Project KO4159 NABL, Northern Axis – Barents Link

WP 6
Kontiomäki - Kemijärvi railway study

February 15, 2022

Northern Axis

Barents Link

Introduction NABL WP 6 Study of the railway Kontiomäki – Taivalkoski – Kemijärvi

The first steps:

1. Request of proposals of outsourced works in Hilma announced 2.3.2020
2. Proposals received 6.4.2020, evaluated and decision made 7.4.2020
3. Outsourced assignment contract signed 29.4.2020
4. Launching meeting organized 8.5.2020
5. Two meetings in the decision-making organ of the Client (ILKY) 6.10. and 8.12.2020
6. Joint meeting between East Lapland Federation of Municipalities, LP and Finnish Transport Infrastructure Agency on 16.12.2020.

Outsourced consultant group contracted:

- Traficon Oy (Finland), leading the group
- Ramboll Finland Oy
- Ramboll Sweden Ab
- OOO Avtodoroshnii Consulting (Russia)

Study of the railway Kontiomäki – Taivalkoski – Kemijärvi

Work program:

1. Update of Russian freight data
2. Railway alternatives Kontiomäki – Kemijärvi (overall level / design level)
3. Estimates of costs for construction
4. Prognosis of passenger transport
5. Estimates of costs for construction of Kontiomäki-Kemijärvi-Salla – Kandalaksha railway, passenger transport prognosis
6. Estimates of costs for construction Kontiomäki-Kemijärvi- Kirkenes railway, passenger transport prognosis
7. Proposals for next steps and reporting

Study of the railway Kontiomäki – Taivalkoski – Kemijärvi

Update of Russian freight data

- Work launched on spring 2020 (by ooo Avtodoroshni consulting)
- Origin-destination of Russian freight export 2015-2019 in 20 commodity groups collected and formed into origin – destination matrixes
- Contacts of the future freight model owner (TRAFICOM) made
- Agreed upon delivery of the data to the model constructor
- The (Finnish) TRAFICOM have organized the model update work
- Freight model will be ready for use on the year 2026

Kontiomäki – Pesiökylä - Taivalkoski current railway

- Finnish government has in 2020 reserved 81 M€ for rehabilitation of Kontiomäki- Pesiökylä railway.
- In the rehabilitation works railway support structures will be renewed, safety equipment installed and crossings with roads arranged.
- Pesiökylä will get a new timber loading terminal and current Ämmänsaari terminal and Pesiökylä – Ämmänsaari railway section would be closed.
- Rehabilitation works has been started on August 2021 and completed by 2023.

Study of the railway Kontiomäki – Taivalkoski – Kemijärvi

Railway alternatives Kontiomäki – Kemijärvi (general level / design level)

- 3 main alternatives made in regional planning level (maps on next pages)
- Variants introduced to decision making organ of Mun. Federation on **6.10.2020**
- Decided to study the third variant (through Kuusamo-Salla)

- Third variant was introduced on **8.12.2020** and made decisions, that all 3 variants will continue to more detailed (rail technical design) phase
- Reindeer economy digital maps was bought from Finnish Reindeer Association

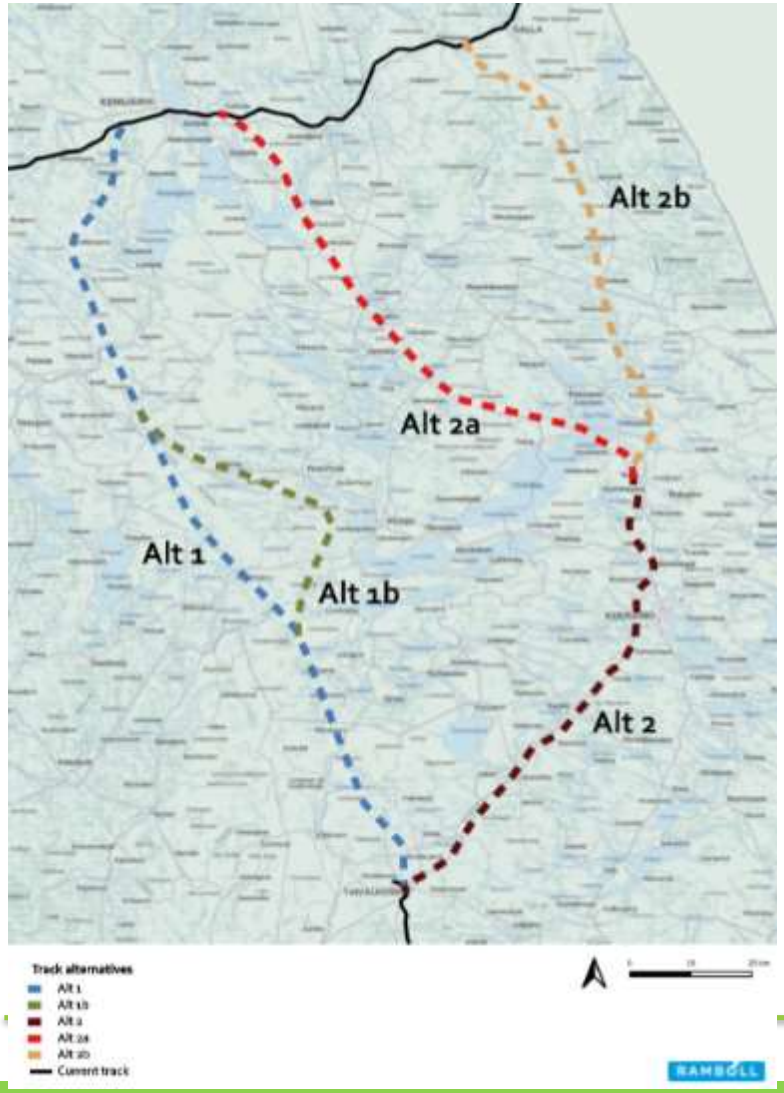
Study of the railway Kontiomäki – Taivalkoski – Kemijärvi

Intermediate results were introduced in Internet meeting b/w the Local Federation, the Lead Partner and NABL-partner Finnish Transport Infrastructure Agency, who is the administrator of railways in Finland (“the railway owner”) on **16.12.2020**.

