish Transport Infrastructure Agency did not assess how the possible new opening of the railway would impact the Natura 2000 areas and how much possible special solutions could cost.

All current Natura areas will be considered when improving the railway. If the railway will be improved in its current location, the planned speed is lower than 200 km/h. If the railway will have a new line or if the railway area will be enlarged, most likely a Natura assessment as stated in the Finnish Act of Nature Protection will be required, unless the use of land under Natura 2000 areas cannot be avoided. This would require a more detailed assessment. Construction of the railway may impact on Natura areas' protection values, even if the railway would be constructed beyond the Natura area (i.e. through impacts of noise and to waterways).

2.1.4 Latest information of the Kontiomäki – Pesiökylä railway project

The following information is based on the internet - pages:

https://vayla.fi/kontiomaki-pesiokyla
https://vayla.fi/pesiokyla-raakapuun-kuormauspaikka

Kontiomäki - Pesiökylä railway rehabilitation

Planning and designing phase:	2020 – second half of 2021
Construction phase:	2021-2023
Ready for the use:	2024
Budget (MAKU – index 130, 2010=100)	Euro 81 million

Pesiökylä timber terminal construction

Planning and designing phase:	2020 – 2022
Construction phase:	2021-2022
Ready for the use:	2023
Budget (MAKU – index 130, 2010=100)	Euro 15 million

2.2 Current railway Rovaniemi - Kemijärvi – Isokylä - Salla – Kelloselkä

The three options for new railway connections in this study (as introduced in the chapter 3) end up in several locations in the existing railway connection Rovaniemi – Kemijärvi – Salla – Kelloselkä.

2.2.1 Rovaniemi – Kemijärvi railway

This 85 km electrified railway section was completed in 1934. Its crushed stone support structure and concrete sleepers allow 22.5 tonnes of axel weight and a maximum speed of 100 km/h for freight and passenger trains. During 2019, the railway transported 25,000 passengers and 0.63 million tonnes of freight.

2.2.2 Railway section Kemijärvi - Isokylä

This 6 km railway was electrified in 2017 and improvements to its crashed stone support structure and concrete sleepers allowed 22.5 tonnes of axel weight and a maximum speed of 60 km/h. During 2019, the railway had 0.470 million tonnes of freight (timber) transport.

2.2.3 Isokylä to Patokangas freight terminal

This 2 km dead-end railway exiting from Isokylä was electrified in 2017, when the Patokangas freight terminal was opened. The terminal is used by the wood industry and the Finnish Army. It has a crashed stone support structure and concrete sleepers allowing 22.5 tonnes axel weight and maximum speed of 60 km/h. During 2019, the railway had 0.47 million tonnes of freight transport.

2.2.4 Isokylä - Salla - Kelloselkä

This railway section is a 74 km unelectrified railway, which has not been used since 2012. The railway has been constructed to the Finnish/Russian border, from where it continues to Kandalaksha located in the main railway St. Peterburg-Murmansk. Construction during 1941-1942 was a pre-condition of the Moscow peace agreement.

The current railway has wooden sleepers laid on the railway gravel foundation. The maximum allowed axel weight during the last functioning year was 20 tonnes at 60 km/h, and about 140,000 tonnes of timber was transported.

If the railway structure (upper and super) is renewed to a depth of 2.6 m without the need to strengthen the structure to a deeper level, or to rebuild the bridges, the unit costs of the railway rehabilitation would be:

- reconstruction 1.78 M€ / railway-km
- electrification 0.31 M€ / railway-km
- automatic blocking and track control 0.23 M€ / railway-km

Improvement of current Isokylä – Salla (60 km) railway without strengthening of the basement or renewing the bridges would cost 140 M€.

3. ALIGNMENT OPTIONS FOR THE NEW RAILWAY TAIVALKOSKI - KEMIJÄRVI

3.1 Objectives and methods

The first aim of this work was to study the implementation of a new railway connection between Taivalkoski and Kemijärvi as a continuation of the current railway between Kontiomäki and Taivalkoski. The studied line alignment options pass through Kuusamo, Salla and Posio (a total of three options, see figure 1).

Potential terrain corridors have been studied with an accuracy that corresponds to the level required for the survey of the regional plan directive marks. The design of the terrain corridors has taken into account the current and planned land use as well as the values of the landscape, the cultural environment and nature.

The design speed was 200 km/h. As a result, the elements of the track lines are long and changes in direction and angles occur over a long distance. The used minimum radius is R3000 m and the used maximum longitudinal gradient is 10 ‰. All alternatives have been designed as single-track, with a 750 m passing loop every 20 km. The implementation costs were (later) evaluated to 200km/h and 100km/h planning speed.

The impacts of the implementation of the terrain corridor options have been assessed with regional plan accuracy. The width of the terrain corridor is several hundred meters. The exact location of the line alignment and the exact width of the terrain corridor will be determined during a more detailed design phase.

The impact assessment focused on the terrain corridor; the wider effects of the rail connection on land use have not been assessed.

3.2 Options

The three options are as follows:

- Alternatives 1 and 1b as the western alternative via Posio. Alternative 1 was not chosen for further assessment as it would have had large negative impacts on Korouoma National Park. Thus, alternative 1b was chosen for a more detailed railway technical assessment.
- Alternative 2 goes via Kuusamo and Ruka. After Ruka, alternative 2a is direct connection to Kemijärvi, and alternative 2b diverts to Salla, where it meets the existing track.

The following figures show the options on the maps of the Land Survey of Finland and on the combined regional plans.

The alternative **1** Taivalkoski – Kemijärvi railway is 154 km long, starting from Taivalkoski going north and passing the Posio municipality centre at about 20 km distance from its western side. Alternative 1a goes through Korouoma recreation and leisure centre, which was considered problematic. Because of this, the client chose in early state another alignment, **1b**, which travels near Posio municipality centre to be assessed in more detailed. This so-called western main alternative passes by lake Kemijärvi from the west and crosses the river Kemijoki between Autti

and Luusua villages and joins to current Rovaniemi - Kemijärvi railway west from Kemijärvi city centre.

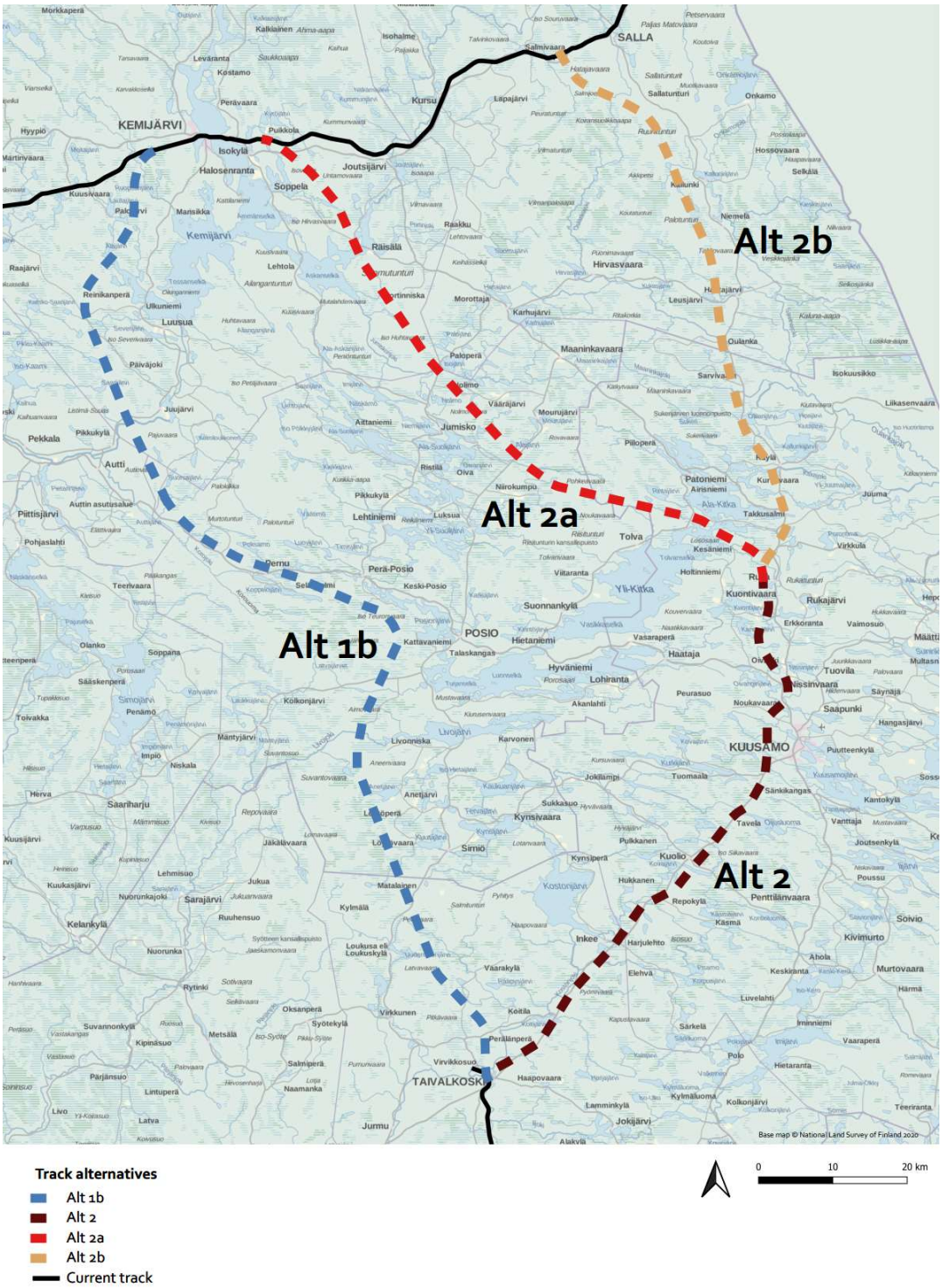

Figure 2. Alternatives on the maps of the Land Survey of Finland.

