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Joint Environmental Management of the River Tana - WP2 Migration barriers

Joint summary report (2017-2019)

ANNI OLKONIEMI (EDIT.)

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JOINT ENVIRONMENTAL MANAGEMENT OF RIVER TANA–WP2 MIGRATION BARRIERS
JOINT SUMMARY REPORT (2017-2019)

Center for Economic Development, Transport and environment for Lapland

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1 Preface

In northern rivers with sparse fish fauna, juvenile salmonid fish may enter small tributaries from the main stems of rivers where they have been born, and use them for nursery habitat during some life stages as nursery habitats (Levings et al. 1995; Erkinaro et al. 1998, Johansen et al. 2005a). Such habitat shifts are likely responses to sub-optimal habitat conditions, e.g. discharge, temperature, substrate, predation or food availability in the original habitats of the fish (Erkinaro 1995; Erkinaro & Niemelä 1995; Kahler et al. 2001; Johansen et al. 2005a,b and references therein). Shifts are typically partial in a population (Jonsson & Jonsson 1993; Erkinaro 1995); individuals whose needs are not satisfied in the natal habitat are likely those actively searching for more favourable conditions (e.g. Erkinaro & Niemelä 1995; Steingrimsson & Grant 2003).

In the Tana river system, juvenile salmon make extensive use of small streams where adult fish do not reproduce but juveniles enter them from the spawning areas in the main stem and larger tributaries (Erkinaro 1995; Johansen et al. 2005a). The streams serve as a secondary (in time) nursery area after emergence and early residence in the spawning rivers. Juvenile salmon stay in the streams for one or more years before descending back to the main stem of the river and/or directly start their migration to the sea. Stream-dwelling juveniles are often larger compared to their counterparts of the same age living in the main rivers, and typically show faster growth also during their first or second year in their original habitat, before the migration from the spawning rivers to the brooks (Erkinaro & Niemelä 1995). The enhanced growth of juveniles has been attributed at least partly to more abundant food resources available in the nursery streams (Erkinaro & Niemelä 1995, Erkinaro & Erkinaro 1998, Johansen et al. 2005b). Moreover, the small streams are also important for Arctic char (Korpisaari 2016) and brown trout, both for spawning (Orell et al. 2017) and juvenile rearing (Erkinaro 1995).

There are probably hundreds of such nursery streams in the salmon distribution area of the Teno catchment, so their total importance for salmon production should not be underestimated (Erkinaro 1997; Erkinaro et al. 1997; Johansen et al. 2005a), and connectivity to these habitats should be safeguarded (Erkinaro et al. 2017). Therefore, it is important to be aware of the possible hindrances or obstacles in the migration routes of juvenile salmon and other salmonid fish species.

1.1 Previous projects and inspections of road barriers

In 1999, Finland and Norway started an Interreg-project where possible barriers to fish migration where identified in the River Tana catchment area (Erosion of the River Tenojoki - Preservation of the River Tenojoki as a salmon river in its natural state, financed by Interreg II North Calotte programme). During the project, 77 sites were inspected in Finland (municipality of Utsjoki) and 68 sites in Norwegian side (Karasjok and Tana municipalties) (Lundvall et al. 2001). The survey of migration barriers in River Tana continued later on in the upper reaches of the River Tana and at the largest tributaries of River Tana in Utsjoki and Karasjok in a follow-up project. ("Preserving the natural state of the river Tenojoki – environmental work, ecological state and monitoring", 2002-2006 Interreg III A North) This survey also included sites in the area between Nuorgam in Finland and the river delta in lower Norwegian parts.

In 2002 and 2003 a survey was done where 63 structures in Norway and 14 structures in Finland were inspected (Norwegian Water Resources and Energy Directorate 2004). In 2015-2016, further inspection work was done on 52 sites in Norway, as a co-operation between Tana and Karasjok municipalities, the local fishing authority (Tana vassdragets fiskeforvaltning) and the Public Roads Administration (Statens vegvesen) through the Tana river basin sub-district (Smeland & Johansen, 2019). Inventories were made mainly on municipal and private roads in the Ánarjohka and and Karasjohka tributaries in Karasjok municipality and lower parts of Tana municipality. In

2017, the environmental authorities of Finland and Norway started a new joint interreg-project “Joint Environmental Management of the River Tana”. In this project, the survey of migration barriers done in 1999 was continued as well as the restoration of possible barriers. In recent years, both countries have developed new technologies to ease the fish migration trough the road culverts. These technologies were used restoring the migration barriers during this project (Karjalainen & Kurkela 2018).In the summer of 2018, 84 road crossings were surveyed in Finnish side by Center for Economic Development, Transport and the Environment (ELY) as a part of the project work. In Norway, 16 sites were inspected over the years 2017-2019. Results from these inspections are presented in this report along with a sum-up of previous surveys to give a status on fish migration barriers in the Tana river system per 2019.

2. Inspections of road barriers (2017-2019)

In Finnish side of River Tana, the same sites were surveyed as in the year 1999 and in addition, some new sites. The details of the inspected sites in 2018 are presented in Annex 1. Five of the surveyed sites were not included in the survey done in 1999. Road culverts that were not reported before were in Áibmejohka, Raideborjohka and Gorrehatája. In addition, a new bridge was inspected at Geassemajohka. Goahtesaijohka (site 13.1) is a completely new channel that was not inventoried in 1999. Compared to the inspection done in 1999, one of the sites (Anárašjohka) was not inspected during the latest survey as well as few sites (52, 64 and 66) that had a road culvert or bridge at private road (Karjalainen & Kurkela 2018).In Norway, 23 sites along 16 tributaries (side- river systems) were surveyed by Tanavassdragets fiskeforvaltning (TF) in cooperation with Statens vegvesen over the years 2017-2019(See table 1). The tributaries included comprised sites previously inspected in 2001, excluding one new tributary (Lievrranrássejohka by Luovttejohka/Luftjok). Electrofishing was conducted in all 16 inspected tributaries.

2.1 Methods

To equalize the results of the inspections, at the beginning of the project a joint template for the technical inspections was created to give guidelines for the culvert inspection work (Annex 3). In Finland, the fieldwork was carried out in summer 2018 and in Norway in 2018 and 2019. During the inspections in terrain, the joint template was filled for each object. At each site, the culvert diameter and for bridges, the width of the bridge opening was measured as well as the threshold at the pipe outlet (drop between the pipe outlet and the bottom of the river channel).

The method included evaluation of the water flow in the pipe and whether the fishes can go through it. The length of the object (culvert or bridge) was measured later from aerial picture. For the river channel, the width and depth was either measured or estimated upstream and downstream from the object. If possible, every site was photographed. In some cases, the surrounded area of the object was so thick that having a good photo of the object was not possible. Inspections also involved the evaluation of water quantity in the channel and possible natural barrier for the fish migration.

2.2 Results

As a result of the inspections in 2018, out of the 84 sites there were a structural barrier evaluated in 26 sites in Finland (Table 2). The number includes three sites, which had a partial barrier caused by low water level. The identified migration barrier were road culverts, which had 20 -120 cm drop from the pipe outlet to the bottom of the river channel. At 16 sites, there were also a natural barrier in the stream (e.g. steep, rocky slope). Channels that were evaluated to have a migration barrier were electrofished at 13 out of 26 sites according to the survey done in 1999. Six of the streams did not have occuration of juvenile salmon. Out of sites that had a partial barrier in 2018, juvenile salmonids were observed in two locations (Karjalainen & Kurkela, 2018).Three restored sites in Finland (Gárnjárnjohka, Mohkkarasája, and Beahkágurája) are estimated as barrier in dry seasons (common in summertime) (Table 1). In two of the channels where road culverts (4 Vuolit Boratbokcájohka I ja 22B Vuolit Beašnjeará lower branch) are located, there is a natural barrier. In Bajit Boratbockájohka there is a partial natural barrier in dry seasons (Karjalainen & Kurkela, 2018).

In Norway, structural barriers were found at 11 out of the 16 tributaries. This includes four locations where the culverts were partially a barrier. Out of these, one tributary had sites with high restoration potential, another 7 sites were classified with medium potential and 2 locations of low potential. The location with high potential (Lišmmajohka) has already been restored as a part of this project, along with Vuohppejohka of medium potential (see desriptions in chapter 4). For an overview of restored barriers in Norway over the period 1999-2019, see table 3.

Table 1. Inscpected sites in Norway (2017-2019)

Name of the site	Type	Resto-ration of barrier	Type of survey	Comment
Bajit Hoašširjohka	Culvert	2002	Control survey 2018	Medium restoration potential (**) Maintenance of previous resto-ration needed
Sávkadasjohka	Bridge	2013	Control of restored site 2018	Good status
Čihččetbaijohka	Culvert		Control survey 2018	Migration barrier, damage to culvert, low-medium restoration potential (*-**)
Hárrejohka	Culverts (2)		Control survey 2018	Low restoration potential (*)
Ikkajohka (kom-munegrensen)	Culvert		Control survey 2019	Good status
Dordnejohka	Culvert		Control survey 2019	No potential for restoration
Jovvnitjohka	Culvert	2003	Control of restored site 2018	Medium restoration potential (**)
Čavastat (Laksnes)	Culvert		Control survey 2019	Good status
Gálgojohka (Biev-ra)	Culvert		Control survey 2019	Medium restoration potential (**)Partial a barrier, part of the shoulder of the road has slided.
Sirpmájohka (Sir-ma)	Culverts (6)	2001	Control survey 2019	Medium restoration potential (**) Partial barrier, high water veloci-ty in two culverts
Áitejohka	Culvert		Control survey 2019	Good status
Njuorganjohka	Culvert		Control survey 2017	Migration barrier with medium potential (**)
Lišmmajohka	Culvert	2019	Control survey 2017-2018	Partial a migration barrier before restauration, high restoration potential (***)
Vuohppejohka	Culverts (2)	2019	Control survey 2017-2018	Migration barrier before the res-tauration, medium potential (**)
Álletjohka	Culvert	2013	Control of restored site 2019	Good status
Lievranrássejohka (Luovvte-johka)	Culvert		Control of restored site 2019	Low restoration potential (*)

Table 2. Status of restored sites in 2018 (Finland)

Name of the site	Map reference	Type	Year/decade of restoration	Comment
Vuolit Boratbokcájohka I	4	Culvert	2003	Barrier (excess drop 55 cm), also a natural barrier
Vuolit Boratbokcájohka II	4	Culvert	2001	
Bajit Boratbokcájohka	5	Culvert	2004	Natural barrier caused by low water lever
Veahcajohka (Vetsijoki)	12	Bridge	1980	
Gárnjárnjohka	14	Culvert	2004	Partial barrier (excess drop 17 cm)
Ochejohka (Utsjoki)	18	Bridge	1980	
Áibmejohka (Äimäjoki)	19	Bridge	1990	
Vuolit Beašnjeará	22	Culvert	2000	
Bajit Beašnjeará	22B	Culvert	2000	Natural barrier in the river channel
Junttejohka (Junttijoki)	23	Culvert	2000	
Koappeloaivinjohka	24	Bridge	2004	
Nuvvosjohka	37	Bridge	1990	
Sieiddejohka	45	Bridge	2000	
Áhkojohka (Akujoki)	50	Bridge	1980	
Mohkkarasája	68	Culvert	2004	Partial barrier (excess drop 25 cm)
Beahkágurája	69	Culvert	2004	Partial barrier (excess drop 30 cm)

Table 3. Restored migration barriers in Norwegian parts of the Tana river system (1999-2019)

Name of the site	Type	Year of restoration	Authority
Oalgejohka	Culvert	Before 2001	Statens vegvesen
Baddjevuohppejohka	Bridge	Before 2001	Statens vegvesen
Golggotjohka (Gulbjok)	Bridge	2005	Statens vegvesen
Sirpmájohka	Culvert	Before 2001	Private (project financed)
Bajit Hoašširjohka	Culvert	2002	Statens vegvesen
Jovnnitjohka	Culvert	2003	Statens vegvesen
Sávkadasjohka	Bridge	2011	Statens vegvesen
Álletjohka	Culvert and water reservoir	2013	Statens vegvesen and Tana municipality
Lišmmajohka	Culvert	2019	Tana municipality
Vuohppejohka	Culverts (2)- main road and private road	2019	Statens vegvesen and Tana municipality

3 Electrofishing

3.1 Methods

Seven of the road culverts restored in 2000-2004, and monitored until 2010 were revisited and elecrofished by Natural Resources Institute Finland (LUKE) as a part of Joint Environmental Management of the River Tana- project in 2018. These sites were monitored in a previous project ("Preservation of the River Tenojoki as a salmon river in its natural state – environmental work, ecological condition and monitoring", 2002-2006 Interreg III A North) - and its follow-up monitoring (Erkinaro & Erkinaro 2006; Erkinaro et a. 2017). The electrofished sites and juvenile salmon densities are presented in figure 1.. In Norway, electrofishing was conducted in all 16 inspected tributaries by Tanavassdragets fiskeforvaltning (TF).

Electrofishing was conducted using a generator-powered electrofisher (Hans Grassl ELT60IIHI, 300/500V, 580/960 V peak, max. 1300 w). A single-pass electrofishing employing standard methods (Niemelä et al. 2001) was used to derive an index of abundance (ind./100m2) of fish at the sampling sites. Sites both downstream and upstream of the culverts were electrofished to evaluate the functionality of the previously restored culverts. All fish were returned alive back to the streams after they were individually measured (nearest mm) and scale-sampled.

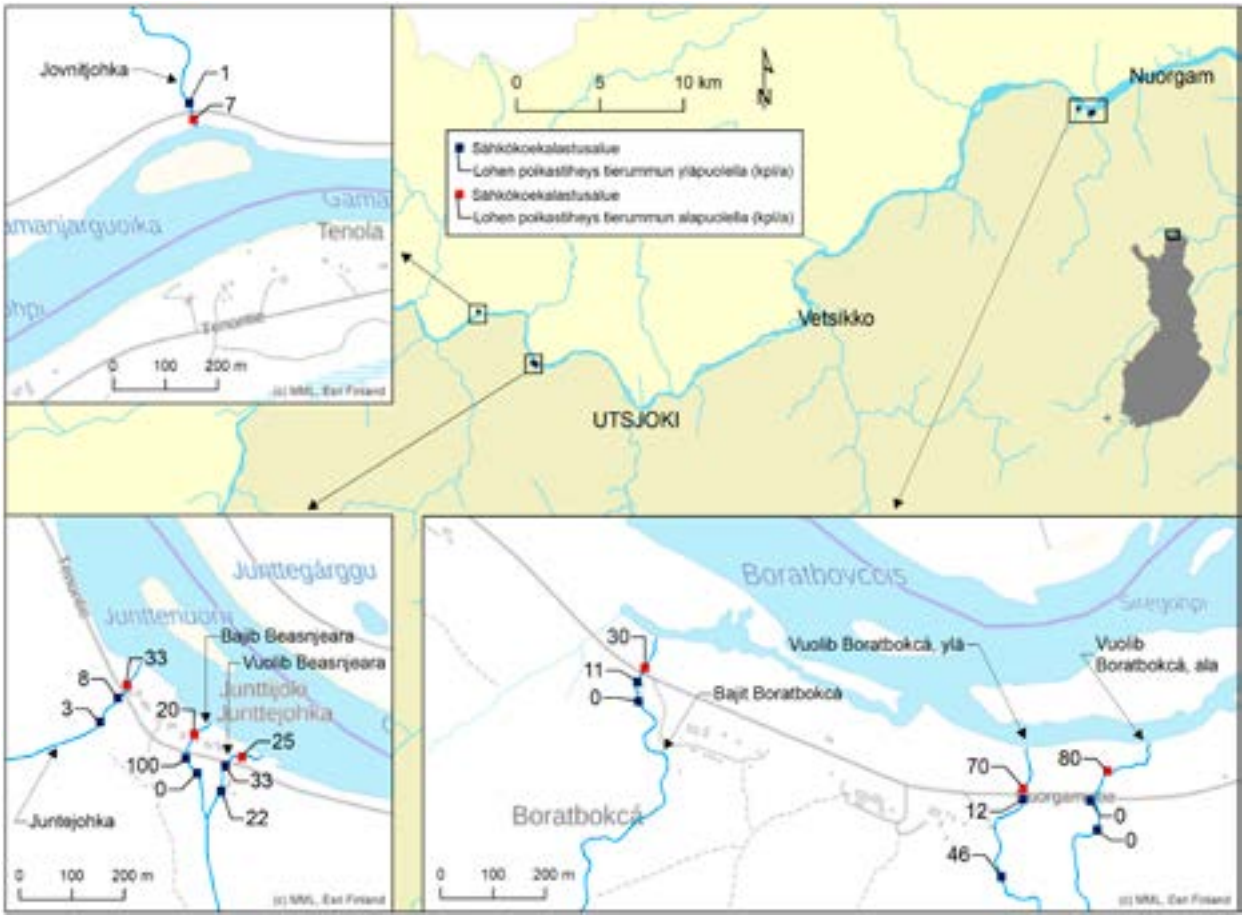

Figure 1. Streams and sites electrofished in 2018 by the Natural Resources Institute Finland (Luke). Numbers at sampling sites denote juvenile salmon densities (fish per 100 m2); sites marked in red are downstream the road culvert; sites marked in dark blue are upstream.