After that meeting three intermediate decisions were made:

- Railway technical planning will be made in planning speed 200 km/h.
- Costs estimates will be made to 200km/h and 100km/h railway.
- Railway freight transport potential will be assessed by the client.

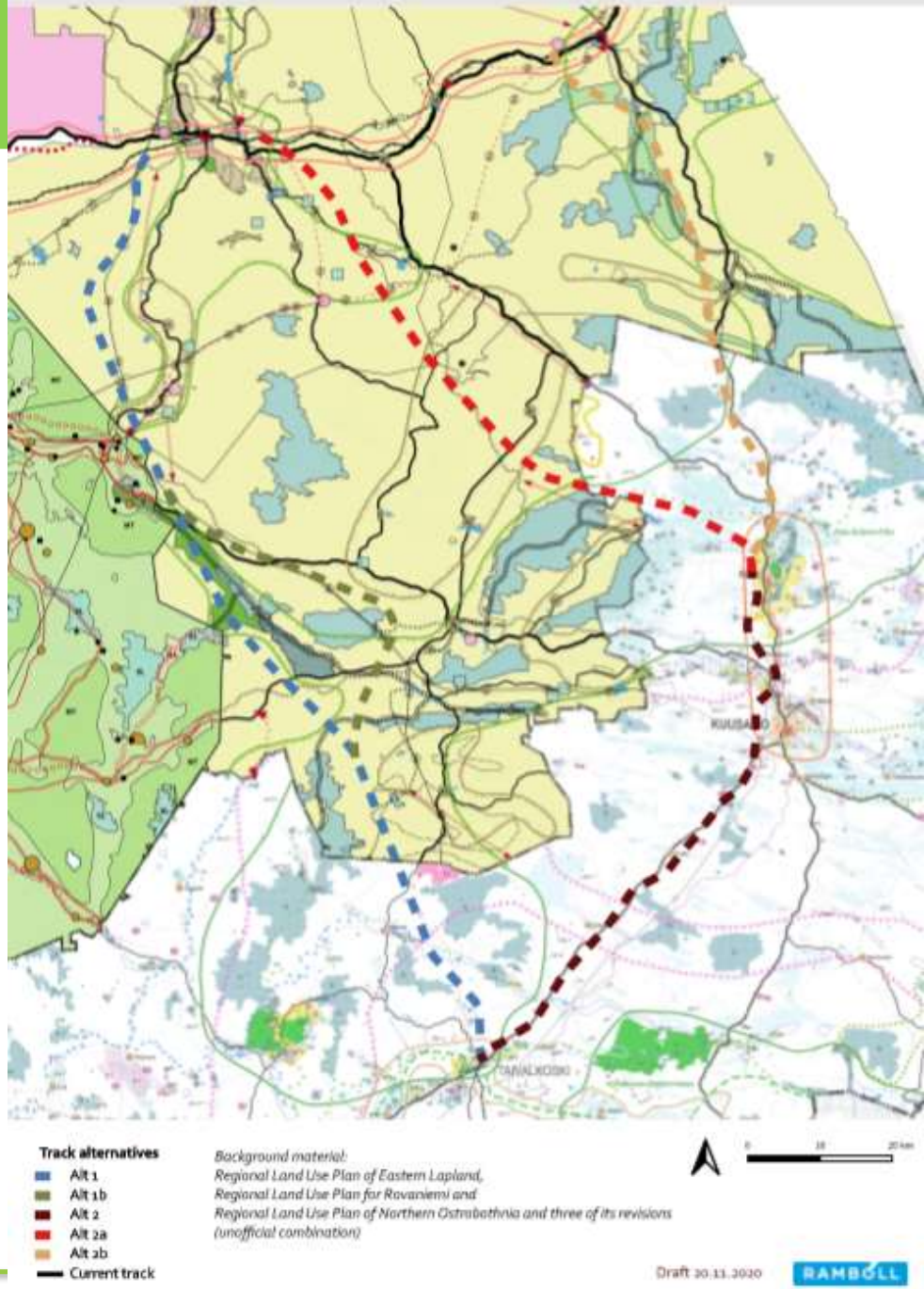
Kontiomäki-Kemijärvi railway, alternatives 1b, 2a, 2b for the new railway section