The alternative **2a** Taivalkoski – Kemijärvi railway is 180 km long, starting from Taivalkoski towards the north-east and following the main direction of the highways 20 and 5 to Kuusamo and Ruka. After Ruka, the alignment diverts from the main highway 5 and crosses the Kitka lake between Yli-Kitka and Ala-Kitka. This alignment is in an uninhabited area all the way to the mountain of Suomutunturi, where it bypasses the mountain from the east. This alternative joins with the existing Kemijärvi – Salla railway east from Isokylä.

The alternative **2b** Taivalkoski – Kemijärvi railway diverts from alternative 2a after Ruka to East and is line near Salla municipality centre (to the west of it) and joins the current Salla – Kemijärvi railway between Paikanselkä and Salmivaara railway station. The new railway line between Taivalkoski and Salla is 169 km long. The alternative 2b connects to the existing track in Salla approximately 60 km from Isokylä.

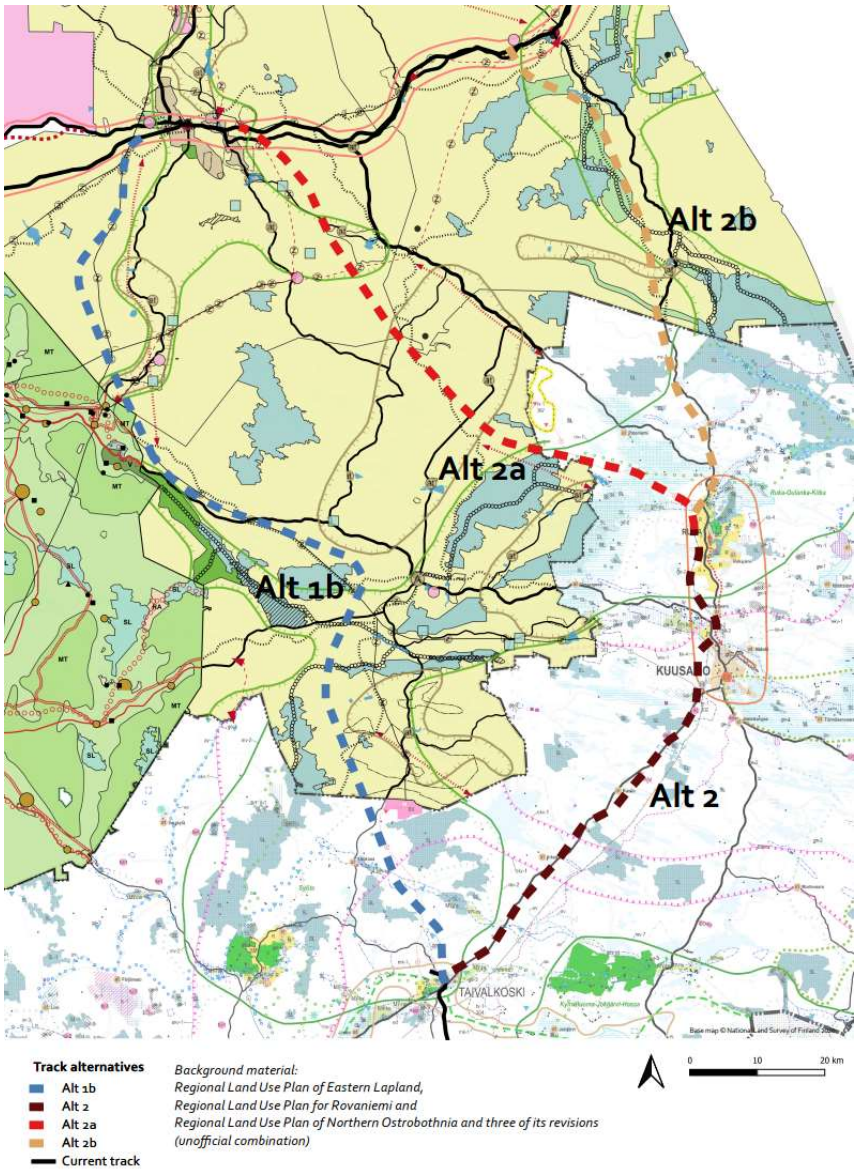

Figure 3. Railway alternatives on the combined regional plans.

3.3 Current land use

Alternative 1b passes through three municipalities – Taivalkoski, Posio and Kemijärvi – and is lined rather close to areas of the municipality of Rovaniemi. Alternative 2a additionally passes through Kuusamo and 2b through Salla municipality. Kuusamo centre is the largest populated area close to the alignment options with approximately 8,400 inhabitants. The municipal centre of Posio has approximately 1,300 and the municipal centre of Salla has approximately 1,600.

Alternative 1b passes mainly through uninhabited areas. It runs from the eastern side of the nature reserve and recreation area of Korouoma. The corridor intersects with three groundwater areas, and in the vicinity of alignment are one ancient relic and two other sites of archaeological cultural heritage.

Alternative 2 (jointly 2a and 2b) between Taivalkoski and Ruka goes past the population centres of Kuusamo and Ruka, and also goes through or past the settlement villages of Kuolio, Tavela and Nissinvaara. Otherwise, the corridor passes through uninhabited areas. Alternatives 2a and 2b align closely with the existing main road between the centres of Taivalkoski and Kuusamo and further, following the main road 5 to Ruka. The railway is located at a distance of 2 km or nearer to the following Natura 2000 areas: Isosuo – Kivisuo, Oijusluoma, Pötkönsuo and Valtavaara – Pyhävaara. Alignment 2 intersects with three groundwater areas and in the vicinity of the alignment are ancient relics (nine objects) but no archaeological cultural heritage objects.

Alternative 2a is directed through Mustosenvaara and Räisälä villages. Otherwise, the corridor travels through uninhabited areas. The alignment passes the Riisitunturi Natura 2000 area twice. Alternative 2a intersects with two groundwater areas and in the vicinity of the alignment are two ancient relics but no archaeological cultural heritage objects.

Alternative 2b passes Ruka centre, Käylä and Hautajärvi villages and the mountain of Sallatunturi. Otherwise, the corridor travels through uninhabited areas. The railway is located at a distance of 2 km or nearer to the following Natura 2000 areas: Sukerijärvi, Oulanka, Suksenpaistama – Miehinkävaara and Peuratunturi. Additionally, this alternative passes the regionally important Leusjärvi birth area (MAALI area). Alternative 2b intersects with four groundwater areas and in the vicinity of alignment are four ancient relics. The option is lined on the western side of Salla municipality centre near Paikanselkä fighting area, which is a nationally-important built cultural environment.

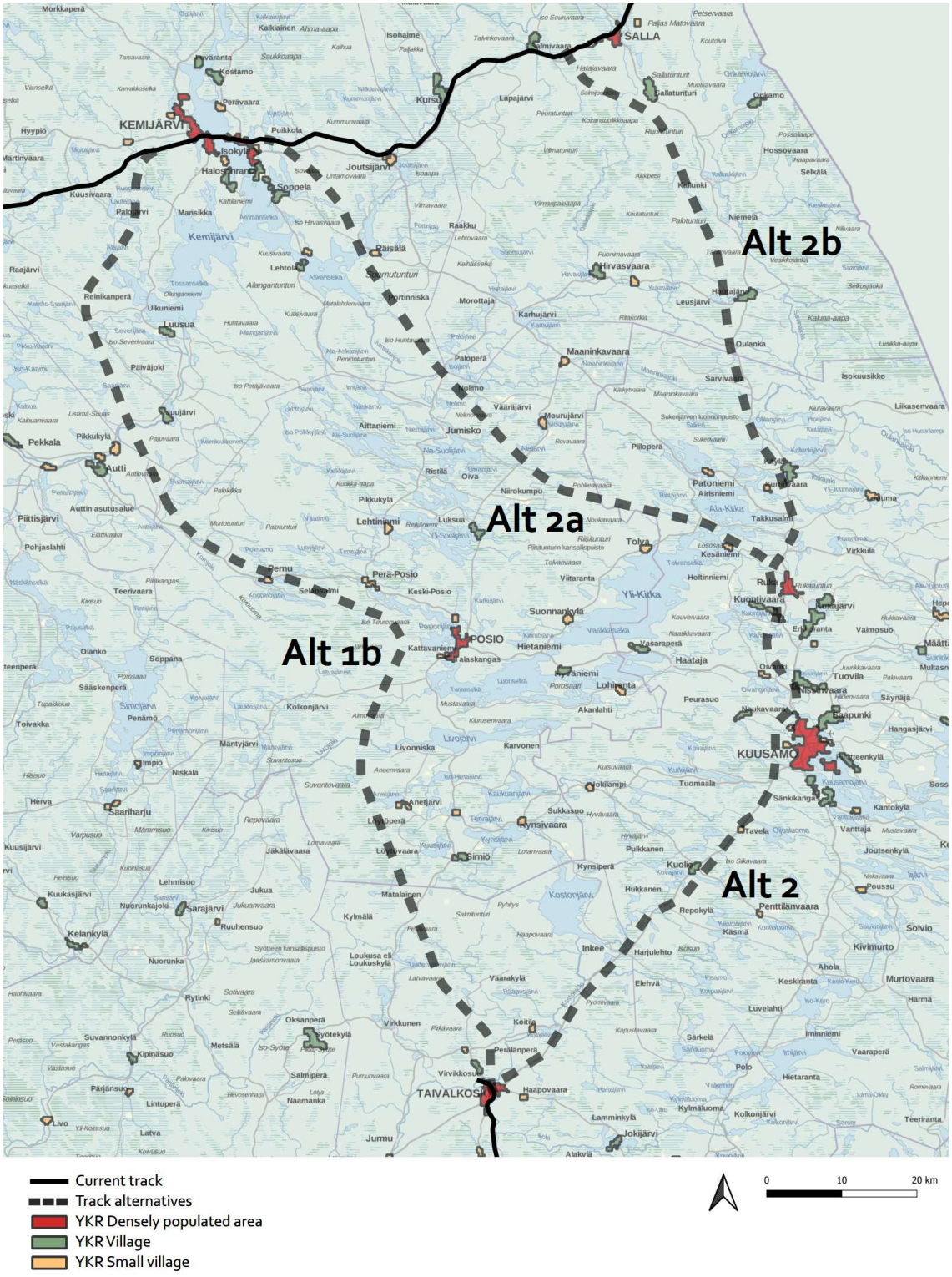

Figure 4. Railway alternatives, densely populated areas, villages and small villages.