3.2 Results

According to the results of the study done by Natural Resources Institute Finland, the culverts seemed to be supporting conductivity in the streams and in most cases the juvenile salmon densities were higher on both sides of the culverts than during the earlier surveys (Figure 1; see also Erkinaro et al. 2017). However, at, Vuolib Boratbokcá the vertical drop below the culvert had increased in height to 60 cm and at least under the late summer flow conditions, the culvert was severe hindrance, if not totat barrier to fish migration from down stream. Vuolit Boratbokcá (lower branch) was then restored as a part of this project in July 2019 (more details of the restoration on page 9).

In Norway All the tributaries were electrofished, and juvenile salmon were registered in 15 out of the 16 tributaries. In 6 out of the 15 tributaries, salmon parr were not registered above the culvert. Lievranrássejohka was the only tributary without juvenile salmon. In Lievranrássejohka only trout and arctic char were registered, and only below the culvert. No salmon parr were were registered above the culverts in Vuohpejohka, while a few were registered above the culvert in Lišmmajohka. Road culvert in Jovnnitjohka was surveyed by both authorities (LUKE and TF). Because the drop from down stream had increased since restoration, the culvert was estimated as migration barrier for juvenile salmoninds.

4 Restorations of migration barriers in the Tana Interreg project (2018-2019)

4.1 Vuolit Boratbokcájohka, lower branch (Utsjoki municipality, Finland)

From restored sites after the year 2000, road culvert in Vuolit Boratbokcájohka I (lower branch) was still a migration barrier. At the survey done by the Center for Economic Development, Transport and the Environment (ELY) in summer of 2018, the estimated drop at road culverts in Vuolit Boratbokcájohka was around 40 cm from the pipe outlet to the surface of the channels water. Another measurement done by Natural Recourses Institute Finland (LUKE) later in the year 2018 the drop was estimated as 60 – 70 cm.

The restoration work started in July 2019. Matti Kylmäniemi from Natural Recourses Institute Finland advised and supervised the installation of the blasted stones (quarry). He knew that during the spring flood, the water would completely fill the drums. The juveniles rise to the tributaries of the River Tana immediately after the spring flood. After the restoration, the threshold is 15 cm enabling the fish migration. Restoration of Vuolit Boratbokcájohka was done by Finnish infrastructure company Destia Oy 29.7 – 1.8.2019.

Figure 2. Vuolit Boratbokcájohka before restoration.

Figure 3. Vuolit Boratbokcájohka after restoration.

Figure 4. Vuolit Boratbokcájohka during restoration.

4.2 Vuohppejohka (Tana municipality, Norway)

Vuohppejohka is a side- river that was surveyed in 2004 and re-surveyed in 2013 and 2014. Two sites had barriers for migrating fish on the stretch from the main river to lake Vuolit Vuohppejávri. The lower site consisted of a road crossing on a private road with 5 culverts creating a barrier (fig. 5). The drop from the outlet of the lowest culvert to the water surface was 20 cm. On the main road, another site with one culvert created a drop of 75 cm (fig.7). This culvert was restored in 2019 by the Public Roads Administration and Finnmark county (fig 8). The culverts on the private road have not been removed. However, in 2019, as a part of this project as threshold was built downstream the culverts to increase the water lever and enable fish passings (fig.6).

Figure 5. Culverts on the private road at Vuohppejohka.

Figure 6. The threshold built to increase the water level Vuohppejohka (private road).

Figure 7. Vuohppejohka before the restoration (main road).

Figure 8. Vuohppejohka after the restoration (main road)..

4.3 Lišmmajohka (Tana municipality, Norway).

Lismmajohka is a side river 5,5 km upstream the municipal centre of Tanabru. There are two road crossings on the river stretch between the outlet of the river and the lake Lismajávri. The upper crossing along the main road has been inspected and does not constitute a migration barrier. However, the crossing on the private road 200 meter upstream the river delta was constructed in the 1980's with two culverts creating a barrier for migrating fish (drop of 50 cm and high water velocity) (fig 8). Electrofishing in 2004 and later in 2017 documented salmon parr below the culvert, but only a few individuals upstream the road crossing. The two culverts were replaced in 2019 as a part of our Interreg project with a new and larger culvert. A threshold was also created above the road crossing to lower the height difference and decrease the water velocity (see photoes 9,10 and 11).

Figure 9. Lišmmajohka before the restoration (Photo: NVE nord).

Figure 10. Figure 10 Lišmmajohka during the restoration (Photo:NVE nord).

Figure 11. Lišmmajohka after the restoration (Photo: NVE nord).

5 Conclusion

Over the years 1999-2019, a total of 270 road crossings have been inspected in River Tana catchment area (NO 170, FIN 100). During the past 20 years, 22 sites has been restored to enable fish migration. As a result of the recent surveys (2017-2019), 15 sites were classified as potential restoration objects. Seven of these objects were classified with medium restoration potential in Norway: Bajit Hoašširjohka, Čihččetbaijohka, Gálgojohka (Bievra), Sirpmájohka, Njuorganjohka, Jovnnitjohka and Vuohppejohka. These sites are recommended for restoration in the future. From road crossings in Finnish side of River Tana, seven culverts had excess drop at the outlet causing a possible barrier for fish migration. The restoration potential of these sites were low, and there are currently no plans to restore these culverts. All sites that have been evaluated before as high restoration potential have been restored, in addition of the re-restoration of Vuolit Boratbokcájohka.

Follow-up inspections should be accomplished at the remaining 7 sites in Norway which have not been inspected earlier (Fielbmajohka siderivers i Bonakas, Benjaminsbukt, Stohpujohka/Bonakasbekken under the road to Smalfjord, Suobmaavzzejohka, Ivarjok Dilijohka private road, Nammajohka upper culvert and Beagcejogas in Iešjohka). In the future, the restored sites may need maintenance, because conditions on sites of road/river crossings may change over time due to erosion and corrosion of materials. It is recommended that the functionality of the restored culverts should be inspected for connectivity, both through physical evaluation and electrofishing, at regular intervals of 10 years.

Information collected during inspections of fish migration barriers in the Teno (Tana) river system will be saved by the partner organisations in their archives and loaded to relevant official databases. Data from the inspected sites in Norway will be saved in the Water Directive (WFD) database “vannnett” (https://vann-nett.no/portal/). In Finland, the information of inspected sites will be saved to environmental administrations information system Hertta. Service for open environmental data that is available for public use is found at https://www.syke.fi/fi-FI/Avoin_tieto/Ymparistotietojarjestelmat. The project reports will be published in Doria database (https://www.doria.fi/), which is an archive of publications maintained by the National Library. The link for the published reports will be send to key-persons of municipalities and other project-partners.

The template developed in this project (see annex 2) and the project reports will be exchanged with road authorities (in Norway: Public Roads administration- Statens vegvesen, Troms and Finnmark county, the municipalities of Tana and Karasjok). Later, the template is recommended to be used in ArcGis Collector-application. The format was previously used in terrain inventories in Kolarctic CBC Reac-project, where the data of terrain was collected using ArcGIS Collector-application. For the application, a web-map is done in ArcGIS Online (ESRI cloud service). Utilizing the application, the data of migration barriers can be saved using an excisting form for the inspection work.

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7 The appendices

Annex 1. Inspected road crossings in 2018 (Finland)

Table 4. Inspected sites1-19

Map reference	Name of the site	Type (Ø m)	Type of survey	Comment
1	Gálddašjohka	Bridge	Control survey 2018	Not a barrier, no need for resto-ration
2	Skáidejohka	Culvert (1,2)	Control survey 2018	Not a barrier, no need for resto-ration
4	Vuolit Boratbokcájohka I	Culvert (1,2)	Control survey 2018	Barrier, excess drop of 40 cm
4B	Vuolit Boratbokcájohka II	Culvert (1,2)	Control survey 2018	Not a barrier, no need for resto-ration
5	Bajit Boratbokcájohka	Culvert (1,2)	Control survey 2018	High flow speed in channel
6	Geassemahjohka	Culvert (1,5)	Control survey 2018	Not a barrier
6,1	Geassemahjohka II	Bridge	New site	Not a barrier, no need for resto-ration
7	Gorrehatája	Culvert (1)	Control survey 2018	High threshold at culvert outlet
7,1	Gorrehatája II	Culvert (0,8)	New site	Not a barrier, no need for resto-ration
8	Olenjohka (Njallavárjohka)	Culvert (1)	Control survey 2018	Barrier, threshold at culvert outlet, steep slope
9	Vuolit Jeagelveijohka (Olenjohka)	Bridge	Control survey 2018	Not a barrier, no need for resto-ration
10	Bajit Jeagelveijohka	Bridge	Control survey 2018	Not a barrier, no need for resto-ration
11	Orešjohka	Culvert (1)	Control survey 2018	Barrier, threshold at culvert outlet
12	Veahcajohka (Vetsijoki)	Bridge	Control survey 2018	Not a barrier, no need for resto-ration
13	Njallajohka	Culvert (1)	Control survey 2018	Not a barrier, no need for resto-ration. Main culvert is a bit mossy and dilapidated.
13,1	Goahtesaijohka	Culvert (1,2)	New site	Not a barrier, no need for resto-ration
14	Gárnjárjohka	Culvert (1,2)	Control survey 2018	Partial barrier, threshold at culvert outlet that might become a barrier at dry seasons
15	Vidgaveadji	Bridge	Control survey 2018	Not a barrier. Bridge was under construction during survey.
16	Ráideborjohka	Culvert (0,8)	Control survey 2018	Barrier, threshold at culvert outlet, steep channel.
17	Ailegasjohka	Culvert (1,2)	New site	Not a barrier
17,1	Ailegasjohka II	Bridge	Control survey 2018	Not a barrier, no need for resto-ration
18	Ochejohka (Utsjoki)	Bridge	Control survey 2018	Not a barrier, no need for resto-ration
19	Áibmejohka (Äimäjoki)	Bridge	Control survey 2018	Not a barrier, no need for resto-ration.
19,3	Áibmejohka II	Culvert (0,9)	New site	Not a barrier

Table 5. Inspected sites 19-36

Map reference	Name of the site	Type (Ø m)	Type of survey	Comment
19,3	Áibmejohka II	Culvert (0,9)	New site	Not a barrier
19,4	Áibmejohka III	Culvert (0,9)	New site	Not a barrier. Small collapse between main culvert and the road. Culvert might be damaged.
20	Vuolit Rátnojohka	Culvert (1)	Control survey 2018	Barrier, threshold at culvert outlet and steep slope above the culvert (natural barrier). No need for restoration.
21	Bajit Rátnojohka	Culvert (1,2)	Control survey 2018	Barrier, steep slope creates a natural barrier.
22	22B Bajit Beašnjeará	Culvert (1,5)	Control survey 2018	Not a barrier. Low amount of water in both culverts and ice in one of them. Steep slope above the culvert.
22	Vuolit Beašnjeará	Culvert (1,2)	Control survey 2018	Not a barrier. A crack on the upper edge in one of the culverts.
23	Junttejohka (Junttijoki)	Culvert (1,5)	Control survey 2018	Good status. Not a barrier, no need for restoration.
24	Koappeloaivinjohka (Nuorásjohka?)	Tubular bridge (2)	Control survey 2018	Good status. Not a barrier, no need for restoration.
25	Goahppelašjohka	Bridge	Control survey 2018	Not a barrier, no need for restoration.
26	Viercanjeriidája	Culvert (0,8)	Control survey 2018	Barrier. High threshold at culvert outlet. Suggested restoration measures.
27	Badda	Bridge	Control survey 2018	Not a barrier, no need for restoration.
28	Gistujohka	Bridge	Control survey 2018	Not a barrier
29	Dánsejohka	Tubular bridge (2)	Control survey 2018	Not a barrier
30	Juolgetbealjohka	Culvert (1)	Control survey 2018	Barrier, natural barrier. Threshold at culvert outlet, steep slope. No need for restoration.
31	Gazzanjavejohka	Culvert (0,8)	Control survey 2018	Barrier. Threshold at both culvert outlets and a steep slope above. Other culvert nearly dry.
32	Goatneljohka	Bridge	Control survey 2018	Not a barrier, no need for restoration
33	Bádošjohka	Tubular bridge (5)	Control survey 2018	Not a barrier. No need for restoration. Steep slope above the culvert.
34	Cierrunjohka	Culvert (1)	Control survey 2018	Natural barrier, steep slope.
35	Hánnojohka	Bridge	Control survey 2018	Not a barrier. Bridge was under construction during the survey.
36	Suohpajohka	Culvert (1,2)	Control survey 2018	Barrier, natural barrier. Threshold at culvert outlet, steep slope above the culvert.

Table 6. Inspected sites 37-68

Map reference	Name of the site	Type (Ø m)	Type of survey	Comment
37	Nuvvosjohka	Bridge	Control survey 2018	Not a barrier
38	Njiljohka (Nilijoki)	Bridge	Control survey 2018	Not a barrier, no need for restoration.
39	Hánasjohka	Culvert (0,8)	Control survey 2018	Barrier, natural barrier. Threshold at culvert outlet, steep slope above the culvert.
40	Valljášjohka	Culvert (1)	Control survey 2018	Possible natural barrier during dry season.
41	Áitejohka (Aittijoki)	Culvert(1)	Control survey 2018	Barrier, natural barrier. Threshold at culvert outlet and steep slope.
42	Erkkejohka	Culvert (1)	Control survey 2018	Barrier, natural barrier. Threshold at culvert outlet and steep slope above the culvert.
43	Jeagelveijohka	Bridge	Control survey 2018	Not a barrier, no need for restoration.
44	Roahkája	Culvert (0,8)	Control survey 2018	Barrier. Threshold and a concrete tile at the culvert outlet. Suggested restoration measures.
45	Sieiddejohka	Bridge	Control survey 2018	Good status. Not a barrier.
46	Culloveijohka	Bridge	Control survey 2018	Not a barrier, no need for restoration.
47	Sávdneája	Culvert (1)	Control survey 2018	Not a barrier
48	Veanzeája	Culvert (1)	Control survey 2018	Not a barrier
49	Gorsaája	Culvert (0,8)	Control survey 2018	Barrier, natural barrier. Threshold at culvert outlet, steep slope.
50	Áhkojohka (Akujoki)	Bridge	Control survey 2018	Good status, not a barrier.
51	Bihteája	Culvert (0,8)	Control survey 2018	Barrier, threshold at culvert outlet.
52	Fierranjohka	Culvert (1,2)	Control survey 2018	Survey done from main road. Not a barrier, no need for restoration.
53	Biesjohka (Piesjoki)	Bridge	Control survey 2018	Not a barrier
54	Roavveája	Culvert (0,4)	Control survey 2018	Not a barrier, no need for restoration.
55	Gáivojohka	Bridge	Control survey 2018	Not a barrier, no need for restoration.
56	Stuorragurája	Culvert (1)	Control survey 2018	Barrier, natural barrier. Threshold at culvert outlet, rocky and steep channel.
57	Luossagoatnelája (Lohikosteoja)	Culvert (0,8)	Control survey 2018	Possible partial barrier in dry seasons. Steep slope above the culvert.
58	Rásseája	Culvert (1)	Control survey 2018	Barrier. Threshold at culvert outlet. Suggested restoration measures.
59	Meaddenvárája	Tubular bridge	Control survey 2018	Not a barrier
60	Vuopmanjohka	Culvert (1,6)	Control survey 2018	Not a barrier, no need for restoration.
61	Basejohka	Bridge	Control survey 2018	Not a barrier, no need for restoration.
62	Gáregasjohka	Bridge	Control survey 2018	Not a barrier, no need for restoration.
63	Nuhppirjohka	Bridge	Control survey 2018	Not a barrier, no need for restoration.
64	Bistuája (Pisto-oja)	Culvert (0,5)	Control survey 2018	Not a barrier, no need for restoration.
65	Doarrovasjohka	Culvert (1,6)	Control survey 2018	Barrier, threshold at culvert outlet.
66	Gameljohka	Bridge	Control survey 2018	Not a barrier, no need for restoration.
67	Bálggatjohka	Bridge	Control survey 2018	Not a barrier, no need for restoration.
68	Mohkkarasája	Culvert (0,8)	Control survey 2018	Possible barrier at culvert outlet when water level is low.

Table 7. Inspected sites 69-77

Map reference	Name of the site	Type (Ø m)	Type of survey	Comment
69	Beahkágurája	Culvert (1)	Control survey 2018	Good status. Possible barrier at culvert outlet in dry season.
70	Guollnájohka	Bridge	Control survey 2018	Not a barrier
71	Badje-Guoldná	Culvert (0,8)	Control survey 2018	Barrier. Threshold at culvert outlet. Suggested restoration measures.
72	Guottoveijohka	Bridge	Control survey 2018	Not a barrier
73	Coalosjohka	Bridge	Control survey 2018	Not a barrier, no need for restoration.
74	Ruvašája	Culvert (0,8)	Control survey 2018	Barrier, threshold at culvert outlet.
75	Vuopmaveadji	Bridge	Control survey 2018	Not a barrier, no need for restoration.
76	Beavrretjohka	Culvert (1,2)	Control survey 2018	Possible barrier at culvert outlet in dry season.
77	Váddejohka	Culvert (1,6)	Control survey 2018	Not a barrier, no need for restoration.