Kontiomäki-Kemijärvi railway, alternatives for the new railway section

Railway alternatives 1b, 2a and 2b between Taivalkoski – Kemijärvi

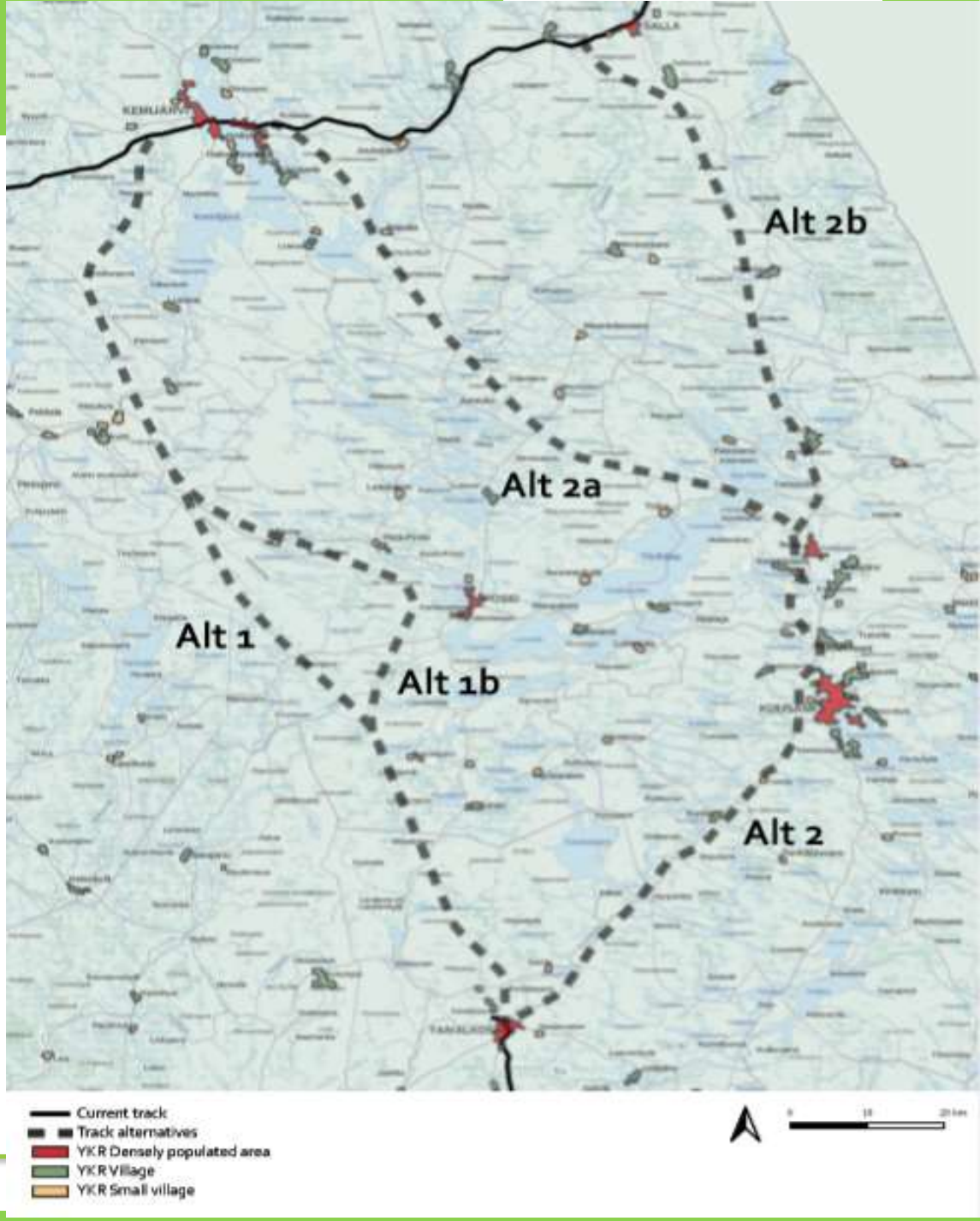
on the map of the regional plan