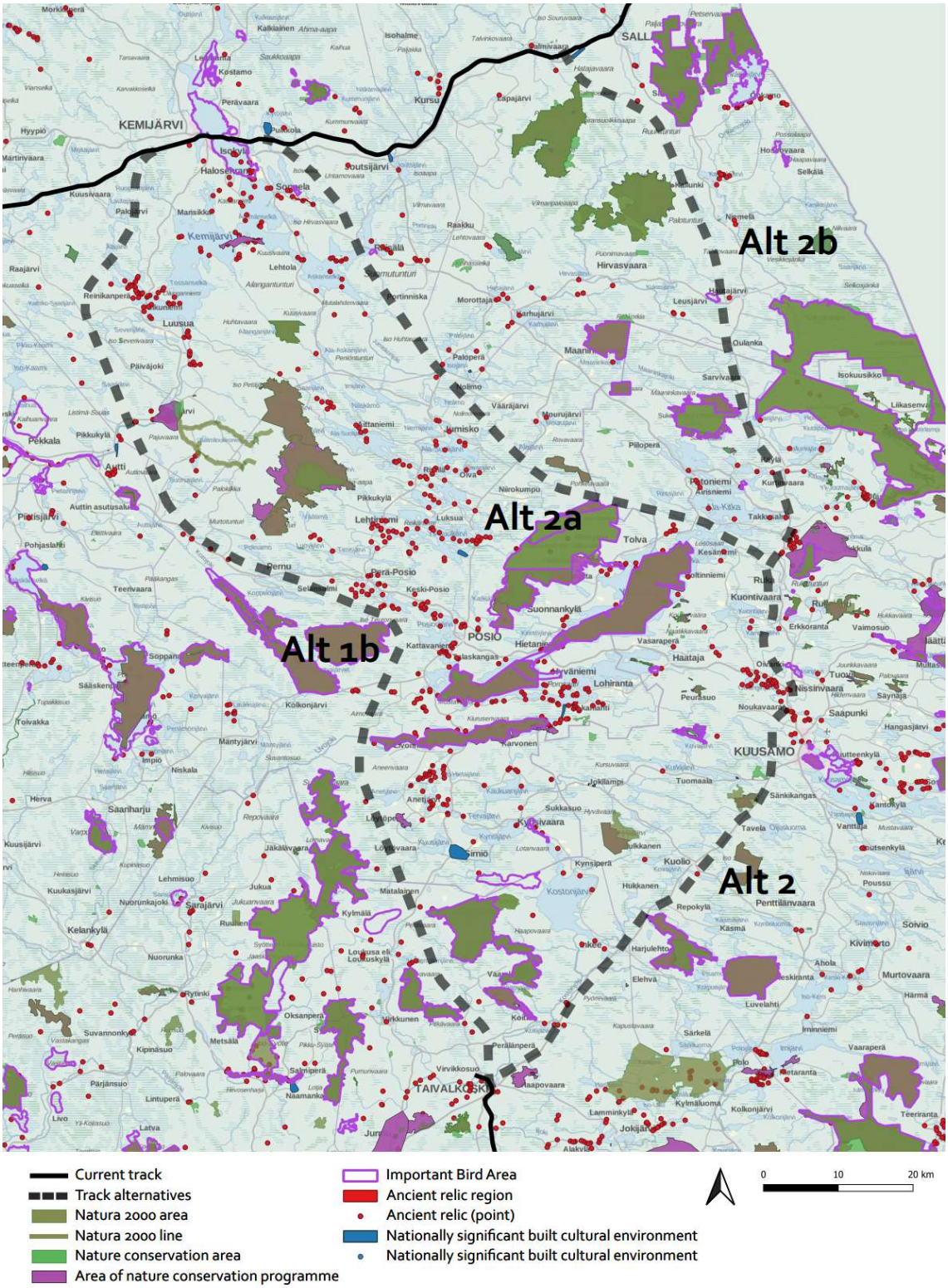

Figure 5. Railway alternatives and protected areas.

3.4 Planned land use

3.4.1 Regional land use plans

The following regional plans have been established by law in the study area: Regional Land Use Plan of Eastern Lapland, Regional Land Use Plan for Rovaniemi and Regional Land Use Plan of Northern Ostrobothnia and three of its revisions. Most of the study area has been marked as agriculture and forestry area (M) or so-called white area in the regional land use plans.

Alternative 1b goes close to the Korouoma recreation area (V 843) of the regional land use plan. In addition, alignment runs partly through the tourism and recreation development area (overlapping plan symbol: mv) of Eastern Lapland.

In regional plans, alternative 2 goes over or past the peat industry area (EO-tu) of Kapustasuo, the nature reserve area (SL) near Tavela village, the population centre area (A) of Kuusamo centre, the holiday and tourism areas (R) of Kuusamo and Ruka centres, and the provincially valuable landscape area of Kitka. In addition, the alignment runs partly through the tourism and recreation development area (mv) of the regional land use plans.

Alternative 2a passes regionally valuable scenery in Kitka surrounding an important water area. Additionally, it goes between the two nature protection areas (SL) and two tourism and recreation areas (mv) marked in the Northern Ostrobothnia regional plan. On the eastern side of Salla city centre, alternative 2a joins the current Kemijärvi (Isokylä) – Salla - Kelloselkä railway. The railway between Salla and Kemijärvi is marked in the regional plan as part of the Barents Corridor (bk), which is a nationally-important international transport corridor.

Alternative 2b also passes regionally valuable scenery in Kitka surrounding an important water area. Additionally, it goes through a tourism and recreation development area (mv) marked in the regional plans. Near Ruka, the alignment passes a holiday and tourism area (R). Alternative 2b passes the following nature protection areas (SL): Sukerijärvi, Oulanka, Suksenpaistama–Miehinkävaara and Peuratunturi. At south of Salla municipality centre, alternative 2b crosses the area of dispersed settlement (overlapping plan symbol: mk) marked in the regional plan. On the western side of Salla municipality centre, alternative 2b joins the current Kemijärvi (Isokylä) – Salla - Kelloselkä railway. The railway between Salla and Kemijärvi is marked in the regional plan as part of the Barents Corridor (bk), which is a nationally-important international transport corridor.

3.4.2 General land use plans (master plans)

In alternative **1b**, the railway does not cross with the existing general plans.

The following general plans impact the railway alternatives **2, 2a and 2b**: Kuusamo strategic general plan 2025 (approved 13.12.2016), Ruka – Kuusamo tourism area general plan (24.9.2018), Oivanki waterfront general plan (30.6.2000), Ruka-Kuusamo tourism area general plan (24.9.2018), Kuontivaara village plan (24.9.2018), Pyhäjärvi waterfront general plan (23.5.2011), Veska area general plan (18.6.2001) and Kesäjärvi area general plan (25.2.2004).

For the line of alternative **2a** or in its vicinity, the following general plans apply: Töllinniemi – Ritaniemi – Juamiskonperä – Askankanava waterfront general plan (approved 15.11.2001), Räisälä – Haaparanta general plan (20.3.2017) and Vietteri – Lehtola – Askanperä – Käsmänperä waterfront general plan (18.11.1996).

On the line of alternative **2b** or in its vicinity the following general plans are relevant: Kesäjärvi general plan (approved 25.2.2004), Ruka general plan (25.2.2004) and Sallatunturi area general plan (2.10.2009).

The Kuusamo strategic general plan has the new Taivalkoski – Kemijärvi railway line reservation. New stations and railway stops have been planned for Ruka, Kuusamo city centre, Kuusamo airport and near the freight terminal south of Kuusamo. In the general plan, the railway reservation is located near the existing main roads 20 (Kuusamontie) and 5 (Kemijärventie). The railway line reservation has been described in more detail in the general plan, where the railway area reservation passes in some sections through "nature values" - marked ("luo"). Alternative 2 in this study has been lined in the same way as in the general plans.

Near the villages Kuolio and Tavela, alternative **2** crosses the wind park area marked in the general plan (tv-1) and the peat industry area (EO). Southwest from Kuusamo city centre, alternative 2 crosses with two job-area markings. Between Kuusamo and Ruka centres, alternative 2 passes, for example, the following reservation areas in the general plans: Ukonlampi and Nissinlampi recreation living areal marking (RA), Pölkky industrial area, Rääpyslampi job-area, Nissivaaran housing area (A) and job-area (TP-res), Ihtinki city plan, Kuontivaarantie housing area (A) and Moisasensuo recreation housing area (RA).

Alternative **2a** goes through areas of nature values ("luo-1") at a few points and has been lined between the two groundwater intake areas (EN). Between Ala-Kitka and Yli-Kitka, alternative 2a passes two reservation areas for development: recreation time area reserve and cottage housing area reserve, both marked on the waterfront of lake Kitka.

Northeast from Ruka centre, alternative **2b** passes or goes through several recreation housing area reservations (RA). Additionally, 2b goes through Käylä village and passes the Takkusalmi bio plant. Alternative 2b is also situated in the Räväjärvi free time development zone.