Annex 2. Template for registration of fish migration barriers

TEMPLATE FOR REGISTRATION OF FISH MIGRATION BARRIERS,

TANA INTERREG PROJECT

Date		
Name of inventory staff		
Name of river		
Muncipality		
Basin number	ID of water body	
Road owner		
Object number (coding) of culvert (optional)		

1. PREVIOUS WORK

Previous inpections, date	Type of previous restoration work *

* 1= road reconstructed, 2= culvert replaced, 3= channel restored upstream,

4= channel restored downstream.

2. LOCATION OF STRUCTURE (possible fish migration barrier)

Type of mapping *	Northern coordinates (y)	Eastern coordinates (x)	Code of structure on own map

1= X and Y coordinates, 2= UTM32, 3= UTM 33, 4= UTM 34, 5= UTM 35, 6=UTM 36

3. ROAD SURFACE MATERIAL *

* 1=clay, 2=sand, 3=gravel, 4=asphalt, 5=other,what?

4. STRUCTURE TYPE *

* 1=bridge, 2=tubular bridge (culvert >2m diam.), 3=culvert, 4= causeway, 5=ford,

6=other, what?

5. CROSSING STRUCTURE

Length in cm	Diameter in cm	Material *	Condition (good, bad, ruined)	Bottom substrate inside culvert (no substrate, sand, gravel)

* 1=concrete, 2=plastic, 3=metal, 4=other, what?

MORE INFORMATION ON CROSSING STRUCTURE (If needed)

Shape: round, square, arc, other (specify) Inclination, degrees Surface: smooth or folded

6. FLOW INFORMATION

Current water level in culvert (cm) (measured at the downstream end)	Maximum water level in culvert (cm)	Drop from culvert to water surface downstream (cm)	Drop from culvert to channel bottom downstream (cm)	Flow speed*	Notes (exceptionally dry or wet day/week etc)

* 1=no flow, 2=weak flow, 3=moderate flow, 4=strong flow.

7. SIGNIFICANCE FOR FLOODING *

1=no information, 2=no significance, 3=small hazardous risk,

4=barrier may influence flood behaviour, 5=big hazardous risk

8. INFORMATION ABOUT STREAM (UPSTREAM/DOWNSTREAM)

1. BOTTOM MATERIAL (%)

Downstream			**Upstream**		
rock (%, diameter)	gravel	mud	rock (%, diameter)	gravel	mud

2. CHANNEL WIDTH

Downstream in 0m, 1m and 3m distance from the structure			**Upstream in 0m, 1m and 3m distance from the structure**		
0 meter	1 meter	3 meter	0 meter	1 meter	3 meter

3. CHANNEL DEPTH

Downstream in 0m, 1m and 3m distance from the structure			**Upstream in 0m, 1m and 3m distance from the structure**		
0 meter	1 meter	3 meter	0 meter	1 meter	3 meter

4. WATER QUALITY *

* 1=clear, 2=humic, 3=turbid, 4=other, what?

9. INFORMATION ABOUT FISH POPULATIONS UPSTREAM/DOWNSTREAM

Downstream fish presence			**Upstream fish presence**		
Expert evaluation (yes/no/unknown), date		Electro fishing, date	Expert evaluation (yes/no/unknown), date		Electrofishing, date *

* If yes, please fill data in sheet 2

10. IMPEDIMENT

Barrier type *

*Barrier, partly a barrier, not a barrier

11. MORE INFORMATION ON IMPEDIMENT (Please add written description)

12. PHOTO NUMBERS

Number of photos downstream	Number of photos upstream

13. SUGGESTED RESTORATION MEASURES (DESCRIPTION)

Annex 3. Sum-up table of inspected sites 1999-2019 (Norway)

Table 8. Sum-up table of sites 1-23 (Norway)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
1	Rássejohka/Rasjok	Bridge	2015		+		
2	Rássejohka/Rasjok	Bridge	2015		+		
3	Rássejohka/Rasjok	Bridge	2015		+		
4	Rássejohka/ Rasjok, main road	Culvert	2015		+		
5	Rássejohka/Rasjok	Culvert	2015		+		
6	Rássejohka/Rasjok	Culvert	2015		+		
7	Rássejohka/Rasjok	Culvert	2015		-		
8	Rássejohka/ Rasjok, road to Tanahus	Culvert	2015		-		
9	Stohpojohka	Bridge	2004		+		Sandy substrate
10	Hárrejohka (Harrelv)	Bridge	2004		+	Yes	
	Hárrejohka (Harrelv)	Bridge	2013		+	Yes	
11	Golggotjohka/ Gulbojok (Bánnegállájohka)	Bridge	2004	0,7	**	Yes	
	Golggotjohka/ Gulbojok (Bánnegállájohka)	Bridge	2015		+	Yes	
12	Golggotjohka (private road)	Bridge	2015		+	Yes	
13	Golggotjohka (farming road)	Bridge	2015		+	Yes	
14	Ivarjok	Culvert	None				Steep above road
15	Noaidejohka	Culvert	None				Going through road at two locations
16	Suobmávžžejohka	Culvert	None	0,4			visited nov 2019, revisit next summer
17	Máskejohka	Bridge	2004		+	Yes	
18	Biehtarjohka (Bekk v/Kumpula)	Culvert	2004		-		
19	**Luovttejohka (Luftjok)**	**Bridge**	**2004**		**+**	**Yes**	**Trout and greyling**
20	Lievlanrássejohka	Culvert	2019		-	Yes	
21	Torvbekken	Culvert	None				Steep above
22	Geaidojohka	Bridge	2013		+	yes	Extra road/culvert (+) above bridge in 2019
23	Hanaelva	Bridge	2013		+		

Table 9. Sum-up table of sites 24-48 (Norway)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
24	Vierasaijohka (Lieksegurra)	Culvert	2004		-		Steep
25	Moahkkevei/ Máskevarjohka	Bridge	2004		+		
26	Mohkkeveai-johka	Bridge	2004		+	Yes	
26B	Mohkkeveaijoh-ka, private road	Bridge	2015		+		
27	Sieiddájohka E6	Bridge	2004		+		
28	Sieiddájohka	Culvert	2019		+		
29	Skiippagurjohka	Culvert	2004	0,6	-		Steep
30	Birrgetjohka-Korselva	Bridge	2004		+		
31	Lišmmajohka	Culverts	2004	0,5	***	Yes	Restored 2019
	Lišmmajohka	Culvert	2018		***	Yes	Shallow river delta. Resto-red 2019.
31B	Lišmmajohka	Bridge	2004				
32	Jávvájohka	Bridge	2004		+		
33	Fielbmajohka/Ár-banatjohka (E6)	Bridge	2004		+		Channeling
34	Árbanatjohka municip. Road	Culvert	2015		+		Channeling
35	Rivttatjohka	Culvert	2004		+		Several culverts have not been checked out
36	Doaresjohka	Culvert	2004				Dry
37	Ádjájohka	Culvert	2004				Dry
38	Álletjohka	Culvert	2004	0,85	3	Yes	Restored 2013
	Álletjohka	Culvert	2019		+	Yes	
39	Roddjejohka	Culvert	2004	0,9	-		Steep
40	Vuoksájohka	Culvert	2004	0,2	-		
41	Vuohppejohka	Culvert 2	2004	0,75	**	Yes	Restored 2019
	Vuohppejohka	Culvert 2	2013	0,5			Restored 2019
	Vuohppejohka	Culvert 2	2017		**	Yes	Trout above the main road. Restored 2019.
41B	Vuohppejohka	Culvert 1	2013	0,2			Restored 2019.
	Vuohppejohka	Culvert 1	2017		**	Yes	Trout above the main road. Restored 2019.
42	**Polmakelva**	**Bridge**	**2004**		**+**		**Salmon river**
43	Njalahásjohka	Culvert	2001		+		
	Njalahásjohka	Culvert	2016		+		
44	Fielbmájohka	Culvert 1	2004				Dry
	Fielbmájohka	Culvert 1	2015	0,15	*		
45	Fielbmájohka	Culvert 2	2015	0,15	*		
46	Mártenjohka	Culvert	2004		-		
47	Gárotjohka	Culvert	2004				Dry
48	Skoarrujohka	Bridge	2001		+		

Table 10. Sum-up table of sites 49-75 (Norway)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
49	Gieddejohka	Bridge	2001	0,6	-		Steep
50	Nuorggánjohka	Bridge	2001	2	***		Plans for restorations made (SSV)
	Nuorggánjohka	Bridge	2017	0,3	**	Yes	Only arctic char upstream..
51	Erkkeaja	Bridge	2001		-		
52	Gáldojohka	Bridge	2001	0,5	-		Small
53	Jalvvijohka	Bridge	2001		-		Small, steep
54	Fállenjoasjohka	Bridge	2001		+		Small
55	Áitejohka	Culvert	2001		+		
	Áitejohka	Culvert	2019		+	Yes	
56	Silbašaja	Bridge	2001	0,15	-		Small
57	**Lakšjohka**	**Bridge**	**2001**		**-**		**Salmon river**
58	Sirpmájohka (lower private road)	Culvert	2001		+		
	Sirpmájohka (lower private road)	Culvert	2019		+		
59	Sirpmájohka (farmer road 1)	Culvert	2019		*		High velocity in culvert
60	Sirpmájohka (farmer road 2)	Culvert	2001	1	***	Yes	Restored 2001
	Sirpmájohka (farmer road 2)	Culvert	2019		*		High velocity in culvert
61	Sirpmájohka, tributary (main road E6)	Culvert	2001	0,15	*		Easy to fix, low potential above road
	Sirpmájohka, tributary (main road E6)	Culvert	2019	0,15	-		
62	Sirpmájohka (main road E6)	Culvert	2001				
	Sirpmájohka (main road E6)	Culvert	2019		+		
63	Sirpmájohka (municip road)	Culvert	2019		+	Yes	
64	Galbajohka	Bridge	2001		+	Yes	
65	Galgojohka	Culvert	2001	0,15	+	Yes	
	Galgojohka	Culvert	2019		**	Yes	
66	Luosnjarjohka	Culvert	2001		+		
67	Čavástat	Culvert	2001		+	Yes	Pit-tag studies (2007-2009)
	Čavástat	Culvert	2019		+	Yes	
68	Levssejohka	Bridge	2001		+	Yes	
69	Geinnošaja	Culvert	2001	1,2	-		Small, steep
70	Goržanjohka	Culvert	2001		+		
71	Vuolit Viđis	Culvert	2001		+	Yes	Pit-tag studies (2007-2009)
72	Bajit Viđis	Culvert	2001		+	Yes	Pit-tag studies (2007-2009)
73	Jovnnitjohka	Culvert	2001	0,4	*	Yes	Steep
	Jovnnitjohka	Culvert	2018	0,3	+	Yes	Steep
74	Borsejohka	Bridge	2001		+		
75	Njallageinnošája	Culvert	2001		-		Steep upstreams, culvert blocked

Tabel 11. Sum-up table of sites 76-103 (Norway)

Map refe-rence	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inven-tory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
76	Áitejohka	Culvert	2001	0,4	-	Yes	Steep
77	Boahkkojohka	Culvert	2001	0,5	-	Yes	Steep
78	**Leavvajohka**	**Bridge**	**2001**		**+**		
79	Galbmagálsa-vvonjohka	Culvert	2001		+		
80	Dordnejohka	Culvert	2001	0,5	-	Yes	Steep
	Dordnejohka	Culvert	2019	0,7	-	Yes	Steep, demands too much effort
81	Lávddetgurra	Culvert	2001	0,1	-		Steep
82	Buollanjohka	Culvert	2001	0,1	-		Steep
83	Ikkájohka	Bridge	2001		+	Yes	
83B	Ikkájohka	Culvert	2019		+	Yes	Natural substrate in culvert
84	Fielbmajohka	Bridge	2001		+	Yes	
85	Njirranája	Culvert	2001	0,6	-		Small stream
86	Uhca-Nuvvosjoh-ka	Culvert	2001	0,6	-		
87	Floodway 1	Culvert	2001	1,2	-		Small stream
88	Báišjohka	Bridge	2001		+		
89	Stuorrajárjohka	Culvert	2001	0,6	-		
90	Sohpparjohka	Bridge	2001		+	Yes	
91	Lállájohka	Culvert	2001		+		
92	**Váljohka**	**Bridge**	**2001**		**+**		
93	Njivlojogas	Culvert	2001		+		Steep
94	Roavvejohka	Culvert	2001		+		
95	Gálssotjohka	Culvert	2001		+		
96	Hárrejohka (priva-te road)	Culvert 1	2001	0,3	**		400 m creek above
	Hárrejohka (priva-te road)	Culvert 1	2013	0,3	-		Too high cost
	Hárrejohka (priva-te road)	Culvert 1	2018	0,3	*	Yes	Steep
97	Hárrejohka (main road - E6)	Culvert 2	2001	0,3	**		
	Hárrejohka (main road - E6)	Culvert 2	2013	0,3	-		Too high cost
	Hárrejohka (main road - E6)	Culvert 2	2018	0,3	*	Yes	Steep
98	Sámmol-Ásllat ája	Culvert	2001	0,1	-		Steep, small
99	Vuolitnjárjohka	Culvert	2001	0,65	-		
100	Šumpu	Culvert	2001	0,2	-		Steep, small
101	Čiččetbaijohka	Culvert	2001	0,3	-		Small
	Čiččetbaijohka	Culvert	2018	0,3	**	Yes	Steep culvert, some potential upstream
102	Ovlláluhppojohka	Culvert	2001		-		Culvert blocked, small steam
103	Geahtaveadji	Culvert	2001		-		

Table 12. Sum-up table of sites 104-128 (Norway)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
104	Sávkadasjohka	Bridge	2001		3	Yes	
	Sávkadasjohka	Bridge	2018		+	Yes	Long, nice habitat, sea trout river. Restored 2011
105	Vuolit Hoaiššrjohka	Culvert	2001		+		
106	Bajit Hoaiššrjohka	Culvert	2001	0,2	**		Restored 2002
	Bajit Hoaiššrjohka	Culvert	2013	0,2	**		
	Bajit Hoaiššrjohka	Culvert	2018	0,3	**	Yes	Maintenance needed
107	Itkkojogaš (private road)	Culvert	2004	0,5	-		
108	Itkkojogaš (main road - E6)	Culvert	2004		-		Small
109	**Kárášjohka**		**2001**				
110	Vuollevuohpejohka	Bridge	2004		+		
111	Vuolit Siffarjohka	Culvert	2004	0,8	-		
112	Bajit Siffarjohka	Bridge	2004	2	-		Steep
113	Baddjevuohppejohka	Bridge	2004	0,3	+		
114	Baddjevuohppejohka	Culvert	2013	0,3	**		Half compleeted work
115	Ájojogaš		2004				Dry
116	Dilijohka	Bridge	2004		+	Yes	
117	Dilijohka, gravel road	Culvert	None				
118	Njárgasašjohka	Culvert	2004	0,5	-		Dry
	Njárgasašjohka	Culvert	2013	0,5	-		Steep, probably low potential
119	Oalgejohka	Culvert	2004		+		
	Oalgejohka	Culvert	2013		+	Yes	Changed earlier, working fine
120	Niitošjohka main road 1	Culvert 1	2004		-		Dry
121	Niitošjohka main road 2	Culvert 2	2004		-		Dry
122	Niitošjohka private road	Culvert	None				
123	Giemasjogaš	Culvert	2004		-		Dry
124	Rávdojohka	Bridge	2004		+		
125	Rávdojohka, private road	Bridge	2019		+		
126	Dáktejohka	Bridge	2004		+		Steep
127	Báhkkiljohka, private road	Bridge	2019		+		
128	Báhkkiljohka	Bridge	2004		+		

Table 13. Sum-up table of sites 129-159 (Norway)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
129	Dánssetjohka	Culvert	2004		-		Dry
130	Sammaljohka	Culvert	2004		-		Dry
	Sammaljohka	Culvert	2016		-		Steep
131	Balojohka	Bridge	2004		+	Yes	
132	Niitomohkkejohka	Culvert	2004		-		
	Niitomohkkejohka	Culvert	2016		-		Steep
133	**Geaimmejohka**	**Bridge**	**2004**		**+**	**Yes**	
	Geaimmejohka	**Bridge**	**2019**			**Yes**	**Salmon river**
134	Ápmemohkkejohka	Culvert	2016		+		
135	Ápmemohkkijogaš	Culvert	2016	0,05	-		Steep
136	Goržejohka	Bridge	2004		+		
	Goržejohka	Bridge	2016		+		
137	Heargejogaš	Culvert	2016		-		Natural barrier below (steep)
138	Námmájohka	Culvert	2004		+		
139	Námmájohka	Bridge	2016		+		
140	Námmájohka, upper		None				
141	Gákkohkjogaš	Culvert	2016		+		Probably natural barrier below
142	Gorvvájohka, road one	Culvert	2016		+		
143	Gorvvájohka, private road	Culvert	2016		+		
144	Čohkejogaš	Culvert	2016		-		Steep
145	Roavvejogaš	Culvert	2016		-		Steep
146	Gumpejohka	Culvert	2016		-		Natural barrier below (steep)
147	Loddejohka	Culvert	2004		-		Dry
148	Njáhhkájávri	Culvert	2004	0,3	+		
149	Sáđejohka	Bridge	2004		+	Yes	
150	Stohpoguoika	Culvert	2004		-		Dry
151	Lágaguoika	Culvert	2004		-		Dry
152	Rávdojohka	Bridge	2004		+		
153	Liidnebeachcanjohka	Culvert	2004		-		Dry culvert
154	Suhpenjunesjohka	Culvert	2004	0,6	-		New survey needed
155	Jerguljohka	Bridge	2004		+	Yes	
156	Čearrogeašjohka	Bridge	2019		+		
157	Beagcejogaš	Culvert	None				
158	Gámehisjohka	Bridge	2001		+		
159	Čahppesjohka	Bridge	2001	0,2	+	Yes	Steep, salmon parr above
	Čahppesjohka	bridge	2016	0,2	***	Yes	Steep, high velocity in culvert
159.1	Nameless	Culvert	2016		-		Steep, hindering below