Kontiomäki-Kemijärvi railway, alternatives for the new railway section

Railway alternatives
1b, 2a and 2b
between Taivalkoski – Kemijärvi

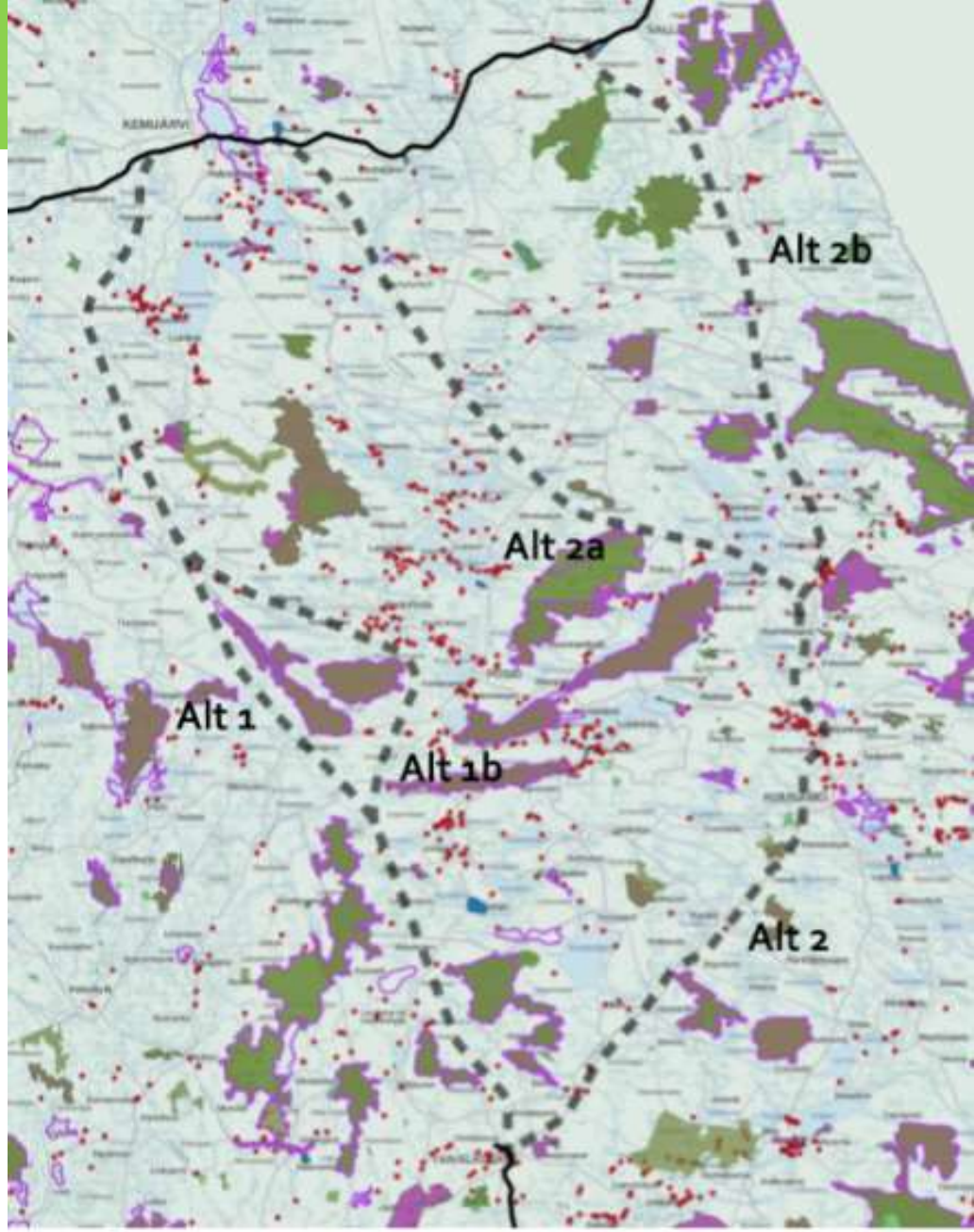
with populated areas, cities and villages



