Kuopion Energia Oy

Environmental impact assessment of a small modular reactor (SMR) plant

Environmental impact assessment programme

March 2026

KUOPION ENERGIA

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CONTACT DETAILS AND PUBLIC DISPLAY

Party responsible for the project:

Kuopion Energia Oy

Esa Lindholm, CEO

+358 40 709 7101

firstname.lastname@kuopionenergia.fi

www.kuopionenergia.fi

Competent authority:

Ministry of Economic Affairs and Employment

Linda Kumpula, Senior Specialist

+358 29 506 0125

firstname.lastname@gov.fi

www.tem.fi

International consultation:

Finnish Environment Institute

Latokartanonkaari 11, 00790 Helsinki

transboundaryEIA.SEA@syke.fi, kirjaamo@syke.fi

www.syke.fi

EIA consultant:

AFRY Finland Oy

Liisa Kopisto, EIA Project Manager

+358 50 327 3817

firstname.lastname@afry.com

www.afry.com

The EIA programme is available electronically at:

https://tem.fi/en/kuopion-energia-eia-programme

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CONTENTS

ABSTRACT 10

EIA TEAM 19

TERMS AND ABBREVIATIONS 23

1 INTRODUCTION 27

2 DESCRIPTION OF THE PROJECT 27
2.1 Party responsible for the project 27
2.2 Project and assessed options 27
2.3 Project location and land use requirements 28
2.3.1 Hepomäki 28
2.3.2 Sorsasalo 29
2.4 Background and objectives of the project 30
2.4.1 Regional objectives 30
2.4.2 International and national objectives 30
2.4.3 The objectives of the project manager and the schedule of the project 31
2.5 Location options explored in previous phases of the project 31
2.6 The project's relationship with other projects 32

3 TECHNICAL DESCRIPTION OF THE PROJECT 33
3.1 Operating principles of an SMR plant for district heat production 33
3.2 General description of the plant type 33
3.2.1 Reactor type and plant size 33
3.2.2 Operating principle 34
3.2.3 Plant area, buildings and structures 35
3.3 Nuclear and radiation safety 35
3.3.1 Nuclear energy legislation and regulatory control 35
3.3.2 Nuclear safety 36
3.3.3 Radiation and its monitoring 37
3.3.4 Emergency preparedness 38
3.3.5 Precautionary action zone and emergency planning zone 38
3.3.6 Physical protection 38
3.4 Procurement and use of nuclear fuel 39
3.4.1 Refuelling maintenance 39
3.5 Waste management 39
3.5.1 Spent nuclear fuel 39
3.5.2 Very low level, low level and intermediate level operational waste 39
3.5.3 Conventional waste 40
3.5.4 Waste exempted from control 40

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3.6 District heating transmission connection 40
3.6.1 Hepomäki 40
3.6.2 Sorsasalo 42
3.7 The need and procurement of water 43
3.8 Strain on the water system 44
3.8.1 Wastewater 44
3.8.2 Stormwater and firefighting wastewater 44
3.8.3 Flood risks 45
3.9 Radioactive releases 45
3.10 Conventional emissions to air 46
3.11 Electricity demand and transmission 46
3.12 Traffic 46
3.13 Noise and vibration 48
3.14 Chemicals 48
3.15 Decommissioning 48

4 PERMITS, PLANS AND DECISIONS REQUIRED FOR THE PROJECT 50
4.1 General 50
4.2 Environmental impact assessment 50
4.3 International consultation procedure 50
4.4 Decisions and licences under the Nuclear Energy Act 51
4.4.1 Decision in principle 51
4.4.2 Construction licence 52
4.4.3 Operating licence 52
4.4.4 Decommissioning licence 53
4.4.5 Other permits 53
4.5 Permits required for the transport of radioactive substances 53
4.6 Permits under the Radiation Act 53
4.7 Building Act and Land Use Act 53
4.7.1 Local detailed plan required for the project 53
4.7.2 Construction permit 54
4.8 Environmental permit 54
4.9 A permit under the Water Act 55
4.10 Permits and documents in accordance with the Chemicals Act 55
4.11 Permits and agreements required for connection to the district heating, water and sewerage network 55
4.12 A crossing permit 56
4.13 Other permits, agreements and plans that may be required 56
4.13.1 Aviation obstacle permission 56
4.13.2 Permits for deviations from the Nature Conservation Act 56
4.13.3 Natura assessment 57
4.13.4 A permit to interfere with a fixed relic 57

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5 EIA PROCEDURE 58
5.1 The need for the EIA procedure and the parties 58
5.2 The objective, content and phases of the EIA procedure 59
5.2.1 General 59
5.2.2 Preliminary consultation 60
5.2.3 EIA programme 61
5.2.4 EIA report 61
5.2.5 Reasoned conclusion 62
5.3 Time schedule of the EIA procedure 62
5.4 Participation, interaction and communication 63
5.4.1 Public notice and display 63
5.4.2 Communication and participation 63
5.4.3 Other communication 65

6 DESCRIPTION OF THE ASSESSMENT WORK 66
6.1 Assessed impacts 66
6.2 Limitations of the assessment and impact areas 66
6.3 Available input data and project-specific surveys 68
6.4 Comparison of the options and assessment of the significance of impacts 69

7 URBAN STRUCTURE AND LAND USE 71
7.1 Current status 71
7.1.1 National land use objectives 71
7.1.2 Regional plans 71
7.1.3 Master plans 83
7.1.4 Local detailed plans 90
7.1.5 Ongoing planning projects in the project area and its vicinity 93
7.2 Impact assessment and methodology 95

8 LANDSCAPE AND CULTURAL ENVIRONMENT 97
8.1 Current status 97
8.1.1 Regional landscape 97
8.1.2 Hepomäki 97
8.1.3 Sorsasalo 100
8.1.4 Archaeological heritage 104
8.2 Impact assessment and methodology 109
8.2.1 Landscape and cultural environment 109
8.2.2 Archaeological heritage 110

9 NOISE AND VIBRATION 111
9.1 Current status 111
9.1.1 Hepomäki 111
9.1.2 Sorsasalo 111

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9.2 Impact assessment and methodology 113

10 TRAFFIC 115
10.1 Current status 115
10.1.1 Hepomäki 115
10.1.2 Sorsasalo 117
10.2 Impact assessment and methodology 121

11 AIR QUALITY 123
11.1 Current status 123
11.2 Impact assessment and methodology 124

12 PEOPLE'S HEALTH, LIVING CONDITIONS AND COMFORT 125
12.1 Current status 125
12.1.1 Hepomäki 125
12.1.2 Sorsasalo 130
12.2 Impact assessment and methodology 138

13 SOIL, BEDROCK AND GROUNDWATER 140
13.1 Current status 140
13.1.1 Soil 140
13.1.2 Bedrock 144
13.1.3 Groundwater 148
13.1.4 Seismicity 152
13.2 Impact assessment and methodology 155

14 SURFACE WATERS 156
14.1 Current status 156
14.1.1 Overview of the water system 156
14.1.2 Hydrology 156
14.1.3 Stormwater and flood risks 157
14.1.4 Water quality 158
14.1.5 Sediment quality 163
14.1.6 Water management 163
14.1.7 Water ecology 167
14.1.8 Fish stock and fishing 174
14.2 Impact assessment and methodology 178
14.2.1 Water systems and hydrology 178
14.2.2 Stormwater and flood risks 179
14.2.3 Fish stock and fishing 180

15 VEGETATION AND HABITAT TYPES 181
15.1 Current status 181
15.1.1 Hepomäki 182
15.1.2 Sorsasalo 185

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15.1.3 Valuable natural sites and noteworthy species 187
15.2 Impact assessment and methodology 192

16 FAUNA AND BIRDS 194
16.1 Current status 194
16.1.1 Species listed in Annex IV (a) of the EU Habitats Directive 194
16.1.2 Birds 197
16.2 Impact assessment and methodology 201

17 PROTECTED AREAS 204
17.1 Current status 204
17.2 Impact assessment and methodology 210

18 CLIMATE 211
18.1 Current status 211
18.1.1 Climate 211
18.1.2 Greenhouse gas emissions 213
18.2 Impact assessment and methodology 215

19 EXPLOITATION OF NATURAL RESOURCES AND CONVENTIONAL WASTE 217
19.1 Current status 217
19.1.1 Hepomäki 217
19.1.2 Sorsasalo 218
19.2 Impact assessment and methodology 219

20 RADIOACTIVE WASTE 221
20.1 Impact assessment and methodology 221

21 EXCEPTIONAL AND EMERGENCY SITUATIONS 222
21.1 Impact assessment and methodology 222
21.1.1 Methods used for modelling severe accidents 222
21.1.2 Assessment of radiation doses to the population in the event of an accident 224
21.1.3 Consideration of uncertainties related to dispersion modelling 224

22 EFFECTS ON SAFETY AND ENVIRONMENTAL RISKS 226

23 CUMULATIVE IMPACTS WITH OTHER PROJECTS 226
23.1 Other projects 226
23.2 Cumulative impact assessment 226

24 ASSESSMENT OF TRANSBOUNDARY IMPACTS 227

25 IMPACTS OF DECOMMISSIONING 227

26 IMPACTS OF THE ZERO OPTION 227

27 UNCERTAINTIES IN THE IMPACT ASSESSMENT 228

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28 HARM PREVENTION, MITIGATION AND IMPACT MONITORING 228

29 REFERENCES 229

Appendices

Appendix 1. International consultation document

Appendix 2. Vegetation and habitat type survey 2025

Appendix 3. Benthic animals survey 2025

Appendix 4. Aquatic vegetation survey 2025

Appendix 5. Underwater archaeological inventory 2025

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ABSTRACT

Party responsible for the project and purpose of the project

Kuopion Energia Oy is planning a small-scale nuclear power plant in Kuopio, where two alternative plant sites, Hepomäki and Sorsasalo, are under review. The purpose of the small-scale nuclear power plant, or SMR (Small Modular Reactor) plant, is to produce district heat for the district heating network of the City of Kuopio.

Kuopion Energia Oy is a wholly owned energy company of the City of Kuopio, with operations such as energy production, district heating and district cooling. Energy production takes place mainly at the Haapaniemi combined heat and power plant, where wood is the principal fuel and peat is still used to a limited extent. The older unit of the power plant is expected to be decommissioned in around 2035, and small-scale nuclear power is regarded as a viable future option for district heat production.

Description of the project

The SMR plant considered in the project is a heat-only plant for district heat production. The SMR plant would consist of up to four reactor units. The planned combined heat output of the reactors at the plant is up to about 150 MW_{th}. The efficiency of the plant is estimated to be up to 95%, so it is possible to produce a maximum of around 143 MW_{th} of heat to the district heating network in the SMR plant.

The SMR plant is used for supplying the district heating base load, meaning it is operated mainly at a steady full output. When necessary, the SMR can also be operated more flexibly at lower power levels in accordance with the plant's operating conditions. For example, during the summer, when the demand for district heat is low, the plant needs to be operated at a lower power level. A heat-only SMR used for district heat production does not require cooling water from a water body, and therefore does not discharge heat into the aquatic environment.

The SMR has alternative locations in Kuopio, Hepomäki and Sorsasalo. The Hepomäki project area is located approximately nine kilometres southwest of the centre of Kuopio. Rudus Oy's aggregate extraction site is currently located in the area. The Sorsasalo project area is located approximately six kilometres northeast of the centre of Kuopio. The Sorsasalo area has industry; the project area is currently forested.

District heat produced in the SMR plant will be transferred to Kuopion Energia's district heating network via a new district heat transmission connection to be built. In Hepomäki, the district heat transmission connection will be placed under a new road to be built in the area. A new district heat transmission connection will be built from Sorsasalo to the Haapaniemi power plant across Lake Kallavesi, with the transmission pipeline installed along the bottom of the lake. The construction of the district heating transmission connection requires dredging in the lake at the pipeline's landing points where the water depth is 3.5 metres or less. The estimate of the mass to be dredged is about 25,000 solid cubic metres.

The estimated space requirement for the SMR plant and the related buildings and structures is around 3 hectares. The SMR plant can be located either in an above-ground open pit or in a rock cavern excavated mainly underground. The amount of excavation

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required depends largely on the location of the reactor, and is estimated at up to around 130,000 m^3.

During operation, the SMR plant generates very low-, low- and intermediate-level radioactive waste (operational waste), as well as high-level spent nuclear fuel. The handling and interim storage of this waste in the plant area are included in the EIA procedure. Operational waste is sorted and processed within the power plant area and packaged into its final form for storage in the on-site interim storage facility, or transferred for interim storage outside the plant area. From the interim storage facility, the waste is transferred for final disposal at a repository site located outside the plant area. Interim storage of spent nuclear fuel can be implemented either on the plant site or in a centralised interim storage facility located elsewhere. After interim storage, the spent fuel will be finally disposed of at a licensed final repository site located in the Finnish bedrock. The environmental impact assessment does not include the final disposal of very low-, low- and intermediate-level radioactive waste or of spent nuclear fuel. A separate EIA procedure for these will be undertaken, if required, at a later stage.

The implementation of the project also requires the construction of new road connections, an electrical connection and water and sewer connections on the plant site.

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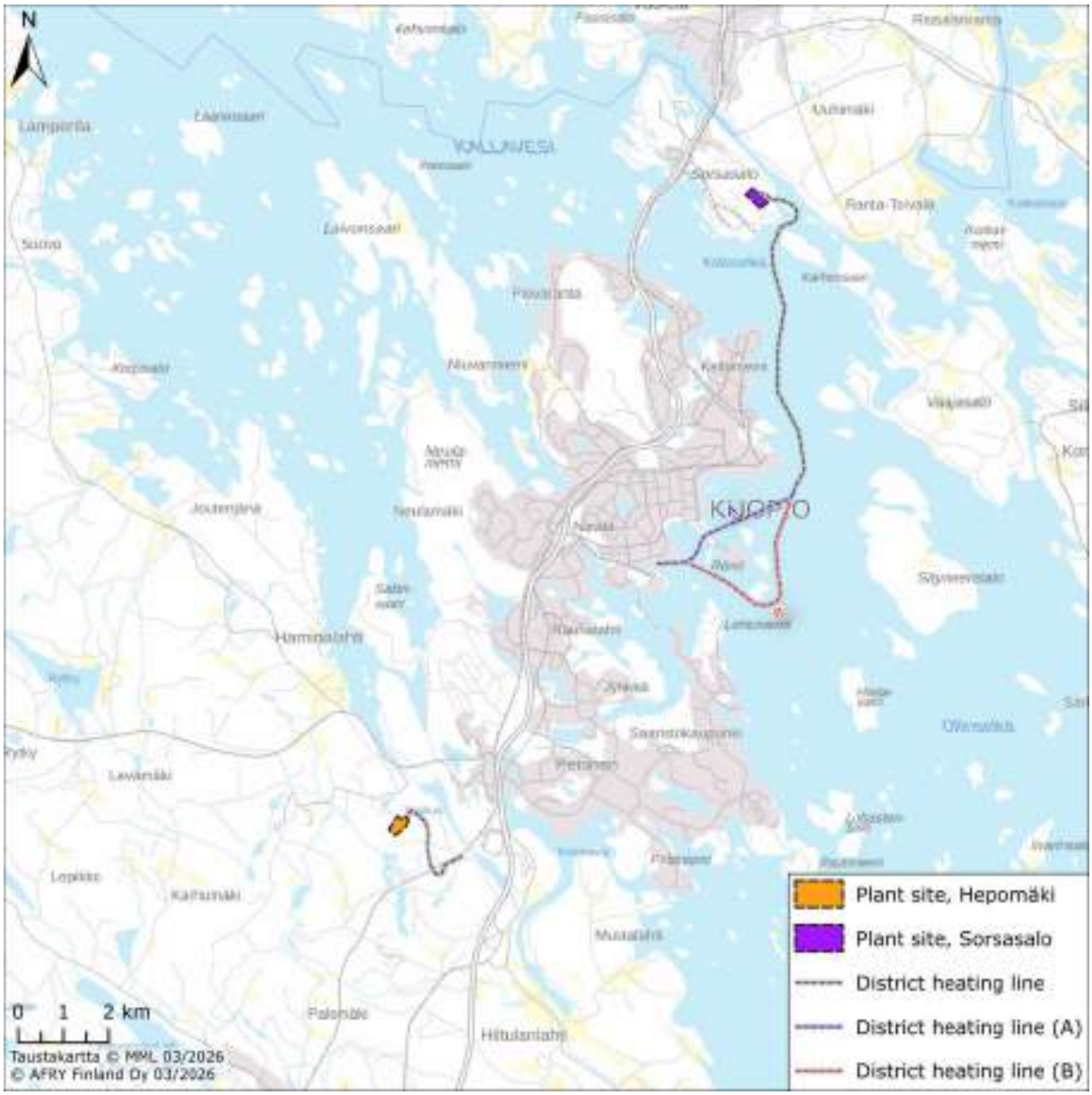

Figure 1. The location of the Hepomäki and Sorsasalo project areas in Kuopio.

Assessed options

This EIA procedure examines two project options, VE1 and VE2. In addition, the EIA procedure includes a zero option (VE0), in which the project is not implemented and the current state of the environment remains unchanged.

The options to be assessed in the EIA procedure are as follows:

VE0: The project will not be implemented. District heat production will continue in its current form using a combustion-based solution.

VE1: An SMR plant with a thermal output of up to around 150 MW will be built in Hepomäki, consisting of up to four reactors dedicated solely to district heat production. The district heat transmission connection from the plant to the existing district heating network will be built as an underground installation.

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VE2: An SMR plant with a thermal output of up to around 150 MW will be built in Sorsasalo, consisting of up to four reactors dedicated solely to district heat production. The district heat transmission connection from the plant to the existing district heating network will be built mainly along the bottom of the lake and partly as an underground installation.

EIA procedure

The purpose of the EIA procedure is to assess the environmental impacts of the project and to promote their consideration in its planning. At the same time, the objective is to improve access to information and participation opportunities for all stakeholders. The EIA procedure does not involve making decisions on the project, but it is a prerequisite for subsequent decision-making.

The environmental impact assessment procedure (EIA procedure) is regulated by the EIA Act (252/2017) and Decree (277/2017). The planned activity corresponds to item 7(b) of the project list in Annex 1 of the Environmental Impact Assessment Act: Nuclear power stations and other nuclear reactors. This project is subject to the Espoo Convention on Environmental Impact Assessment in a Transboundary Context.

The EIA procedure is a two-step process. The EIA programme is submitted to the Ministry of Economic Affairs and Employment, which acts as the competent authority, and the Ministry announces the EIA programme by publishing a public notice on its website. The EIA programme is made available for public review for a period of 30–60 days. During the public notice period, the authorities, local residents and other parties concerned may submit statements and opinions on the EIA programme to the competent authority. An international consultation is being carried out at the same time. The competent authority compiles all the opinions and statements submitted on the programme and issues its own statement on the basis of them.

In the next phase of the EIA procedure, an environmental impact assessment report (EIA report) is prepared on the basis of the EIA programme and the competent authority's statement on it. The results of the assessment are compiled in the EIA report, which is submitted to the competent authority. The EIA report is announced in due course in the same way as the assessment programme, and an international consultation is carried out at the same time as the national consultation. On the basis of the EIA report and the statements and opinions submitted, the competent authority prepares its reasoned conclusion on the significant environmental impacts of the project. The permit applications for the project must include the EIA report and the reasoned conclusion.

Time schedule of the project and the EIA procedure

The EIA programme was completed in March 2026, and the competent authority's statement on it is expected to be issued in June 2026. The preparation of the EIA report begins immediately after the programme phase. The aim is to complete the EIA report by the end of 2026 and the EIA procedure in spring 2027.

According to the current plan, the decision on proceeding with the SMR plant project will be made during 2030. The construction phase is estimated to take around five years, and the planned commissioning of the SMR plant is in around 2035.

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Assessed environmental impacts and assessment methods

Urban structure and land use

The area of the Hepomäki SMR plant is located in an industrial and storage area (T) in accordance with the Hepomäki component master plan, and in an area dominated by agriculture and forestry, with environmental values and recreational outdoor use (MU). A local detailed planning process is underway for the area, during which the potential placement of the SMR plant will be examined.

In Sorsasalo, a legally binding local detailed plan is in force, designating the SMR plant area as an industrial and storage block area where a major plant manufacturing or storing hazardous chemicals may be located (T/kem-2). A revision of the local detailed plan is underway for the area, and the process includes examining the potential placement of the SMR plant in the area.

The impact assessment examines the project's relationship to the current and planned urban structure, planning processes, and land use. The assessment takes into account how the requirements set out in STUK's Guide YVL A.2 and STUK's Regulation Y/2/2024 regarding location, precautionary action zone and emergency planning zone are implemented from the viewpoint of planning processes and land use.

Landscape and cultural environment

The project areas are located in the lake district of eastern Finland, in the North Savo region. The Hepomäki plant area is located in the aggregate extraction area. The area's landscape is dominated by an open-pit mine and open fields, which are bordered to the east and south-west by a continuous forest area. There is a steep quarry face in the southern part of the plant area. The landscape of the Sorsasalo project area is characterised by hilly topography, forested and partly industrial views, as well as the proximity of water bodies.

The area limits of the Savo railway cultural heritage site are located in the immediate vicinity of the district heating transmission line of the Hepomäki project option. There are no known archaeological sites in the vicinity of the operations located in the Sorsasalo project area. The planned district heating transmission line from Sorsasalo across Kallavesi to Haapaniemi touches two wreck sites that have been entered in the Ancient Relics Register, Oil Harbour 1 and Oil Harbour 2, at a distance of about 29–66 metres near the Haapaniemi landing area. In addition, an underwater archaeological inventory carried out in November 2025 identified three new sites at a distance of 0–25 metres from the transmission line options: one site from route A and two sites from route B. Within 500 metres of the district heating transmission line, 16 other archaeological sites are also known.

The project's impact on the area's landscape and cultural environment is assessed in terms of its scope, nature and significance, and the sensitivity of the landscape and cultural environment. The assessment focuses on those impacts that are most significant for the landscape. In order to support the assessment and illustrate the impacts, illustrative images of the SMR plant are prepared. The impacts of the project are assessed by examining the relationship of the location of the construction measures to known ancient relics and other archaeological cultural heritage sites, both on land and in the water area.

Noise and vibration

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The noise impact assessment evaluates the project's impacts using noise modelling. The modelling is carried out for the most significant noise scenarios during construction and operation. In addition to the modelling, the impact assessment examines the qualitative aspects of the noise produced at different phases of the project. Vibration impacts are assessed for the construction and operation scenarios, and the intensity of the vibration is estimated based on the magnitude of the operation causing vibration, taking into account existing information and experience from similar projects carried out previously.

Traffic

Traffic impacts of constructing an SMR plant occur mainly during the construction phase, as the traffic volumes resulting from the plant's operation are significantly smaller. During the construction phase, the largest transport volumes result from earthworks and excavation for the district heating transmission connections, the plant area and the premises. In both location options, new road connections must be built to the plant and traffic will be directed to the main roads near the project areas. In the Sorsasalo project option, in addition to road traffic, temporary impacts occur on water traffic during the construction phase, when the district heating transmission line is dredged and pipes installed in Kallavesi. In the Hepomäki project option, in addition to road traffic, temporary impacts will also be caused to rail traffic during construction, as the new road connection and district heating transmission line intersect with the Savo railway.

The assessment describes the current situation of the transport network in the area (road connections, the current state of the traffic routes, traffic volumes and traffic accidents in the area) and compares it with the planned activities and the changes caused by them during operation and construction. The traffic impact assessments examine the project's effects on traffic volumes on the road network and on traffic flow and safety. Particular attention is paid to the transport of hazardous goods, as well as to sites vulnerable to road safety impacts (for example, schools). Road traffic, waterborne traffic and rail traffic are taken into account in the impact assessment.

Air quality

Air quality impacts of the project are evaluated as an expert assessment, based on the current state of air quality in the project area and the airborne release generated by the operations. The impact assessment takes into account emissions from the SMR plant's emergency diesel generators, exhaust gas emissions of traffic and the impacts of dust generated during construction on air quality. The report also provides a verbal assessment of the reduction in airborne release volumes resulting from the replacement of the HPN2 power plant unit at the Haapaniemi district heating power plant and their impact on air quality.

People's health, living conditions and comfort

The area surrounding the Hepomäki SMR plant is sparsely populated. The nearest residential and holiday buildings are about 300 metres away. The most densely populated areas are Kylmämäki to the northeast of the plant area, Tahvanlahti to the north, and Nuolimäki to the southeast. Settlement is sparse on the west side of the project area. Some residential and holiday buildings are located in the vicinity of the SMR plant area in Sorsasalo. The nearest, more densely populated areas are Vuorela in Siilinjärvi, to the north of the plant, and Kettulanlahti and Päiväranta, to the south of the plant.

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The impact of the project on people's health, living conditions and comfort is assessed by using computational and qualitative estimates generated in other impact assessment sections, such as noise impacts and impacts on water bodies and traffic. The assessment emphasises both impacts assessed as significant and those people perceive as such and which give rise to concerns. The impacts on health are assessed by comparing the estimated impacts of the project with the health-based guideline value or recommendation for each impact. Estimates of the quantities of radioactive emissions from the normal operation of the SMR plant is compared with the emission limits and actual emissions from the normal operation of Finland's current nuclear power plants. The assessment uses the information about the area collected from stakeholders and their views on the project.

Soil, bedrock and groundwater

At the SMR plant area in Hepomäki, aggregate has been extracted, and the area is no longer in a natural state. The SMR plant area in Sorsasalo is located on a natural rock hill, where the soil cover consisting of fine-grained till is thin. The project areas are not located in a classified groundwater area.

The impacts of the project on soil, bedrock and groundwater are mainly the direct result of construction, but it can also alter local groundwater conditions. The magnitude of the impacts is influenced by the extent of the soil replacement and excavation required for construction. The impacts are assessed in terms of the changes caused by the planned operation by comparing it with the current situation. The impacts during construction and operation are assessed separately. Issues related to seismic events are taken into account as required by the requirements.

Surface waters

There are a few small water bodies in the vicinity of the Hepomäki plant area. The Sorsasalo plant area is located on the island of Sorsasalo in the northern part of Central Kallavesi. The ecological status of Kallavesi is currently good, but according to the latest data, it is declining towards satisfactory because of nutrient concentrations and low oxygen levels. The amount of phytoplankton and chlorophyll concentrations indicate an increase in eutrophication.

The impacts on water system are assessed by experts, mainly based on the project's planning information and information about the area's current state. The most significant surface water impacts are on Kallavesi due to the construction of the district heating transmission connection in the Sorsasalo project option. Route A crosses Väinölänniemi and B goes around the islands in front of Rönö on its way to Haapaniemi. Dredging sites are examined for possible sediment contaminants. In the impact assessment, stormwater and construction site runoff are also taken into account. The impacts on fish stock and on fishing are described, focusing on the Kallavesi area.

Vegetation, fauna, and protected sites

The project areas are located in the biogeographical region of North Savo, in the southern boreal forest vegetation zone in the lake district of Finland. The SMR plant area in Hepomäki is an anthropogenic environment and its natural state has been altered. The area of the district heating transmission line is mainly young, even-aged managed forest. To the east of the plant area, there is an old forest area that stands out from the rest of the environment. The SMR plant area in Sorsasalo and the area of the district heating transmission line are partly anthropogenic environments where the natural state has

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changed to varying degrees. The plant area contains a forest access road, wasteland and relatively young managed forests. In the areas of the project options, or in their vicinity, there are no Natura 2000 regional network boundaries, nature conservation site boundaries, or supplementary proposed sites for mire protection.

An expert assessment is carried out of the impact of the construction and operation of the project on the natural environment and protected sites. Nature surveys are carried out during the 2026 field season to support the impact assessment. The supplement to the vegetation and habitat survey and the Siberian flying squirrel survey are carried out in both project areas. A moor frog survey is conducted in the Sorsasalo project area, and a scarce fritillary survey in the Hepomäki project area. The breeding bird survey is carried out in the Sorsasalo project area and in Hepomäki, within the area of the district heating transmission line. According to the preliminary assessment, it is not necessary to prepare Natura assessments for the project in accordance with Section 35 of the Nature Conservation Act.

Climate

The climate impacts of the project are assessed by calculating the carbon footprint (CO_2e) during the project's life cycle. The positive climate impacts of the project are assessed by comparing the emission intensity of the district heat produced in the project with the emission intensity of the district heat produced in other ways. The impacts of climate change on the project are assessed by examining the risks caused by extreme weather events and the adaptation measures required by them.

Exploitation of natural resources and conventional waste

The impact assessment of exploitation of natural resources examines the natural resources within the project area and the economic and recreational activities that use them. In addition, the material needs of the project as well as the resulting conventional waste and their treatment are examined.

Radioactive waste

The formation, quality and quantity of radioactive waste arising during the operation of the SMR plant, and its treatment and storage, are described, taking into account the waste's activity levels (very low-level, low level, intermediate level and high level waste). The impact assessment of the final disposal of spent nuclear fuel and other radioactive waste fractions is not part of this EIA procedure. The impacts are assessed based on the properties of the waste and the treatment methods. The assessment is carried out on the basis of the technical design of the project, as well as existing information about the projects and studies that have already been carried out.

Exceptional and emergency situations

As part of the environmental impact assessment, a fictitious severe accident at the SMR plant and the resulting radioactive release are modelled. The impacts of the accident are assessed within a radius of 300 km of the SMR plant. The preliminary size of the SMR plant's precautionary action zone and emergency planning zone is assessed on the basis of the requirements set out in STUK Regulation Y/2/2024. For the results, lifetime radiation doses are assessed for a one-year-old child, a ten-year-old child and an adult, in accordance with the recommendations of the International Commission on Radiological Protection (ICRP). In addition, the general impacts of radioactive fallout and radiation are examined.

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Effects on safety and environmental risks

The impact assessment initially identifies the project's environmental risks and assesses their potential impacts on the environment and public health. The environmental risk assessment examines the risks posed by major process disruptions, fires and chemicals, as well as those related to weather conditions and traffic. The assessment also considers potential risks to the project arising from activities in its vicinity.

Accidents and disturbances, their effects and likelihood are assessed during construction and operation. Accident risks caused by extreme weather phenomena that increase with climate change are also taken into account.

Cumulative impacts

The impact assessment examines the potential cumulative impacts of the SMR project in conjunction with other projects in the vicinity. In the assessment of cumulative impacts, consideration is given to activities planned for the area that the project may interact with and for which sufficient information is available for the assessment. To support the assessment of cumulative impacts, noise modelling of the cumulative impacts is carried out for the Sorsasalo project option, covering the cumulative noise impacts of existing operations and planned industrial activities located in Sorsasalo.

Assessment of transboundary impacts

Within the EIA procedure, the assessment covers both the impacts occurring within Finland and any potentially harmful transboundary impacts caused by the project. Preliminary assessment indicates that the SMR project is not likely to cause significant transboundary impacts. Only a severe reactor accident and the resulting radioactive release could potentially have harmful transboundary impacts. However, in this regard, the preliminary estimate is that the impacts are likely to remain within Finland's borders. The assessment area for radioactive release dispersion modelling in the event of an accident, carried out during the EIA report phase, is 300 kilometres.

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EIA TEAM

The preparation of the environmental impact assessment programme has been carried out by AFRY Finland Oy as a consultant. The experts of the EIA team are presented in the table below (Table 1-1).

Table 1-1. The team of the EIA consultant and their qualifications.

Name	Education, role and experience
Liisa Kopisto	MA, environmental biology M.Sc. (Eng), environmental engineering
	Project manager
	Leading expert, environmental consulting. Over 10 years of work experience, including project manager positions for EIA procedures and coordinating impact monitoring and permit processes. Approximately 10 years of work experience in the nuclear power sector.
Juha Niemistö	PhD, aquatic sciences
	Project coordinator
	Leading expert, environmental consulting. 15 years of experience in research on nutrient cycling in Finland's inland waters and the coastal areas of the Baltic Sea. Has worked as a project coordinator and water system expert in environmental impact assessments and permit applications for projects in the infrastructure, industry and energy sectors.
Ilkka Suntio	M.Sc. (Eng), energy technology
	Nuclear engineering, nuclear waste
	10 years of experience as an expert and project manager in nuclear energy projects, including 5 years in SMR surveys.
Sini Pitkäranta	MA, environmental science and technology
	Environment
	Over 20 years of experience and extensive expertise in quality management systems and quality management at company level. Several years of experience in quality assurance of nuclear power projects. Has worked as an environmental and quality expert in SMR surveys. In addition, more than 15 years of experience in environmental permits and environmental management in the forest and energy industries.
Pekka Lähde	Environmental planner, UAS, sustainable development
	Quality assurance
	About 15 years of work experience in EIA projects and in the environmental sector. Has worked as a project manager and expert in several EIA procedures.
Maarit Suomenkorpi	Landscaping architect, planner's qualification (YKS 359)
	Urban structure and land use
	Over 20 years of experience in planning processes and land use planning. Has been involved in several EIA procedures as well as plans and surveys related to land use, including location surveys for SMR projects.
Tiia Piippo	Bachelor of Engineering in Civil and Construction Engineering (UAS)
	Urban structure and land use

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	In total, about five years of experience in building supervision, facility and property management tasks, as well as planning and land use planning tasks.
Aija Degerman	MA, biology; Bachelor of Horticulture (UAS) (built environment)
	Landscape and cultural heritage, vegetation and habitats, fauna, protected sites
	About 20 years of experience. Has been involved in several EIA procedures and carried out environmental impact assessments and Natura assessments. Has carried out landscape and cultural environment impact assessments in EIA projects. Has prepared nature and landscape surveys for EIA and planning projects.
Anna Taskinen	MA, biology, ecology
	Archaeological heritage
	Environmental expert. Approximately 1.5 years of experience in coordination and specialist tasks for EIA procedures for wind and solar power and power transmission projects. In expert assignments, the focus has been on assessing the impacts on archaeological cultural heritage. Also has five years of previous project experience.
Tapio Lukkari	M.Sc. (Eng), mechanical engineering
	Noise and vibration
	About 8 years of experience. Extensive experience of noise issues in various industrial, road and railway projects. Has worked on several EIA and planning projects and carried out environmental noise modelling.
Juho Peltoniemi	M.Sc. (Eng), industrial engineering
	Traffic
	M.Sc. (Eng) Peltoniemi has 2 years of experience in EIA procedures, and he works as an expert in investigating traffic-related impacts of various projects. Two years of experience in the planning sector specialising in traffic impact assessment, preceded by 1.5 years of experience in traffic research.
Jatta Salmi	MA, environmental sciences
	Air quality
	Altogether, more than 20 years of experience in the environmental sector, especially in air quality studies, airborne release dispersion model surveys and impact assessments.
Stella Selinheimo	MA, geography
	Impact on people, health
	About 8 years of work experience in various social impact assessment projects. Has worked as an expert in several EIA procedures in different sectors (energy, industry, infrastructure). Has worked as a social impacts expert in an SMR survey.
Mikko Brander	MA, geology
	Soil, bedrock and groundwater; sediments
	More than 10 years of experience in the environmental field as an expert and project manager, especially in soil and groundwater contaminant studies and environmental surveys (Due Diligence surveys).
Marianne Malm	MA, geophysics
	Seismology
	Over 15 years of work experience in the field of seismology (e.g. seismic hazard, risk and monitoring) as an expert and project manager.

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Lotta Lehtinen	M.Sc. (Agr. & For.), limnology
	Surface waters: Water system and aquatic ecosystem
	Over 15 years of work experience in observing and assessing surface water impacts extensively in inland waters and marine areas in EIA and permit projects related to different industries.
Anna Väisänen	MA, aquatic sciences and fish biology
	Surface waters: benthic animals
	More than 15 years of work experience in monitoring and studying water systems across various industries, especially in the fields of aquatic ecology and fisheries. Has worked in numerous EIA and permitting procedures, as well as in water system restoration, and has prepared several Natura assessments and aquatic species surveys, including EU directive species.
Joni Nyyssönen	M.Sc. (Eng), environmental engineering
	Stormwater, flood risks
	Over 10 years of experience in the environmental field. Has worked both as a project manager and as an expert. Expertise in network and stormwater planning for industrial sites.
Miska Haapsalo	MA, aquatic sciences and fish biology
	Fish stock and fishing
	About five years of work experience in the environmental field. The areas of expertise include knowledge of the Water Act and the Environmental Protection Act, the preparation of water and environmental permit applications, as well as fishery and water system expertise, particularly regarding migratory fish and stream ecosystems.
Terhi Alsila	MA, biology
	Vegetation, fauna, protected sites
	Four years of work experience in preparing nature surveys related to land use planning, processing spatial data, and working on several EIA projects and Natura assessments.
Juha Kiiski	MA, biology
	Birds
	Approximately 20 years of work experience in preparing nature surveys related to land use planning and working on several EIA projects and Natura assessments.
Tuukka Nissilä	D.Tech., environmental engineering
	Climate
	Approximately two years of experience in climate impact assessments related to EIA procedures, carbon balance and carbon footprint calculation of projects. Further experience includes research related to the circular economy of materials.
Mira Vähkyrä	M.Sc. (Eng), environmental engineering M.Sc. (Econ), environmental management
	Exploitation of natural resources, conventional waste
	Four years of experience in various projects related to the conservation and sustainable use of natural resources. Experience of several EIA procedures as an expert and project coordinator.
Robert Broed	MA, nuclear physics
	Exceptional and emergency situations
	Over 25 years of experience in software development, radionuclide migration modelling and dose assessment. Has been responsible,

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	among other things, for radionuclide migration modelling and dose assessments for the safety assessment of the final disposal of spent nuclear fuel.
Eemeli Hurmerinta	Bachelor of Engineering (UAS), electronics
	Spatial data sets, maps
	15 years of experience in various environmental studies, reporting and tasks related to spatial data.

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TERMS AND ABBREVIATIONS

The following terms and abbreviations have been used in the EIA programme:

Term	Description
AISM	AFRY Intelligent Scenario Modelling. Modelling software used to calculate radiation doses to population.
Activity (Bq)	Activity indicates the number of nuclear decays per time unit of a radioactive substance. The unit of activity is Becquerel (Bq) = one decay per second.
AUSTAL	The dispersion model used in local-scale calculations of a nuclear power plant's precautionary action zone and emergency planning zone.
CO_2	Carbon dioxide.
dB(A), decibel	Unit of sound volume. An increase of ten decibels in the noise level means that the sound energy increases tenfold. In noise measurements, filters that emphasise different frequencies in different ways are used. The most common is the so-called A filter, which aims to describe more accurately the effect of sound on people.
Ely Centre	The centre for economic development, transport and the environment.
FENCAT	The Earthquake Catalogue of Northern Europe maintained by the Institute of Seismology of the University of Helsinki.
FINIBA area	A nationally important bird area (Finnish Important Bird Area).
Fission	The splitting of a heavy atomic nucleus into two or more new nuclei releasing a large amount of energy, neutrons and neutrinos.
GTK	Geological Survey of Finland.
GWh	Gigawatt-hour.
Project area	The project area in the EIA programme refers to the area where the project activities are located. In this EIA programme, the project area includes the SMR plant area as well as the district heating transmission line.
Stormwater	In built-up areas, rainwater or meltwater that accumulates on the ground, on the roof of a building, or on other surfaces.
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory. The dispersion model used in local-scale calculations of a nuclear power plant's precautionary action zone and emergency planning zone.
Efficiency (η)	The ratio between the electrical energy generated by a power plant and the thermal energy of a reactor.
IBA area	A nationally important bird area (Important Bird and Biodiversity Area).
INES	INES (International Nuclear Event Scale) is an international severity scale of nuclear facility events and it classifies nuclear safety incidents and accidents into eight categories (categories INES 0–INES 7).
Ion	An electrically charged atom or molecule. Radiation that generates ions when it hits a medium is called ionising radiation.
Ionising radiation	Electromagnetic radiation or particle radiation that generates free electrons and ions upon contact with a medium. It is able to break internal chemical bonds of molecules, for example, the DNA molecule that carries the cell genome. For this reason, ionising radiation is harmful to health.
Isotope	Isotopes are different forms of the same element. They differ in the number of neutrons in the nucleus and the properties of the nucleus. Almost all elements occur in nature as several isotopes. For example, hydrogen has three isotopes: protium (hydrogen), deuterium and tritium, of which tritium is radioactive.

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ISUH	Institute of Seismology, University of Helsinki.
International consultation	Consultation procedure on transboundary environmental impact assessment under the Espoo Convention, in which the affected states may participate and which is carried out for activities that are likely to have significant transboundary adverse effects.
Intermediate level waste	Intermediate level and low level wastes are operational waste from a power plant. In addition, it is produced during the decommissioning of a power plant. Effective radiological protection arrangements (activity usually between 1 and 10,000 MBq/kg) are required for the treatment of intermediate level waste.
Equivalent continuous sound level (LAeq)	The A-weighted sound level is used to assess the annoyance of environmental noise. The A-weighting is intended for the assessment of noise disturbance experienced by people. When noise that varies over a long period of time and any resulting harm to a person's health or comfort are expressed as a single value, the equivalent continuous sound level is used. Other names for the equivalent continuous sound level are the A-weighted equivalent sound level and the equivalent level, and its symbol is LAeq. The equivalent continuous sound level is not just a regular average of the noise level. The squaring included in the definition means that sound pressures above the average receive an emphasised weight in the final result.
Light water reactor	A type of reactor where ordinary water is used in the reactor core as coolant and moderator. Most nuclear reactors worldwide are light water reactors.
Kilovolt (kV)	Kilovolt, a unit of voltage.
Spent nuclear fuel	Nuclear fuel is considered spent when it has been in the reactor for power generation and has been removed from the reactor. Spent nuclear fuel contains uranium fission products such as caesium and is highly radioactive.
Conventional waste	Conventional or hazardous waste that is not radioactive.
High level waste	Radioactive waste with a very high activity concentration, usually above 10 GBq/kg. High level waste requires very effective radiological protection arrangements and usually also cooldown. In Finland, spent fuel from nuclear reactors is classified as high level waste.
Plant area	The plant area in the EIA programme refers to the area where the SMR plant would be located. See project area. The boundaries of the plant area in Hepomäki and Sorsasalo are presented in chapter 2.3.
Final disposal	Placing radioactive waste permanently in the soil or bedrock so that the site does not need to be supervised and the radioactivity of the waste does not pose a danger to the environment.
LPDM	Lagrangian Particle Dispersion Model. A particle dispersion model used to assess the release of radionuclides into the atmosphere.
LVV	Finnish Supervisory Agency
Thermal power (W)	The power at which the plant generates thermal energy (reactor thermal power).
MAALI area	A regionally important bird area.
Magnitude (M)	Magnitude (M) is a way of measuring the size and intensity of an earthquake or a seismic event at the source of the seismic waves themselves. Magnitude readings are objective scales, that is, they do not depend on the location of the observation point or the observer.

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Low level waste	Low level and intermediate level wastes are operational waste from a power plant. In addition, it is produced during the decommissioning of a power plant. Low level waste can be processed without radiological protection arrangements, as its radioactivity is low (usually up to 1 MBq/kg).
masl	Metres above sea level.
MW	Megawatt, a unit of power (1 MW = 1,000 kW).
MWh (GWh, TWh)	Megawatt-hour (gigawatt-hour, terawatt-hour), a unit of energy (1 GWh = 1,000 MWh, 1 TWh = 1,000 GWh).
PAP	Participation and assessment plan.
Pressurised water reactor	A type of light water reactor in which the pressure of the water used as coolant and moderator is kept so high that it does not boil despite the high temperature. Water that has passed through the reactor core releases its heat in separate heat exchangers to the water in the secondary circuit.
Fuel bundle	A bundle of more than 200 fuel rods to be placed in a reactor. The reactor core of an SMR plant has about 30–40 fuel bundles, depending on the technology.
Fuel pellet	A fuel tablet pressed from uranium dioxide powder (UO_2).
Fuel rod	A rod assembled from fuel pellets with a gas-tight cladding typically made of zirconium.
Small nuclear power plant, SMR	SMR = small modular reactor. A reactor with a typical electrical output of less than 300 megawatts, which can be almost fully built at the factory and transported as complete modules. The plant is then built on site from these modules. An SMR plant may have one or more reactors. Both heat and electricity can be generated in an SMR plant. This project looks only at an SMR plant that generates district heat.
Decision in principle	The use of nuclear energy requires a decision in principle made by the Government and confirmed by the Parliament. A prerequisite for the decision in principle is the overall benefit to society, the positive attitude of the municipality where the plant is located towards the project, and the Radiation and Nuclear Safety Authority's positive preliminary safety assessment. With the ongoing legislative amendment, changes to the content of the decision in principle are expected.
Radioactivity	Radioactive substances spontaneously decay into lighter elements or isotopes of the same element with lower energy. The process releases ionising radiation, which is either electromagnetic radiation or particle radiation.
Radionuclide	A radionuclide is a nucleus of an atom that is unstable due to additional neutrons or protons. This instability causes extra energy to be released through radioactive decay. Radionuclides can emit radiation such as alpha, beta or gamma radiation.
SAC area	Special Areas of Conservation selected for the Natura 2000 network on the basis of the Habitats Directive.
Seismicity	The incidence or frequency of seismic events in the area.
Sievert (Sv)	The unit of radiation dose. The higher the radiation dose, the more likely it is to cause harm to health. The unit millisievert (mSv) or microsievert (µSv) is often used (1 µSv = 0.001 mSv = 0.000001 Sv).
SPA area	An area selected for the Natura 2000 network on the basis of the Birds Directive.
Precautionary action zone	An area where, in the event of an accident, it may be necessary to take protective measures to prevent or limit severe radiation effects on the population. The area is subject to land use restrictions.
STUK	Radiation and Nuclear Safety Authority. An independent authority and expert whose task is to promote and supervise radiation safety and the safe use of nuclear energy in Finland.

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Radiation	Radiation is either electromagnetic wave motion or particle radiation.
MEAE	Ministry of Economic Affairs and Employment. Competent authority for the EIA procedure and the supreme authority for the use of nuclear energy.
Tukes	The Finnish Safety and Chemicals Agency, which, among other things, monitors and promotes the safety and reliability of products, chemicals, mines, the chemical and explosives industry, equipment and services. In addition, large-scale storage and handling of chemicals requires a permit issued by Tukes.
Uranium (U)	A chemical element with the symbol U. Uranium makes up 0.0004% of all substances (four grams per tonne) in the Earth's crust. All uranium isotopes are radioactive. The majority of natural uranium is the isotope U-238, which has a half life of 4.5 billion years. Approximately 0.71% of natural uranium is U-235, which is suitable as a fuel for nuclear power plants.
VAMA	Nationally valuable landscape areas.
Storage area	An area located north of the project area that serves as a storage area during construction. The area will then be used for other purposes indicated by the city.
Emergency planning zone	An area where, in the event of an accident, it may be necessary to implement urgent protective measures directed at the population in order to limit the radiation effects and for which the authority must draw up an external rescue plan in accordance with the Rescue Act. The precautionary action zone is included in the emergency planning zone.
Water system	A water system is the whole formed by inland waters that share a common river draining into the sea. In the Water Act, a water system means a lake, pond, river, stream and other natural water bodies, as well as a reservoir, canal and other similar artificial water bodies.
Civil protection measure	In the event of a radiation hazard arising from a serious nuclear accident, the key protective measures to limit the radiation dose to population are sheltering indoors, taking iodine tablets and evacuating.
Nuclear waste	A general term for radioactive waste arising from the operation of a nuclear facility. Nuclear waste is very low level, low level or intermediate level waste or high level fuel waste.
Nuclear fuel	A uranium-containing compound intended for use in reactors of nuclear power plants, packaged in such a way that it can be assembled into a reactor core inducing a chain reaction based on nuclear fission.
EIA	Environmental impact assessment.
EIA procedure	The environmental impact assessment (EIA) procedure means a process in accordance with EIA legislation to identify, assess and describe the likely significant environmental impacts of specific projects and to consult public authorities and those whose circumstances or interests may be affected by the project, as well as communities and foundations whose field of activity may be affected by the project.
EIA programme	The EIA programme presents a plan drawn up by the party responsible for the project, covering the necessary surveys and the organisation of the assessment procedure.
EIA report	The EIA report refers to a document prepared by the party responsible for the project, which presents information about the project and its options, as well as a uniform assessment of their likely significant environmental impacts.

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1 INTRODUCTION

Kuopion Energia Oy is planning a small nuclear power plant (SMR) in Kuopio. Two alternative plant sites are under review: Hepomäki and Sorsasalo. The purpose of the small-scale nuclear power plant, or SMR (Small Modular Reactor) plant, is to produce district heat for the district heating network of the City of Kuopio.

The planned activity corresponds to item 7(b) of the project list in Annex 1 of the Environmental Impact Assessment Act (252/2017), or the EIA Act: nuclear power stations and other nuclear reactors.

The plant's planned commissioning is around 2035, when the older unit of Kuopion Energia's combined heat and power plant in Haapaniemi is decommissioned.

2 DESCRIPTION OF THE PROJECT

2.1 Party responsible for the project

Kuopion Energia Group consists of the parent company Kuopion Energia Oy and its subsidiary Kuopion Sähköverkko Oy. Kuopion Energia Oy is a company operating in the energy sector, wholly owned by the City of Kuopio, with roots dating back to 1906. Its operations began as a power plant. District heating was introduced in Kuopio in 1963. Kuopion Energia Group in its current form was established in 2015, when Kuopion Energia Oy and Kuopion Energia Liikelaitos were merged to form the group.

The parent company includes the energy production, district heating and cooling business, business technology and group administration, while the electricity network business belongs to the subsidiary that is wholly owned by the parent company. The parent company, Kuopion Energia Oy, is responsible for the SMR project.

In 2024, the Group's turnover was approximately €123 million. Kuopion Energia Oy's turnover is approximately €103 million. There are about 6,300 district heating customers and they were supplied with 942 GWh of district heat and 10 GWh of district cooling in 2024. The electricity produced was sold to the wholesale and balancing electricity markets for a total of 210 GWh.

Energy production takes place mainly at the Haapaniemi combined heat and power plant, where wood is the principal fuel and peat is still used to a limited extent. The goal is to eliminate CO_2 emissions from fossil fuels by 2028. After spring 2026, peat will be used only as a backup fuel to maintain security of supply. The older unit of the power plant, Haapaniemi 2 (HPN2) is expected to be decommissioned in around 2035, and small-scale nuclear power is regarded as a viable future option for district heat production.

2.2 Project and assessed options

The EIA procedure examines an SMR plant with a maximum thermal output of approximately 150 MW, with a maximum of four reactors producing only district heat. The SMR has alternative locations in Kuopio, Hepomäki and Sorsasalo. District heat produced in the SMR plant will be transferred to Kuopion Energia's district heating network via a new district heat transmission connection to be built. From Hepomäki, a new district heating transmission connection is built at the connection point of the district heating network in the Matkus area. The district heating transmission pipe will be placed under the future new road connection. A new district heat transmission connection will be built from Sorsasalo

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to the Haapaniemi power plant across Lake Kallavesi, with the transmission pipeline installed along the bottom of the lake.

The EIA procedure involves the handling and interim storage in the plant area of very low level, low level and intermediate level nuclear waste, as well as high level spent nuclear fuel, generated during the operation of the SMR. The environmental impact assessment does not include the final disposal of very low-, low- and intermediate-level radioactive waste or of spent nuclear fuel. A separate EIA procedure for these will be undertaken, if required, at a later stage.

The project also requires the construction of new road connections, an electrical connection and water and sewer connections on the plant site.

According to the EIA legislation, one option in the assessment procedure must be to refrain from carrying out the project, unless such an option is unnecessary for a specific reason. Therefore, the review includes a zero option (VE0), in which the project is not implemented and the current state of the environment remains unchanged.

The options to be assessed in the EIA procedure are as follows:

VE0: The project will not be implemented. District heat production will continue in its current form using a combustion-based solution.

VE1: An SMR plant with a thermal output of up to around 150 MW will be built in Hepomäki, consisting of up to four reactors dedicated solely to district heat production. The district heat transmission connection from the plant to the existing district heating network will be built as an underground installation.

VE2: An SMR plant with a thermal output of up to around 150 MW will be built in Sorsasalo, consisting of up to four reactors dedicated solely to district heat production. The district heat transmission connection from the plant to the existing district heating network will be built mainly along the bottom of the lake and partly as an underground installation.

2.3 Project location and land use requirements

The project has two alternative locations in Kuopio: Hepomäki and Sorsasalo.

2.3.1 Hepomäki

The project is located approximately nine kilometres southwest of the centre of Kuopio. The plant area of the SMR plant is about 10 hectares. Rudus Oy's aggregate extraction site is currently located in the area. In addition, NCC Industry Oy and Savon Kuljetus Oy have extraction sites for aggregates near the area, and Jätekukko Oy's Kuopio waste treatment centre is located to the west of the area.

The SMR plant area is located on property 297-411-34-4, owned by the City of Kuopio.

According to the preliminary plan, the SMR plant's district-heating transmission connection is located under the new road connection leading to the area. The road connection is planned as part of the currently ongoing local detailed planning process in the Hepomäki area. The length of the new district heating transmission connection is about 2,5 kilometres.

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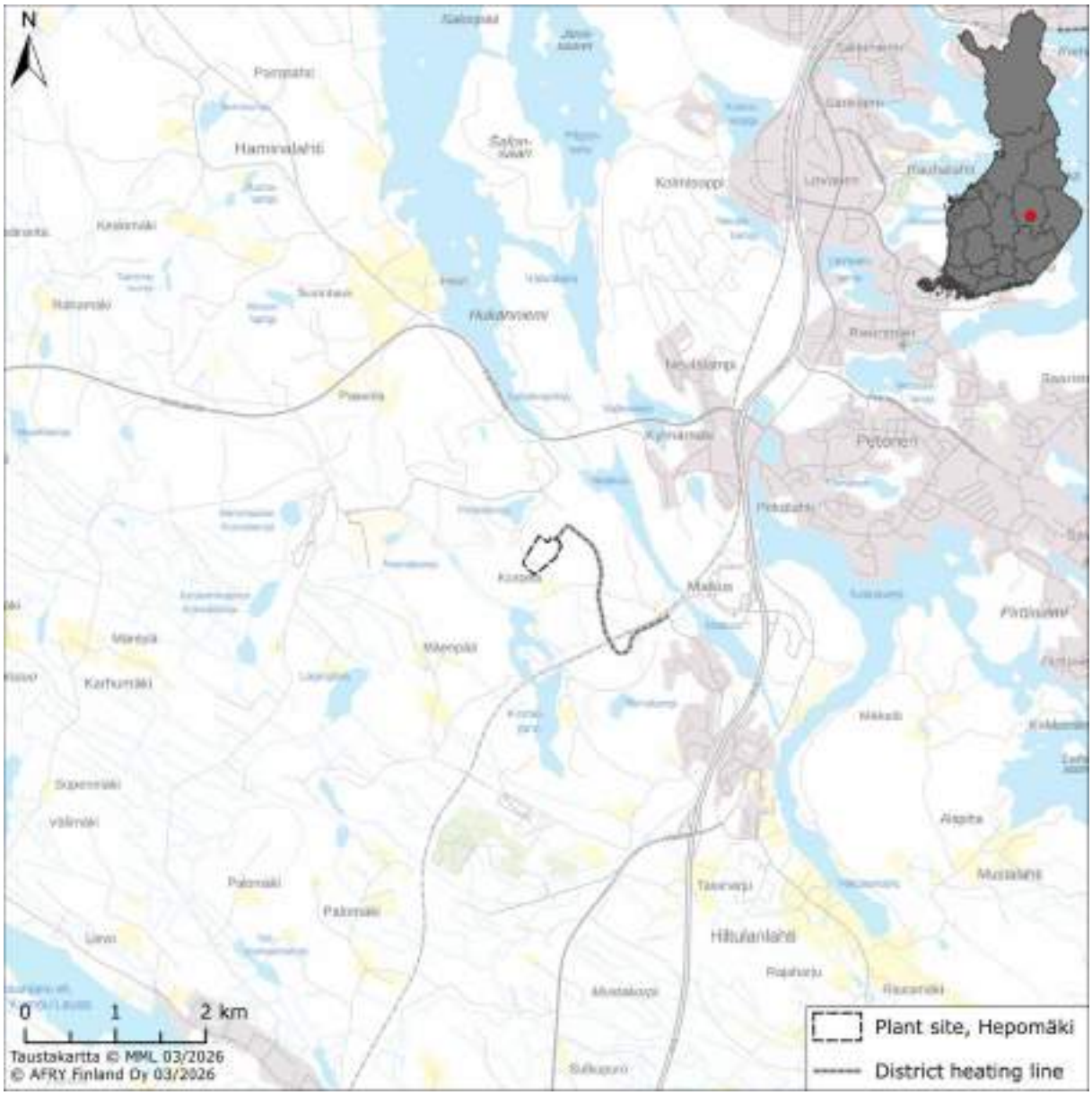

Figure 2-1. Location of the Hepomäki plant site.

2.3.2 Sorsasalo

The project is located approximately six kilometres northeast of the centre of Kuopio. There is industry in the Sorsasalo area. In the southwestern part of the area, there are Mondi Powerflute Oy's factory, NG Nordic Finland Oy's scrap metal recycling plant and M-Real's old closed landfill. The plant area of the SMR plant is located in the southeastern part of Sorsasalo. The area is currently forested. The plant area of the SMR plant is about 10 hectares.

The SMR plant area is located on property 297-22-21-12, owned by the City of Kuopio.

The SMR plant's district-heating transmission connection runs via Kallavesi to the Haapaniemi power plant. In the southern part of the route, the district heating transmission connection has alternative sections A and B. Section A crosses Väinölänniemi and runs to the Haapaniemi power plant, while section B goes around Rönö and the other nearby

islands from the south. The length of the district heating transmission connection is about 11–13 kilometres.

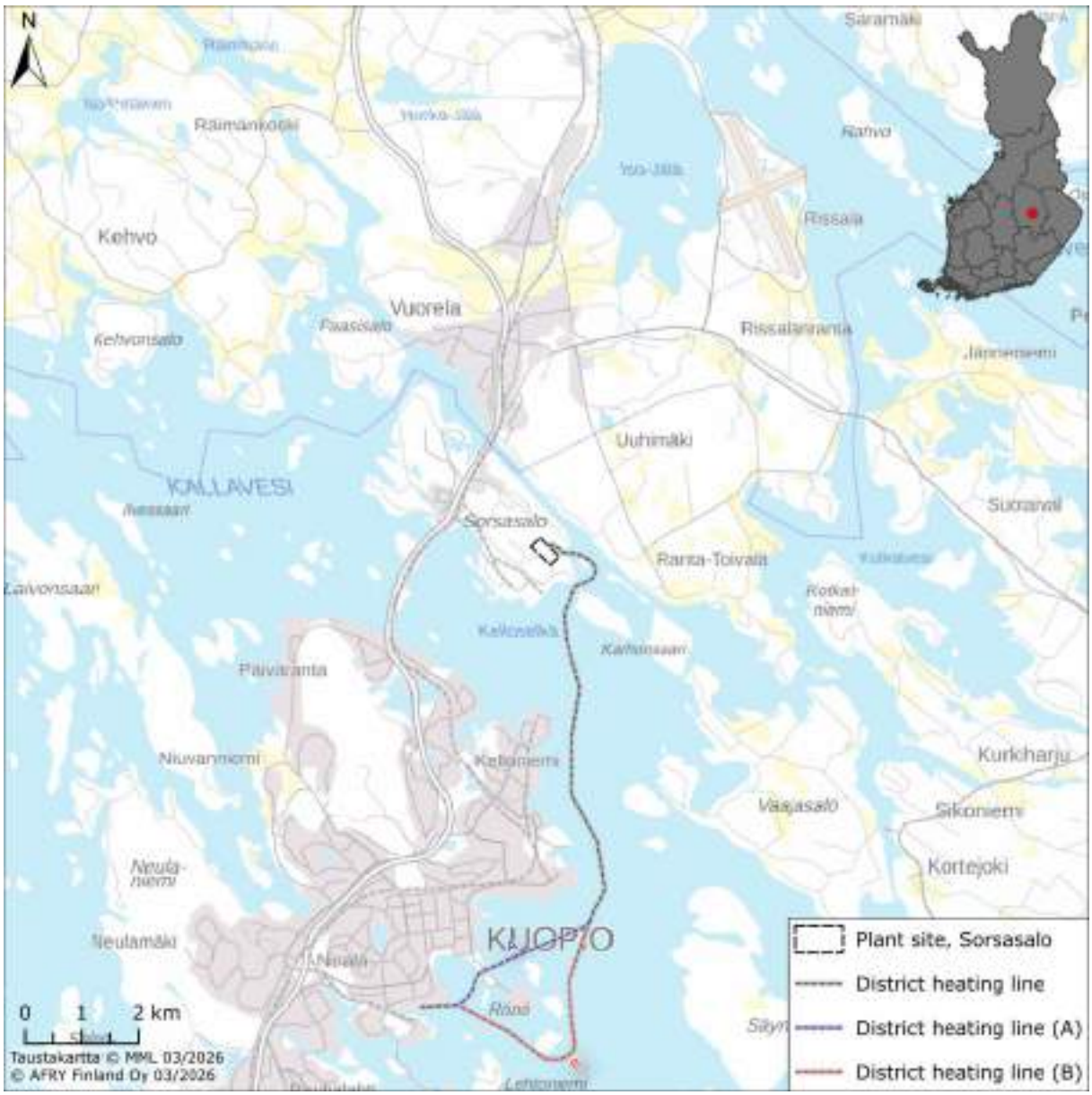

Figure 2-2. Location of the Sorsasalo plant site.

2.4 Background and objectives of the project

2.4.1 Regional objectives

The objective of the region of North Savo is to be carbon neutral in 2035 (North Savo ELY Centre 2021). This objective is achieved by reducing greenhouse gas emissions by 80% compared to 2007 levels and by capturing or compensating for the remaining emissions. The City of Kuopio aims to achieve the same objectives in 2030 (City of Kuopio 2024).

2.4.2 International and national objectives

The European Parliament has adopted the European Climate Law, which increases the EU's emissions reduction target for 2030 from the previous 40% to 55% and makes climate neutrality a legally binding target by 2050.

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EU's Climate Law is part of the European Green Deal, the EU's roadmap towards climate neutrality. To achieve its objectives, the European Union is working on an ambitious legislative package known as Fit for 55. It includes a number of new climate and energy bills and an update of existing legislation.

Small modular reactors (SMRs) are part of achieving the EU's climate targets by 2040. According to the European Commission, the goal is that the first reactors can be commissioned commercially by 2030. (European Commission 2024).

According to the Commission, the climate target for 2040 means that the EU must reduce its greenhouse gas emissions by 90% compared to 1990 levels. To achieve this, the Union's dependence on fossil fuels needs to be reduced by 80% by 2040 compared to 2021 levels. (European Commission 2024)

The European Commission recognises the potential of small-scale nuclear power to support energy and climate targets in line with the European Green Deal.

In accordance with the target outlined in the Finnish Climate Act (423/2022), Finland must be carbon neutral and the first fossil-free welfare society by 2035. This requires accelerated emission reductions in all sectors as well as reinforcement of carbon sinks. Finland's electricity and heat production must be nearly emission-free by the end of the 2030s. As a low-emission form of electricity and heat production, nuclear power plays a significant role in achieving this goal.

2.4.3 The objectives of the project manager and the schedule of the project

Kuopion Energia's district heating is mainly produced at the Haapaniemi power plant. The plant consists of the Haapaniemi 2 (HPN2) and Haapaniemi 3 (HPN3) power plant units as well as an electric boiler (HPN4) to be commissioned in spring 2026. HPN2 is coming to the end of its life cycle in 2035. Kuopion Energia has decided to explore the possibilities of using an SMR plant as a heat source for its district heating system. This decision is based on the need to find sustainable and environmentally friendly energy solutions that can reduce dependence on fossil fuels and minimise carbon footprint. District heating produced using small-scale nuclear power is believed to be a competitive and price-stable production method for customers over the long term.

The aim is to complete the EIA procedure for the project during the spring of 2027. According to the current plan, the decision on proceeding with the SMR plant project will be made during 2030. The construction phase is estimated to take around five years, and the planned commissioning of the SMR plant is in around 2035.

2.5 Location options explored in previous phases of the project

Kuopion Energia Oy has reviewed the areas suitable for the SMR plant during 2023. The possible locations were examined across eight areas, five of which were selected for further examination. Of these, two areas emerged that are relatively remote in terms of settlement and population centres compared to the others. These areas to be included in the environmental impact assessment are Sorsasalo in the north of Kuopio and Hepomäki in the south (see chapter 2.3). Originally, the review also included areas in Vuorela (Siilinjärvi), Kumpusaari, Huuha's old petrol cave, Kelloniemi, Kolmisoppi and Pieni Neulamäki.

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2.6 The project's relationship with other projects

The SMR plant project is related to Kuopion Energia's need to replace part of its current district heating generation. At present, Kuopion Energia's energy production takes place mainly at the Haapaniemi combined heat and power plant by burning wood and a small amount of peat. Kuopion Energia's goal is to eliminate CO_2 emissions from fossil fuels by 2028. After spring 2026, peat will be used only as a backup fuel to maintain security of supply. The older unit of the power plant is expected to be decommissioned in around 2035, and small-scale nuclear power is regarded as a viable future option for district heat production.

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3 TECHNICAL DESCRIPTION OF THE PROJECT

3.1 Operating principles of an SMR plant for district heat production

The SMR plant considered in the project is a heat-only plant for district heat production. SMR plants that produce only heat are currently in the planning phase, which is why there is limited information available about the technology. However, the technical solutions are largely based on the technology of nuclear power plants used in power generation, for which there is extensive operational experience. Plant options intended for district heat production are commercially available within the schedule required for the Kuopion Energia project.

Energy production in a nuclear power plant is based on fission in uranium fuel and its controlled nuclear chain reaction. An SMR plant uses uranium dioxide (UO_2) as fuel, where the U-235 isotope concentration is less than 5%. In fission, when a neutron hits the U-235 nucleus, the nucleus splits into two lighter nuclei, also releasing a few neutrons and energy. The neutrons released during fission can cause new fission processes, forming a chain reaction. Energy production at nuclear power plants is based on the use of heat generated in a controlled nuclear chain reaction in the core of the reactor.