Table 14. Sum-up table of sites 159-177 (Norway)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurrence of juvenile salmonids	Comment (upstreams habitat)
159	Čahppesjohka	Bridge	2001	0,2	+	Yes	Steep, salmon parr above
	Čahppesjohka	bridge	2016	0,2	***	Yes	Steep, high velocity in culvert
159.1	Nameless	Culvert	2016		-		Steep, hindering below
160	Solccar lilleelv	Culvert	2001		+		Steep and small
	Solccar lilleelv	Culvert	2016		+		
160.1	Nameless	Culvert	2016		-		
160.2	Nameless	Culvert	2016		+		Steep
161	Vuolit Ruovttujohka	Bridge	2001		+		
	Vuolit Ruovttujohka	Bridge	2016		+		
162	Bajit Ruovttujohka	Bridge	2001		+		
	Bajit Ruovttujohka	Bridge	2016		+		
162.1	Nameless	Culvert	2016		+		up to a small pond
163	Vealeája	Culvert	2016		-		Steep, natural barrier below road
163.1	Nameless	Culvert	2016		-		Steep, natural barrier below road
164	Iškorasjohka	Bridge	2001		+		Nice river, mainly sea tout spawning?
	Iškorasjohka	Bridge	2016		+	Yes	
165	Mohkkaras	Culvert	2001		+		
166	Floodway 2	Culvert	2001		+		Small
167	Máreveadji	Bridge	2001		+		
	Máreveadji	Bridge	2016		+		
167.1	Nameless	Culvert	2016		-		Natural barrier below road
167.2	Nameless	Culvert	2016		+		Partly barrier below
167.3	Nameless (Njalahásjohka)	Culvert	2001		+		Steep and small
	Nameless (Njalahásjohka)	Culvert	2016		+		Steep and small
168	Njalahásjohka	Culvert	2001		+		
	Njalahásjohka	Culvert	2016		+		
169	**Goššjohka**	**Bridge**	**2001**		**+**		**Salmon river**
	Goššjohka	**Bridge**	**2016**		**+**	**Yes**	
170	Gállája	Culvert	2001		+		Small
	Gállája	Culvert	2016		+		Small
171	Dierpmesája	Culvert	2001	0,2	-		Small
	Dierpmesája	Culvert	2016		-		Small, steep below the road
172	Ruvvašjohka	Culvert	2016		*		High velocity in culvert
173	Nameless	Culvert	2016		+		
174	Nameless	Bridge	2016		+		Natural barrier below road
175	Nameless	Culvert	2016	0,2	-		Natural barrier 50 m above road
176	Ássuorgi (Bridge)	Bridge	2016		+		
177	Ássuorgi (Culvert)	Culvert	2016	0,2	-		Natural barrier below road

Table 15. Sum-up table of sites 178-188 (Norway)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
178	Ráitejohka	Culvert	2016		***		Culvert is not a compleet hindering
179	Ráitejohka, tributary	Culvert	2016		+		
180	Nameless	Culvert	2016		-		Small, steep
181	Nameless	Culvert	2016		+		Probably a natural barrier below road
182	Nameless	Culvert	2016		+		
183	Nameless	Culvert	2016		-		Steep, small
184	Nameless	Culvert	2016		+		
185	Geassesaiája	Culvert	2016		+		
186	Guorrasjohka	Bridge	2016		+		
187	Allavuohčojohka	Culvert	2016		+		
188	Cáskibjohka	Bridge	2016		+		

Legends:

- **-** No restoration potential due to natural barriers, low water flow, steep river stretch and/or poor fish habitat upstreams
- **+** Object without barrier- not in need of measures
- ***** Restoration object of uncertain potential
- ****** Restoration object of medium potential
- ******* Restoration object of large potential

Bold text = Spawning river

Annex 4. Sum-up table of inspected sites 1999-2019 (Finland)

Table 16. Sum-up table of sites 1-13 (Finland)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
1	**Gálddašjohka**	**Bridge**	**1999**		**+**	**yes**	**Restoration measurements done**
			2004		+		
			2018		No potential		Restoration plan done in 2003 but not implemented.
2	Skáidejohka	Culvert	1999		+	yes	
			2018		No potential		
3	Anárašjohka	Culvert	1999		-		steep
4	Vuolit Boratbokcájohka I	Culvert	1999	0,9	-	yes	Steep.Restored 2003.
			2018	0,35-0,4	Potential for restoration		Restored 2019
4 B	Vuolit Boratbokcájohka II	Culvert	1999	0,5	3	yes	Bridge needed.Restored 2001.
			2018		No potential		Good status
5	Bajit Boratbokcájohka	Culvert	1999	0,9	3	yes	Bridge needed.Restored 2004.
			2018	0,1	Potential for restoration		Need to lower the natural barrier and reparing corrosion parts
6	Geassemahjohka I	Culvert	1999		+	yes	
			2018		No potential		
6,1	Geassemahjohka II	Bridge	2018		No potential		
7	Gorrehatája I	Culvert	1999	0,5	-		small
			2018	0,45	No potential		
7,1	Gorrehatája II	Culvert	2018		No potential		
8	Njallavárjohka	Culvert	1999	1	-	yes	small
			2018	0,4			
9	Vuolit Jeagelveaijohka	Bridge	1999		+	yes	
			2018		No potential		
10	Bajit Jeagelveaijohka	Bridge	1999		+	yes	
			2018		No potential		
11	Orešjohka	Culvert	1999	0,4	+		cramped culvert
			2018	0,4			steep drop
12	Veahcajohka (Vetsijoki)	Bridge	1999		+	yes	Restoration measures done.Restored 1980.
			2018		No potential		
13	Njallajohka	Culvert	1999		+	yes	
			2018		No potential		

Table 17. Sum-up table of sites 13-26 (Finland)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
13,1	Goahtesaijohka	Culvert	2018		No potential		
14	Gárnjárnjohka	Culvert	1999	0,6	2	yes	Need to raise the water level.Restored 2004.
			2018	0,15	Potential for restoration		Need to lower the excess drop
15	Viđgaveadji	Bridge	1999		+	yes	
			2018		No potential		Under construction
16	Ráideborjohka	Culvert	1999	0,5	-	yes	Private road
			2018	0,35			Steep channel
16,1	Ráideborjohka II	Culvert	2018			yes	
17	Ailegasjohka	Bridge	1999		+		
			2018		No potential		
18	**Ochejohka (Utsjoki)**	**Bridge**	**1999**		**+**	**yes**	**Restoration measurements done 1980.**
			2019		No potential		
19	Áibmejohka (Äimäjoki)	Bridge	1999		+	yes	Private road.Restored 1998.
			2018		No potential		Restoration measurements done
19,3	Áibmejohka II	Culvert	2018		Potential for restoration		Restorations done almost yearly, bridge recommended.
19,4	Áibmejohka III	Culvert	2018		No potential		
20	Vuolit Rátnojohka	Culvert	1999	0,5	-		Steep
			2018	0,25	No potential		Steep
21	Bajit Rátnojohka	Culvert	1999	0,5	-		Steep
			2018	0,2	No potential		Steep
22	22B Bajit Beašnjeará	Culvert	1999		+	yes	Restored 2000.
			2018		No potential		
22	Vuolit Beašnjeará	Culvert	1999	0,3	1	yes	steep, restoration measurements done.Restored 2000.
			2018		No potential		
23	Junttejohka (Junttijoki)	Culvert	1999	0,3	-	yes	Steep, restored. Restored 2000.
			2018		No potential		
24	Koappeloaivinjohka (Nuorásjohka)	Tubular bridge	1999	0,2	2		Sheet i
25	Goahppelašjohka (Kuoppilasjoki)	Bridge	1999		+	yes	Restoration measurements done.
			2018		No potential		
26	Viercanjeriidája	Culvert	2001		+		
			2018		No potential		0,45 m drop to stream bed.

Table 18. Sum-up table of sites 27-47 (Finland)

Map refe-rence	Name of river	Type of structure	Year of inven-tory	Drop from out-let (meter)	Restoration potential (in year of inven-tory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
27	Bađđa	Bridge	1999		+	yes	
			2018		No potential		
28	Gistujohka	Bridge	1999	rocky	+		small
			2018		No potential		
29	Dánsejohka	Tubular bridge	1999		+	yes	low
			2018		No potential		
30	Juolgetbealjoh-ka	Culvert	1999		+		steep
			2018		No potential		
31	Gazzanjavejoh-ka	Culvert	1999		+		Steep
			2018	1			Steep
32	Goatneljohka	Bridge	1999		+	yes	Steep
			2018		No potential		
33	Báđošjohka	Tubular bridge	1999		+	yes	Steep
			2018		No potential		Steep
34	Cierrunjohka	Culvert	1999		-		Steep
			2018		No potential		
35	Hánnojohka	Bridge	1999		+		Steep
			2018				Steep
36	Suohpajohka	Culvert	1999	0,8	-	yes	Steep
			2018	0,7			Steep, 0,7 m drop to stream bed.
37	Nuvvosjohka	Bridge	1999		+		Low. Restored 1990.
			2018				
38	Njiljohka (Nili-joki)	Bridge	1999		+		low
			2018		No potential		
39	Hánasjohka	Culvert	1999		No potential		Steep, small
			2018	0,25			Dry and narrow channel
40	Valljášjohka	Culvert	1999	0,1/ rocky	-	yes	Steep
			2018	0,25			Steep
41	Áitejohka (Aitti-joki)	Culvert	1999	0,6	-	yes	Steep
			2018	0,3			Steep
42	Erkkejohka	Culvert	1999	0,5	-		Steep, small
			2018	1			Steep
43	Jeagelveaijohka	Bridge	1999		+	yes	
			2018				
44	Roahkája	Culvert	1999	0,4	-		Steep, small
			2018	0,35			
45	Sieiddejohka	Bridge	1999	rocky	2	yes	Steep, restored.Restored 2000.
			2018				
46	Čulloveaijohka	Bridge	1999		+	yes	
			2018				
47	Sávdneája	Culvert	1999		+		
			2018		No potential		

Table 19. Sum-up table of sites 48-65 (Finland)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
48	Veanzeája	Culvert	1999		+		
			2018	0,15	No potential		
49	Gorsaája	Culvert	1999	0,5	-		Small
			2018	0,8			
50	Áhkojohka (Akujoki)	Bridge	1999		+		Restoration measurements done 1980.
			2018				Estuary has become lower and wider again
51	Bihteája	Culvert	1999	0,3	+		Steep, small.
			2018	0,4			Steep
52	Fierranjohka	Culvert	1999		+	yes	Privateroad
			2018		No potential		
53	Biesjohka (Piesjoki)	Bridge	1999		+	yes	
			2018				
54	Roavveája	Culvert	1999	0,5	+		
			2018		No potential		Threshold at pipe outlet and inlet in bigger culvert
55	Gáivojohka	Bridge	1999		+	yes	Natural erosion
			2018		No potential		
56	Stuorragurája	Culvert	1999		+		
			2018	0,4	No potential		
57	Luossagoatnelája (Lohikosteoja)	Culvert	1999	0,3	-		Small
			2018	0,15	No potential		
58	Rásseája	Culvert	1999	0,1	+		Cramped culvert
			2018	0,55	Potential for restoration		Lower the threshold
59	Meaddenvárája	Tubular bridge	1999		-		Sheet ice
			2018		No potential		
60	Vuopmanjohka	Culvert	1999		+	yes	Juvenile salmonids observed 1993 el-fishing
			2018		No potential		
61	Basijohka	Bridge	1999		+	yes	
			2018		No potential		
62	Gáregasjohka (Karigasjoki)	Bridge	2001		+	yes	
			2018		No potential		
63	Nuhppirjohka	Bridge	1999		+	yes	
			2018		No potential		
64	Bistuája (Pistoja)	Culvert	1999	0,3	+		
			2018		No potential		Excess drop at upper culvert.
65	Doarrovasjohka	Culvert	1999		-		Small, natural barrier below the culvert.
			2018	0,5			

Table 20. Sum-up table of sites 66-77 (Finland)

Map reference	Name of river	Type of structure	Year of inventory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Occurence of juvenile salmonids	Comment (upstreams habitat)
66	Gameljohka	Bridge	1999		+	yes	
			2018		No potential		
67	Bálggatjohka	Bridge	1999		+	yes	Juvenile salmonids observed elfishings 1980,1984
			2018		No potential		
68	Mohkkarasája	Culvert	1999	0,3 / 0,5	2		Need to raise the waterlevel.Restored 2004.
			2018	0,25	Potential for restoration		Excess dropp might become a barrier in dry seasons
69	Beahkágurája	Culvert	1999	0,25	2	yes	Need to raise the waterlevel.Restored 2004.
			2018	0,1	No potential		Waterlevel was raised in restoration 2004
70	Guoldnájohka	Bridge	1999		+	yes	
			2018				
71	Badje-Guoldná	Culvert	1999	0,5	-		Small
			2018	0,4	Potential for restoration		Lower the threshold
72	Guottoveijohka	Bridge	1999		+	yes	Juvenile salmonids observed elfishing 1980
			2018				
73	Čoalosjohka	Bridge	1999		+	yes	Juvenile salmonids observed elfishing 1980
			2018		No potential		
74	Ruvašája	Culvert	1999	0,25 0,9	-		Steep culvert and multiple natural barriers in channel
			2018				Structural and natural barrier
75	Vuopmeveadji	Bridge	1999		+		
			2018		No potential		
76	Beavrretjohka	Culvert	1999		+		
			2018	0,25			
77	Váddejohka	Culvert	1999		+		
			2018		No potential		

Legends:

- No restoration potential due to natural barriers, low water flow, steep river stretch and/or poor fish habitat upstreams
+ Object without barrier- not in need of measures
1 Restoration object of uncertain potential
2 Restoration object of medium potential
3* Restoration object of large potential

Bold text = Spawning river

Table 21. Sum-up table of sites surveyd in 2004 (Utsjoki, Finland)

Map refe-rence	Name of river	Type of structure	Year of inven-tory	Drop from outlet (meter)	Restoration potential (in year of inventory)	Res-tored (year)	Occu-rence of juvenile salmo-nids	Comment (upstreams habitat)
A 59	Nameless (Mantojärvi)	Culvert	2004	0,2	÷			Steep
A 60	Vuolle-Seavttet	Bridge	2004		+		Yes	Good densities
A 61	Badje-Seavttet	Bridge	2004		+		Yes	
A 62	Námmájohka	Culvert	2004		+		Yes	Dry pipe
A 63	Mielkejohka	Culvert	2004		+		Yes	
A 64	Rássejohka	Culvert	2004	0,2	+			Steep
A 65	Cieskuljohka	Bridge	2004		÷			Steep
A 66	Leaibejohka	Culvert	2004		÷			Steep
A 67	Korretoja	Culvert	2004		÷			
A 68	Háratjohka	Culvert	2004	0,2	÷			Steep
A 69	Ivvánasjohka	Bridge	2004		+			
Pulmak/ Pulman-kijärvi								
A 70	Viercajohka(Jääräjoki)	Bridge	2004		+			
A 71	Skáidejohka	Bridge	2004		+			

Legends:

- No restoration potential due to natural barriers, low water flow, steep river stretch and/or poor fish habitat upstreams

+ Object without barrier- not in need of measures

***** Restoration object of uncertain potential

****** Restoration object of medium potential

******* Restoration object of large potential

Bold text = Spawning river

Annex 5. Maps of inspected road crossings in River Tana catchment area

Figure 12. Map of sites 1-9 (Norway)

Figure 13. Map of sites 10-16 (Norway)

Figure 14. Map of sites 17-26B (Norway)

Figure 15. Map of sites 27-37 (Norway)