Kontiomäki-Kemijärvi railway, alternatives for the new railway section

Railway alternatives 1b, 2a and 2b b/w Taivalkoski – Kemijärvi

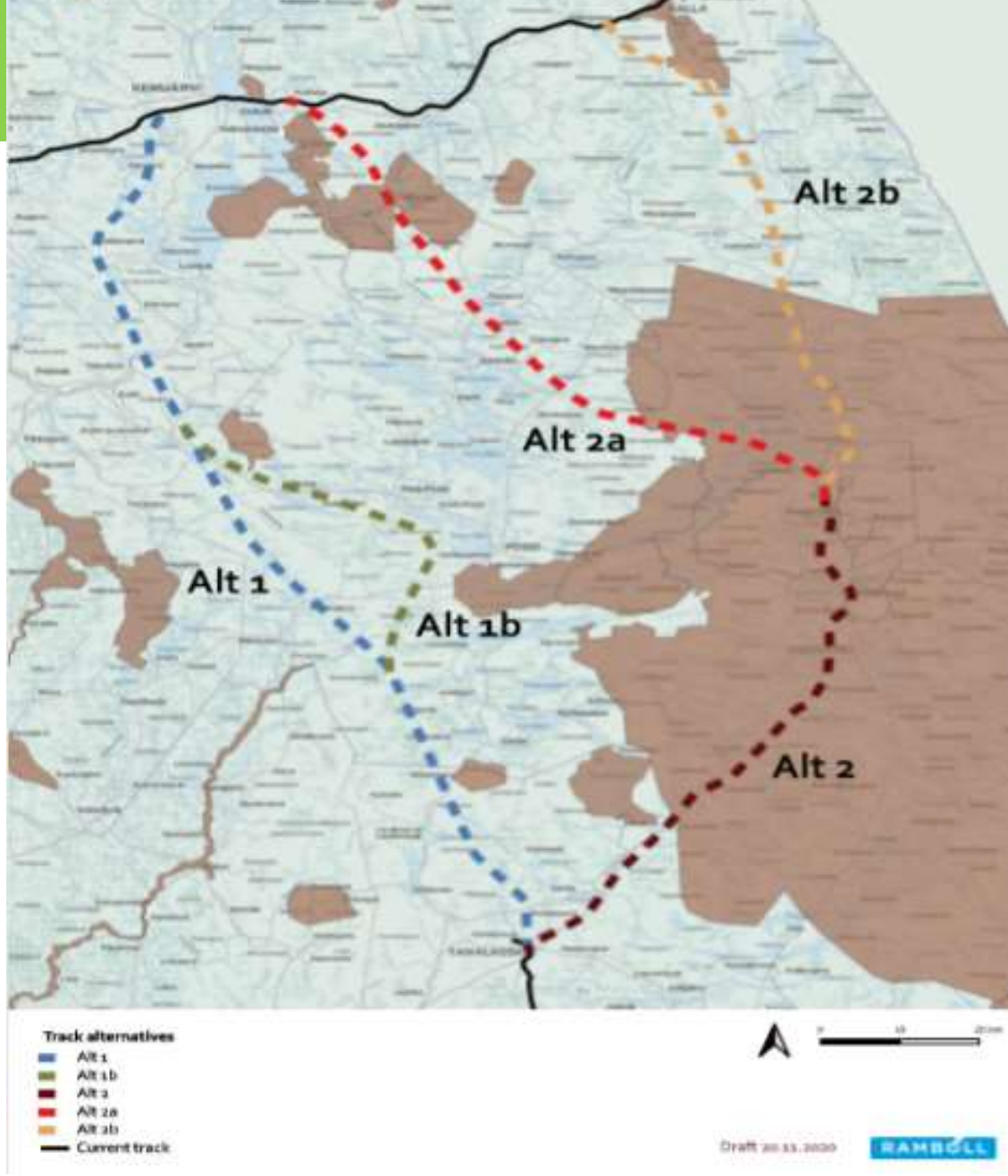
with protected areas



Kontiomäki-Kemijärvi railway, alternatives for the new railway section

Railway alternatives 1b, 2a and 2b b/w Taivalkoski – Kemijärvi

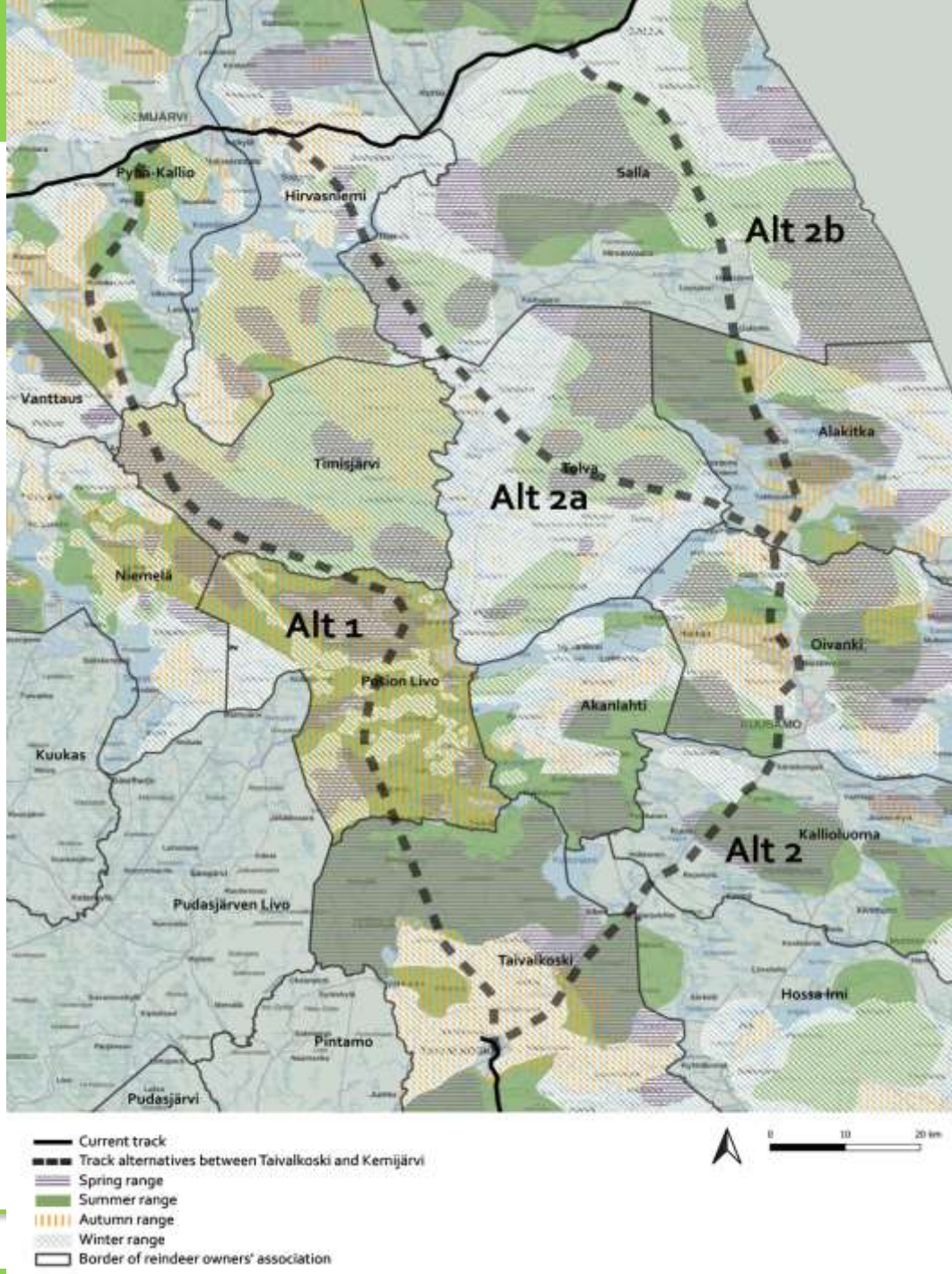
with areas covered by general land use plans