The plant options examined in the project are so-called pressurised water reactors. The heat generated in the reactor is transferred to a separate secondary circuit in the heat exchanger, which in turn heats the water circulating in the district heating network. A heat-only SMR used for district heat production does not require cooling water from a water body, and therefore does not discharge heat into the aquatic environment.

The SMR plant is used for supplying the district heating base load, meaning it is operated mainly at a steady full output. When necessary, the SMR can also be operated more flexibly at lower power levels in accordance with the plant's operating conditions. For example, during the summer, when the demand for district heat is low, the plant needs to be operated at a lower power level. The planned service life of the SMR plant is 60 years.

The SMR plant is connected to Kuopion Energia's existing district heating network. It is necessary to build a new district heating connection from the proposed plant sites to a suitable point in the existing network. New district heating transmission connection routes from alternative plant sites are presented in chapter 3.6. In addition, the existing district heating network will undergo the necessary line renovations to transfer the heat produced in the network. The project's technical description is based on the preliminary design information currently available.

3.2 General description of the plant type

3.2.1 Reactor type and plant size

The SMR plant examined in the project is, in principle, a light water reactor plant. The majority of the world's nuclear power plants and all the nuclear power plants in use in Finland are light water reactors. The SMR plant under examination is a pressurised water reactor, which is the most common plant type in the world. The Loviisa nuclear power plants as well as the Olkiluoto 3 plant are pressurised water reactors. In the case of a plant producing only district heat, the facility is significantly smaller and simpler than the nuclear power plants currently operating in Finland.

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The SMR plant consists of up to four reactor units. The planned combined heat output of the reactors at the plant is up to about 150 MW_{th}. Depending on heat demand, some reactors may be out of service and the thermal output of an individual reactor can be adjusted between 20–100%. Thus, the SMR plant can produce heat flexibly in the range of about 7–150 MW_{th}, depending on the technology chosen and the number of reactors. The efficiency of the plant is estimated to be up to 95%, so it is possible to produce a maximum of around 143 MW_{th} of heat to the district heating network in the SMR plant.

3.2.2 Operating principle

In the reactor's primary circuit, the operating pressure is less than 8 bar and the operating temperature is up to about 155 °C. Due to the pressure, the water does not evaporate. The water circulation in the primary circuit is based on natural circulation, where the heated water in the reactor core at the lower head rises. Therefore, the water circulation in the primary circuit and the cooling of the reactor core do not require pumps or other external work. In the plant, the entire primary circuit is inside the pressure vessel. From the primary circuit inside the pressure vessel, heat is transferred through the heat exchangers to the secondary circuit. The pressure in the secondary circuit is higher than in the primary circuit, so any leakage in the heat exchangers would cause water from the secondary circuit to leak into the primary circuit. Thus, radioactivity from the primary circuit does not leak outside the pressure vessel.

In the secondary circuit, the pumps recycle water from the district heat exchangers to the heat exchangers in the primary circuit, and the heated water is further recycled back to the district heat exchangers, where the water in the secondary circuit heats the water circulating in the district heating network. The water heated by the district heat exchangers flows to the district heating network. The pressure in the district heating network is higher than the pressure in the secondary circuit, in which case any leakage will always occur towards the plant.

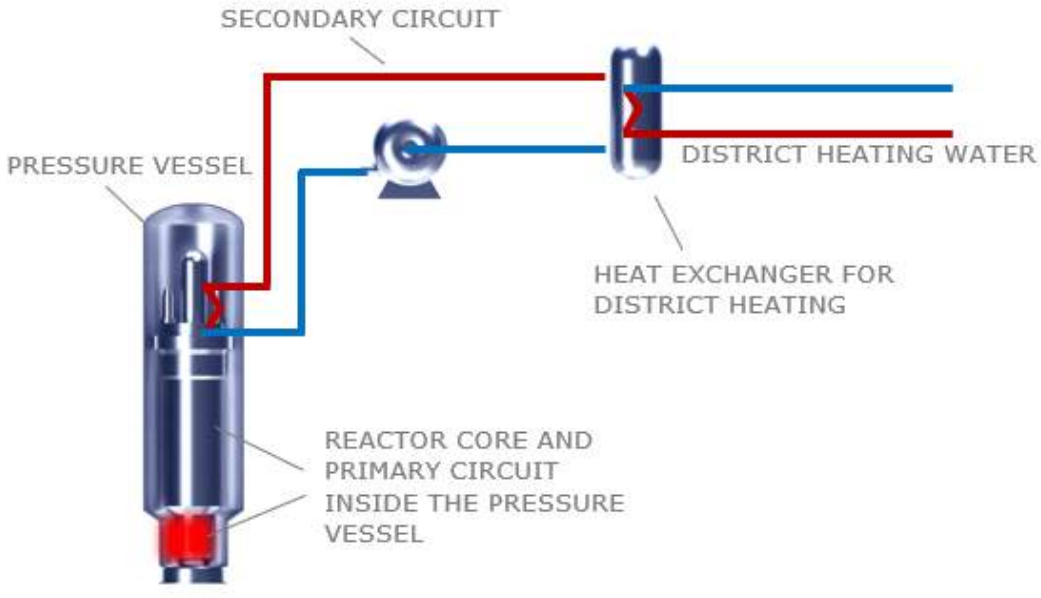

Figure 3-1. Schematic illustration of an SMR plant for district heat production.

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3.2.3 Plant area, buildings and structures

The estimated space requirement for the SMR plant and the related buildings and structures is around 3 hectares. The plant area reserved for the project also houses temporary activities during construction, as well as the necessary facilities for the temporary storage of removed and excavated soil. The total plant area is about 10 hectares.

The most important buildings and facilities of the SMR plant are the reactor building, which can be located on the ground level or completely or partially underground, facilities for non-nuclear systems and auxiliary systems, control room, offices, the access control of the plant area and the storage facility/workshop. There are also tanks in the plant area for storing, for example, fire water, light fuel oil and auxiliary water used in the process. The plant may also have a ventilation chimney. The plant is surrounded by a safety fence. The area also has a car park and the necessary road connections and, in the case of underground facilities, the required tunnels and access routes to them. A stormwater basin may also be needed in the plant area for managing stormwater caused by heavy rainfall, melting snow, etc.

The tallest building/structure in the plant area extends about 20 metres above the ground. In addition, the height of the potential ventilation chimney is about 40 metres above ground level.

Interim storage of spent fuel and the treatment and interim storage of solid and liquid radioactive waste are also carried out in the plant area. The final disposal of this radioactive waste is carried out centrally outside the plant area. Interim storage of both spent fuel and solid and liquid waste can also be done centrally outside the plant area. Centralised interim storage requires a separate environmental impact assessment if implemented.

For the construction of the SMR plant, soil will be removed from the plant site and rock excavated. The plant can be located either in an above-ground open pit or in a rock cavern excavated mainly underground. The amount of excavation required depends largely on the location of the reactor, and is estimated at up to around 130,000 m^3. Some of the removed soil and excavated aggregate can be used as earthfill at the plant site, which helps reduce the amount of surplus soil and rock.

3.3 Nuclear and radiation safety

3.3.1 Nuclear energy legislation and regulatory control

In Finland, the use of nuclear energy must be safe under the Nuclear Energy Act (990/1987) and must not pose a risk to people, the environment or property. The nuclear safety requirements applicable to a nuclear facility are based on the Nuclear Energy Act (990/1987) and the Nuclear Energy Decree (161/1988), supplemented by the regulations issued by the Radiation and Nuclear Safety Authority (STUK) and by the detailed requirements set out in the Regulatory Guides on nuclear safety (YVL Guides) and Regulatory Guides on preparedness (VAL Guides). STUK's regulations relating to the use of nuclear energy concern the safety of the nuclear power plant (Y/1/2018), emergency arrangements (Y/2/2024), physical protection (Y/3/2020) and the final disposal of nuclear waste (Y/4/2018). The Radiation Act (859/2018) and the Government Decree on Ionizing Radiation (1034/2018) lay down requirements for radiation safety. In addition to STUK's regulations and YVL Guides, requirements and limit values are set in the plant's safety-

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technical operating conditions, which STUK approves. STUK monitors the safe use of nuclear power.

The comprehensive reform of the Nuclear Energy Act is currently underway at the Ministry of Economic Affairs and Employment, and a draft of the new Act along with some related legislation was published on the consultation service portal in June 2025. The target for the entry into force of the new Nuclear Energy Act is 2027. In addition to the comprehensive reform of the Nuclear Energy Act, STUK's regulatory reform is also underway. The new regulations will enter into force following the new Nuclear Energy Act. The objective of the comprehensive reform of the Nuclear Energy Act is, among other things, to promote the introduction of new nuclear energy solutions (e.g. SMRs) and the placement of facilities close to points of consumption. It is also intended to improve the investment environment for nuclear installations by reforming the permit system, reducing regulatory project risks and enhancing predictability. The aim is to take into account the different types of operating and cooperation models, the diversity of SMR plants and other nuclear facilities, as well as the proportionality of the requirements at the different phases of the projects and the licence system.

3.3.2 Nuclear safety

The objective of nuclear safety is the safe operation of the nuclear facility and the protection of people and the environment from radiation. Nuclear safety consists of measures and systems that apply the principles of redundancy, separation and diversity in accordance with their safety significance.

In a nuclear power plant, the purpose of the safety functions is to prevent disturbances and accidents, to stop such situations from escalating and to mitigate the consequences of accidents. In an SMR plant, the key safety functions are passive, meaning that they do not require an external power source, such as electricity, to operate. The most important safety functions are:

- Reactivity management
- Removing decay heat
- Radioactivity confinement

Functionally, safety is ensured through the defence-in-depth safety principle, which consists of several successive and mutually reinforcing levels:

1. Prevention of operating transients and defects
2. Management of operating transients and defects
3. Management of accidents
4. Severe accident management and release control
5. Mitigation of the consequences of the release of radioactive substances (preparedness and rescue operations)

The defence-in-depth principle is also applied in the prevention of the spread of radioactive substances. The prevention of the release of radioactivity from nuclear fuel consists of the following successive levels:

1. Nuclear fuel including fuel pellets with ceramic cladding and fuel rods with gas-tight cladding
2. Reactor primary circuit
3. Reactor pressure vessel / reactor overpack

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4. A reactor building designed to withstand an aircraft impact, located either above ground or underground

An SMR plant and its structures and systems are designed to withstand situations related to external threats, such as extreme weather events, seismic events, potential external events caused by other production plants, and aircraft impact.

3.3.3 Radiation and its monitoring

In an SMR plant, radioactive substances are generated as fission products when the atomic nuclei of the fuel split, through neutron activation in or near the reactor, and as products of the radioactive decay of the substances described above.

Systems containing radioactive substances are located within the controlled area, where specific safety instructions are followed to ensure protection against radiation. In the design of an SMR plant, the ALARA (As Low As Reasonably Achievable) principle is applied, meaning that all radiation exposures are kept as low as possible through practical measures, taking economic and societal factors into account.

Before an SMR plant is commissioned, a baseline environmental survey will be carried out within the plant area and its surroundings to determine the prevailing radiation conditions prior to the start of operation. During operation, radiation and releases of radioactive substances are monitored in accordance with the radiation monitoring programme approved by STUK.

The limit values for radiation doses to the public arising from the operation of a nuclear power plant are defined in the Nuclear Energy Decree (161/1988, Section 22b). The limit on the annual dose received by an individual of the population from the normal operation of a nuclear power plant is 0.1 millisieverts, which is less than 2% of the average annual radiation dose (5.9 mSv) of Finns. The majority of the annual radiation dose to Finns is caused by indoor radon (4 mSv). (Radiation and Nuclear Safety Authority 2025a; Radiation and Nuclear Safety Authority 2025b)

Radiation from soil and building materials causes an annual dose of about 0.5 mSv. In addition, natural background radiation includes radiation from space, which causes a radiation dose of about 0.33 mSv annually. Radiation dose from the soil varies by location between 0.17–1 mSv/yr. External radiation is highest in the rapakivi granite area of southeastern Finland. (Radiation and Nuclear Safety Authority 2025a; Radiation and Nuclear Safety Authority 2025b)

For events deviating from the normal operation of a nuclear power plant, the Nuclear Energy Decree (161/1988, Section 22b) defines the limit values for radiation doses to the public as follows:

- Anticipated operational occurrences – 0.1 mSv
    - The expected occurrence of the incident is one or more times over a period of 100 years of operation
- Class 1 anticipated accidents – 1 mSv
    - The expected occurrence of the incident is less than one time over a period of 100 years of operation, but at least one time over a period of 1,000 years of operation
- Class 2 anticipated accidents – 5 mSv
    - The expected occurrence of the incident is less than one time over a period of 1,000 years of operation

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- Extension of an anticipated accident – 20 mSv
    - An anticipated operational occurrence or a Class 1 anticipated accident is accompanied by a common cause failure in the system required to perform the safety function, or
    - A combination of defects identified as significant based on probabilistic risk analysis, or
    - A rare external event that the plant is required to withstand without severe fuel damage.

3.3.4 Emergency preparedness

The purpose of emergency arrangements is to prepare for a highly unlikely accident situation in which it is necessary to take measures to protect the population around an SMR plant. As the last level, emergency preparedness is part of the defence-in-depth principle, which aims to mitigate the consequences of the release of radioactive substances.

Emergency preparedness planning will be carried out in accordance with the requirements set by the current Nuclear Energy Act and STUK's regulations. In addition, STUK's instructions related to emergency preparedness are taken into account.

3.3.5 Precautionary action zone and emergency planning zone

In 2024, STUK published an updated regulation on the emergency arrangements of a nuclear power plant (Y/2/2024), in which the determination of the precautionary action zone and emergency planning zone was changed from fixed kilometre boundaries to a case-by-case assessment. This enables new nuclear projects to be zoned closer to the point of use in the same manner as in district heat production.

In the event of an accident, it must be possible to carry out the necessary evacuation measures in the precautionary action zone effectively in order to prevent or limit serious direct adverse effects on the population, which is why the area is subject to land use restrictions. The precautionary action zone is determined so that the radiation dose to an unprotected person outside it does not exceed 1 Sv within 10 hours from the start of exposure. The precautionary action zone is part of the emergency planning zone.

In the event of an accident in the precautionary action zone, it may be necessary to implement urgent protective measures directed at the population in order to limit the occasional adverse effects of ionising radiation, and an external rescue plan in accordance with the Rescue Act must be drawn up for the area by the authority. In the event of an accident, it is highly likely that sheltering of the people located outside the emergency planning zone will not be necessary. The emergency planning zone is defined so that the radiation dose to an unprotected person outside it does not exceed 10 mSv within 48 hours of the start of exposure. In addition, the emergency planning zone extends up to about 20 kilometres from the power plant.

3.3.6 Physical protection

Physical protection for the SMR plant is designed and implemented in accordance with regulatory requirements to protect the plant and its nuclear materials from illegal activities such as vandalism, sabotage and terrorism. Physical protection includes administrative, technical and operational measures, including information security. The person in charge of operating the SMR plant is responsible for physical protection, and various authorities,

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such as the police, are also involved. Physical protection also applies to the construction period of the SMR plant, thereby protecting it from unlawful activity during construction.

3.4 Procurement and use of nuclear fuel

The number and characteristics of the fuel bundles in the reactor core of the SMR plant depend on the plant technology chosen. The fuel and fuel bundles are similar to those used in traditional large light water reactor plants. These can be manufactured by several Western operators from whom the fuel will be procured. The preliminary estimate of the amount of spent nuclear fuel is approximately 750–1,250 kg per year. Fresh fuel is only slightly radioactive, and fuel bundles can be delivered to the plant by lorry.

3.4.1 Refuelling maintenance

The reactors of the SMR plant are shut down at regular intervals for refuelling, plant maintenance and inspections. During short refuelling maintenance, part of the fuel is replaced, and during longer maintenance, more extensive inspection and maintenance work is carried out in addition to refuelling. The timing and frequency of maintenance depend on how the plant is used, and these matters will be clarified as the project progresses. The initial idea is that refuelling maintenance is carried out every two years.

3.5 Waste management

3.5.1 Spent nuclear fuel

Spent nuclear fuel removed from the reactor is highly radioactive. The spent fuel is transferred to a storage rack located in the reactor pool, where the fuel will cool down for about five years according to preliminary estimates, resulting in a decrease in fuel activity and heat output. The spent fuel from the fuel pools is transferred underwater to the spent fuel tank, in which the spent fuel is transported to the interim storage. Interim storage can be implemented either on the plant site or in a centralised interim storage facility located elsewhere.

When carrying out interim storage at the plant site, the necessary underground facilities will be excavated for operations or an interim storage building will be built above ground.

The interim storage period for spent nuclear fuel at Finnish nuclear power plants is typically tens of years, but this depends on the characteristics of the spent nuclear fuel and will become more precise as the project progresses. The spent fuel has the same properties as the spent fuel of nuclear power plants operating in Finland. After interim storage, the spent fuel will be finally disposed of at a licensed repository site located in the Finnish bedrock. Alternatives for the final disposal of spent nuclear fuel may include, for example, an existing repository or any new repositories that are going to be built.

3.5.2 Very low level, low level and intermediate level operational waste

During the operation of the SMR plant, waste related to the plant’s operation and maintenance is generated, such as filters, plastics and work clothes, as well as waste from purification systems. Waste is classified on the basis of activity as very low, low and intermediate level waste. Operational waste generated is sorted and processed within the power plant area and packaged into its final form for storage in the on-site interim storage facility, or transferred for interim storage outside the plant area. When carrying out interim storage at the plant site, the necessary underground facilities will be excavated for operations or an interim storage building will be built above ground.

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From the interim storage facility, the waste is transferred for final disposal at a repository site located outside the plant area. Alternatives for the final disposal of operational waste may include, for example, existing operational waste repositories and any new repositories that are going to be built. The preliminary estimate of the amount of waste is about 15 m^3 per year.

3.5.3 Conventional waste

In addition to active waste, conventional waste (e.g. metals, wood, paper, cardboard and plastic) is generated at the power plant area. Conventional waste is appropriately sorted at the plant. Hazardous waste (e.g. waste oils) is generated during maintenance and repair work, and it is stored and managed appropriately. Waste is managed as required by legislation and the power plant's environmental permit, in cooperation with an expert waste management company.

During construction, larger amounts of conventional waste are generated, including packaging and surplus materials. These are managed appropriately.

3.5.4 Waste exempted from control

Waste generated in the controlled and supervised areas of the nuclear power plant is treated as radioactive because of its origin. When the amount of radioactive substances in the waste is sufficiently low and it is below the exemption thresholds, the waste can be exempted from radioactivity control and managed as non-hazardous waste. Radioactivity is determined by measurements that show the waste does not require special measures because of its radioactivity. Waste exempted from control falls within the scope of the Waste Act, after which it is managed using the methods described in chapter 3.5.3.

The Radiation and Nuclear Safety Authority (STUK) supervises the exemption procedures, and waste must not be intentionally diluted to exempt it from control. (Radiation and Nuclear Safety Authority 2023)

An example of the use of waste exempted from control is the cooperation between Teollisuuden Voima Oyj and Rauman Biovoima Oy, in which maintenance waste exempted from control is used by burning it to produce energy. (Teollisuuden Voima Oyj 2025)

3.6 District heating transmission connection

3.6.1 Hepomäki

In Hepomäki, the district heating transmission connection is placed under a new road to be built in the area (Figure 3-2). The location route of the road is planned as part of the local detailed planning of the Hepomäki area, which means that the routing is preliminary, and it will be specified as the planning progresses. According to the current plan, the location route of the road will run south from the SMR plant area, cross the railway in a bridge structure and run south of the railway towards the east. It is also possible that the intersection of the location route of the road and the district heating transmission line will be made under the railway. The connection point of the new district heating connection to the existing district heating network is located in the Matkus area.

The SMR plant's district heating transmission line is similar to a conventional one. The district heating transmission line is implemented as a buried pipeline connection. The routing of the pipeline is located at least 70 cm below ground level. The length of the new pipeline is about 2.5 kilometres. The district heating pipes are plastic-coated, steel-

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structured pipes insulated with polyurethane. The pipes come as elements from the factory and are connected by welding at the construction site. Two district heating pipes run in the underground trench. The size of the pipeline is DN700; its outer diameter is one metre. The pipes' initial installation depth is about 1.8 metres.

Approximately half a metre of space is left between the pipes in the underground trench. The trench is about 3.5 metres wide at the bottom; the slope of the ramp is 1:2. In this case, the width of the trench is about 11 metres. The width of the construction area is about 20–25 metres.

Before construction, trees and topsoil are removed from the area of the district heating line. The soil is dug out of the pipe trench and placed beside it during the installation of the pipes. The soil is used to fill the trench after the pipes have been installed. Since the district heating transmission line in Hepomäki is located under the road to be built, the area of the district heating transmission line is used during the operation as a transport route.

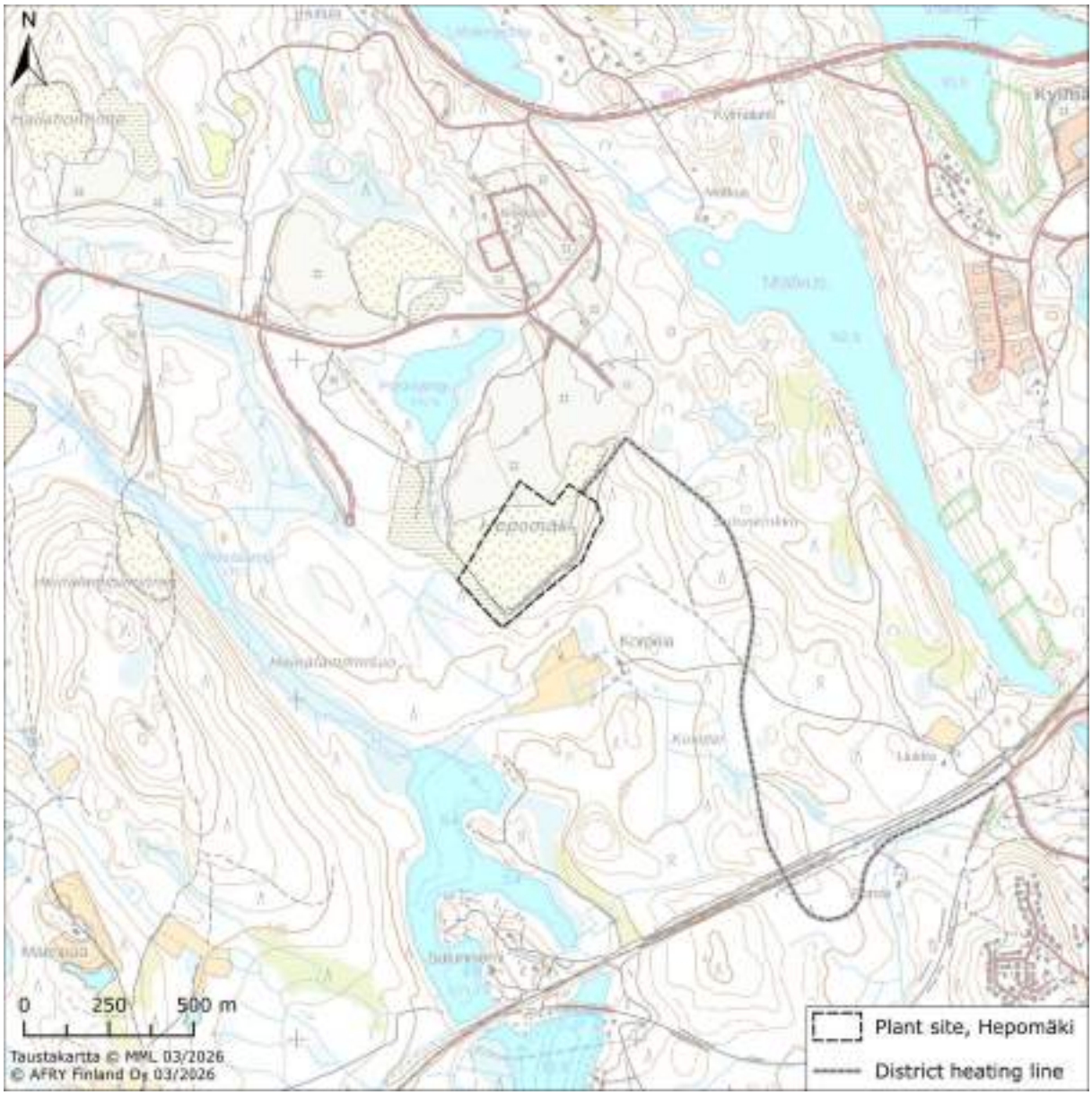

Figure 3-2. The preliminary routing of the district heating transmission connection in the Hepomäki project area.

If Hepomäki is selected as the location for the SMR plant, it is necessary to renovate the transmission connections of the existing district heating network for a total distance of about 7.3 kilometres between Matkus and the Haapaniemi power plant.

3.6.2 Sorsasalo

In Sorsasalo, the district heating transmission connection is partly on land but mostly in water. The district heating transmission line runs from Sorsasalo across Kallavesi to the Haapaniemi power plant (Figure 3-3). The transmission line has alternative route sections A and B in the southern part of the route (about 11 km and 13 km). Route A goes through Väinölänniemi, route B goes around the islands in front of Väinölänniemi.

A waste heat pipeline for VolagHy's synthetic aviation fuel production project is also planned along the same route as the district heating transmission connection from Sorsasalo to the Haapaniemi power plant (see chapter 23). The waste heat generated in the VolagHy project can be used in the production of district heat. Thus, a total of three pipes would run in parallel along the same route, two district heating pipes and one waste heat pipeline.

In the water, the district heating transmission line is installed by sinking the pipes into the lake bed. The district heating pipes are steel-structured pipes insulated with polyurethane. There is a steel outer shell on top of the insulation. The pipes come as elements from the factory and are connected by welding on land near the construction site. Along the shore, weights are attached to the pipes after which the pipes are pulled into the lake along the planned pipeline route. After this, the buoyancy pipes are detached and the pipe is submerged in the planned location. Two district heating pipes are installed side by side on the lake bed. The size of the pipeline is DN700; its outer diameter is one metre. Initially, two metres of space are left between the pipes. In total, the width of the pipeline area would be about 10 metres if a waste heat pipe from the VolagHy project were also placed on the line (see chapter 23).

The construction of the district heating transmission connection requires dredging in the lake at the pipeline's landing points where the water depth is 3.5 metres or less. The estimate of the mass to be dredged is about 25,000 solid cubic metres. In the landing areas, the width of the dredging area is about 20 metres if the VolagHy project's waste heat pipeline were also placed in the trench (see chapter 23).

On land in Sorsasalo, the district heating transmission line is implemented as it is in Hepomäki. The width of the trench on land is about 15 metres, and a 30-metre-wide area is kept treeless. Unlike in Hepomäki, there is no road route in the area of the district heating transmission connection in Sorsasalo. Therefore, during operations, the terrain must be kept treeless in the area of the pipeline route which means that forestry, for example, is not possible in the area. In Haapaniemi, the district heating transmission line is connected to the current district heating network.

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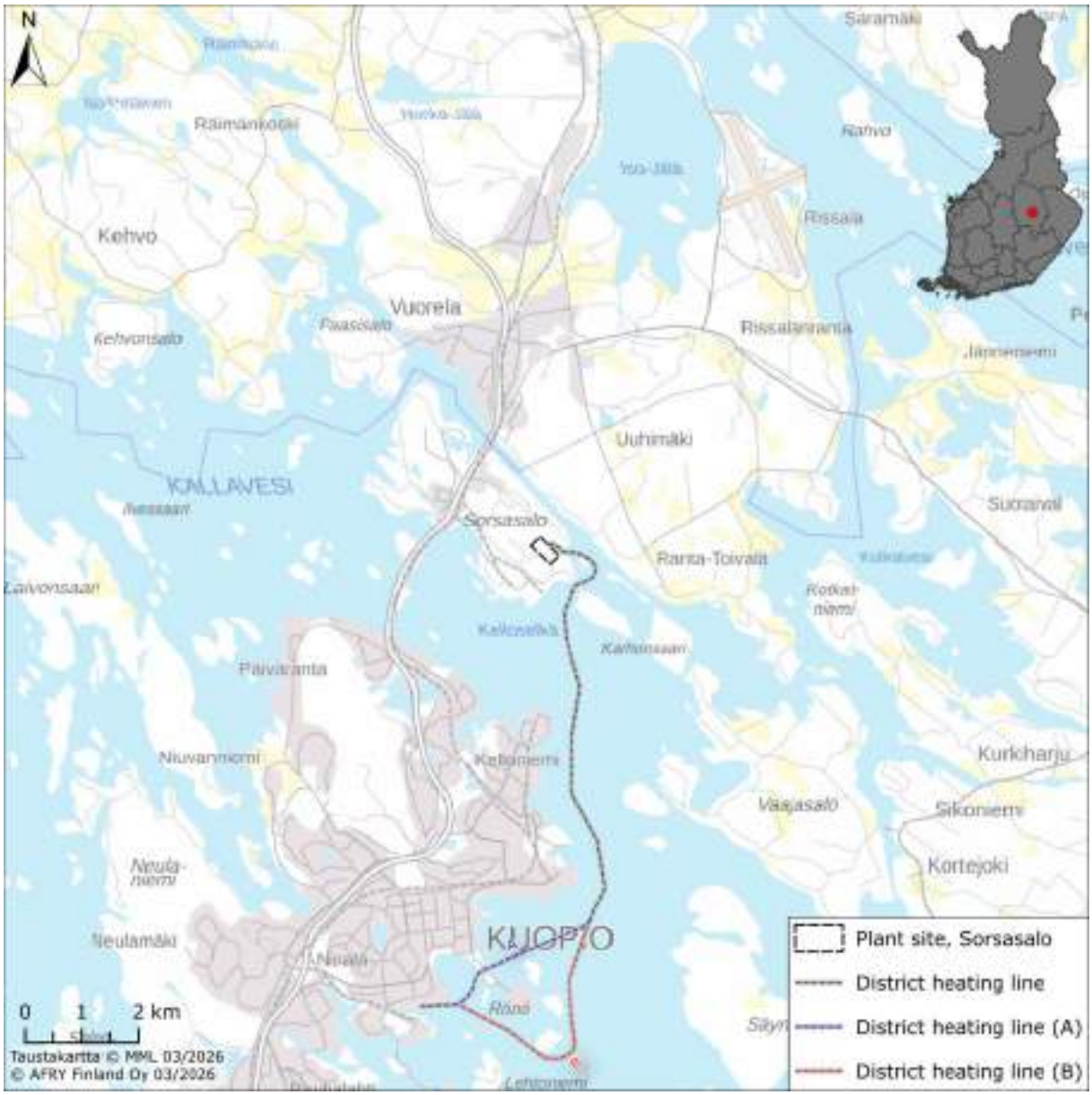

Figure 3-3. The preliminary routing of the district heating transmission connection in the Sorsasalo project area.

3.7 The need and procurement of water

The water required by the SMR plant is sourced from the municipal water supply network. In the SMR plant, water is used as a medium for heat transfer, as well as in auxiliary systems of the plant. In addition, water is needed for firefighting and for domestic use. To prepare process water, the plant has a desalination plant that uses tap water as raw water.

During construction and commissioning, the need for water varies according to the project phase and the number of personnel working in the area. Water use is exceptionally high during the commissioning of the SMR plant when the reactor pools are first filled. It is possible use tank trucks to bring the water needed to fill the pools to the plant.

The water consumption of the plant during normal operation is estimated to be approximately 10 m^3/day. During plant maintenance shutdowns, the water consumption is estimated to reach a maximum of about 50 m^3/day.

3.8 Strain on the water system

3.8.1 Wastewater

Wastewater generated during operation of the power plant consists of domestic wastewater and process wastewater. Domestic wastewater is generated, for example, in sanitary facilities, showers and hand-washing. It is led into the city's sewage network. The process itself does not normally generate wastewater, but wastewater may be generated as a result of various measures related to the operation and maintenance of the plant. The amount of wastewater in normal operation is about 40 m^3/day, of which 30 m^3/day is water seeping from the soil into the plant's underground facilities, which is then directed to the sewer network after quality inspection. The largest amount of wastewater is related to maintenance shutdowns, which involve changing the water in the systems and draining the systems. In these cases, the amount of wastewater per day can be 150 m^3/day.

Radioactive wastewater and its treatment are described in chapter 3.9.

3.8.2 Stormwater and firefighting wastewater

Clean stormwater generated on the power plant area is discharged into the environment. If necessary, the discharge flow of stormwater on site is regulated by detaining it. The assessment of the need for detainment takes into account the capacity of the receiving water system. Preparations are also being made for the quality management of stormwater. Stormwater with potentially higher loads, such as that generated at chemical discharge sites (see chapter 3.14), is discharged to the municipal wastewater sewer where necessary. Water drainage is agreed separately with the local water treatment plant. Operational stormwater discharge sites are not yet known. Stormwater can be discharged into the stormwater network or into receiving water systems through free flow channels. Stormwater quality, discharge routes and stormwater volumes will be specified during the EIA reporting phase.

At the plant, preparations are made for the collection and on-site retention of potential firefighting wastewater generated during accident situations. Firefighting wastewater is collected primarily through the stormwater system and by directing it over surfaces. Firefighting water is prevented from entering the environment. The stormwater systems are equipped with a shut-off system, and in the event of an accident, the water is retained in a separate reservoir or pool. The firefighting water collection system is dimensioned on the basis of fire scenarios, taking into account heavy rain situations. The drainage of potentially radioactive firefighting water is planned separately from the treatment of other firefighting water. The preliminary technical description of firefighting wastewater collection will be clarified during the EIA reporting phase.

During construction, the site waters mainly consist of surface runoff from the site, dewatering from excavations, and waters produced by rock excavation. Suspended matter is washed into site runoff during earthworks. Soil replacement and groundworks can also cause elevated electrical conductivity in site water. In exceptional situations, the water generated on the site may also become contaminated with oil from broken equipment. The discharge routes and arrangements are agreed with the authorities, and the stormwater systems are implemented before commencing actual construction work. Stormwater during blasting, possible crushing of the rock, interim storage, and use in fills may contain elevated nitrogen concentrations due to explosive residues in the rock.

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Site water is treated using qualitative management methods before being discharged into the environment. If necessary, preparations are made to direct the most heavily loaded runoff from the construction site (e.g. nutrients, pH level, oil residues from work machinery) into the wastewater sewer. Site water management will be specified at a preliminary level during the EIA reporting phase. The qualitative and quantitative management and treatment of construction site waters will be planned in more detail in the later implementation planning phases of the project and will be dealt with in connection with the project's permit process in accordance with the Building Act. Stormwater can also be used for dust control during aggregate crushing, which increases evaporation and reduces the amount of stormwater to some extent.

Preparations for flooding situations that may be caused by heavy rains during construction are made by designing the sites in accordance with the minimum planning requirements that take climate change into account (Hulevesirakenteet [Stormwater structures] RT 103006; Hulevesien hallinta [Stormwater management] RT 89-11196; Rakennustyömaan hulevesien hallinta [Stormwater management at construction sites], RTS 16:23 instruction; RT 103169, Ilmasto. Perustietoa suunnittelijalle [Climate. Basic information for a planner] and RT 103170, Ilmastonmuutos. Hillintä ja sopeutuminen rakennetussa ympäristössä [Climate change. Mitigation and adaptation in a developed environment]). The management and treatment (both qualitative and quantitative) of stormwater causing cloudiness during construction will be planned in more detail in the later design phases of the project.

3.8.3 Flood risks

The project areas or their immediate vicinity are not flooding zones. The potential flood risk caused by heavy rainfall and large amounts of snowmelt at the plant area will be taken into account in determining the altitude of the plant site and in the design of water management systems. The flood routes of stormwater systems are implemented in a controlled manner, primarily using surface runoff routes.

3.9 Radioactive releases

The operation of the SMR plant results in small, controlled releases of radioactive liquids and gases from the plant, which are clearly below the emission limits set by legislation and permits. Prior to removal from the plant, gases and liquids are filtered and purified in such a way that their radiation effect is very small compared to the effect of naturally occurring radioactive substances. Radioactive substances are produced during operations in the nuclear reactor, most of which remain inside the fuel rods. In addition, activation products are generated when neutrons react with contaminants in the reactor coolant, in which case a small proportion of radioactive substances are also present in the primary circuit water, as well as in the purification and wastewater systems related to the primary circuit.

In the processing of radioactive gases generated in the SMR plant, the gases are collected, filtered and delayed in order to reduce radioactivity. Small amounts of gases containing radioactive substances are discharged into the air in a controlled manner through a ventilation chimney, the height of which is up to about 40 metres. During operation, radioactive release consists mainly of inert gases (such as krypton and xenon), iodine, aerosols, and carbon-14 isotopes.

Radioactive water is treated and delayed to reduce radioactivity. When the activity limits set by the authority for exemption from control are not exceeded, the wastewater exempted from control is discharged from the plant into the sewer network like other

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wastewater. Dilution below the limit values is not allowed. About 500 m^3 of wastewater exempt from control and discharged into the sewage system is generated each year.

3.10 Conventional emissions to air

In the SMR plant, conventional emissions to air are mainly caused by emergency diesel generators, the testing of which produces some nitrogen oxide, sulphur dioxide, particulate matter and carbon dioxide emissions. The use of emergency diesel generators is not continuous. In addition, traffic generates conventional emissions to air. However, operational traffic is mainly staff commuting.

3.11 Electricity demand and transmission

An SMR plant that produces district heating does not generate electricity. The electricity demand of the plant is at most about 12 MW. Different pumps and fans consume electricity at the plant, among others. The plant is connected to a medium voltage network of 20 kV. A new electrical connection is built for the SMR plant as an underground cable, the route of which is not yet known. The matter will be specified in the EIA report.

3.12 Traffic

During construction, heavy transports can be carried out via transport connections close to the plant site. Road connections to the plant sites will be built, and the needs of heavy traffic during construction are taken into account. The location route of the road in Hepomäki is shown below (Figure 3-4), and the one in Sorsasalo will be specified during the reporting phase.

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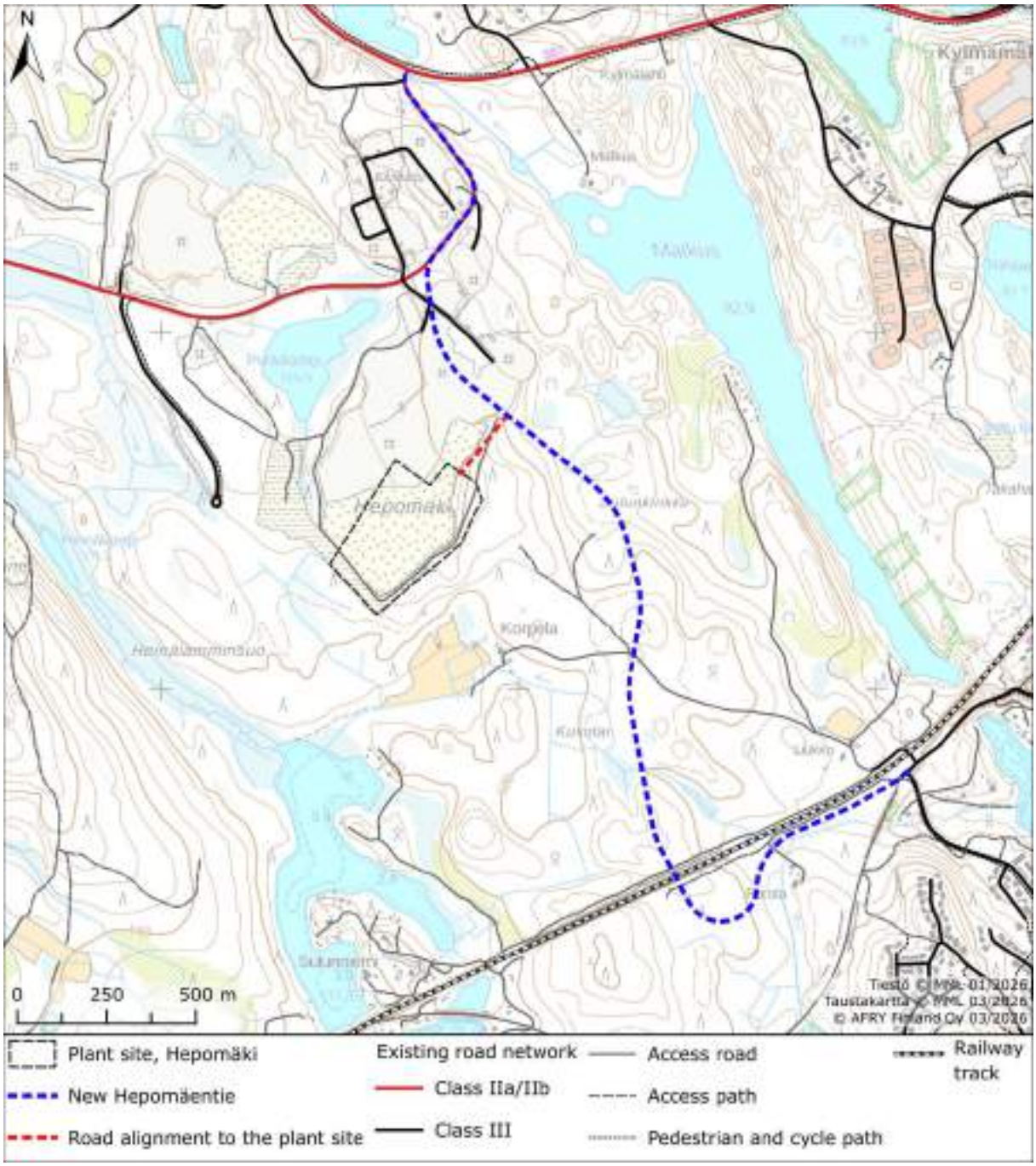

Figure 3-4. The new location route of the road in Hepomäki.

Traffic is similar to that of other industrial construction. The majority of this traffic is related to earthworks, such as the transport of quarried aggregate. Construction staff travelling to and from the site also cause traffic around the plant. The estimated number of staff during construction is at most 300 people.

During the operation of the SMR plant, traffic mainly consists of staff commuting as well as traffic during plant maintenance. During operation, the plant employs about 20 people, and during refuelling maintenance, up to about 100 people. There is no need for regular, daily fuel or similar transportation to the plant. Fresh fuel is brought to the plant approximately every two years, and transportation of spent fuel from the plant site to the interim storage site or final disposal are estimated to take place about every five years. Transportation and the plans required for them are carried out in accordance with

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regulatory requirements. Final transportation volumes will be specified as the project progresses on the basis of more accurate fuel and waste management solutions.

3.13 Noise and vibration

The phase that causes the most noise and vibration is at the beginning of construction, when earthworks and excavation are carried out in the area. At that time, the most significant sources of noise and vibration are excavation operations, as well as the processing and transportation of aggregate. The most significant effects in terms of the equivalent continuous sound level are caused by the noise from the drill and possible crushing. The noise from explosions is easily distinguishable but short-term. In terms of vibration effects, blasts are the most significant work phase.

During operation, the most significant sources of noise in the SMR plant are certain mechanical devices, such as pumps and fans, as well as the movement of water in the process. In addition, ventilation systems cause noise. The noise level during normal operation of the plant is assumed to be less than 55 dB in daytime and less than 50 dB at night over 250 metres from the plant. Emergency diesel generators cause intermittent noise, for example, in connection with testing. No noticeable vibration occurs during operation.

3.14 Chemicals

Various chemicals are used at the SMR plant, for example, for reactivity control, in process and district heating water, for purification, and as fuel for emergency generators. Chemicals and their quantities vary depending on the type of plant.

Examples of chemicals that may be used include boron, gadolinium, glycol, refrigerant (e.g. R1234ze), nitrogen, light fuel oil and lubricating oils. In addition, chemicals are used for the treatment and decontamination of process and district heating water. Also laboratory chemicals and welding gases are used.

The following chemicals are added to the water circulating in the district heating network at the Haapaniemi power plant. The plant also has chemical storage facilities, as is currently the case.

- SuproPyra SG7: concentration 1 mg/kg. The reason for this addition is that the district heating water dye is green, and it is observed under UV light.
- Amersite 60: concentration: 50–70 mg/l. It is a deoxidation chemical and protects the piping.
- Performax 24L: pH 9.5–10.0. Adjustment of pH and flocculation of iron particles.
- NaoH 50%: pH 9.5–10.0. Adjustment of pH if Performax is not in use.

The treatment and storage of chemicals are carried out in accordance with the environmental permit and the permits granted by the Finnish Safety and Chemicals Agency (Tukes).

3.15 Decommissioning

The planned service life of the SMR plant is at least 60 years, and when its operation ends the plant will be decommissioned. Decommissioning and its planning are carried out in accordance with the Nuclear Energy Act, the applicable regulations and STUK’s regulations and requirements. A decommissioning permit in accordance with the Nuclear Energy Act will be applied for in due course and an EIA procedure in accordance with the EIA Act will

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be implemented. The decommissioning phase is estimated to last approximately 10 years after the end of the plant's operation.

When the plant is decommissioned, the radioactive systems are dismantled and the area is purified of all radioactivity, after which it can be exempted from regulatory control. The demolition of inactive buildings and structures depends on the intended use of the area after decommissioning. In the SMR plant, the implementation of decommissioning has already been taken into account in the design phase of the plant concept. Based on the accumulated experience, the best available technology will be used for decommissioning and waste treatment in due course.

The decommissioning strategy of the plant is immediate dismantling, that is, the dismantling of the plant begins immediately after its operations end. All fuel bundles are removed from the reactor and transported to the storage for final disposal. Next, all radioactive systems are dismantled and the activated components are taken to final disposal or stored for final disposal. Contaminated structures and equipment are purified and disposed of or recycled. The advantage of immediate dismantling is the availability of competent workforce who knows the plant when moving directly to decommissioning. The challenge is the higher radiation levels, which make dismantling more difficult.

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4 PERMITS, PLANS AND DECISIONS REQUIRED FOR THE PROJECT

4.1 General

Once the environmental impact assessment procedure has been completed, the project proceeds to the permit phases. The EIA report and the reasoned conclusion issued by the competent authority are attached to the permit applications. The following chapters briefly describe what procedures, permits and decisions may be required.

4.2 Environmental impact assessment

The need and phases of the EIA procedure are described in chapter 5.

The EIA procedure of the project includes the preparation of the EIA programme and the EIA report. The EIA report and the reasoned conclusion issued by the competent authority (in this project, the Ministry of Economic Affairs and Employment) are a prerequisite for obtaining permits for the project.

4.3 International consultation procedure

This project is subject to the Espoo Convention on Environmental Impact Assessment in a Transboundary Context (see chapter 24 and Appendix 1). The application of the Espoo Convention is recorded in Chapter 5 and Sections 28 and 29 of the EIA Act.

The assessment of environmental impacts in a transboundary context is governed by the Espoo Convention (*Convention on Environmental Impact Assessment in a Transboundary Context*). Finland ratified this United Nations Economic Commission for Europe convention in 1995. The convention entered into force in 1997. In Finland, the obligations of the Espoo Convention have been implemented through the Environmental Impact Assessment Act and the Decree on the entry into force of the Convention on Environmental Impact Assessment in a Transboundary Context (SopS 67/1997). Internationally, public participation and rights of appeal are regulated in the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (SopS 121–122/2004, the Aarhus Convention). The Aarhus Convention aims, among other objectives, to enable the public to participate in decision-making in environmental matters. The Aarhus Convention has been implemented in the EU through a number of directives, including the EIA Directive.

The parties to the Espoo Convention have the right to participate in an environmental impact assessment procedure carried out in another country if the harmful and likely significant environmental impacts of the project under assessment may affect their country ("the affected party"). The international consultation procedure is necessary if a proposed project listed in Annex 1 to the Espoo Convention is likely to have significant adverse transboundary effects. This list of projects includes nuclear power plants and other nuclear reactors. Accordingly, the transboundary environmental impact assessment procedure under the Espoo Convention may be applied to SMR plants.

The Point of Contact of the party (country) of origin notifies the Points of Contact of those parties (countries) considered likely to be affected by the project of the commencement of the EIA procedure and offers them the opportunity to participate in the procedure. If the affected party (country) decides to participate in the assessment procedure, it will make the project documentation provided by the party (country) of origin publicly available in

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the affected country for comments and opinions from its authorities and the public. The Point of Contact of the affected Party (country) compiles the comments and opinions received and then submits them to the Point of Contact of the Party (country) of origin. The Point of Contact of the Party (country) of origin submits the comments and opinions received to the competent authority for consideration in its own statement.

In the transboundary consultation procedure under the Espoo Convention, the competent authority for Finland (Party of origin) is the Finnish Environment Institute (Syke). The Finnish Point of Contact (Syke) submits the comments and opinions received from the affected parties to the national EIA authority, which takes the comments and opinions/feedback into account in its own statement.

Possible transboundary impacts are described in more detail in Annex 1 to the EIA programme.

4.4 Decisions and licences under the Nuclear Energy Act

In Finland, the use of nuclear energy is based on the Nuclear Energy Act (990/1987) and the Nuclear Energy Decree (161/1988). In addition to the Nuclear Energy Act and Decree, the permits and their information requirements presented in this chapter are also based on the Regulatory oversight of safety in the use of nuclear energy (YVL A.1) and the information published by the Ministry of Economic Affairs and Employment (MEAE) and the Radiation and Nuclear Safety Authority (STUK). Currently, a comprehensive reform of nuclear energy legislation is underway, and as a result, changes in licence procedures are expected in the future, which will also be taken into account in this project.

The current license and decision-making process related to the use of nuclear energy can be seen in the following image (Figure 4-1).

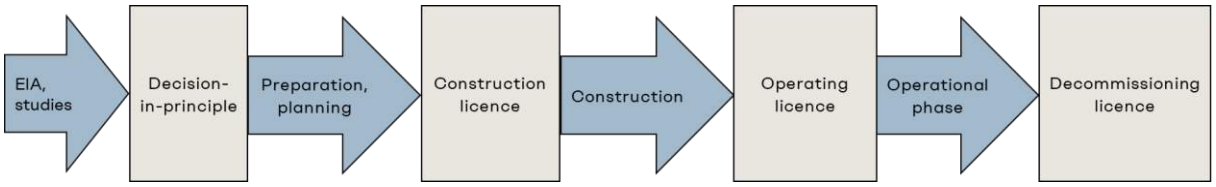

Figure 4-1. The licence process related to the use of nuclear energy in Finland. The image shows the different phases of the permit process as well as the phases to be completed between them.

4.4.1 Decision in principle

According to the Nuclear Energy Act, the construction of a nuclear facility requires a Government decision in principle that the construction of the nuclear facility is in line with the overall interest of society. When making a decision in principle, the Government pays particular attention to the following factors:

- the need for the nuclear facility project in relation to the country's energy supply;
- the suitability of the intended location of the nuclear facility and its effects on the nuclear facility and on the environment;
- arrangements for nuclear fuel and waste.

The decision in principle requires the approval of the Parliament.

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At the application phase for the decision in principle, STUK will conduct a preliminary safety assessment of the project, and will provide its views on the prerequisites for the construction of the nuclear facility in its statement. In its safety assessment, STUK states whether the prerequisites for the construction of the nuclear facility are met as required by the Nuclear Energy Act. In this phase, the technology and safety of the future nuclear facility are not yet being assessed on a detailed level.

The decision in principle also requires a statement from the Ministry of the Environment and the municipality where the plant will be located, as well as from neighbouring municipalities. Support from the host municipality is a prerequisite for the decision in principle.

Alternatives for the plant supplier and the technology to be used may be proposed in the application for the decision in principle, and different location options may also be suggested for the plant.

The documents and information to be submitted to STUK in connection with the application phase of the decision in principle are specified in Guide YVL.A1 (Regulatory oversight of safety in the use of nuclear energy). Other more specific requirements are presented in the YVL for different topics.

The information submitted to STUK at the application phase of the decision in principle must provide sufficient grounds for STUK to prepare a preliminary safety assessment for the nuclear facility project.

An environmental impact assessment (EIA) in accordance with environmental legislation must be carried out for new nuclear facility projects before applying for the decision in principle.

4.4.2 Construction licence

Under the Nuclear Energy Act, a construction licence for a nuclear facility is applied for by submitting a written application to the Government. STUK issues a statement on the construction licence application and carries out a safety assessment. The safety assessment includes a statement on the fulfilment of the requirements that fall within STUK’s area of responsibility. The documents and information to be submitted to STUK in connection with the construction licence application are specified in Guide YVL.A1 (Regulatory oversight of safety in the use of nuclear energy). Other more specific requirements are presented in the YVL for different topics.

As part of processing the application for a construction licence for a nuclear facility, STUK also carries out inspections and assessments related to the activities of the licence applicant, the plant supplier and all organisations participating in the project, whose work is considered to have a significant impact on safety. Audits and evaluations focus on the management systems of the organisation concerned, in particular the operation of the organisation and resource management, competence management, quality management procedures, management of deviations and the security of information systems.

4.4.3 Operating licence

Once the nuclear facility has been completed, an operating licence in accordance with the Nuclear Energy Act must be applied for. The operating licence is granted for a fixed period of time. The operating licence for a nuclear facility is applied for from the Government by means of a written application.

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YVL A.1 contains more detailed information about the documents to be submitted to STUK in connection with the operating licence application.

4.4.4 Decommissioning licence

As the end of the operating life of the nuclear facility approaches, the operating licence holder must initiate measures for the decommissioning of the facility and apply for a licence for it. The licence must be applied for early enough to allow the authorities time to assess the application before the nuclear facility's operating licence expires.

4.4.5 Other permits

The operation of an SMR plant may also require other permits in accordance with the Nuclear Energy Act, which STUK issues upon application. Such permits include, for example, those related to the possession, manufacture, production, transfer, handling, use, storage, transport and import of nuclear materials and nuclear waste, as provided for in the Nuclear Energy Decree 161/1988.

The project may possibly also require an application for an export licence for dual-use products from the Ministry for Foreign Affairs.

The Nuclear Energy Act also requires that the applicant has control of the area required for the use of nuclear energy.

4.5 Permits required for the transport of radioactive substances

The Act on the Transport of Dangerous Goods (541/2023), the Nuclear Energy Act (990/1987) and the Radiation Act (859/2018) regulate the transport of radioactive waste. An approval in accordance with the Nuclear Energy Act is required for the transport of nuclear fuel and nuclear waste. The permit authority is STUK.

4.6 Permits under the Radiation Act

In accordance with the Radiation Act (859/2018), radiation operations other than the use of nuclear energy require a safety authorisation issued by STUK. This may apply, for example, to radiation sources and X-ray equipment used in radiochemical analyses carried out in the plant's laboratory, in the inspection of materials and structures, and in the calibration of equipment.

4.7 Building Act and Land Use Act

4.7.1 Local detailed plan required for the project

There are no areas within or around the Hepomäki plant area that are covered by a local detailed plan or a shoreline detailed plan. The City of Kuopio is preparing a local detailed plan for the area. The planning proceeds in parallel with the EIA procedure.

A local detailed plan is in force for the Sorsasalo plant area, and it came into force in 2016 (see chapter 7.1.4.2). The City of Kuopio is preparing an amendment to the local detailed plan for the area. The amendment to the local detailed plan proceeds in parallel with the EIA procedure.

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4.7.2 Construction permit

A construction permit in accordance with the Building Act (RakL 751/2023) is required for the buildings of the SMR plant. The construction permit is applied for from the municipal (Kuopio in this case) building supervision authority.

4.8 Environmental permit

A SMR plant is treated as a nuclear power plant, and its operation requires an environmental permit under the Environmental Protection Act (527/2014) (Annex 1, Activities subject to a permit, Table 2, Other installations, Section 3, Energy production, b) nuclear power plants). Emergency diesel generators may also require an environmental permit, with the permit requirement based on their total fuel power.

The permit authority is the Finnish Supervisory Agency.

During the construction phase of the project, an environmental permit is likely to be required for the following activities:

- Excavating and crushing of aggregate: According to Annex 1, Table 2, Section 7c of the Environmental Protection Act 527/2014, if the quarried aggregate is crushed in the same area for at least 50 days, the crushing operation requires an environmental permit. The permit is usually applied for from the municipal environmental protection authority. If the crushing lasts less than 50 days, this can be done with a notification in accordance with Section 118 of the Environmental Protection Act (temporary activity causing noise and vibration).
- Noise and vibration: According to Section 118 of the Environmental Protection Act 527/2014, the operator must submit a written notification (so-called noise notification) to the municipal environmental protection authority for temporary activities that cause noise and vibration (e.g. excavation work in the construction phase).
- Concrete plant: It is possible that the project requires a fixed concrete plant. A fixed concrete plant is an installation located permanently, or for at least two months, at a particular site. Fixed concrete manufacturing plants and concrete products plants are activities to be registered in accordance with Annex 2, Section 8 of the Environmental Protection Act. A registration notification of the operation must be submitted to the municipal environmental protection authority. The concrete plant and the concrete products plant to be registered must meet the requirements of the Government Decree (858/2018). A new concrete plant may require an application for a construction permit.
- Soil placement: If the soil resulting from construction activities is placed in a final disposal area, it requires an environmental permit for a new landfill site or a change of permit for an existing landfill site. According to Environmental Protection Decree 713/2014, an environmental permit is required for a landfill designed for an annual waste volume of less than 50,000 tonnes (Section 2, item 12 a). The permit authority is the municipal environmental protection authority. If the amount of soil to be placed on a landfill exceeds 50,000 tonnes per year, the permit authority is the Finnish Supervisory Agency (Environmental Protection Decree, Section 1, items 13(e) and 13(f)). It should be noted that if the annual amount of soil to be deposited exceeds 50,000 tonnes, the EIA procedure must be carried out in the soil filling area (Act on the Environmental Impact Assessment Procedure 252/2017, Annex 1, Section 11, item b).

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4.9 A permit under the Water Act

The Water Act (587/2011) provides for whether or not water resources management projects are subject to a permit or not. A water resources management project means an operation or the use of a structure on water or land areas that may affect surface water or groundwater, the aquatic environment, water management or the use of a water area. The operations described in Chapter 3 (Sections 2 and 3) of the Water Act require a water permit. A permit in accordance with the Water Act is always required for dredging when the quantity of dredged material exceeds 500 m^3.

The permit authority for permits under the Water Act is the Finnish Supervisory Agency.

In this project, it is likely that a water permit will be required for the construction of the district heating transmission connection in the Sorsasalo project option, as the district heating transmission connection crosses several inland waterways. It is also possible that a water permit is required for the dredging works of the district heating transmission connection in Kallavesi. In accordance with the instructions of the Ministry of the Environment's dredging and dumping guide (2015), the dredged material is placed on suitable land and treated appropriately.

4.10 Permits and documents in accordance with the Chemicals Act

Plants engaged in the large-scale industrial processing and storage of chemicals require a permit issued by Tukes. The extent of industrial processing and storage of chemicals is determined on the basis of the amount and hazard of chemicals stored at the plant. In smaller-scale operations, the processing of the chemical permit is the responsibility of the local fire and rescue service. Conditions are set in the permit for the operation and a commissioning inspection is carried out at the plant after the permit has been issued.

The following laws and regulations may apply to the project:

- Act on the Safe Handling and Storage of Dangerous Chemicals and Explosives (390/2005, the so-called Chemical Safety Act)
- Government Decree on the Monitoring of the Handling and Storage of Dangerous Chemicals (685/2015)
- Government Decree on Safety Requirements for Industrial Handling and Storage of Dangerous Chemicals (856/2012)
- Chemicals Act (599/2013)

4.11 Permits and agreements required for connection to the district heating, water and sewerage network

Installation of district heating, water and sewer pipes in the ground generally requires permission from the property owner. The municipal building supervision authority is entitled to decide on the placement if the matter has not been agreed with the owner or holder of the property. When deciding on placement, attention must be paid to not causing significant inconvenience to the use of the property (Section 131 of the Building Act). The placement of a cable, pipe, power line or other similar structure on the road area of a public road requires a permit issued by the Economic Development Centre of Inland Finland.

The discharge of wastewater into the city's sewage network must be covered by an industrial wastewater agreement with Kuopion Vesi. The agreement defines the conditions for wastewater management and quality monitoring, and its purpose is to prevent damage

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caused by wastewater to the wastewater treatment plant, the quality of wastewater and sludge, and the environment.

4.12 A crossing permit

A crossing permit applies to placements under a railway track, alongside the track, or otherwise in an area owned by the Finnish Transport Infrastructure Agency. Crossing refers to wires, pipes or cables located in a railway area. The crossing goes over or under a track, or runs through a railway area or other structures (such as road bridges or underpasses, cable ducts, etc.). The permit is granted by the Finnish Transport Infrastructure Agency. A crossing permit is likely to be needed in the Hepomäki area as the new road and district heating connections pass under the railway.

4.13 Other permits, agreements and plans that may be required

4.13.1 Aviation obstacle permission

According to Section 158 of the Aviation Act (864/2014), a permission from the Finnish Transport and Communications Agency Traficom is required for erecting a device, building, structure or marker of a specified height (30 metres or more), if the obstacle is located within 45 kilometres of the airport reference point referred to in Section 75.

The Sorsasalo project area is located approximately 6.5 kilometres and the Hepomäki project area approximately 22 kilometres from Kuopio Airport. An aviation obstruction permission is required due to the SMR plant's ventilation chimney, as its height is about 40 metres.

The potential need for a no-fly zone is investigated and presented in the assessment report.

4.13.2 Permits for deviations from the Nature Conservation Act

The Nature Conservation Act (9/2023) contains several prohibitions related to the protection of areas or species, and it is possible to apply for a permission to deviate from them in some cases (Environmental administration's online service 2024a, permits and notifications).

If the implementation of the project adversely affects species under strict protection, protected species or species listed in Annex IV(a) of the Habitats Directive (92/43/EEC), an application for a deviation permit under the Nature Conservation Act must be submitted.

Under Section 74 of the Nature Conservation Act, species whose existence has been threatened or where protection has otherwise proved necessary are protected. Picking or destroying protected plants or parts thereof is prohibited.

Under Section 77 of the Nature Conservation Act, it is forbidden to destroy or otherwise impair a site that is important for the survival of a species under strict protection. The prohibition is in force after the ELY Centre (from 1.1.2026 onward the Finnish Supervisory Agency) has made and notified a decision on the boundaries of the area. Species under strict protection are those endangered species where there is an obvious threat of their extinction. The species can be found in Annex 6 of the Nature Conservation Decree. The Finnish Supervisory Agency may grant a permit to deviate from the conservation provisions concerning a plant species or a prohibition related to a species under strict protection, provided that the species' conservation status remains favourable.

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Under Section 78 of the Nature Conservation Act, the destruction and deterioration of breeding sites and resting places for animal species listed in Annex IV (a) of the Habitats Directive is prohibited. The prohibition applies to all breeding sites and resting places without a separate decision being made. The Finnish Supervisory Agency may grant an exemption from the prohibition only on strictly defined grounds as set out in Article 16 (1) of the Habitats Directive.

A deviation permit may be required due to the Siberian flying squirrel in the vicinity of the project areas.

4.13.3 Natura assessment

Section 35 of the Nature Conservation Act (9/2023) provides that if a project or plan, alone or in combination with others, is likely to significantly deteriorate the natural values of an area included in the Natura 2000 network for the protection of which the area was included in the network, the project implementer or the plan author must assess these impacts in an appropriate manner.

4.13.4 A permit to interfere with a fixed relic

Ancient relics are protected by the Antiquities Act (295/1963). Without the permission granted under the Antiquities Act (Section 11), any interference with a fixed relic, such as digging, covering, altering, damaging and removing, is prohibited. The Finnish Heritage Agency may grant a permit to interfere with a fixed relic if the relic causes unreasonable harm or detriment relative to its significance. The permit to interfere must be applied for from the Finnish Heritage Agency by submitting a written application.

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5 EIA PROCEDURE

5.1 The need for the EIA procedure and the parties

The environmental impact assessment procedure (EIA procedure) is regulated by the EIA Act (252/2017) and Decree (277/2017). The EIA procedure is applied to projects and their modifications that are likely to have significant environmental impacts.

Depending on the type and size of the project, the EIA procedure is applied either directly, based on projects listed in the EIA Decree, or a decision on a case-by-case basis. In this project, the EIA procedure is applied on the basis of Section 3(1) of the EIA Act and Annex 1, item 7 b (nuclear power plants).

The key parties in the EIA procedure are the **party responsible for the project**, which is Kuopion Energia Oy in this project, and the **competent authority**, in this case the Ministry of Economic Affairs and Employment.

The other parties to the EIA procedure are:

- other authorities
- those whose circumstances or interests may be affected by the project, and
- communities and foundations whose fields of activity may be affected by the project's impacts.

The parties to this EIA procedure are listed in the figure below (Figure 5-1). The group entitled to participate is wide, and practically everyone interested in the project and the EIA procedure can do so by giving opinions and attending public events (Pölönen and Perho 2018).

One of the parties is AFRY Finland Oy, which prepared the EIA programme as a consultant. Its EIA team is presented in the table (Table 1-1).

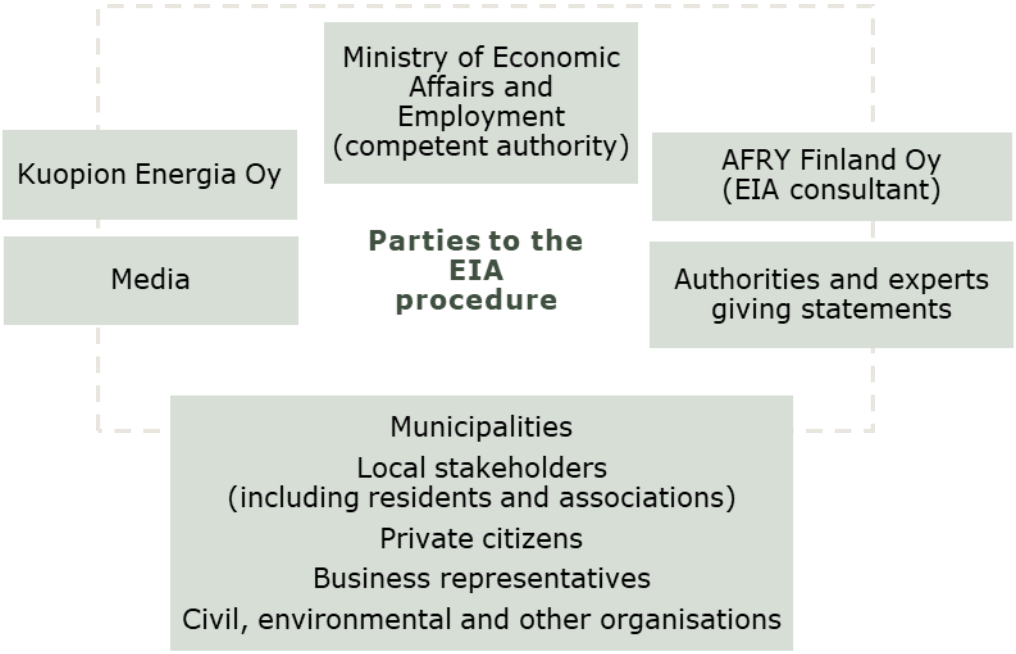

Figure 5-1. Participants in the EIA procedure.