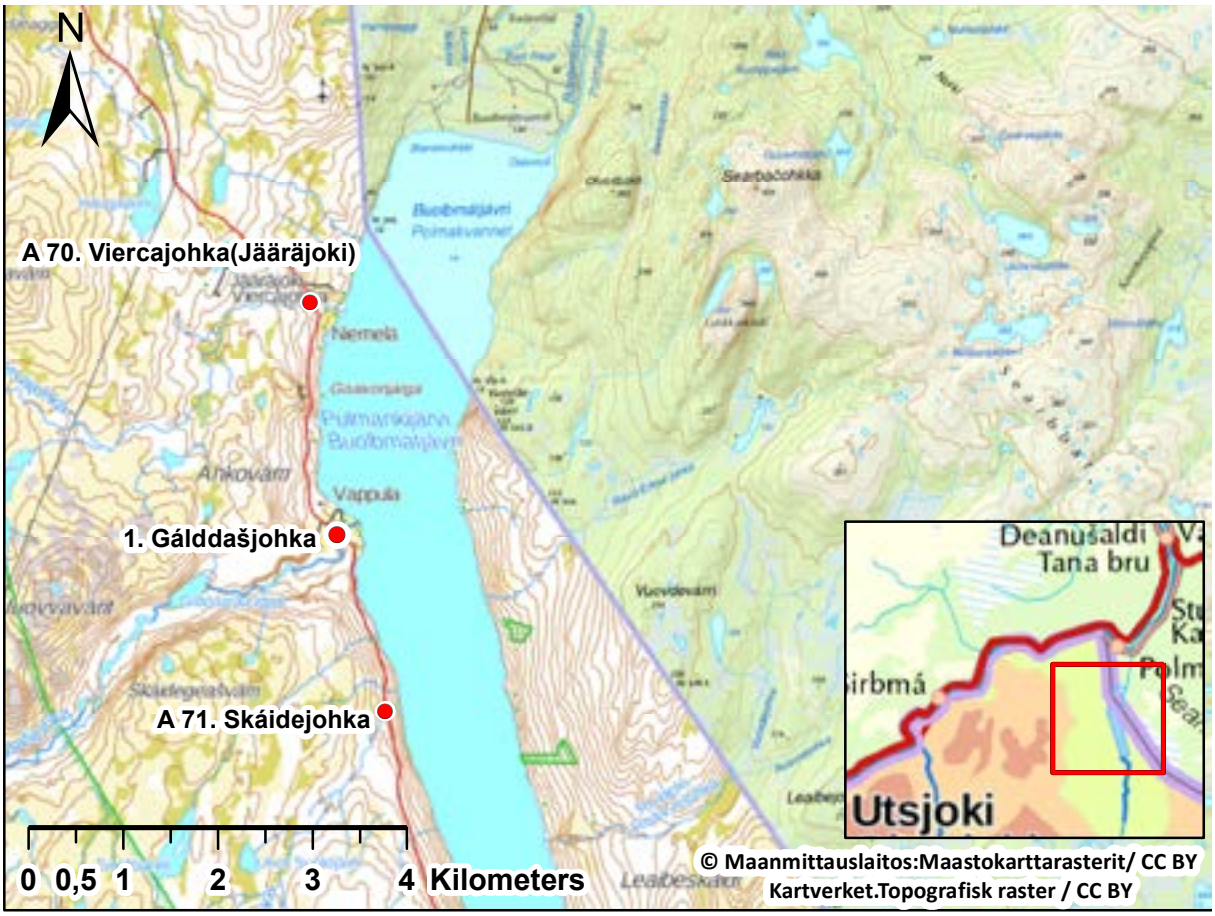

Figure 16. Map of sites 1, A70 and A71 (Finland)