Kontiomäki-Kemijärvi railway, alternatives for the new railway section

Railway alternatives 1b, 2a and 2b b/w Taivalkoski – Kemijärvi

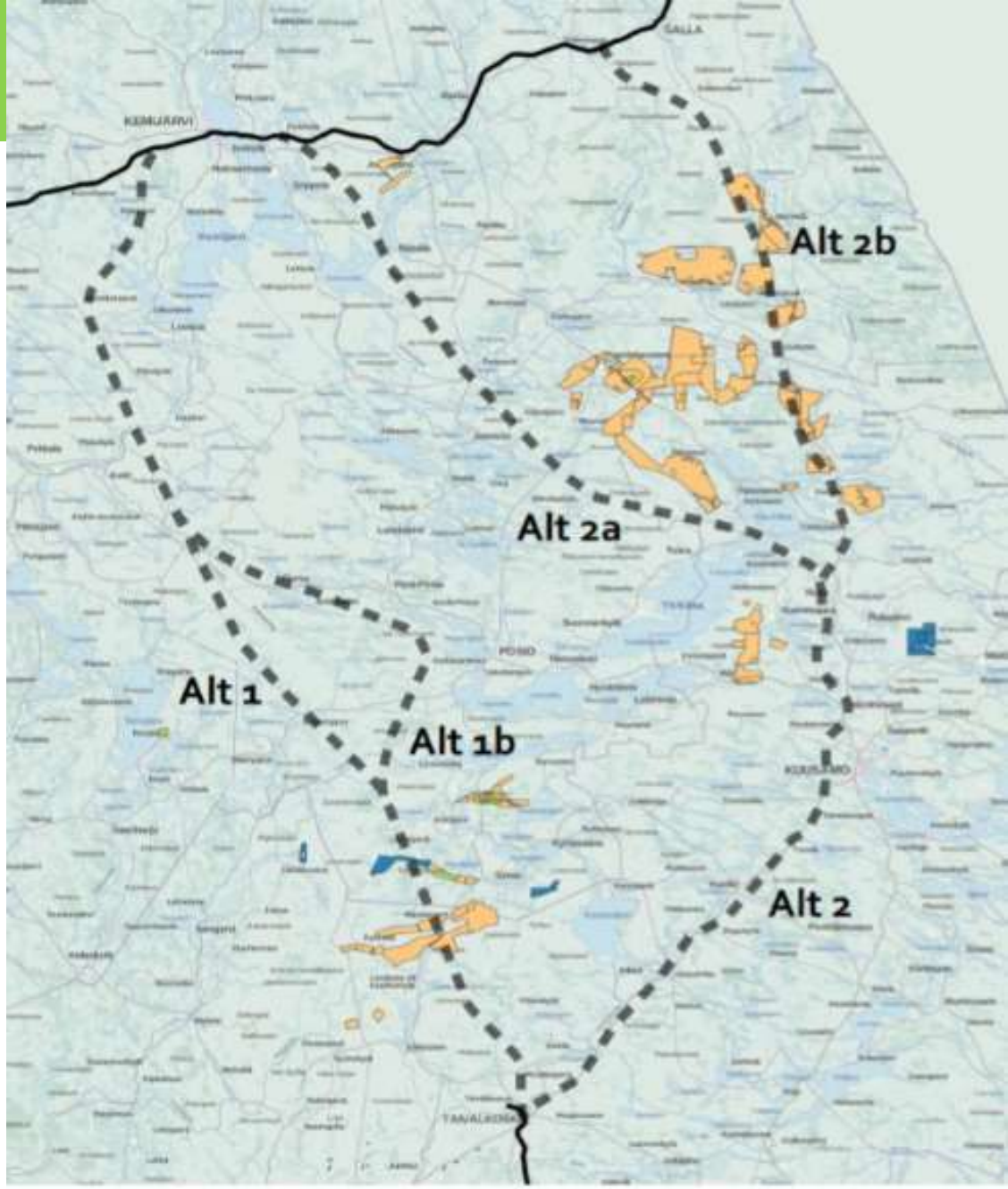
and range areas of reindeer herding



Kontiomäki-Kemijärvi railway, alternatives for the new railway section

Railway alternatives 1b, 2a and 2b b/w Taivalkoski – Kemijärvi

with areas for permits of ore prospecting



Tunnels and bridges

Tunnels have been used when alignment requires deep cuttings (15 m or more). Alignment alternatives with design speed of **200 km/h** includes bridges and tunnels as follows:

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

Design speed of **100 km/h** would reduce the amounts of bridges and tunnels significantly:

- Less tunnels by 70 %.
- Less bridges are needed (they can also be shorter in length)

Potential freight origins using the new railway connection Kontiomäki-Kemijärvi

- Current **Patokangas freight terminal** produced about **650.000 tons** freight flow in 2020.
- **Energy timber** (small size timber) **100.000-200.000 tons** annually. The market is 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. If the mine will be opened and railway to Solki constructed to, the railway Solki-Kelloselkä would carry **1,8-1,9 Mtons** annually. The railway Kontiomäki - Kemijärvi would offer an alternative to ore transport. It would be very attractive direction, if the development location of Sokli ore would be Siilinjärvi (one rather likely location).
- Finish Government has made in 2020 decision to reconstruct the first part of Kontiomäki-Kemijärvi new railway connection for the use of forest industry raw material transportation. The 81 MEuro investment to Kontiomäki – Pesiökylä current 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 to transport directions of forest raw materials. Several biochemical plants are planned or have the investment decision.

Potential freight origins after the new railway connection Kontiomäki-Kemijärvi and possible Kemijärvi – Salla – Kandalaksha railway

Assumption of the distribution of forecasted freight volumes 2030:

Salla – Kemijärvi – Rovaniemi, 50%
2,5 Mtons/a

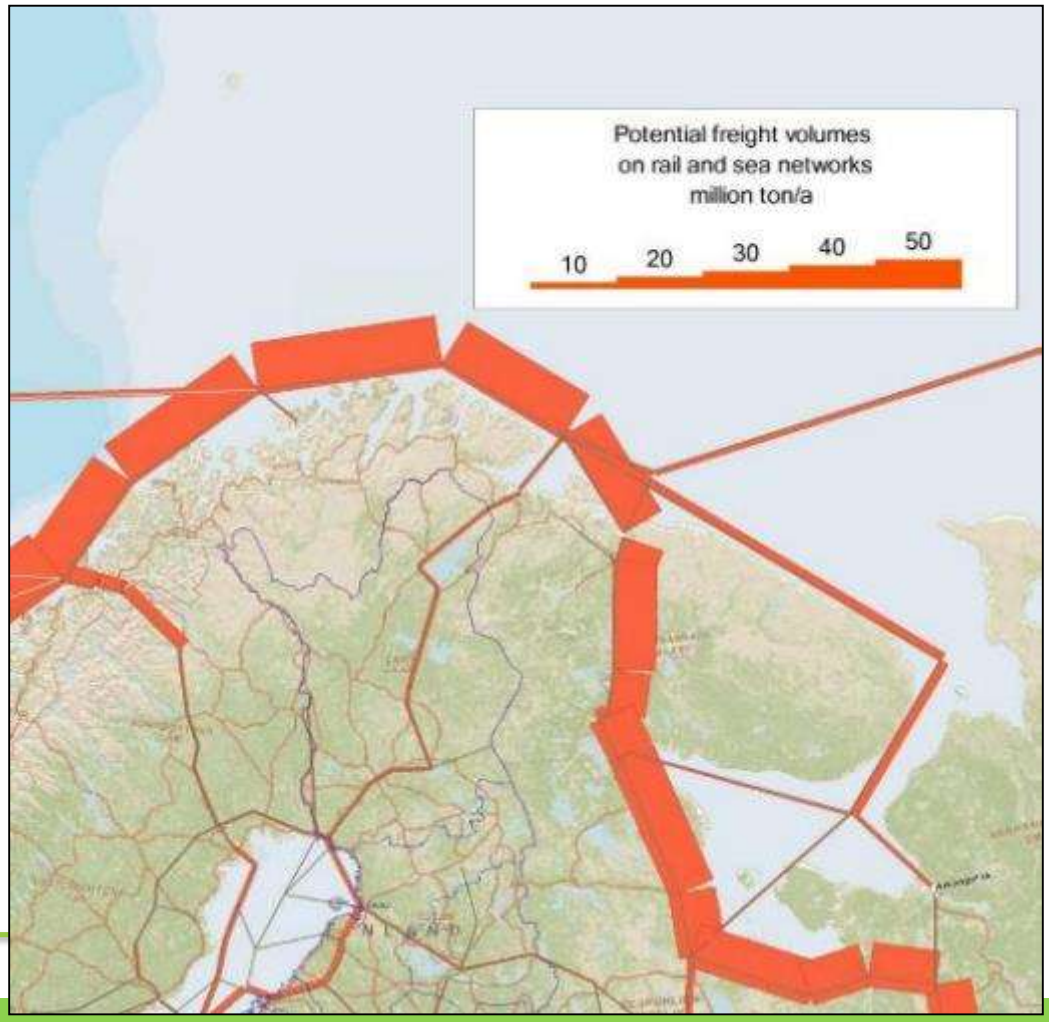
Salla – Kontiomäki
50%
2,5 Mtons/a

Potential freight origins after the new railway connection Kontiomäki-Kemijärvi and possible Kemijärvi – Kirkenes railway

Assumption of the distribution of forecasted freight volumes 2030:

Kemijärvi – Rovaniemi, 50%
2 Mtons/a

Kemijärvi – Kontiomäki 50%
2 Mtons/a



Forecast of passenger transport

Evaluated on passenger transport model (the figures below are annual passenger flows on the railway in the year 2040)

Variant 1b (via Posio):

- Kontiomäki–Taivalkoski: 105 000
- Taivalkoski–Kemijärvi: 75 000

Impacts to other railway connections:

- 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)

Variant 2a (via Kuusamo):

- Kontiomäki – Kuusamo: 135 000
- Kuusamo–Kemijärvi: 80 000

Impacts to other railway connections:

- 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)

Forecast of passenger transport

Variant 2b (via Kuusamo and Salla):

- Kontiomäki – Kuusamo: 140 000
- Kuusamo–Salla: 90 000
- Salla–Kemijärvi: 80 000

Impacts to other railway connections:

- 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)

To get a scale of the figures they can be compared to current (2019) passenger flows:

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

The new railway forms a second South-North railway passenger transport route Helsinki - Kuopio –Taivalkoski - Kemijärvi and with the end station Rovaniemi.

Alternative implementation in stages of Kontiomäki – Taivalkoski – Kemijärvi railway

The first stage of implementation will be made soon as Kontiomäki - Pesiökylä current railway section will be rehabilitated in the coming years.

The following implementation stages could be done in different methods:

1. To reconstruct Pesiökylä - Taivalkoski current railway and construct the new section Taivalkoski – Kemijärvi and start to exploit the railway in diesel locomotives. After that electrifying the whole railway line Kontiomäki – Kemijärvi, or

2. The reconstruction of Pesiökylä - Taivalkoski and construction of Taivalkoski – Kemijärvi and electrification of both sections in one 3-5 years implementation project.

Principles used in the cost estimations

- Used **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.
- Following assumptions has been used in cost estimates:
    - Embankment 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%**

Principles used in the cost estimations

- The cost have been evaluated with **2 meters deep ballasted substructure**.
- The costs of bridges include **road arrangements (1 km per bridge)** but does 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 in every 500 meters**.
- **Tunnels** will be used when the railway structures would otherwise require a **15 or more meters deep cutting**.
- The cost of the tunnels is evaluated by calculating an average cost per meter for **a single-track rock tunnel**.

Principles used in the cost estimations

- The costs have been calculated with the 200 km/h planning speed.
- In addition, cost estimates are done also for 100 km/h planning speed.

- The following factors make the costs lower when the planning speed is reduced from 200 km/h into 100km/h:

  - Railway bank will be narrower
  - Electricity and safety equipment costs are lower
  - At-grade-crossing are allowed.
  - In smaller road (than regional ones), instead of bridges will be at-grade-crossings
  - Bridges over the waters can be implemented shorter
  - About 70 % of tunnels can be avoided
  - About 30 % of sections with soft ground can be avoided.