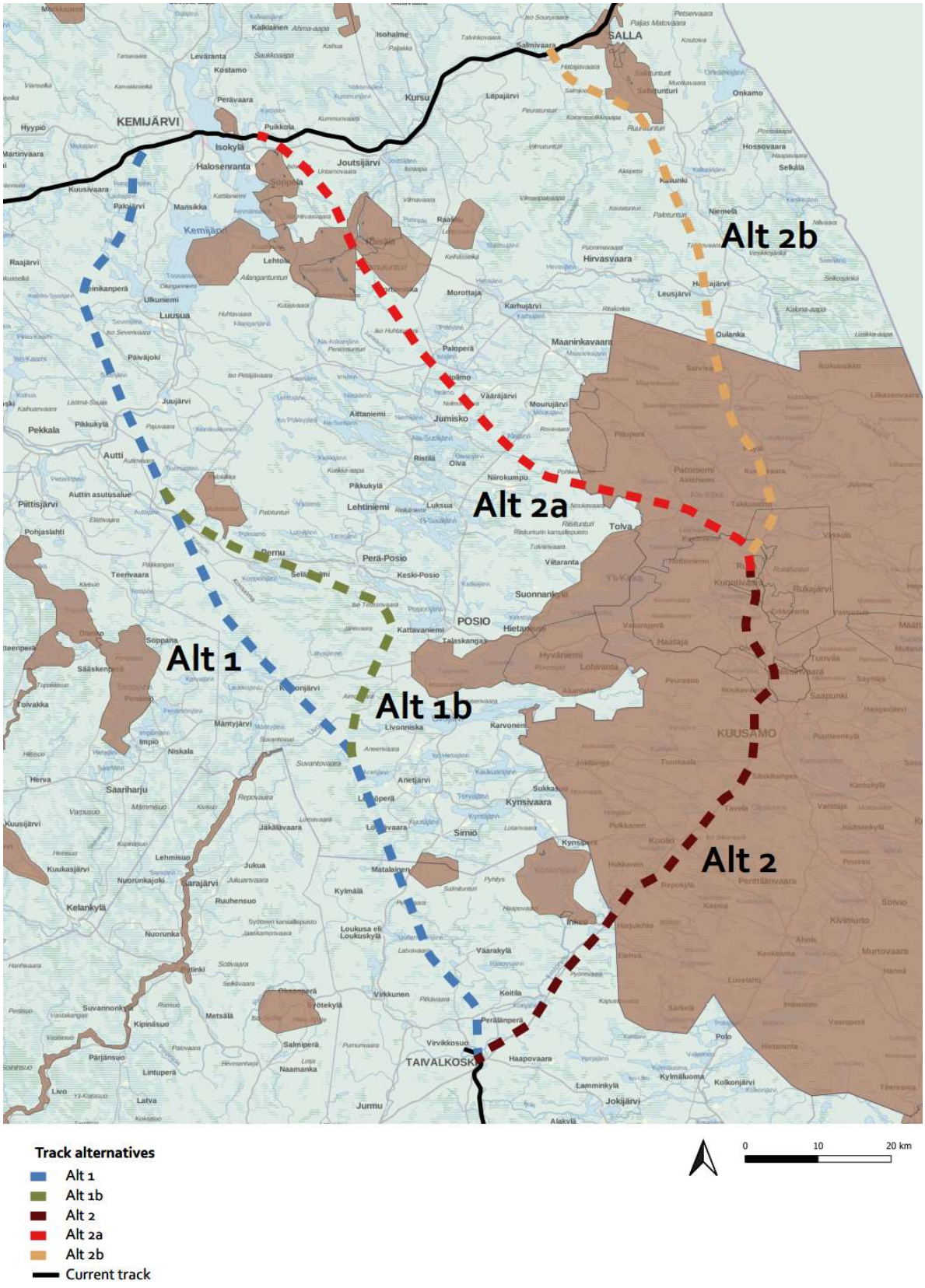

Figure 6. The railway alternatives and the general plans.

3.5 Impacts on reindeer herding

Railway transport causes losses to the reindeer economy in many ways. This is due to, for example, decreasing of pasture area, hindrances on moving and lost reindeers in accidents. There are some ways to try to mitigate these effects. Communication and dialogue are important both during the construction of the railway and during its operation. It is crucial to have a dialogue during the design stage of the railway to minimise its adverse effects and to make mitigation measures as effective as possible. Such measures may be, for example, fence solutions, subways, crossings and switching areas between reindeer owners' associations. More detailed planning can be used to attempt to circumvent problem areas.

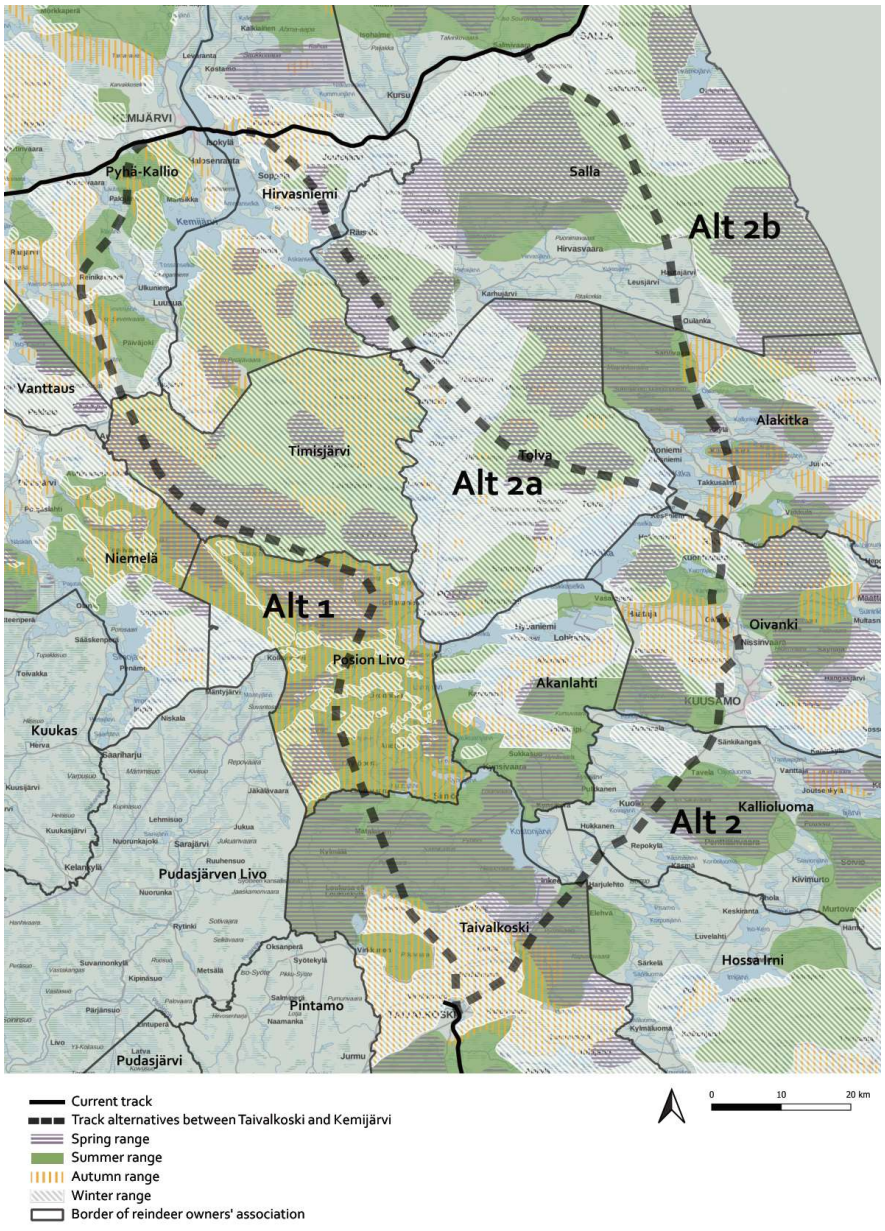

Figure 7. The railway alternatives and range areas of reindeer owners' associations

3.6 Areas with permits for ore prospecting and the applications

The purpose of exploration is to locate and explore a deposit containing mining minerals through geological, geophysical and geochemical investigations and sampling. In practice, an operator doing exploration takes samples of soil and bedrock through, for example, test hole drilling, to analyse the size and quality of a potential deposit.

Exploration may be based on prospecting work, the landowner's consent, an exploration permit or a mining permit.

Along all of the assessed railway alternatives there exist areas with permits for ore prospecting and areas with applications for ore prospecting (figure 7). Along the railway alternatives 2a and 2b, there are more applications for ore prospecting than the other alternatives.