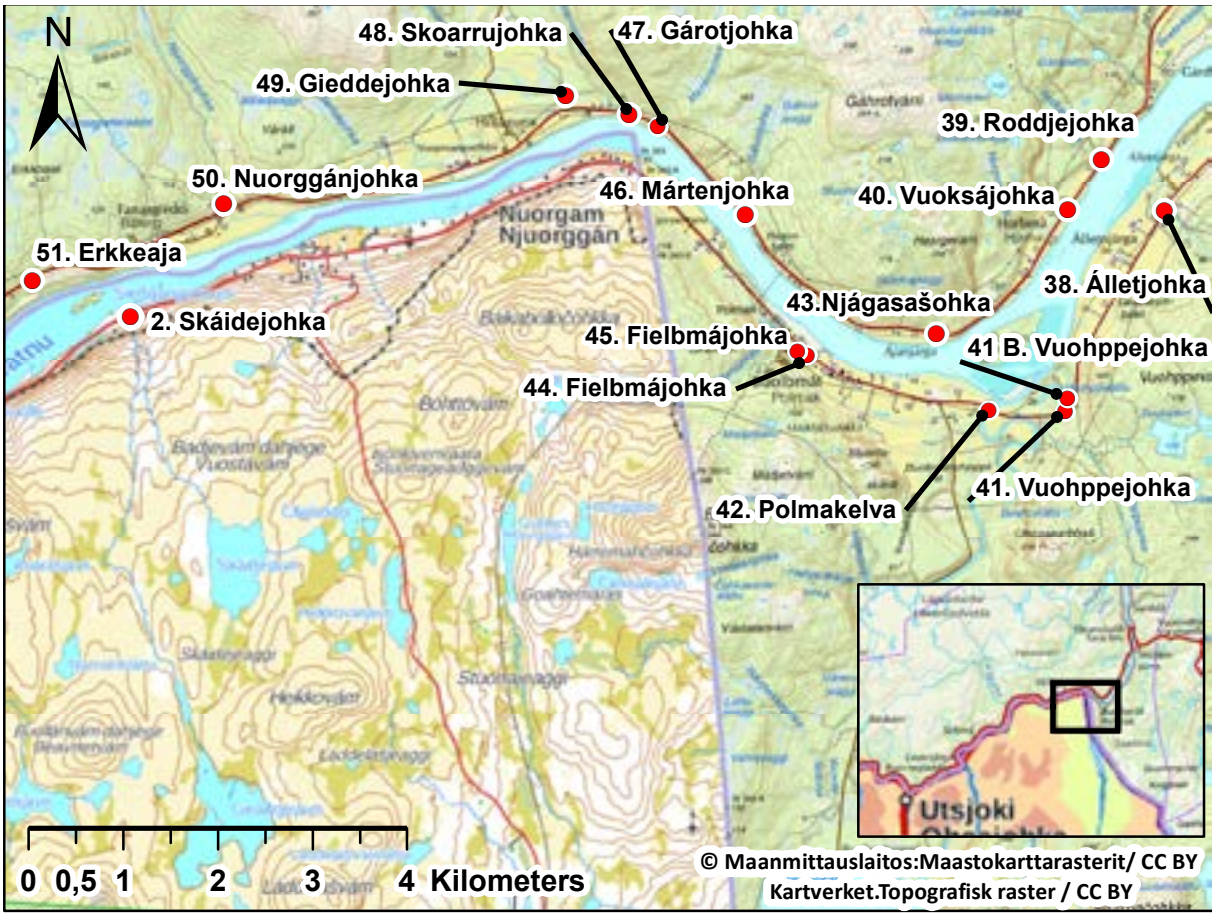

Figure 17. Map of sites 38-51 in Norway and site 2 in Finland

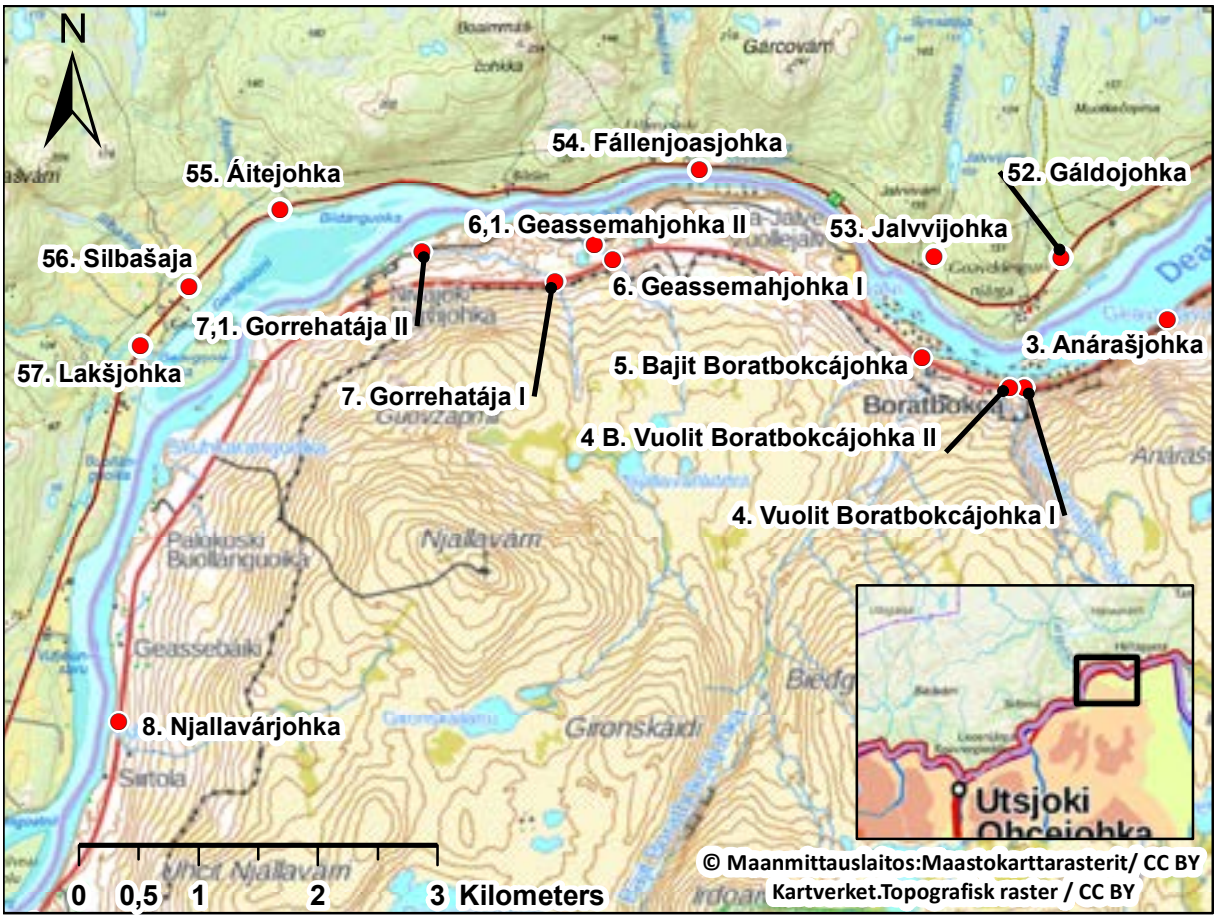

Figure 18. Map of sites 52-57 in Norway and 3-8 in Finland

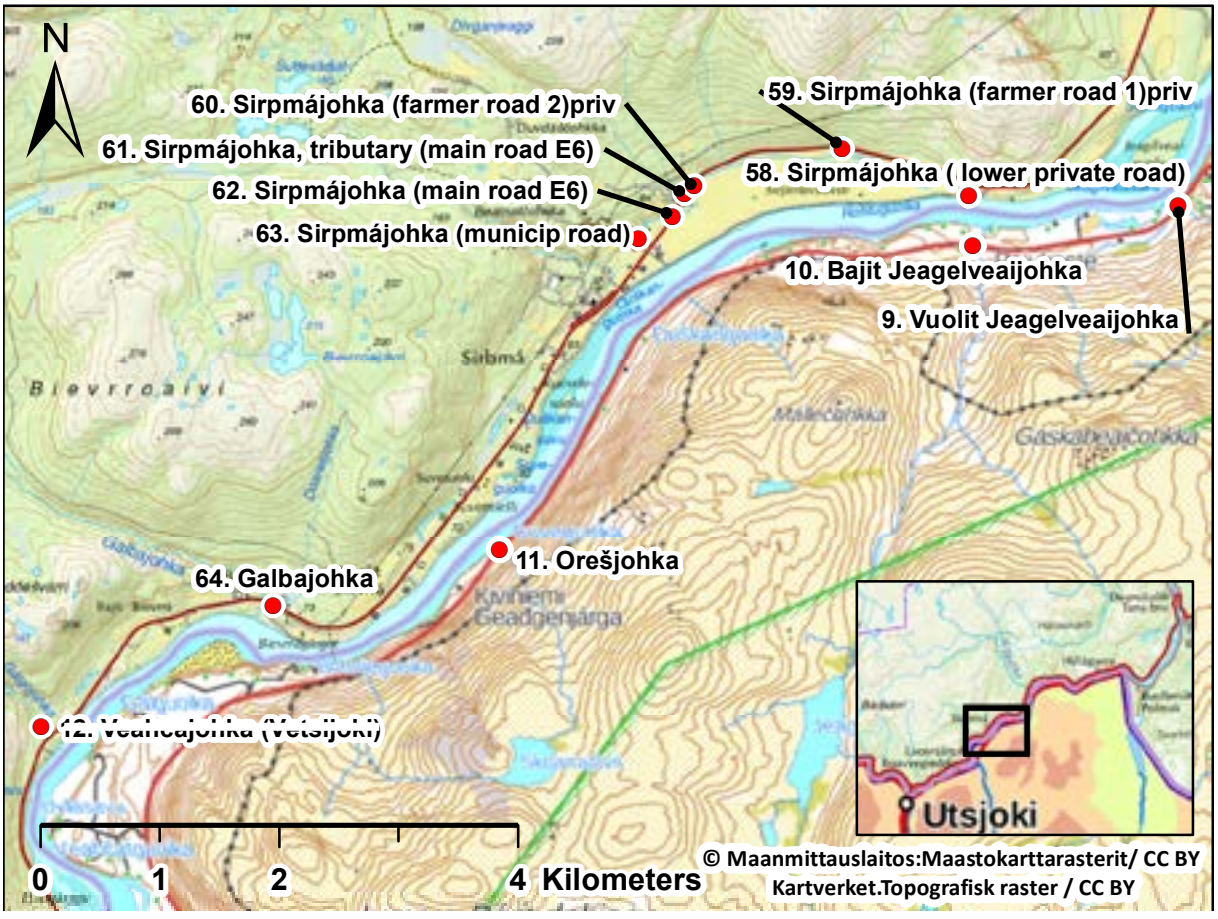

Figure 19. Map of sites 59-64 in Norway and 9-11 in Finland

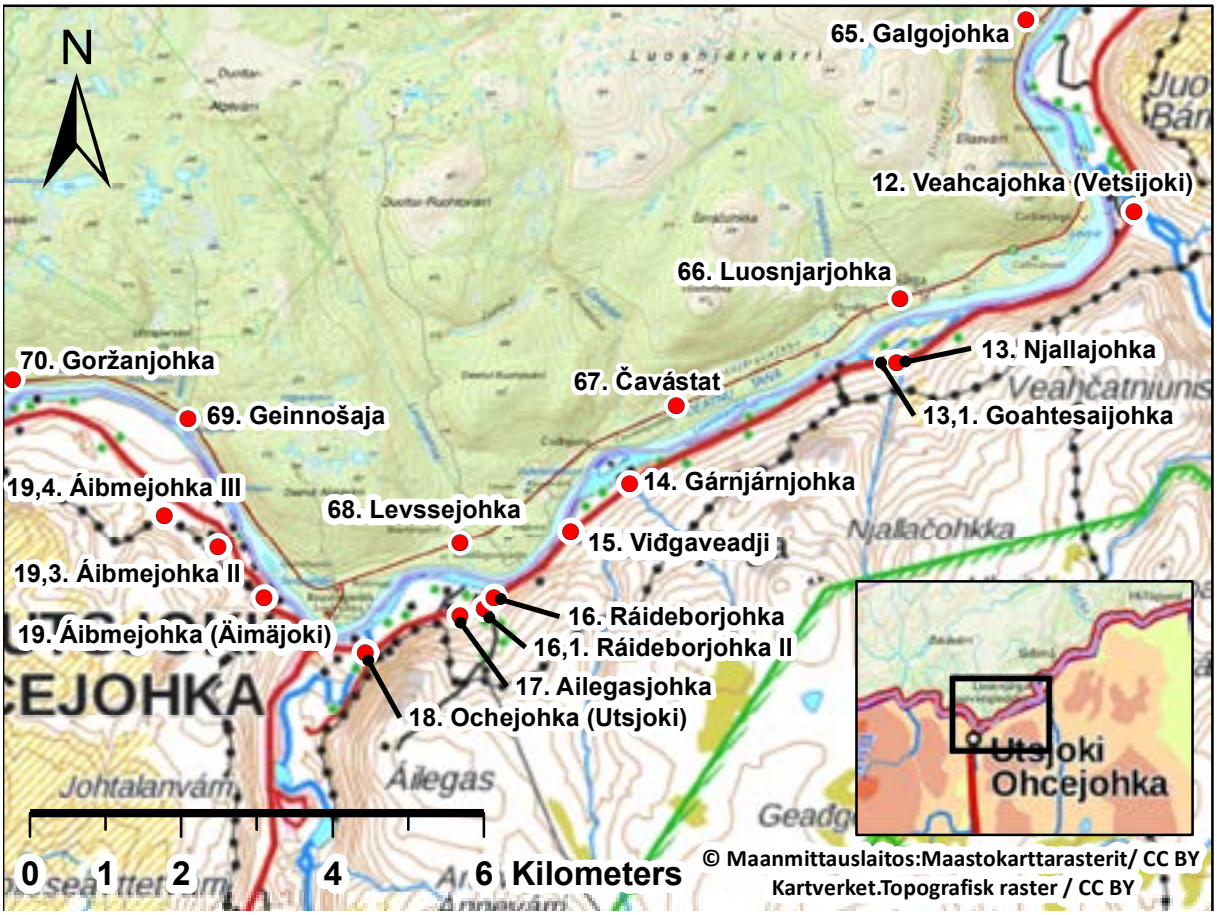

Figure 20. Map of sites 65-70 in Norway and 13-19.4 in Finland

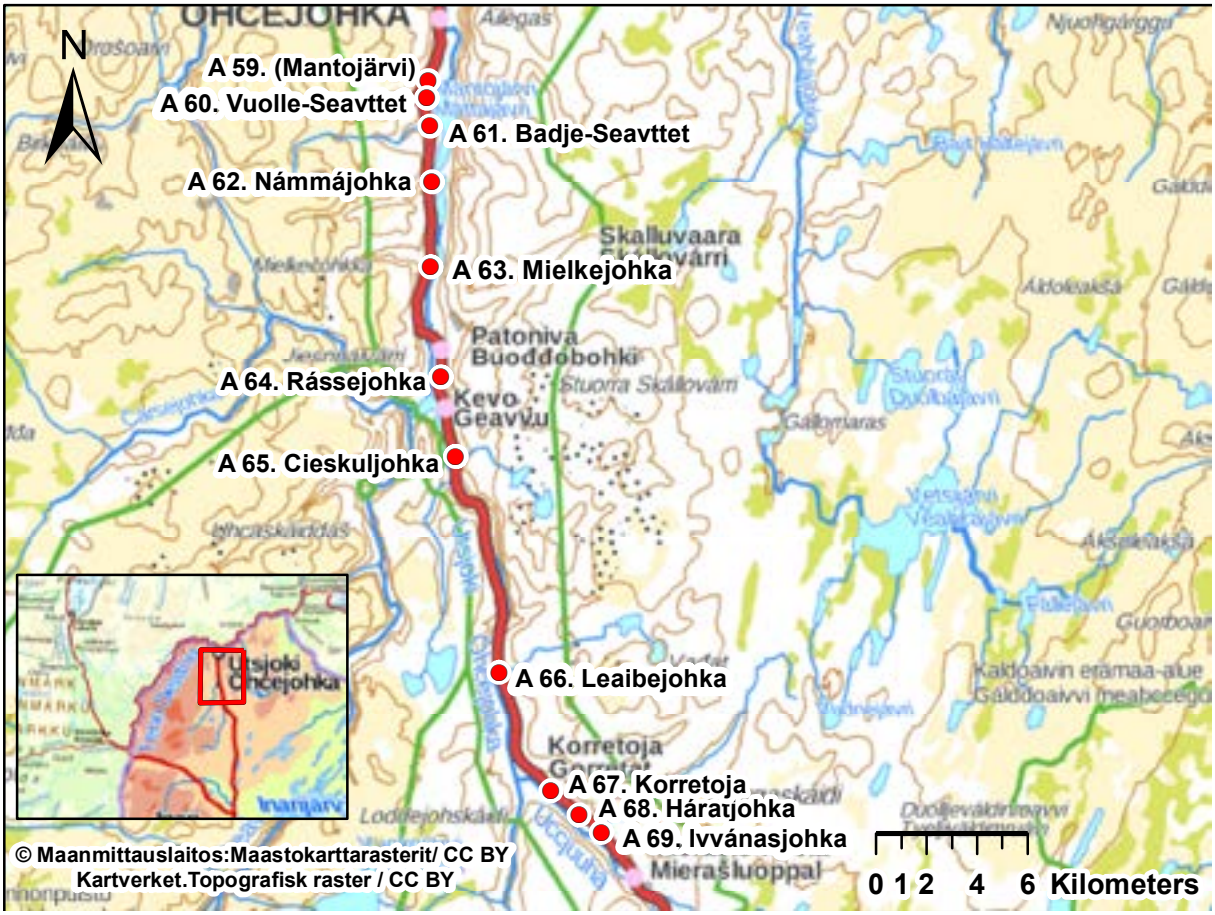

Figure 21. Map of sites A59-A69 in Utsjoki,Finland

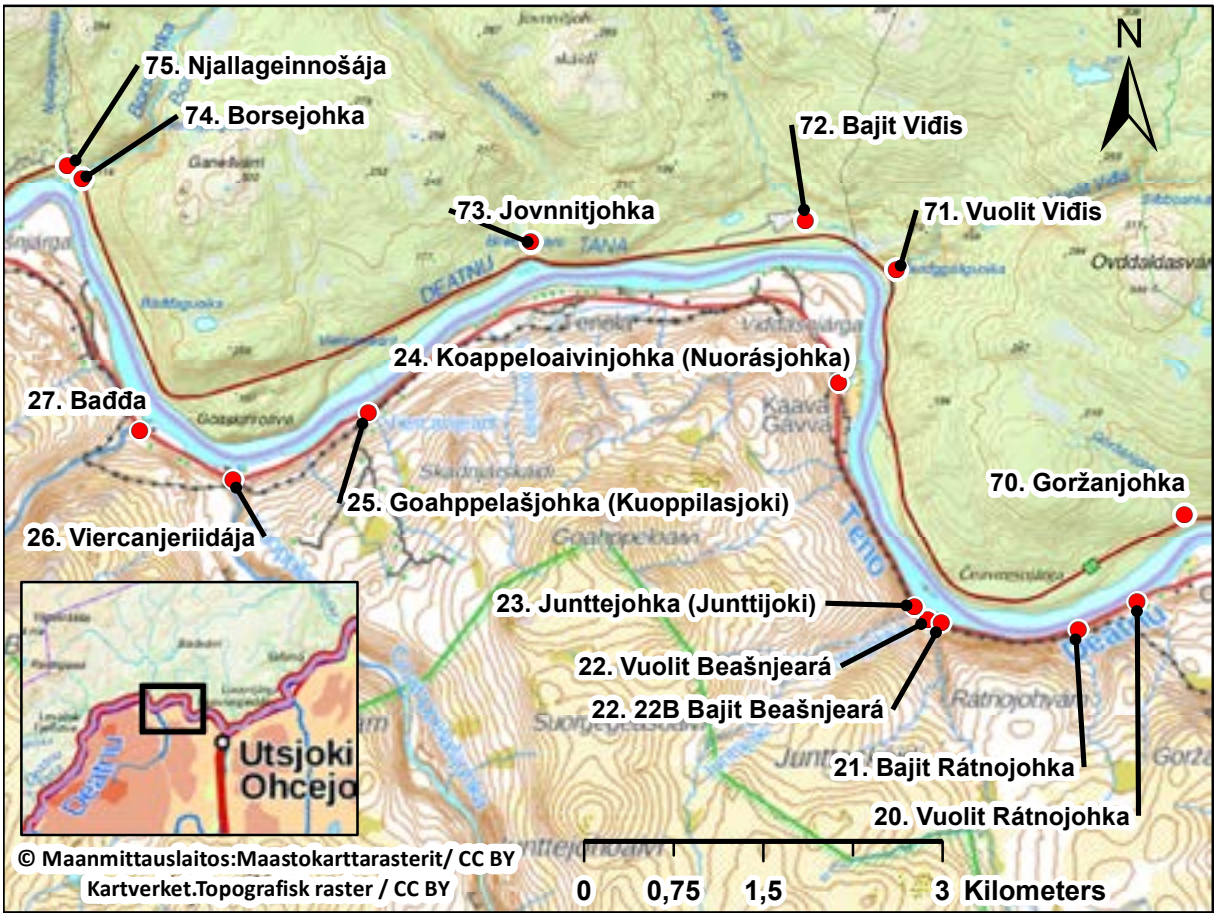

Figure 22. Map of sites 70-75 in Norway and 20-27 in Finland