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5.2 The objective, content and phases of the EIA procedure

5.2.1 General

The objective of the EIA Act is to promote environmental impact assessment and the uniform consideration of the assessment in planning and decision-making. At the same time, the objective is to improve access to information and participation opportunities for all stakeholders.

The environmental impacts of the project must be assessed in the statutory EIA procedure at the earliest possible phase of project planning, when the options are still open. The EIA procedure does not involve making decisions on the project, but it is a prerequisite for subsequent decision-making. It is therefore provided that the authorities may not grant permits for the implementation of the project, or make other comparable decisions, before the EIA procedure has been completed.

The EIA procedure is an open process, and one of its objectives is to improve access to information and participation opportunities for all stakeholders. Participation in the EIA procedure refers to the interaction between the party responsible for the project, the competent authority, other authorities and those whose circumstances or interests may be affected by the project, as well as communities and foundations whose fields of activity may be affected, in the environmental impact assessment. Participation includes, for example, providing information, consulting, expressing opinions and positions, and giving statements during the procedure (Pölönen and Perho 2018).

The key phases of the EIA procedure are shown in the figure below (Figure 5-2) and in the following chapters 5.2.2–5.2.5.

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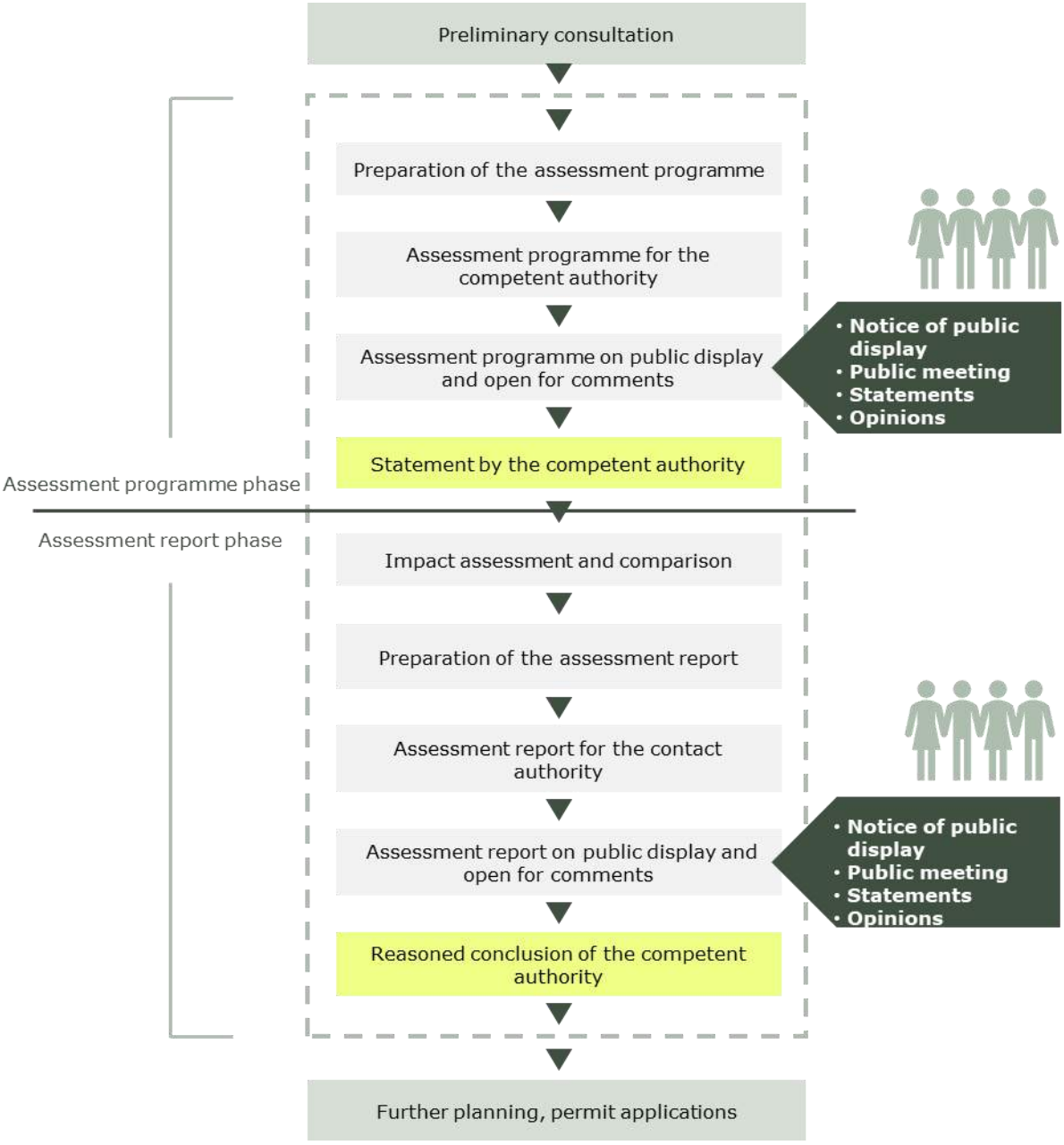

Figure 5-2. Phases of the EIA procedure.

5.2.2 Preliminary consultation

Prior to the start of the EIA procedure or during the procedure, a preliminary consultation can be arranged in cooperation with the party responsible for the project and key authorities. The aim of the preliminary consultation is to promote the overall management of the evaluation, planning and permit procedures required by the project, to facilitate the exchange of information between the party responsible for the project and the authorities, and to improve the quality and usability of surveys and documents, as well as to streamline these procedures.

In this project, the preliminary consultation was held on 25 November 2025. In addition to the competent authority, the party responsible for the project and the EIA consultant, representatives of the authorities from the Regional State Administrative Agency for Eastern Finland, the North Savo ELY Centre, the City of Kuopio (city planning and

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environmental protection), the Finnish Environment Institute and the Radiation and Nuclear Safety Authority participated in the preliminary consultation.

5.2.3 EIA programme

In the first phase of the EIA procedure, an environmental impact assessment programme (EIA programme) is drawn up, which is a plan (work programme) for the organisation of the EIA procedure and the surveys required for it.

This EIA programme provides the following information:

- Description of the project, its purpose, design phase, location, size, land-use needs and the project's connection to other projects.
- Information on the person responsible for the project, as well as an assessment of the project's planning and implementation schedule.
- Project implementation options and the zero option. In principle, solutions that would cause as little disruption as possible, while being operationally and economically viable and feasible based on preliminary assessments, have been sought as the implementation options for this project.
- Information on the plans and permits required for the implementation of the project.
- Description of the current state and development of the environment in the likely impact area.
- Proposal on identified environmental impacts and those that should be assessed (including cumulative impacts with other projects).
- Information on the prepared and planned surveys on environmental impacts, as well as on the methods used in the acquisition and evaluation of the material and the related assumptions.
- Information on the competence of the authors of the assessment programme.
- A plan for organising the assessment procedure and related participation, as well as their connection to the planning of the project.

The EIA procedure is officially started when the EIA programme is submitted to the competent authority. The competent authority informs about the start of the EIA procedure and the public display of the EIA programme electronically on its own website and in the municipalities likely to be affected by the project.

The public display period starts on the date of publication of the notice and lasts for 30 days (for a special reason, up to 60 days). In this EIA procedure, the duration of the EIA programme is likely to be 60 days, as the project is subject to an international consultation in accordance with the Espoo Convention.

During the public notice period, the authorities, local residents and other parties concerned may submit statements and opinions on the EIA programme to the competent authority. The competent authority requests statements on the programme from various authorities. An international consultation will take place in parallel with the national consultation procedure. The competent authority compiles all the statements and opinions submitted on the EIA programme and issues its own statement on the basis of them to the person responsible for the project within one month of the end of the public display period.

5.2.4 EIA report

In the next phase of the EIA procedure, an environmental impact assessment report (EIA report) is prepared on the basis of the EIA programme and the competent authority's statement on it. The EIA report must describe how the competent authority's statement on the EIA programme has been taken into account in the report. The EIA report presents,

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among other things, a description of the project, the current state of the environment, the likely significant environmental impacts of the project and its options, mitigation of the impacts, monitoring and comparison of the options, as well as information on the implementation of the EIA procedure and a simplified summary.

A public notice of the EIA report will be issued in the same manner as for the EIA programme, and during the public display period of the EIA report, an international consultation will be carried out in parallel with the national consultation with those parties to the Espoo Convention that have announced their participation in the assessment procedure. The assessment report will be available for a minimum of 30 days and a maximum of 60 days. On the basis of the EIA report and the statements and opinions submitted during both the national and international consultation procedures, the competent authority prepares its reasoned conclusion on the significant environmental impacts of the project.

5.2.5 Reasoned conclusion

The competent authority reviews the appropriateness of the environmental impact assessment report and then draws up its reasoned conclusion on the significant environmental impacts of the project on the basis of the EIA report within two months of the end of the public notice period. The reasoned conclusion summarises the other statements and opinions given on the EIA report.

The competent authority is responsible for communicating the conclusion.

The permit application for the project must include the EIA report and the reasoned conclusion.

5.3 Time schedule of the EIA procedure

The preliminary schedule for the EIA procedure is shown in the figure below (Figure 5-3). The EIA programme was completed in March 2026, and the competent authority's statement on it is expected to be issued in June 2026. The preparation of the EIA report begins immediately after the programme phase. The aim is to complete the EIA report by the end of 2026 and the EIA procedure in spring 2027. The schedule may change, for example, due to the consultation procedure.

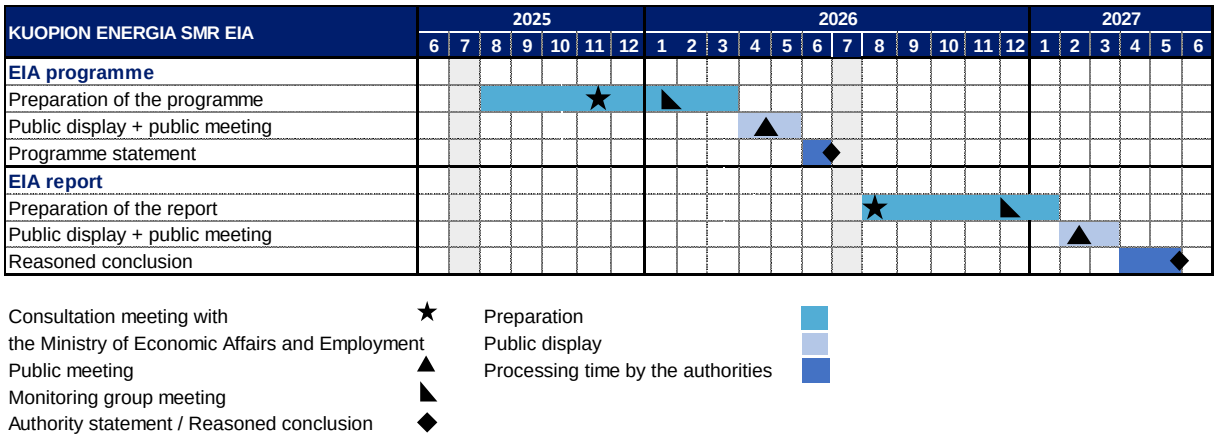

Figure 5-3. A preliminary assessment of the schedule of the project's EIA procedure.

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5.4 Participation, interaction and communication

5.4.1 Public notice and display

The EIA programme is submitted to the Ministry of Economic Affairs and Employment, which acts as the competent authority, and the Ministry announces the EIA programme by publishing a public notice on its website (see chapter 5.2.3). The public notice states where the EIA programme can be viewed in municipalities and by when the statements and opinions concerning the programme must be submitted.

During the public notice period, local residents and other parties concerned may give their opinions on the EIA programme to the competent authority. Opinions may concern, for example, the need for a survey of the project's impact assessment and whether the information and plans presented in the EIA programme are sufficient. In addition, the competent authority requests statements on the programme from various authorities. The competent authority compiles the opinions and statements given on the programme and issues its own statement on the basis of them to the person responsible for the project within one month of the end of the public display period.

In due course, a public notice will be given of the EIA report in the same way as of the EIA programme, and during the public notice period, local residents and other interested parties may give their opinions on the EIA report to the competent authority (see chapter 5.2.4).

5.4.2 Communication and participation

5.4.2.1 Monitoring group work

A monitoring group consisting of public authorities and non-profit associations has been set up to monitor and guide the EIA procedure. The composition of the monitoring group is presented below. AFRY Finland Oy acts as convener of the monitoring group.

The purpose of the monitoring group is, among other things, to obtain information and views from various parties and to ensure that the information used during the work is up-to-date and as comprehensive as possible. The monitoring group oversees the progress of the environmental impact assessment and provides opinions on the preparation of the environmental impact assessment programme and report and supporting surveys.

Parties invited to the monitoring group:

City of Kuopio

City of Iisalmi

Municipality of Juuka

Municipality of Kaavi

Municipality of Lapinlahti

Municipality of Leppävirta

Municipality of Pielavesi

Municipality of Rautavaara

Municipality of Siilinjärvi

City of Suonenjoki

Municipality of Tervo

Municipality of Tuusniemi

Ministry of Economic Affairs and Employment

Finnish Supervisory Agency

Economic Development Centre of Eastern Finland

Radiation and Nuclear Safety Authority

Finnish Environment Institute

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Kuopio Cultural History Museum	Haminalahden nuorisoseura/kyläyhdistys
Regional Council of Pohjois-Savo	Kettulanlahden asukastoimikunta
Rescue Department of North Savo	Kuopion Luonnon Ystäväin Yhdistys ry
Finnish Safety and Chemicals Agency	Kuopion talviuimarit ry
Traficom	Lintuyhdistys Kuikka ry
Finnish Transport Infrastructure Agency	Siilinjärven luonnonsuojeluyhdistys ry
Finnish Defence Forces	North Savo Nature Conservation District
Natural Resources Institute Finland	Savo-Karjalan Luontoliitto
National Emergency Supply Agency	Savo-Karjalan Vesiensuojeluyhdistys ry
Kallavesi fisheries area	Päivärannan Asukasyhdistys ry
Pohjois-Savon Kalatalouskeskus ry	Päivärannan siirtolapuutarhayhdistys
Kuopion Vesi Oy	Ranta-Toivala – Uuhimäki kyläyhdistys ry
Kuopion Sähköverkko Oy	Vuorelan kylätoimikunta
Savon Voima Verkko Oy	Wanhan Haapaniemen asukasyhdistys
Mondi Powerflute Oy	Business Kuopio
NG Nordic Finland Oy	GTK
Jätekukko Oy	Fortum Power and Heat Oy
Rudus Oy	Teollisuuden Voima Oy
Etelä-Siilinjärven asukasyhdistys	Posiva Oy

The monitoring group met for the first time on 20 January 2026. In the meeting, the input data for the impact assessment, the commercial readiness of SMR plants designed for the production of district heating, and the selection of the plant sites involved in the EIA procedure were discussed, among other things.

The monitoring group will meet for the second time during the EIA reporting phase.

5.4.2.2 Information and discussion sessions for the public

During the EIA procedure, two information and discussion sessions are organised, which are open to all interested parties. The public events are convened by the Ministry of Economic Affairs and Employment, the competent authority, and they will be announced on the EIA website.

The first public event will be held during the public display period of the EIA programme. The project and the EIA programme will be presented at the meeting, and the public will have the opportunity to express their views and ask questions.

An information and discussion session on the environmental impact assessment report will be held after the assessment report has been completed. The results of the environmental

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impact assessment will be presented at the event. The public will have the opportunity to express their views on the environmental impact assessment work carried out and whether or not it is adequate.

5.4.2.3 Stakeholder events

Kuopion Energia wants to respond to the information needs of stakeholders. In spring 2025, the company organised an invitation-only event to provide background on the SMR project for the media and selected stakeholders (such as civil servants and municipal decision-makers). An open information event for Kuopio residents was held at the company's office building in September 2025. The events will continue regularly as the project progresses, several times a year. The company also welcomes invitations from stakeholders to come and present the project. Kuopion Energia has participated, for example, in the City of Kuopio's events, presented the project to teachers in the field and at the event of Haminalahden kyläyhdistys (Haminalahti village association). A separate event for the rescue authorities is also planned for spring 2026.

5.4.2.4 Opinion surveys for residents

In 2025, Kuopion Energia conducted an opinion survey aimed at residents of Kuopio and the surrounding areas, which showed the respondents' attitudes towards SMR plants. The survey will be repeated annually during the EIA procedure. The survey raises residents' awareness of the project and its impacts, and provides important information about their opinions and perspectives.

5.4.3 Other communication

The project and its environmental impact assessment are communicated through the Ministry of Economic Affairs and Employment's internet pages.

Kuopion Energia provides information on the progress and environmental impact assessment of the project on its website [https://www.kuopionenergia.fi/vastuullisuus/pienydinvoima/]. The website has a background on the project's EIA and permit procedures, a link to the EIA materials on the competent authority's website, and a feedback channel for citizens.

However, official feedback on the EIA procedure must be submitted directly to the competent authority.

Information about the project and its environmental impacts will be communicated regularly as the project progresses. Local customers and stakeholders are informed especially through the newsletter and the Sähköviesti customer magazine. Information is also shared via social media channels, press releases, media coverage, various information events and materials, as well as presentations both locally and nationally. Paid advertising can also be used.

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6 DESCRIPTION OF THE ASSESSMENT WORK

6.1 Assessed impacts

Environmental impacts refer to the direct and indirect impacts of the project on the environment. In accordance with Section 2 of the EIA Act, the assessment examines the environmental impacts caused by the project on:

- The population and people's health, living conditions and comfort
- Land, soil, water, air, climate, vegetation, organisms and biodiversity
- Urban structure, material assets, landscape, cityscape and cultural heritage
- Exploitation of natural resources, and
- Interactions between these factors.

The environmental impact assessment is targeted at the likely significant environmental impacts of the project. Based on preliminary assessments, the main impact categories identified for this project are:

- Impacts on the aquatic environment during construction of the district heating transmission line (project option VE2)
- Impacts on nature during construction
- Impacts on people's living conditions, comfort and health
- Impacts on climate (positive impact)

The assessment considers impacts during construction and operation, as well as impacts arising after the end of operations. The impacts of the non-implementation of the project are also assessed (zero option). The assessment also highlights the uncertainties related to the assessment and the measures to prevent and mitigate adverse impacts.

The impact assessment is carried out in the form of expert assessments. The assessment work is based on existing and publicly available materials, as well as on surveys and models carried out as part of the assessment work (see chapter 6.3).

6.2 Limitations of the assessment and impact areas

The environmental impact assessment examines impacts both within the project area and beyond it. The assessment area refers to the area defined for each type of impact, where the relevant environmental impact is investigated and assessed. It is defined to be so large that no significant environmental impacts can be expected to occur outside the area. The impact area refers to the area where environmental impacts are expected to occur. If it becomes evident during the assessment work that an environmental impact has a wider impact area than previously estimated, the scope of the assessment and impact areas for that impact will be redefined. Thus, the actual determination of the impact areas takes place as a result of the assessment work in the environmental impact assessment report.

Initially, the following assessment areas have been determined for environmental impacts:

- The **land use impacts** of the project are examined at different regional levels: whether the implementation of the project has an impact on the urban structure of the area, the land use of the project's activities in the vicinity, or individual sites in the immediate impact area. Correspondingly, the relationship of the project's activities to current and pending city plans and other land use plans, as well as national land use objectives, will be examined. The assessment will also make use of the computational and qualitative assessments generated in other parts of the

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assessment process (e.g. severe accident modelling, noise, nature, traffic) and the impacts will be examined regionally to the extent required by these impact assessments.

- The assessment area for **landscape and cultural environment impacts** has been initially determined to cover an area of approximately two kilometres around the project area. The impacts on valuable sites of the landscape and cultural environment are examined within a radius of 3–5 kilometres from the project area. The extent of the assessment area is based on the project's estimated visual impact area. The assessment area will be expanded if the assessment identifies significant impacts on more distant sites.
- The impacts on the **archaeological cultural heritage** are assessed on land in the area of the plant and the district heating transmission line, as well as in their vicinity (at a distance of up to 100 metres). In addition, the assessment of the impacts on the underwater cultural heritage takes into account the resuspension of sediments caused by possible dredging and installation works of the district heating transmission pipeline. The sites are taken into account from an estimated distance of about 500 metres.
- **Noise impacts** are considered to the extent that they are estimated to result from the project based on noise modelling. The assessment area for noise dispersion modelling extends to about two kilometres from the plant area. If necessary, the impact up to the identified sensitive sites or nature reserves will be considered.
- **Vibration impacts** are examined within an estimated radius of one kilometre around the project area.
- **Traffic impacts** are examined by estimating the transport volumes and primary routes leading to the plant area related to both construction and operation.
- The **air quality impacts** of the project are assessed in the project area and its vicinity.
- **Human impacts** are assessed using computational and qualitative estimates generated during other parts of the impact assessment process. The impacts on living conditions and comfort (e.g. noise, landscape, traffic) are examined regionally to the extent indicated by the project's impact assessments. Some of the social impacts (e.g. economic impacts) extend to a wider area and are assessed regionally. In addition, the results of stakeholder cooperation are used in the impact assessment.
- **Impacts on soil, bedrock and groundwater** are examined in the areas of the plant and the district heating transmission line and in their immediate vicinity, in areas to which the impacts of construction work and operations extend. Impacts on groundwater are assessed at a distance of about 500 metres.
- The **impacts on water systems** of the project will be examined for water formations and small waters, such as streams and ponds, that are in the vicinity of or in the area of the SMR plant and the district heating transmission line. The impacts on water systems are also assessed for stormwater from land.
- The impacts on **flora and fauna** are assessed in the area of the plant and the district heating transmission line and in their vicinity. The vegetation impacts are assessed within a radius of about 100–500 metres. The impacts on animals are examined more extensively. The impacts on **protected areas** located within approximately one kilometre of the project's activities and whose conservation criteria may be affected by the project are assessed.
- The assessment area of **climate impacts** ranges from municipal-level climate targets to global targets and the progression of climate change. The project area is

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examined from the perspective of climate change adaptation. The climate impacts are assessed computationally, taking into account the greenhouse gas emissions generated during the project's life cycle.
- The impacts on the **exploitation of natural resources** are examined by focusing on the resources present in the project area, whose use may be restricted, as well as those required for project implementation on a general level from the perspective of sustainable resource use.
- The assessment area of the impacts of a **severe accident** is 300 kilometres.
- The impacts of **accidents and incidents** are assessed to the extent that they are estimated to arise from the project based on any risk assessments that may be prepared.

6.3 Available input data and project-specific surveys

The environmental impact assessment is based on existing data, publicly available material and information generated during the plant's preliminary design. Various surveys have been prepared for the local detailed planning of both project areas, which are used in the EIA procedure. As part of the environmental impact assessment work related to this project, the following surveys have been carried out during the EIA programme phase to support the existing material:

- Construction feasibility study in Sorsasalo and Hepomäki (AFRY Finland Oy 2025e)
- Vegetation and habitat survey in Sorsasalo and Hepomäki (AFRY Finland Oy 2025a; Appendix 2)
- Benthic animals survey (Savo-Karjalan Ympäristötutkimus 2025b; Appendix 3)
- Aquatic vegetation survey in Lake Kallavesi (AFRY Finland Oy 2026; Appendix 4)
- Natural seismicity assessment (AFRY Finland Oy 2025g)
- Archaeological underwater inventory (Stella Maria Oy 2025; Appendix 5)

The results of these surveys have already been used in the preparation of the EIA programme.

During the EIA report phase, the following surveys will be carried out to support the environmental impact assessment work:

- Sediment sampling and contaminant analysis in Lake Kallavesi
- Siberian flying squirrel survey in Sorsasalo and Hepomäki
- Supplement to vegetation and habitat surveys in Sorsasalo and Hepomäki
- Breeding bird survey in Sorsasalo and Hepomäki
- Moor frog survey in Sorsasalo
- Scarce fritillary survey in the vicinity of the Hepomäki project area
- Noise modelling for the construction and operational phases
- Combined noise modelling (Sorsasalo)
- Illustrative images of the SMR plant
- Severe accident modelling
- Vibration survey (Hepomäki)

The results of the above-mentioned surveys are presented in the EIA report.

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6.4 Comparison of the options and assessment of the significance of impacts

The significance of environmental impacts is assessed by comparing the resilience of the environment in relation to each environmental load, taking into account the current environmental load of the area. The impact assessment uses, where applicable, the practices and tools of the so-called multi-criteria decision analysis developed in the EU's LIFE+ IMPERIA project (Marttunen et al. 2015) to evaluate the significance of impacts.

The significance of the impacts is affected by the sensitivity of the area or site, as well as the magnitude of the changes caused by the project (Figure 6-1). The sensitivity of the affected site describes the characteristics of the affected site or area. Its components include legislative guidance related to the impact (laws, programmes, guidelines, local plans), the social significance of the area or aspect, and the site's susceptibility to change. Factors affecting societal significance include, among other things, the area's recreational use and natural values, the number of people affected and the possibility of conflicts. In turn, susceptibility to change is influenced by the ability to tolerate changes and the number of sensitive sites. The magnitude of the change describes the characteristics of the change caused by the project, where the direction can be either negative or positive. The magnitude consists of the intensity and direction of the change, its regional scope and duration.

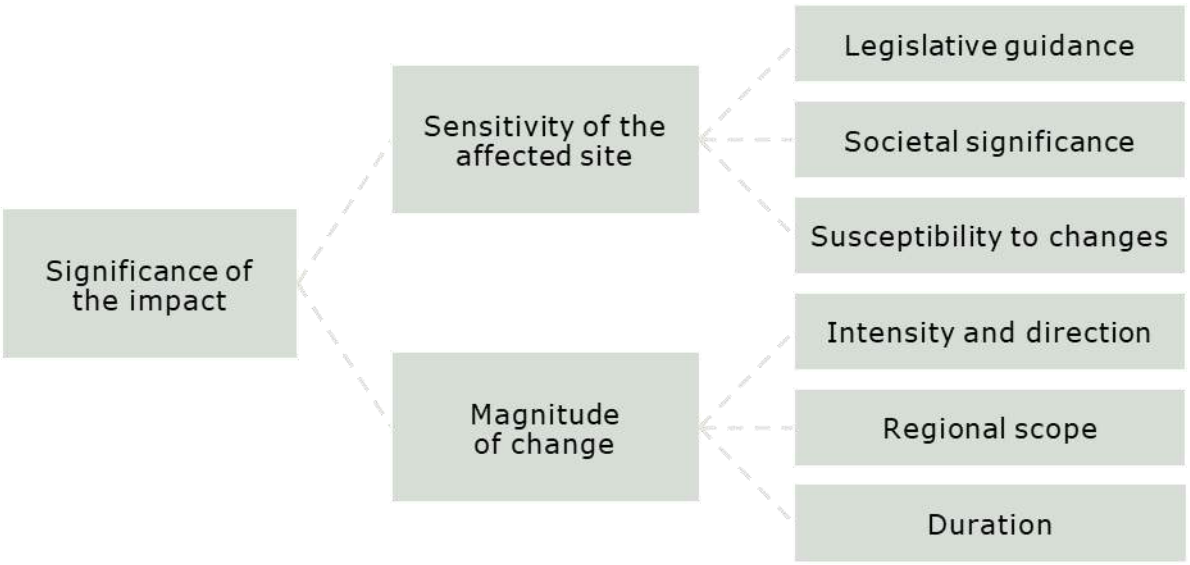

Figure 6-1. The method of assessing the significance of impacts used in the IMPERIA project (Marttunen et al. 2015).

The uniform criteria presented in the table (Table 6-1) are used to assess the significance of the impacts.

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Table 6-1. Criteria used to assess the significance for the options.

	Very high ++++	The project will cause a very clearly noticeable positive and long-term change that will have a regional impact on people's daily lives and the surrounding nature.
Significance of impacts	High +++	The project will cause a clearly noticeable positive and long-term change that will have a regional impact on people's daily lives or the surrounding nature.
	Moderate ++	The project will cause a clearly noticeable positive change that will have a local impact on people's daily lives or the surrounding nature.
	Low +	The positive change caused by the project is noticeable, but does not significantly impact people's daily activities or the surrounding nature.
	No impact	The change is so small that it is practically not noticeable and does not cause any harm or create any benefit.
	Low -	The negative change caused by the project is noticeable, but does not significantly impact people's daily activities or the surrounding nature.
	Moderate --	The project will cause a clearly noticeable negative change that will have a local impact on people's daily lives or the surrounding nature.
	High ---	The project will cause a clearly noticeable negative and long-term change that will have a regional impact on people's daily lives or the surrounding nature.
	Very high ----	The project will cause a very clearly noticeable negative and long-term change that will have a regional impact on people's daily lives or the surrounding nature.

The positive, negative and neutral environmental impacts of the project are compiled in the table for comparison. All options included in the EIA procedure are compared so that their main environmental impacts are taken into account. At the same time, the feasibility of the project is assessed on the basis of the results after the environmental impact assessment.

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7 URBAN STRUCTURE AND LAND USE

7.1 Current status

7.1.1 National land use objectives

National land use objectives are part of the land use planning system in accordance with the Land Use Act. The Government decided on the national land use objectives on 14 December 2017. The purpose of the land use objectives is, among other things, to help achieve the objectives of the Land Use Act and land use planning, the most important of which are good living environment and sustainable development. (Finnish Environment Institute 2025a)

The national land use objectives apply to projects that have significance beyond the regional level in terms of regional structure, land use, the transport network, or the energy network. According to the Land Use and Building Act, the objectives must be taken into account and their implementation must be promoted in regional planning, municipal planning and the activities of governmental authorities.

The national land use objectives are divided into five sections:

- Functional communities and sustainable mobility
- An efficient transport system
- A healthy and safe living environment
- A vibrant natural and cultural environment, as well as natural resources
- Renewable energy supply

Supporting the transition to a low-carbon society is one of the purposes of the land use objectives. Low-carbon urban development is essential for Finland to be able to meet its emission reduction commitments under the Paris Agreement. (Finnish Environment Institute 2025a)

One of the objectives of the functional communities and sustainable mobility sections is to create the prerequisites for low-carbon and resource-efficient urban development, which primarily relies on the existing structure. (Finnish Environment Institute 2025a)

The relationship of the project to the national land use objectives is described in more detail at the report phase of the environmental impact assessment.

7.1.2 Regional plans

The North Savo region is undertaking a region-wide update of the regional plan, and the North Savo regional plan 2040 is prepared in three phases: Phase 1 in 2017–2018, phase 2 in 2019–2024 and phase 3 in 2023–2026. (Regional Council of Pohjois-Savo 2025d)

The first phase, approved by the regional assembly on 19 November 2018, and the second phase, approved by the regional assembly on 17 December 2024, of the North Savo regional plan 2040 are in force in the region. The first phase came into force on 1 February 2019, and it covered the following themes: large retail units, freight terminals, marshland protection areas, fields, power transmission lines, shooting ranges, motorsport and driving training tracks, areas and protection zones of the Finnish Defence Forces, geoenergy, mining areas and protection zones at Yara Suomi Oy’s Siilinjärvi mine, the Päijänne–

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Saimaa Canal, Finnish national road 5 at the centre of Leppävirta, wind power areas that impair the work of the Finnish Defence Forces, and areas removed from peat production. (Regional Council of Pohjois-Savo 2025d)

By its decision of 24 February 2025, Section 17, the regional government ordered that the second phase regional plan of the North Savo regional plan 2040 be brought into force before it attains legal effect. The entry into force was announced on 26 February 2025. Three appeals against the second phase regional plan have been filed with the Administrative Court of Eastern Finland, and all appeals concern the theme of wind power. The second phase regional plan covers the following themes: regional structure and development principles, transport system, natural values and biodiversity, natural resources, cultural environment, energy, urban technology and technical maintenance, as well as all themes for Joroinen. The cross-cutting theme is climate change. (Regional Council of Pohjois-Savo 2025c)

When the second phase regional plan of the North Savo regional plan 2040 entered into force on 26 February 2025, it has revoked or changed some of the plan notations of the first phase regional plan and revoked the majority of the regional plan of the Kuopio region. (Regional Council of Pohjois-Savo 2025c)

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Figure 7-1. An excerpt from the unofficial combination of North Savo's regional plans from Hepomäki with project activities.

Figure 7-2. An excerpt from the unofficial combination of North Savo's regional plans from Sorsasalo with project activities.

The following plan notations and regulations have been assigned to the project areas and their surroundings in the current phased regional plans:

Plan notation	Description
	DEVELOPMENT ZONES FOR CORRIDOR 5, CORRIDOR 9 AND CORRIDOR 23 *(Hepomäki and Sorsasalo)* The notation indicates the inter-regional area development and business development zones formed by national road 5 and the Savo railway, national road 9, and national road 23 and the Pieksämäki–Varkaus–Joensuu railway, in accordance with the Decree on the Arterial Roads and Railways . *Development principle:*

	The zones are developed as viable international development and transport corridors, whose land use planning must pay special attention to the smooth and safe operation of long-distance traffic, the promotion of public transport and sustainable mobility, the promotion of transport and tourism services and business activities, and the availability of all propulsion options (AFIR Regulation). In addition, attention should be paid to the quality of the traffic environment, the reduction of traffic nuisances and the continuity of ecological connections. The development of Corridor 5 and Corridor 9 must take into account that Finnish national roads 5 and 9, as well as Savo railway are part of the comprehensive trans-European TEN-T network. The Kuopio urban region is a TEN-T urban node. Land use planning must take into account the space reservations and restrictions that air traffic, high-capacity road and rail transport, and energy and telecommunications lines impose on surrounding land use. In addition, the needs of digitalisation and traffic automation must be taken into account. Within the zones, the conditions for the development of regional rail services must be improved and secured.
	KUOPIO–SIILINJÄRVI–TAHKO TOURISM DEVELOPMENT CORRIDOR *(Hepomäki and Sorsasalo)* The notation indicates a nationally significant tourism development corridor between Kuopio, Siilinjärvi and Tahko tourist centres. *Development principle:* Networking between tourist centres and areas is developed so that functional service packages emerge. In planning the development corridor, the regional transport system required by tourism and supporting sustainable accessibility, as well as the land use planning it requires, must be taken into account.
	URBAN FUNCTIONS DEVELOPMENT ZONE *(Hepomäki and Sorsasalo)* The notation indicates the largest urban areas in the region with a diverse range of services, as well as Tahko tourism areas whose urban structure development is important for the whole region. The zone covers areas reserved for land use coordination including housing, service, industrial and workplace activities, recreation, nature conservation, as well as traffic and logistics. At the conceptual level, the notation includes room for expansion, the implementation conditions of which will be clarified during detailed planning. *Development principle:* The urban structure of the urban development zone must be developed and enhanced based on the current structure. The conditions for public transport, walking and cycling must be improved. In the more detailed planning of the zone, the distinctiveness of the areas as well as the values of the recreational, natural and cultural environment must be strengthened. The planning and construction of the zone must aim to promote local energy self-sufficiency and take into account sustainable adaptation to climate change. The availability of daily services, sufficient opportunities for outdoor and local recreation, as well as walking and cycling connections to regional

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	recreation areas must be secured. More detailed planning should promote the connection of the ecological network both inside and outside the zone. In addition, care must be taken that the project or plan, alone or in combination with other projects and plans, does not significantly weaken the natural values that are the basis of the areas belonging to the Natura 2000 network. The lower size limits for regional large retail units in the Iisalmi, Kuopio, Siilinjärvi and Varkaus regions are shown on the appendix maps of the Notes and regulations document.
	WATER TOURISM DEVELOPMENT AREA *(Sorsasalo)* Regionally significant lake areas are designated as water tourism development areas, with development needs primarily focusing on promoting lake-based activities, boating, canoeing and fishing. The development area also includes special areas that combine housing, holiday homes, tourism and recreation. *Development principle:* Ecologically and culturally sustainable use of the protected area network, valuable landscape areas and archaeological (including underwater) cultural heritage is promoted in the development of water tourism and the planning of the use of the area. In the archipelago of the national urban park in Kallavesi, sustainable accessibility must be promoted. In the archipelago, there is a need for landing points and base camps for day-trippers. *Planning provision:* In the development of water tourism in Varkaus and Joroinen, the presence of the highly endangered Saimaa ringed seal must be taken into account.
	CIRCULAR ECONOMY DEVELOPMENT AREA *(Hepomäki)* The notation indicates regionally significant circular economy development areas.
	NATURE'S CORE AREA *(Hepomäki and Sorsasalo)* The notation indicates concentrations of Natura 2000 areas and nature conservation areas, as well as other regionally significant, highly diverse natural areas and lake ecosystems. *Development principle:* The use of areas promotes biodiversity and the interconnectedness of nature conservation areas.
	ECOLOGICAL CONNECTION *(Hepomäki and Sorsasalo)* The notation indicates regionally significant ecological connections. These can be areas used for agriculture and forestry. Ecological connections link areas that possess regionally significant natural values. Ecological connection ensures opportunities for the movement and spreading of species. *Development principle:* The preservation of ecological connection is ensured by avoiding its fragmentation by other land uses so that extensive, permanent or

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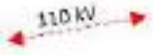
	long-lasting discontinuities do not occur. In connection with planning or with any permit-requiring measure that affects the ecological connection, measures must be taken to ensure that the regionally significant ecological connection is preserved or maintained in a way that guarantees continuity. Sustainable forestry is one way to ensure that the ecological connection is maintained.
	DIRECTION OF EXPANSION OF THE URBAN STRUCTURE *(Sorsasalo)* The notation indicates the regionally significant direction of expansion of the urban structure. *Development principle:* When planning the expansion of the urban structure, transport conditions to enable the development of new areas must be secured, and recreational and ecological connections, natural heritage and landscape values must be protected.
	NEED FOR HARMONISATION OF THE URBAN STRUCTURE *(Sorsasalo)* The notation indicates the regionally significant harmonisation needs sought for developing the urban structure and functioning rail-based public transport. *Development principle:* The area is developed as an efficiently built area for urban or city centre functions, relying on public transport and especially rail transport. Provision for park-and-ride facilities must be taken into account in the planning of the area.
	CONNECTION NEED FOR A POWER TRANSMISSION LINE *(Sorsasalo)* The notation indicates new long-term connection needs for power transmission lines, the location and implementation of which are uncertain. *Planning provision:* More detailed planning must identify the most appropriate and environmentally least harmful options for the use of the areas.
	REGIONALLY IMPORTANT AREA OR SITE FOR THE PRESERVATION OF THE CULTURAL ENVIRONMENT OR LANDSCAPE *(Sorsasalo)* The notation indicates the regionally significant areas and sites of the built cultural environment (MA, ma), as well as traditional biotopes formed by conventional agriculture and livestock farming (ma-b). The notation highlights a regionally significant cultural environment, the conservation or preservation conditions of which are decided in more detailed planning. Planning provision for MA and ma notations: When designing an area or site, the overall integrity and distinctive character of the built cultural environment must be taken into account. The special features of the area or site should be preserved. Detailed planning must pay attention to updating local detailed plans and master plans that are outdated with regard to preservation of the cultural environment . Conservative repair of buildings should be the goal also because of emission impacts.

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	URBAN CULTURAL ENVIRONMENT *(Sorsasalo)* The sites and areas of the built cultural environment located in the notation area are shown in sub-area-specific appendix maps because of the scale of the regional plan.
	NATIONAL URBAN PARK *(Sorsasalo)* The notation indicates the Kuopio national urban park area.
	AREA OF CITY CENTRE FUNCTIONS *(Sorsasalo)* The notation indicates the core areas of the centres in Iisalmi, Kuopio, Siilinjärvi and Varkaus, where centre-oriented specialist retail and administrative services, large retail units and housing are located. Large retail units of regional significance may be located in the area indicated by the notation. *Planning provision:* In planning land use, the conditions must be created to enable the development of a high-quality, attractive city centre and the location of diverse speciality retail services, and especially the placement of international, cross-regional and regional functions in Kuopio city centre. In planning, special attention should be paid to the cityscape of the area, the values of the cultural environment, accessibility, as well as the area's connection to the rest of the urban structure. When planning land use, it is advisable to combine housing, commercial premises and offices into a single whole. The urban character of the urban structure must be ensured by densifying and supplementing the existing urban structure in accordance with sustainable principles. In city centres, special attention should be paid to walking- and cycling-oriented solutions and the development of pedestrian centres. In the planning of the area, special attention should be paid to the traffic arrangements of the area and the formation of smooth trip chains from one mode of transport to another.
ej	WASTE TREATMENT AND CIRCULAR ECONOMY AREA *(Hepomäki and Sorsasalo)* The notation indicates waste treatment and circular economy areas. There is a construction restriction in force in the area in accordance with Section 33 of the MRL.
en	ENERGY SUPPLY AREA *(Sorsasalo)* The notation indicates the most significant areas of energy supply. There is a construction restriction in force in the area in accordance with Section 33 of the MRL.
eo	SOIL EXTRACTION AREA FOR THE EXTRACTION OF GRAVEL, MORAINE AND SAND AND FOR ROCK EXCAVATION *(Hepomäki)* The notation indicates the most important gravel, moraine or sand extraction areas as well as rock excavation areas for soil supply. *Planning provision:* In large or multifunctional soil extraction areas, the extraction plans should be based on a component master plan or landscape survey covering the whole area (MAL 5.1).

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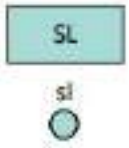
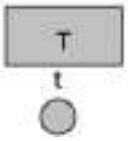
	When the extraction area is located within the ge sub-areas or is surrounded by the MY area, the area is subject to the following planning provision: The landscape values of the surrounding ridge area and the characteristic features of the ridge formation, as well as the surrounding water and cultural landscape, must be taken into account in the planning of the use of the areas. Before any extraction of soil in the area, it is necessary to contact the museum authority well in advance so that the need for an archaeological survey can be assessed. In the planning of the use of areas, care must be taken that the project or plan alone or when considered together with other projects and plans does not significantly weaken the natural values that are the basis of the areas belonging to the Natura 2000 network, within the meaning of Section 34 of the Nature Conservation Act. In planning, special attention must be paid to the impacts on the surface runoff conditions of Natura areas.
	AGRICULTURAL AND FORESTRY AREA WITH SPECIAL ENVIRONMENTAL VALUES *(Hepomäki)* The notation indicates rock and ridge areas that have landscape-related values as referred to in Section 3 of the Act on Soil Excavation. The notation also indicates valuable rock and moraine sites, sandy beaches, stony areas, serpentine cliffs, and wind and shore deposits. In addition, the notation indicates bedrock protection and educational sites. *Planning provision:* When planning the land use of the area, alongside agriculture and forestry, special attention must be paid to the landscape values of the area and the characteristic features of the ridge, moraine and rock formation, sandy beach, rocky terrain and wind and shore deposits.
	NATURE RESERVE *(Hepomäki and Sorsasalo)* The notation indicates areas designated or awaiting designation as special protection areas under the Nature Conservation Act. There is a construction restriction in force in the area in accordance with Section 33 of the MRL. *Planning provision:* No measures that weaken conservation values should be taken in areas awaiting designation as special protection areas.
	INDUSTRIAL AND STORAGE AREA OR SITE *(Hepomäki and Sorsasalo)* The notation indicates regionally significant industrial and storage areas with traffic or environmental impacts. *Planning provision:* When planning the use of the area, care must be taken to prevent significant environmental disturbances in adjacent areas. When planning the use of the area, special attention must be paid to traffic safety and the area's sustainable accessibility. Current protection distances for Seveso III sites must be checked.
	INDUSTRIAL AND STORAGE AREA OR SITE WHERE A PLANT MANUFACTURING OR STORING HAZARDOUS CHEMICALS MAY BE LOCATED *(Sorsasalo)* The notation indicates areas of the chemical industry that are significant at regional and local levels.

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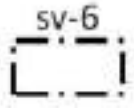
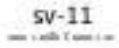
	Planning provision: Environmental risks arising from the use and storage of hazardous chemicals must be taken into account in planning the use of the area and its immediate surroundings. Current protection distances for Seveso III sites must be checked.
	Precautionary action zone for temporary military aviation aerodromes sv-6 (radius 12 km, Vieremä, Tervo, Siilinjärvi-Kuopio and Varkaus-Joroinen) *(Sorsasalo)* The notation indicates areas whose use must be restricted due to activities causing danger or significant disturbance in the vicinity. *Planning provision:* Land use restrictions arising from a temporary military aerodrome must be taken into account in the planning of the area. In the more detailed planning and licencing the area, a statement from the Finnish Defence Forces must be requested, as well as a statement in accordance with the Aviation Act on plans where a building or structure with a height of more than 30 m is allowed in the area.
	PRECAUTIONARY ACTION ZONE, sv-11 *(Hepomäki and Sorsasalo)* The notation indicates the precautionary action zones of the production plants referred to in the Seveso III Directive. Up-to-date information on precautionary action zones must be checked with the authority (TUKES). *Planning provision:* When planning the use of an area within the precautionary action zone, the risks related to the operation of the production plant with respect to major accident hazards must be assessed. Construction on the site is intended to be based on more detailed planning. When assessing the permit, particular attention must be paid to the accident risk in the area and to the safety distances required (MRA, Section 57). When planning the area's land use and considering new building permits, the fire and rescue authorities, the operator and the Finnish Safety and Chemicals Agency (TUKES) must be given the opportunity to give a statement. Statements should also be requested when considering a permit for an extension or change of use of an existing building, if the extension project or change of use significantly increases the number of persons at risk of a major accident. Activities that significantly increase the number of people exposed to the risk of a major accident, such as schools, daycare centres, hospitals, etc., must not be located in the area. Other industries or similar activities may be located in the area. Within the boundary of the precautionary action zone, all land use planning and construction in the area must take into account the possible environmental impacts of the waste treatment area.
	PORT AREA *(Sorsasalo)* The notation indicates the deep-water ports used for passenger and/or freight transport. There is a construction restriction in force in the area in accordance with Section 33 of the MRL.

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	Planning provision: In port areas, the need for an inventory of underwater relics must be determined before hydraulic engineering works that alter the seabed are carried out.
	MARINA, LOG FLOATING SITE *(Sorsasalo)* The notation indicates the most important harbours and piers used for boating, as well as the log floating sites. There is a construction restriction in force in the area in accordance with Section 33 of the MRL.
	COMBINED TRANSPORT TERMINAL *(Hepomäki)* The notation indicates the general location of the combined transport terminal in Eastern Finland. *Planning provision:* In the planning of the use of the area, care must be taken that the project or plan alone or when considered together with other projects and plans does not significantly weaken the natural values that are the basis of the Natura 2000 network areas located in or adjacent to the area, within the meaning of Section 34 of the Nature Conservation Act. The use of the area must be planned so that noise levels in urban areas near the site do not exceed 55 dBA.
	SAVO RAILWAY: DOUBLE-TRACK HIGH-SPEED MAIN RAILWAY *(Hepomäki and Sorsasalo)* The notation indicates the double-track main railway, Savo railway, to be developed in stages for high-speed train traffic, with a target speed of at least 160 km/h. The Savo railway is governed by the Decree on the Arterial Roads and Railways and part of the comprehensive trans-European TEN-T network. The notation also includes the new stops, terminals and passing places, as well as level crossing removals and the road arrangements required by them. In addition, the notation enables routing changes in the same terrain corridor. There is a construction restriction in force in the area in accordance with Section 33 of the MRL. *Planning provision:* In the planning of the use of the area, care must be taken that the project or plan when considered alone or together with other projects and plans does not significantly weaken the natural values that are the basis of the areas belonging to the Natura 2000 network, within the meaning of Section 34 of the Nature Conservation Act. In planning, special attention must be paid to the impacts on groundwater and surface runoff conditions in Natura areas and to the preservation of green corridors.
	BRANCH LINE *(Sorsasalo)* The notation indicates the dead-end tracks used by freight traffic. There is a construction restriction in force in the area in accordance with Section 33 of the MRL.
	MOTORWAY *(Sorsasalo)* Existing motorway. There is a construction restriction in force in the area in accordance with Section 33 of the MRL.

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	SHIPPING CHANNEL (draught 4.3 / 4.2 / 2.4 m) *(Sorsasalo)* The notation indicates deep-water channels as well as channels for cruise traffic and log floating.
	BOAT CHANNEL (draught 1.2 m) *(Sorsasalo)*
	CONNECTION NEED FOR A SNOWMOBILE ROUTE *(Sorsasalo)* The notation indicates the indicative existing and planned regional snowmobile trunk routes. *Planning provision:* More detailed planning of the route must be done in cooperation with different municipalities and landowners.

In addition, the currently valid phased regional plans include planning provisions covering the entire region, the most important of which for this project are:

Climate change mitigation and adaptation

Climate change mitigation and adaptation must be taken into account in all measures related to land use and traffic throughout the region. Efforts are being made to increase carbon sinks and improve carbon fixation. Ways to preserve carbon storages in peatlands should be sought, for example, in municipal climate plans.

Changes caused by the increasing frequency and intensification of extreme weather events must be planned for in land use planning. Flood, cave-in and landslide risk areas must be indicated in master and local detailed plans either as areas or as construction restrictions, especially in the central urban areas of Iisalmi, Kuopio, Varkaus and Kiuruvesi. Construction sites must not be planned in areas where there is a risk of flooding, cave-ins or landslides.

Infiltration areas must be provided for the capture and treatment of stormwater in urban areas.

Transport routes must be designed to withstand extreme weather phenomena.

Ecological status of surface waters

Measures that directly or indirectly affect water systems must aim to improve the ecological status of surface waters. The objective in the North Savo area is to raise the ecological status of surface waters to good or excellent in all water systems by 2040.

Urban areas

In the urban regions of Kuopio, Iisalmi and Varkaus, the functionality and economic efficiency of living environments must be promoted by using and harmonising the existing urban structure. The preservation of ecological connection should be promoted.

The Kuopio region should be developed as a nationally attractive, high-quality area in terms of its urban structure and cityscape, and as an integrated whole

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encompassing education, expertise, business activity, specialist retail services, and tourism and leisure services.

Energy transmission connections

When designing energy production areas, special attention must be paid to arranging energy transmission connections. The connection of adjacent energy production areas to the power transmission network must primarily take place using the existing power line corridor or a shared power line corridor and shared power pylons, in cooperation with other energy-production projects.

When designing energy transmission connections, the separate and cumulative impacts of energy transmission and production projects must be taken into account, in particular those on housing, livelihoods, landscape, birds, biodiversity, fauna and ecological links, as well as cultural heritage, and efforts must be made to prevent adverse effects.

7.1.3 Master plans

7.1.3.1 Hepomäki

The area is covered by the Hepomäki component master plan, which has been approved by the city council on 20 May 2019. The component master plan entered into force on 16 July 2019. The SMR plant area is located in an industrial and storage area (T) in accordance with the component master plan, and in an area dominated by agriculture and forestry, with environmental values and outdoor recreation (MU). In the industrial and storage area (T), the master plan regulation 136 applies, in accordance with which, pursuant to Section 43(1) of the MRL, groceries must not be located in the area. In addition, the master plan regulation 137 applies in the area, in accordance with which office premises can be located in the T, TV, TY and TY-1 areas. Also, the area is designated as a soil extraction area (eo), which is the part of the area where extraction may be permitted. When granting permission for soil extraction, it must be ensured that the area can be used for the purpose indicated in the master plan after the extraction has been completed.

On the northeast side of the industrial and storage area (T), a location route of a road has been assigned, and on its west side, the main connection for bicycle and pedestrian traffic. An industrial and storage area (T) is designated to the east of the location route of the road. In other parts, the industrial and storage area (T) is surrounded by an area dominated by agriculture and forestry, with environmental values and recreational outdoor use (MU). On the southeast side of the industrial and storage area (T), a southwest–northeast snowmobile route, an indicative outdoor route, an area of special importance for biodiversity (luo) and an area of special importance for biodiversity (luo-1), where breeding sites and resting places (e.g., those of the Siberian flying squirrel) as referred to in Section 49 of the Nature Conservation Act have been identified, have been designated. When preparing the local detailed plan, the protection of breeding sites and resting places and the possible ecological connections required for them must be taken into account. A water area (W) has been designated to the northwest of the industrial and storage area (T), and the area around it has been designated as being of particular importance for biodiversity (luo).

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The route location of the district heating pipeline follows the location routes of roads in accordance with the component master plan. The pipeline is located near the Savo railway in the outer noise zone (am-2) of the motor racing track and shooting range. To the south of the Savo railway, the road connection along which the district heating pipeline runs crosses an area of particular importance for biodiversity (luo-1), where breeding sites and resting places (e.g. those for the Siberian flying squirrel) referred to in Section 49 of the Nature Conservation Act have been identified. When preparing the local detailed plan, the protection of breeding sites and resting places and the possible ecological connections required for them must be taken into account.

The district heating pipeline is located for a small section within the Hiltulanlahti component master plan area. The component master plan was approved by the city council on 17 August 2009 and entered into force on 26 May 2012. The district heating pipeline is located in a protected green area (EV) in accordance with the component master plan, and an indicative road or street area and an outdoor route have been designated to the area. To the north of the protected green area (EV) lies the Savo railway, which has been designated as a railway-traffic area (LR). A recreation area (V) has been designated to the south of the protected green area (EV). An underpass or an overpass has been designated at the boundary between the protected green area (EV) and the recreation area (V). A nature conservation site to be protected (SL-1) has been designated on the edge of the recreation area (V) opposite the protected green area (EV), as well as an existing building that can be preserved. Renovation and minor extensions of the building, excluding new construction, may be allowed in the local detailed plan and in the processing of building permits and permits for deviations. The indicative outdoor route in the area lies within the protected zone of another archaeological cultural heritage site (s-2). Removal of historical structures and deposits located in the area is allowed only for a specific reason and after sufficient archaeological documentation. The museum authorities must be consulted when making plans for the area.

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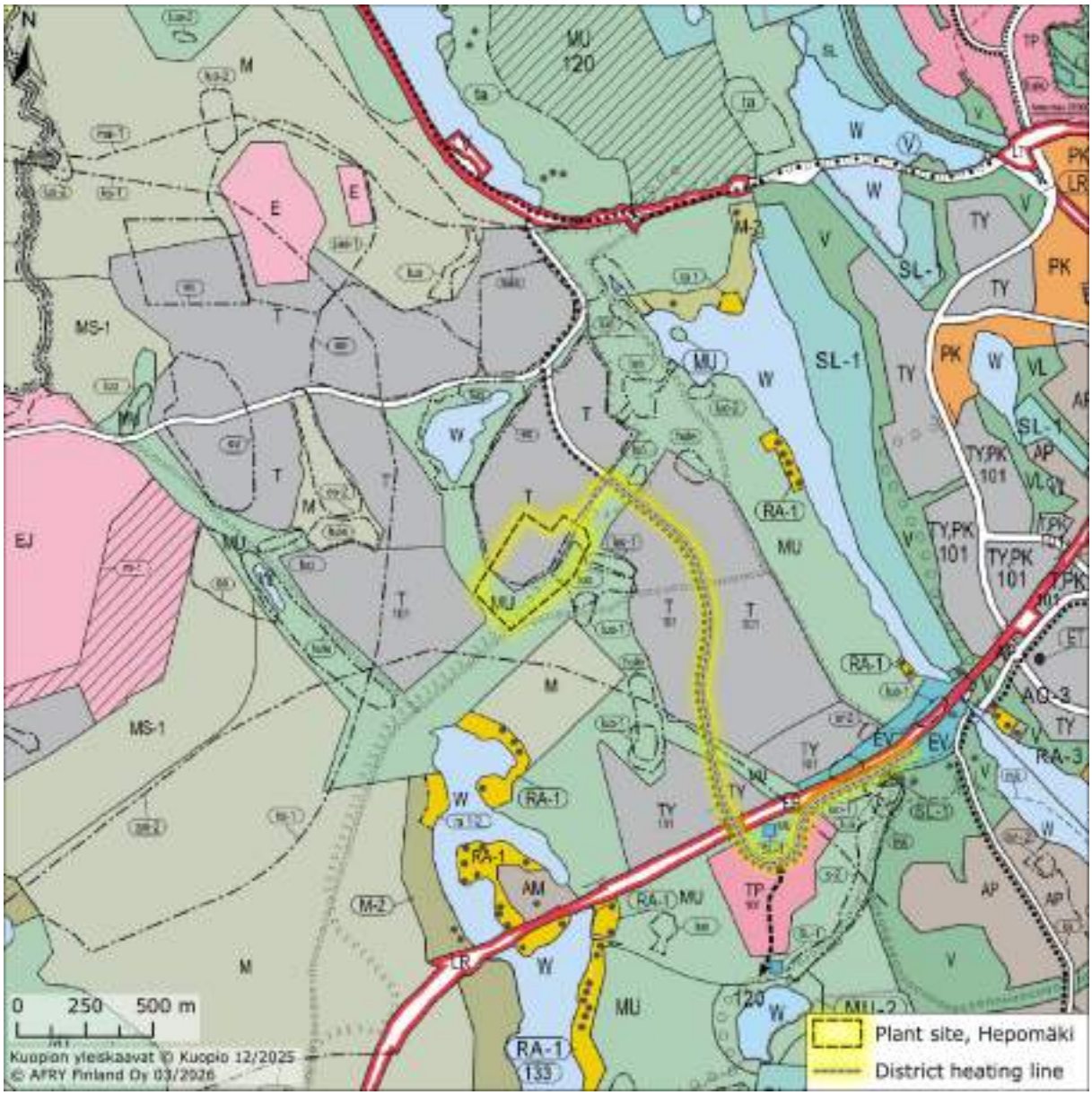

Figure 7-3. Excerpt from the up-to-date master plan of Hepomäki, showing project activities.

7.1.3.2 Sorsasalo

The master plan for the central urban area of Kuopio, approved by the city council on 11 December 2000 and entered into force on 9 October 2001, applies in Sorsasalo.

The SMR plant site has been designated in the current master plan as an industrial and storage area and as a traffic area (T, L). There are buildings marked on the area's southeast shore, and these buildings can be preserved. These construction sites are subject to the master plan regulation 221, in accordance with which renovation and minor extensions of the building, excluding new construction, may be allowed in the local detailed plan and in the processing of building permits and permits for deviations.

To the north of the SMR plant area, an industrial and storage area (T) has been designated, to which the master plan regulations 136 and 137 apply. In accordance with the master plan regulation 136, pursuant to Section 43(1) of the MRL, groceries must not be located in the area, and in accordance with the master plan regulation 137, office premises can be

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located in the T, TV, TY and TY-1 areas. In addition, an agricultural and forestry area (M), a recreation area (V) and an existing holiday home area (RA-1) have been designated to the north of the area. The recreation area (V) is subject to the master plan regulation 203, in accordance with which the recreation area is preserved as a natural outdoor and recreation area, the master plan regulation 103, in accordance with which, pursuant to Section 43(2) of the MRL, only buildings serving general recreational activities may be built in the area, and the master plan regulation 101, in accordance with which the area is subject to an action restriction in accordance with Section 128 of the MRL. The existing holiday home area (RA-1) is subject to the master plan regulation 226, in accordance with which the suitability of the existing and new building sites indicated in the master plan as sites for holiday homes has been examined on a site-by-site basis. At these building sites, construction may be permitted without a local detailed plan. In addition, the master plan regulation 133 applies in RA-1, RA-3, M-2, MU and V areas, under which the combined floor area of the building site must not exceed 120 m² of floor area. Individual buildings may be no more than 80 m² of floor area.

A water area (W) has been designated on the east side of the SMR plant area. The water area beyond and adjacent to the industrial and storage area has been designated as a water traffic area (LV). In Potkunsaari, located in front of Sorsasalo, there are designated holiday home areas and areas of special character (RA-2), which are subject to the master plan regulation 273, under which new buildings must be designed to fit into a unified villa setting. Individual buildings may be no larger than 60 m² of floor area, and the width of their gable end no more than 7 metres. The combined floor area of the construction site must not exceed 100 m² of floor area. In addition, a nature reserve (SL) and a recreation area (V) have been designated to Potkunsaari. The nature conservation area is subject to the master plan regulation 207, in accordance with which it is a protected area under the Nature Conservation Act. The recreation area (V) is subject to the master plan regulations 203, 103, 101 and 133.

An industrial and storage area (T) has been designated to the south and west of the SMR plant area. The master plan regulations 136 and 137 apply in the area. In addition, an indicative rail traffic area (LR) has been designated to the south. A soil treatment and dumping area (eo-2) has also been designated to the west, and it is subject to the master plan regulation 287. The regulation is worded as follows: *"Part of the area where the dumping and treatment of soil may be permitted. When granting permission for the dumping of soil, it must be ensured that the area can be used for the purpose indicated in the master plan after the dumping has been completed."* The master plan regulation 101 is also in force in the area.

On the northeastern shore of Virtasalmi, the master plan for the eastern shore of Kuopio is in force. It has been approved by the city council on 6 September 1993. To the coastal area of the northeastern shore of Virtasalmi, holiday residential areas (RA-1), construction sites, a nature reserve (SL), an indicative outdoor route, an agricultural and forestry area (M) and an agricultural and forestry area with holiday homes (M-2) have been designated in the current master plan. The master plan regulations 226 and 133 apply to existing holiday home areas. In accordance with the master plan regulation 226, the suitability of the existing and new building sites indicated in the master plan as sites for holiday homes has been examined on a site-by-site basis. At these building sites, construction may be permitted without a local detailed plan. In accordance with the master plan regulation 133, the combined floor area of the building site must not exceed 120 m² of floor area. Individual buildings may be no more than 80 m² of floor area. The nature conservation

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area (SL) is subject to the master plan regulation 207, in accordance with which it is a protected area under the Nature Conservation Act. The agricultural and forestry area with holiday homes (M-2) is subject to the master plan regulation 108, in accordance with which the building sites of holiday homes and the buildings themselves must be located within the construction areas indicated in the master plan. Pursuant to Section 143 of the MRL, it is laid down that buildings may not be located outside the construction area without a local detailed plan or a deviation permit.

The district heating pipeline is located in a industrial and storage area, a traffic area (T, L), an agricultural and forestry area (M), and, to a small extent, a recreation area (V), in accordance with the master plan in force in Sorsasalo. In other parts, the district heating pipeline is mainly located in the water areas (W) designated in the current master plans for Kuopio's central urban area and eastern shore. In accordance with the current master plan for Kuopio's central urban area, the route section A of the district heating pipeline in Väinölänniemi is located in a recreation area where the environment is preserved (V/s). The area is subject to the master plan regulation 146, in accordance with which the area should be planned so that the valuable features of the environment or the setting are preserved. Special attention should be paid to how new construction and alterations to existing buildings fit into the cityscape or local environment. The recreation area (V) is subject to the master plan regulation 203, in accordance with which the recreation area is preserved as a natural outdoor and recreation area, the master plan regulation 103, in accordance with which, pursuant to Section 43(2) of the MRL, only buildings serving general recreational activities may be built in the area, and the master plan regulation 101, in accordance with which the area is subject to an action restriction in accordance with Section 128 of the MRL. In addition, the master plan regulation 133 applies in RA-1, RA-3, M-2, MU and V areas, under which the combined floor area of the building site must not exceed 120 m² of floor area. Individual buildings may be no more than 80 m² of floor area. In addition, the route section crosses the indicative outdoor route and the main pedestrian and bicycle route, and lies in the immediate vicinity of a groundwater area (pv-1). The master plan regulations 237, 238 and 123 apply in the groundwater area. In accordance with the master plan regulation 237, such facilities, structures or activities that may cause changes to or contamination of groundwater must not be located in the area (VL 1:18 and 1:22). In accordance with the master plan regulation 238, when planning measures for the area, the plan for the restrictions and use of groundwater areas approved by the city government on 12 March 1990 and its specification must be taken into account. In accordance with the master plan regulation 123, the area is subject to an action restriction under Section 128 of the MRL to protect groundwater. However, a permit is not required for water supply measures. In the water area in front of the Haapaniemi district heating power plant, the pipeline is located in the water traffic area (LV) and lands in the area of the district heating power plant, which has been designated as a community management area (ET).