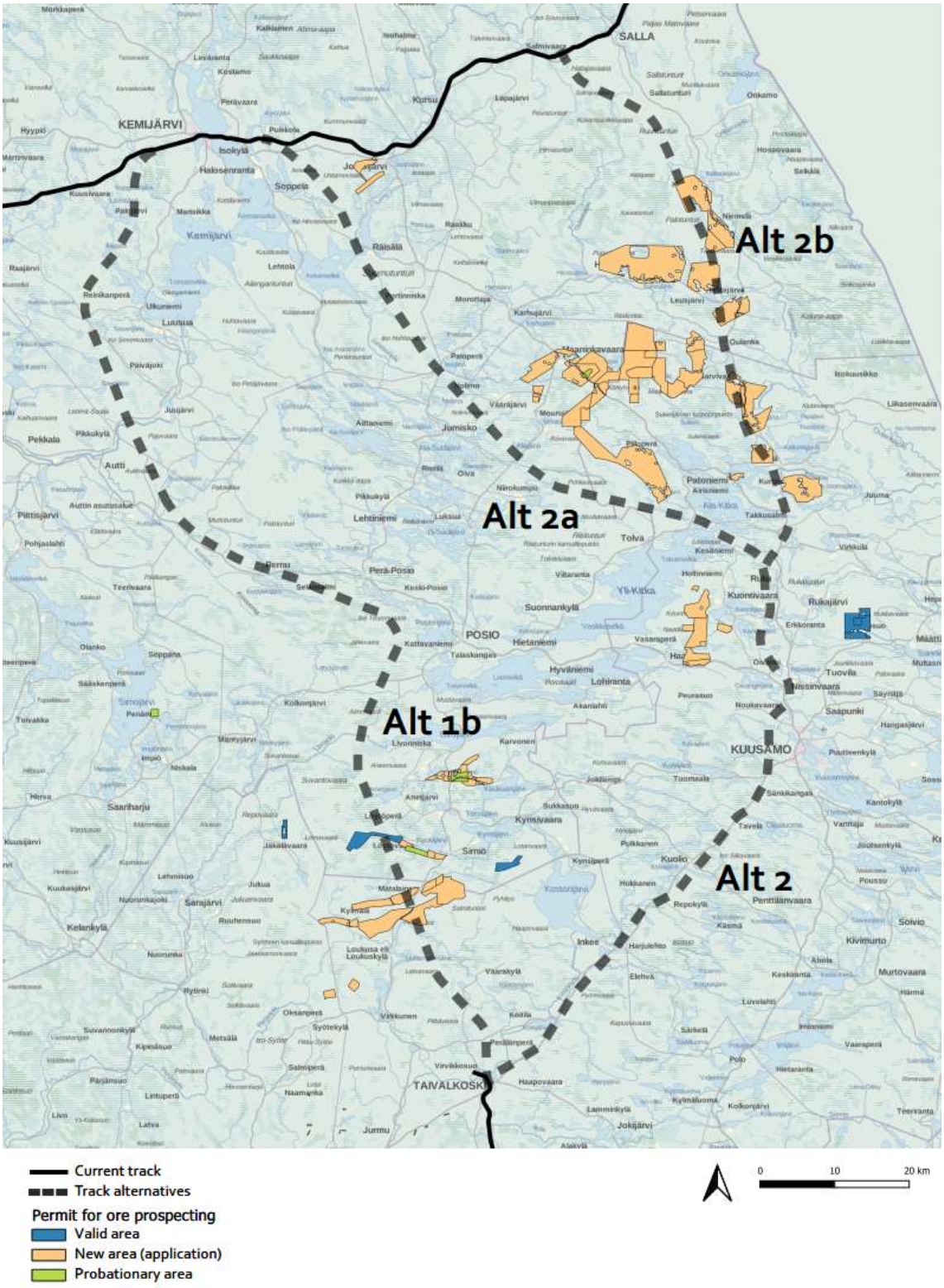

Figure 8. Railway alternatives and areas with permits for ore prospecting and areas with applications for ore prospecting.

3.7 Impacts to land-use

All railway alternatives would change or limit current local land use because the implementation of the railway would create barriers to the use of local roads, leading to an increase in local trips. This barrier effect mostly impacts the forest economy recreation activities. Near the railway alternatives 2, 2a and 2b exist Kuusamo, Ruka and Salla population centres and some smaller villages. Alternative 1a would divide the Korouoma leisure and recreation area. The railway would form a barrier to movement or would cause longer trips. A tunnel solution could decrease these impacts, but alternative 1a was not considered further in this study.

Alternative 1b would be located mainly on uninhabited areas. At the regional level, however, the alignment does not significantly conflict with current or planned land use.

Alternative 2 limits the land use in Kuusamo, Ruka and near several villages. On the other hand, the dense land use would make it possible to plan railway stations and stops and therefore create a demand for new modes of transport. The railway would pass near current and planned housing and leisure housing areas between Kuusamo and Ruka. Near Kuusamo city centre, this railway alternative goes through three labour areas, limiting their utilisation.

Implementation of alternatives **2a or 2b** does not significantly contradict current and planned land use. The most significant scenery impacts would occur in the Kitkajärvi area, which has been evaluated as having regionally-important scenery. Alternative 2a splits the area into two and 2b goes through the area's corner. Alternative 2b's negative impacts are less significant. Alternative 2b passes regionally important Leusjärvi bird area and further study of potential noise impacts on birds is necessary.

All alternatives pass Natura 2000 areas with a minimum distance of 2 km. Along alternative 1, there are four Natura areas; along alternative 2 there are three; along alternative 2a there is one; and along alternative 2b there are four. The Finnish Act of Nature Protection states that the nature values of a Natura area cannot be significantly reduced. This also applies to projects that are implemented beyond the area. To summarise the impacts of the projects, all of the alternatives may require a Natura assessment, as mentioned in the Finnish Act of Nature Protection. Additionally, alternative 2 between Taivalkoski and Kuusamo goes very close to the following nature objects: Harjaniemi, Oijusluoma and Aarnivalkea–Kivisuo.

Implementation of the Taivalkoski – Kemijärvi new railway requires rehabilitation of the current **Kontiomäki – Taivalkoski** railway. The current railway goes through or passes several Natura 2000 areas. Rehabilitation of the current railway requires the Natura assessment mentioned in the Finnish Act of Nature Protection.

There are more ancient relics on alternatives 2**,** 2a and 2b. More detailed impacts to ancient relics and archaeological cultural heritage areas can be evaluated only after a more detailed railway planning stage.

It seems that large cuttings and long tunnels can be avoided. It has been evaluated that a tunnel is needed when railway structures are more than 15 meters deeper than the cover of the earth.

3.8 Security of Supply

All the 3 alternatives would increase Finnish national security of supply" as the new railway would:

- be an alternative route for freight transport for Kemijärvi-Rovaniemi – Oulu railway
- be an alternative route for passenger transport for Kemijärvi-Rovaniemi–Oulu–Helsinki railway
- complement the corridor formed currently of the main road no 5.

3.9 Tunnels and bridges

Bridges have not been planned for smaller stretches of streams, ditches, or small roads or paths. Tunnels have been used when alignment requires deep cuttings (15 m or more). Alignment alternatives with a design speed of 200 km/h includes bridges and tunnels as follows:

- Alternative 1a includes 17 tunnels, with a total length of 18,376 m and 59 bridges
- Alternative 2a includes 19 tunnels, with a total length of 31,788 m and 86 bridges
- Alternative 2b includes 13 tunnels, with a total length of 22,916 m and 79 bridges.

A design speed of 100 km/h would reduce the number of bridges and tunnels significantly. It is estimated that a lower speed would reduce the number of tunnels by 70%. In addition, fewer bridges are needed, and they can also be shorter in length.

4. POTENTIAL FREIGHT ORIGINS USING THE NEW RAILWAY CONNECTION

The aim of this chapter is to introduce identify the freight flows that might use the new Kontiomäki - Kemijärvi railway after its opening. The chapter has been written by representatives of the client of this study, the Local Federation of East Lapland.

4.1 After the new railway connection Kontiomäki-Kemijärvi

The following freight transport flows might use the new railway connection:

The current **Patokangas freight terminal** at the end point of the electrified railway Rovaniemi-Kemijärvi – Isokylä – Patokangas produced about **650,000 tons** of freight flow in 2020. The new railway connection could attract some of these flows. This depends on the destination of the flow, which is now mostly the bank of the Gulf of Bothnia and lesser amounts elsewhere in Finland.

The Finnish new energy policy, which is quickly abandoning peat, will lead to an increasing need for **energy timber** (small size timber that currently mostly remains in the forest as a waste). The forests surrounding the Isokylä- Kelloselkä railway can easily provide **100,000-200,000 tons** of energy timber annually. The new Kontiomäki - Kemijärvi railway will have even bigger potential for this product. The markets are Western and Southern Finland, meaning that the shortest route would be the new railway line.

Sokli is a rich ore deposit in the north of Savukoski municipality. The former owner, the Norwegian Yara, sold the deposit to a Finnish state-owned mining company in 2020. Sokli Oy has the world largest phosphate deposit. The value is increased as the ore is cadmium-free, and Sokli also has plenty of other minerals that are on the EU's so-called "critical list". Utilisation of the Sokli deposit depends largely on the transport solution. Sokli has an approved route for a new railway (about 100km) between the deposit and Kelloselkä, the endpoint of the current railway. The richest deposit part can be utilised in 20 years, but the railway connection would make the less-rich parts of the deposit also feasible for use, continuing the life of the mine for several decades. If the mine will be opened, the railway Solki-Kelloselkä- Kemijärvi would carry **1.8-1.9 Mtons** annually to the ports of the Gulf of Bothnia. If the new railway Kontiomäki - Kemijärvi was available, the Solki would have an additional alternative for ore transport. It would be a very attractive outcome for this sector if the development location of Sokli ore was Siilinjärvi (one rather likely location).

In 2020, the Finnish Government made the decision to reconstruct the first part of the Kontiomäki-Kemijärvi new railway connection for the use of the forest industry for raw material transportation. The 81 MEuro investment in the current Kontiomäki – Pesiökylä railway rehabilitation, to be launched in 2021, would transport **1.1 Mtons of wood** to factories along the Gulf of Bothnia.

The forest industry investments in the next decades will heavily impact on the transport directions of forest raw materials. Several biochemical plants are planned or are subject to the investment decision.

4.2 After the new railway connection Kontiomäki-Kemijärvi and possible Kemijärvi – Salla – Kandalaksha railway

The starting points provided in chapters 4.2 and 4.3 are the freight traffic volume analysis results of the Barents Freeway – Kolarctic ENPI CBC project (2014). They were made in the Frisbee (worldwide) freight database of freight and infrastructure. At that time, the computer runs were carried out with the STAN- programme. Originally, in the NABL-project, several work packages were planned to conduct freight traffic volume analyses using the same method as in Barents Freeway 2014 (with the updated freight data), but the Frisbee database and the STAN computer model were closed down on 31.12.2019. The following similar freight model (produced by Traficom) will be available no earlier than in 2026.