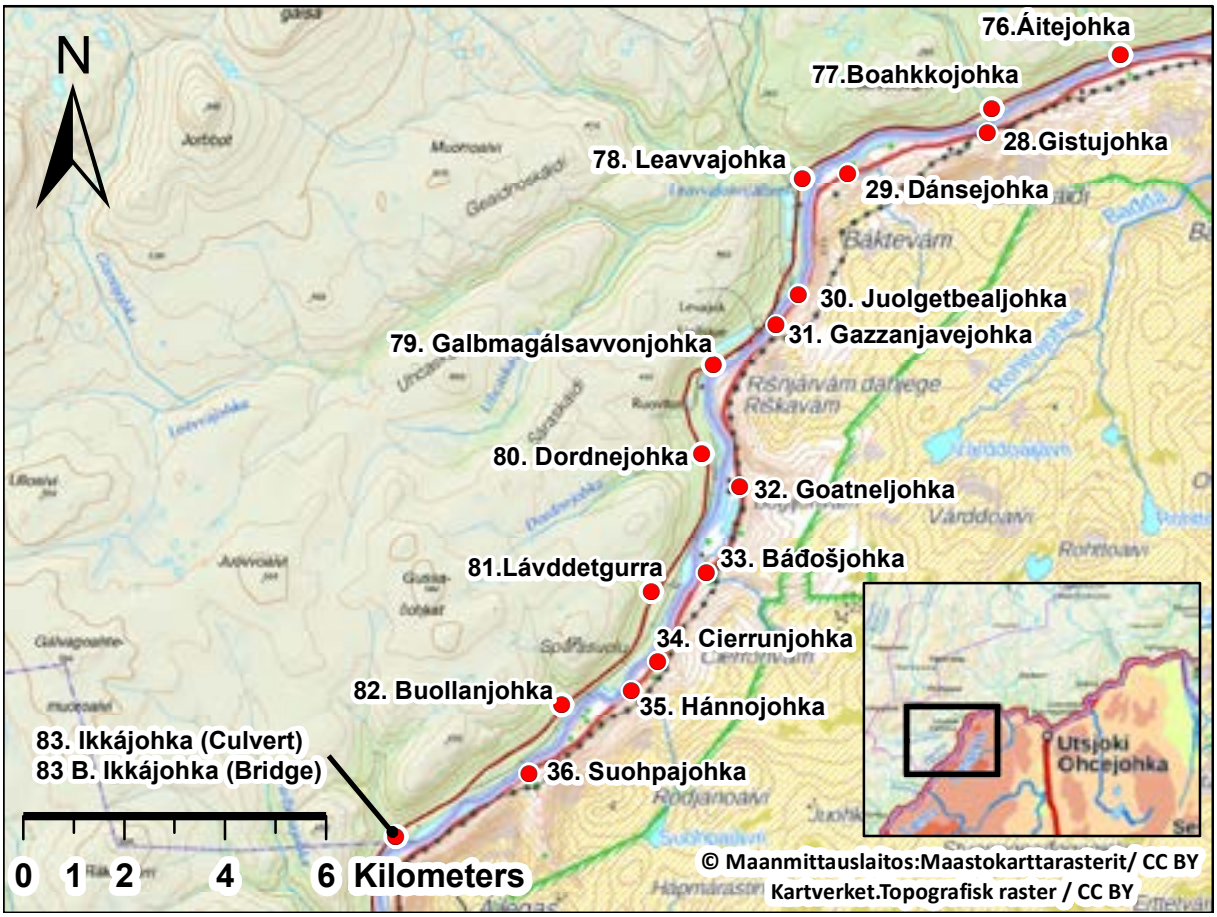

Figure 23.Map of sites 76-83B in Norway and 28-36 in Finland

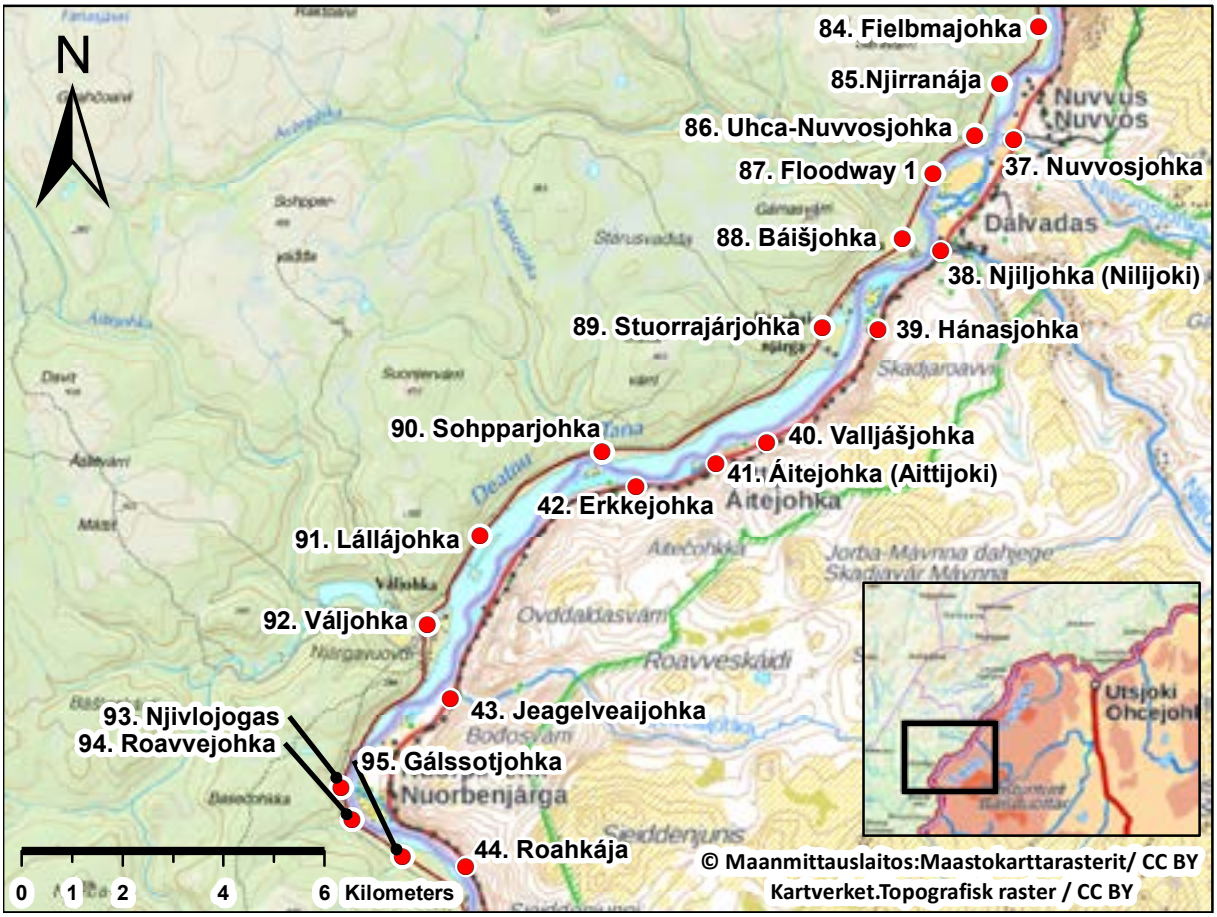

Figure 24. Map of sites 84-95 in Norway and 37-44 in Finland

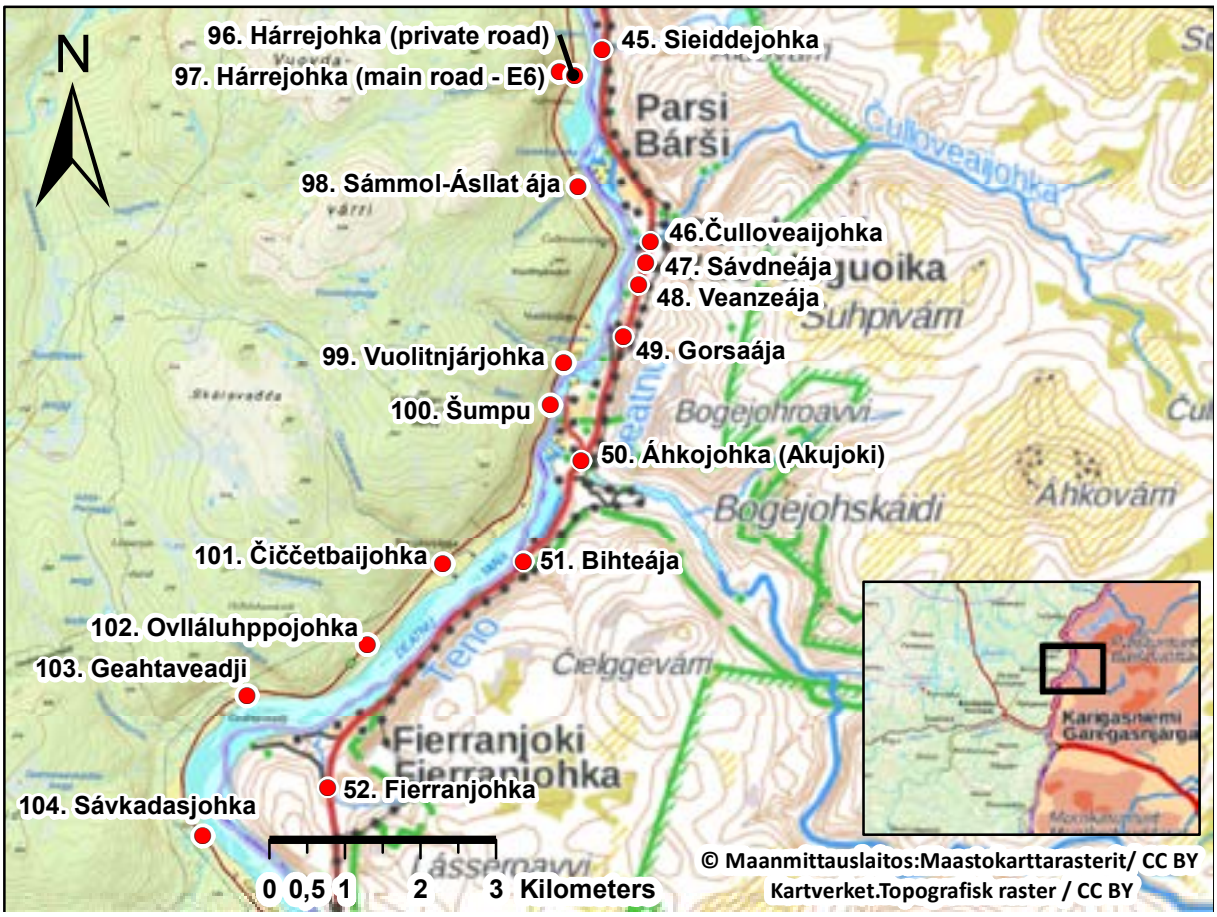

Figure 25. Map of sites 96-104 in Norway and 45-52 in Finland

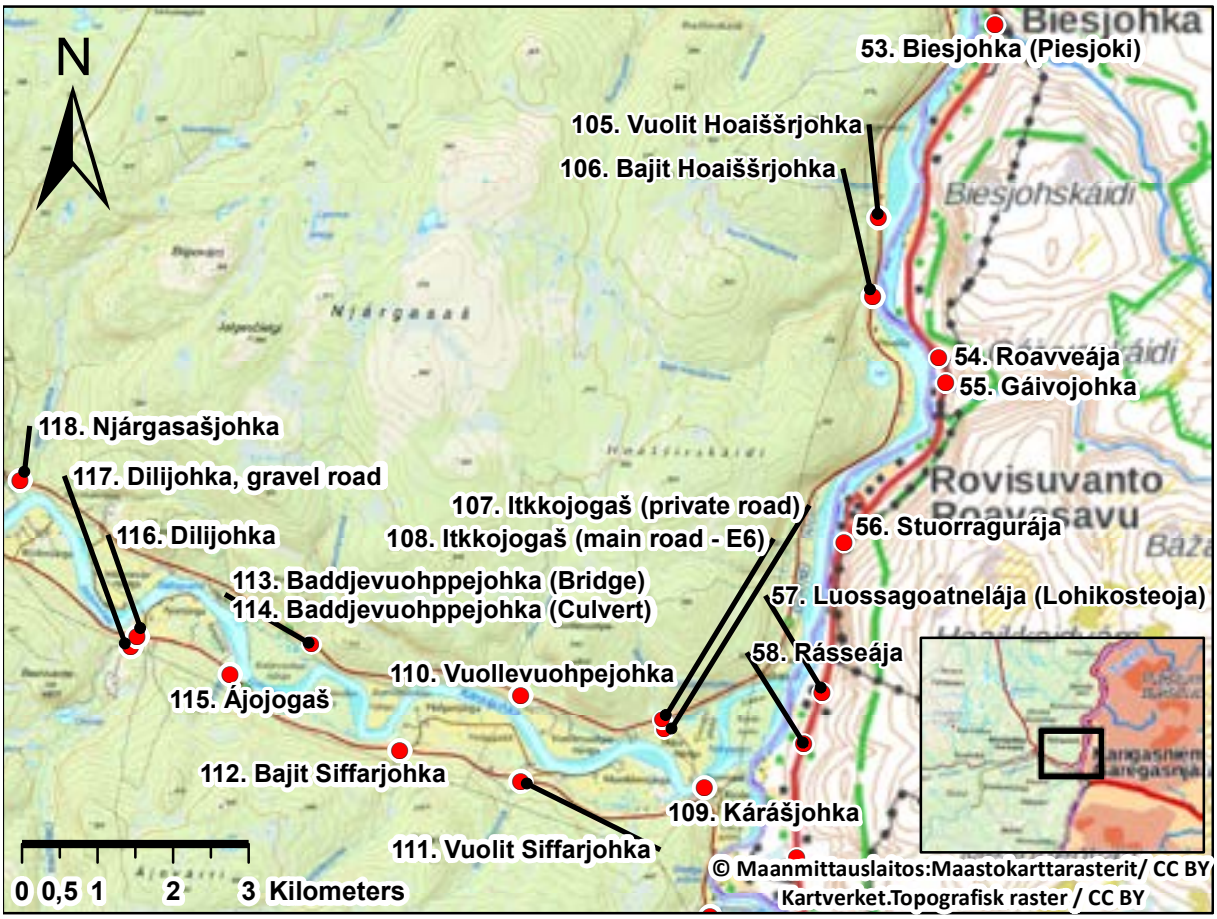

Figure 26. Map of sites 105-118 in Norway and 53-58 in Finland

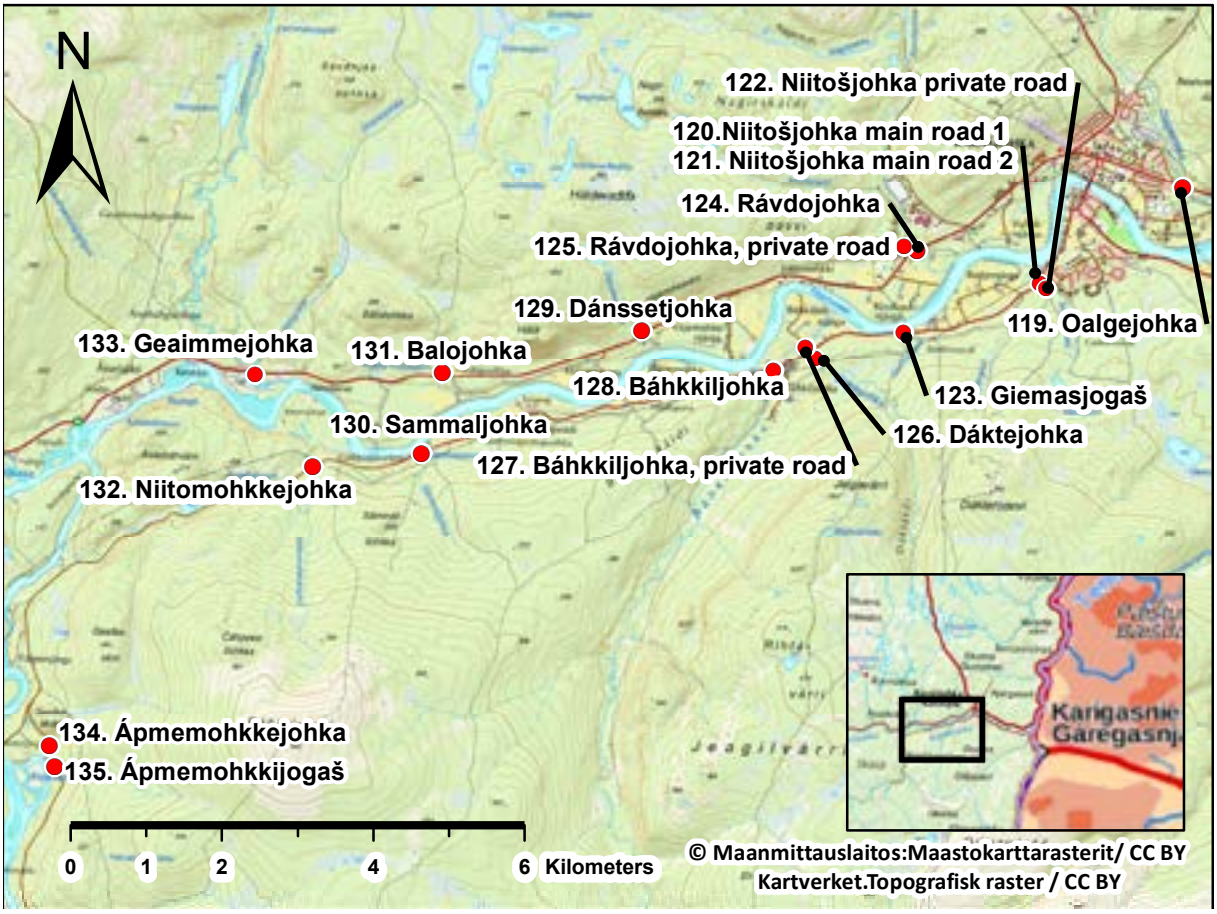

Figure 27. Map of sites 119-135 in Karasjok, Norway

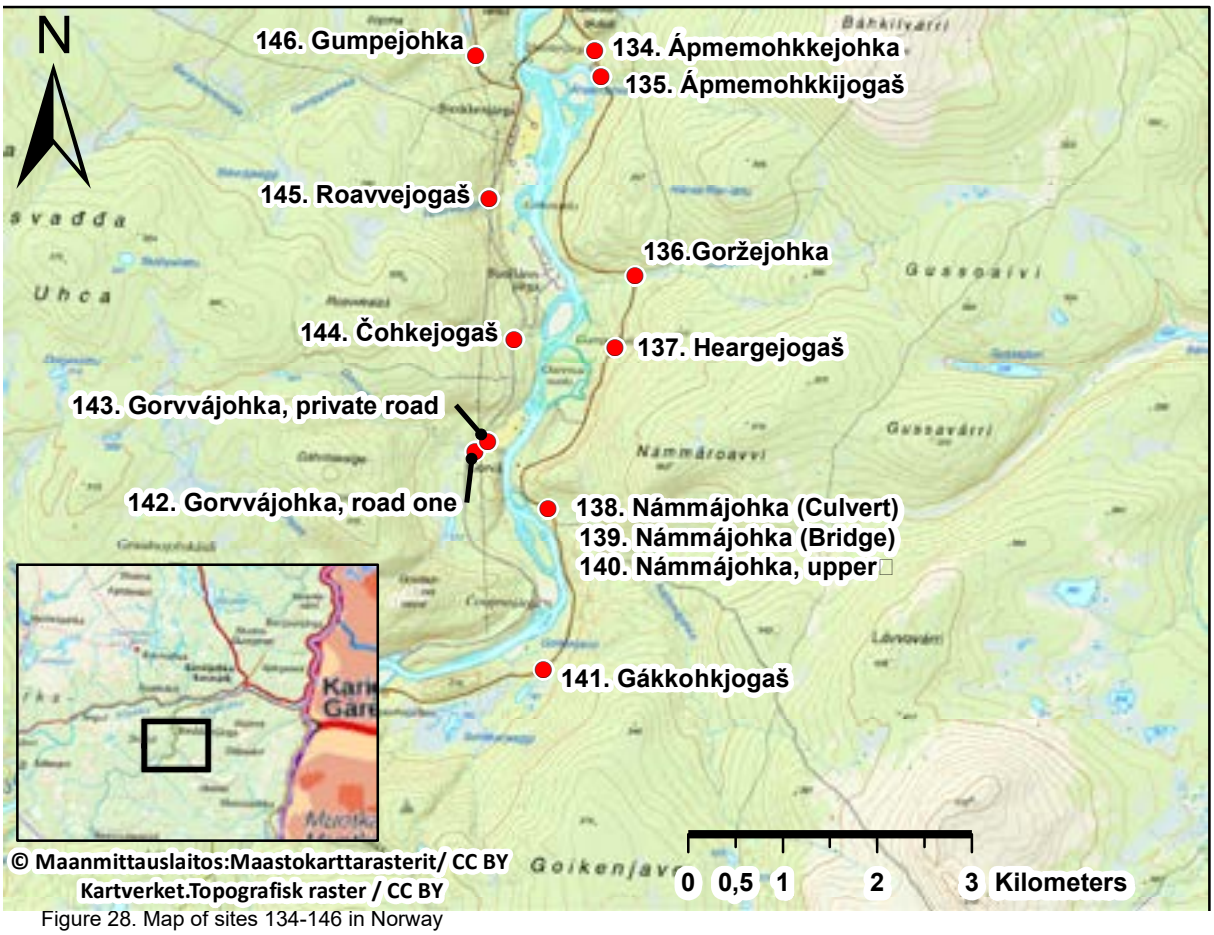

Figure 28. Map of sites 134-146 in Norway

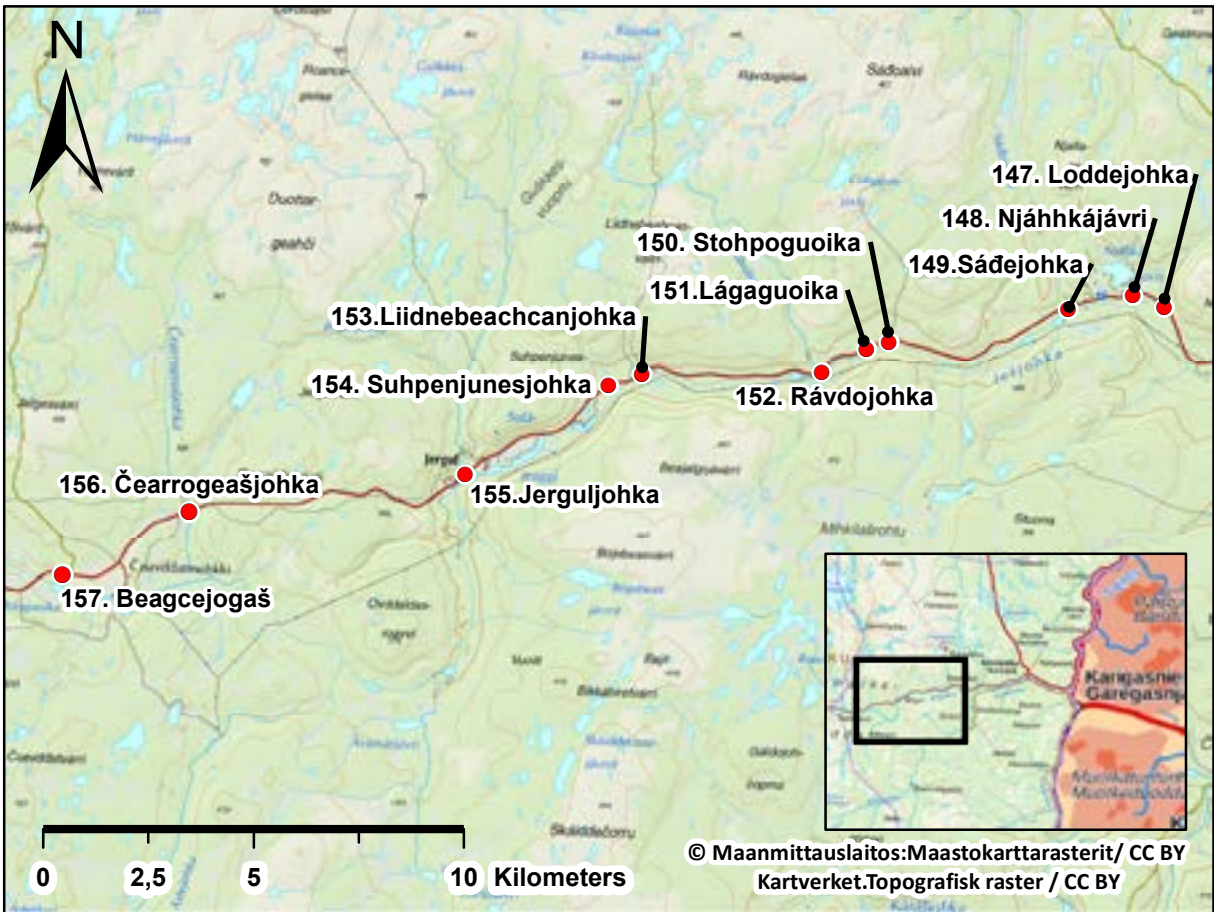