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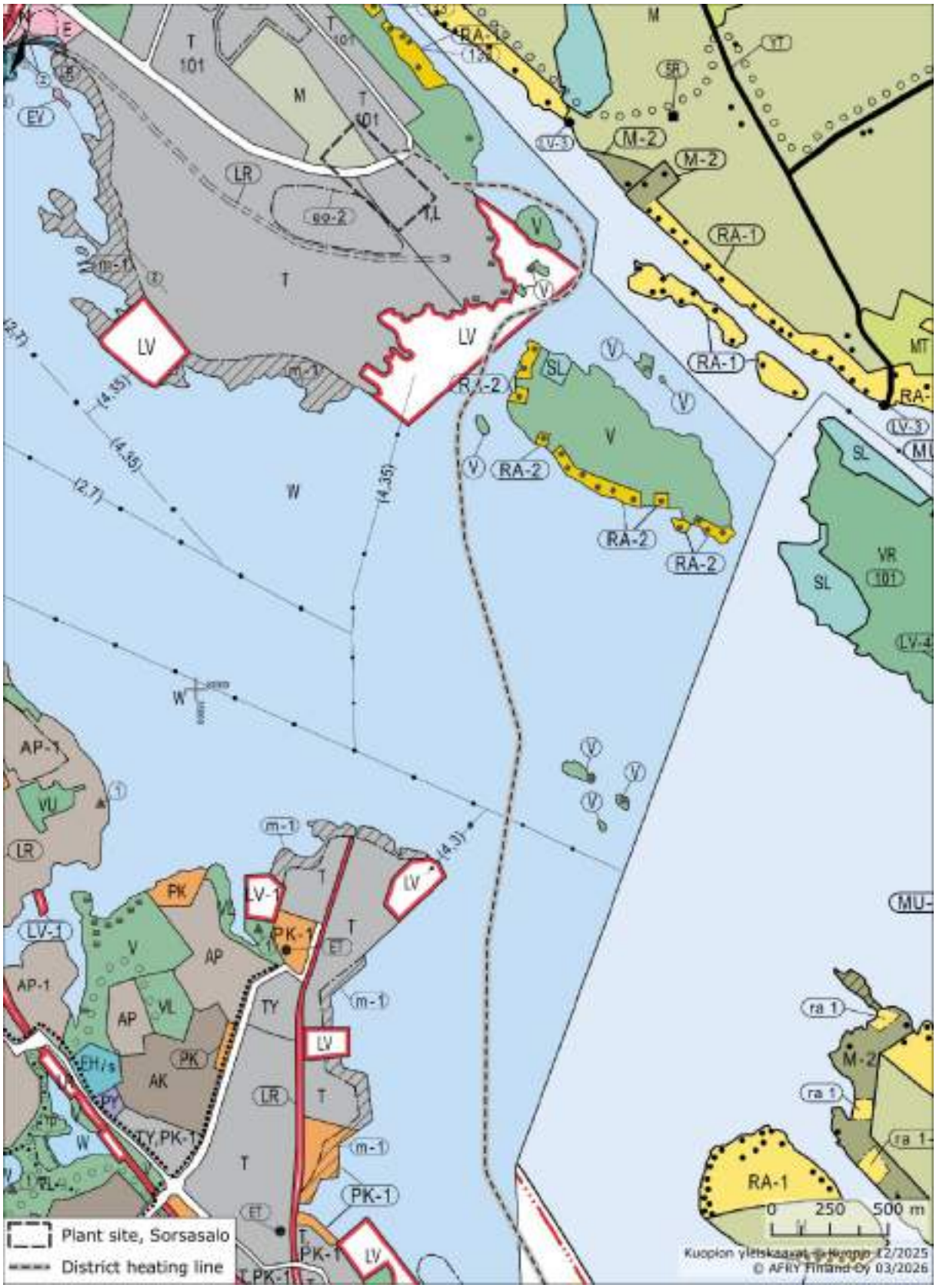

Figure 7-4. Extract from the current master plan showing the activities for the Sorsasalo project option (the SMR area and the northern part of the district heating line).

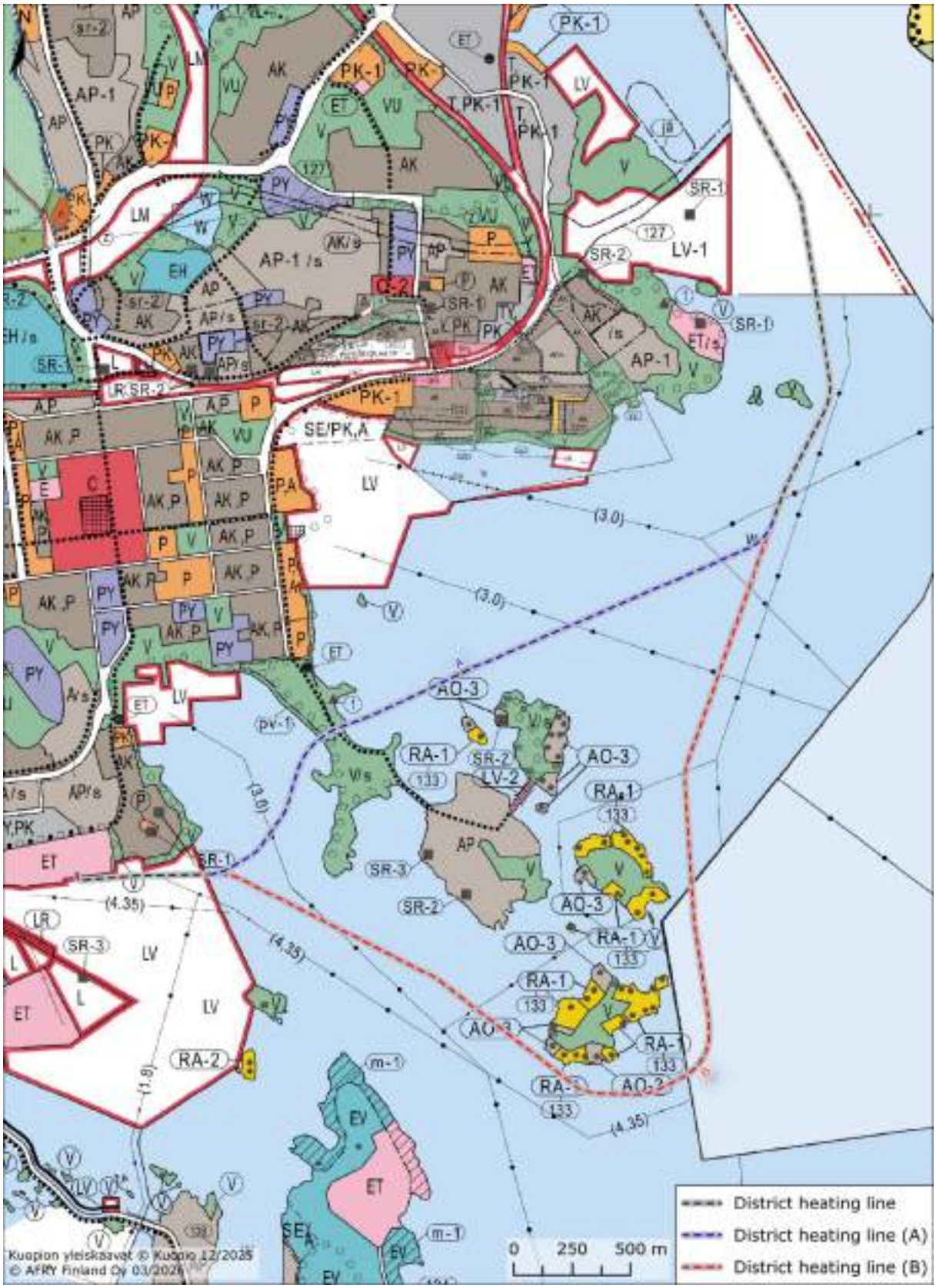

Figure 7-5. Extract from the current master plan showing the activities for the Sorsasalo project option (southern parts of the district heating line).

7.1.4 Local detailed plans

7.1.4.1 Hepomäki

There are no areas within or around the SMR plant area that are covered by a local detailed plan or a shoreline detailed plan. A local detailed planning process is underway for the area, during which the potential placement of the SMR plant will be examined (see chapter 7.1.5.1).

The district heating pipeline is mainly located in an area not covered by a local detailed plan and, to a small extent, in the area of the local detailed plan 781 south of the Savo railway. The local detailed plan has been approved by the city council on 23 May 2016 and has entered into force on 5 July 2016. The district heating pipeline is located within the street area specified by the plan. In the local detailed plan, detached housing and local services, recreation areas, areas serving community management, as well as the necessary street connections, are designated to the area.

Figure 7-6. Extract from the current local detailed plan for the district heating line south of the Savo railway.

7.1.4.2 Sorsasalo

The area is subject to the local detailed plan 787, which has been approved by the city council on 5 September 2016 and entered into force on 19 January 2018. The SMR plant area has been designated as an industrial and storage block area where a major plant

manufacturing or storing hazardous chemicals may be located (T/kem-2). The plant in question must be located in the construction area specifically allocated to it.

The planning area is subject to the sv-1 notation, the provision of which reads: *"The notation indicates the consultation zone of a production plant in line with the Seveso Directive. Activities that significantly increase the number of people exposed to the risk of a major accident, such as schools, daycare centres, hospitals, etc., must not be located in the area. Other industries or similar activities may be located in the area. Deviation permits for residential buildings may be granted for the area.*

In connection with new building permits, an opportunity to issue a statement must be reserved for the fire and rescue authority and the operator, and, if necessary, the Finnish Safety and Chemicals Agency (TUKES). Statements should also be requested when considering a permit for an extension or change of use of an existing building, if the extension project or use increases the number of persons at risk of a major accident."

The SMR plant area is located within the sma-2 area in accordance with the plan, and this area is designated as a protective forest area for industrial activity, where special attention must be paid to the protective function of the tree stand.

A revision of the local detailed plan is underway for the area, and the process includes examining the potential placement of the SMR plant in the area (see chapter 7.1.5.2).

The area north of the SMR plant is not covered by a local detailed plan.

On the western side of the SMR plant area, a section of the area has been designated for placing an embankment (me-5) as a noise and visual barrier, and a section where the vegetation must be treated so that the surface structure layers of the closed landfill area remain intact. If the area must be tampered with, it requires a permission from the environment authority (et-6), and a construction area, on which it is allowed to build an industrial waste processing and recycling centre with its final disposal areas, as well as other fields, equipment, structures and buildings required for operation (tkk-1).

To the east of the SMR plant area, an indicative access line has been designated, as well as a notation at the border of the planned area, indicating that the property on the side of the border must build a protective fence on the border. An indicative part of the area reserved for the industrial railway track has been designated to the east, south and west sides of the project area.

The district heating transmission line in Sorsasalo is located on an industrial and storage block area in accordance with the local detailed plan, where a major plant manufacturing or storing hazardous chemicals may be located (T/kem-2). In other parts, the district heating transmission line and its alternative route sections are located in the water areas of Kallavesi and at Väinölänniemi, in an area not covered by a local detailed plan. Local detailed planning work will begin in Väinölänniemi in 2026 (City of Kuopio 2025p). The local detailed plan 773 is in force for the area of the Haapaniemi district heating power plant and the adjacent waters, and it has entered into force on 9 May 2017. In the water area, the pipeline is located within a port area (LS) as per the local detailed plan, and also shipping channels have been designated to it. When it lands, the pipeline is located in the district heating plant area, which is designated in the plan as a block area for buildings and facilities serving energy production (ET-4).

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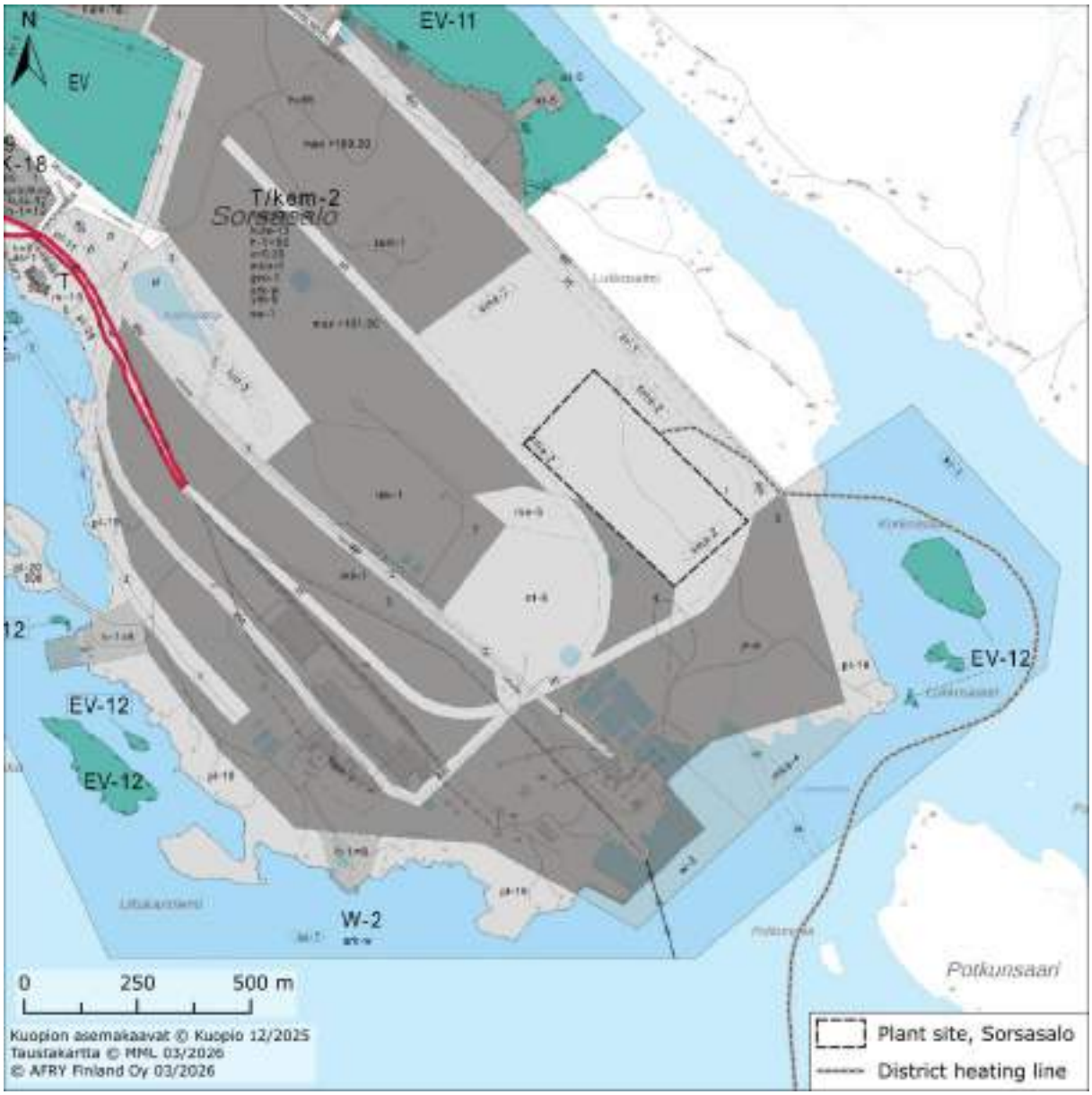

Figure 7-7. Extract from the current local detailed plan for Sorsasalo, including project activities.

Figure 7-8. Extract from the current local detailed plan for the Haapaniemi district heating power plant area, covering the district heating line and its alternative route sections.

7.1.5 Ongoing planning projects in the project area and its vicinity

7.1.5.1 Hepomäki

<u>The local detailed plan of the Hepomäki industrial area</u>

In the Hepomäki area, the local detailed plan for the Hepomäki industrial area is pending, and its participation and evaluation plan has been made available for inspection by the the Board of Urban Planning and City Infrastructure's decision on 28 May 2025 (Section 114). (City of Kuopio 2025b)

The planning project will enable the realisation of a new circular economy area and the establishment of the SMR plant for district heating in the Hepomäki area. In the context of local detailed planning, the impacts of the planning project and its relationship with, for

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example, the built environment, climate, natural habitats, people, the economy, businesses and the city's strategy are examined. (City of Kuopio 2025c)

The local detailed plan and its amendment for the Matkus business area

At its meeting on 7 May 2025 (Section 102), the Board of Urban Planning and City Infrastructure discussed the draft material for the local detailed plan and its amendment for the Matkus business area and decided to place them on public display. (City of Kuopio 2025d) The local detailed plan area is situated at its closest about 850 metres from the planned SMR plant area and approximately 400 metres from the district heating pipeline.

With the local detailed plan and its amendment, the potential removal of the undeveloped street area between the TK block areas in Kylmämäki and the potential change the use of the undeveloped LP area to a block area for industrial, storage, commercial and office buildings (TK) are examined. In the vicinity of Riihilampi, the potential change of use of the undeveloped commercial block areas (KL) into industrial, storage, retail and office block areas (TK) is examined. New industrial, storage, commercial and office building block areas (TK) are being examined in the Takaharju area. In addition, in connection with the planning work, street connections, traffic arrangements and stormwater management and treatment in the area are examined, among other things. In connection with the planning work, the necessary area reservations for community technology as well as railway, local recreation and nature conservation areas are designated to the area. (City of Kuopio 2025e)

7.1.5.2 Sorsasalo

Amendment to the local detailed plan for the Sorsasalo industrial area

In the eastern part of Sorsasalo, an amendment to the local detailed plan for the Sorsasalo industrial area is pending, and its participation and evaluation plan has been made available for inspection by the the Board of Urban Planning and City Infrastructure's decision on 28 May 2025 (Section 115). (City of Kuopio 2025f)

By amending the local detailed plan, the Sorsasalo industrial area will be developed to enable more versatile industrial activities than the unrealised Finnpulp factory project. In addition, the amendment to the local detailed plan examines the suitability of the Sorsasalo industrial area as a site for the SMR plant for district heating that could possibly replace the HPN2 power plant unit of Kuopion Energia Oy's district heating plant in Haapaniemi. New development in the area complements the industrial built environment that has developed there and partly uses the existing municipal infrastructure. New development increases traffic in the area and its surroundings. In the context of local detailed planning, the impacts of the planning project and its relationship with, for example, the built environment, climate, natural habitats, people, the economy, businesses and the city's strategy are examined. (City of Kuopio 2025g)

Component master plan for Sorsasalo

In the western part of Sorsasalo, component master plan work for Sorsasalo is pending and will not be actively prepared in 2025 or 2026. (City of Kuopio 2025h) The component master plan area is situated at its closest about 2 kilometres from the planned SMR plant area.

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The planning area covers the northernmost parts of Kuopio's central urban area up to the municipality of Siilinjärvi. The component master plan amends the 2001 master plan for the central urban area concerning Sorsasalo. The purpose of the plan is to examine the development possibilities of the Sorsasalo area in the future. In the future, the component master plan will guide the area's local detailed planning and other detailed planning. (City of Kuopio 2025h)

Component master plan for Kelloniemi

The component master plan for the Kelloniemi area has been underway since 2017. The draft plan materials were made available for inspection by the decision of the Board of Urban Planning and City Infrastructure on 7 May 2025 (Section 103) for the period from 14 May to 16 June 2025. (City of Kuopio 2025i) The component master plan area is situated at its closest about 300 metres from the district heating pipeline off the tip of Kelloniemi.

The component master plan defines the principles for housing and workplace construction and for recreation areas, the boundaries for the areas to be built, the future use of blocks and basic transport solutions. In the future, the component master plan will guide the area's local detailed planning and other detailed planning. New housing will be made possible on the eastern shore and in the area of the old meat-processing plant for about 1,000–2,000 new residents. In addition, the plan promotes the development of industrial areas into diverse areas of workplace activities, enables complementary building of existing areas, and integrates the Talasniemi area into the rest of Kelloniemi's settlement structure. The plan enables the addition of business plots and 1,000–2,000 new residents to the area through local detailed planning. The component master plan refines the master plan for Kuopio's central urban area that became legally effective in 2001. (City of Kuopio 2025j)

Component master plan for Kuopio city centre

In Kuopio city centre, component master plan work is pending and will not be actively prepared in 2025 or 2026. (City of Kuopio 2025h)

The basic objective of the component master plan work is to ensure and develop solid interaction between the activities, mobility and the environment that form the basis of the planning. The goal is to create the conditions for a balanced, functionally diverse, attractive and vibrant centre as an environment. The component master plan for the city centre is being worked on after the city centre development plan has been updated. (City of Kuopio 2025h)

7.2 Impact assessment and methodology

The land use conditions for the placement of an SMR plant are examined in accordance with the Land Use Act. Previously, the starting point for the planning of nationwide nuclear power has been based on the assumption that a large nuclear power plant will be built in an area that is by definition sparsely populated and that it is relevant from the point of view of the nation's energy policy. The implementation of a nuclear power plant project has required that the site has been allocated the necessary area reservations for nuclear power plants at all plan levels. (Finnish Energy 2021)

The Land Use Act does not separately specify the requirements related to the site of a nuclear power plant, but the conditions for placement are examined through the content requirements of the plans set at different plan levels. With regard to planning, the

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suitability of the nuclear power plant site, its dimension and the land use restrictions in its vicinity are strongly guided by the Radiation and Nuclear Safety Authority (2019) Guide YVL A.2 Site for a nuclear facility. (Finnish Energy 2021)

In February 2024, STUK's new regulation Y/2/2024 entered into force, in accordance with which standard precautionary action zones and emergency planning zones based on distance were abandoned. Nuclear power plants must continue to have a precautionary action zone and an emergency planning zone, but the zones are defined on a case-by-case basis. The precautionary action zone is defined in such a way that, in the event of an accident, there is a high probability that there will be no need to evacuate the population outside the precautionary action zone and that the necessary evacuation measures can be carried out effectively within the precautionary action zone. In order to enable efficient evacuation, restrictions on land use must be applied to the precautionary action zone. The emergency planning zone is defined in such a way that there is a high probability that there will be no need for the population to protect themselves outside the emergency planning zone in the event of an accident. (Radiation and Nuclear Safety Authority 2024)

When assessing the impacts on urban structure and land use, the project's relationship to the current and planned situation is examined. For the purpose of the assessment, information on the project area and its surrounding area is clarified regarding the current land use, existing plans and planned land use.

When assessing the impacts on urban structure and land use, the project's impacts at different regional levels are examined: whether the implementation of the project has an impact on the urban structure of the area, the land use of the area in the vicinity of the project area, or individual sites in the immediate impact area. Correspondingly, the relationship of the project to current and pending city plans and other land use plans, as well as national land use objectives, will be examined.

The land use impacts of the project can be either direct or indirect. The project area may cause changes in the environment that affect current land use or change the starting points or limiting conditions related to future land use planning. In principle, indirect impacts may arise, for example, from changes in environmental distractions. As part of the assessment, the impacts restricting the project construction are examined. The assessment takes into account how the requirements set out in the Radiation and Nuclear Safety Authority's Guide YVL A.2 and the Radiation and Nuclear Safety Authority's Regulation Y/2/2024 regarding location, precautionary action zone and emergency planning zone are implemented from the viewpoint of planning processes and land use. Possible land use conflicts and need for changes in plans are indicated and described.

At the reporting phase of the environmental impact assessment, the timeliness of the description of the plan situation is reviewed, and, if necessary, the description of the current status and the plan situation are revised on the basis of the feedback received from the assessment programme. The assessment pays attention to the significance of the impacts, and illustrative map material is prepared for the assessment. The impacts are examined as an expert assessment carried out by a land use specialist.

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8 LANDSCAPE AND CULTURAL ENVIRONMENT

8.1 Current status

8.1.1 Regional landscape

The alternative project areas Hepomäki and Sorsasalo are located in the regional landscape division of Finland in the eastern Finnish Lakeland and specifically to the Northern Savo lake region (Ministry of the Environment 1992). In the Northern Savo lake region, the Kuopio area is located more specifically in the area of large open lake areas (Ahola et al. 2014). The eastern Finnish Lakeland is a wide, but scenically fairly uniform, flat area with varying terrain. The bedrock topography has created numerous labyrinthine lakes. The landscape varies with forests and lakes. Only a few swamp areas are located in the regional landscape. Settlements are focused along waterways and coastal ridges. The Northern Savo lake region is the most sharply outlined area in the eastern Finnish Lakeland. In the northern part of the region, both the bedrock and the topography begin to have the features of the hill region of North Karelia. In the North Savo lake region, the lakes are large and handsome, and the landscape features range from dense archipelagos to wide open waters in Kallavesi, for example. The North Savo lake region is characterised by settlements on hills and slopes. In addition to the hilltop areas, settlements can be found on the slopes of forested ridges or in valleys and coastal mounds. In the area extending from Kuopio to Nilsiä, general lushness is brought to the landscape by the Kuopio region, i.e. the North Savo herb-rich forest concentration (Ministry of the Environment 1992).

8.1.2 Hepomäki

8.1.2.1 Overview of the landscape

The Hepomäki plant area is located in the aggregate extraction area. The area's landscape is dominated by an open-pit mine and open fields, which are bordered to the east and south-west by a continuous forest area. There is a steep quarry face in the southern part of the plant area. On a large scale, the geography of the area is oriented from southeast to northwest. The surroundings of the project area is slightly hilly. On the northwest side of the project area, there is the small Poskilampi pond with a forest shore and, on the east side, there is the larger Matkus lake. Due to the geography and forest cover, there are no open views of the project area from the nearest roads and the Matkus lake. The planned district heating line and location route of the road are located in closed forest terrain. The topography of the area is shown in the below figure (Figure 8-1), which also shows the location of buildings, roads and power lines.

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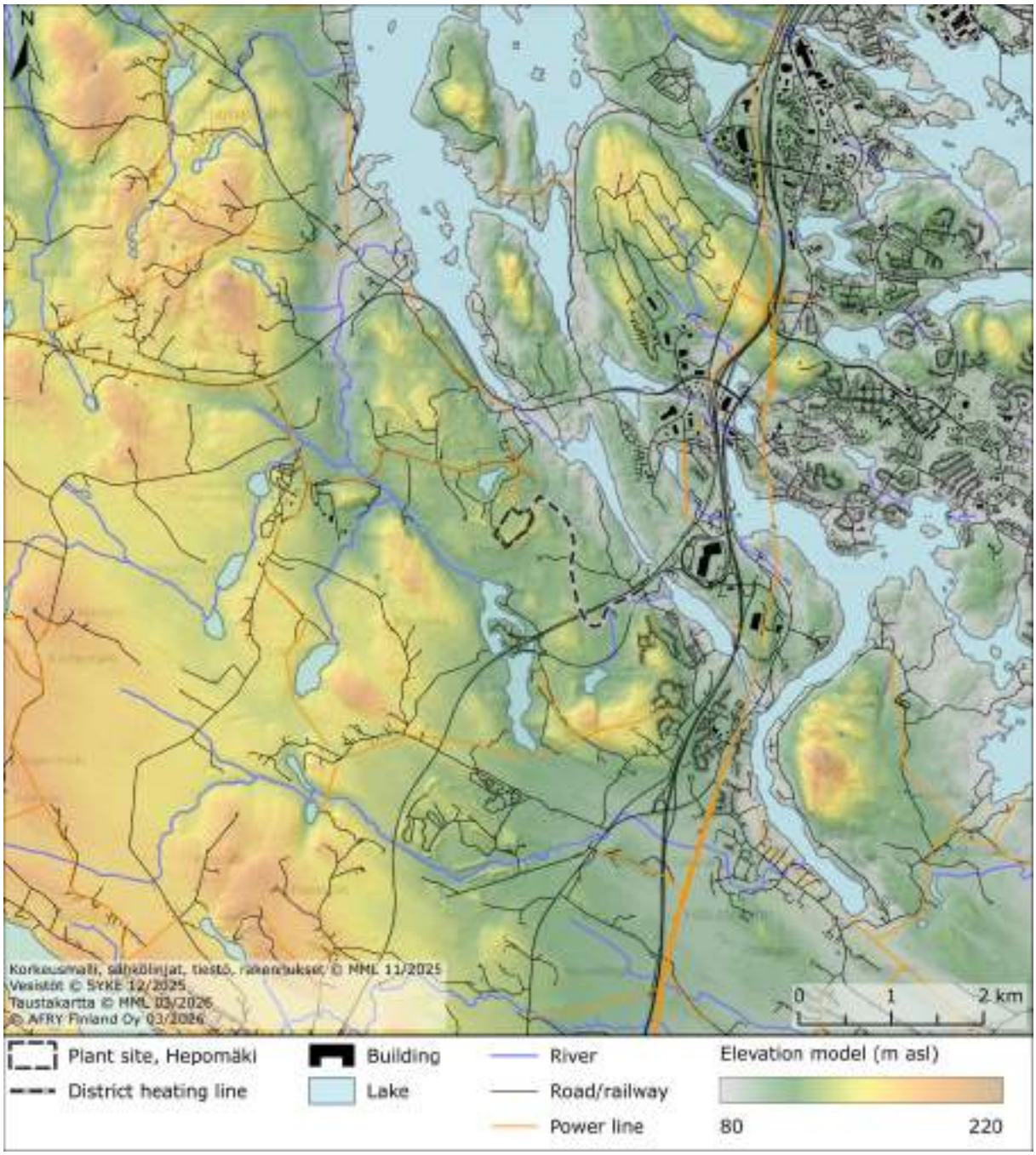

Figure 8-1. Topography of the project area, buildings, roads, power lines and water systems.

8.1.2.2 Value areas and sites of the landscape and cultural environment

There are no **nationally valuable landscape areas** near the Hepomäki project area (VAMA2021, Ministry of the Environment and Finnish Environment Institute 2021). The nearest site is the scenery of Puijo at a distance of about nine kilometres. Puijo is a well-known landscape attraction, which is the landmark of Kuopio with its tower. The values of Puijo are based on its cultural history, lake and city views from the hill, and significant natural and recreational values. On the west side of Puijo, on the shore of Kallavesi, is the Niuvanniemi hospital area of historical value (Ministry of the Environment and Finnish Environment Institute 2021).

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The **nationally significant built cultural environment** (RKY) (Finnish Heritage Agency 2025a) closest to the Hepomäki project area is the cultural landscape of Haminalahti about 1.0 kilometres north of the area (Figure 8-2). The planned location route of the road is connected to the Karttulantie road in the southern part of the cultural landscape of Haminalahti. The cultural landscape of Haminalahti consists of the Haminalahti manor with its cultivated landscapes, forested hillside cliffs and a water system dotted with small islands in Kallavesi. Other nationally significant built cultural environment sites are located more than seven kilometres away in the Kuopio city centre area, which also houses the nearest **buildings protected** by the building heritage register (Finnish Heritage Agency 2025b). Kuopio's **national urban park** is located more than eight kilometres away from the project area. In addition to city centre areas, the national urban park includes the Kallavesi archipelago off Kuopio (City of Kuopio 2025m).

Of the regionally valuable landscape and cultural environment sites, the closest is the **regionally valuable landscape area**, the cultural landscapes of southern Siilinjärvi (FCG Suunnittelu ja tekniikka Oy 2019) more than 17 kilometres north of Hepomäki. **Of the regionally significant built cultural environment** sites (Regional Council of Pohjois-Savo 2025d), the closest site to the project area is Juttuharju, the community hall of Haminalahti, at a distance of about 5.7 kilometres. The meadow of Riihilampi at a distance of about 1.8 kilometres to the east of the project area is a **regionally valuable traditional biotope** (Figure 8-2) (Regional Council of Pohjois-Savo 2025d).

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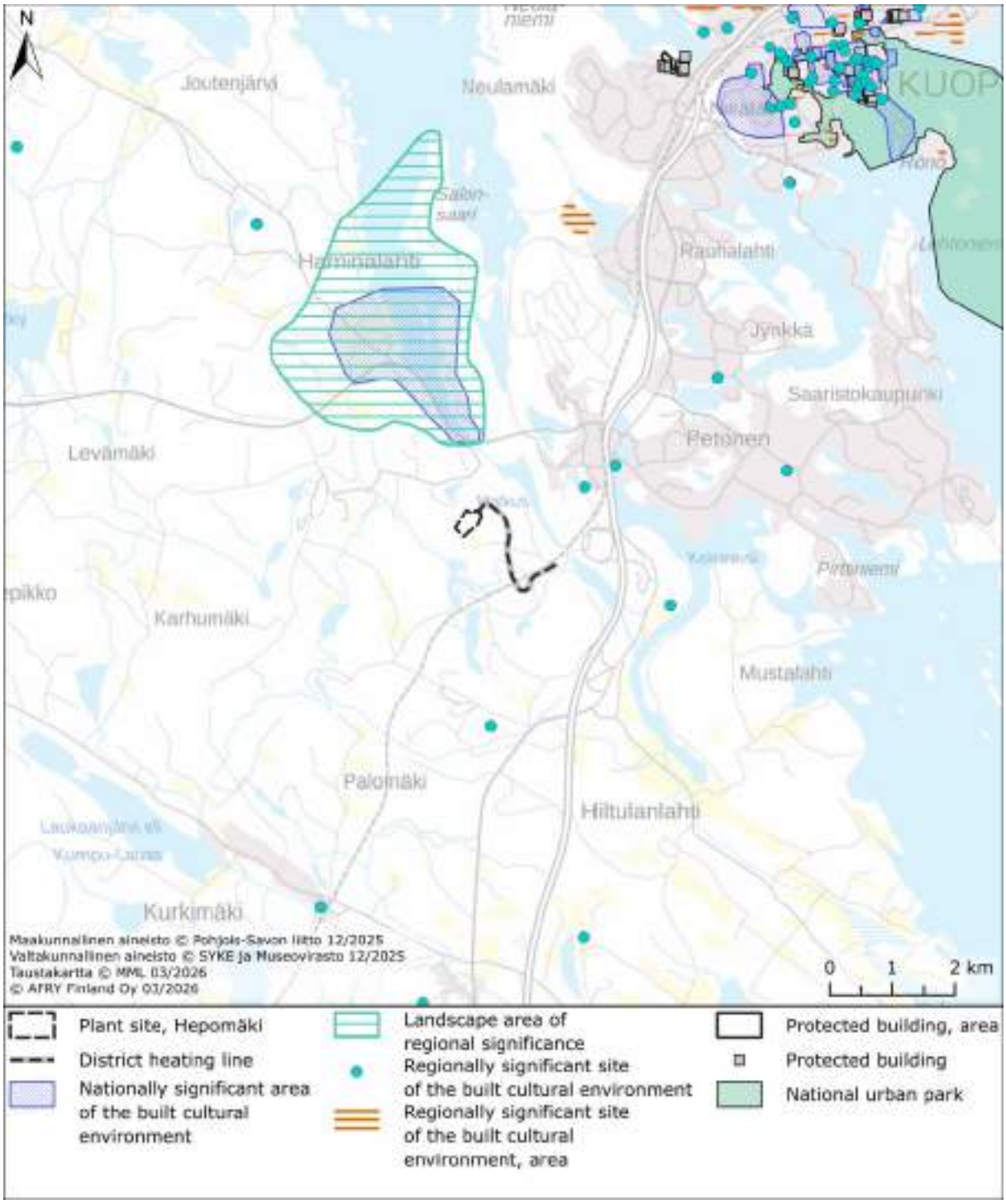

Figure 8-2. Value areas and sites of the landscape and cultural environment around the project area of Hepomäki (VE1).

8.1.3 Sorsasalo

8.1.3.1 Overview of the landscape

The SMR plant area is located on the island of Sorsasalo. Sorsasalo is part of the fragmented archipelago of Kallavesi, and it is located between Kelloselkä's extensive water area and the narrow Virtasalmi. The landscape of the area is characterised by the orientation of the geography from the northwest to the southeast. Sorsasalo is a hilly/slightly undulating island in terms of topography. The range of elevation levels is

about 30–40 metres. The highest point of Sorsasalo on the top of the forest ridge on the northwest side of the plant area is 130 metres above sea level (m.a.s.l.). In the background, in the northeast north of Virtasalmi, Uuhimäki rises to a level of more than 200 m.a.s.l.

In the surroundings of the project area on the island of Sorsasalo, the landscape is varyingly forested or characterised by industry. From Finnish national road 5 that crosses Sorsasalo, road vt5/E63, the landscape of Sorsasalo is an industrial area or forest. A lake landscape opens up from the bridge over Virtasalmi and the Kalla bridges. The beaches are forested. Viewed from the road in the direction of Sorsasalo and the plant area, the landscape shows an industrial plant with its chimney behind the forest. The plant area is located in the central parts of the island of Sorsasalo in the currently closed forest

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landscape. The topography of the area is shown in the below figure (Figure 8-3), which also shows the location of buildings, roads and power lines.

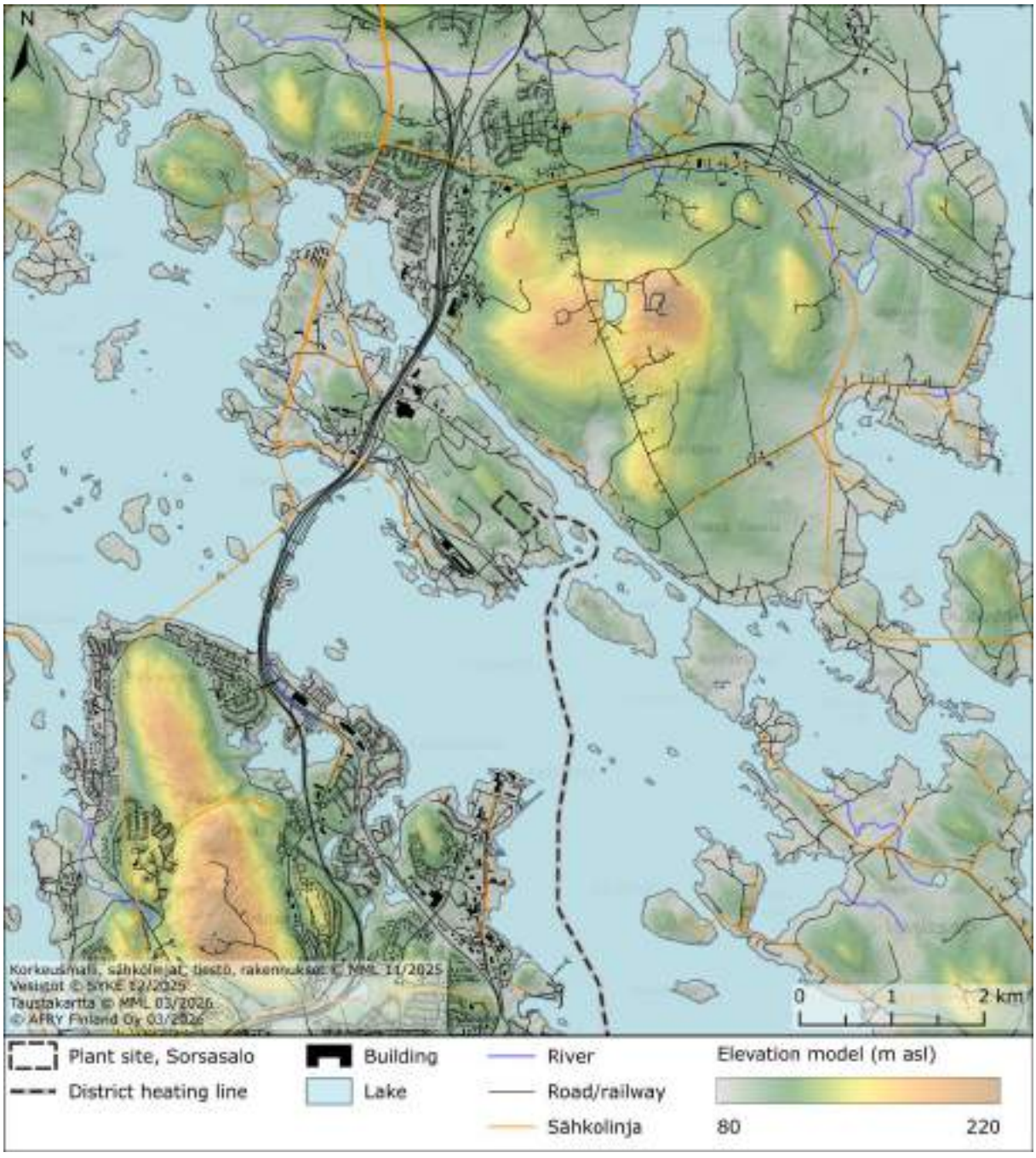

Figure 8-3. Topography of the project area, buildings, roads, power lines and water systems.

8.1.3.2 Value areas and sites of the landscape and cultural environment

The **nationally valuable landscape area** (VAMA2021) closest to the project area is the Puijo landscape, and it is located at a distance of about 2.9 kilometres (Figure 8-4). Puijo is a well-known landscape attraction, which is the landmark of Kuopio with its tower. The values of Puijo are based on its cultural history, lake and city views from the hill, and significant natural and recreational values. The ridge of Puijo stands out in the landscape as a higher land form than its surroundings. Puijo forests are mainly spruce-dominated herb-rich forests. The urban areas belonging to the City of Kuopio surround Puijo in all

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directions. On the west side of Puijo, on the shore of Kallavesi, is the Niuvanniemi hospital area of historical value (Ministry of the Environment and Finnish Environment Institute 2021).

The project area or its surroundings do not have **nationally significant built cultural environments** (RKY) (Finnish Heritage Agency 2025a). The closest nationally significant built cultural environment sites are located more than five kilometres away to the southwest/south in the Niuvanniemi and Kuopio city centre area, which also houses the nearest **buildings protected** (Figure 8-4) by the building heritage register (Finnish Heritage Agency 2025b). More than six kilometres from the Sorsasalo project area is Kuopio **national urban park**, which includes the Kallavesi archipelago off Kuopio (City of Kuopio 2025m) in addition to the city centre areas. About 400 metres of the planned district heating line from Sorsasalo to the centre of Kuopio is located in the area of Väinölänniemi, which is a nationally significant built cultural environment. The district heating line is also located in the water area of the national urban park.

Of the regionally valuable landscape and cultural environment sites, the closest is the **regionally valuable landscape area**, the cultural landscapes of southern Siilinjärvi (FCG Suunnittelu ja tekniikka Oy 2019), while the Haapalahti–Kehvo area is over five kilometres away to the southwest of the project area. The cultural landscape area has open agricultural landscapes and farm-related settlements, as well as farmyards and villas located along the water system. Several **regionally significant built cultural environment** sites are located in the landscape area (Regional Council of Pohjois-Savo 2025d). The closest site to the project area is the Sandels artillery stations (Regional Council of Pohjois-Savo 2025d; Regional Council of Pohjois-Savo 2006) north of Virtasalmi at a distance of about 0.8 kilometres to the northeast of the project area (Figure 8-4). In Karhonsaari, about two kilometres southeast, are the Karhonsaari villas (Regional Council of Pohjois-Savo 2025d; Regional Council of Pohjois-Savo 2006). About two kilometres north of the project area, north of Virtasalmi, on the side of the municipality of Siilinjärvi in Toivala, is the Vuorela tsasouna (Jumalansynnyttäjän kuolonuneen nukkumisen tsasouna). The site represents the Orthodox building heritage and is a regionally valuable site of modern cultural heritage (Regional Council of Pohjois-Savo 2021). About 3.2 kilometres northwest of the project area, on the island of Sorsasalo, the Virranniemi communal garden is located. It is a regionally valuable site of modern built cultural heritage. Its values are scenic, historical and cultural-historical/building-historical (Regional Council of Pohjois-Savo 2021). Approximately 3.2 kilometres southeast of the project area, a regionally significant built cultural environment site, the Karhonsaari settlement (Figure 8-4), is located (Regional Council of Pohjois-Savo 2025d; Regional Council of Pohjois-Savo 2006).

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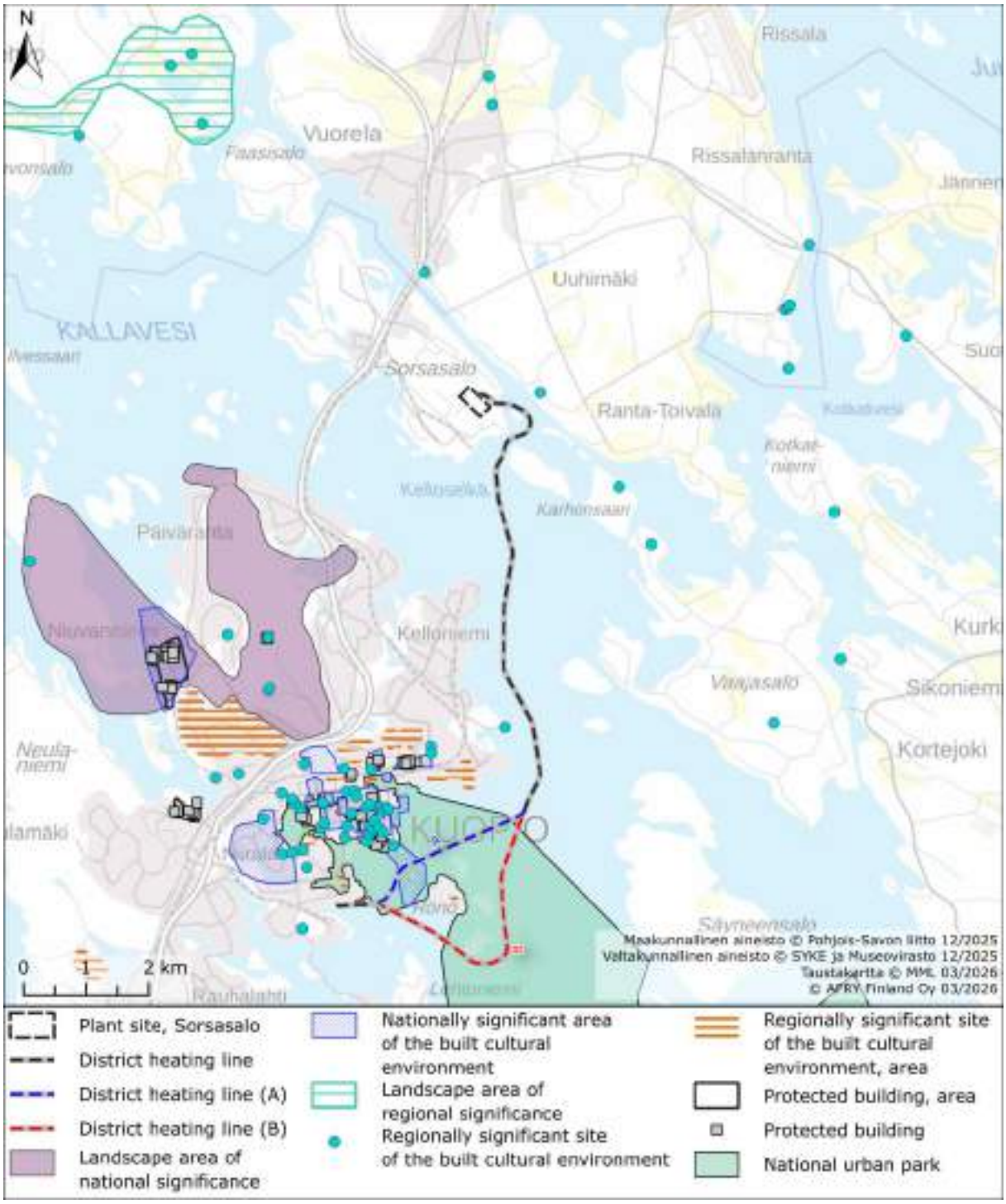

Figure 8-4. Value areas and sites of the landscape and cultural environment around the project area of Sorsasalo (VE2).

8.1.4 Archaeological heritage

Archaeological cultural heritage refers to the remnants, structures, layers and finds of human activity in prehistoric and historical times that have survived on land or water. Fixed relics are a central part of the archaeological cultural heritage and are protected in Finland by the Antiquities Act (295/1963), which prohibits measures that may endanger the preservation of a relic (e.g. covering or removal). The Antiquities Act protects underwater relics in the same way as those on land. A shipwreck or a part of a wreck is comparable to

a fixed relic if it can be assumed to have sunk more than a hundred years ago. Other sites belonging to the archaeological cultural heritage are not fixed relics protected by the Antiquities Act, but their preservation is often justified by their historical significance and cultural heritage values. Human-made structures underwater, such as fairway barriers and the remains of bridges and piers, are protected as memories of our country's previous settlements and history. Such sites are automatically protected regardless of age and may not be tampered with without the permission from the National Board of Antiquities.

The planned SMR plant has two possible plant sites: Hepomäki (VE1) and Sorsasalo (VE2). The planned site of Hepomäki now has a gravel extraction site, and there are no known archaeological sites in its vicinity. The closest known fixed relic is the shipwreck Matkusjärvi 1 (2015) at a distance of about 2.2 kilometres at the bottom of the Matkus lake, and the Savo railway (1000030820) at a distance of about 1.4 kilometres defined as another type of cultural heritage. The area limits of the Savo railway in accordance with the Ancient Relics Register is located in the immediate vicinity of the planned district heat transmission line of the project, to the south of it, at the end point of the transmission line at the corner of the streets Nuolimäenkatu and Hiltulanlahdenkatu (Figure 8-5). (Finnish Heritage Agency 2025c)

There is industry in the Sorsasalo area, but the SMR plant has been designed for the southeastern part of Sorsasalo, which is a forested area. In connection with the surveys carried out when compiling the local detailed plan for the eastern part of Sorsasalo, no special values related to prehistory and cultural history were found in the area (City of Kuopio 2016b). The closest known sites of the planned Sorsasalo plant area, the Halmejoki settlement from the Stone Age (297010026) and the artillery station Pökösenmäki (1000007074), are located on the other side of Virtasalmi in Ranta-Toivola, about a kilometre away. In addition, two shipwrecks classified as other sites (Ranta-Toivola 1 and Ranta-Toivola 2) are located on the shore of Ranta-Toivola at a distance of about 570 metres from the project area. The planned district heating transmission line from Sorsasalo across Kallavesi to Haapaniemi touches two wreck sites that have been entered in the Ancient Relics Register, Oil Harbour 1 and Oil Harbour 2, at a distance of about 29–66 metres near the Haapaniemi landing area (Figure 8-6). In the data of the National Board of Antiquities, 16 other archaeological sites have been identified near the Sorsasalo district heat transmission line at a distance of less than 500 metres, of which 12 are underwater sites (Table 8-1). However, these other underwater sites are more than 250 metres away from the planned district heating transmission line. (Finnish Heritage Agency 2025c) In November 2025, diagonal scanning and underwater archaeological inventory were carried out on the district heating transmission line, where, in addition to the previously known sites in the project area, Oil Harbour 1 and 2, three new sites, two boat wrecks and one site consisting of two frames of approximately 1 m x 1.8 m were found (Appendix 5, Stella Maria Oy 2025). The new sites are located on alternative routes of the district heating transmission line in front of Rönö: one wreck site on route A and two other sites on route B (Figure 8-6).

The location of the new road connections, electrical connection and water and sewerage connections required for the plant sites in relation to archaeological sites is examined in the EIA report.

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Table 8-1. Archaeological sites located at a distance of less than 500 metres from the planned district heating transmission line in Sorsasalo. No sites are known at a distance of 500 metres from the Sorsasalo project area boundary. (Finnish Heritage Agency 2025c, Stella Maria Oy 2025)

Site (Ancient Relics Register, site ID)	Type of the site	Status of the site	Distance from the centre line of the district heating transmission line
Ranta-Toivala 2 (2006)	Shipwrecks	Other site	394 metres
Ranta-Toivala 1 (2005)	Shipwrecks	Other site	374 metres
Varvisaari (2590)	Shipwrecks	Potential ancient relic	413 metres from route B
Itkonniemi 1 (1000042236)	Shipwrecks	Potential ancient relic	444 metres from route A
Itkonniemi 5 (1000045231)	Wooden structures	Other site	477 metres from route A
Itkonniemi 6 (1000045324)	Shipwrecks	Other site	372 metres from route A
Itkonniemi 4 (1000045230)	Shipwrecks	Other site	295 metres from route A
Vasikkasaari, east (1000045229)	Shipwrecks	Potential ancient relic	256 metres from route A
Tiilisaari (2003)	Shipwrecks	Other cultural heritage site	331 metres from route A
Kuopionlahti (1000032693)	Shipwrecks	Other cultural heritage site	415 metres from route A
Old vicarage (1000027651)	Settlements, vicarages	Fixed relic	304 metres from route A (site on land)
Väinölänniemi cemetery (297500003)	Burial sites, cemeteries	Fixed relic	190 metres from route A (site on land)
Perjurer’s line (1000049082)	Art, monuments	Fixed relic	357 metres from route A (site on land)
Peräniemi (2655)	Shipwrecks	Fixed relic	392 metres from route A
Peräniemi 2 (1000054030)	Art, monuments	Other cultural heritage site	235 metres from route B 265 metres from route A (site on land)

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Site (Ancient Relics Register, site ID)	Type of the site	Status of the site	Distance from the centre line of the district heating transmission line
Myhkyri (2412)	Shipwrecks	Other site	274 metres from route B 434 metres from route A
Oil Harbour 2 (2416)	Shipwrecks	Other site	29 metres
Oil Harbour 1 (2414)	Shipwrecks	Other site	66 metres
New site 1	Wreck	Other site	0 metres from route A
New site 2	Wreck	Other site	0 metres from route B
New site 3	Two frames (undefined structure)	Other site	25 metres from route B

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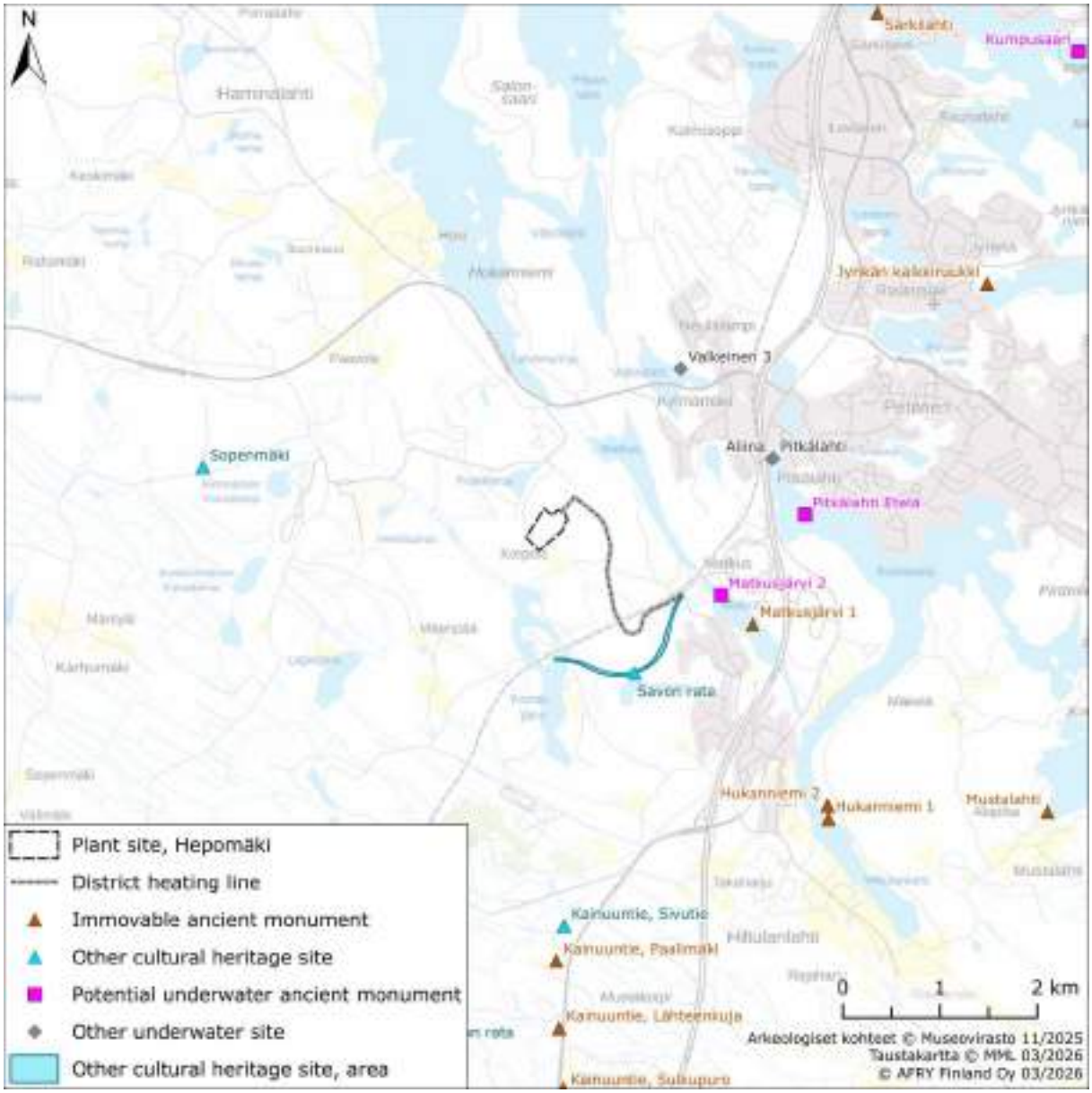

Figure 8-5. Archaeological cultural heritage sites in the vicinity of the project option VE1 (Hepomäki) (Finnish Heritage Agency 2025c).

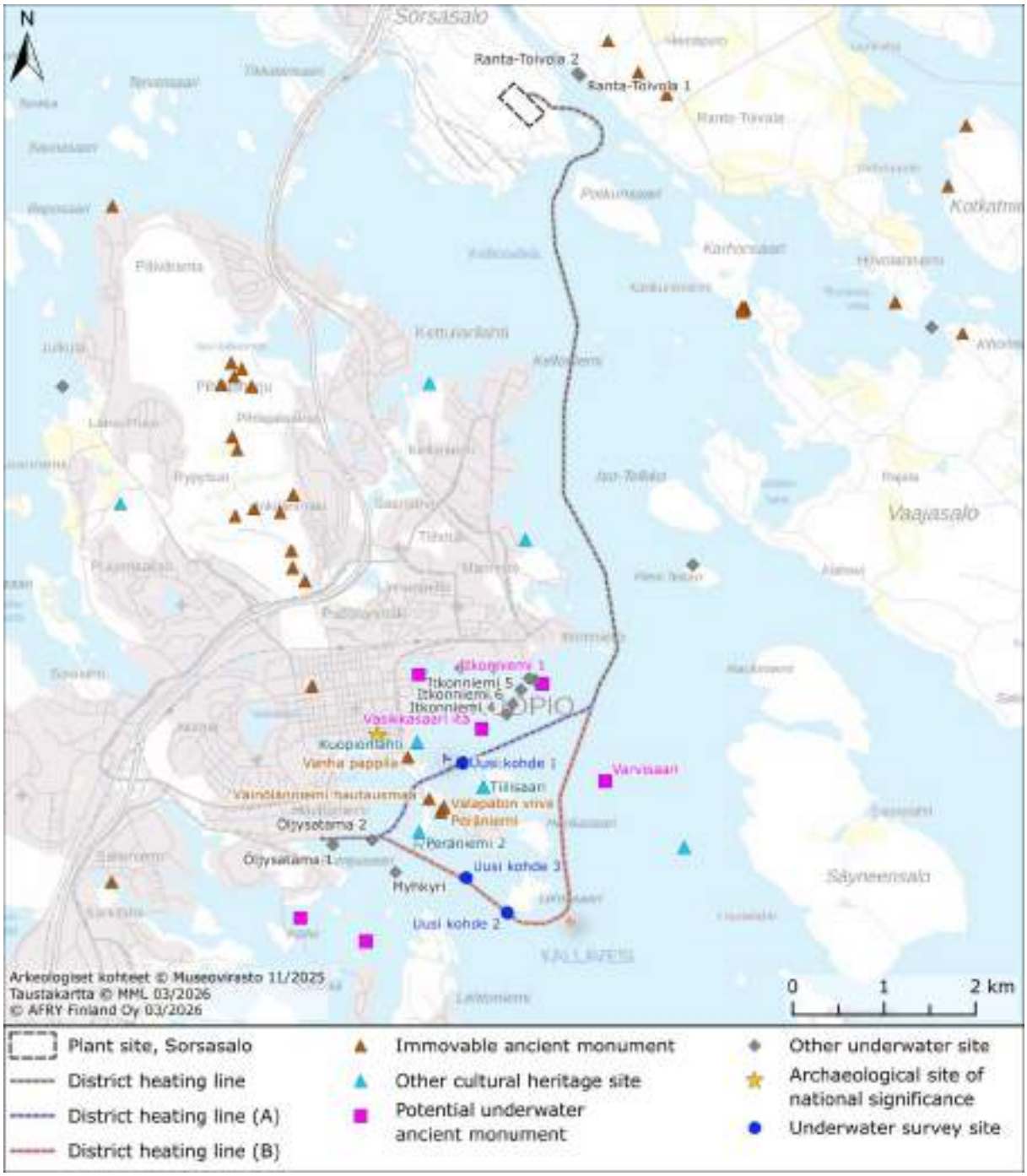

Figure 8-6. Archaeological cultural heritage sites in the vicinity of the project option VE2 (Sorsasalo). Sites located at a distance of less than 500 metres from the project structures are named on the map. (Finnish Heritage Agency 2025c, Stella Maria Oy 2025)

8.2 Impact assessment and methodology

8.2.1 Landscape and cultural environment

Landscape impacts of the project are caused by the change in the landscape caused by the production plant to be built, the district heating transmission connection, roads and power transmission. The impact will be on the immediate surroundings of the project area. The project's impact on the area's landscape and cultural environment is assessed in terms of its scope, nature and significance, and the sensitivity of the

landscape and cultural environment. The assessment focuses on those impacts that are most significant for the landscape. Landscape impacts are assessed from the point of view of housing and recreation, as well as the natural landscape and cultural environment, taking into account the value areas for the landscape and the closest value sites for cultural environment. The impacts are examined within a radius of 3–5 kilometres from the project area. The project plan, terrain maps, aerial images, terrain elevation model and available tree stand data are used as input data for the impact assessment. In order to support the assessment and illustrate the impacts, illustrative images/photo montages of the SMR plant are prepared.

8.2.2 Archaeological heritage

The impacts of the project are assessed by examining the relationship of the location of the construction measures to known ancient relics and other archaeological cultural heritage sites, both on land and in the water area.

It is not considered necessary to carry out an archaeological inventory of the planned plant areas. The planned Hepomäki plant area is currently a gravel extraction area and is not considered to have archaeological potential. The local detailed plan for the eastern part of Sorsasalo and the amendment to the local detailed plan state that the archaeologist of the Kuopio Museum has studied the planning area with regard to dry land. The area has not been found to have any special values related to prehistoric and cultural history and nothing that refers to a fixed relic has been found in the area in connection with the archaeological inventory.

In the area of the Sorsasalo district heating transmission line located at the bottom of Kallavesi, lake bottom sounding was carried out in November 2025, where sites located in the survey area were identified. If the nearest known sites are about to be destroyed during the project, it is likely to be necessary to study the sites by diving and, if necessary, by taking dating samples. The decision on the need for protection and further research of the sites is made by the National Board of Antiquities.

The impact assessment is carried out at the EIA reporting phase as an expert assessment on the basis of the results from the sounding and the register material of the National Board of Antiquities.

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9 NOISE AND VIBRATION

9.1 Current status

9.1.1 Hepomäki

In the current situation, stone and soil extraction, as well as waste treatment, are being carried out in the Hepomäki area and in the Heinälamminrinne area to the west. The Kuopio region's noise survey (WSP 2022) carried out in 2022 has examined the region's industrial noise impacts. The information on noise sources in the survey is from the year 2019. The most significant sources of noise in the area are several quarries and crushing plants. According to the results, in a situation where all the functions of the area would be running at the same time, the noise impact area according to the daily guideline value of 55 dB in the area is about two kilometres in diameter. There are no residential buildings left in this area. In practical operations, the noise impacts are smaller, as all operations are very unlikely to run at the same time.

According to the Kuopio region's noise survey (WSP 2022) carried out in 2022, the noise levels of road and rail traffic in the Hepomäki area remain below 45 dB. Traffic noise on the routes is likely to be distinguished in the area, but the noise levels will remain low.

In terms of vibration impacts, the rock excavation work in the area causes vibrations in the surrounding area. The area has been excavated for a long time, so the characteristics of the rock and soil are known and the vibration impacts can be controlled to ensure that the recommended vibration values are not exceeded. The vibration decreases as the distance increases and the distances from the excavation sites to the nearest residential or holiday buildings are long.

9.1.2 Sorsasalo

In the current situation, environmental noise in the Sorsasalo area is mainly caused by road traffic on Finnish national road vt5 and Mondi Powerflute Oy's fluting mill. Civil and military aircraft traffic at Rissala Airport also causes noticeable noise in the area. In the case of aircraft noise, noise is momentarily produced during overflight. Aircraft noise differs from that caused by road traffic and industry and is therefore often distinguishable in the Sorsasalo area. Other noise-causing activities include NG Nordic's material handling centre and rail traffic. There is an industrial area in the northern part of Sorsasalo, but the activities in the area do not cause significant noise. The noise impacts of the fluting mill have been studied in the noise survey made in 2024 (APL 2025). In the survey, noise was monitored using long-term environmental noise measurements and noise modelling. The daytime noise modelling result of the fluting mill is shown in the figure below (Figure 9-1).

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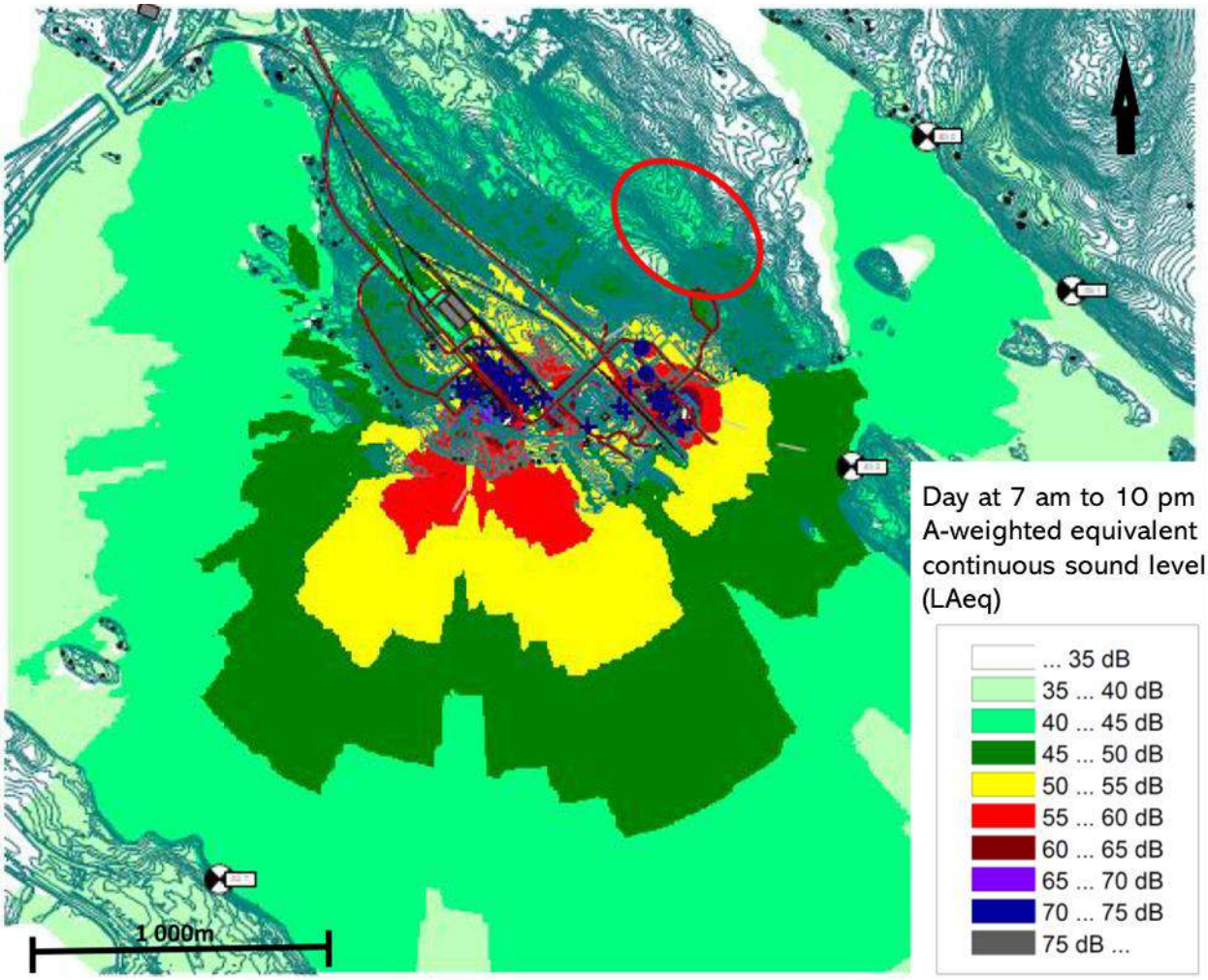

Figure 9-1. Modelled noise impacts of the Mondi Powerflute Oy's fluting mill, equivalent continuous daytime sound level LAeq (07:00–22:00). The project area is roughly marked with a red circle. (edit. APL 2025)

The nearest affected sites near the fluting mill are residential and holiday buildings, where, according to the modelling, the noise caused by the mill is 39–45 dB during the day (07:00–22:00) and 38–43 dB at night (22:00–07:00). The results are below the guideline values set for residential buildings, which are 55 dB during the day and 50 dB at night (VnP 993/1992). The noise is at or below 45 dB, which is the daytime guideline value for holiday buildings. The guideline value of 40 dB for the night time for holiday buildings is exceeded at the nearby holiday home buildings on the west side of Potkunsaari.