The freight traffic analyses conducted in the Barents Freeway – project in 2014 forecasted that the Salla-Kandalaksha railway, joining the current railway and ending up in Finnish Kelloselkä (near Salla border crossing) and the Russian current railway ending up in Alakurtti, would have about 5 Mtons of freight volumes in 2030. Out of that, 75% would be freight from Russia to Finland and 25% from Finland to Russia. Figure 8 shows the forecast.

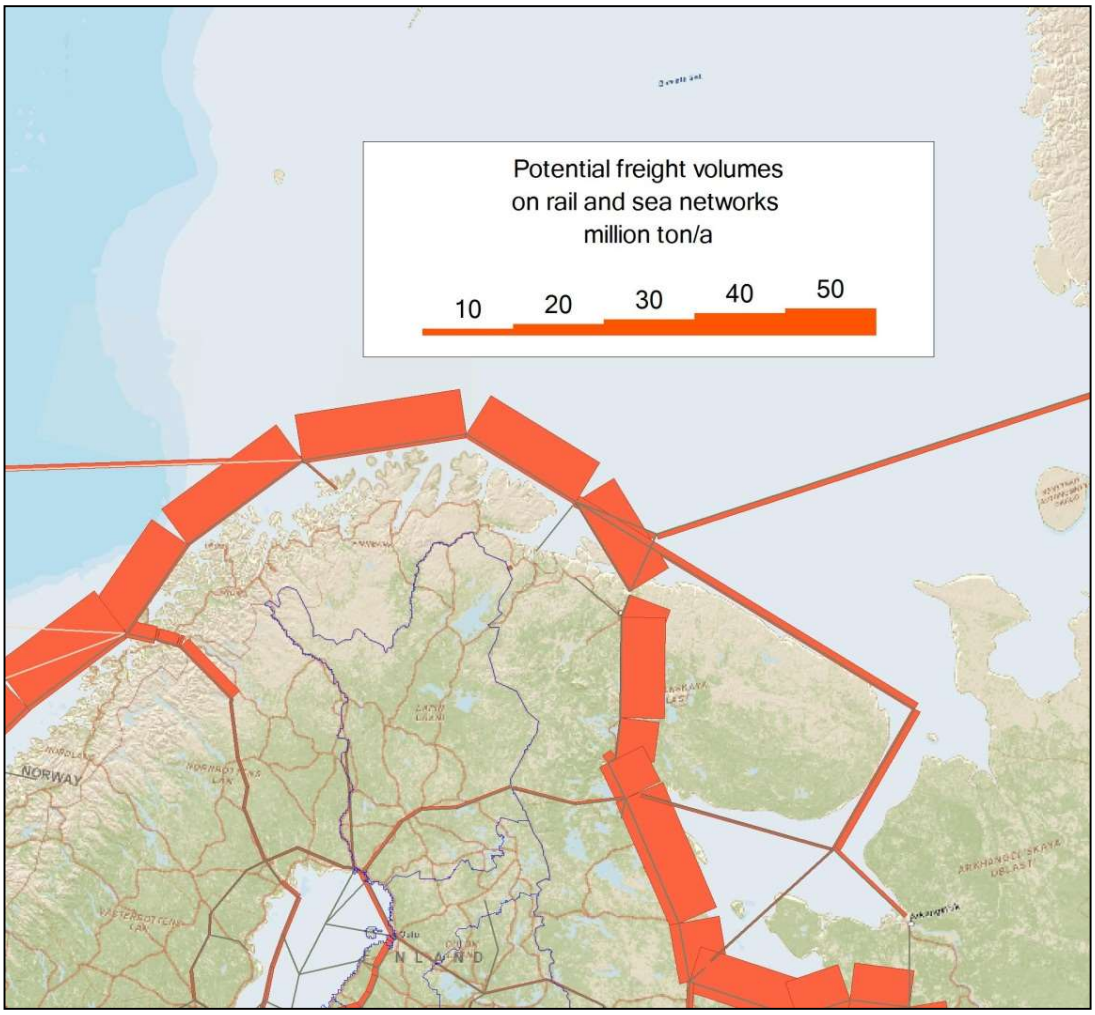

Figure 8. Potential freight volumes on the railways and sea in the scenario including Salla- Kandalaksha railway 2030. Source: Barents Freeway report: "Salla - Kandalaksha Railway Study 2014"

If we make a rough assumption that of the forecasted railway freight crossing the border, half will use the current route Salla – Kemijärvi - Rovaniemi and further, and another half would use the new Kontiomäki – Kemijärvi new railway route, this will create about **2.5 Mtons** of new freight flow to the new Kontiomäki – Kemijärvi railway.

4.3 After the new railway connection Kontiomäki-Kemijärvi and possible Kemijärvi – Kirkenes railway

The freight traffic analyses conducted in the Barents Freeway – project in 2014 forecasted that the Rovaniemi - Kemijärvi railway continuing to Kirkenes (Norway) would have about 4 Mtons of freight volume in 2030. Out of that, about 90% was freight from Finland to Europe. Figure 9 shows the forecast.

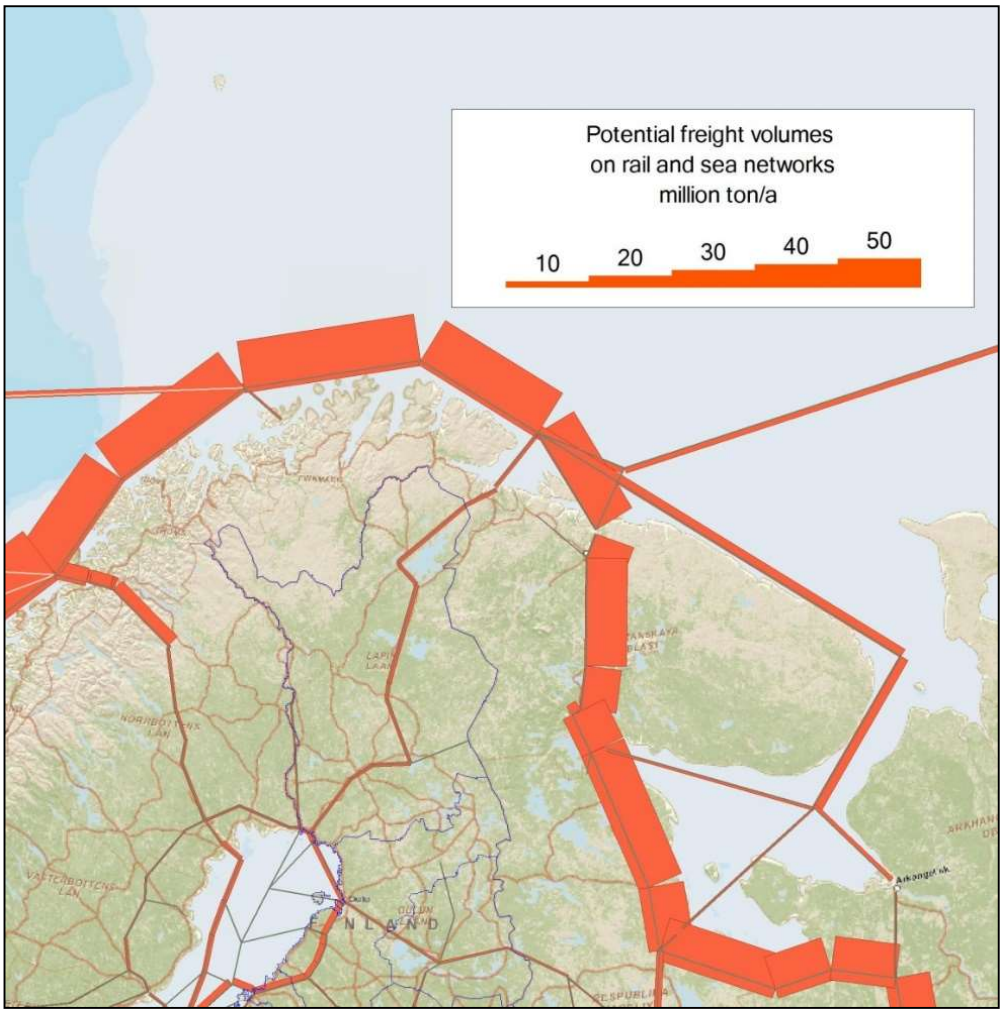

Figure 9. Potential freight transport volumes on the railways and sea in the scenario including Rovaniemi - Kemijärvi - Kirkenes railway 2030. Source: Barents Freeway report: "Rovaniemi - Kemijärvi - Kirkenes Railway Study 2014"

If we make a rough assumption that of the forecasted railway freight crossing the border, half will use the current route Kemijärvi - Rovaniemi and further, and another half would use the new Kontiomäki – Kemijärvi new railway route, this will create about **2 Mtons** of new freight flow to the new Kontiomäki – Kemijärvi railway.