Figure 29. Map of sites 147-157 in Norway

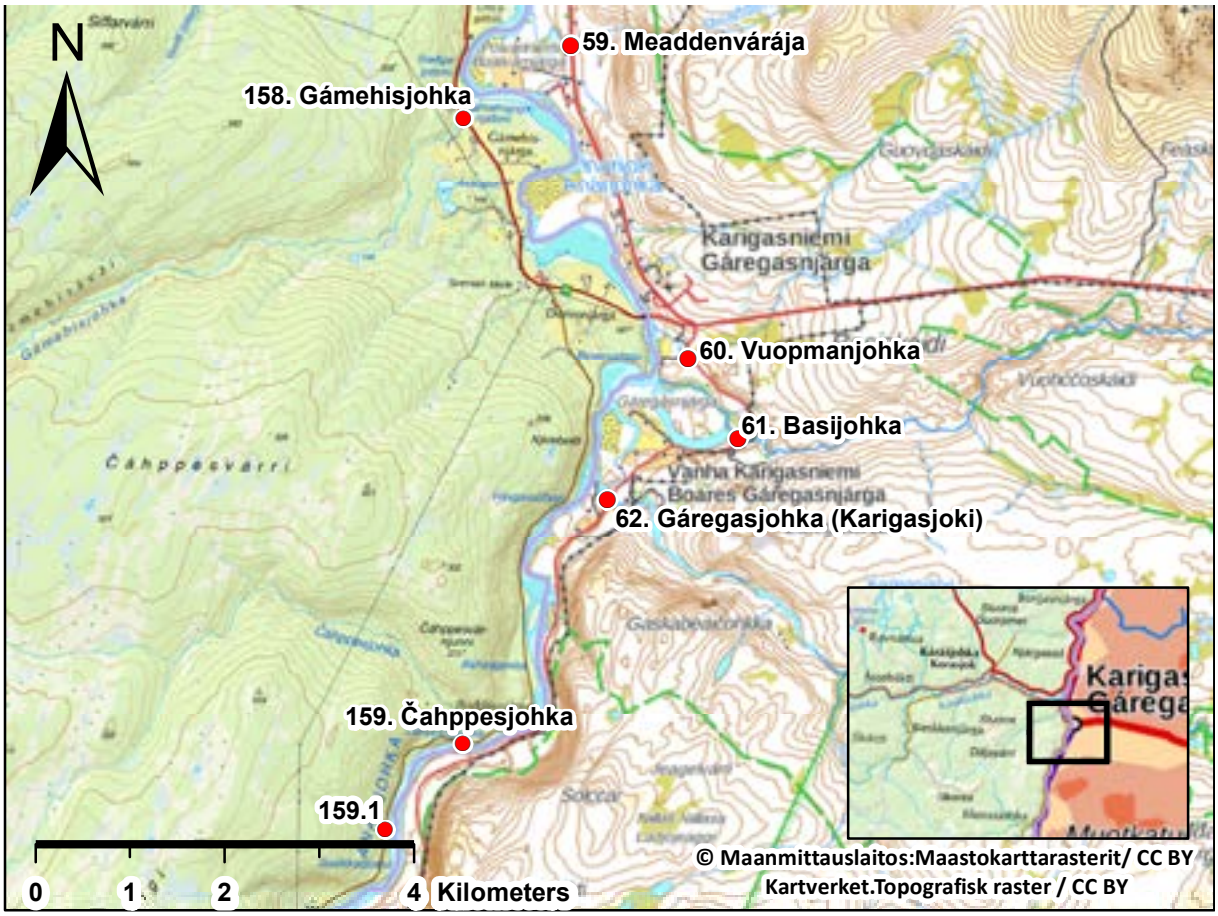

Figure 30. Map of sites 158-159.1 in Norway and 59-62 in Finland

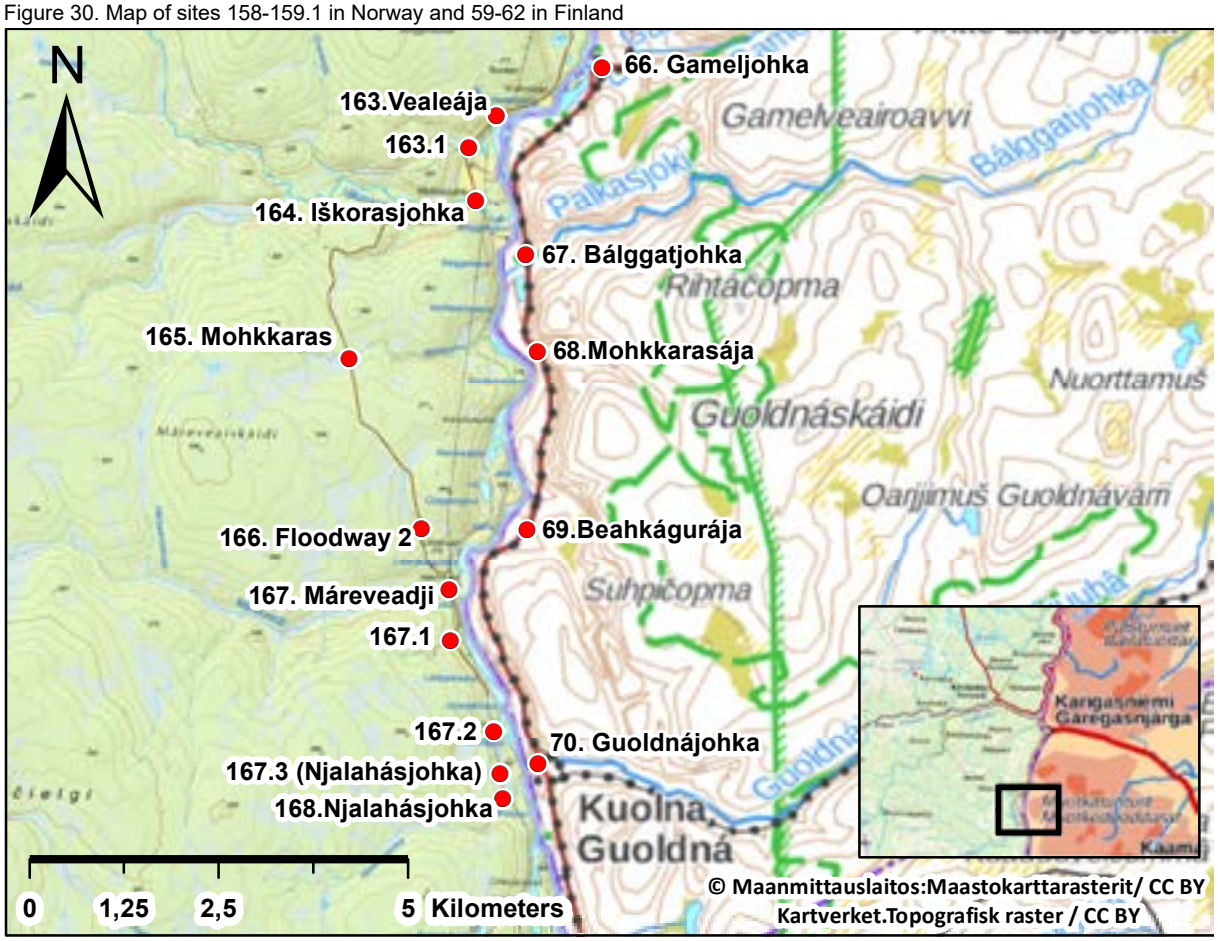

Figure 31. Map of sites 163-168 in Norway and 66-70 in Finland

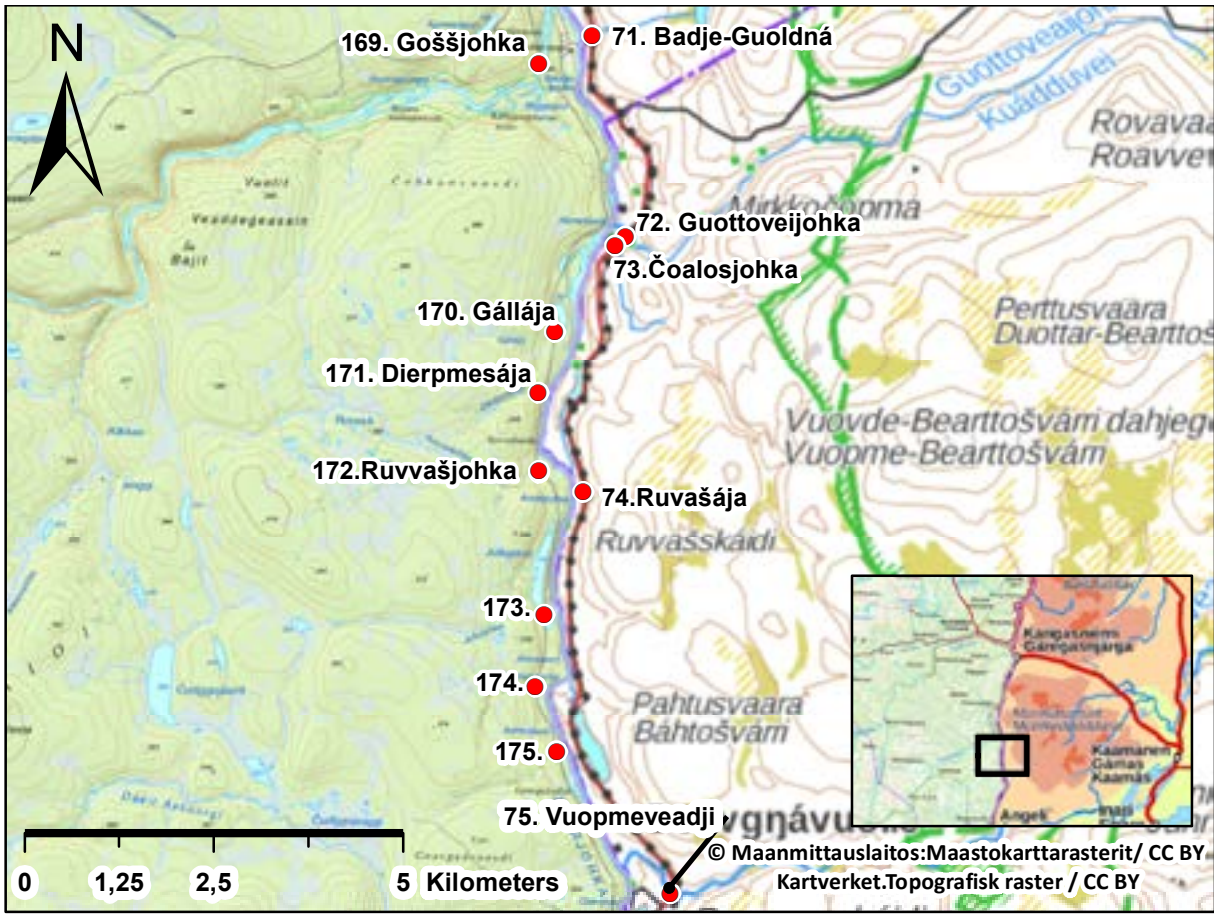

Figure 32. Map of sites 169-175 in Norway and 71-75 in Finland

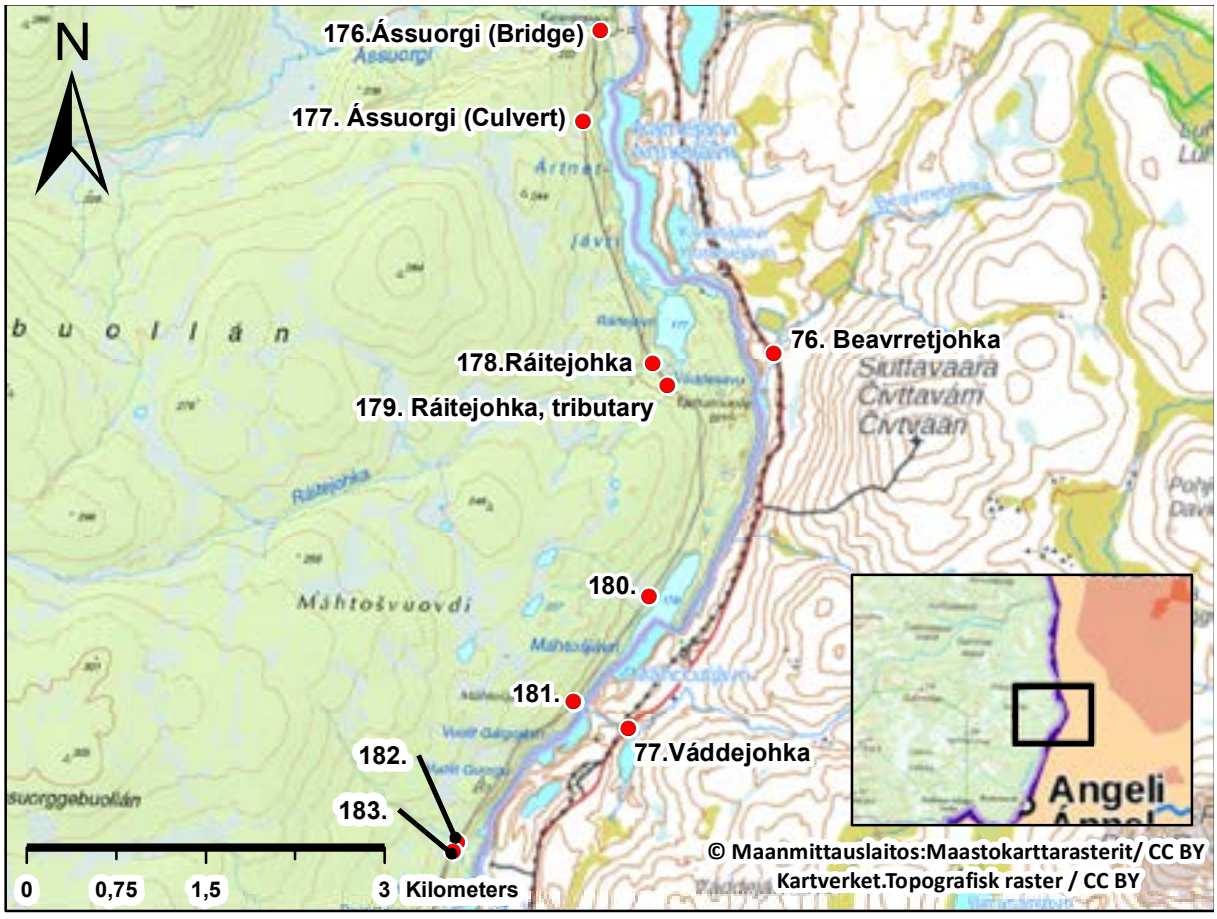

Figure 33. Map of sites 176-183 in Norway and 76-77 in Finland

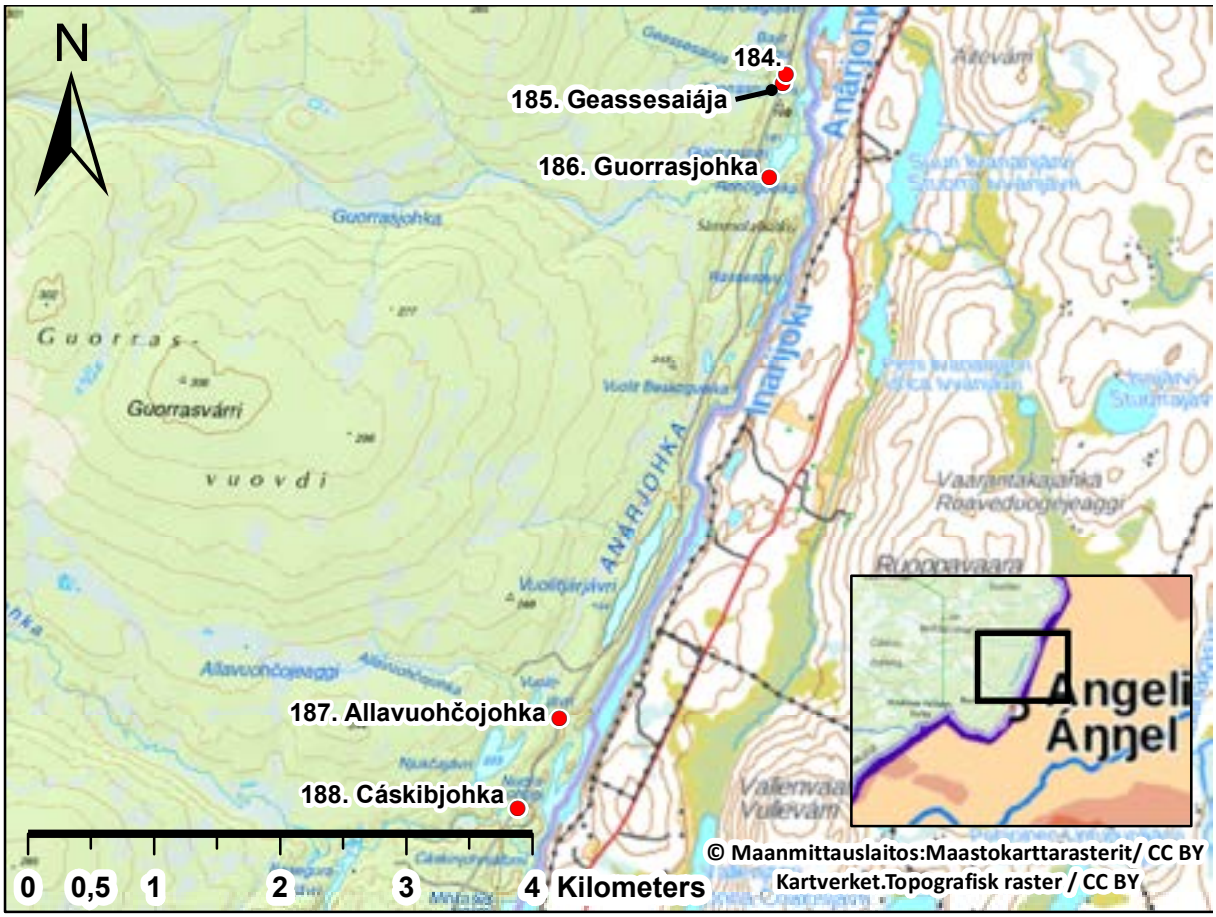

Figure 34. Map of sites 184-188 in Norway

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