The noise caused by NG Nordic Finland Oy's scrap metal recycling plant consists of the impacts caused by waste treatment operations, the machinery used and traffic. The operations of noise sources are not continuous and are mainly limited to daytime operation. According to the conducted noise surveys, the noise is below the environmental noise guideline values at the nearest affected sites. (AVI 2022)

The area near Sorsasalo is affected by the noise impacts caused by road traffic on the national road vt5 and the railway. The noise impact of traffic has been assessed in the national noise survey conducted in 2022 (WSP 2022). The noise impact area of 55 dB caused by road traffic during daytime (from 07:00 to 22:00) spreads at Sorsasalo to a

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distance of about 700 metres from the national road. The noise impact area according to the night time value of 50 dB is limited to a slightly shorter distance. The corresponding noise impact areas of rail traffic during daytime and at night are at their widest limited to a distance of about 100 metres from the railway line.

Sorsasalo's industrial plants and operations do not cause significant vibration impacts. Vibration impacts can mainly be caused by rail traffic and, to a small extent, by heavy road traffic. The vibration impacts of traffic are limited to the vicinity of the routes.

9.2 Impact assessment and methodology

The assessment of the industrial noise impacts of the project is based on the planning data of the project, the volumes of transport related to the activity, experience with the noise of other similar plants and activities, as well as the current noise surveys of the site environment in terms of the total industrial noise of the area.

Noise impacts are assessed as expert work with the help of an industrial noise survey prepared for the project. The noise survey is prepared for both project options VE1 and VE2. The noise survey calculates the environmental noise levels caused by the plant using noise modelling for the operating condition in a situation where the plant has been implemented according to plans. The average environmental noise levels caused by the plant are assessed using Nordic industrial and road traffic noise calculation models. In terms of construction, noise modelling is implemented for the option VE2 in Sorsasalo, as there are residential and holiday buildings in the vicinity of the area. The assessment of the noise impacts of the project option VE1 in Hepomäki during construction is based on an expert's assessment.

Noise modelling takes into account the loudest work phases during construction (e.g. excavation operations and transports) and, in the modelling during operations, the noise emissions caused by the plant's equipment, as well as the noise caused by transports within the assessment area. Noise calculations are used to assess the daytime and nighttime equivalent continuous sound levels (LAeq) caused by the above activities, taking into account the daily operating times of construction and the normal running times of the equipment during the day.

The modelling is carried out in accordance with the noise modelling guideline 20/2007 of the Ministry of the Environment (Ministry of the Environment 2007). The results of the modelling are presented with illustrative noise maps. The impacts of noise on health, comfort and annoyance (maximum sound level, narrowbandness, impulsiveness) are assessed by comparing the situation with health-based noise level guideline values and the current state of noise. Estimates are based on noise data from similar processes or work phases.

Combined noise with other current and future operations in Sorsasalo is examined with the help of combined noise modelling. The modelling takes into account the combined noise impacts of existing operations (e.g. Mondi Powerflute Oy's fluting mill) and planned (eSAF plant) industrial operations. In the combined noise modelling, the situation during the operation of the SMR plant is examined.

With regard to vibration, the assessment examines the vibration impacts caused by construction work during construction and transport during construction and operation. The intensity of the vibration is estimated based on the magnitude of the operation causing vibration, taking into account existing information and experience from similar projects

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carried out previously. The assessment takes into account the buildings and structures located in the vicinity of the project area, as well as the progression of the vibration to different distances. In addition, the possible disturbance experienced by people is assessed. Measures to prevent and mitigate vibration impacts are presented. In addition, during the operation, it is examined how much vibration to the SMR plant area is caused by the aggregate extraction in the vicinity and whether the operation of the SMR plant restricts the aggregate extraction.

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10 TRAFFIC

10.1 Current status

10.1.1 Hepomäki

10.1.1.1 Road traffic

A new road connection of about 3 kilometres is built at the SMR plant in Hepomäki, and it is located between the streets Kaatopaikantie and Nuolimäenkatu which are part of Kuopio city's street network. In connection with the location route of the road, the district heating transmission connection from the SMR plant to the south up to the connection point of the current district heating network in the Matkus area is also implemented. The planned road line is shown in the map below (Figure 10-1). From the street Kaatopaikantie that is located about 500 metres to the north of the SMR plant, there is a connection to Karttulantie (Finnish regional road 551), through which there is a connection to Finnish national road 5 (2+2 lane motorway) in the west via the Pitkälahti interchange, which is located approximately 2 km away. To the south of the SMR plant, the location route of the road runs for about 2.5 km, passing under the railway and connecting to the street Nuolimäenkatu. There is a connection from Nuolimäenkatu via Matkuksentie to Finnish national road 5 via the Matkus interchange, located just over a kilometre away.

According to the traffic volume data of the Finnish Transport Infrastructure Agency, an average of 5,618 vehicles pass through Karttulantie at the Kaatopaikantie intersection per day, of which 247 vehicles, or about 4.4% of the total traffic volume, are heavy traffic. On Finnish national road 5 north of the Pitkälahti interchange, the traffic volume is 35,205 vehicles/day, of which 2,120 vehicles (about 6%) are heavy traffic, the traffic volume between the Pitkälahti and Matkus interchanges is 19,452 vehicles/day, of which 1,185 vehicles (about 6.1%) are heavy traffic, and the traffic volume south of the Matkus interchange is 15,740 vehicles/day, of which 1,080 vehicles (about 6.9%) are heavy traffic. (Finnish Transport Infrastructure Agency 2025) Traffic volume data is not available for the streets Kaatopaikantie, Nuolimäenkatu and Matkuksentie, which are part of the city's street network.

The public roads near the Hepomäki SMR plant and their traffic volumes are shown in the figure below (Figure 10-1).

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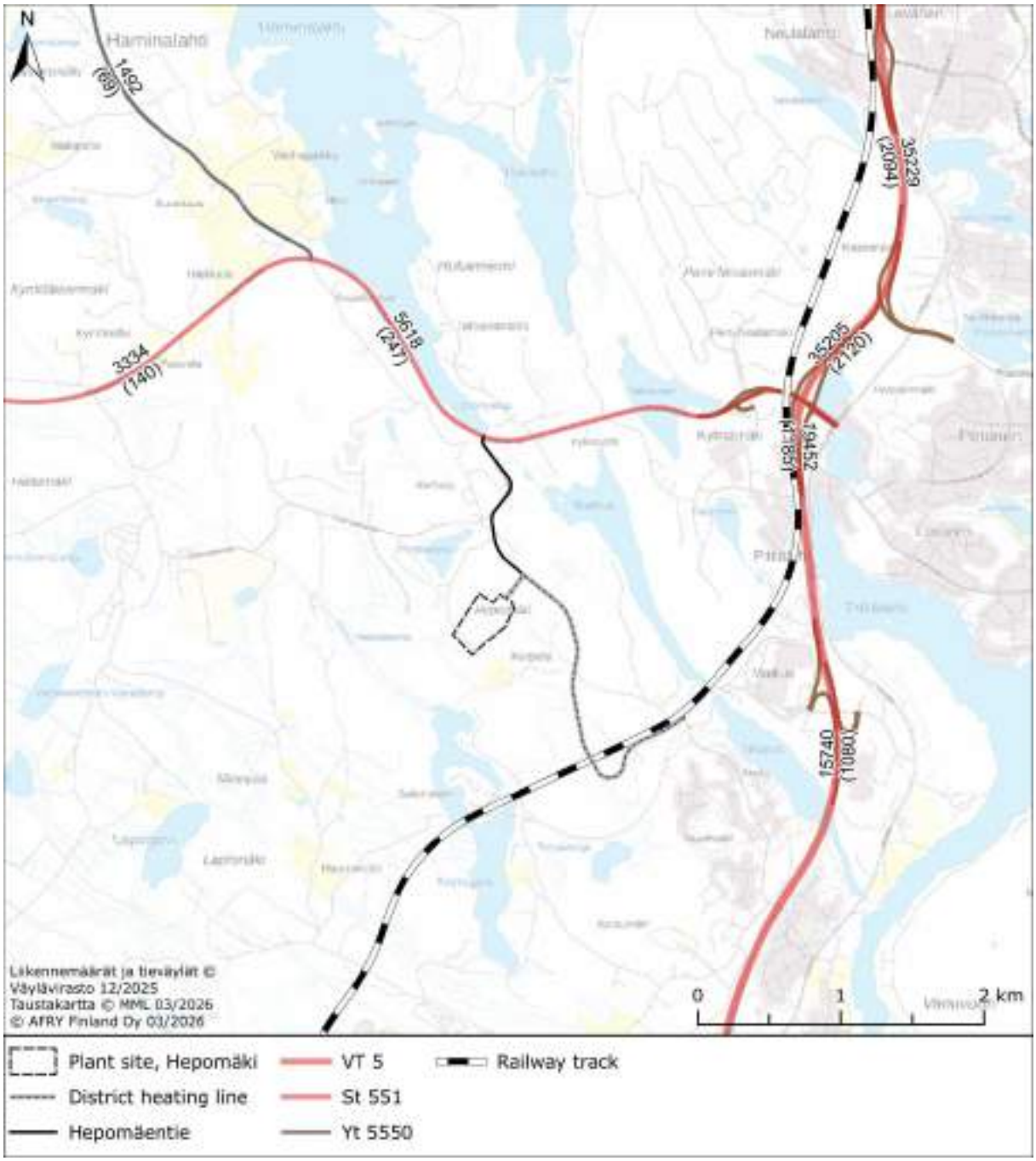

Figure 10-1. Public roads near the Hepomäki plant area and their traffic volumes.

During the past five years (2020–2024), there have been a few traffic accidents in the area between Hepomäki and Finnish national road 5. In the intersections between Karttulantie and the Finnish national road 5 interchange, there have been two accidents that led to injuries (an accident while turning and a crossing accident) and two accidents (an accident while turning and a crossing accident) that did not lead to personal injuries. There have been two accidents at roundabouts in Matkuksentie that resulted in injuries (a single accident and a crossing accident) and one accident (overtaking accident) that did not result in personal injuries. (Ramboll Finland Oy 2025) The speed limits of the area are 100 km/h at Finnish national road 5, 80, 60 or 50 km/h at Karttulantie depending on the section, 50 km/h at Kaatopaikantie and Matkuksentie and 40 km/h at Nuolimäenkatu (Finnish Transport Infrastructure Agency 2025). There is a separate pedestrian and cycling path

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along Karttulantie and Neulamäenkatu, but there is no pedestrian and cycling path along Kaatopaikantie or a separate crossing point across Karttulantie.

10.1.1.2 Inland waterway traffic

The Hepomäki project option does not cause impacts on inland waterway traffic.

10.1.1.3 Rail traffic

The single-track and electrified Savo railway runs to the east and south of Hepomäki. The railway section has regular daily passenger and freight traffic. A new underpass will be built under the railway track for the new road connection from Nuolimäenkatu to the SMR plant. The construction of a new bridge will cause temporary inconvenience to rail traffic, such as speed limits and track outages.

The crossing point of the new location route of the road and the Savo railway is shown on the map in the figure below (Figure 10-1). The crossing point is preliminary and will be specified as the planning of the location route of the road progresses.

10.1.1.4 Air traffic

The nearest airport to the project is Kuopio Airport, located approximately 22 kilometres to the northeast. Kuopio Airport's air traffic is mainly the Finnish Air Force's training activities and scheduled flights. The SMR plant is located less than 45 kilometres from the airport, so for structures over 30 metres high, an aviation obstacle permission must be applied for (Traficom 2025).

10.1.2 Sorsasalo

10.1.2.1 Road traffic

From the point of view of the SMR plant, the most important road connection is Finnish national road 5, which runs through Sorsasalo as a 2+2 lane motorway, along which there is a connection in the south direction towards Kuopio and in the north direction towards Siilinjärvi and Finnish national road 9. The road connection from the national road to the project area goes through the Sorsasalo interchange along Selluntie, Sorsasalontie and Lukkosalmentie, which belong to the Kuopio city's street network. Reaching the SMR plant, however, requires the construction of new road connections, as well as the improvement and access to existing (private) roads used by other operators in the area. Sorsasalontie and Päivärannantie form a parallel road connection to the motorway in the south and north directions. (Finnish Transport Infrastructure Agency 2025)

According to the traffic volume data of the Finnish Transport Infrastructure Agency, the traffic volumes at Finnish national road 5 are high at Sorsasalo. To the north of the interchange, the average daily traffic volume is 30,391 vehicles per day, of which 1,631 vehicles, or about 5.4%, are heavy traffic. To the south of the interchange, the volume of traffic is 30,470 vehicles per day, of which heavy traffic accounts for 1,590 vehicles (about 5.2%). The traffic volumes of the one-way ramps of the Sorsasalo interchange are as follows (Finnish Transport Infrastructure Agency 2025):

- Ramp from Finnish national road 5 from the south to the road Selluntie: 1,253 vehicles/day, of which 251 vehicles (20%) are heavy traffic.
- Ramp from Finnish national road 5 from the north to Selluntie: 696 vehicles/day, of which 190 vehicles (27%) are heavy traffic.

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- Ramp from Selluntie to Finnish national road 5 to the south: 1 319 vehicles/day, of which 257 vehicles (19%) are heavy traffic.
- Ramp from Selluntie to Finnish national road 5 to the north: 795 vehicles/day, of which 234 vehicles (29%) are heavy traffic.

Traffic volume data is not available for the roads Selluntie, Päivärannantie, Sorsasalontie and Lukkosalmentie, which are part of the city's street network, but the share of heavy traffic can be assumed to be significant, as there are industrial activities and companies in the area.

The public roads near the Sorsasalo SMR plant and their traffic volumes are shown in the figure below (Figure 10-2).

Figure 10-2. Public roads near the Sorsasalo plant area and their traffic volumes.

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The most essential intersections in terms of the traffic impacts of the project are the intersections of the ramps of Finnish national road 5 to Selluntie. The intersections are located close to each other, and the Virransalmentie and Sorsasalontie/Päivärannantie intersections are also close, so the space is limited. The speed limits of the area are 100 km/h at Finnish national road 5, 50 km/h at Selluntie, Sorsasalontie and Päivärannantie and 30 km/h at Lukkosalmentie (Finnish Transport Infrastructure Agency 2025). The SMR plant area can be reached by walking and cycling from the north and south along the pedestrian and cycling path along Sorsasalontie and Päivärannantie. There is no separate pedestrian and cycling path along Lukkosalmentie leading to the plant area.

During the past five years (2020–2024), several traffic accidents have occurred in the Sorsasalo area. There has been one accident while turning at the Sorsasalontie and Lukkosalmentie intersection, which did not lead to personal injuries. There has been one bicycle accident that resulted in an injury and two other accidents (a crossing accident and a single accident) that did not result in personal injuries at the Selluntie and Sorsasalontie/Päivärannantie intersection. There have been two crossing accidents on the intersections of Finnish national road 5 ramps and Selluntie, which did not lead to personal injury. Three accidents (two overtaking accidents and one rear-end collision) have occurred on Finnish national road 5 in the Sorsasalo area, which did not lead to personal injuries. (Ramboll Finland Oy 2025)

10.1.2.2 Inland waterway traffic

In the project option of Sorsasalo, the district heating pipelines from the SMR plant to the Haapaniemi power plant of Kuopio Energia cross in Kallavesi off Kuopio with several inland waterways (Finnish Transport Infrastructure Agency 2025):

- Kelloniemi – Savon Sellu fairway (fairway class 2)
- Boat channel of Kallansillat bridges (fairway class 5)
- Säyneensalo – Kelloniemi fairway (fairway class 2)
- Kelloniemi shipyard fairway (fairway class 3)
- Southern Vaajasalo fairway (fairway class 5)
- Kuopio boat harbour fairway (fairway class 5)
- Muuraissaari – Itkonniemi fairway (fairway class 3)
- Kuopio passenger harbour fairway (fairway class 3)
- Kuopionlahti harbour fairways (fairway class 5)
- Haapaniemi fairway (fairway class 5)
- Route B: Rönö fairways (fairway class 6)

The location route of district heating pipelines has two alternative route sections, A and B. The route section A crosses Väinölänniemi, and the alternative route section B circumvents the islands in front of Väinölänniemi. The total length of the district heating transmission connection is about 11 kilometres along the route section A and about 13 kilometres along the route section B. The district heating pipes are placed on the lake bed, and the lake is dredged at the landing points and in the shallows in order to install the pipes to a sufficient depth.

Inland waterway traffic in Kallavesi largely consists of private boating and various inland waterway cruises. Kallavesi also has an opportunity for log floating, but the traffic is not very regular.

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The routes of the district heating pipelines of the Sorsasalo SMR plant and the inland waterways/fairway areas of Kallavesi are shown on the map in the figure below (Figure 10-3).

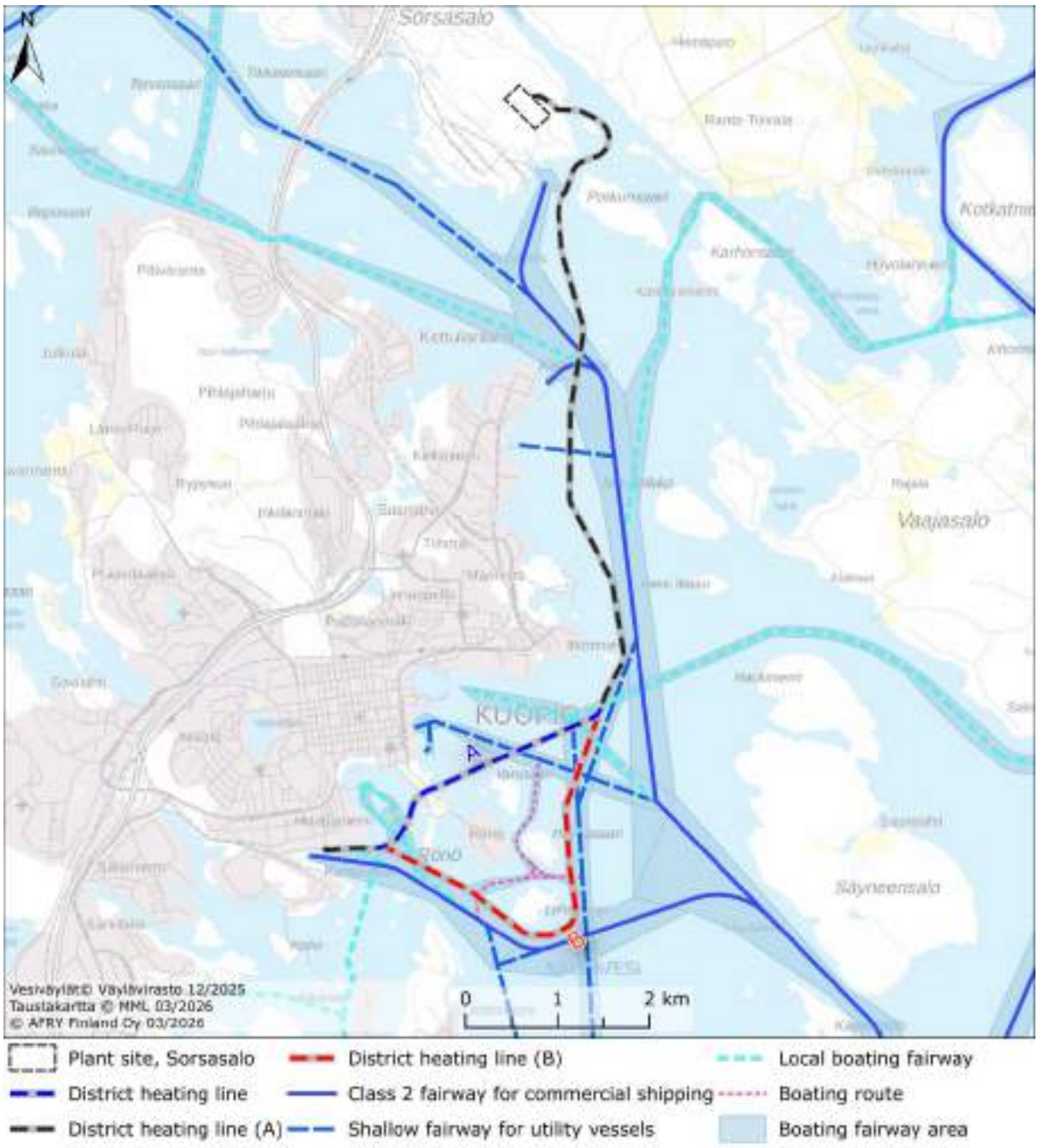

Figure 10-3. The routes of the district heating transmission lines of the Sorsasalo SMR plant and the inland waterways and fairway areas of Kallavesi.

10.1.2.3 Rail traffic

The Savo railway, which is single-track and electrified, runs through Sorsasalo alongside Finnish national road 5. The railway section has regular daily passenger and freight traffic. At Sorsasalo, a not electrified industrial rail connection also branches off from the railway section to the Mondi Powerflute Oy's factory area. This connection is only used for freight traffic and has regular traffic, for example, in connection with the product transport of the production plant. The industrial railway crosses Päivärannantie through a guarded level

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crossing (booms and warning devices). According to a preliminary assessment, the construction or operation of the SMR plant does not involve rail transport.

10.1.2.4 Air traffic

The nearest airport to the project is Kuopio Airport, located approximately 6.5 kilometres to the northeast. Kuopio Airport's air traffic is mainly the Finnish Air Force's training activities and scheduled flights. The SMR plant is located within the airport's height restriction area, so for structures over 30 metres high, an aviation obstacle permission must be applied for (Traficom 2025). Civil and military aircraft traffic at the airport also causes noticeable noise in the Sorsasalo area.

10.2 Impact assessment and methodology

Traffic impacts of constructing an SMR plant occur mainly during the construction phase, as the traffic volumes resulting from the plant's operation are significantly smaller. During the construction phase, the largest transport volumes result from earthworks and excavation for the district heating transmission connections, the plant area and the premises. In both location options, new road connections must be built to the plant and traffic will be directed to the main roads near the project areas. Construction staff travelling to and from the site also cause traffic to the project areas. Traffic volumes during construction are specified during the EIA reporting phase. In the Sorsasalo project option, in addition to road traffic, temporary impacts occur on water traffic during the construction phase, when the district heating transmission line is dredged and pipes installed in Kallavesi. In the Hepomäki project option, in addition to road traffic, temporary impacts will also be caused to rail traffic during construction, as the new road connection and district heating transmission line intersect with the Savo railway.

The construction phase temporarily increases traffic volumes on the roads near the project area, and the increase in heavy traffic in particular has an impact on traffic flow and traffic safety. During the operation of the SMR plant, traffic mainly consists of staff commuting as well as traffic during plant maintenance. There is no need for regular daily transportation to the plant, for example, for fuels, but fresh fuel is imported approximately every two years and spent fuel transports are estimated every five years. Transportation and the plans required by them are carried out in accordance with regulatory requirements, and the final transport volumes are specified as the plans progress on the basis of more accurate fuel and waste management solutions. The impact assessment during operation also takes into account the traffic impacts of the reduction in fuel transport due to the replacement of the HPN2 power plant unit at the Haapaniemi district heating power plant.

Traffic during the construction and operation of the project is mainly by road, so in the assessment of the traffic impacts, special emphasis is placed on the assessment of the road traffic impacts. The impacts on water traffic and rail traffic in the construction of both of the project options are also taken into account in the assessment. The assessment describes the current situation of the traffic network in the area (road connections, current status of the routes, traffic volumes and traffic accidents in the area) on the basis of existing data and information (for example, data from the Finnish Transport Infrastructure Agency). Traffic impacts are assessed on the basis of operational planning data by comparing the current state of the area with the planned activities and the changes caused by them. The traffic impact assessments examine the project's effects on traffic volumes on the road network and on traffic flow and safety. Particular attention is paid to the transport of hazardous goods, as well as to sites vulnerable to road safety impacts (for

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example, schools). The impacts are assessed in more detail in the vicinity of the traffic routes leading to the area and in relation to the current traffic and condition of the routes. The traffic impact assessment also takes into account the cumulative impacts with other relevant projects and proposes ways to mitigate the impacts. The traffic impacts of the project are evaluated as expert assessments and carried out by an expert who is familiar with the traffic impacts.

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11 AIR QUALITY

11.1 Current status

The main point sources of airborne release in Kuopio are Mondi Powerflute Oy's fluting mill in Sorsasalo and Kuopion Energia Oy's Haapaniemi power plant. However, significant emission sources include road traffic as well as various diffuse emission sources, such as street dust, machinery and property-specific heating. Air quality is monitored in Kuopio at seven air quality measuring stations across the city. The closest to the Hepomäki project area is the Haminalahti measuring station along Länsirannantie, about three kilometres northwest of the SMR plant. This measuring station measures the concentrations of odorous sulphur compounds (TRS). In turn, the closest to the Sorsasalo project area is the Sorsasalo measuring station, which is located along Selluntie leading to Mondi Powerflute Oy's mills, about 500 metres to the west of the SMR plant. This measuring station measures the concentrations of sulphur dioxide (SO_2) and odorous sulphur compounds. (AERI 2025) The regional environmental protection services of the City of Kuopio are responsible for air quality measurements and reporting.

In Kuopio, the concentrations of inhalable particles (PM_{10}) have been in clear decline in the 2000s, as the fight against street dust has been intensified. During the street dust season, the concentrations of inhalable particles increase especially in the vicinity of busy traffic routes and in the city centre area. Street dust occurs in the spring in March–May on dry streets after the snow has melted and in late autumn at the beginning of the winter tyre season before snow cover. In both planned project areas, high particle concentrations can occur especially during the street dust season, due to traffic to and from nearby industrial areas, as heavy traffic vehicles in particular lift street dust into the air. In addition, during dry periods, wind erosion also causes dusting on bare parts of the terrain where there is no binding vegetation.

The concentrations of fine particles ($PM_{2.5}$) measured in Kuopio are mainly long-range transboundary air pollution, but locally, small-scale burning of wood and road traffic have an impact on the concentrations. The concentrations of fine particles are at their highest during the street dust season and during winter frosts. The measured concentrations are below the limit values for inhalable particles and fine particles at all air quality measuring stations (AERI 2025).

Nitrogen dioxide (NO_2) concentrations measured in Kuopio are almost exclusively from road traffic. Nitrogen dioxide concentrations have decreased since the 2010s as a result of lower road traffic emissions. The measured concentrations are well below the annual, daily and hourly limit values for nitrogen dioxide at all air quality measuring stations. Nitrogen dioxide concentrations are typically at their highest during the coldest time of the year, i.e. around January–March and October–December. (AERI 2025)

Sulphur dioxide concentrations (SO_2) are measured in Kuopio only at the Sorsasalo air quality monitoring station. The sulphur dioxide concentrations measured at the station have clearly decreased from the 1990s level as a result of the reduction in Mondi Powerflute Oy's emissions. The sulphur dioxide concentrations in Kuopio are currently very low, and no significant changes in concentrations have occurred in the 2000s. (AERI 2025)

At the air quality monitoring stations in Hepomäki and Sorsasalo, the concentrations of reduced, i.e. odorous, sulphur compounds (TRS) are measured. In Hepomäki, the purpose is to monitor the impacts of odour emissions from Jätekukko Oy's waste facility in

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Heinälamminrinne and in Sorsasalo, the impacts of odour emissions from Mondi Powerflute Oy's fluting mill. The measured concentrations have been quite low throughout the 2000s. In addition to the emissions from the fluting mill, the odour nuisance of the Sorsasalo area can be affected to a small extent by the odour emissions of the Fortum Waste Solutions Oy's waste facility.

The air quality in Kuopio has also been assessed by modelling, most recently in 2020 (Komppula et al. 2020). The dispersion model calculation examined the concentrations of nitrogen oxide and particulate matter in the ambient air caused by vehicle traffic, property-specific heating, industry and energy production. Based on the results, the contribution of industry and energy production was generally less than 1% of the nitrogen dioxide concentrations and the majority of the nitrogen dioxide concentrations came from traffic exhaust emissions (about 75–90% of the concentrations depending on the location). In the case of fine particles and inhalable particles, the share of industry and energy production of the impacts was up to less than 1% of the generated concentrations, and street dust, traffic exhaust gases and property-specific heating had a more significant impact on the concentrations of the breathing air. Nitrogen dioxide and particulate matter concentrations in both Hepomäki and Sorsasalo and their vicinity were generally clearly lower than in the Kuopio city centre area or along the motorway (Finnish national road 5). Concentrations in these areas remained well below the air quality guideline and limit values.

11.2 Impact assessment and methodology

Air quality impacts of the project are evaluated as an expert assessment, based on the current state of air quality in the project area and the airborne release generated by the operations. Conventional airborne discharges that impair air quality are not released from the SMR plant and are therefore not modelled separately. The use of emergency diesel generators is not continuous at the SMR plant. They cause emissions into the air only during testing and in possible situations where the generators are used. The nitrogen oxide, sulphur dioxide and particulate emissions into the air generated by the generators are assessed on the basis of design data (technical data, estimated use, etc.). The exhaust emissions caused by the plant's traffic are estimated on the basis of traffic volumes. In addition, the air quality impacts of dust emissions from the project's construction work and from traffic during the construction period, and the measures to mitigate them, are assessed. The report also provides a verbal assessment of the reduction in airborne release volumes resulting from the replacement of the HPN2 power plant unit at the Haapaniemi district heating power plant and their impact on air quality.

Radioactive releases into the air are described in more detail in chapter 3.9. In principle, the SMR plant is designed in such a way that its radioactive releases are below the limit values set for them and do not have adverse effects on the environment or humans. Radioactive releases into the air during operation are assessed by experts by comparing preliminary data from the SMR plant with emission limits for existing nuclear power plants and with actual emissions. Exceptional and emergency situations involving radioactive substances and their modelling are described in chapter 21.

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12 PEOPLE'S HEALTH, LIVING CONDITIONS AND COMFORT

12.1 Current status

12.1.1 Hepomäki

12.1.1.1 Settlement

The area surrounding the Hepomäki SMR plant is sparsely populated (Figure 12-1). The nearest individual residential building is located south of the plant area, approximately 270 metres from the plant area boundary. Holiday homes are located to the south of the plant area, the nearest about 350 metres away from the area, and to the north-east about 770 metres away. An individual residential building is located about 870 metres to the north of the plant area. The most densely populated areas are Kylmämäki to the northeast at a distance of just over a kilometre, Tahvanlahti to the north at about a kilometre, and Nuolimäki to the southeast at about 1.5 kilometres from the project area. Settlement is sparse on the west side of the project area.

The district heating line mainly runs in an uninhabited area. The nearest residential buildings are located approximately 65–100 metres from the district heating line in Purola.

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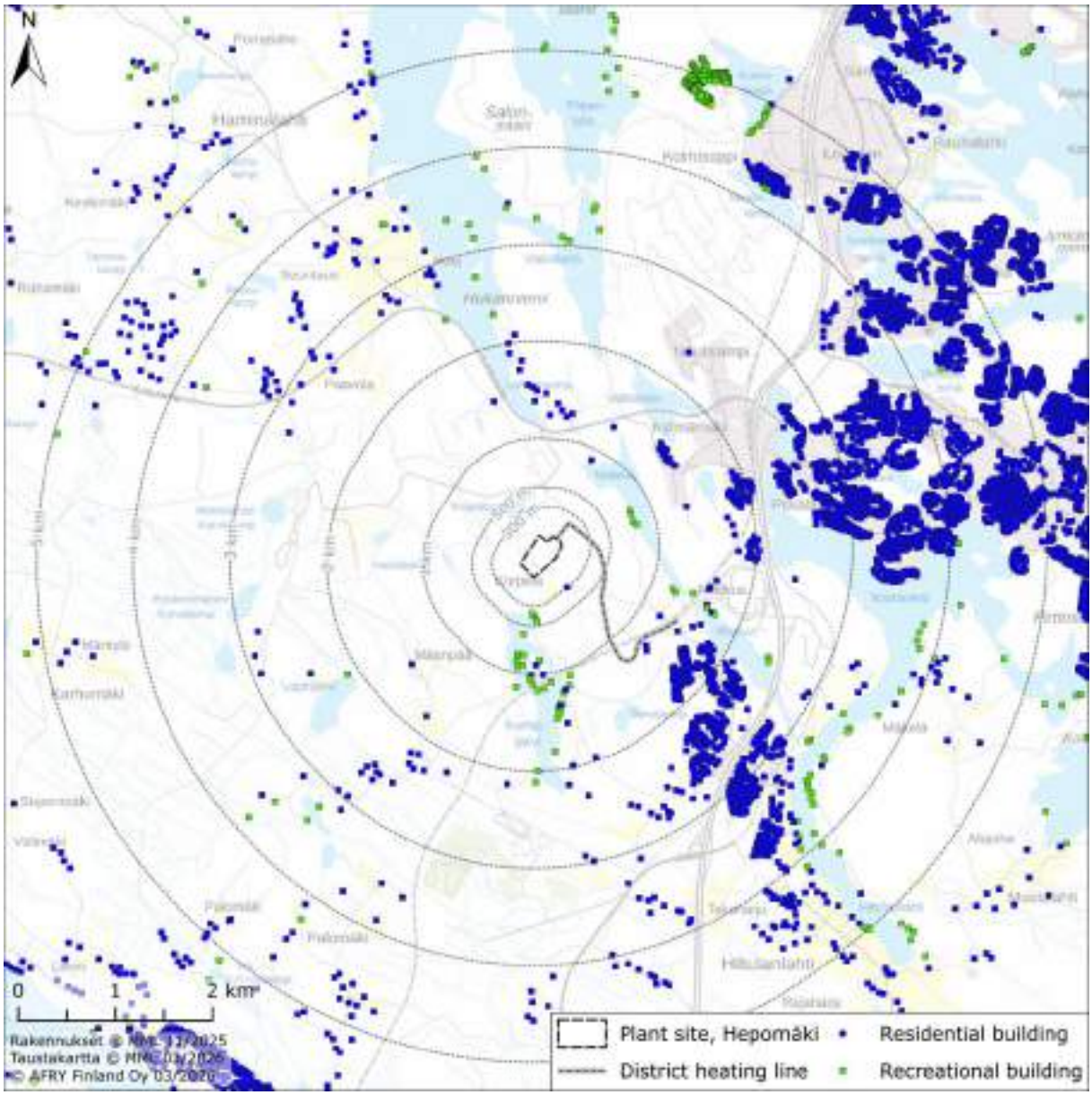

Figure 12-1. Settlements around the Hepomäki project area.

The most densely populated areas in the vicinity of the Hepomäki SMR plant area are located to the east of the project area, for example, in the Petonen, Rasinmäki and Särkilahti areas (Figure 12-2).

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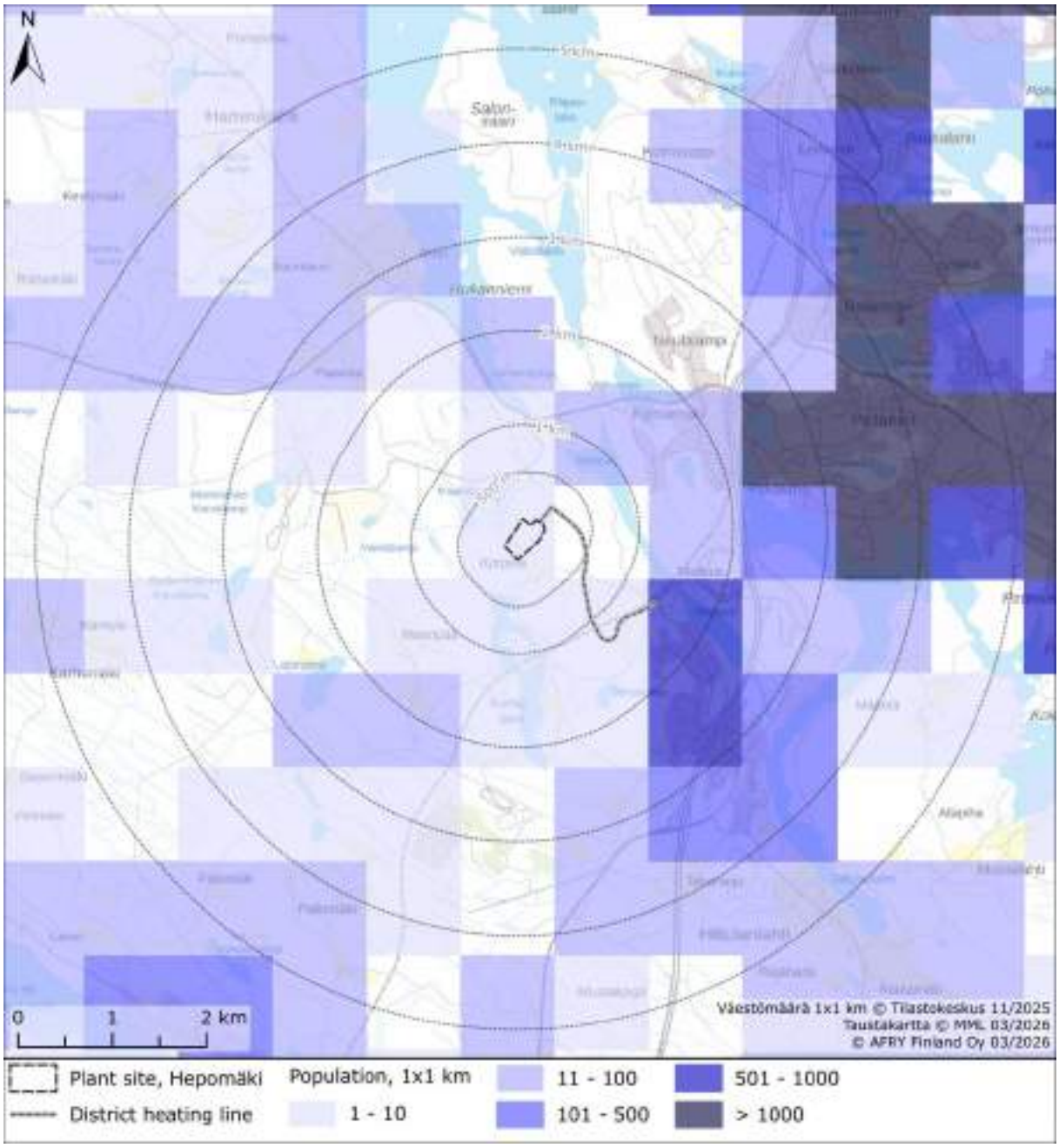

Figure 12-2. Population around the Hepomäki project area within a radius of about five kilometres.

The number of people living around the Hepomäki plant area is described in the distance zones (Table 12-2). About 3,200 people live within three kilometres from the plant area, about 16,000 live within five kilometres and about 110,500 live within 20 kilometres (Statistics Finland 2025b). Fewer than 322,000 people live within a 100 kilometre radius. The largest population centres are Kuopio, Siilinjärvi, Iisalmi, Varkaus and Pieksämäki within less than 100 kilometres of the project areas.

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Table 12-1. The number of inhabitants around the Hepomäki plant area in the distance zones.

Distance from Hepomäki plant area	Number of inhabitants (persons)
3 km	about 3,200
5 km	about 16,000
20 km	about 110,500
100 km	about 322,000

12.1.1.2 Other sensitive sites

The nearest sensitive sites to the plant area are located in the Petonen area (Figure 12-3). The nearest school is about 2.6 kilometres northeast of the plant area boundary, the health centre about four kilometres northeast, and the nursing home about 3.5 kilometres west. In the Hiltulanlahti area, about three kilometres southeast of the plant area, there is a school and two daycare centres.

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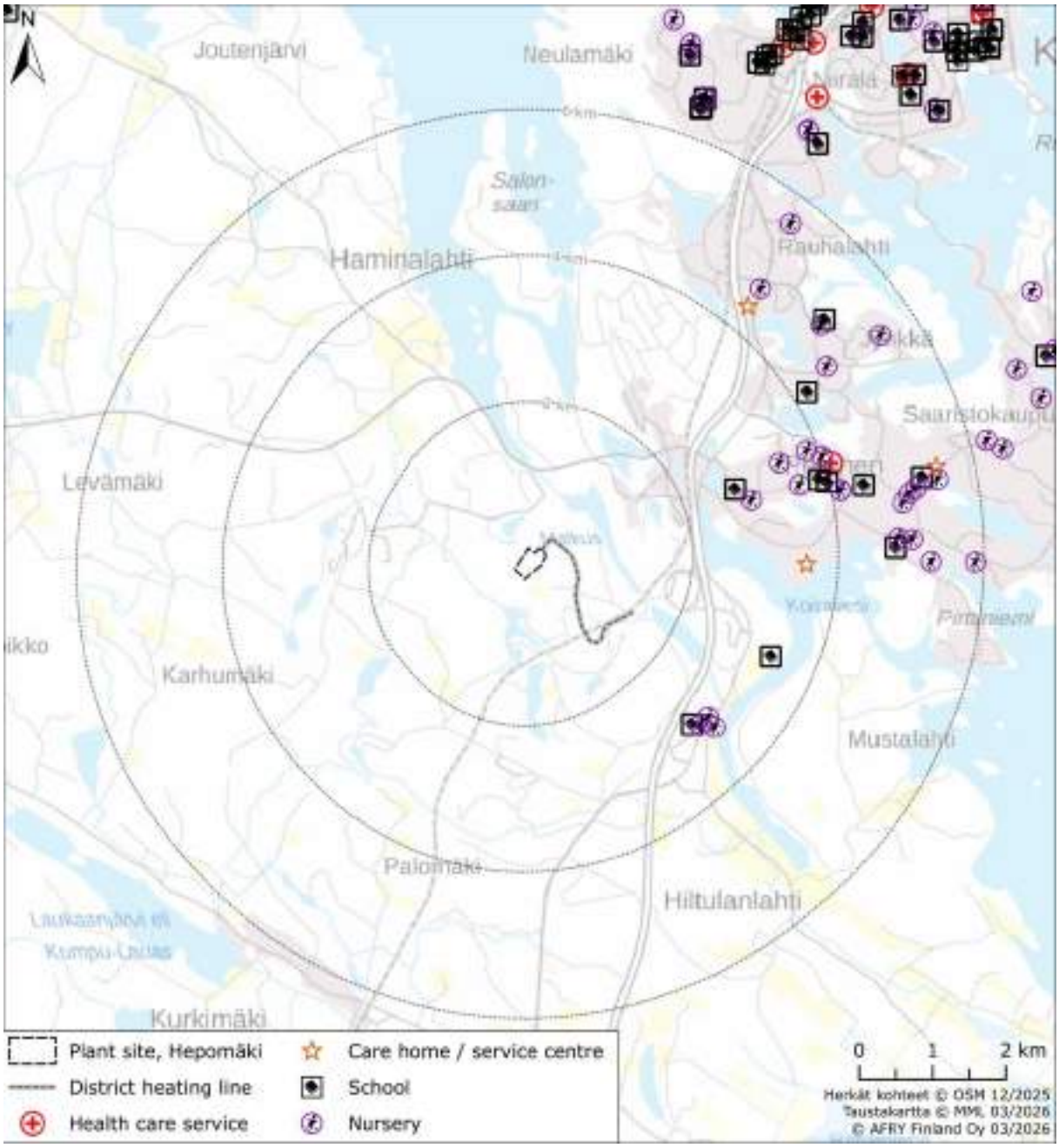

Figure 12-3. Sensitive sites in the vicinity of the Hepomäki project area.

12.1.1.3 Recreation

There are no recreational routes or sites in the spatial data register of sports in the immediate vicinity of the Hepomäki plant area (University of Jyväskylä 2025). The nearest recreational route is a cycling route (Figure 12-4) located approximately one kilometre north of the plant area. The Haminalahti lean-to and cultural trail are to the north of the plant area at a distance of about two kilometres.

A snowmobile track (Figure 12-4) is just over a kilometre south of the plant area. The snowmobile track is located south of the district heating line, at its nearest point approximately 180 metres away. A nature trail runs around Tervalampi, partly in a nature reserve, about 400 metres south of the district heating line (approximately 1.8 km from the plant area).

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The environment of the project area can also be used for independent recreational purposes, such as activities in nature, mushroom picking and berry picking.

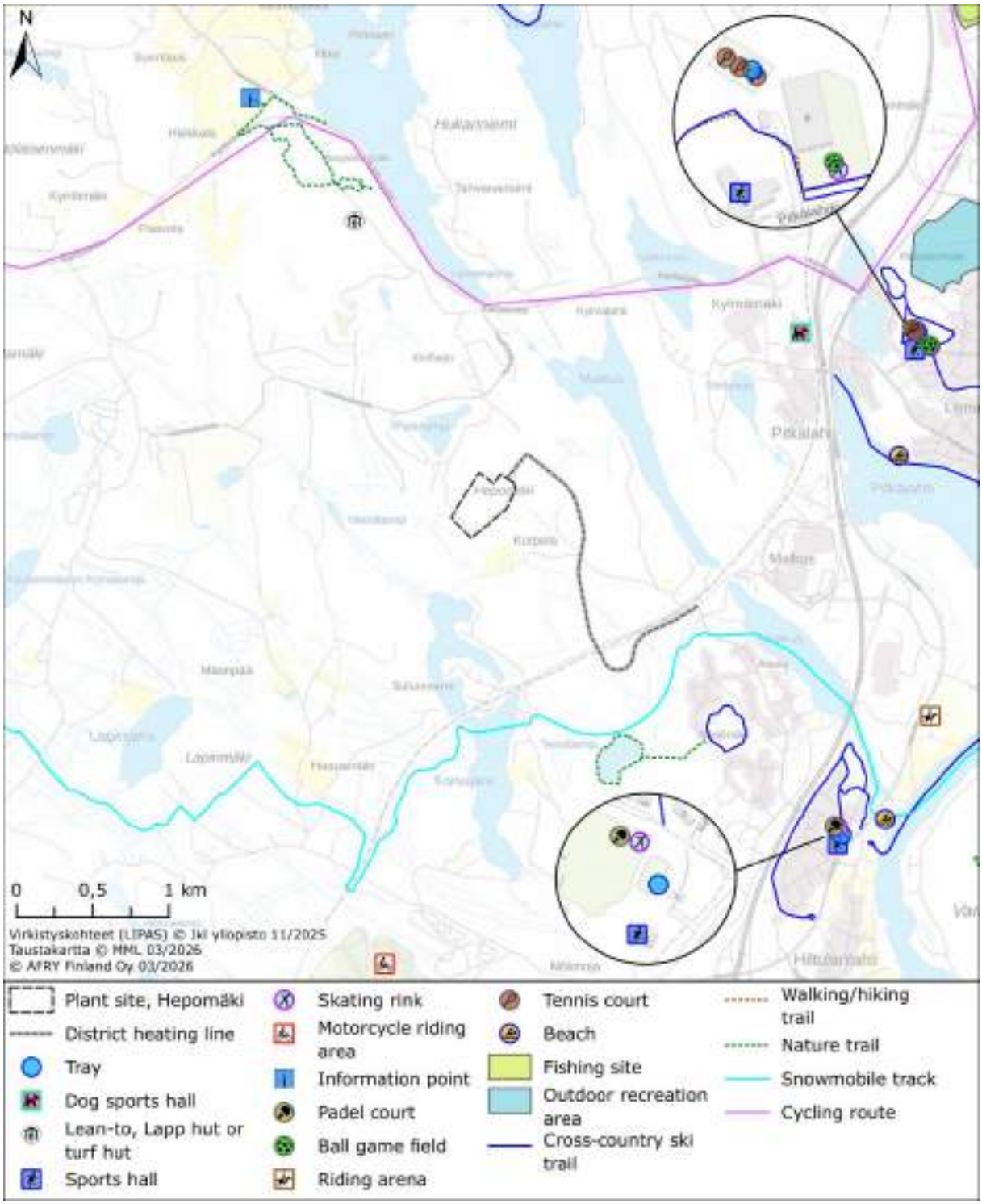

Figure 12-4. Recreational sites and routes in the vicinity of the Hepomäki project area.

12.1.2 Sorsasalo

12.1.2.1 Settlement

The nearest individual residential building is about 280 metres northeast of the SMR plant area (Figure 12-5). Individual residential and holiday buildings are located to the north of

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the plant area, the nearest being at a distance of approximately 330 metres. The holiday buildings located south of the plant area on the Mondi Powerflute Oy's property are owned by Mondi and not used for permanent holiday home purposes. On the northern shore of Virtasalmi and in the southwestern and northwestern parts of Sorsasalo, holiday homes are particularly common. Within a radius of three kilometres, settlement is found especially in the Vuorela area of Siilinjärvi and on the Kuopio side in Kettulanlahti.

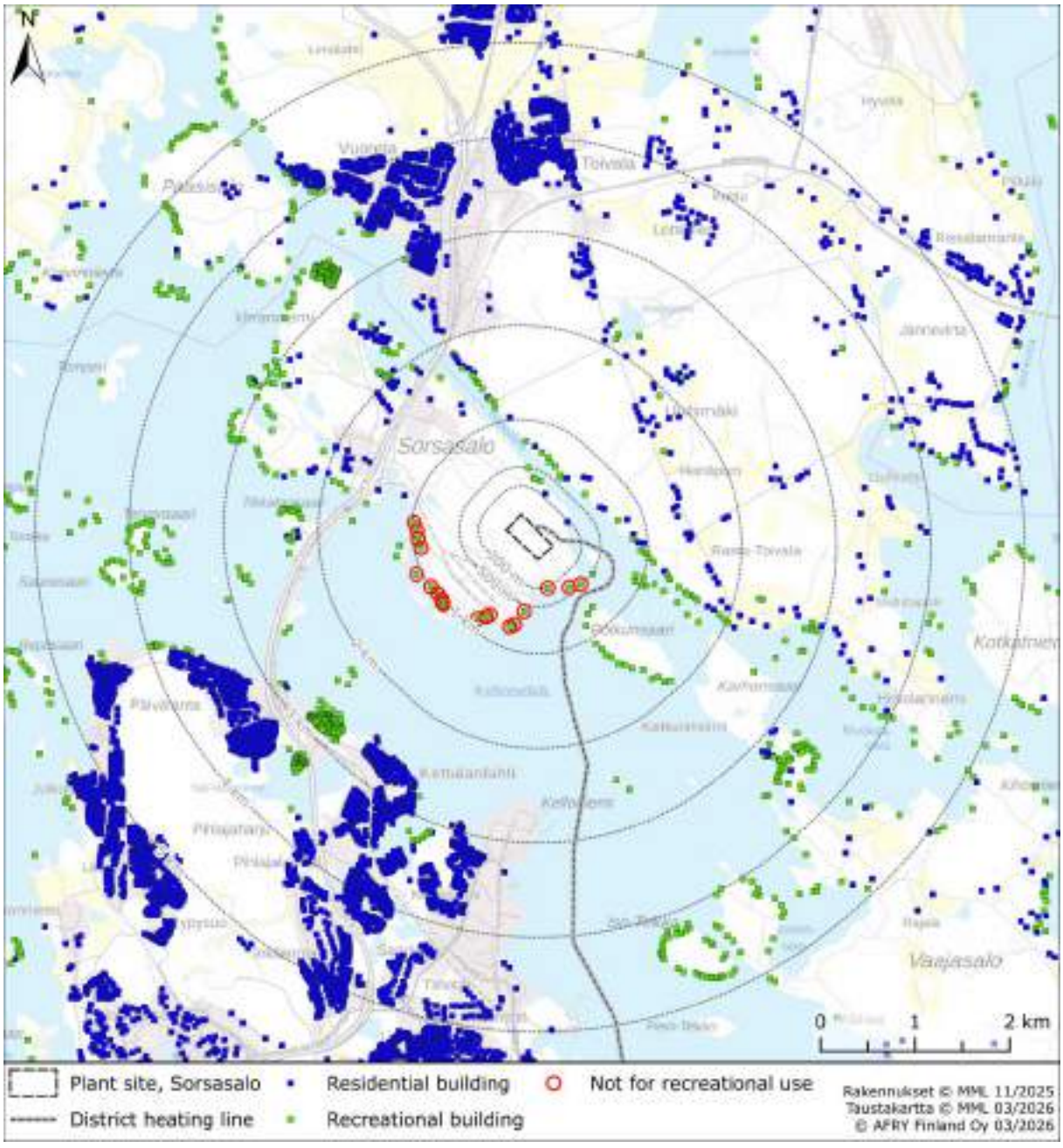

Figure 12-5. Settlements in the vicinity of the Sorsasalo plant area.

No settlements are located in the immediate vicinity of the district heating line. In Sorsasalo, the nearest residential building is located approximately 190 metres from the district heating line (Figure 12-5). In the first section of the district heating line, the holiday buildings on nearby islands, such as Lukkosaari, Tervasaari and Potkunsaari, are located at a distance of about 150 metres from the district heating pipeline. In the southern part of the district heating line on route B, Lehtosaari's holiday and residential buildings lie just

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over 65 metres from the line (Figure 12-6). In Haapaniemi, the nearest residential buildings are located approximately 75 metres from the district heating line.

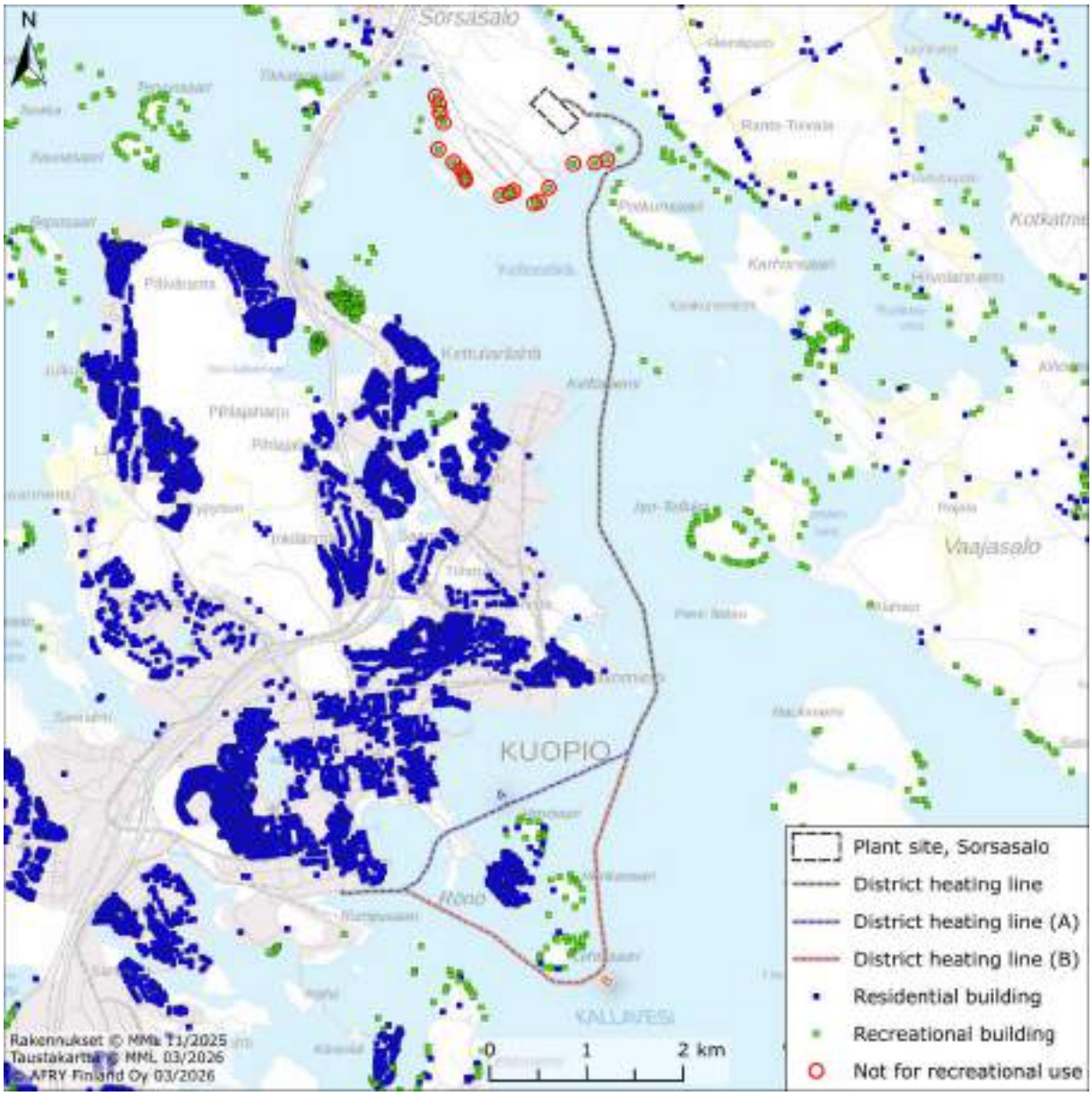

Figure 12-6. Settlements in the Sorsasalo project area.

The most densely populated areas near the SMR plant area are Vuorela and Toivala in Siilinjärvi, and to the south of the site, Päiväranta, Länsi-Puijo and Kuopio city centre (Figure 12-7).

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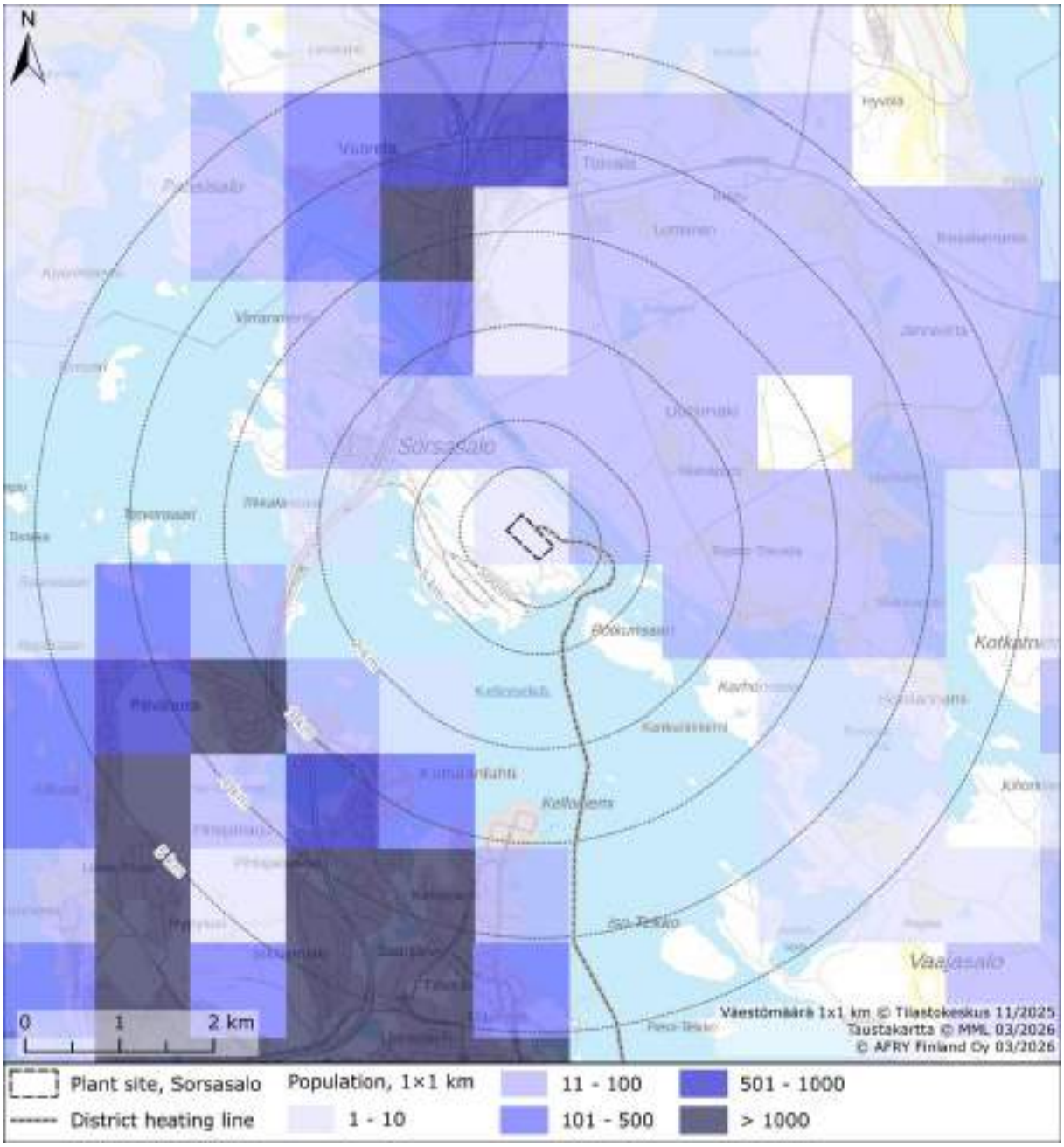

Figure 12-7. Population around the Sorsasalo plant area.

The number of inhabitants in the Sorsasalo plant area are described in the distance zones (Table 12-2). About 1,800 people live within three kilometres, about 18,000 within five kilometres and about 122,000 within 20 kilometres (Statistics Finland 2025b). Approximately 307,000 people live within one hundred kilometres from the project area.

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Table 12-2. The number of inhabitants around the Sorsasalo plant area in the distance zones.

Distance from the Sorsasalo plant area	Number of inhabitants (persons)
3 kilometres	about 1,800
5 kilometres	about 18,000
20 kilometres	about 122,000
100 kilometres	about 307,000

12.1.2.2 Other sensitive sites

In the Vuorela area of Siilinjärvi, several daycare centres, schools and a health centre are located at a distance of about 2.5 kilometres to the northwest of the plant area (Figure 12-8). In Siilinjärvi, about four kilometres north of the plant, there are two schools and a daycare centre. On the side of the City of Kuopio, in the Päiväranta area about 3.5 kilometres southwest of the plant, there are two schools, a daycare centre and a child health clinic. To the south of the plant area in Kettulanlahti, there is also a school and a daycare centre about 3.5 kilometres away. Schools, daycare centres and a hospital are located in the Julkula and Länsi-Puijo areas, with the nearest of these about five kilometres from the plant area boundary. Several hospitals, schools and daycare centres are located in the centre of Kuopio and in the Puijonlaakso area, just over six kilometres from the plant area.

No sensitive sites are located in the immediate vicinity of the district heating line (Figure 12-8).

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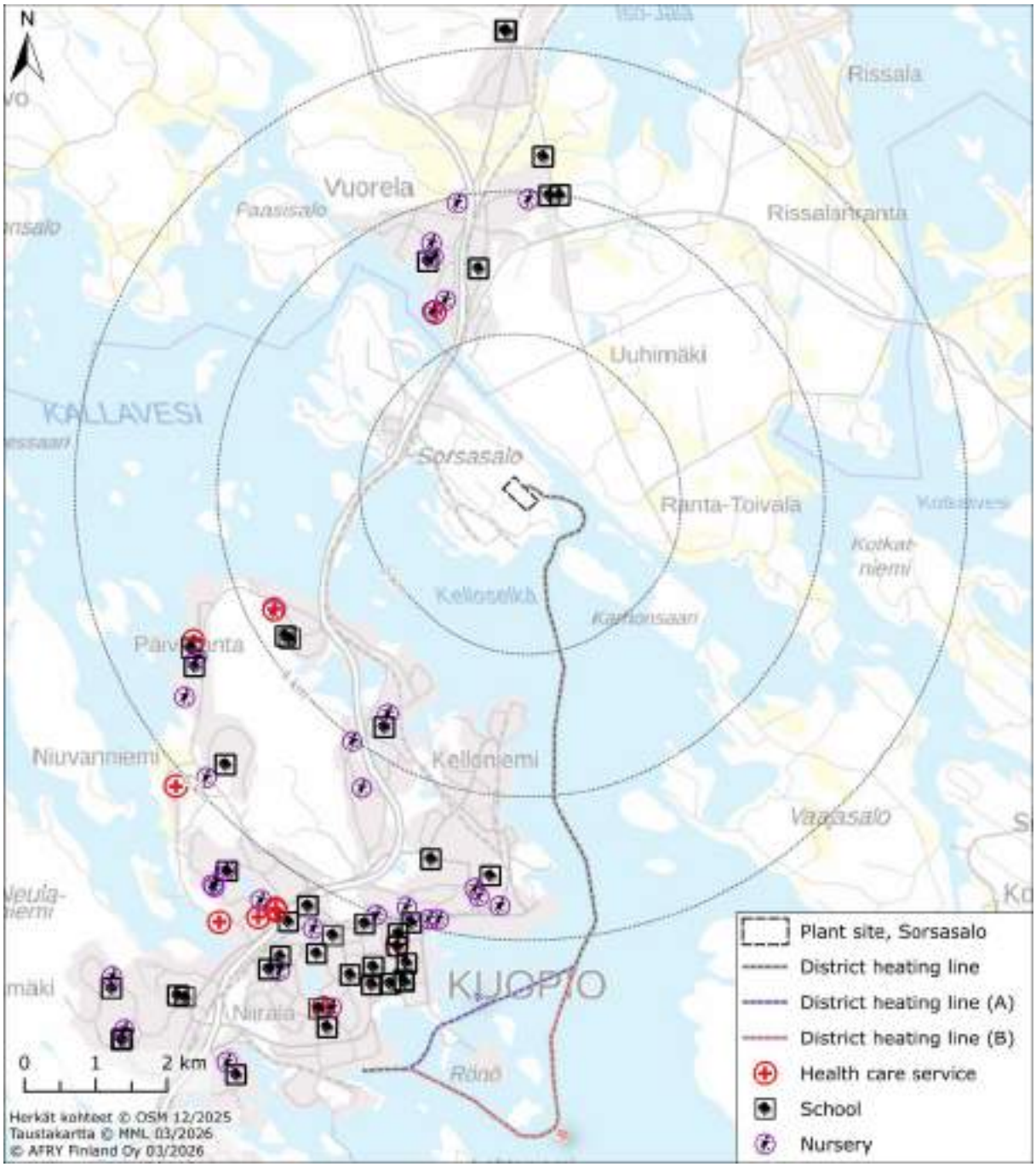

Figure 12-8. Sensitive sites in the vicinity of the Sorsasalo project area.