5. KONTIOMÄKI–KEMIJÄRVI RAILWAY COSTS AND PASSENGER VOLUMES

Summary table of the investment costs and passenger volumes in railway alternatives

Alternative	Investment costs on planning speed 100 km/h	Investment costs on planning speed 200 km/h	Passenger transport forecast, passengers in the year 2040
1b (Kontiomäki – Taivalkoski - Posio – Kemijärvi)	**900 M€**	**1300 M€**	**75.000 - 105.000**
2a (Kontiomäki – Taivalkoski – Kuusamo – Ruka – Kemijärvi)	**1100 M€**	**1800 M€**	**80.000 – 135.000**
2b (Kontiomäki – Taivalkoski – Kuusamo – Ruka – Salla – Kemijärvi)	**1050 M€**	**1650 M€**	**80.000 – 145.000**

5.1 Timing of railway implementation used in calculations

The construction time and timing used in the analysis of the Kontiomäki – Kemijärvi railway are the following:

- Planning, political, and administrative decisions, field investigation/detailed design 2025-30
- Construction period 2031-2035
- Opening to exploitation 2035
- Operating period in exploitation cost counts 2035-2065

However, the following facts of a railway project implementation in Finland for future decades have to be recognized:

- Implementation of any bigger railway project in Finland would require a political decision made by the Parliament, before it proceeds to planning and implementation.
- The railway project, if implemented, has to be included in "Transport 12" – plan, which is the Finnish national transport plan for next 12 years approved by the Parliament. The current Parliament has approved the "Transport 12" – plan for the years 2021-2032.
- The next Parliament will be elected in 2023 and the "Transport 12" – plan will be updated during 2024-2025, the Government will decide about the "Transport 12" – plan in 2025 for the next 12 years. This cycle will continue after the Parliament elections of 2027 and 2031.
- In Finland are plans of some large railway development projects with implementation range for the future 10-20 years. They are e.g. the "Finland Railway" Helsinki – Tampere, the "One Hour Railway" Helsinki - Turku and the "Eastern Railway" Helsinki – Porvoo - Kouvola. Initiative implementation timetables are not earlier than in the future decade and total summary budgets around 9000 – 11000 M€.

5.2 Implementation in stages

The first stage of implementation has already been completed as the current Kontiomäki - Pesiökylä railway section will be rehabilitated in the coming years. The following implementation steps could follow different plans:

1. Reconstruct Pesiökylä – Taivalkoski current railway, construct the new section Taivalkoski – Kemijärvi and start to exploit diesel locomotives for the railway. After that, electrify the whole railway line Kontiomäki – Kemijärvi; or
2. Reconstruct Pesiökylä – Taivalkoski, construct Taivalkoski – Kemijärvi and electrify both sections in one three-five year implementation project.

5.3 Cost estimates

5.3.1 Principles and methods used

The costs have been evaluated using the HOLA method (hankeosalaskelma). The cost level used is MAKU 130 / 2010=100 (Finnish earth works construction index value 130 when the value 100 was in 2010). The cost level in January 2021 was MAKU 115.2. The following assumptions have been used in the cost estimates:

- Bank and cutting materials travel distances are 20-25 km
- Management costs included in unit costs are 20%
- Client costs (planning, design, construction management) included in unit costs are 15%.

The cost have been evaluated based on a 2 m deep ballasted substructure. The costs of bridges include road arrangements (1 km per bridge) but do not take into consideration smaller roads or paths leading to plots. Bridges over small streams or ditches are not evaluated, but cost evaluation includes culverts every 500 m. Tunnels will be used when the railway structures would otherwise require a 15 m or more deep cutting. The cost of the tunnels were evaluated by calculating an average cost per meter for a single-track rock tunnel.

The costs have been calculated using a 200 km/h planning speed. In addition, cost estimates were also completed for a 100 km/h planning speed. The following factors mean the costs would be lower when the planning speed is reduced from 200 km/h to 100 km/h:

- Railway bank will be narrower
- Electricity and safety equipment costs are lower
- At-grade-crossings are allowed for smaller roads (regional ones), instead of bridges
- Shorter bridges over water can be implemented
- About 70% of tunnels can be avoided
- About 30% of sections with soft ground can be avoided.

5.3.2 Construction costs

The cost estimates of the railway between Kontiomäki and Kemijärvi made using various planning speeds for each section are as follows:

5.3.2.1 Alternative 1b (Kontiomäki – Taivalkoski – Posio – Kemijärvi)

Table 1. Cost estimate with design speed of 100 km/h.

Section	Length	Construction costs	Electrification cost	Total
Rehabilitation of Kontiomäki – Taivalkoski current railway 100 km/h	157 km	135 + 14 M€	54 M€	203 M€
New railway Taivalkoski – Kemijärvi 100 km/h	154 km	650 M€	48 M€	700 M€
Total	311 km	800 M€	102 M€	**900 M€**

Table 2. Cost estimate with design speed of 200 km/h.

Section	Length	Construction costs	Electrification cost	Total
Rehabilitation of Kontiomäki – Taivalkoski current railway 100 km/h	157 km	135 + 14 M€	54 M€	203 M€
New railway Taivalkoski – Kemijärvi 200 km/h	154 km	1,050 M€	48 M€	1,100 M€
Total	311 km	1,200 M€	102 M€	**1,300 M€**

5.3.2.2 Alternative 2a (Kontiomäki – Taivalkoski – Kuusamo – Ruka – Kemijärvi)

Table 3. Cost estimate with design speed of 100 km/h.

Section	Length	Construction costs	Electrification cost	Total
Rehabilitation of Kontiomäki – Taivalkoski current railway 100 km/h	157 km	135 + 14 M€	54 M€	203 M€
New railway Taivalkoski – Kemijärvi 100 km/h	180 km	850 M€	56 M€	900 M€
Total	337 km	1,000 M€	110 M€	**1,100 M€**

Table 4. Cost estimate with design speed of 200 km/h.

Section	Length	Construction costs	Electrification cost	Total
Rehabilitation of Kontiomäki – Taivalkoski current railway 100 km/h	157 km	135 + 14 M€	54 M€	203 M€
New railway Taivalkoski – Kemijärvi 200 km/h	180 km	1,550 M€	56 M€	1,600 M€
Total	337 km	1,700 M€	110 M€	**1,800 M€**

5.3.2.3 Alternative 2b (Kontiomäki – Taivalkoski – Kuusamo – Ruka – Salla – Kemijärvi)

Table 5. Cost estimate with design speed of 100km/h.

Section	Length	Construction costs	Electrification cost	Total
Rehabilitation of Kontiomäki – Taivalkoski current railway 100 km/h	157 km	135 + 14 M€	54 M€	203 M€
New railway Taivalkoski – Kemijärvi 100 km/h	169 km	650 M€	52 M€	700 M€
Rehabilitation of current railway (Kemijärvi) – Isokylä – Salla	60 km	121 M€	19 M€	140 M€
Total	386 km	920 M€	125 M€	**1,050 M€**

Table 6. Cost estimate with design speed of 200 km/h.

Section	Length	Construction costs	Electrification cost	Total
Rehabilitation of Kontiomäki – Taivalkoski current railway 100 km/h	157 km	135 + 14 M€	54 M€	203 M€
New railway Taivalkoski – Kemijärvi 200 km/h	169 km	1,250 M€	52 M€	1,300 M€
Rehabilitation of current railway (Kemijärvi) – Isokylä – Salla	60 km	121 M€	19 M€	140 M€
Total	386 km	1,520 M€	125 M€	**1,650 M€**

5.3.3 Costs for railway maintenance and running in 30 years

The value of 10,000 €/km in the year 2035 was used in the calculations (including track maintenance and traffic control costs). The annual track maintenance and traffic control costs for 2035 – 2065 have been discounted to 2035 at a 3.5% rate. The following annual track maintenance and traffic control costs from 2035 – 2065 were calculated for the different alternatives:

- Alternative 1b – **64 M€**
- Alternative 2a – **70 M€**
- Alternative 2b – **82 M€.**

5.4 Passenger traffic demand

A new railway between Kontiomäki and Kemijärvi creates a connection between the eastern part of Finland and Finnish Lapland. Depending on the route, the municipalities along the new route are Taivalkoski, Posio, Kuusamo and Salla. The most important potential for passenger demand comes from the tourists that would be travelling to holiday resorts in the area.

The potential for passenger demand has been estimated using a transport model that covers the whole of Finland. The model covers all modes of passenger travel. It estimates the number of travellers in different parts of the network based on the development of the transport network and services.

According to the model, the routes going through Kuusamo and Salla (2a and 2b) have a larger potential for passenger demand than the alternative (1b) going through Posio. This is because Kuusamo (together with Salla) acts as a regional centre of the area and it attracts tourists thanks to the Ruka and Sallatunturi holiday resorts and Oulanka National Park. The Kontiomäki–Taivalkoski–Kuusamo–Kemijärvi railway also creates a connection between Kuusamo and Rovaniemi, which is the capital of Finnish Lapland.

The model predicts the following numbers of passengers on different sections of the railway. These figures refer to the approximate annual number of passengers in 2040:

Alternative **1b via Posio:**

- **Kontiomäki – Taivalkoski: 105,000**
- **Taivalkoski – Kemijärvi: 75,000**
- Decrease in existing Oulu **–** Kemi connection from 845.000 to 805,000 (40,000)
- Increase in existing Iisalmi **–** Kontiomäki connection from 190,000 to 310,000 (120,000).

Alternative **2a via Kuusamo:**

- **Kontiomäki–Kuusamo: 135,000**
- **Kuusamo–Kemijärvi: 80,000**
- Decrease in existing Oulu-Kemi track from 845,000 to 830,000 (15,000)
- Increase in existing Iisalmi **–** Kontiomäki connection from 190,000 to 350,000 (160,000).

Alternative **2b** via Kuusamo and Salla:

- **Kontiomäki – Kuusamo: 140,000**
- **Kuusamo–Salla: 90,000**
- **Salla–Kemijärvi: 80,000**
- Decrease in existing Oulu-Kemi track from 845,000 to 835,000 (10,000)
- Increase in existing Iisalmi **–** Kontiomäki connection from 190,000 to 355,000 (165,000).

These numbers are comparable with the actual number of passengers in 2019:

- Kontiomäki–Oulu: 130,000
- Kemi–Kolari: 75,000.

It has been assumed that the passenger trains serving the new railway route are trains coming from Helsinki and travelling via Kuopio and Taivalkoski to Kemijärvi and terminating at Rovaniemi.

Therefore, the new railway will also increase the number of passengers between Kemijärvi and Rovaniemi.