Cost estimation Kontiomäki – Taivalkoski – Kemijärvi railway

Alternative 1b (Kontiomäki - Taivalkoski - Posio – Kemijärvi) **100 km/h**

Section	length	constr. costs	electr. 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€
Together	311 km	800 M€	102 M€	**900 M€**

Cost estimation Kontiomäki – Taivalkoski – Kemijärvi railway

Alternative 1b (Kontiomäki - Taivalkoski - Posio – Kemijärvi) **200 km/h**

Section	length	constr. costs	electr. 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	1050 M€	48 M€	1100 M€
Together	311 km	1200 M€	102 M€	**1300 M€**

Cost estimation Kontiomäki – Taivalkoski – Kemijärvi railway

Alternative 2a (Kontiomäki - Taivalkoski – Kuusamo – Kemijärvi) **100 km/h**

Section	length	constr. costs	electr. 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€
Together	337 km	1000 M€	110 M€	**1100 M€**

Cost estimation Kontiomäki – Taivalkoski – Kemijärvi railway

Alternative 2a (Kontiomäki - Taivalkoski – Kuusamo – Kemijärvi) **200 km/h**

Section	length	constr. costs	electr. 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	1550 M€	56 M€	1600 M€
Together	337 km	1700 M€	110 M€	**1800 M€**

Cost estimation Kontiomäki – Taivalkoski – Kemijärvi railway

Alternative 2b (Kontiomäki - Taivalkoski - Kuusamo - Salla - Kemijärvi) **100 km/h**

Section	length	constr. costs	electr. cost	Total
Rehabilitation of Kontiomäki – Taivalkoski current railway, 100 km/h	157 km	135 + 14 M€	54 M€	203 M€
New railway Taivalkoski – Salla, **100 km/h**	169 km	650 M€	52 M€	700 M€
Rehabilitation of current railway (Kemijärvi) – Isokylä – Salla, 100 km/h	60 km	121 M€	19 M€	140 M€
Together	386 km	920 M€	125 M€	**1050 M€**

Cost estimation Kontiomäki – Taivalkoski – Kemijärvi railway

Alternative 2b (Kontiomäki - Taivalkoski – Kuusamo – Salla - Kemijärvi) **200km/h**

Section	length	constr. costs	electr. cost	Total
Rehabilitation of Kontiomäki – Taivalkoski current railway, 100 km/h	157 km	135 + 14 M€	54 M€	203 M€
New railway Taivalkoski – Salla, **200 km/h**	169 km	1250 M€	52 M€	1300 M€
Rehabilitation of current railway (Kemijärvi) – Isokylä – Salla, 100 km/h	60 km	121 M€	19 M€	140 M€
Together	386 km	1520 M€	125 M€	**1650 M€**

Cost estimation Kontiomäki – Kemijärvi – Salla – Kandalaksha railway

Kontiomäki – Kemijärvi alternative **1b** and Kemijärvi - Salla - Kandalaksha railway projects implementation together would cost **1700 - 2100 M€** (100 – 200 km/h).

Kontiomäki – Kemijärvi alternative **2a** and Kemijärvi - Salla - Kandalaksha railway projects implementation together would cost **1900 - 2600 M€** (100 – 200 km/h)

Kontiomäki – Kemijärvi alternative **2b** and Kemijärvi - Salla - Kandalaksha railway projects implementation together would cost **1700 - 2300 M€** (100 – 200 km/h)

Cost estimation Kontiomäki – Kemijärvi – Sodankylä – Kirkenes railway

Kontiomäki – Kemijärvi alternative **1b** and Kemijärvi – Sodankylä - Kirkenes railway projects implementation together would cost **2900 - 3300 M€** (100 – 200 km/h).

Kontiomäki – Kemijärvi alternative **2a** and Kemijärvi – Sodankylä - Kirkenes railway projects implementation together would cost **3100 - 3800 M€** (100 – 200 km/h)

Kontiomäki – Kemijärvi alternative **2b** and Kemijärvi – Sodankylä - Kirkenes railway projects implementation together would cost **2900 - 3500 M€** (100 – 200 km/h)

Forecast of passenger transport to Kontiomäki – Kuusamo – Kemijärvi – Sodankylä - Ivalo (Kirkenes) railway

Evaluated on passenger transport model (the figures below are annual passenger flows on the railway in the year 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.

Final words

The study gives guidelines to the further planning, but 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 accordingly to master plan. Together with general plan the environmental impact assessment for the alignment option should be prepared as well.

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

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

Final words

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 value for freight transportation should be studied carefully since the investment costs are significant.

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.

Reindeer economy is impacted by the railway in many ways. The pasture area is decreased, reindeer movement is hindrance and reindeers are lost in accidents. The ways to mitigate these problems is to have dialogue between stakeholders during the design phase, 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 (next phase from this study) is the most important and appropriate platform for the full citizen participation process of this railway´s project cycle.

Final words

Originally, in this and in NABL -projects several other work packages, was planned to make the freight traffic volume analyses in the same method that in Barents Freeway 2014 (with the updated freight data). However, the tools to make that (the Frisbee database and the STAN computer model) were closed on 31.12.2019. The following similar **freight model (to be produced by Traficom) will be available not earlier than in 2026**.

This (lack of analyzing tool) is also the reason, why economic profitability calculations were not carried out. During Barents Freeway 2014 projects 4 railway pilot studies were notified that the consigner benefits (that could be revealed with Frisbee - STAN analyses) were **roughly 80% of all the benefits** of the railway infrastructure projects.

The lack of state-of-the-art analyzing tool to make the economic profitability calculations (to analyze consigner benefits) was also one of the reasons, why it was decided to propose **3 variants** to analyses of the future planning phase, as serious economic analyze to justify the best variant was not possible to produce.

Final words (marketing)

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€.

THE LOCAL FEDERATION OF EAST LAPLAND

REGIONAL COUNCIL OF KAINUU

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