12.1.2.3 Recreation

In Uuhimäki to the northeast of the Sorsasalo plant area, there is a nature trail, a campfire site and a landing point for paddlers at a distance of about 670 metres from the edge of the SMR plant area (Figure 12-9). A ski track is located in Uuhimäki at a distance of about 1.5 km. In the northwestern part of Sorsasalo, there is a racetrack, a dog sport facility, riding arenas and a canoe/kayak launch. The distance from recreational sites to the plant area is just over two kilometres at its closest. A cycling route runs along Finnish national road 5. Tikkalansaari has a boat landing site and on the east side of Finnish national road 5 there is a paddling dock about 1.7 km from the plant area boundary. In Karhonsaari on the southeast side of the project area, there is a nature trail, a lean-to and a pier for boating about two kilometres from the plant area.

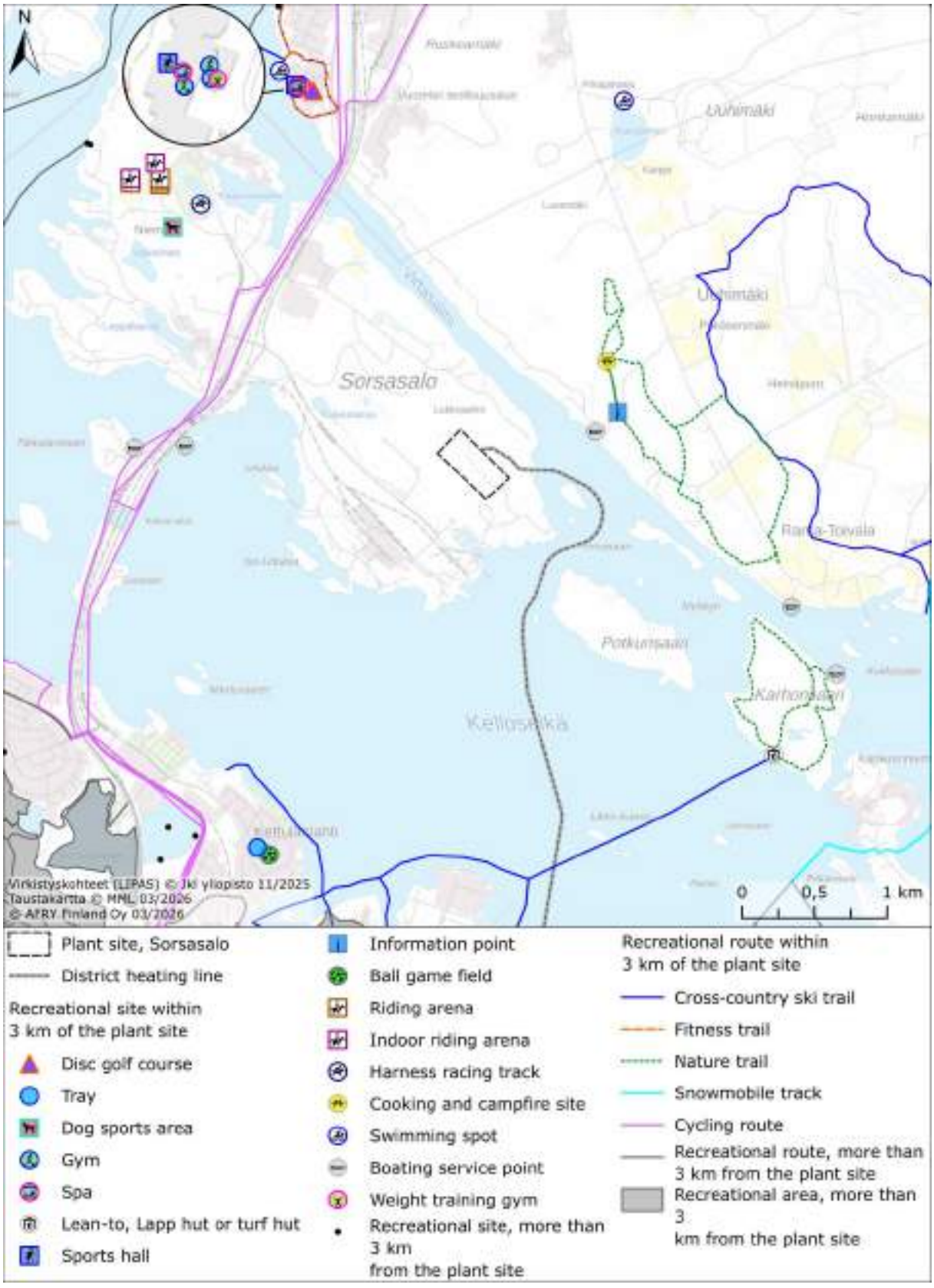

Figure 12-9. Recreational routes and sites in the vicinity of the Sorsasalo plant area.

The district heating line has impacts on the recreational use of the area mainly during its construction. If construction takes place during the winter, it may cause temporary

restrictions on recreational use of the ice, such as snowmobiling or skiing. At other times, short-term impacts may occur, for example, on boating.

The route of the district heating line crosses with the ski track network on the east side of Kelloniemi (Figure 12-9) The ski track crosses with the transmission pipeline on the east side of Honkalahti (Figure 12-10) for the second time. On the Pieni-Telkko island, there is a lean-to about 850 metres east of the transmission pipeline. A snowmobile track crosses the transmission pipeline on the southeast side of Itkonniemi.

The district heating line A crosses the snowmobile track and reaches Väinölänniemi on the north side of the beach volleyball court (Figure 12-10). The line intersects a cycling route and a recreational route on Väinölänniemi's eastern and western shores. In Kuopionlahti, the district heating line crosses the ski track twice. The Keiliniemi swimming area lies to the east of district heating line A, about 120 metres away.

The district heating line B crosses the snowmobile track twice (Figure 12-10). At their nearest point, Rönö's ski tracks run about 60 metres to the north of the district heating line B. Alternative district heating lines meet south of Haapaniemi and intersect the ski track once before reaching Haapaniemi. The cycling and outdoor routes are at their closest approximately 55 metres from the district heating line in Haapaniemi.

In addition to the recreational routes and sites listed in the spatial data register of sports, the surroundings of the project area can be used for independent recreational purposes, such as activities in nature, boating, mushroom picking and berry picking.

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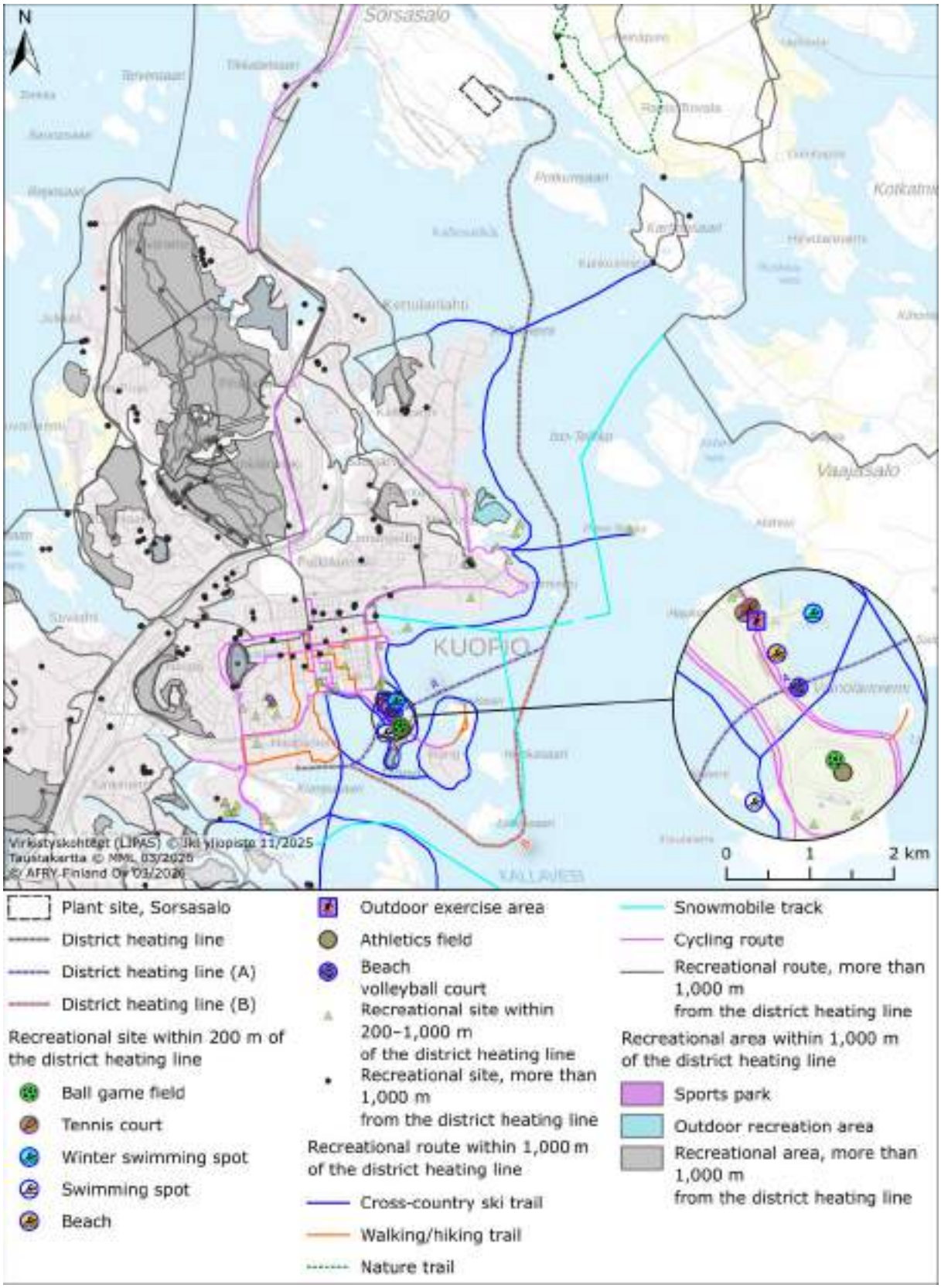

Figure 12-10. Recreational routes and sites in the vicinity of the Sorsasalo project area.

12.2 Impact assessment and methodology

The impact of the project on people's health, living conditions and comfort is assessed by using computational and qualitative estimates generated in other impact assessment

sections, such as noise impacts and impacts on water bodies and traffic. In addition, the assessment uses other relevant information produced during the planning process concerning the project's characteristics. The assessment emphasises both impacts assessed as significant and those people perceive as such and which give rise to concerns.

The assessment considers the area's current use and examines the project-related changes to its present condition. Background material is used to describe the project area, including the locations of settlements and recreational areas, as well as the so-called sensitive sites such as daycare centres and schools. The attitudes of residents and other stakeholders to the project will be explored, for example, by using the views presented at the public event at the EIA programme phase and in the project monitoring group. In addition, the opinions given on the assessment programme and the discussions at get-togethers and other events held for the residents of Kuopion Energia are examined.

The impacts on health are assessed by comparing the estimated impacts of the project with the health-based guideline value or recommendation for each impact. Impacts on health may be caused, for example, by traffic, noise, dust, vibration and other emissions into the air.

In the normal operation of a nuclear power plant, the radiation exposure limit for an individual is 0.1 millisievert (161/1988, Section 22b), and the undercutting of the limit value is taken into account in the design of the SMR plant. The radiation dose caused by Finland's operating nuclear power plants to the surrounding population has been less than one percent of the set annual dose limit (Radiation and Nuclear Safety Authority 2026). Estimates of the quantities of radioactive emissions from the normal operation of the SMR plant is compared with the emission limits and actual emissions from the normal operation of Finland's current nuclear power plants.

Radiation exposure related to emergency and accident situations will be modelled taking into account the impacts of a severe accident, which is described in chapter 21.

The assessment area of the impacts on people is determined by the spatial extent of the impacts. The main focus of the assessment is on the immediate environment of the project area, as the most significant impacts are expected to be on the immediate area of the project during operation.

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13 SOIL, BEDROCK AND GROUNDWATER

13.1 Current status

13.1.1 Soil

13.1.1.1 Hepomäki

At the SMR plant area, aggregate has been extracted, and the area is no longer in a natural state. Unquarried area and thus natural topsoil remain only on the southwestern and southeastern edges of the plant area, as well as in the northeastern part. On the quarried area, on top of the rock, there is approximately a one metre thick layer of crushed rock from the rock extracted on site (AFRY Finland Oy 2025e).

According to the soil map of the Geological Survey of Finland, the topsoil in the area of the SMR plant is sandy till (Figure 13-1). The soil along the route of the district heating transmission connection is sandy till. In the area of Sulunkinkku and the railway underpass, bedrock is marked on the soil map, so the bedrock lies less than one metre below ground level. (Geological Survey of Finland 2025a)

Based on the Geological Survey of Finland's Surveys on Acid Sulfate Soils material (Geological Survey of Finland 2025b), there are no acid sulphate soils or black shale in the SMR plant area or the area of the district heating transmission pipeline. The nearest black shale, interpreted from an electromagnetic map, is in the Matkus area approximately 790 m northeast of the plant area.

There are no nationally valuable moraine formations or wind and shore deposits in the vicinity of the project's activities (Finnish Environment Institute 2025h).

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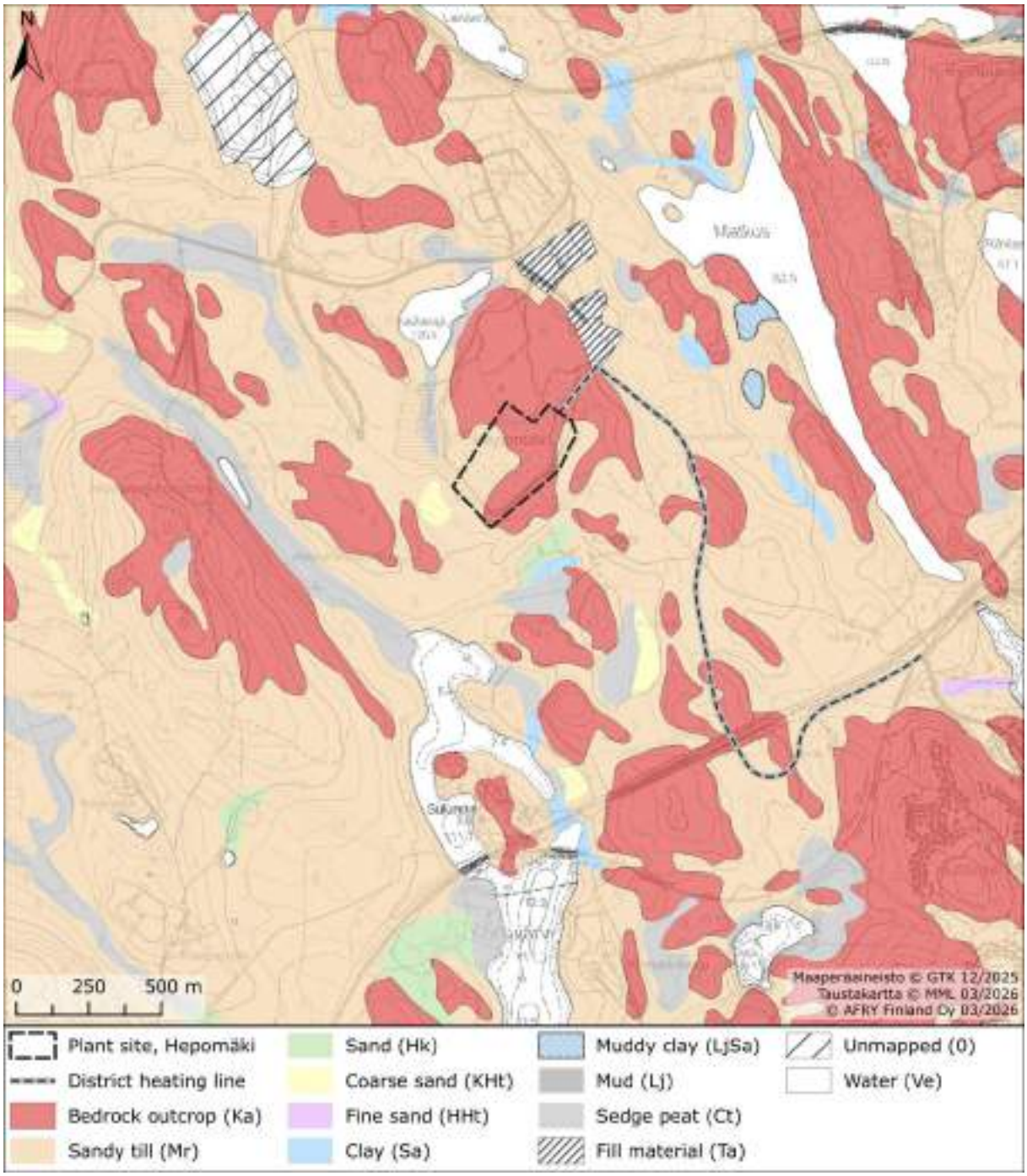

Figure 13-1. Soil types on and around the Hepomäki plant area and the district heating transmission line area.

Sites marked in the national soil database system (MATTI), maintained by the Finnish Environment Institute, are located to the west and north of the plant area (Finnish Environment Institute 2025i). The database system contains information on potentially contaminated areas, areas confirmed as contaminated, cleaned areas and areas confirmed as clean. The information is constantly updated, but may not be fully up to date. In Kuopio, the Finnish Supervisory Authority is responsible for updating the information regarding the system.

Rudus Oy's aggregate quarry in Hepomäki is listed in the soil database system under the code 100300752 (Finnish Environment Institute 2025j). In 2013, an electricity transformer

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leak occurred in the aggregate quarry area, after which the rescue department visited the site to determine the situation, and the soil contaminated with oil was repaired the next day as replacement of soil (Wallenius, J. 2025).

The asphalt station located north of the plant area at a distance of about 100 metres is in the soil database system under the code 100323099 (Finnish Environment Institute 2025k). Approximately 92 tonnes of heavily contaminated soil was removed from the site in 2005 (Wallenius, J. 2025).

13.1.1.2 Sorsasalo

The SMR plant area is located on a natural rock hill, where the soil cover consisting of fine-grained till is thin, 0–2 metres (AFRY Finland Oy 2025e). According to the soil map of the Geological Survey of Finland (Geological Survey of Finland 2025a), the thickness of the fine-grained till layer on the northeastern edge of the plant area is over one metre. Along the route of the district heating transmission connection near the plant area, the soil consists of fine-grained till, clay on the shore of Kallavesi, and sand at Väinölänniemi south of Kuopio city centre (route option A) (Figure 13-2). In other areas, the route of the transmission pipeline runs underwater at the bottom of Kallavesi. Available information on the bottom sediment is presented in chapter 14.1.5. The soil at the landing area of the district heating transmission connection at the Haapaniemi power plant site has not been mapped by the Geological Survey of Finland.

Based on the Geological Survey of Finland's Surveys on Acid Sulfate Soils material (Geological Survey of Finland 2025b), there are no acid sulphate soils in the SMR plant area or the area of the district heating transmission connection. The nearest black shale, interpreted from an electromagnetic map, is in the Virtasalmi area approximately 600 m northeast of the plant area and 300 m northeast of the district heating transmission connection.

There are no nationally valuable moraine formations or wind and shore deposits in the vicinity of the project's activities. (Finnish Environment Institute 2025h)

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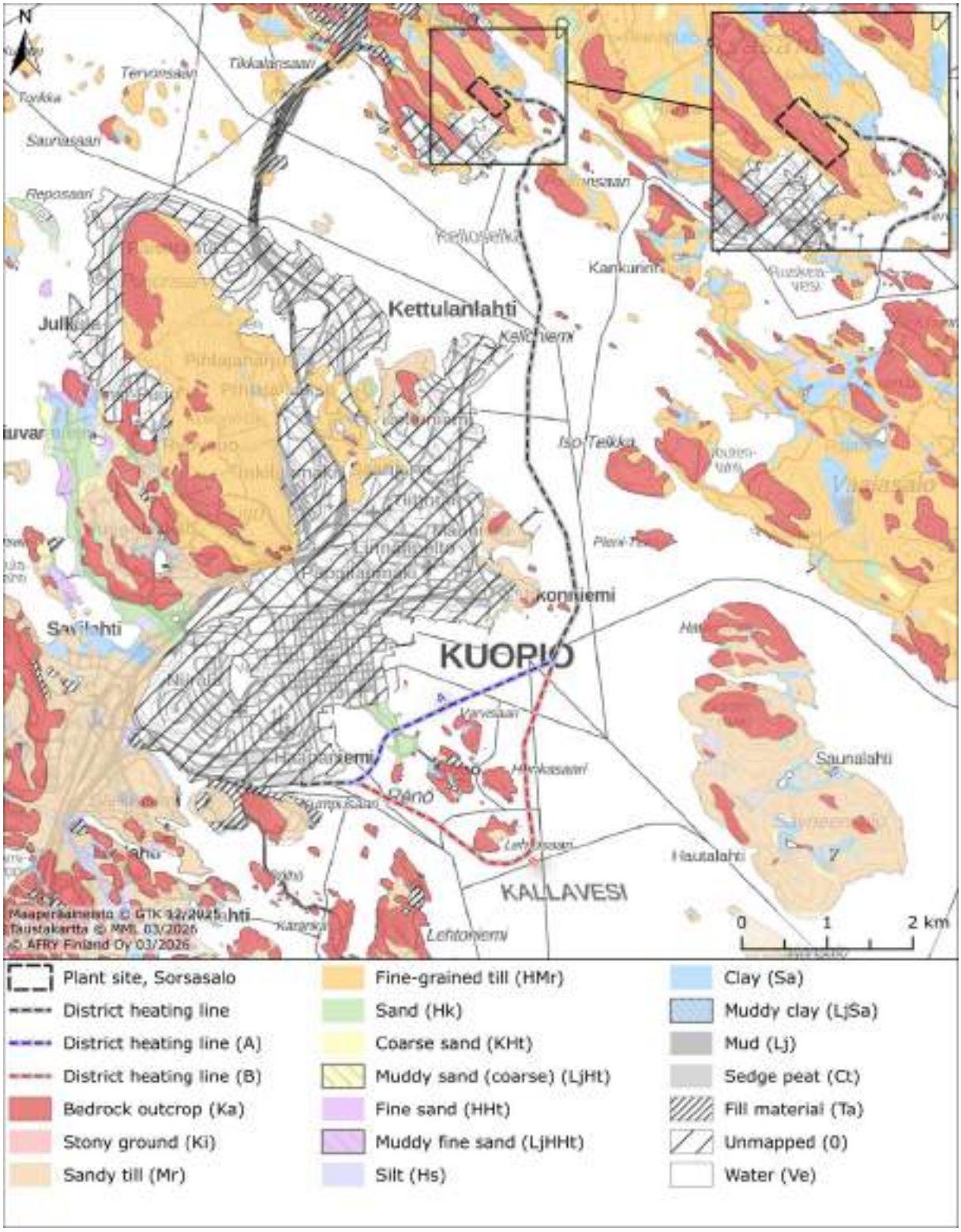

Figure 13-2. Soil types on and around the Sorsasalo plant area and the district heating transmission line area.

A site marked in the national soil database system (MATTI), maintained by the Finnish Environment Institute, is located to the southwest of the plant area (Finnish Environment Institute 2025i). The database system contains information on potentially contaminated

areas, areas confirmed as contaminated, cleaned areas and areas confirmed as clean. The information is constantly updated, but may not be fully up to date.

The site located on the southwest side of the plant area is Mondi Powerflute Oy's mill, which is recorded in the soil database system under the former owner name, Metsä-Serla, Savon Sellu Oy, with ID 100322141. The mill's old landfill was decommissioned in 2001, after which it was landscaped. The mill property 297-430-1-97 requires an assessment. The supervisory authority must be contacted if earthworks or changes in land use are planned, as increased concentrations of soil contaminants have been found on the site. (Finnish Environment Institute 2025l).

The route of the district heating transmission connection passes through the property of the aforementioned mill for about 100 metres along the shore of Kallavesi.

The old sludge area of the mill was renovated in 2001. In addition, soil and sediment in the area were studied in 2002, when harmful substances were found only in the sediment at significant concentrations. The Savon Sellu plot was inspected in 2003. Based on the results, there was no need for immediate follow-up measures. (Wallenius, J. 2025)

13.1.2 Bedrock

The project's activities are located in the Kuopio shear and fault zone (Figure 13-3) that is approximately 50 km wide, and it is called the Raahe–Laatokka zone. The so-called Suvasvesi fault runs along the northeastern edge of the zone, and the so-called Iisvesi fault runs along the southwestern edge. (AFRY Finland Oy 2025e)

In 2025, AFRY Finland Oy prepared a building feasibility survey for the Hepomäki and Sorsasalo areas (AFRY Finland Oy 2025e, AFRY Finland Oy 2025f), in connection with which the rock quality of the project's alternative sites was examined. The boundaries of the surveyed area differed slightly from the project areas of the EIA procedure (see chapter 13.1.3). As a result, Hepomäki's survey points are located just north of the plant area of the current SMR plant. Survey points in Sorsasalo are located in the central and southeastern parts of the current plant area.

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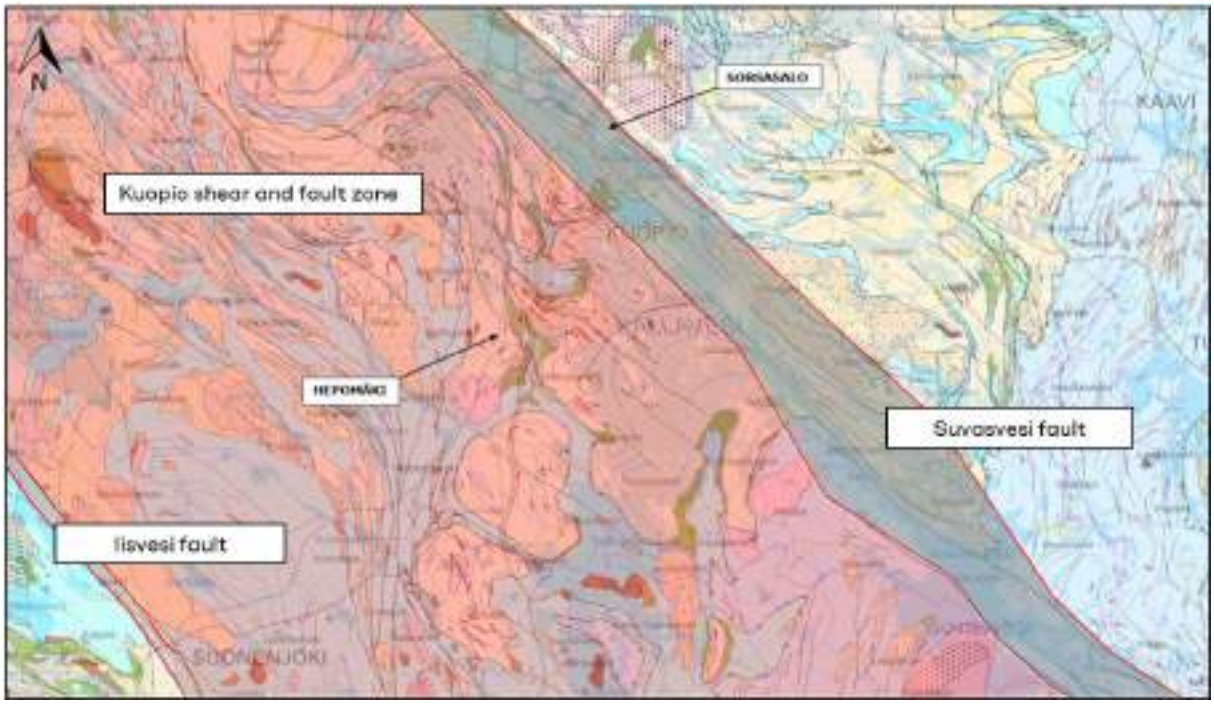

Figure 13-3. Alternative locations for the project's SMR plant and the Kuopio shear and fault zone. (Figure by: AFRY Finland Oy 2025e)

13.1.2.1 Hepomäki

According to the bedrock map of the Geological Survey of Finland (Geological Survey of Finland 2025c), the rock type of the SMR plant area and the area of the district heating transmission connection is tonalitic migmatite (Figure 13-4).

At the plant area, aggregate has been extracted, and the area is no longer in a natural state. The possibly more fractured surface layer of the rock has been extracted. The schistosity of the area is typically north–south or northwest–southeast oriented and almost vertical. Across the site, the Geological Survey of Finland has interpreted a north–south structure (Figure 13-4), which is a potential zone of weakness, on the basis of magnetic data. In addition to fissuring parallel to the schistosity, the Hepomäki quarry walls exhibit a near-vertical, east–west main fissure orientation and a gently sloping southeast–south fissure orientation. Based on the results of the building feasibility study, the rock quality in Hepomäki was found to be moderate – good. (AFRY Finland Oy 2025e)

At Matkus, the Geological Survey of Finland's Bedrock of Finland 1:200 000 data indicate an undetermined northwest–southeast fault (Geological Survey of Finland 2025c).

There are no nationally valuable rock areas or cobble deposits nearby. The nearest such area (a very valuable rock area, the Korsunmäki rock area) is located about 500 metres south of the district heating transmission line. (Finnish Environment Institute 2025h)

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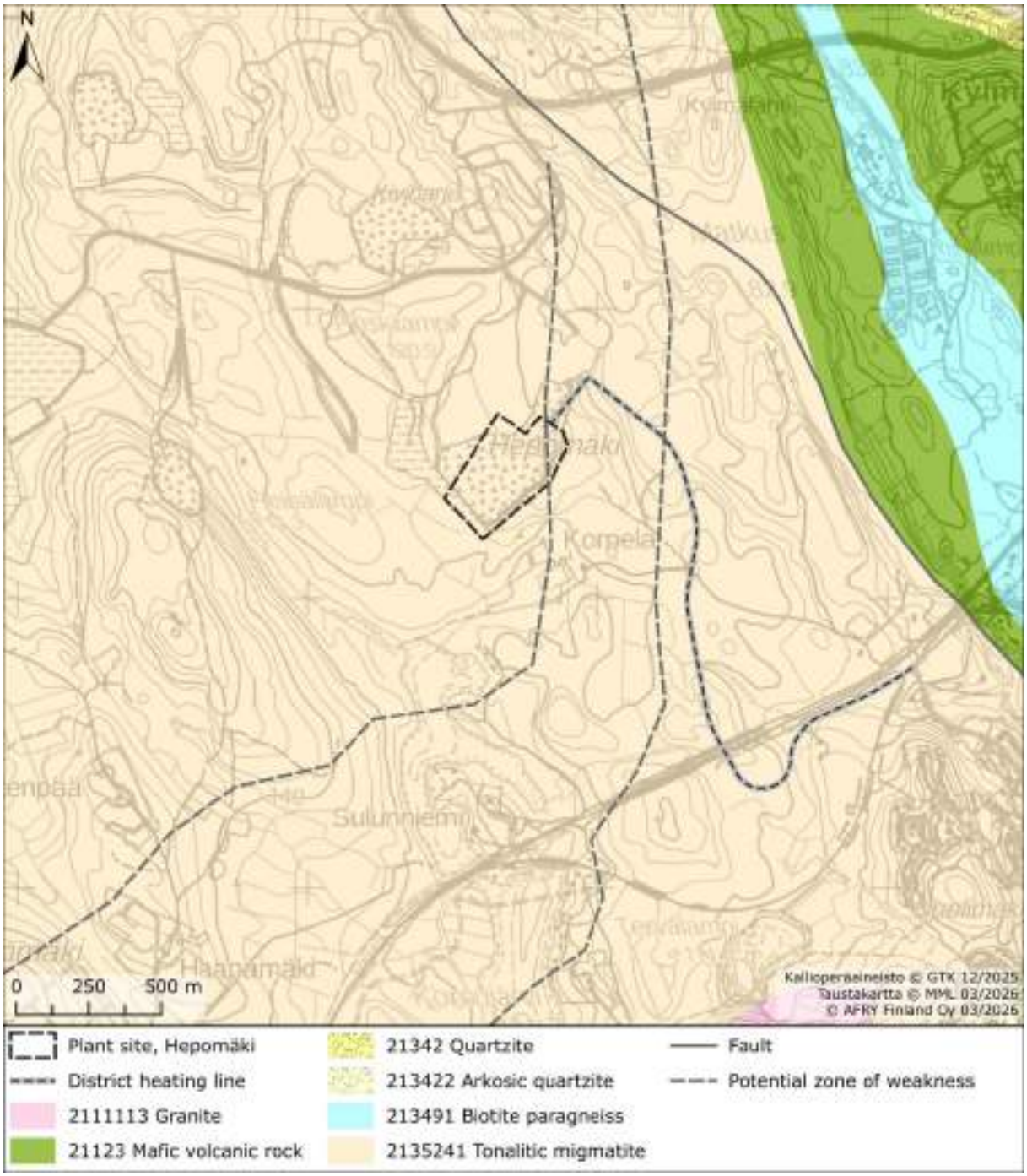

Figure 13-4. The rock types in the Hepomäki plant area and the district heating transmission connection area, as well as their surroundings, together with a potential zone of weakness and an unspecified fault.

13.1.2.2 Sorsasalo

According to the bedrock map of the Geological Survey of Finland (Geological Survey of Finland 2025c), the rock type of the area of the SMR plant is tonalite (Figure 13-5).

The area's schistosity mainly follows the direction of the Suvasvesi fault and is thus northwest–southeast oriented and nearly vertical. During the site visit for the building feasibility survey, in addition to fissuring parallel to the schistosity, a nearly perpendicular, vertical fissure orientation relative to the schistosity was observed. No observations could be made of horizontal or gently sloping fissuring in the rock outcrops of the terrain.

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However, the horizontal fissuring of the rock surface is clearly visible on the excavated rock faces, about 300 metres northwest of the site of the SMR plant. On the basis of research data, the Sorsasalo bedrock was interpreted to be intact and of at least moderate rock quality, except for surface sections and narrow fracture zones occurring at greater depth. (AFRY Finland Oy 2025e)

The parts of the Suvasvesi fault have been interpreted by the Geological Survey of Finland on both sides of the Sorsasalo project area (Figure 13-5). The strongest evidence of this is the narrow, elongated Virtasalmi, more than 10 metres deep, to the northeast of Sorsasalo, which was probably formed along such a fault line. The interpreted positions of the fault lines are indicative. (AFRY Finland Oy 2025e)

According to the bedrock map of the Geological Survey of Finland (Geological Survey of Finland 2025c), the rock types in the area of the district heating transmission connection are micaceous gneiss, granodiorite, tonalite gneiss, quartzite and biotite paragneiss (Figure 13-5).

There are no nationally valuable rock areas or cobble deposits nearby. The nearest such area (a very valuable rock area, Vierunmäki) is located approximately 13 kilometres southeast of the SMR plant area. (Finnish Environment Institute 2025h)

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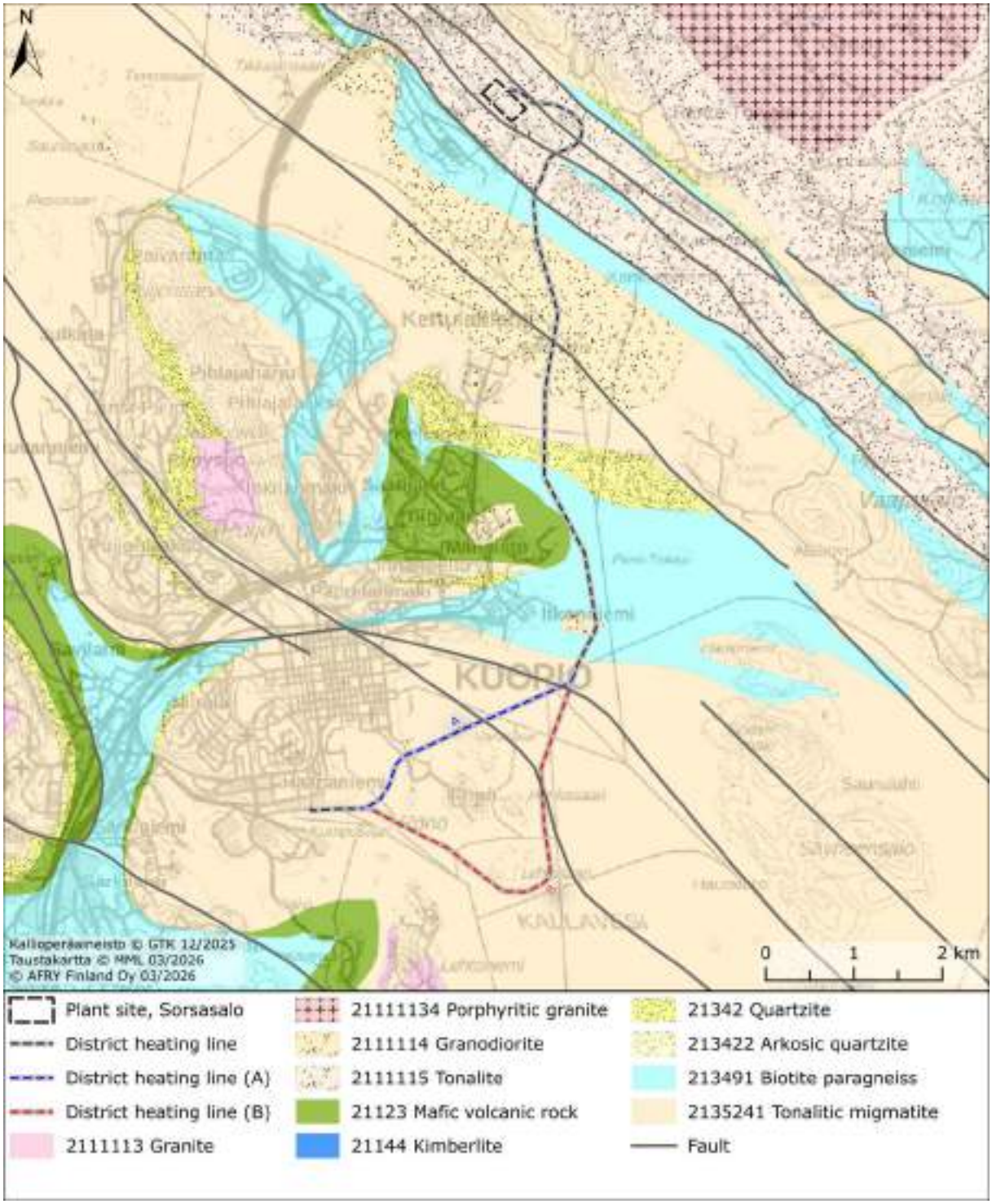

Figure 13-5. Rock types and faults on and around the Sorsasalo plant area and the district heating transmission line area.

13.1.3 Groundwater

The Hepomäki plant area or the district heating transmission line is not located in a classified groundwater area (Finnish Environment Institute 2025m). The nearest classified groundwater area is Kurkimäki (class 1, code 0829710) approximately 6.2 kilometres from the Hepomäki plant area and to the southwest from the route of the district heating

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transmission connection (Figure 13-6). The groundwater area Pellesmäki (1E class, code 0829711) is 7.0 kilometres south of the plant area and 6.4 kilometres south of the route of the district heating transmission connection (Figure 13-6).

In the terrain map of the National Land Survey of Finland, a spring is marked on the southeast side of the Hepomäki plant area at a distance of about 200 metres (National Land Survey of Finland 2025a). There are no springs in the area or in or around the area of the district heating transmission connection.

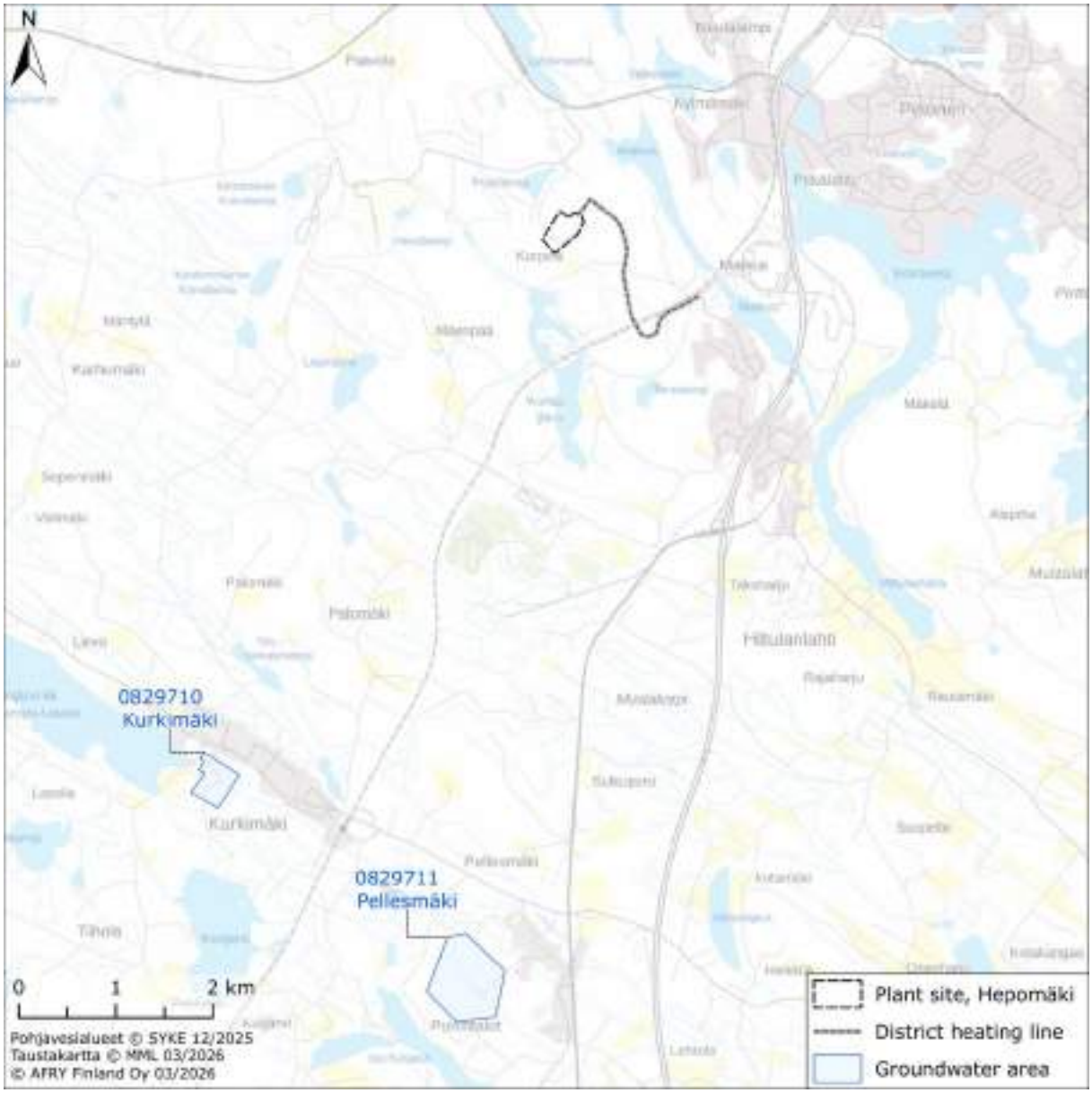

Figure 13-6. Groundwater areas closest to the Hepomäki project area.

The Sorsasalo plant area or the district heating transmission connection is not located in a classified groundwater area (Finnish Environment Institute 2025m). The nearest classified groundwater area is Hietasalo (class 1, code 0829704), approximately 2.0 kilometres southeast of the district heating transmission pipeline. The Kotkatniemi groundwater area (class 1, code 0829708) is approximately 4.9 kilometres east of the Sorsasalo plant area and 4.2 kilometres east of the district heating transmission connection (Figure 13-7). Reposaari groundwater area (class 2, code 0829703) is 5.0 kilometres west of the plant

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area (Figure 13-7). Based on a map review, there are no springs in or near the Sorsasalo plant area (National Land Survey 2025a).

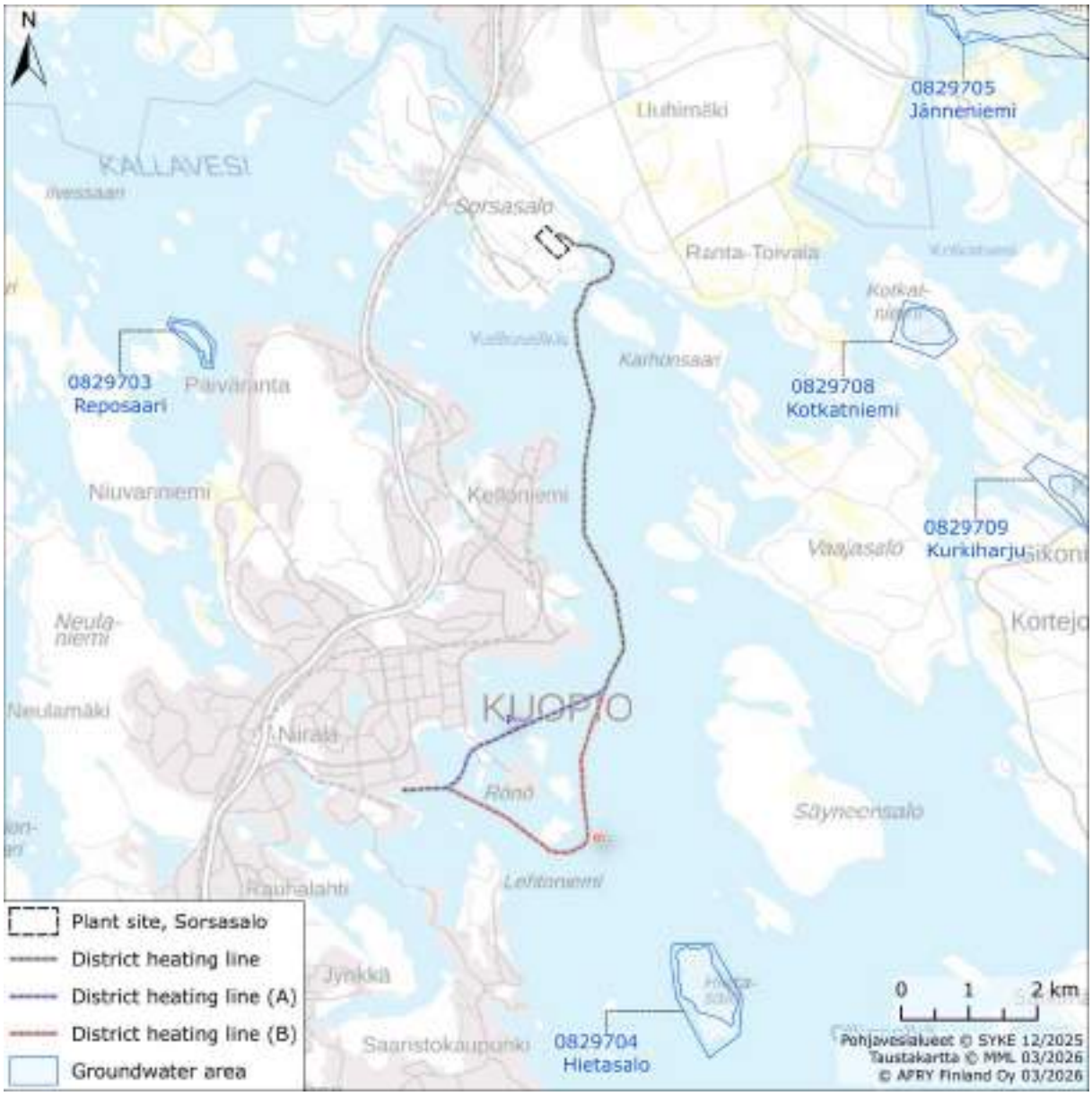

Figure 13-7. Groundwater areas near the Sorsasalo project area.

No significant amount of groundwater is estimated to occur in either of the alternative sites of the SMR plant, as there is only a thin layer of soil on top of the rock.

In connection with the 2025 building feasibility survey (AFRY Finland Oy 2025f), bedrock groundwater monitoring pipes approximately 50 metres deep were installed in the boreholes at both plant areas, through which the bedrock groundwater level can be measured and samples taken. Groundwater pipes enable monitoring of groundwater conditions before extraction and during construction.

Based on preliminary measurements of groundwater pipes (Figure 13-8) installed in test holes, the groundwater level in Hepomäki H1K is at +117.11 (at a depth of 1.61 metres from the ground) and at +119.70 (3.73 metres) in H2K. In Sorsasalo, the groundwater level in the S1K groundwater pipe is at +110.47 (6.13 metres). In the groundwater pipe

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S2K of survey point S2, there is an obstacle at a depth of four metres that prevents measurement. The groundwater level could not reached above this. (AFRY Finland Oy 2025f)

According to the building feasibility survey, open fissures occur in the bedrock of both Hepomäki and Sorsasalo, mainly in the surface layer of the rock. The bedrock's watertightness and, consequently, its fissuring and fracturing were studied as part of the building feasibility survey by a water loss measurement, in which water is pumped into the drill hole under pressure and water consumption (water loss) is monitored. In Hepomäki, open fissures do not involve high water consumption, so the water conductivity of the fissures is low. In Hepomäki, the fracturing and open fissures of the bedrock are confined to the surface layer of the rock, down to a depth of 2–3 metres. Deeper down the rock is solid and intact. At the Sorsasalo survey point S2, more extensive fracturing of the rock is present only within the top six metres. Narrow fracture zones also occur deeper down. Sorsasalo's high water consumption in the upper part of the bedrock down to a depth of 21 metres can be attributed to individual open fissures with high water conductivity. The (open) fissures deeper down are not associated with high water consumption, and the water conductivity of the bedrock is low. (AFRY Finland Oy 2025e, AFRY Finland Oy 2025f)

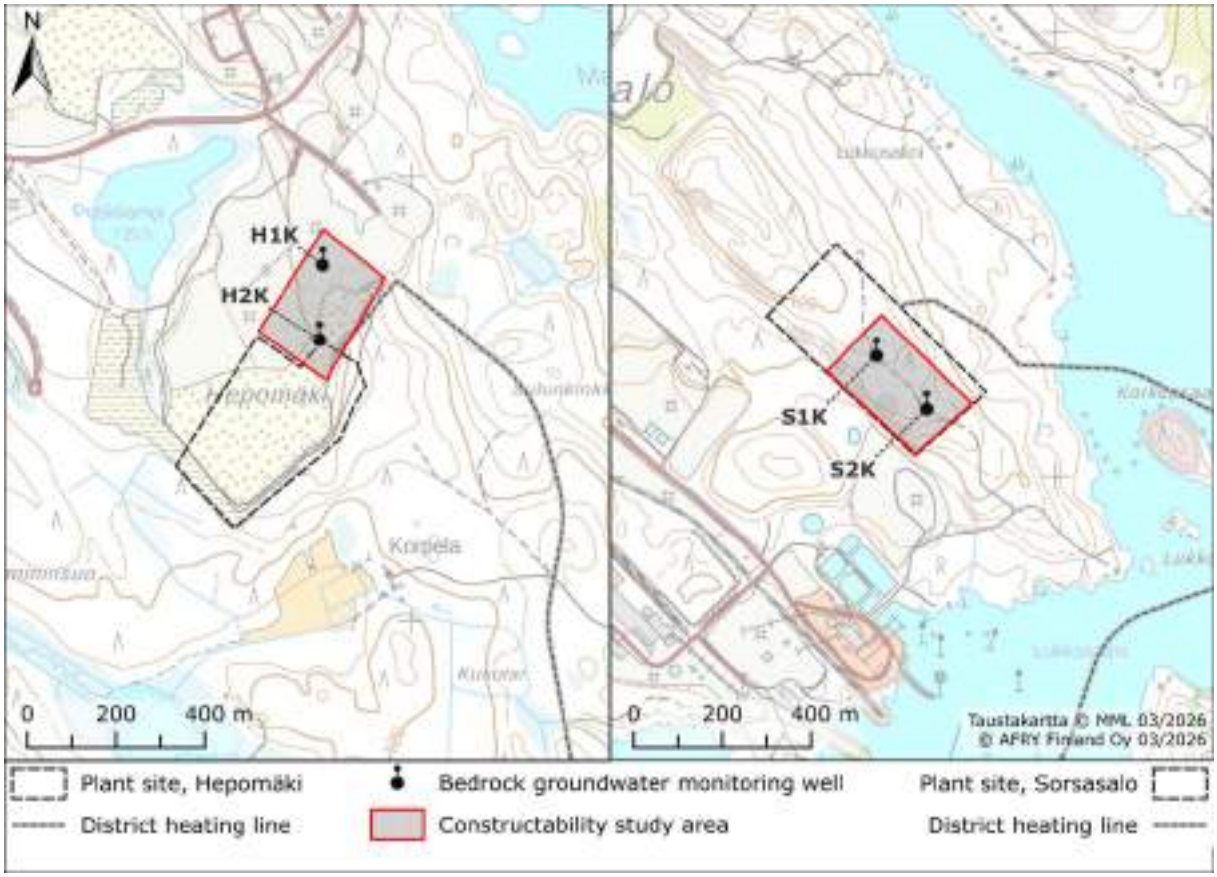

Figure 13-8. The plant areas of Hepomäki and Sorsasalo and the locations of the bedrock water pipes installed on them in the 2025 building feasibility study. The research area of the building feasibility survey is the original proposal for the plant area, which has been changed on both plant sites based on the recommendations from the survey. In Hepomäki, the plant area has also changed slightly from that shown in the figure as the planning process has progressed.

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Wells

The nearest residential building to the Hepomäki plant area is located south of it at about 270 metres, and the nearest holiday buildings are located about 350 metres to the south (chapter 12.1.1). The district heating transmission connection mainly runs in the unbuilt area (Figure 12-1). In Purola, the nearest residential buildings are located approximately 65–100 metres from the district heating transmission connection.

The nearest residential building to the Sorsasalo plant is located approximately 280 metres to the northeast of the plant area (chapter 12.1.2). In addition, individual residential and holiday buildings are located to the north of the plant area, the nearest being at a distance of approximately 300 metres (Figure 12-5).

According to the City of Kuopio's map service (City of Kuopio 2025n), the nearest buildings described above are located in areas that are not covered by water supply and sewerage. There is no data available for private wells in these areas.

13.1.4 Seismicity

The bedrock of both project area options is part of the Fennoscandian Shield. In general, shield areas are considered to be seismically both stable and low-activity areas. Seismic events in the vicinity of the project areas are mainly caused either by the tension generated by the spreading of the Mid-Atlantic Ridge or by land uplift resulting from the melting of the continental ice sheet. Although the plant sites are geographically very close to each other, there are small differences in the seismic event data collected around them when looking at the entire 300-kilometre area around the plant sites. Quantitatively, the majority of the seismic events that have occurred around both plant sites have been located in the Kuusamo and Northern Ostrobothnia regions, and especially in the Kymenlaakso region, the rapakivi area, where earthquake sequences are common.

An examination of natural seismicity has been carried out for both plant sites and a separate catalogue of seismic events listed in the FENCAT Earthquake Catalogue maintained by the Institute of Seismology of the University of Helsinki (Ahjos & Uski 1992, ISUH 2025, AFRY Finland Oy 2025g) has been collected. Catalogues contain historical seismic events, that is, earthquakes that occurred before 1971, as well as seismic events detected with seismic measuring devices. The locations and magnitudes of historical seismic events are based only on observations of vibrations and sounds by human senses, as well as possible damage to buildings. For this reason, their locations and magnitudes are more uncertain compared to more recent observations. The Finnish seismic observation network has also been modernised and supplemented during its life cycle (Kortström et al. 2015). Thus, the perceptional threshold and accuracy of seismic events have improved significantly. Only seismic events with a specified magnitude, location and depth were used in the examination. The Hepomäki seismic event dataset included 1,155 events and the dataset for Sorsasalo included 1,172 events from the assessment areas. The figure below (Figure 13-9) shows the seismic event observations by time for the Hepomäki plant site, and by depth for the Sorsasalo plant site (Figure 13-10).

The largest instrumentally observed seismic event (M4.0) in both catalogues occurred north of Alajärvi on 17 February 1979, at a distance of approximately 190 kilometres from the Hepomäki plant site and approximately 195 kilometres from the Sorsasalo plant site. The largest historical seismic event (on 10 April 1902, M4.4) in the observation datasets collected at a distance of 300 kilometres is from Oulujärvi, northwest of Kajaani, about 160 kilometres from Hepomäki and about 150 kilometres from Sorsasalo.

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The majority of the seismic events observed at both alternative plant sites are small in magnitude (M<2.0) and larger seismic events (M≥4.0) are rare based on the data (Figure 13-9). In addition, the majority of the seismic events in the assessment areas of both project options have occurred in the upper parts of the crust (0–15 kilometres), only a small proportion in the middle crust (16–35 kilometres) and only isolated events deeper in the lower crust (≥36 kilometres) (Figure 13-10).

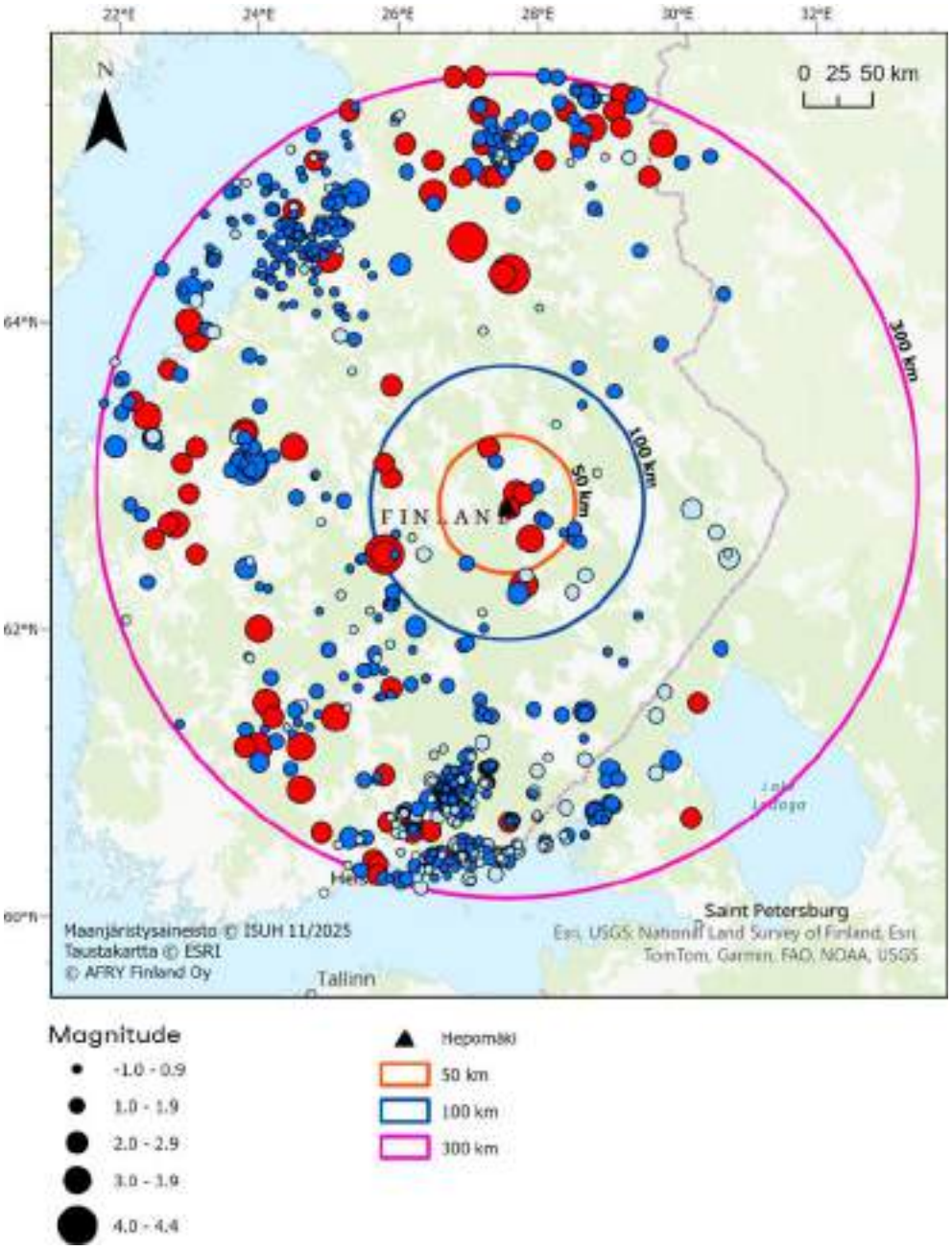

Figure 13-9. Observed natural seismic events within a 300-kilometre radius of the Hepomäki plant site between 16 October and 30 October 2025, 1,155 observations. Historical seismic events (1610–1970) are shown in red, verified events registered by instruments (1971–2021) in dark blue, and preliminary seismic events registered by instruments (2022–30 October 2025) in light blue. The size of the circles is proportional to the magnitude of the events (Seismic events: Ahjos & Uski, 1992; ISUH, 2025).

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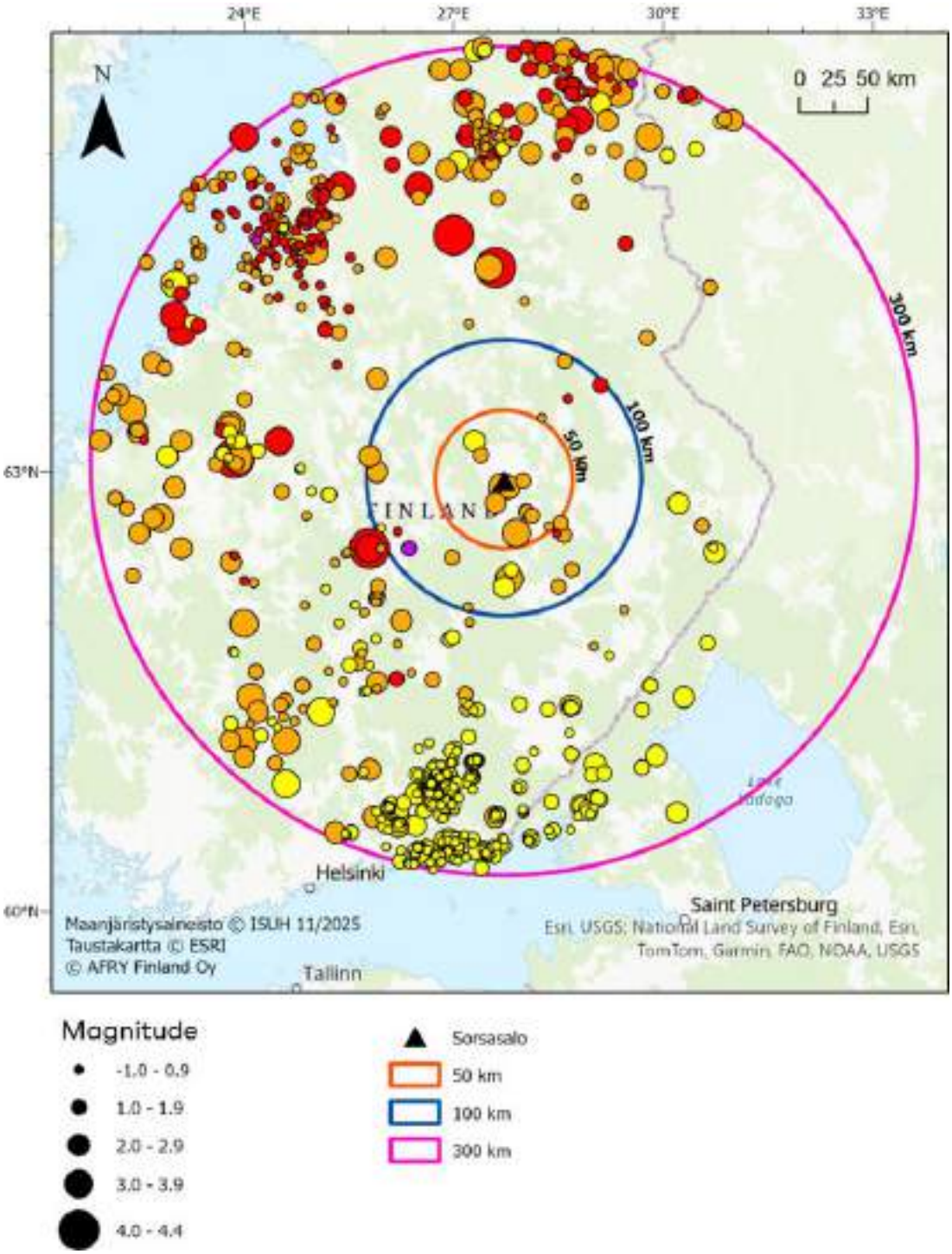

Figure 13-10. Observed natural seismic events within a 300-kilometre radius of the Sorsasalo plant site between 16 October and 30 October 2025, 1,172 observations. Events are coloured by depth: 0–5 km (yellow) and 6–15 km (orange) represent events occurred in the upper crust, 16 – 35 km (red) in the middle crust, and ≥36 km (purple) deeper in the lower crust. Depth rating according to Korja and Kosonen (2015). The size of the circles is proportional to the magnitude of the events (Seismic events: Ahjos & Uski, 1992; ISUH, 2025).