It is not possible to distinguish how the new trips would be established due to limitations in the transport model. However, the total number of trips can be said to originate from:

- re-routed railway trips with the same origin and destination but with a different route than before
- re-routed railway trips with destination change (e.g. different holiday resort than before)
- modal change (trips that would be done on other modes of transportation without the new railway connection)
- completely new trips, which would not be made at all without the new railway connection.

The monthly fluctuation of the passenger demand is high. The number of passenger trains serving this area would likely be highest during the busiest holiday months, and a very limited service would operate during quieter times.

In all alternatives this new railway connection would form a new alternative North - South railway (night train) passenger transport route to current Helsinki – Rovaniemi - Kemijärvi route.

6. KONTIOMÄKI–KEMIJÄRVI–SALLA–KANDALAKSHA–MURMANSK COSTS AND PASSENGER VOLUMES

This combination would create a new railway connection between Northern Finland and the Barents Sea consisting of new Kontiomäki – Kemijärvi and new Kemijärvi (Isokylä) - Salla Kandalaksha railways. The cost information for the latter has been adopted from the Salla - Kandalaksha railway study conducted in 2015 for the Kolarctic CBC "Barents Freeway" project.

6.1 Cost estimates (MAKU 130, 2010 = 100)

6.1.1 Alternative 1b

Table 7. Kontiomäki-Kemijärvi via Posio (100 km/h), Kemijärvi-Salla-Kandalaksha.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (1b)	311 km	800 M€	102 M€	900 M€
Kemijärvi - Salla - Kandalaksha	258.5 km	796 M€		800 M€
Total				**1,700 M€**

Table 8. Kontiomäki-Kemijärvi via Posio (200 km/h), Kemijärvi-Salla-Kandalaksha.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi	311 km	1,200 M€	102 M€	1,300 M€
Kemijärvi - Salla - Kandalaksha	258.5 km	796 M€		800 M€
Total				**2,100 M€**

6.1.2 Alternative 2a

Table 9. Kontiomäki-Kemijärvi via Kuusamo (100 km/h), Kemijärvi-Salla-Kandalaksha.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (2a)	337 km	1,000 M€	110 M€	1,100 M€
Kemijärvi - Salla - Kandalaksha	258.5 km	796 M€		800 M€
Total				**1,900 M€**

Table 10. Kontiomäki-Kemijärvi via Kuusamo (200 km/h), Kemijärvi-Salla-Kandalaksha.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (2a)	337 km	1,700 M€	110 M€	1,800 M€
Kemijärvi - Salla - Kandalaksha	258.5 km	796 M€		800 M€
Total				**2,600 M€**

6.1.3 Alternative 2b

Table 11. Kontiomäki-Kemijärvi via Salla (100 km/h), Kemijärvi-Salla-Kandalaksha.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (2b)	326 km	800 M€	106 M€	900 M€
Kemijärvi - Salla - Kandalaksha	258.5 km	796 M€		800 M€
Total				**1,700 M€**

Table 12. Kontiomäki-Kemijärvi via Salla (200 km/h), Kemijärvi-Salla-Kandalaksha.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (2b)	326 km	1,400 M€	106 M€	1,500 M€
Kemijärvi - Salla - Kandalaksha	258.5 km	796 M€		800 M€
Total				**2,300 M€**

6.2 Passenger traffic demand

If the railway connection between Salla and Kandalaksha is reopened, there is a theoretical potential for passenger trains using this section.

The number of persons crossing the border in Salla was 120,000 in 2019, and only a small percentage of these travellers are potential users of railway services. It is difficult to see any major potential for passenger trains because the potential destinations for passengers are distant and the number of passengers would be low compared with the capacity of a train. The daily or weekly passengers crossing the border could effectively be transported by buses.

However, instead of regular trains, there is a certain potential for charter-type train services, for example, to and from Murmansk.

7. KONTIOMÄKI–KEMIJÄRVI–KIRKENES RAILWAY COSTS AND PASSENGER VOLUMES

This combination would create a new railway connection between Northern Finland and the Barents Sea consisting of new Kontiomäki – Kemijärvi and new Kemijärvi – Sodankylä - Kirkenes railways. The cost information from the latter has been adopted from the Kemijärvi - Kirkenes railway study conducted in 2015 for the Kolarctic CBC "Barents Freeway" project.

7.1 Cost estimates (MAKU 130, 2010 = 100)

7.1.1 Alternative 1b

Table 13. Kontiomäki-Kemijärvi via Posio (100 km/h), Kemijärvi-Kirkenes.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (1b)	311 km	800 M€	102 M€	900 M€
Kemijärvi-Kirkenes	456 km	2,000 M€		2,000 M€
Total				**2,900 M€**

Table 14. Kontiomäki-Kemijärvi via Posio (200 km/h), Kemijärvi-Kirkenes.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (1b)	311 km	1,200 M€	102 M€	1,300 M€
Kemijärvi-Kirkenes	456 km	2,000 M€		2,000 M€
Total				**3,300 M€**

7.1.2 Alternative 2a

Table 15. Kontiomäki-Kemijärvi via Kuusamo (100 km/h), Kemijärvi-Kirkenes.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (2a)	337 km	1,000 M€	110 M€	1,100 M€
Kemijärvi-Kirkenes	456km	2,000 M€		2,000 M€
Total				**3,100 M€**

Table 16. Kontiomäki-Kemijärvi via Kuusamo (200 km/h), Kemijärvi-Kirkenes.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (2a)	337 km	1,700 M€		1,800 M€
Kemijärvi-Kirkenes	456km	2,000 M€		2,000 M€
Total				**3,800 M€**

7.1.4 Alternative 2b

Table 17. Kontiomäki-Kemijärvi via Salla (100 km/h), Kemijärvi-Kirkenes.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (2b)	326 km	800 M€	106 M€	900 M€
Kemijärvi-Kirkenes	456km	2,000 M€		2,000 M€
Total				**2,900 M€**

Table 18. Kontiomäki-Kemijärvi via Salla (200 km/h), Kemijärvi-Kirkenes.

Section	Length	Construction costs	Electrification cost	Total
Kontiomäki-Kemijärvi (2b)	326 km	1,400 M€	106 M€	1,500 M€
Kemijärvi-Kirkenes	456km	2,000 M€		2,000 M€
Total				**3,500M€**

7.2 Passenger traffic demand

If the new railway is extended from Kemijärvi to Kirkenes via Sodankylä and Ivalo, there is a potential to extend the passenger train services from Kemijärvi further north. The greatest potential is from Kemijärvi to Sodankylä, where there are the holiday resorts of Pyhätunturi and Luosto nearby. From Sodankylä to Ivalo, the passenger potential is smaller. Between Ivalo and Kirkenes, the number of passengers would be so small that there is no potential for regular passenger trains there.

The potential for passenger demand according to the transport model is as follows. The numbers presented are the approximate annual number of passengers expected in 2040:

- Kontiomäki–Kuusamo: 150,000
- Kuusamo–Kemijärvi: 95,000
- Kemijärvi–Sodankylä: 65,000
- Sodankylä–Ivalo: 40,000.

It has been assumed that the passenger trains going to Sodankylä and Ivalo are trains coming from Helsinki and travelling both via Kuopio and Kuusamo and via Oulu and Rovaniemi. Therefore, there is a connection to Sodankylä and Ivalo both from the eastern and western parts of Finland.

The monthly fluctuation of passenger demand is high. The number pf passenger trains serving this area would likely be highest during the busiest holiday months, and a very limited service would operate during quieter times.

8. FINAL WORDS

This preliminary study included the first evaluation of three proposed track alignments between Kontiomäki – Kemijärvi. The study consisted of an approximate cost evaluation and analysis of potential effects on land use. It provides gives guidelines for further planning; however, a more in-depth cost-benefit analysis should be done for the basis of decision-making. The alignment should be included in the general land use plan (maakuntakaava) and master plans should also be updated. The general plan of track alignment must be devised according to the master plan. Together with the general plan, an environmental impact assessment for the alignment option should be prepared as well.

After the general plan is complete, the city plan and rail plan should be done. When these are approved, the actual building plan can take place.

Freight transport may be a justification for the new rail connections and further studies are needed on the demand for goods on trains in the area. The study area also has a certain potential for new passenger trains. However, the number of passenger trains serving new rail connections is limited, up to a couple of trains per day per direction. That is why passenger trains are mainly an added value of new rail links. The value for freight transportation should be studied carefully since the investment costs are significant.

The reindeer economy is impacted by the railway in many ways. The pasture area is decreased, reindeer movement is hindered, and reindeers are lost in accidents. These problems can be mitigated by creating a dialogue between stakeholders during the design phase, and addressing possible solutions such as fences, subways, and crossings.

A significant citizen participation process was not carried out in this phase. In Finnish infrastructure project cycles, the preliminary engineering (the next phase after this study) is the most important and appropriate platform for inclusion of the full citizen participation process in this railway’s project cycle.

Originally, in this and in several other work packages of the NABL-project, it was planned to include freight traffic volume analyses using the same method as in the Barents Freeway 2014 project (with the updated freight data). However, the tools to do so (the Frisbee database and the STAN computer model) were closed on 31.12.2019. A similar freight model (to be produced by Traficom) will be available no earlier than in 2026. This lack of an analysing tool is also the reason why economic profitability calculations were not carried out. During the Barents Freeway 2014 projects, four railway pilot studies were notified that the consigner benefits (that could be revealed with Frisbee - STAN analyses) were roughly 80% of all of the benefits of the railway infrastructure projects.

The lack of a state-of-the-art analysing tool to make the economic profitability calculations (to analyse consigner benefits) was also one of the reasons why it was decided to propose three variants for analyses in the future planning phase. This is because it was not possible to produce serious economic analysis to justify the best variant.

The NATURA areas that are in the vicinity of the Kontiomäki-Pesiökylä railway must be notified and related assessments must be made in the first parts of the next phases of the railway rehabilitation planning and designing. A lack of these assessments may significantly slow down the railway implementation process.

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