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13.2 Impact assessment and methodology

The project's impacts on the soil and bedrock are direct consequences of construction. Groundwater is particularly affected during construction, but excavation and construction can also permanently change local groundwater conditions. In assessing the significance of environmental impacts on soil, bedrock and groundwater, the spatial extent of the impacts, the affected site's sensitivity to change and the reversibility or persistence of the impacts are essential.

The impacts are assessed in terms of the changes caused by the planned operation by comparing it with the current situation. The impacts during construction and operation are assessed separately. The impacts are also assessed separately for both project options (Hepomäki and Sorsasalo), and based on this, the project options are compared with each other. The impacts on the soil and bedrock are assessed in the project areas (plant area and district heating transmission line) and in their immediate vicinity, to which the impacts of the construction work and operations extend. Impacts on groundwater are assessed at a distance of about 500 metres. The assessment uses surveys carried out in the areas of the project's activities and possible other surveys. In addition, the significance of the adverse effects is assessed and measures are presented to prevent or mitigate them. Issues related to seismic events are taken into account as required by the requirements.

Environmental impacts are assessed through expert work and based on accumulated experience and knowledge of similar activities. The assessment is carried out by specialists in soil, bedrock, seismology and groundwater. Initially, the most significant impact mechanisms during construction are removal of topsoil, covering of the ground and excavation. The impacts are initially estimated to be similar to conventional earthworks and excavation work, and the SMR plant will not have any impacts on soil, bedrock or groundwater during operation. The magnitude of the impacts is influenced by the extent and depth of the replacement of soil, and especially the excavation, required for construction, all of which are specified as the planning progresses. As these aspects are specified, the need to map the private wells (their type and purpose) near the project areas will be assessed.

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14 SURFACE WATERS

14.1 Current status

14.1.1 Overview of the water system

The planned location of the SMR plant in option VE1 is in Hepomäki, where some small waters are located in the vicinity of the plant area: Poskilampi to the north of the project area and Korsujärvi to the south. Heinälamminoja, which flows from Korsujärvi, and its widened channel, Heinälampi, run along the west side of the project area. In addition, the district heating transmission line passes under a small ditch, which joins the stream that flows from Tervalampi to Ala-Matkus.

In project option VE2, the SMR plant is located on the island of Sorsasalo in the northern part of Central Kallavesi. The island is separated from the mainland by Virtasalmi, Siilinsalmi, Lukkosalmi and Kelloselkä. The area is located in the Kallavesi water system of the Vuoksi water system (4.272, catchment area = 31,059.85 km^2, lake percentage = 12.54%), which includes Central Kallavesi, Sotkanselkä and Koirus below the Kalla bridges. The Vuoksi water system drains into Lake Ladoga.

The planned district heating pipeline route runs through the waters of Kallavesi, in the Kelloselkä area. Route A crosses Väinölänniemi and B goes around the islands in front of Rönö on its way to Haapaniemi.

The load on Central Kallavesi consists mainly of inputs from upstream routes via the Kallansillat bridges and Jännevirta. In addition, the load comes from the near water catchment area, deposition and point source input. In 2024, the total nutrient load to Central Kallavesi is estimated to be 370 kg/d of phosphorus and 11,498 kg/d of nitrogen, of which 80–90% originate from upstream routes. Point source input is estimated to be about 2% for phosphorus and about 21% for nitrogen. The most significant point sources are Mondi Powerflute Oy, the Lehtoniemi wastewater treatment plant of the City of Kuopio, Fox Yard Oy (formerly Neuron) and Kuopion Energia Oy's Haapaniemi power plant. It is estimated that approximately 33% of the phosphorus entering Kallavesi is retained in the sediment, and about 12% of the nitrogen is retained there (Savo-Karjalan Ympäristötutkimus Oy 2025a).

14.1.2 Hydrology

The SMR plant area in Hepomäki is located on two small catchment areas. According to the Finnish Environment Institute's (2025f) water catchment division, on the 4-level areas FI2-04.04.025 (25.9 km^2, Hepolamminoja) and FI2-04.04.168 (38.6 km^2) (Figure 14-2). In addition, the district heating transmission line runs in a different sub-catchment area (FI2-04.04.244, 64.4 km^2). The waters from the last two shore areas flow via smaller channels into Matkus. The alternative project area of Sorsasalo belongs to the same area that includes the shore areas of Kallavesi FI2-04.04.244. It should be noted that the distribution of catchment areas describes the natural flow direction of the waters and does not take into account possible stormwater drainage in the area. Directions of water drainage are explained in more detail in connection with the project's more detailed stormwater planning.

The waters of Kallavesi are regulated for the needs of flood protection, hydropower and water traffic. The regulation is quite mild compared with regulations purely for the requirements of the power sector. A fixed lower limit has been set for the water level of

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Kallavesi (NN+80.90 m). There is no absolute upper limit, but pre-releases of water in accordance with the regulation permit are aimed at preventing the water level from rising above the target upper limit (NN+82.00 m) (SYKE 2025n). The figure (Figure 14-1) shows the average daily and long-term (1972–2024) fluctuation of the water level at Itkonniemi, Kallavesi. At the Itkonniemi measuring station, the average water level (N2000) has been +82.1 m for the period 1972–2024 and also as the average for 2024 (SYKE 2025n).

In recent years, Kallavesi has frozen between late November and mid-January, and the ice cover has typically broken up between late April and early May (SYKE 2025n). In the Sorsasalo area, the flow is fairly strong and the ice can be weak at times.

The Kelloselkä area of Central Kallavesi is an intersection of two large waterways, where water flows from the Iisalmi route in the northwest and from the Nilsiä route in the north. From North Kallavesi, water flows to Kelloselkä mainly through the Kallansilta openings. The waters of the Nilsiä route that pass through Jännevirta split at Kortesalmi, and a part of the water flows directly south, while the other part (two-thirds) turn and flow in front of the Kuopio mill. Water flows in the Kelloselkä area at about 99 m^3/s, with a retention time of 51 d.

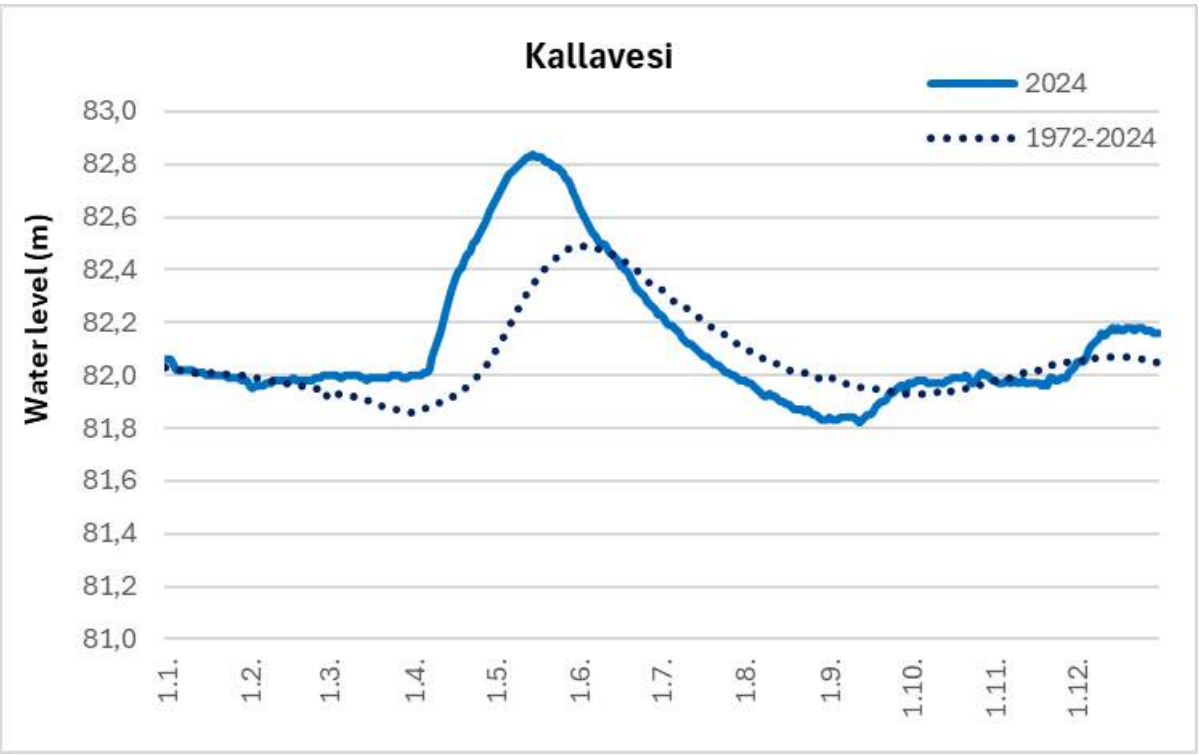

Figure 14-1. Water level at the Itkonniemi observation station in Kallavesi on a daily basis in 2024. For comparison, the long-term average (1972–2024) (SYKE 2025n).

14.1.3 Stormwater and flood risks

In its current state, the Hepomäki project area (VE1) is mainly a gravel extraction area, where stormwater is partly absorbed into the soil and partly led along surfaces. In its current state, the Sorsasalo project area (VE2) is mainly an undeveloped wooded area, where stormwater drains along surface profiles into nearby water systems and is absorbed into the soil.

The project areas or their immediate vicinity are not flooding zones.

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14.1.4 Water quality

The water quality of Heinälamminoja near the Hepomäki project area is regularly monitored as mandatory monitoring of the nearby Jätekukko Oy's waste treatment area. In the monitoring, parameters measured include, for example, pH, conductivity, nutrients (nitrogen, phosphorus), solids and harmful compounds such as heavy metals and PFAS. At the Heinälamminoja monitoring site (Figure 14-2) above the waste treatment area, the water quality was mainly good in 2024 monitoring: pH was neutral, conductivity and chloride content were low, the solids content and the COD_{Mn} value indicating organic matter were moderate. Of the nutrients, total nitrogen levels were elevated, indicating a slight nitrogen load. No harmful substances were detected in the ditch water (Eurofins Environment Testing Oy 2025).

Joint monitoring of Kallavesi has been carried out in accordance with various programmes since 1975. The joint monitoring programme for Kallavesi was last updated in 2015 (Savo-Karjalan Ympäristötutkimus Oy 2015). In the monitoring programme, there are water quality observation points according to the flow of the route, starting from the upstream to North Kallavesi and ending at Puutossalmi. In addition to water monitoring, oxygenation monitoring has been carried out in the Kallavesi area at a total of six points. In 2024 in Kallavesi, there were three oxygenators operating in the Kelloselkä area (Kallavesi 338H, 338BH and 340H) (Figure 14-2). (Savo-Karjalan Ympäristötutkimus Oy 2015) In the following, the focus has been on the area near the district heating pipeline to be built (sampling points 338A, 345, 358), but for comparison, the results of the upper (330, 333) and lower water areas (374, 375, 377, 378) have also been presented (Figure 14-2). The water quality of Kallavesi is monitored through joint monitoring four times a year. The determinations made on the samples vary slightly from point to point and from season to season. The average and extreme values of water quality for the years 2015–2025 are shown in the table (Table 14-1) and the figures (Figure 14-3 and Figure 14-5) below. The results from the aeration stations (338H, 338Bh and 340H) were not assessed as relevant for this project and therefore have not been presented in this context.

At the deep basin point on the North Kallavesi side above the project area (observation point 330) and in the deep basin of Kallavesi south of Sorsasalo (observation point 338A), an obvious decrease in oxygen concentrations have been observed in late winter/early spring, and oxygen has at times been virtually depleted (Table 14-1, Figure 14-3). Oxygenation of the deep basins with bottom aerators has improved the oxygen concentration of the hypolimnion.

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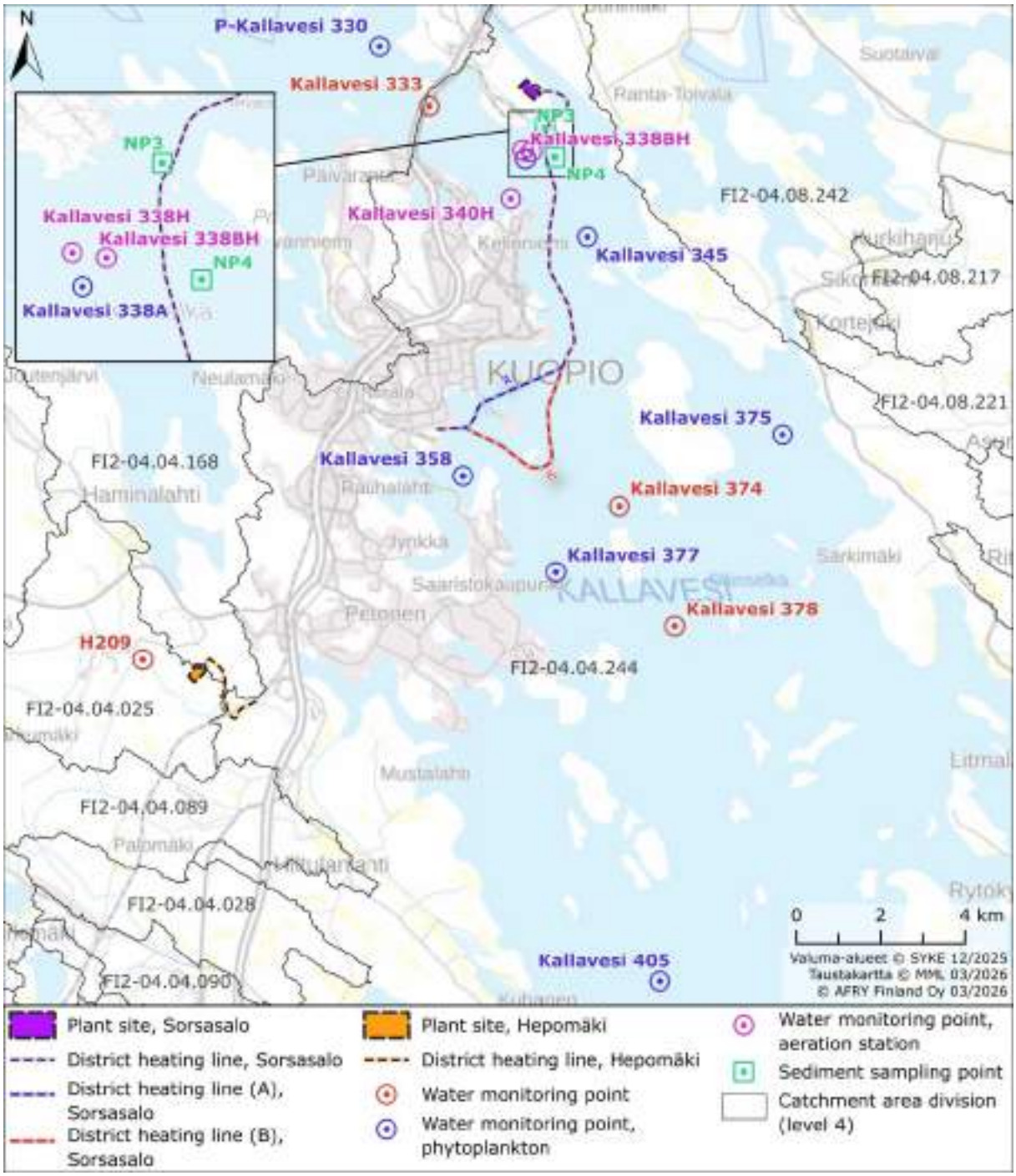

Figure 14-2. Sampling points for joint monitoring of Kallavesi and sediment sampling points NP3 and NP4 (see chapter 14.1.5). The letter H in the point's name refers to the aeration station.

The average electrical conductivity of Kallavesi has typically been low (about 5 mS/m) and close to neutral in pH. The sulphate content of the water is on average 4–6 mg/l, with a range of 4–18 mg/l. The chemical oxygen demand (COD_{Mn}) in the epilimnion has varied at a level typical of slightly humus-influenced lakes, at around 13–14 mg/l. The visibility depth of Kallavesi varies from one and a half to four metres. There has been no significant deterioration in the hygienic quality of the water.

In Kallavesi, north of the Kalla bridges (330) and in Kelloselkä in front of Sorsasalo (observation points 338A and 345), the total nitrogen concentrations in the surface water

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have been on average at a satisfactory level according to the ecological status classification (Aroviita et al. 2019) (691–740 µg/l). Total phosphorus concentrations have been at a good/satisfactory (24–28 µg/l) level (Table 14-1). On average, the water coming through the Kalla bridges (observation point 333) has been slightly more phosphorus-rich.

The quality of the hypolimnion in Kallavesi has varied more and, as a rule, concentrations have been higher than at the surface. During stratification periods, total nutrient concentrations in the hypolimnion are clearly affected by the oxygen condition of the hypolimnion. Off Sorsasalo, the effluent waters from Mondi's mill have caused a deterioration in the oxygen condition of the hypolimnion, along with elevated concentrations of nitrogen and sulphate and increased electrical conductivity. The impacts on water systems have usually been most noticeable during late-winter sampling rounds. The impacts of the load diminish further out in Kelloselkä, but are still noticeable in the deeper water layers during stratification periods, especially in winter. The water quality of Kelloselkä is also affected by the quality of the water coming from the Iisalmi route via the Kallansillat bridges. Also, near the Lehtoniemi treatment plant at point 377, there are occasional heavier increases in concentration (Figure 14-3) in the hypolimnion.

Table 14-1. Average and extreme values of water quality in Kallavesi from 2015 to 2025 (SYKE 2025o), n = number of observations.

Position	Depth	Temp.	Oxygen	Oxygen	pH	Electr. cond.	Colour	COD_{Mn}	Total P	PO_4-P	Total N	NH_4-N	NO_3-N	SO_4	Chloro-phyll-a
	m	°C	mg/l	sat.-%		mS/m	mg/l Pt	mg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/l	µg/l
N Kallavesi 330															
average	**1.0**	**12.8**	**10.8**	**92**	**7.0**	**5.2**	**85**	**14**	**28**	**3**	**691**	**14**	**179**	**4**	**11.4**
minimum		0.2	8.4	80	6.7	4.7	54	11	18	1	510	2	28	4	3.3
maximum		23.3	14.2	120	7.4	5.8	160	21	54	13	900	51	310	5	22.0
n		81	40	40	20	40	40	40	81	43	81	81	41	10	42
average	**36.3**	**5.1**	**6.9**	**55**	**6.6**	**5.7**	**92**	**13**	**36**	**21**	**795**	**32**		**4**	
minimum		1.5	0.9	8	6.4	4.8	60	10	18	18	640	1		3	
maximum		9.1	11.9	94	6.9	8.4	140	19	58	24	980	220		6	
n		75	75	75	31	75	37	75	75	13	75	75	2	16	
Kallavesi 333															
average	**1.0**	**8.8**	**10.6**	**91**	**7.0**	**5.2**	**83**	**13**	**30**		**738**	**23**			
minimum	1.0	0.6	8.1	78	6.6	4.8	59	11	18		540	1			
maximum	1.0	23.0	12.5	120	7.4	5.7	130	17	59		1,100	260			
n		41	41	41	20	40	20	20	41		41	41			
Kallavesi 338A															
average	**1.0**	**12.7**	**10.6**	**91**	**6.9**	**5.1**	**78**	**13**	**24**	**2**	**740**	**66**	**231**	**6**	**10.9**
minimum		0.1	1.3	53	6.6	4.2	57	10	17	1	610	2	120	4	2.3
maximum		24.6	12.1	110	7.2	5.6	100	15	54	9	1,500	650	230	8	22.0
n		82	13	46	9	46	5	46	18	42	18	82	5	12	42
average	**28.9**	**6.9**	**6.9**	**58**	**6.7**	**6.0**	**80**	**13**	**36**	**12**	**950**	**193**		**8**	
minimum		1.9	0.4	3	6.5	4.5	57	6	17	7	540	6		6	
maximum		13.1	11.9	95	6.8	9.7	130	17	92	17	2,100	1,200		13	
n		39	39	39	21	39	20	39	39	2	39	39		11	
Kallavesi 345															
average	**1**	**12.7**	**10.5**	**90**	**6.9**	**5.0**	**77**	**13**	**23**	**2**	**697**	**37**	**220**	**6**	**11.2**

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Position	Depth	Temp.	Oxygen	Oxygen	pH	Electr. cond.	Colour	COD_{Mn}	Total P	PO_4-P	Total N	NH_4-N	NO_3-N	SO_4	Chloro-phyll-a
	m	°C	mg/l	sat.-%		mS/m	mg/l Pt	mg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/l	µg/l
minimum		0.2	7.1	74	6.5	4.3	57	10	13	1	420	2	120	4	2.3
maximum		24.9	13.5	120	7.3	5.5	120	16	41	10	900	230	390	9	42.0
n		82	45	45	25	45	24	24	82	41	82	82	41	11	58
average	**44.6**	**5.2**	**8.0**	**63**	**6.5**	**5.4**	**78**	**12**	**28**		**813**	**38**		**6**	
minimum		1.1	1.5		6.4	4.5	51	10	14		540	2		5	
maximum		9.1	11.9	94	6.8	6.6	120	17	45		1,100	400		8	
n		41	41	41	21	41	20	20	41		41	41		11	
Kallavesi 358															
average	**1.0**	**12.8**	**10.9**	**95**	**7.1**	**5.5**	**68**	**12**	**21**	**2**	**669**	**11**	**214**		**11.5**
minimum		0.1	7.7	82	6.9	5.0	51	9	10	1	510	1	110		3.8
maximum		24.8	13.8	120	7.8	6.9	94	14	40	10	960	63	320		20.0
n		84	47	47	43	46	22	24	83	39	83	83	41		41
average	**37.3**	**4.7**	**6.0**	**47**	**6.7**	**6.5**	**67**	**11**	**29**		**836**	**38**			
minimum		2.4	0.5	4	6.4	5.7	53	9	10		640	1			
maximum		6.1	12.3	97	7.1	8.8	89	13	57		1,100	370			
n		43	43	43	39	42	18	20	42		42	42			
Kallavesi 374															
average	**1.0**	**12.7**	**10.7**	**91**	**7.0**	**5.2**	**72**	**12**	**21**	**2**	**683**	**14**	**229**	**6**	**10.1**
minimum		0.1	8.1	76	6.7	4.6	51	10	12	1	560	2	120	4	3.5
maximum		23.8	13.4	110	7.3	5.6	120	22	39	11	930	60	360	11	20.0
n		83	46	46	25	46	46	46	83	41	83	83	41	11	41
average	**32.9**	**6.2**	**8.3**	**67**	**6.7**	**6.1**	**74**	**12**	**27**		**950**	**8**		**9**	
minimum		1.2	2.7	20	6.5	4.9	51	10	12		630	1		6	
maximum		11.6	12.4	97	7.3	9.7	110	18	49		1,900	53		12	
n		42	42	42	21	42	21	42	42		42	42		11	
Kallavesi 377															
average	**1.0**	**12.7**	**10.8**	**92**	**7.1**	**5.3**	**72**	**12**	**21**	**2**	**696**	**12**	**238**	**6**	**9.9**
minimum		0.1	7.7	77	6.8	4.8	51	9	9	1	490	1	120	4	2.9
maximum		23.3	14.1	110	7.5	5.9	110	15	38	13	1,100	59	380	8	20.0
n		82	45	45	26	45	23	23	82	41	82	82	41	12	41
average	**33.6**	**5.9**	**7.8**	**62**	**6.7**	**6.8**	**73**	**12**	**33**		**1,142**	**13**		**11**	
minimum		1.6	1.3	11	6.5	5.0	50	9	11		580	1		8	
maximum		9.8	12.6	98	6.8	15.0	110	15	93		4,300	100		18	
n		39	38	38	19	38	19	19	39		39	39		10	

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Figure 14-3. Water quality at Kallavesi observation points 358, 374, 377 and 345 from 2015 to 2025.

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14.1.5 Sediment quality

The district heating transmission pipeline of the Sorsasalo project option runs mainly along the bottom of Kallavesi (chapter 3.6.2), where it is weighted down. Dredging of bottom sediment is carried out along the transmission pipeline route in shore areas where the water depth is 3.5 metres or less.

Kallavesi sediment has been studied occasionally in connection with the joint monitoring of Kallavesi, as well as in individual sediment contaminant surveys.

The sediment samples belonging to the joint monitoring studies of Kallavesi were last taken in the spring of 2014. Slightly elevated concentrations of total phosphorus (2.4–4.2 g/kg, average) were found in the sediment samples. The lowest phosphorus concentrations were found on the North Kallavesi side and in the vicinity of the former Savon Sellu's (now Mondi Powerflute Oy's) mill and in Kelloselkä. The highest concentrations were found in front of the Lehtoniemi treatment plant and in the southern parts of Kallavesi. Nitrogen content was also highest in South Kallavesi. Total nitrogen concentration varied from 5.1–7.9 g/kg (average). The highest average concentrations of oxygen-consuming material were found off the former Savon Sellu's mill, in the vicinity of Säyneensalo, and in the southern parts of Kallavesi. The highest average concentrations of the sediment's biological oxygen demand (BOD7) (11,5–12,4 gO_2/kg, average) were observed off the former Savon Sellu's mill, in the vicinity of Säyneensalo and in the southern parts of Kallavesi. (Savo-Karjalan Ympäristötutkimus 2014)

In the Accumulation Register maintained by the Finnish Environment Institute (Finnish Environment Institute 2025g), near the route of the district heating transmission pipeline to the west and south-west of Potkunsaari, there are sediment sampling points Potkunsaari NP3 (distance from the route about 50 metres) and Potkunsaari NP4 (about 150 metres) (Figure 14-2). In 2009, elevated concentrations of metals and organotin compounds were found in sediment samples from these sampling points.

In addition, at a distance of about 500 metres to the west of the route is the observation point 338A. In 2012, elevated concentrations of metals, oil hydrocarbons (C_{10}–C_{40}), PAH and PCDD/F compounds, chlordane compounds, phenols and organic tin compounds (Finnish Environment Institute 2025g) were found in the sediment sample from this observation station.

Contaminants in the sediment along the route of the district heating pipeline will be investigated in the sediment survey carried out during the reporting phase (chapter 6.3).

For the project, benthic sampling was carried out in the autumn of 2025 at five different sampling points (chapter 14.1.7.2, Figure 14-6) (Savo-Karjalan Ympäristötutkimus 2025b). In connection with the sampling, the composition of the bottom sediment was also assessed by sensory evaluation. At sampling points P1 and P2, the bottom sediment is sand, clay, silt and mud. At sampling points P3–P4, the bottom sediment is clay, silt and mud.

14.1.6 Water management

The project area is located in the Vuoksi water management area. The latest water management plan for 2022–2027 and the associated action programme have been prepared for the water management area (Kotanen et al. 2022, Vallinkoski et al. 2022). In water management, the status of surface waters is described on the basis of ecological and chemical classification. The starting point for the assessment of the ecological status of the

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water system is the estimated natural status of the water system. Surface waters are divided geographically and by natural characteristics into different types, and each type has been assigned its own status-related objectives according to its characteristics. Indicators describing the current state of the water system, such as nutrient concentrations in the water or the composition of biotic communities, are compared with the water system's natural state that preceded human activity.

In the surface water type classification, Kallavesi and its upstream lakes North Kallavesi and Juurusvesi–Karhonvesi belong to the large humic lake type (Sh). According to the classification of surface waters in the 3rd period, the ecological status of the water systems of Kallavesi and Juurusvesi–Karhonvesi is good and that of North Kallavesi is satisfactory (Figure 14-4). More detailed quality factor-specific classification data for water systems for the 3rd period is presented in the table below (Table 14-2). In the Kallavesi water body, the goal of water management is to maintain a good ecological and chemical status (Kotanen et al. 2022).

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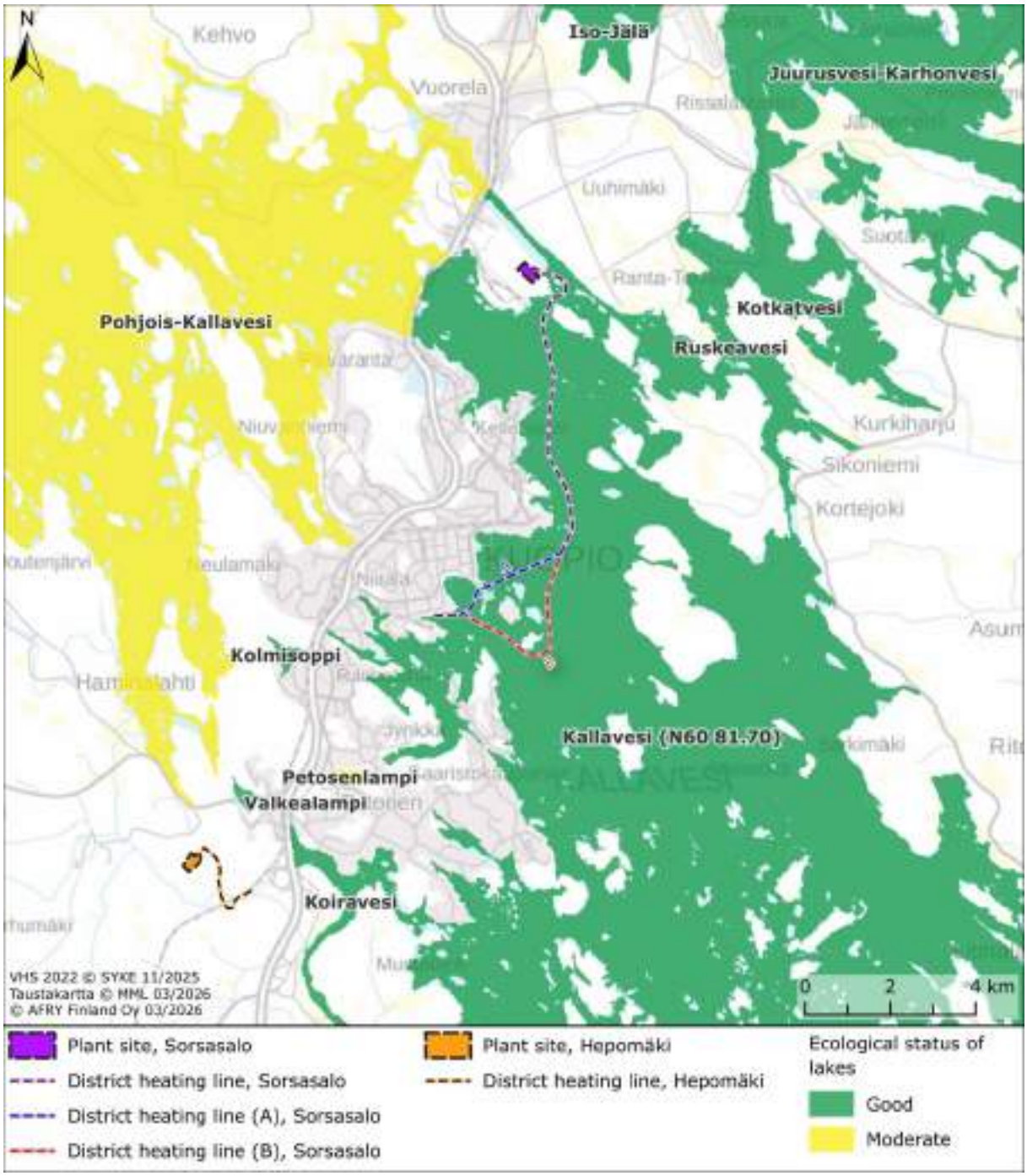

Figure 14-4. The ecological status of Kallavesi, North Kallavesi and Juurusvesi–Karhonvesi in the third period of water management (SYKE 2025p).

Table 14-2. The ecological status of Kallavesi and North Kallavesi by quality factors during the third period of water management (SYKE 2025p).

Status class	Quality factor	Kallavesi	North Kallavesi
Biological status		Good	Satisfactory
	Phytoplankton	Satisfactory	Satisfactory
	Aquatic plants, i.e. macrophytes	Good	Good
	Diatoms	Satisfactory	Poor
	Benthic animals	Good	Satisfactory
	Fish	Good	
Physical-chemical conditions		Good	Satisfactory
	Total phosphorus (µg/l)	Good	Satisfactory
	Total nitrogen (µg/l)	Satisfactory	Satisfactory
Hydrologic-morphological conditions		Excellent	Excellent
Overall classification		Good	Satisfactory

Preliminary data on the results of the updated classification, prepared for the 4th period of water management, from 2028 to 2033, on the basis of the monitoring results from the period from 2018 to 2024, were received from the North Savo ELY Centre (North Savo ELY Centre 2025). The biological classification has been made on the basis of datasets on phytoplankton, aquatic plants and profundal invertebrate. The quality factors for phytoplankton and deep basin benthic animals have been classified as satisfactory.

The phytoplankton quality factor was already at a satisfactory level in the previous classification period and, following the latest classification guidelines (Aroviita et al. 2025) and the one-out, all-out principle, the status class is determined by the weakest quality factor. Of the quality factor variables, an upward trend for chlorophyll-a has persisted, and the variable remains at a good level, although close to the T/Hy threshold. The chlorophyll-a concentration interpreted from satellite imagery indicates a good level. The percentage of harmful cyanobacteria is rated excellent. As in the previous period, the variables total biomass (satisfactory) and the TPI phytoplankton trophic index (satisfactory) are in a weaker status than good, which, overall, lowers the phytoplankton quality factor's status assessment to satisfactory. Profundal invertebrate have declined from the previous period to a marginally satisfactory level. In the longer term, there has also been a declining trend in profundal invertebrate between the 2nd and 3rd classification periods. The larvae of the phantom midge (Chaoborus flavicans) are locally abundant; however, the densities have decreased from 2010s levels. There is more data from the Koirus observation point (Koirus 30) during the classification period than in the previous period, which may partly affect the status assessment of profundal invertebrate. Macrophytes are classified as good. Phytoplankton, benthic animals and macrophytes have been discussed in more detail in chapter 14.1.6. The total phosphorus content of surface water during the summer has slightly decreased since the last classification period, being clearly in the good category. Similarly, the nitrogen content has decreased and is close to the T/Hy limit, but is still

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classified as satisfactory, as in the previous period. Humus content is on an upward trend. Lack of oxygen near the bottom in winter has not occurred at the observation points used for classification, and at the observation point Koirus 30, there has been an improvement in this respect compared with the previous season, although regular lack of oxygen does occur there towards the end of the summer stratification period. An assessment for the fish quality factor based on methodologically incomplete exploratory fishing data has been close to the Hy/E limit, but the uncertain classification result was excluded from the classification.

The chemical status determined on the basis of the presence of harmful substances has been classified as weaker than good in the nearest water bodies, as in all water bodies in Finland due to the exceeding of the concentration of brominated diphenyl ethers (PBDEs) as an expert estimate. PBDE belongs to the so-called ubiquitous or UBI substances, which are ubiquitous, widespread from their original emission sources, persistent, bioaccumulative and toxic substances. Concentrations of these substances cannot be influenced by national measures and they can therefore be exempted from the requirement for good water status.

In water management planning, the measures are targeted to each operator sector. Industrial emissions are restricted by environmental permits in accordance with the Environmental Protection Act. Wastewater treatment methods and the concentration limits of pollutants in wastewater discharged into water systems are presented in the environmental permit granted to the operation. With the amendment of the Environmental Protection Act, the use of best available technology (BAT) is emphasised in operations subject to a permit. Through the measures presented to industrial plants for the period 2022–2027, special attention will be paid to the operation and maintenance of plants and to improving their efficiency. The plans related to risk management and disruptive situations in industrial plants must be up-to-date and the risk reduction measures taken must be dimensioned and implemented taking into account the operating environment. In addition, improving the management of hazardous substances and substances harmful to the aquatic environment at industrial plants is taken into account in the implementation of monitoring. During the 2022–2027 operational programme period, no additional industrial measures will be presented for the water bodies of North Savo.

In this project, actual discharges into water systems are very low, and impacts on water systems arise mainly from construction work in or around the water systems. Dredging and filling work can change the shoreline and are taken into account in water management as hydrological-morphological pressures. Dredging can also cause exceedances of environmental quality standards for harmful substances. The impacts of dredging on the water body are assessed on a case-by-case basis. If dredging can degrade the ecological status or release harmful substances, the measures must be planned so that the impacts are minimised (Aroviita et al. 2025).

14.1.7 Water ecology

The PUROHELMI project has produced spatial data-based modelling estimates of the change in the natural state of the habitat and benthic animals of small streams (Aroviita et al. 2022). The assessments of change are based on statistical models using spatial and terrain datasets. Modelling of changes in habitats has been carried out using a machine-learning method, and changes in the benthic animals have been modelled using multivariate modelling. According to the Purohelmi material (Purohelmi 2025), the upper part of Heinälamminoja upstream of Heinälampi is only slightly altered from its natural

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state (class 4), while the section downstream of Heinälampi is more altered (class 3). Other small water sites close to the project areas have not been assessed in the Purohelmi materials.

14.1.7.1 Phytoplankton

In Kallavesi, the abundance of phytoplankton is monitored by annual chlorophyll-a measurements and, every three years, by assessments of phytoplankton biomass and species composition. Phytoplankton samples were last taken in the summer of 2022 from sites in accordance with the monitoring programme (Figure 14-2). Based on the phytoplankton samples, the ecological status of Kallavesi was assessed using chlorophyll-a concentration, total biomass, the proportion of harmful cyanobacteria and the trophic index (TPI) (Savo-Karjalan Ympäristötutkimus Oy 2023, Eco-Monitor 2023).

At the North Kallavesi observation point (330) above the project area, signs of eutrophication can be seen in the values for phytoplankton species and chlorophyll-a and biomass indicators. The biomass of phytoplankton samples indicated a satisfactory or poor ecological status. In Kallavesi, off Sorsasalo (338A), phytoplankton biomass indicated a satisfactory ecological status, and the TPI eutrophication index results indicated a good or satisfactory ecological status. In Kelloselkä (345) and in the area near Lehtoniemi (377), the total biomass of phytoplankton samples indicated a poor or satisfactory ecological status. The TPI value ranged from good to poor. The phytoplankton community of Kallavesi was diverse. The dominant species were diatoms, cryptophytes, golden algae and cyanobacteria. The amount of harmful cyanobacteria was not significant, and their presence did not cause any deterioration in water quality. On the whole, indicators of eutrophication were stronger in North Kallavesi and Kelloselkä, while in southern Kallavesi and the Säyneensalo area, the water system’s phytoplankton status is slightly better.

Summertime chlorophyll-a concentrations, which indirectly describe phytoplankton production, have averaged 10–11 µg/l (Table 14-1) in Kallavesi, which is on the border of a good/satisfactory ecological status. The increase in phytoplankton in Kallavesi is visible as a slight rise in chlorophyll-a concentrations (Figure 14-5). Especially in South Kallavesi, it has been observed that, in addition to nutrients, a partial decrease in food web regulation — i.e. the grazing effect of zooplankton — has contributed to the increase in phytoplankton (Savo-Karjalan Ympäristötutkimus Oy 2023).

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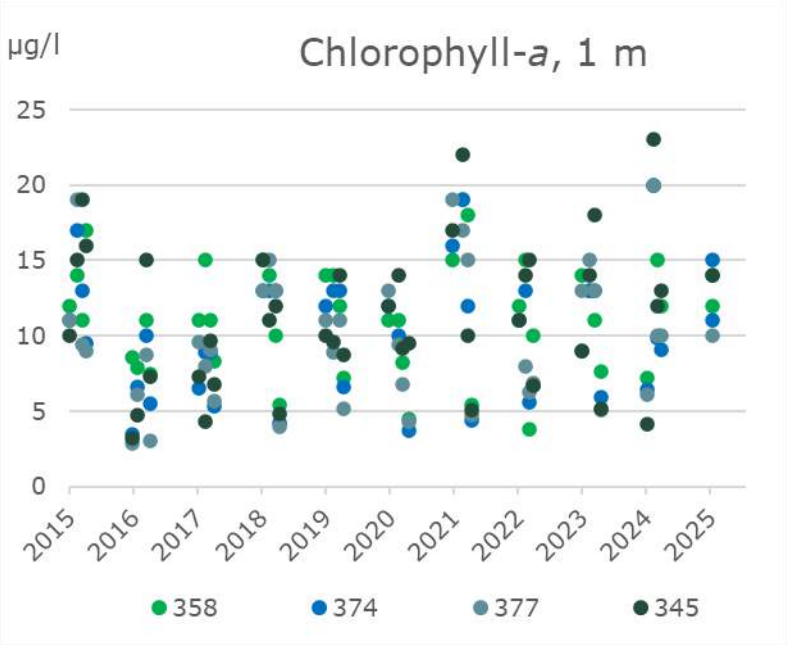

Figure 14-5. Chlorophyll-*a* concentration at Kallavesi observation points 358, 374, 377 and 345 from 2015 to 2025.

According to the classification of the environmental administration, the ecological and biological status class of Kallavesi as a whole is good in the third classification round of water management, but the status of the phytoplankton quality factor is slightly weaker, that is, satisfactory (Figure 14-4 and Table 14-2). In the preliminary data of the latest classification, the status of the phytoplankton quality factor is still satisfactory, especially due to the total biomass and the TPI trophic index. Chlorophyll levels are still good despite a slight upward trend in concentration. In addition, the chlorophyll-a concentration interpreted from satellite imagery indicates a good status. As described above, the percentages of harmful cyanobacteria in Kallavesi have generally been low, with the variable being classified as excellent. In the new classification, the phytoplankton quality factor's satisfactory status means that the overall ecological status of Kallavesi is assessed as satisfactory.

14.1.7.2 Benthic animals

There are relatively many benthic animal observations in the project area (Finnish Environment Institute 2025q). As part of Kallavesi's joint monitoring, benthic animal monitoring has been carried out since 1977 (KVVY Tutkimus Oy 2023). Monitoring of benthic animals is carried out every three years, and the latest samples were taken in September–October 2022. Since 2007, samples have been taken from eight transects, of which five (330, 338A, 345, 377 and 405) are old and three (378, 375 and 25) are new. In addition, aeration points (338BH and 372AH) of the Kelloselkä area (the former Savon Sellu's, now Mondi Powerflute's, observation area) and Lehtoniemi treatment plant were added into the programme, and deep basin samples have been taken from these points. As of 2016, monitoring was reduced so that 10 metre samples were no longer taken from any transect. In addition, samples from 20 and 30 metres were excluded for transects 345, 405 and 25. In 2022, samples were also taken from two new points (372H and 373H) (KVVY Tutkimus Oy 2023).

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The benthic fauna of Kallavesi consisted mainly of taxa typical of eutrophic, slightly eutrophic and mesotrophic waters at all sampling stations in the most recently reported monitoring year, 2022. On average, the harshest lake bottoms were found in the observation areas of North Kallavesi, Säyneensalo and Hietasalo, while the most eutrophic lake bottoms were found in the observation areas of Kelloselkä and Lehtoniemi. (KVVY Tutkimus Oy 2023)

The density of the phantom midge larvae in Kallavesi increased sharply in the 2010s, but during the 2019 monitoring round, the densities of the phantom midge had returned to the level of the early 2000s. In 2022, the densities of the phantom midge were again increasing in many places, but still remained below the 2010s levels. The phantom midge larvae are not actual benthic animals, as they obtain their food by moving around in the water column. The abundant occurrence of the phantom midge larvae usually indicates poor oxygen conditions at the bottom and/or hypolimnion, as they tolerate low oxygen very well. On the other hand, the mere clay or humus content of the water may create good conditions for the larvae, even if there are no serious oxygen problems. The phantom midge benefits from warm summers and may be becoming more abundant as a result of climate change. The general darkening development of water systems also favours the phantom midge. The densities and biomass of benthic animals have increased in many observation areas of Kallavesi compared to the early years of monitoring, but this development is mainly due to an increase in the phantom midge larvae.

According to the Profundal Invertebrate Community Metrics (PICM), the ecological status of the Kallavesi deep basins ranged from poor to excellent. The shallow sampling stations in North Kallavesi and Kelloselkä were classified as at least good, while the deeper stations in these areas were in a satisfactory status. All observation stations in Säyneensalo were classified as at least good ecological status. In the Lehtoniemi area, PICM was in a good status at two stations, and at the other stations it was either satisfactory or poor. The deepest station in Hietasalo was classified as satisfactory, but the shallower stations were classified as good or excellent. In South Kallavesi, PICM indicated a satisfactory status. Based on the Profundal Invertebrate Community Metrics, there have been no significant changes in the status of benthic communities over the past ten years. An exception was Lehtoniemi station 377, where the status indicated by the PICM index shows large year-to-year variation without a clear direction of change (KVVY Tutkimus Oy 2023). The ecological status of the benthic fauna of the Kallavesi water body (N60 81.70) has been classified as good during the third water management period. In the fourth water management period, based on preliminary data, the status has declined to satisfactory (oral communication, North Savo ELY Centre 2025).

For the SMR project, additional sampling was carried out in the autumn of 2025 at five different sampling sites (P1–P5) along the district heating transmission lines (Figure 14-6), which varied in depth from 7 to 24 metres (Savo-Karjalan Ympäristötutkimus Oy 2025b).

At Kallavesi's P1–P5 sampling stations, taxa typical of predominantly eutrophic lake bottoms were observed. The most eutrophic sampling station was P3, and the survey's southernmost stations, P4 and P5, were closer to the average level of eutrophication. Based on the PICM and PMA indices, the benthic communities at the sampling stations were mainly classified as good or excellent. The exception was the sampling station P1, in which the PMA index value was clearly different from the other stations. In the deep basin of the station P1, the structure of the benthic animal community was skewed due to the abundance of phantom midges (*Chaoborus flavicans*) and their high relative proportion,

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which was also reflected in the high biomass recorded at the station. However, species such as *Sergentia coracina* and *Spirosperma ferox* were also found in the samples from P1, and from these, Sergentia was abundant. These species increase the value of the PICM index thanks to their fairly high indicator scores. At other sampling stations, benthic communities were more balanced in terms of species composition and structure, which was also evident in high index values. Individual population densities and biomass were typical for Kallavesi. Of the species, the most significant observations were *Mysis relicta* at the sampling station P3, and *Gammarus lacustris* at the station P4. Both species are relict species of the Ice Age, and Gammarus lacustris in particular is known as a species of cool, deep lakes. (Savo-Karjalan Ympäristötutkimus Oy 2025b)

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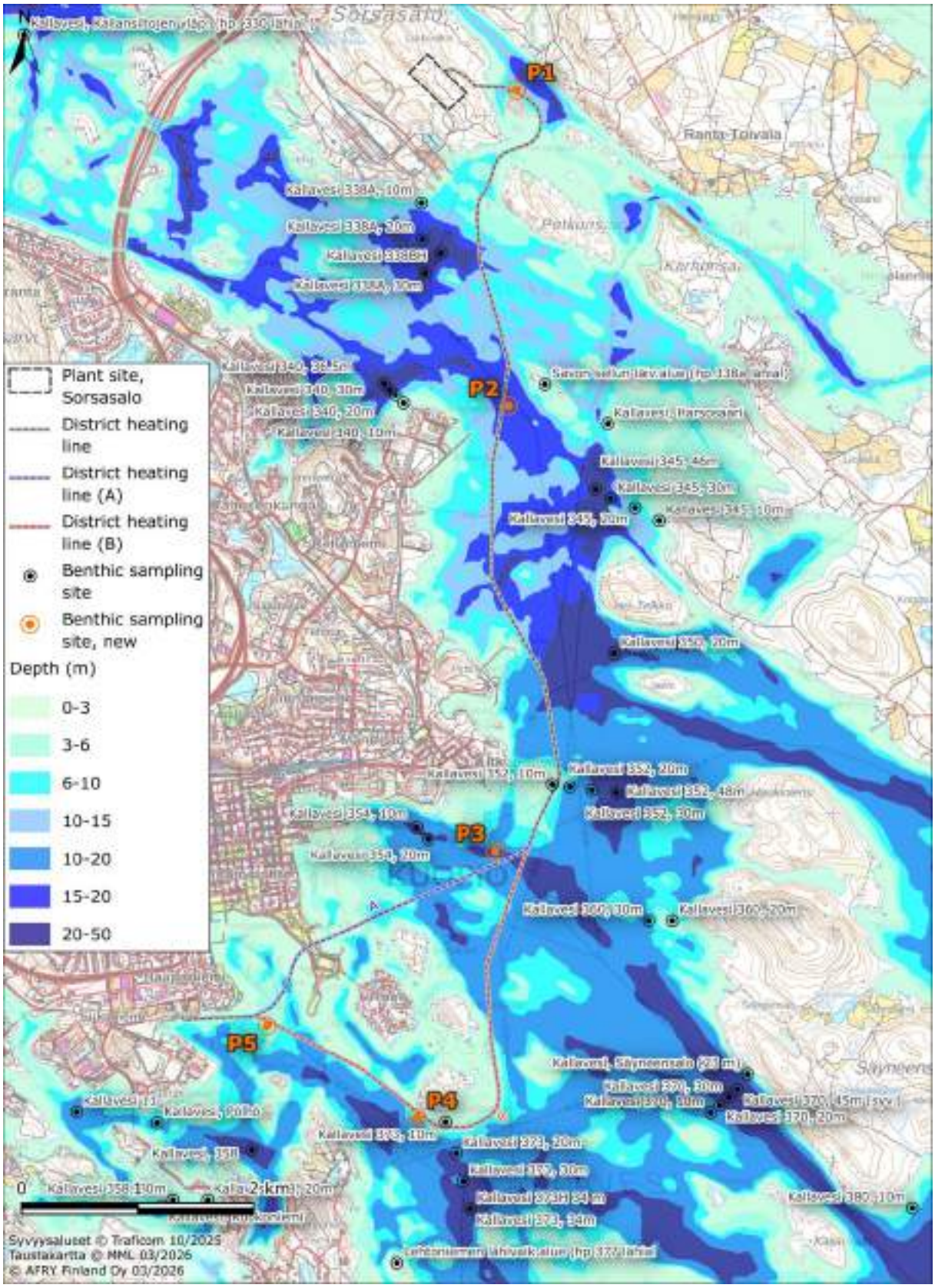

Figure 14-6. Benthic sampling points in Kallavesi, including samples collected for the project (Savo-Karjalan Ympäristötutkimus 2025b).

14.1.7.3 Aquatic flora

In monitoring the ecological status of Kallavesi, aquatic vegetation surveys are also regularly conducted along the main zonal transects. Transect mapping of aquatic vegetation are carried out every six years along the same transect locations as part of the obligation under the Kallavesi regulation. Aquatic vegetation and occurrence zones serve as indicators for classifying the ecological status of the water system, based on three indices: the proportion of type-specific species (TT50), the percent model affinity (PMA) and the reference index (RI). The aquatic vegetation monitoring transects are not located near the project area. In South Kallavesi, the nearest transects are at Puutossalmi, and in North Kallavesi they lie north and northwest of Laaninsaari.

Based on the survey results from the Kallavesi aquatic vegetation transects in 2017 (Alleco Oy 2017) and 2023 (AFRY Finland Oy 2023), Kallavesi's aquatic vegetation is diverse and broadly typical of large humic lakes, but the trend indicates increasing homogenisation of the zones. In particular, the isoetid shoreweed and some of the elodeids have decreased. In South Kallavesi, the water is slightly clearer than in the northern part, and the number of isoetids is clearly higher than in the northern part. In the south, the quillwort forms its own zone, and elodeids such as pondweeds and water milfoils are found more abundantly than in the north. In North Kallavesi, nympheids (water smartweed, yellow water lily) dominate, while elodeids and isoetids occur more sporadically and did not form distinct zones. Nympheid growths have expanded in both the south and north, which can suffocate other zones.

As a whole, the aquatic vegetation of Kallavesi remains diverse, but the trend points to an increase in nympheids and a decrease in elodeids and isoetids. This can be a sign of eutrophication and littoral zone changes.

Based on the indices used in the classification of ecological status, the aquatic vegetation in Kallavesi has been assessed as good in the third water management period (Table 14-2) (SYKE 2025). In the fourth water management period, the status is also being classified as good based on preliminary data (North Savo ELY Centre 2025, oral communication).

In the summer of 2025, a separate aquatic vegetation survey was carried out in the project area off Sorsasalo and the City of Kuopio, at the landing areas of the district heating pipelines, and in areas where the pipeline would run close to the shores (AFRY Finland Oy 2026, Appendix 4). The exact locations of the pipeline routes had not been planned precisely at the time of the survey, so the areas were mapped broadly across a sufficiently large area. The aim of the assessment was to assess the natural state of the beaches, identify aquatic plant communities and assess their abundance, and record any rare or endangered species.

In the field, the survey was carried out by circling the areas by boat and by wading along the shore, with the route recorded on a GPS device. Submerged vegetation was inspected using water binoculars, a rake with a telescopic handle, a weeding hoe and an underwater camera. In connection with the survey, water depths were also observed and areas were photographed. A more detailed report is attached (Appendix 4). Two alternative pipeline landing points were mapped in Sorsasalo and five in front of the city. The district heating line A would pass through Väinölänniemi, and the beaches in this area were also surveyed (the line B goes around the islands in front of Rönö). Some of the landing areas, such as Haapaniemi and the end of Kirkkokatu, were largely altered and developed. In Väinölänniemi and Itkonniemi, the landing areas were also partly located near swimming beaches. On the shore of Väinölänniemi, an invasive species that has rapidly spread in

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inland waters — the magnificent bryozoan — was also found. According to laji.fi, there have so far been only isolated observations of this species in Kallavesi. The invasive plant greater bindweed also grew in many places along the shores of Kuopio. Of the surveyed sites, Kelloniemi's aquatic vegetation was the most diverse. In Sorsasalo and the mapped islands, the shores were mainly rocky and covered in boulders, and the actual aquatic vegetation was sparse, mostly limited to water moss. In sheltered Likolahti, on the other hand, there were abundant growths of yellow water lily and pondweed.

14.1.8 Fish stock and fishing

14.1.8.1 General

There is no information on the possible fish stock in the small waters near the project area on the basis of the management plan of the fisheries area (Pohjois-Savon kalatalouskeskus 2021) or the environmental administration's exploratory fishing register (Koekalastusrekisteri 2025).

Information on fishing in Kallavesi has been obtained based on the joint fisheries monitoring carried out by Mondi Powerflute Oy and the City of Kuopio's Lehtoniemi wastewater treatment plant (Savo-Karjalan Ympäristötutkimus Oy 2024). Fisheries monitoring has included exploratory fishing with nets, exploratory trawling and unmounted net trials (Figure 14-7), as well as previous monitoring of juvenile pikeperch, which has since been replaced by exploratory trawling monitoring.

In addition to the mandatory fisheries monitoring, information on fishing in Kallavesi is available from the use and management plans of the Kallavesi fisheries area and the Tavinsalmi–Kallavesi fisheries areas, as well as from some fishing surveys concerning Kallavesi. (Pohjois-Savon Kalatalouskeskus ry 2021)

According to the classification of surface waters for the third period, Kallavesi's ecological status is good and the lake's fish stock is also assessed as good in the classification. The ecological status of North Kallavesi has been assessed as satisfactory and the status of the fish stock has not been assessed. Based on preliminary data for the fourth water management period, the status is on the borderline between good and excellent, but due to the uncertain classification result, the quality factor is excluded from the classification (oral communication, North Savo ELY Centre 2025).

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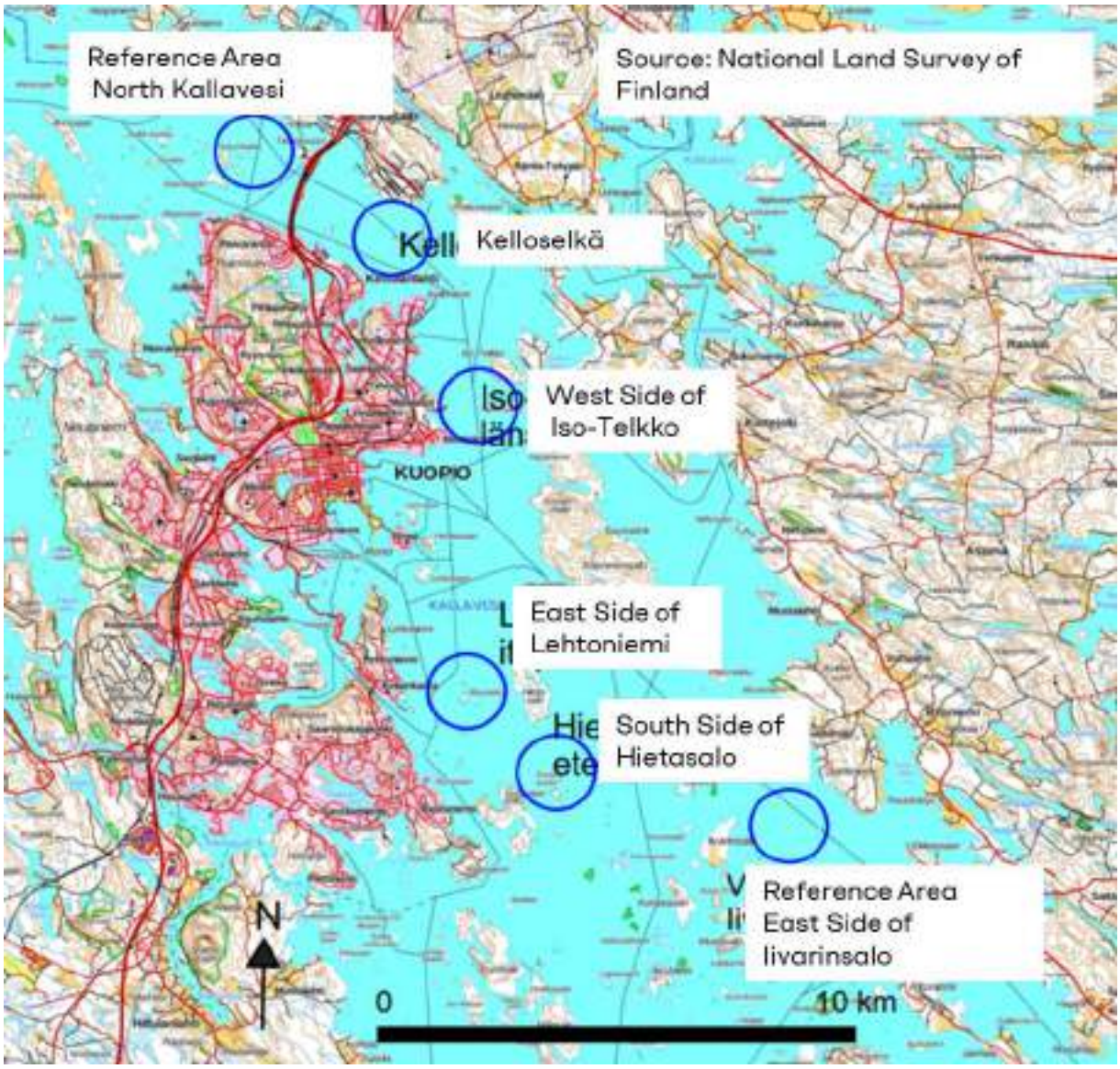

Figure 14-7. Location of exploratory fishing areas in Kallavesi. Exploratory net fishing and unmounted net trials have been carried out in the circled areas. The trawl lines have largely followed the same areas. The figure is from the report on joint fisheries monitoring in Kallavesi in 2024. (Savo-Karjalan Ympäristötutkimus Oy 2024).

14.1.8.2 Fish stocks and fish stock structure

In terms of fish stock, South Kallavesi is a fairly versatile, typical lake of Inland Finland. Pikeperch stocks are good, while brown trout stocks probably rely mainly on planting. The stocks of perch and European whitefish may be large in places. In the spring 2020 survey, the status of fish stocks was generally regarded as good. In South Kallavesi, the stocks of pikeperch, pike, perch and bream were considered good. In particular, pikeperch stocks were considered to have improved over the last 10 years. Instead, the stocks of European whitefish, landlocked salmon, brown trout and vendace in particular were considered to have deteriorated. (Pohjois-Savon Kalatalouskeskus ry 2021)

Unit catches from exploratory net fishing in Kallavesi were small both in terms of catch weight and number of fish. Based on exploratory fishing, the abundance of fish is relatively low compared to the reference values of the water body type and the eutrophication level of the lake. The lake's productivity has possibly been limited by the darkening of the water

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across the country in recent decades. Kallavesi is still classified as excellent for both unit catch variables (number of units and weight) in all areas. The classification of Hietasalo and Iivarinsalo was excellent in these respects, while the classification of other areas was already in the excellent category in previous fishing activity. The structure of the fish stock is balanced, and the share of predatory fish increased in some areas compared to earlier fishing activity. (Savo-Karjalan Ympäristötutkimus Oy 2024)

For unit catch variables, there are no signs of increased eutrophication development in the exploratory fishing areas of Kallavesi. However, the biomass share of cyprinids in Kelloselkä and Iso Telkko, south of Mondi Powerflute Oy, was poorer than in other areas, as in the previous exploratory fishing activity, with the classification remaining unchanged in both areas in this respect. (Savo-Karjalan Ympäristötutkimus Oy 2024)

In exploratory trawling activities, the share of salmonid catches fell significantly in 2024 compared with previous exploratory trawling activities, mainly due to a decrease in vendace catches. The most recent age groups of vendace have been weak in other lakes in the region as well, so the decline in the vendace population is very likely due to unfavourable weather conditions during vendace spawning and/or in spring/early summer, when newly hatched fry move in the littoral zone. (Savo-Karjalan Ympäristötutkimus Oy 2024)

The catch of the exploratory trawling consisted mainly of cyprinids. The decline in vendace may have partly contributed to an increase in the number of fish in the cyprinid family in the open lake areas. However, the total catches per trawling hour remained slightly below the average for the entire survey period. Of the dozens of one summer-old individuals caught in the exploratory trawl in August, it can be concluded that the natural reproduction of pikeperch in Kallavesi is strong, as the majority of one summer-old pikeperch are very likely to pass through the catch bag. (Savo-Karjalan Ympäristötutkimus Oy 2024)

In the unmounted net trials in 2024, the accumulations of substances in unmounted nets were, as a rule, slightly higher than in 2021, but lower than in 2015 and 2018. In the unmounted net trials, the accumulation of substances was highest in the southern part of Kallavesi, in the near and far impact areas of the Lehtoniemi wastewater treatment plant. The accumulations in the reference area Iivarinsalo also increased significantly compared with 2021, so the elevated levels cannot be directly linked to the Lehtoniemi wastewater treatment plant. Instead, there was a broader increase in the southern areas during the test (Savo-Karjalan Ympäristötutkimus Oy 2024).

The pikeperch population in South Kallavesi is strong. In 2021 and 2022, the pikeperch catch from professional fishing in South Kallavesi exceeded the vendace catch by weight, even though two pairs of trawlers fish in the area. Pike, perch and bream are also quite abundant. Also, in Koirus-Sotka south of Puutossalmi, the pikeperch population is good but the pike population is clearly stronger than in South Kallavesi. Salmonids are caught occasionally in the area, and the vendace population varies greatly from year to year and between different parts of the area. (Pohjois-Savon Kalatalouskeskus ry 2021)

In 2016, an European whitefish survey was carried out in the South Kallavesi area, which aimed to determine the age structure and growth rate of Europen whitefish in Kallavesi and to identify species based on the number of sieve teeth. According to the survey, most of the European whitefish weighing at least 700 grams in Kallavesi are planktonic whitefish. Both planktonic and houting fry have been used in the planting of whitefish in South Kallavesi. (Pohjois-Savon Kalatalouskeskus ry 2021)

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According to the survey responses, endangered common crayfish occur in certain parts of the fisheries area, although none were reported from South Kallavesi. According to the survey, the signal crayfish occurs in the Koirus-Sotka area, but not in the South Kallavesi area. (Pohjois-Savon Kalatalouskeskus ry 2021)

14.1.8.3 Fishing

Overview

The project area is located in the Kallavesi fisheries area. South Kallavesi, located north of Puutossalmi, belongs entirely to the Kallavesi fisheries area, and North Kallavesi, located west and northwest of Sorsasalo in the City of Kuopio, belongs to the Tavinsalmi–Kallavesi fisheries area. (Pohjois-Savon Kalatalouskeskus ry 2021)

Fishing in the Kallavesi fisheries area is mainly recreational. Commercial fishing is less common. Commercial fishing is conducted with trawls, nets and traps. In 2020, there were about 10 category I and II fishers in the Kallavesi fisheries area. In the South Kallavesi subregion, there is a popular lure fishing permit area covering the open water of South Kallavesi. A lure fishing permit entitles the permit holder to fish in the permit area with a fly, a spinner and a trolling lure. The number of rods and lures used for trolling is not limited. (Pohjois-Savon Kalatalouskeskus ry 2021)

The fish species planted in Kallavesi are as a rule European whitefish, pikeperch and brown trout. Each year, significant numbers of pikeperch, European whitefish and brown trout juveniles are planted in Kallavesi. (Pohjois-Savon Kalatalouskeskus ry 2021)

Commercial fishing

In the South Kallavesi area, there were 5 class I fishers and 4 class II fishers in 2019. The number has not come down significantly, although in 2016 there were still 6 class I fishers. Year after year, the most important prey fish have been vendace and pikeperch, which are caught the most in terms of kilograms. Vendace and pikeperch also make up the majority of the catch value in euros in commercial fishing in South Kallavesi. From 2016 to 2019, the value of pikeperch catches amounted to approximately 50% of the annual value of the catches in euros in net and trap fishing. The share of vendace of the total catch value in euros was about 30%. (Pohjois-Savon Kalatalouskeskus ry 2021)

In terms of fisheries, the most important areas in South Kallavesi are the open lake areas, as commercial and recreational fishing are concentrated in these areas. Commercial fishing takes place by trawling in the shipping channels, and the area covered by lure permits extends from the Kallansillat bridges through the Central Kallavesi archipelago to Puutossalmi. The entire South Kallavesi area is well suited for commercial fishing. From the point of view of the fisheries area, all commercial fishing tackles allowed by law are suitable for the area. Trawling is not suitable for narrow bays, shallow waters or protected areas. For this reason, trawling in South Kallavesi is mainly limited to shipping channels. (Pohjois-Savon Kalatalouskeskus ry 2021)

Recreational fishing

Indicative figures for recreational fishing in South Kallavesi can be found in the Suomi kalastaa 2009 survey (in Finnish), which was conducted more than 15 years ago. According to the survey, for example, 32,234 fishing days have been recorded in South Kallavesi with a lure fishing permit, 69,296 days by rod and ice-fishing under the everyman’s right, and

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9,689 days under the age-based lure fishing right. (Pohjois-Savon Kalatalouskeskus ry 2021)

A 2006 survey on recreational fishing was also carried out in the part of Kallavesi north of Puutossalmi. The survey was made in accordance with general survey practice for persons who have obtained fishing permits for the area. Therefore, the number of fishers and the total catch are in fact slightly higher than those shown below. About 1,500 households fished in the area covered by the survey. The most important fishing gears were sparse nets, vendace nets, fish traps and various jigging equipment. The fishing area has a popular lure fishing zone that offers good conditions for lure fishing for pike, pikeperch and brown trout. (Pohjois-Savon Kalatalouskeskus ry 2008)

The survey, carried out in spring 2020 to prepare the use and maintenance plan, investigated, among other things, the quality of South Kallavesi as a fishery. In the survey, the current status of South Kallavesi's fishery was assessed by 20 respondents. According to the survey responses, South Kallavesi was largely regarded as moderate or good fishery. (Pohjois-Savon Kalatalouskeskus ry 2021)

The survey also examined how fish are caught in the waters of the fisheries area and how the situation has changed over the last 10 years. Spinning and trolling were seen as active, fairly active or moderate in the area. With regard to trap fishing, the answers were divided, although most respondents considered it minor. According to the results of the survey, fishing with static traps has decreased after 2010. Spinning is slightly more active and the situation has not significantly changed since 2010. The current state of trolling was seen as mostly or fairly active, and it has increased slightly over the last 10 years. Some saw an increase in professional fishing, but for the most part, no position was taken on the status of professional fishing. The same applied to fishing tourism. (Pohjois-Savon Kalatalouskeskus ry 2021)

14.2 Impact assessment and methodology

14.2.1 Water systems and hydrology

The EIA report describes the impacts of the SMR project on the water system in the Kallavesi area. The most significant impact arises from the construction of district heating pipelines on the lake bottom. Water system construction is only included in the Sorsasalo option, where the district heating transmission line would run from Sorsasalo across Kallavesi to the Haapaniemi power plant. In its southern part, there are two alternative routes: route A would pass through Väinölänniemi, while route B would run around the outer east side of Väinölänniemi and the Rönö island. Two pipes are installed side by side, and the total width of the pipeline is about 10 metres. The district heating pipes are insulated, and heat loss along their length is minimal. The pipes are mainly buried at the planned location, causing little impact on water quality and the aquatic environment. However, some of the aquatic vegetation growth areas and habitat of benthic animals are lost. In shore areas, the construction of the pipeline also requires excavation work and dredging of water areas at the pipeline's landing points in areas where the water depth is 3.5 metres or less. The estimate of the mass to be dredged is 25,000 solid cubic metres. Dredging in the water system causes temporary cloudiness in the water and dispersal of suspended solids, which can reduce light availability and smother benthic habitats. Sediment-bound nutrients and contaminants may be released, but the effects are usually minimal. The disturbance is mainly local and short-lived, and the biota typically recovers quickly. A similar slight cloudiness and suspended solids load can result from construction

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on land areas from stormwater runoff, but stormwater management and treatment are planned to minimise impacts on water systems.

In principle, wastewater generated during the plant's operation is discharged into the sewage network, into which radioactive liquids may only be released at levels below the limit values, minimising the load on water systems. The plant's clean stormwater is discharged into the environment in a controlled manner, while more contaminated stormwater is treated and discharged into the sewerage system, so impacts on water systems remain minor. The plant takes water from the municipal water supply network, so it does not have a direct impact on the water system.

The impacts on the water system are assessed by experts, mainly based on the project's planning data and the current state of the area, which are obtained comprehensively especially from the joint monitoring of Kallavesi (Savo-Karjalan Ympäristötutkimus Oy 2015). In addition, surveys have already been carried out for the project at the programme phase to supplement the current status information, such as benthic invertebrate sampling along the pipeline routes (Savo-Karjalan Ympäristötutkimus 2025b, Appendix 3) and vegetation mapping of water and shoreline areas (Appendix 4), and these surveys will be supplemented as necessary during the reporting phase. Possible sediment contaminants are also taken into account in the assessment on the basis of the results of sediment sampling carried out during the reporting phase and in accordance with the Ministry of the Environment's dredging and dumping guide (Ministry of the Environment 2015). The report assesses the impacts on water quality, aquatic life, sediments and fish, as well as fishing (see also chapter 14.2.3) and other water use. The impact assessment will be supplemented by experience from comparable projects and relevant findings from other research. It is possible to model the spread of sediment load caused by dredging, but the effects can largely be prevented by various protective covers, so modelling is not considered necessary.

The environmental impact assessment examines how the project affects the ecological status of the Kallavesi water body and whether it could jeopardise or prevent the water system from achieving good status. The ecological status of Kallavesi is currently classified as good, but according to the latest classification data based on the 2018–2024 monitoring results, the classification is declining to satisfactory.

The assessment is carried out for all project and route options. The report also describes the means of mitigating the impacts, as well as the uncertainties related to the assessment.

14.2.2 Stormwater and flood risks

As part of the assessment of the project's impacts on the water system during operation, the impact of stormwater management on surface waters is assessed. To support the impact assessment, the EIA report phase will clarify the preliminary stormwater discharge sites and the preliminary need for, and implementation of, qualitative and quantitative control measures.

The water system impacts caused by construction site water during construction consist mainly of water generated during the treatment of soil and possible excavations. The preliminary amount of construction site water, discharge routes and treatment will be specified during the EIA report phase. Possible PIMA areas are also taken into account in the assessment of surface water impacts during construction. The impact on water systems caused by the project's stormwater and construction site runoff is assessed on the basis of load data.

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The project is not located in a flood risk area.

The assessment of impacts on water systems from stormwater and construction site runoff is carried out by a water system specialist specialising in surface waters and a stormwater specialist.

14.2.3 Fish stock and fishing

The EIA report describes the impacts of the SMR project on fish stock and fishing in the Kallavesi area. Chapter 14.2.1 describes the impact assessment on surface waters and benthic animals and the methods to be used. This also applies to fish stock and fishing, so the methods used in the surface water impact assessment are used in assessing the impacts on fish stock.

In the pipeline area of the project option VE2, there are no known significant fish spawning areas or surveys of fish reproduction areas in the southern end of Sorsasalo or in front of the Haapaniemi power plant. To the north of the island of Rönö, at the tip of Väinölänniemi, there is a significant spawning area for pike (oral communication, the person in charge of water management in the City of Kuopio). However, the pipeline is to be drawn either north of the island of Rönö across Väinölänniemi (option A) or further away around the southern islands of Väinölänniemi, so it is not located in the pike spawning area. Dredging of the pipeline in the water system causes temporary cloudiness in the water and dispersal of suspended solids, which can weaken fish habitats and briefly hinder fishing in the area.

The impact assessment is carried out for all project and route options. The report also describes the means of mitigating the impacts, as well as the uncertainties related to the assessment. The assessment is based on existing data (mandatory monitoring and other available information).

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15 VEGETATION AND HABITAT TYPES

15.1 Current status

The project options in Hepomäki (VE1) and Sorsasalo (VE2) lie in the biogeographical region of North Savo (Sb) and, in the phytogeographical division, in the southern boreal forest vegetation zone (2b) in the lake district of Finland. In terms of mire vegetation zones, the areas are mainly located on the eccentric kermi bogs and Fuscum bogs of the interior of Finland. (National Land Survey of Finland 2025b). In terms of threatened habitats, Kuopio is part of the Southern Finland assessment area (Kontula & Raunio 2018).

The topography of the Kuopio region is varied. There are plenty of water systems and the forests are mostly coniferous. However, the vegetation in the region is more lush than usual, as Kuopio is the core area of the North Savo herb-rich forest concentration. The nutrient richness of the bedrock is evident in the herb-rich forest concentrations through the occurrence of nutrient-demanding herb-rich forest vegetation and the abundance of herb-rich forests. (City of Kuopio 2025k). No groundwater areas are located in or near the project areas (Finnish Environment Institute 2025f).

A vegetation and habitat type survey was prepared for the Sorsasalo and Hepomäki plant sites and the preliminary planning areas for district heating pipelines during the summer of 2025 (AFRY Finland Oy 2025a), which aimed to mark off nature sites of significant natural value located in the plant and survey areas. The fieldwork for the vegetation and habitat survey was carried out between 20 August and 21 August 2025. The purpose of the surveys was to identify sites in the project area that are valuable for biodiversity, so that they can be taken into account in the project planning. The Sorsasalo (VE2) survey area for 2025 differs from the project plan for the EIA programme phase, particularly regarding the routes of the district heating transmission line, which were revised following the field surveys. The surveys will be supplemented in Sorsasalo during the 2026 field season, as necessary, to cover the project plan area in accordance with the EIA programme phase. The Hepomäki plant area has also changed after the surveys during the EIA programme phase, but it is not necessary to prepare supplementary vegetation and habitat surveys for the area as the previous surveys cover the new plant area.

The input data used were map and aerial photograph materials (National Land Survey of Finland 2025b), map services maintained by authorities, the Finnish Environment Institute's public data services (Finnish Environment Institute 2025f), as well as spatial datasets from the Finnish Forest Centre (2025) on Forest Act sites (habitats of special importance, ETE) and public data. The occurrence data of endangered species were checked and the location data were ordered from the open Laji.fi information system maintained by the Finnish Biodiversity Information Facility (2025). In addition, the results of the nature surveys prepared by Mondi Powerflute Oy (AFRY Finland Oy 2025b) and VolagHy (AFRY Finland Oy 2025c, Luonto Luonnos 2025) for the Sorsasalo area during the spring and summer of 2025, as well as the results of the nature surveys prepared for the Sorsasalo area earlier for EIA projects in 2015 (Pöyry Finland Oy 2015) and 2019 (AFRY Finland Oy 2020), were used.

In addition to the general features of nature, the field surveys also paid special attention to the following sites, which were marked off:

- habitat types protected under Sections 64 and 65 of the Nature Conservation Act (9/2023)

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- protected aquatic habitats (springs, rills, ponds smaller than 1 hectare) under Chapter 2, Section 11 of the Water Act as well as streams under Chapter3, Section 2 of the Water Act
- threatened habitats (Kontula & Raunio 2018)
- habitats of special importance for forest biodiversity pursuant to Chapter 3, Section 10 of the Forest Act (1093/1996)
- occurrences of endangered and protected plant species (species listed in EU Annex IV (b) [92/43/EEC]; Hyvärinen et al. 2019)
- occurrences of invasive species
- other sites that are important for biodiversity, such as regionally and locally representative nature sites (e.g. areas of old-growth trees, natural wetlands, coastal areas of flowing waters).

The surveys were carried out in accordance with the guide "Luontoselvitykset ja luontovaikutusten arviointi" (Nature surveys and assessment of impacts on nature) (Mäkelä & Salo 2023).

15.1.1 Hepomäki

The Hepomäki area is partly built-up and partly forested and sparsely populated. The area contains Rudus Oy's aggregate extraction site, which is completely altered in terms of natural environment. South of the aggregate extraction site is a larger forested area, comprising a mix of young managed stands and older forest.

The SMR plant area in Hepomäki is an anthropogenic environment and its natural state has been altered. The area of the district heating transmission line is mainly young, even-aged managed forest (Figure 15-1). The SMR plant area is located entirely in the Rudus aggregate extraction site, which is a bare rock and sand-based field (Figure 15-2). To the east, there is an old forest area (Figure 15-3) that stands out from the rest of the environment. In addition, a small damp spruce mire area lies to the east of the SMR plant area and the district heating pipeline. In the area of the district heating transmission line, there are mainly young and slightly older even-aged mixed-species forests and managed mesic heath forests dominated by spruce (Figure 15-4). In the southern part of the district heating pipeline route, there is also an unnamed riverbed that has been straightened by excavation and whose natural condition has been altered.

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Figure 15-1. Aerial view of the Hepomäki (VE1) SME plant area and district heating transmission line area.

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Figure 15-2. The natural state of the Rudus aggregate extraction area has changed.

Figure 15-3. An old spruce-dominated forest with plenty of decaying wood.

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Figure 15-4. Typical even-aged, young managed forest in the survey area.

15.1.2 Sorsasalo

The island of Sorsasalo is, to a large extent, an area transformed by construction and, for example, the removal of soil. However, the island also has quite extensive forested areas. Roughly half of the island's area (about 6 km^2) is built-up/developed area, and the other half is forest. In the area around the industrial waste landfill in the southern part of the eastern half of the island, there is both industrial construction (e.g. Mondi Powerflute Oy's fluting mill, NG Nordic Finland Oy's scrap metal recycling plant and MReal's old closed landfill) and forest areas. In addition, VolagHy's eSAF project is also planned for the area, and a related EIA procedure is on-going (AFRY Finland Oy 2025d).

The SMR plant area in Sorsasalo and the area of the district heating transmission line in Sorsasalo are partly anthropogenic environments where the natural state has changed to varying degrees (Figure 15-5). The plant area contains a forest access road, wasteland and relatively young managed forests. Contrary to the aerial view, light selection felling has been carried out on the stand of older forest in the southern part of the SMR plant area, which has made the area more exposed. The ruts from motor vehicles have strongly modified the ground layer, and the natural state of the area has changed (Figure 15-6). To the south of the plant area, there are also stands of older trees as well as lush coastal forests (Figure 15-7). There are a few old holiday homes in the coastal areas, some of which are in poor condition. The district heating transmission line runs from Sorsasalo via Kallavesi to the Haapaniemi power plant. The route option A crosses Väinölänniemi, which is an urban park area.

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Figure 15-5. Aerial view of the Sorsasalo (VE2) SMR plant area and the area of the initial section of the district heating transmission line.

Figure 15-6. Sorsasalo project area's young managed forest (left) and the former old forest area where logging has taken place (right).

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Figure 15-7. Forest of older trees in the coastal area.

15.1.3 Valuable natural sites and noteworthy species

In the areas of the project options VE1 and VE2, there are no protected types of natural habitats in accordance with Sections 64 or 65 of the Nature Conservation Act (9/2023), nor water systems in accordance with Chapter 3, Section 2 of the Water Act. In the terrain map of the National Land Survey (2025a), a spring is marked on the southeast side of the Hepomäki plant area at a distance of about 200 metres, which is a protected aquatic habitat in accordance with Chapter 2, Section 11 of the Water Act. There are no springs or other sites (rills, ponds smaller than 1 hectare, flads, gloe lakes) under Chapter 2, Section 11 of the Water Act in the areas of or in the vicinity of Sorsasalo or the district heating transmission connections.

There are no habitats of special importance in accordance with Section 10 of the Forest Act, marked off by the Finnish Forest Centre (2025), in the areas of the project options or in their vicinity. In the northeastern part of Sorsasalo, one Forest Act site (Section10) is located at a distance of about 540 metres from the plant area, and the nearest site to Hepomäki is located at a distance of about 586 metres to the northeast of the plant area.

In the area of both project options (VE1 and VE2), noteworthy nature sites and those of conservation value were identified in the 2025 surveys (AFRY Finland Oy 2025a), and they have been marked off and classified according to Mäkelä & Salo's (2023) guide into the LuTu, i.e. habitat type value classes 1–4. The noteworthy sites were located in natural or similar forest areas.

The valuable and noteworthy nature sites identified and marked off in the areas of the project options in 2025 are presented in their entirety on the maps below (Figure 15-8 and Figure 15-9). Detailed site descriptions and boundaries are shown in the table (Table 15-1).

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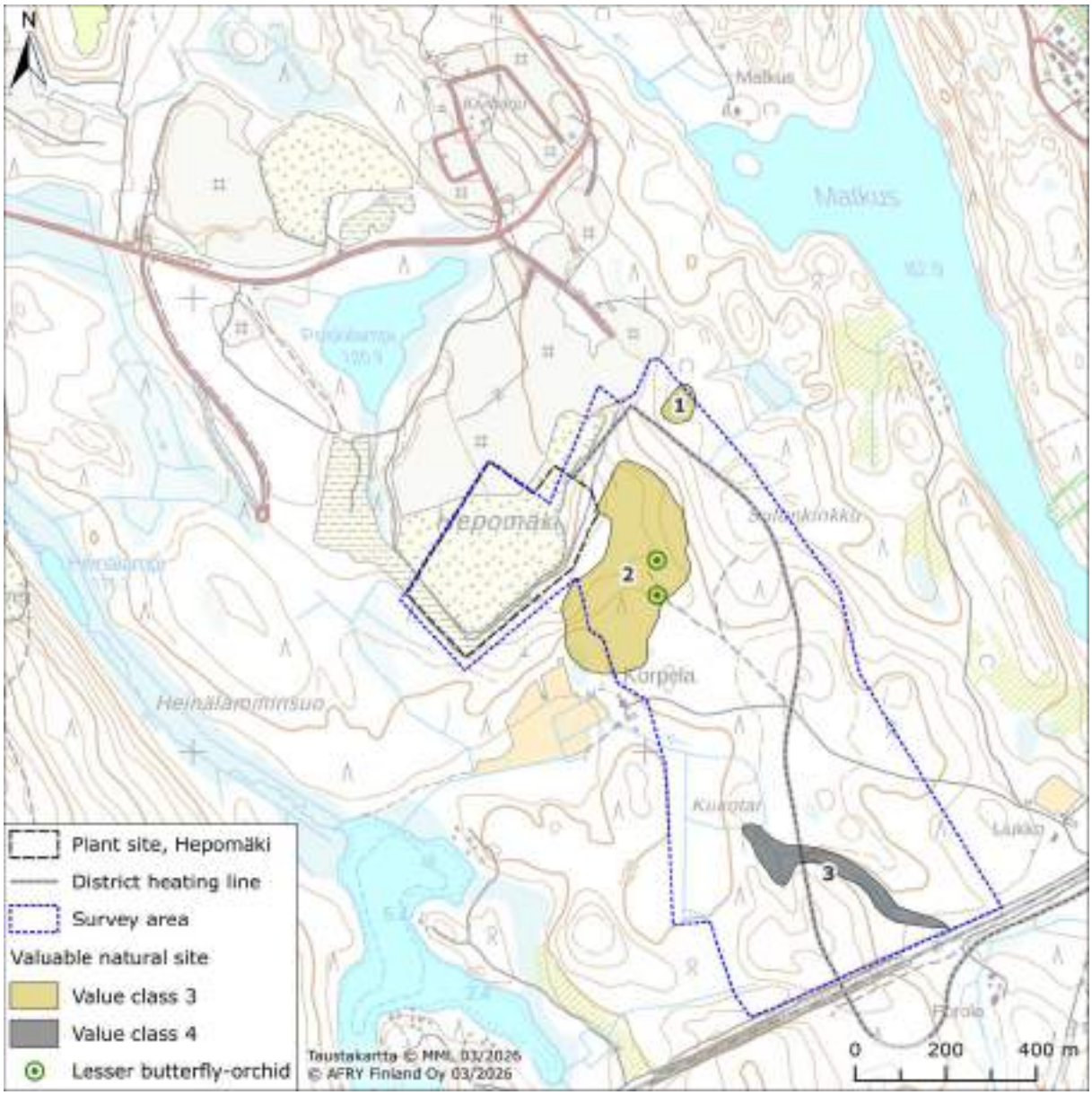

Figure 15-8. Noteworthy vegetation and habitat type sites 1–3 and lesser butterfly orchid observations in the 2025 field survey at the Hepomäki (VE1) SMR plant area and in the area of the district heating transmission line (the plant area changed slightly after the survey was carried out, meaning a small part of the northern edge of the plant area remains outside the survey area; however, this area is the Rudus aggregate extraction site).

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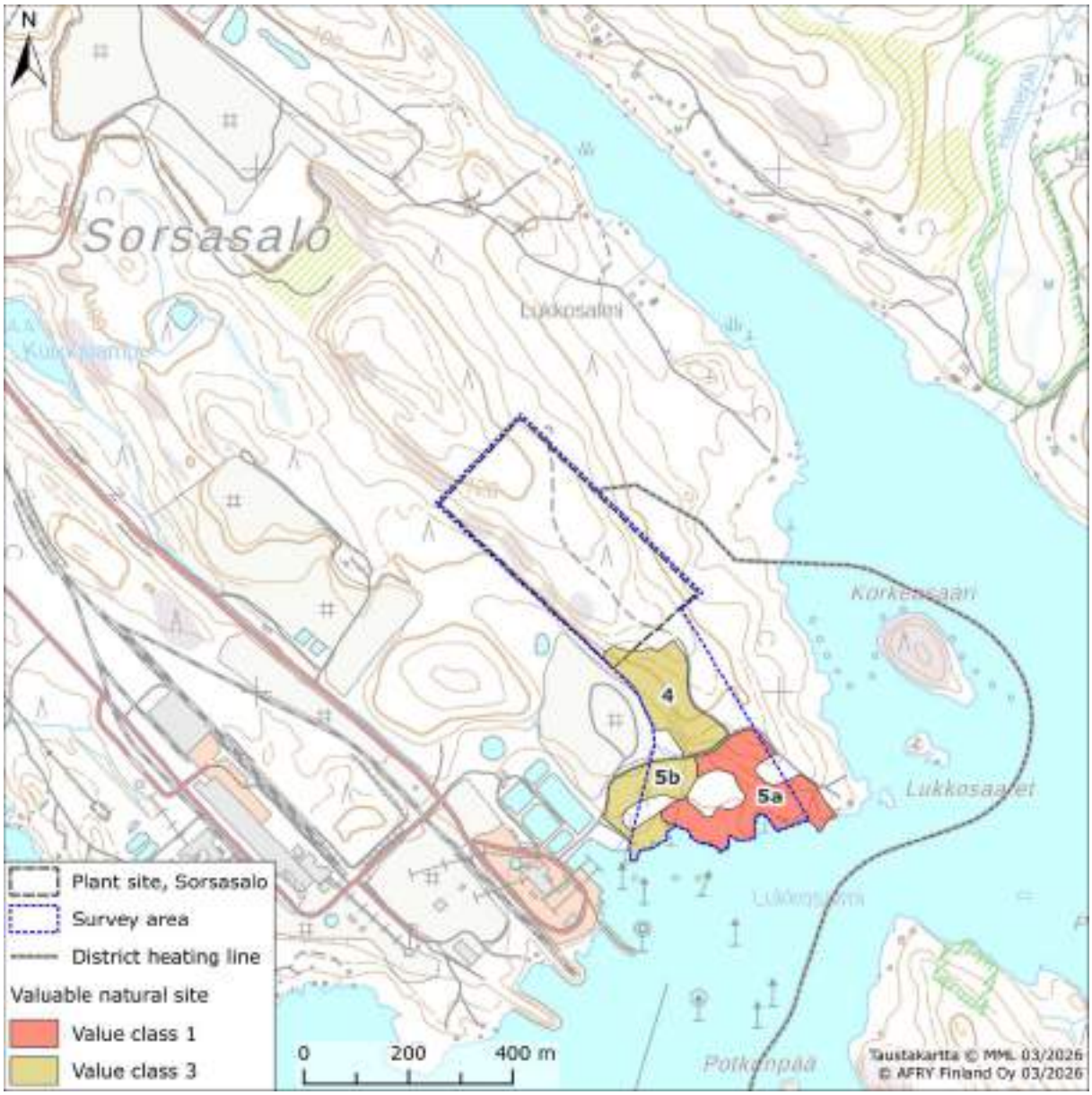

Figure 15-9. Noteworthy vegetation and habitat type sites 4 and 5 observed in the 2025 field survey at the Sorsasalo SMR plant area and the district heating pipeline survey area.

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Table 15-1. Nature sites mapped in the survey area in 2025; the conservation status of the habitat types identified in them in Southern Finland according to Kontula & Raunion (2018), and the sites' value class according to Mäkelä & Salo (2023). Threat status (Southern Finland): CR = critically endangered, EN = endangered, VU = vulnerable, NT = near threatened. The least concern (LC) and data deficient (DD) vegetation types are not recorded separately. The national and, where necessary, regional threat status of habitat types has been presented as part of the site description.

No – site	Legal basis and threat status	Site description	Value class
Hepomäki (VE1)			
1 – Spruce mire	Equisetum sylvaticum spruce mires (EN), thin-peated eutrophic spruce mires (EN)	A small spruce- and birch-dominated patch of mire where the stand is somewhat old and of varying ages. Decayed wood occurs in moderate amounts as fallen trees and as standing deadwood. Around the spruce mire area, there is mixed-species forests with relatively young, managed mesic heath forest forests. The area is an Equisetum sylvaticum spruce mire, and around the depression there are characteristics of a thin-peated eutrophic spruce mire. The area is a site of local significance and interest.	3
2 – Old spruce stand	old mesic heath forests dominated by conifers (EN), mature mesic heath forests dominated by conifers (VU), lesser butterfly orchid (protected throughout the country)	To the east of the Hepomäki aggregate extraction area lies a cohesive, representative area of old-growth forest, where the trees are spruce-dominated. The trees vary in age, and some are old and covered in beard moss. There is a considerable amount of decayed wood in the area, both as fallen trees and as standing deadwood. The area is an old and mature mesic heath forest dominated by conifers. During the field survey, two flowering lesser butterfly orchid specimens were found.	3
3 – The banks of the river bed	young mesic heath forest (VU)	A straightened river bed is located in the Kukotar forest area. The river bed was dry at the time of the survey. A narrow protective zone about 10 metres wide has been left around the river bed. It has denser tree cover and contains more mature trees than the surrounding area. The area does not have particularly significant natural values, but it stands out from its surroundings as a somewhat more representative site. By type, it is young mesic heath forest.	4
Sorsasalo (VE2)			

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4 – Mature spruce stand	mature mesic heath forests dominated by conifers (VU)	The area is distinguished from the surrounding area by its vegetation and habitat type values and by the older trees in the area. There is a mesic heath forest in the area, where most of the trees are mature and, in places, somewhat old spruce trees. Significance as a wooded corridor between the adjacent Siberian flying squirrel habitats. The area is likely to have undergone forest management such as thinning. By type, the forest is a mature mesic heath forest dominated by conifers.	3
5 – Lukkosalmi coastal forest	mesic mesotrophic herb-rich forest (VU) Habitat of the species (Siberian flying squirrel) listed in Annex IV(a) of the EU Habitats Directive	A coastal mixed-species forest, where the trees are of varying ages. Outside the site boundary, there are small, old clear-cuts with regenerating saplings. In some places, the spruce trees are old and sturdy. In the eastern part of the coastal forest (site 5a), an occupied habitat of the Siberian flying squirrel was detected in the spring 2025 surveys.	1 (5a) and 3 (5b)

No occurrences of endangered or species of conservation concern among plants or fungi have been recorded in the Sorsasalo or Hepomäki project areas from 2000 to 2025 (Finnish Biodiversity Information Facility 2025), and the 2025 field surveys in the Sorsasalo (VE2) area did not find any new occurrences of such species. Several lesser butterfly orchid specimens (Figure 15-8) have been observed in the old forest area south of the Hepomäki SMR plant area (VE1) (AFRY Finland Oy 2025a; A-Insinöörit Suunnittelu Oy 2025). Lesser butterfly orchid is classified as a Least Concern (LC) species (Hyvärinen et al. 2019), but it is protected throughout Finland under Section 69 of the Nature Conservation Act (9/2023). There is also an observation of alpine enchanter’s nightshade (A-Insinöörit Suunnittelu Oy 2025) near the Hepomäki district heating transmission route. This plant is a food source of the very endangered (EN) Mompha terminella.

There are observations of harmful invasive species in the Sorsasalo area, including garden lupin and Indian balsam (Vieraslajit.fi 2025). There have been no previous observations of invasive species from the Hepomäki project area or its proximity, and they were not observed during the survey. During the survey of the summer of 2025, Indian balsam and garden lupin were found in the Sorsasalo area, as well as red-berried elder, small balsam, hedge bindweed and Douglas spiraea (Figure 15-10) from other invasive species (AFRY Finland Oy 2025a).

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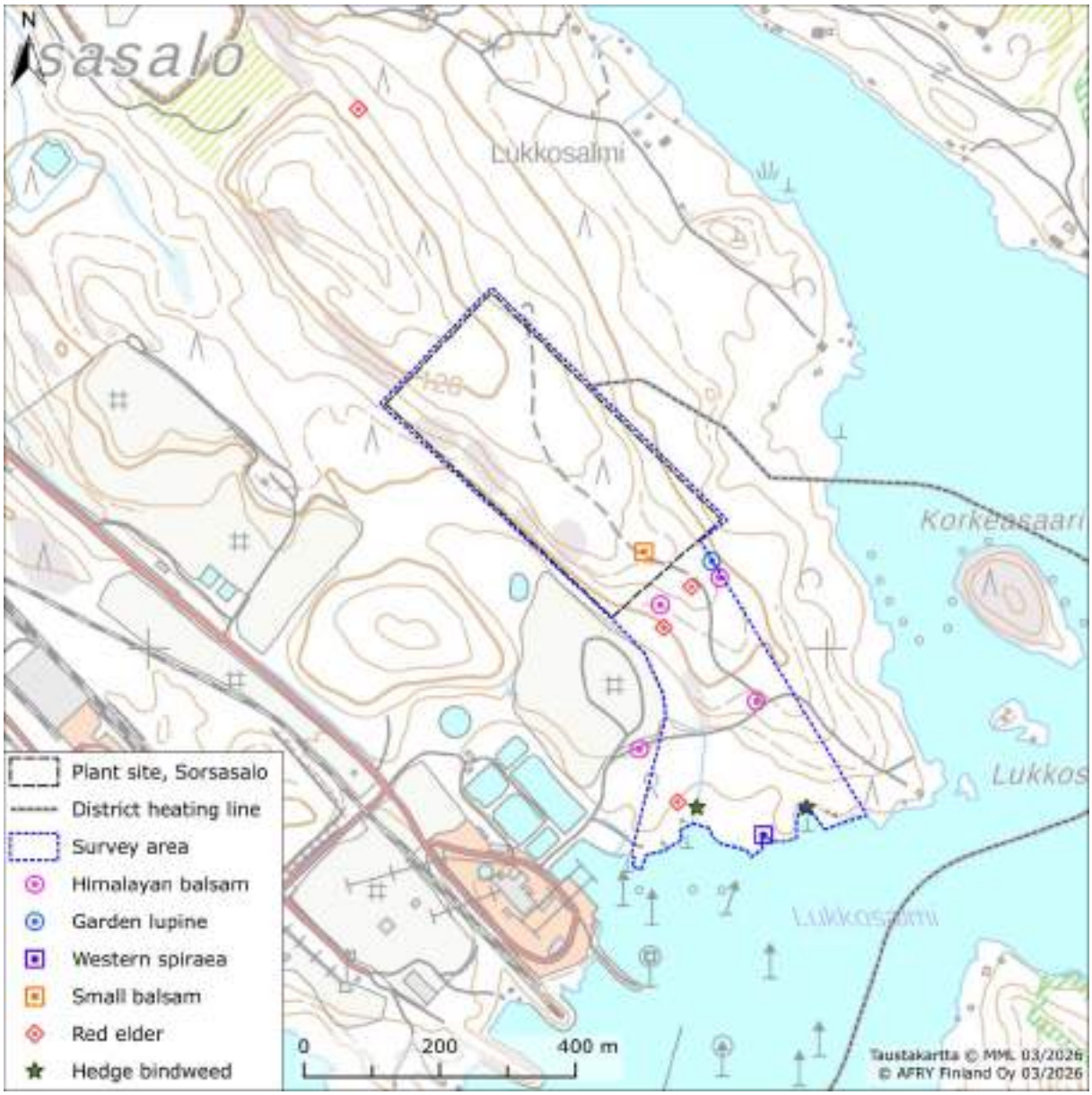

Figure 15-10. Invasive species detected at the Sorsasalo (VE2) plant area and its vicinity in 2025.

15.2 Impact assessment and methodology

The EIA report assesses the impacts that the implementation of the project will have on vegetation and species of conservation interest, as well as on valuable natural sites. The assessment work is based on existing baseline data and nature surveys carried out in the project area in 2025. Field surveys will be supplemented during one field day in the Sorsasalo project area (VE2) during the 2026 field season, where necessary, with regard to the plant area of the expanded SMR plant and the district heating transmission route.

In addition, the impacts on biodiversity and interactions are explored more extensively. The assessment takes into account both direct and indirect impacts and evaluates the sensitivity of the affected site and the magnitude of the impact, which together determine the overall significance of the vegetation impacts.

For the purpose of the nature impact assessment, the information presented in the EIA programme on the valuable natural environment sites closest to the project area is

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reviewed. Other impact assessments to be prepared during the assessment work are available for evaluation and marking the limits of the impact area. The marking the limits of the impact areas for each identified impact mechanism will be specified as the EIA procedure progresses, based on modelling and impact assessments of other components, so that impacts on vegetation can be assessed as reliably as possible and with sufficient scope.

The assessment of the impacts on vegetation takes into account the existing guidelines on the assessment of environmental impacts (Mäkelä & Salo 2023). The assessment of the significance of the impacts takes into account the characteristics and sensitivity of the natural sites, the habitat and site requirements of the species, as well as the latest assessments of the threat status of the habitat types and species in Finland. In addition, it is assessed whether the project has cumulative impacts with other nearby projects, and mitigating measures are presented. Impacts on vegetation are assessed by an experienced biologist.

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16 FAUNA AND BIRDS

16.1 Current status

The rest of the fauna within the project areas consists mainly of mammal species typical of those areas and other species that have adapted to living in or around an artificial industrial area. The most common mammal species in the Sorsasalo industrial area are probably small rodents, brown hares and foxes. In addition to the aforementioned species, elks, white-tailed deer and roe deer may also be present in the Hepomäki project area.

16.1.1 Species listed in Annex IV (a) of the EU Habitats Directive

Animal species listed in Annex IV (a) of the EU Habitats Directive are species of the so-called strict protection system, and the weakening and destruction of their breeding sites and resting places is prohibited under Section 78 of the Finnish Nature Conservation Act (LSL 9/2023) and the Nature Conservation Decree (2023/1066). Of the species listed in Annex IV(a) of the Habitats Directive, the following may occur in the project areas or in their vicinity based on their distribution and previous observations (Finnish Biodiversity Information Facility 2025), as well as field surveys carried out in the area (AFRY Finland Oy 2020 and 2025a–c, Luonto Luonnos 2025): Siberian flying squirrels, moor frogs, otters, bats, large predators, northern birch mice and a few insect species (Nieminen & Ahola 2017).

Siberian flying squirrel occurs quite abundantly in urban forests in the city and in the sparsely populated area, as well as in the woods skirting fields (Finnish Biodiversity Information Facility 2025). In 2011, there were observations of Siberian flying squirrels (Finnish Biodiversity Information Facility 2025, Figure 16-1) near the SMR plant site of Hepomäki (VE1) at a distance of about 20 metres in an old spruce stand and south of the district heating pipeline route in 2025 (Luontoselvitys Robur Oy 2025b). In the south-east corner of the Sorsasalo (VE2) SMR plant and near the district heating transmission routes, there are abundant observations of Siberian flying squirrels from 2007 and 2009 (Finnish Biodiversity Information Facility 2025), with the latest from 2025 (AFRY Finland Oy 2025b, Luonto Luonnos 2025) (Figure 16-2). In addition, in the northern Väinölänniemi, approximately 335 metres beyond the district heating transmission line, a Siberian flying squirrel observation was made in 2021 (Finnish Biodiversity Information Facility 2025). There are no other observations of the species in the area. The species preferably lives in an aged mixed forest with birch, alder and in particular aspen, which are used for food and as nesting trees, as well as spruce trees, which provide shelter and places for storing food. For the species, it is important that there is a corridor formed by trees from the stand to other forest areas.

There are no observations of **moor frogs** or **otters** in or near the project areas of Hepomäki (VE1) or Sorsasalo (VE2) (Finnish Biodiversity Information Facility 2025). There are no habitats suitable for the species in the Hepomäki project area, such as ponds, wetlands or flowing waters. The nearest moor frog observations in the Sorsasalo project area were made at a pond excavated in 2025 about 585 metres northwest of the SMR plant area (AFRY Finland Oy 2025c), but the lake shores near the project area are probably too barren for the species. In 2025, observations were made of otters in the Uitukanniemi area, about one kilometre from the Sorsasalo project area (AFRY Finland Oy 2025a), and it is possible that otters also move occasionally in the Lukkosalmi and Virtasalmi area.

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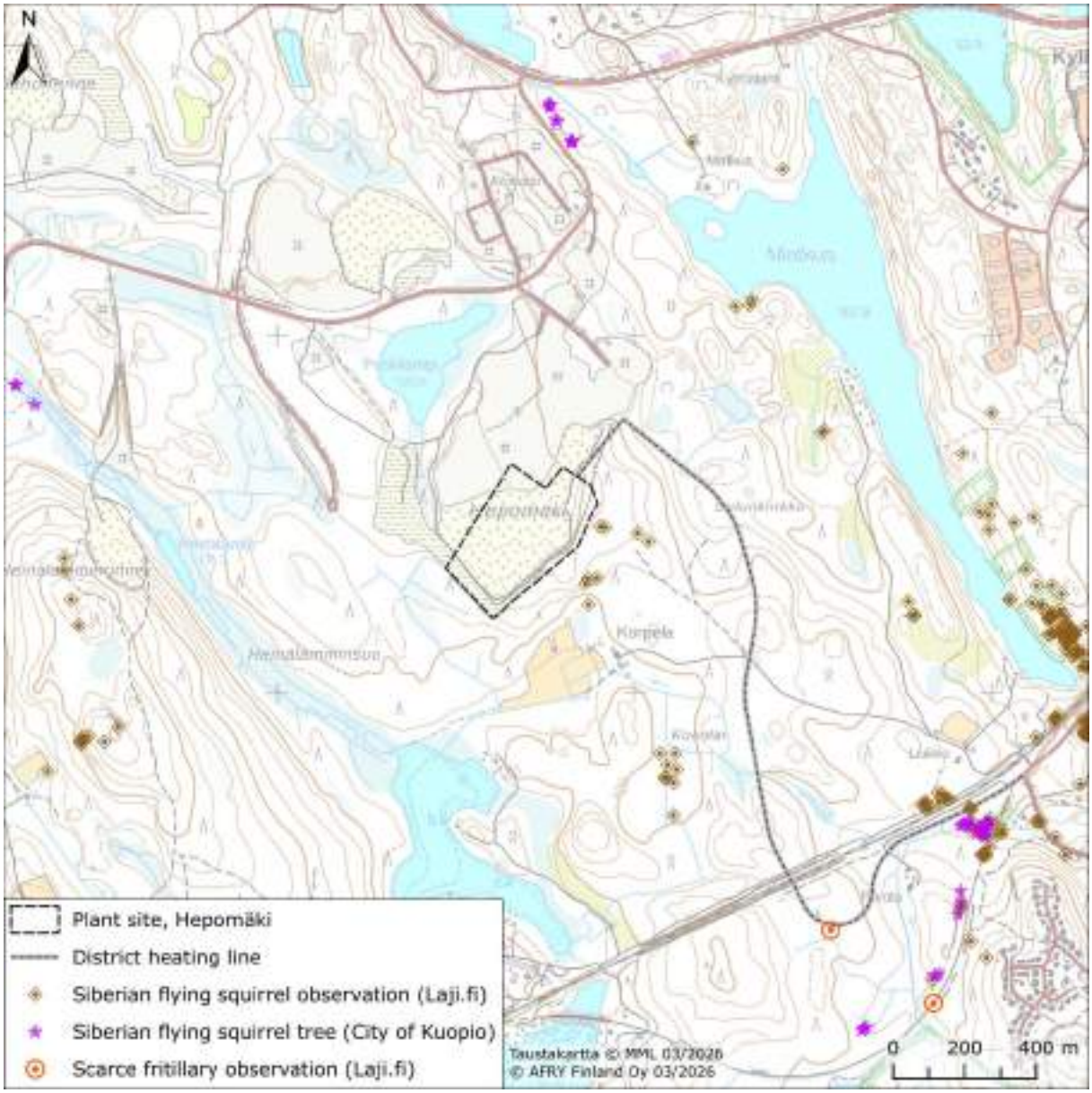

Figure 16-1. Observations of animal species listed in Annex IV(a) of the EU Habitats Directive in the vicinity of the Hepomäki plant area and the district heating transmission line.

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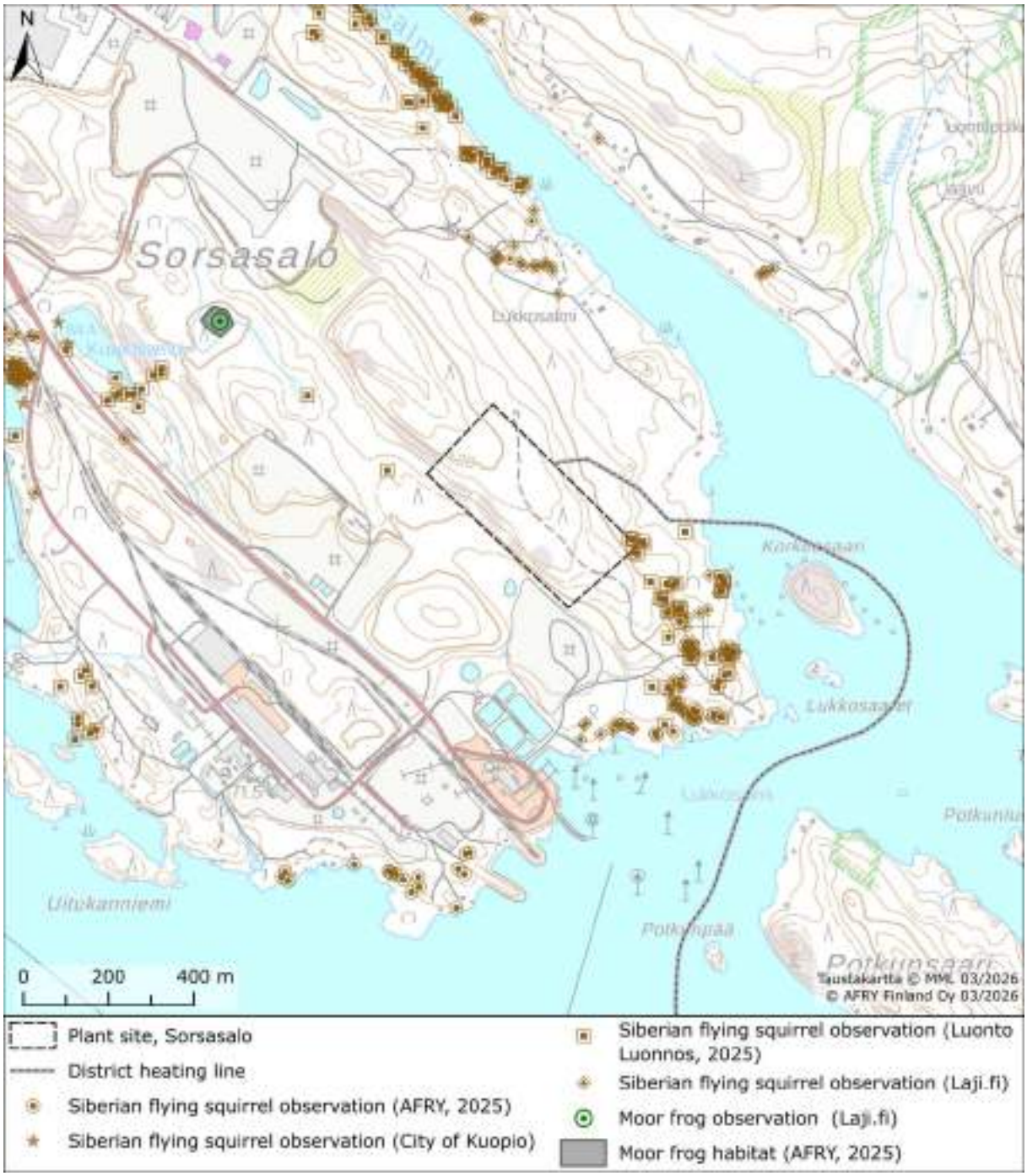

Figure 16-2. Observations of animal species listed in Annex IV(a) of the EU Habitats Directive in the vicinity of the Sorsasalo (VE2) plant area and the district heating transmission line area.

From **bat species**, northern bats, Daubenton's bats, whiskered bats and Brandt's bats may occur due to their distribution in the Kuopio region. No bat observations have been recorded within a five-kilometre radius of the Hepomäki or Sorsasalo plant areas (Finnish Biodiversity Information Facility 2025). However, individual bats can move around in both plant areas. The bat species most likely to occur is the northern bat, which is widespread in almost all of Finland. Whiskered and Daubenton's bats may also move occasionally within the project areas. Due to its habitat requirements, the Brandt's bat avoids urban areas. Hepomäki plant area (VE1) is not suitable as a breeding and resting place for bats, as there are no suitable daytime hiding places in the area. In the vicinity of the Sorsasalo

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plant area (VE2), there may be breeding and resting places suitable for bats, as there are holiday residences in the area that may also serve as daytime hiding places for bats.

Large carnivores (bear, wolf and lynx) listed in Annex IV of the Habitats Directive or wolverines listed in Annex II of the Habitats Directive are unlikely to occur in the Sorsasalo project area (VE2) due to the area's strong human influence and isolated location. Occasionally, large carnivores may move through the Hepomäki project area (VE1), most likely lynx. During the last two months (revised 11/2025), there have been confirmed observations of bears and lynxes in both project areas (LUKE 2025b). However, the observations are presented on 10×10 km grid squares, so the exact location of the observations is not known, but it is likely that no observations have been made in the project areas.

Based on prevalence, **northern birch mice** may occur in the project areas. However, the species' habitat requirements and habits are very poorly known, so there is currently no method that is even a relatively reliable way to survey the species (Nieminen & Ahola 2017).

From the Hepomäki project area (VE1), about 15 metres south of the district heating transmission route, a sighting of a **scarce fritillary** was recorded in 2024 (Finnish Biodiversity Information Facility 2025). No noteworthy insect species have been observed in the Sorsasalo project area (VE2).

16.1.2 Birds

16.1.2.1 Important bird areas

The nearest internationally important bird area (IBA), the Maaninka bird wetlands, is located more than 20 kilometres northwest of the plant area of the project option (VE2) in Sorsasalo (BirdLife Finland 2025a).

Near the project options VE1 and VE2, the open lake areas of the Kuopio region are a large and complex water system within the Kallavesi basin (BirdLife Finland 2025b). The FINIBA area's qualifying species are the breeding species of the lesser black-backed gull and the common tern. The location of the project options in relation to the FINIBA area and the regionally important bird areas (MAALI) is described below for each project option. (BirdLife Finland ry. 2025c, Lintuyhdistys Kuikka 2018)

For the Hepomäki project option (VE1), the open lake areas of the Kuopio region FINIBA area are located 4.3 kilometres north of the plant area at its nearest point. There are also two regionally important bird areas (MAALI) in the vicinity, more than two kilometres from the project option. The regionally important bird area (MAALI) of Vanuvuori is located at least 2.4 kilometres east of the project's district heating pipeline survey area, and the regionally important bird area (MAALI) of Vuorilampi is 4.9 kilometres north of the project area (Figure 16-3). At Vuorilampi, the qualifying species are the breeding populations of the three-toed woodpecker, the greenish warbler and the red-breasted flycatcher. In Vanuvuori, the qualifying species are the same with the addition of capercaillie.

For the Sorsasalo project option (VE2), the open lake areas of the Kuopio region FINIBA area are located 3.8 kilometres northwest of the plant area at its nearest point. In the vicinity of the plant area, the only regionally important bird area (MAALI) is the Kallansillat MAALI area located southwest of Sorsasalo. The Kallansillat bridges are located 1.4 kilometres west of the plant area (Figure 16-4). The site's regional value is based on

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springtime gatherings of great crested grebes, black-headed gulls, lesser black-backed gulls and common terns. The route options A and B for the district heating line of the project option VE2 are located in the regionally important bird area (MAALI) of Kumpusaari on the southern side of Kuopio city centre. In addition, the route option A is located on the southeast side of the Kuopio city centre, near the Vasikkasaari island belonging to the open lake areas of the Kuopio region FINIBA area, and passes through a small islet belonging to the FINIBA area. By contrast, with route option B, the shortest distance to the FINIBA area is about 750 metres.

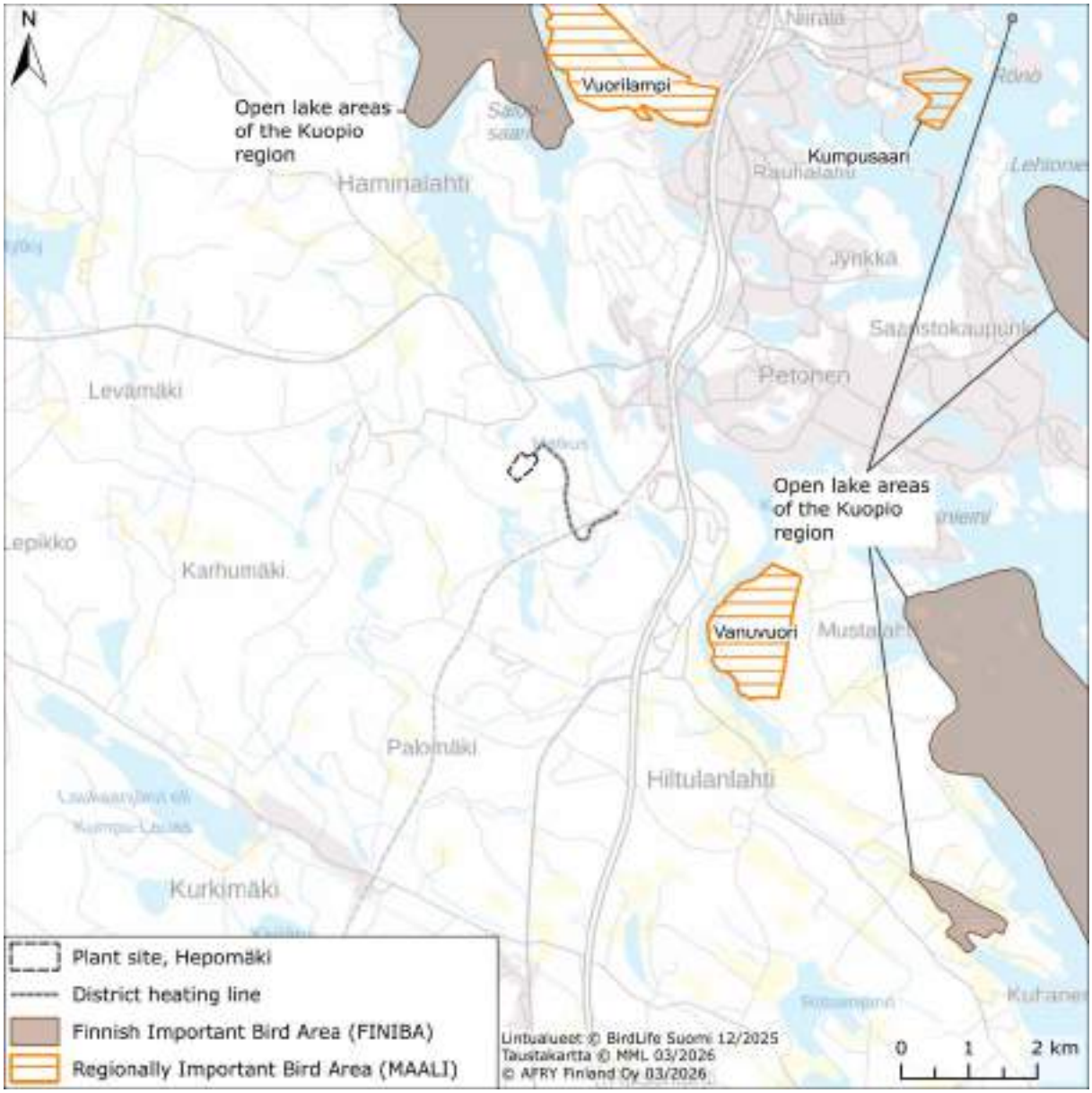

Figure 16-3. Nationally (FINIBA) and regionally (MAALI) important bird areas near the Hepomäki (VE1) project area.

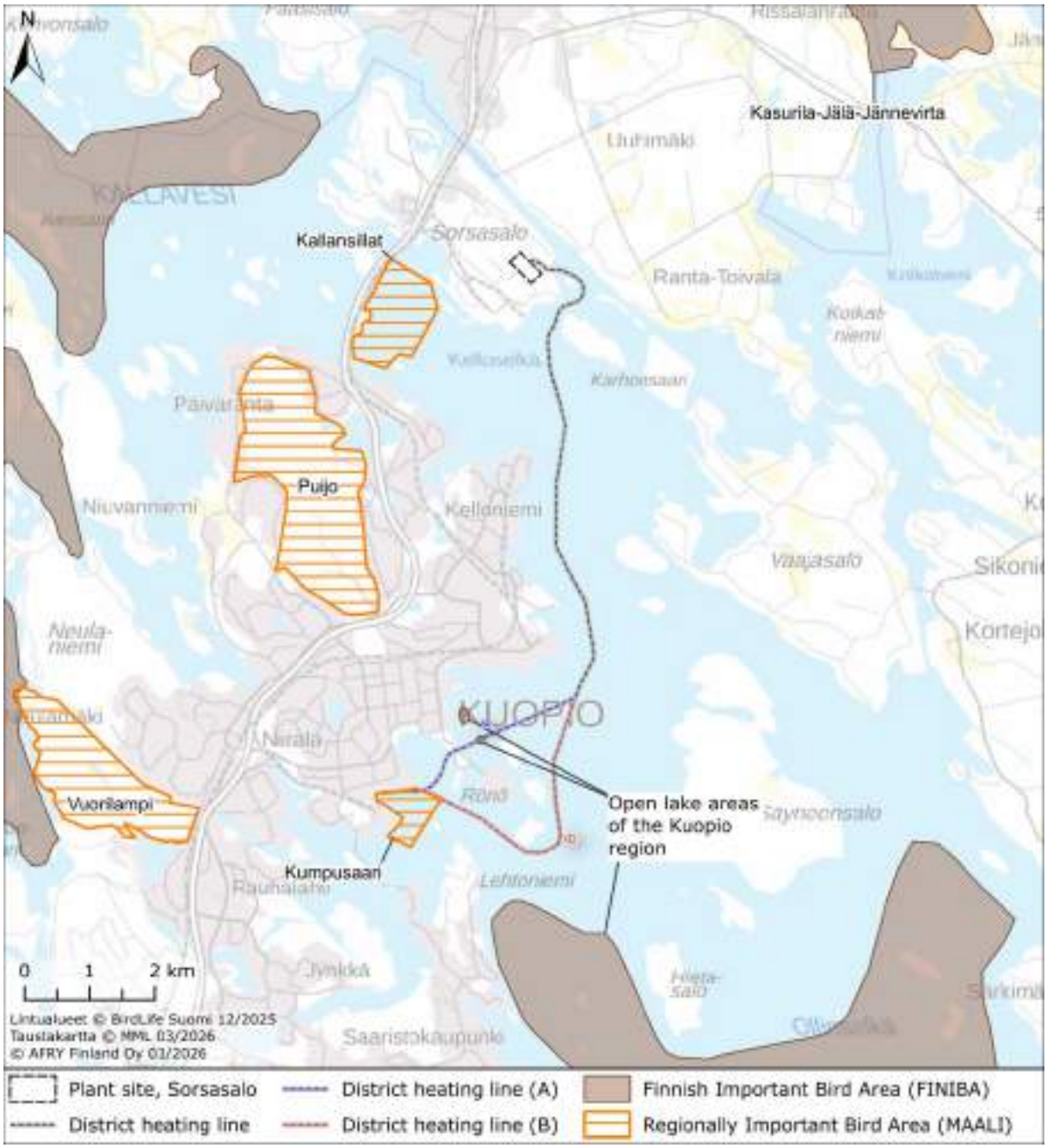

Figure 16-4. Nationally (FINIBA) and regionally (MAALI) important bird areas near the Sorsasalo (VE2) project area.

16.1.2.2 Breeding birds

Information on the birds in the vicinity of the Sorsasalo project option VE2 has been obtained from the breeding bird surveys of other projects in 2025. Seven noteworthy species were found in the survey area of the eSAF project northwest of the project area (Luontoselvitys Robur Oy 2025a). Of the endangered species, the survey recorded the barn swallow (a feeding visitor), classified as vulnerable (VU), and of the near-threatened (NT) species, the white wagtail, the magpie and the common rosefinch. Of the regionally threatened (RT) species, the wheatear is part of the area's breeding bird community. Of other species, the breeding bird community in the project area includes the kestrel, which nested on a rock face of the excavated area. Of the other noteworthy species, the wood sandpiper was not considered to be breeding in the area.

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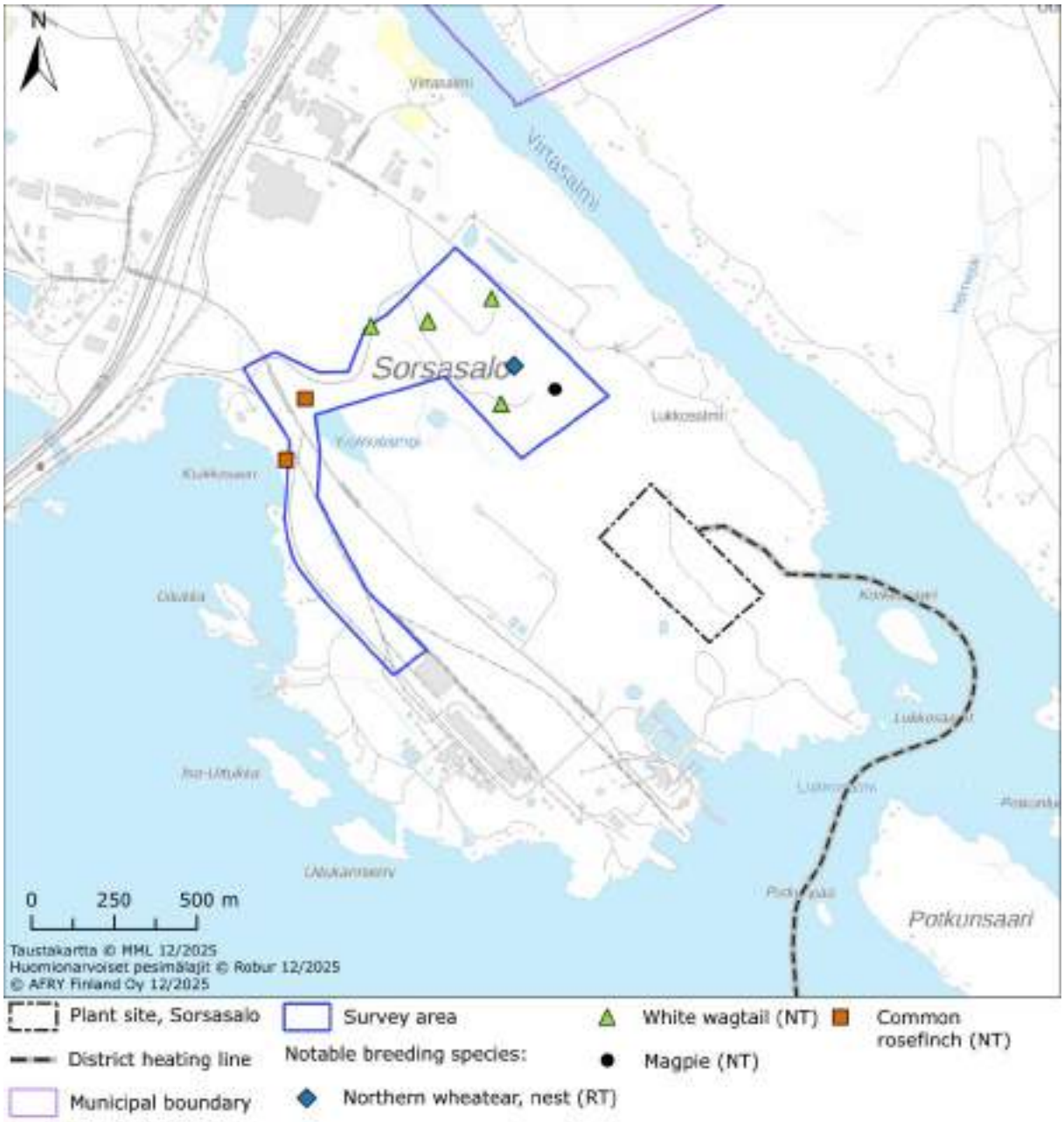

Figure 16-5. Territories of the noteworthy species recorded in the breeding bird survey carried out near the Sorsasalo plant area (VolagHy's eSAF project) (Luontoselvitys Robur Oy 2025a). The nesting site of the kestrel nesting in the survey is not shown on the map.

In accordance with the breeding bird survey carried out in the area south of the Mondi Powerflute Oy industrial area, west of the Sorsasalo project option VE2, the breeding species in the area are diverse (AFRY Finland Oy 2025b). Of the regionally threatened species, the wheatear is part of the breeding bird community in the southern parts of Sorsasalo. Species classified as near threatened (NT) in the area are the great crested grebe, the white wagtail and the common rosefinch. Of the endangered species, those nesting in the current industrial area are the common swift (EN), the western house martin (EN) and the barn swallow (VU). Other nesting species in the area that are listed in Annex I to the Birds Directive include the common tern, the black woodpecker and the grey-headed woodpecker.

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Figure 16-6. Noteworthy bird species observed in the bird survey conducted in the area south of Mondi Powerflute Oy's industrial area (AFRY Finland 2025b).

16.2 Impact assessment and methodology

The fauna is directly affected by the loss of habitat area, as well as by changes to, or fragmentation of, habitats. Indirect impacts on fauna can be caused by noise, disturbance and dust during construction. Fragmentation of habitats can also have indirect and secondary impacts on ecological connections between different habitats and areas related to the life cycle of species.

The assessment of the impacts on fauna takes into account both the direct and indirect impacts of the construction of all the functions of the project, as well as during operations and after the end of operations. Depending on the impact, the area under consideration is the construction area of the plant and of the district heating pipelines, together with their immediate surroundings. The project's direct and indirect impacts on fauna, as well as the significance of these impacts, will be assessed on the basis of existing information, field surveys carried out in the area during the 2026 field season, and previously prepared field surveys (AFRY Finland Oy 2025a–c, Luonto Luonnos 2025) by experienced biologists. The impact assessment focuses on species of conservation value and species listed in Annex IV(a) of the EU Habitats Directive.

In connection with all nature surveys carried out in the project area, attention will be paid to the possible habitats of species listed in Annex IV(a) of the Habitats Directive. The site selection for the field survey is done with the help of map and aerial photography. Existing public species datasets covering protected and endangered species (Finnish Biodiversity Information Facility), as well as previously recorded species observations from the area, are used as support. The scope and brief descriptions of the 2026 surveys are presented

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in the paragraphs below. The results of the surveys are presented in the EIA report and the nature survey report that will be attached to it.

There is no need to draw up a separate bat survey for the project areas in terms of the EIA procedure, as the impacts of the project do not concern the potential breeding and resting places of bats. The construction of the plant areas and the district heating transmission lines does not require the demolition of buildings that may contain bats' daytime hiding places or hibernation sites. In the Sorsasalo project area, the otters are not estimated to be adversely affected by the project, in which case the otter survey is not considered necessary.

Siberian flying squirrel survey

This survey investigates the breeding sites and resting places of the species, the Siberian flying squirrel, listed in Annex IV(a) of the Habitats Directive in both project areas. The habitats suitable for Siberian flying squirrels are marked off on the basis of a map review and previous observations. In the Siberian flying-squirrel survey, forest areas assessed as potential for the species on the basis of a map review are surveyed in the field using a standard method by searching for winter droppings at the bases of trees in accordance with the Siberian flying-squirrel survey instructions (Nieminen & Ahola 2017). Droppings and nesting tree observations (hollow trees, twig nests) are recorded, and based on these observations and the structure of the forest, the habitats of the species and their core areas are marked off. The survey also takes into account known habitats of the Siberian flying squirrel located in the immediate vicinity of the survey areas. The survey examines possible movement corridors important for the Siberian flying squirrel in the survey areas. The implementation of the survey is estimated to require a total of two field days in the Sorsasalo and Hepomäki project areas, and it will be carried out in April–May 2026.

Moor frog survey

This survey identifies the potential habitats of the moor frog (Annex IV(a) species of the Habitats Directive) based on map review and previous records in the Sorsasalo project area (VE2). In field surveys, the presence of moor frogs in water systems suitable for the species is observed based on spring mating calls. Field work in the Sorsasalo area is estimated to take one day in April–May 2026, when the species is most easily detectable. There are no habitats suitable for the moor frog in the Hepomäki project area, so a survey is not considered necessary.

Scarce fritillary

The occurrence of the scarce fritillary is being surveyed in the Hepomäki project area (VE1), where previous records of the species exist, by searching for woven nests that the species' larvae build as shelter in cow-wheat populations. The survey will be carried out during a single field day at the turn of August and September 2026. The location of cow-wheat populations is also investigated in connection with vegetation and habitat surveys. Significant, uniform cow-wheat populations and web formations observed during the survey are recorded with a GPS device. On the basis of observations of webs and species, as well as potential breeding sites, boundaries of the breeding area are drawn up.

Breeding bird survey

A breeding bird survey will be carried out in the Sorsasalo project area in 2026. The method used is a mapping calculation based on two visits. The method is the same as that used in the breeding bird surveys of other projects in the Sorsasalo area in 2025. The results of

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the breeding bird surveys of other projects will be used in the impact assessment. In Hepomäki, a breeding bird survey will also be carried out in 2026 in the district heating transmission line area. The method used is a mapping calculation based on two visits.

A breeding bird survey consisting of two visits on 27 May and 6 June 2025 has been carried out in the area of VolagHy's eSAF plant, located northwest of the project option VE2 in Sorsasalo (Luontoselvitys Robur Oy 2025a). The survey area comprised the eSAF plant and the CO_2 pipeline areas.

The 2025 nature surveys of Mondi Powerflute Oy's mill area in Sorsasalo also included a bird survey (AFRY Finland Oy 2025a). Breeding birds were surveyed in two mapping visits on 14 May and 4 July 2025. The survey area was the coastal forests of the southern part of Sorsasalo and the edge of the industrial area.

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17 PROTECTED AREAS

17.1 Current status

In the areas of the project options, or in their vicinity, there are no Natura 2000 regional network boundaries, nature conservation site boundaries, or supplementary proposed sites for mire protection (Finnish Environment Institute 2025f). Of the Natura 2000 areas, the South Kuopio herb-rich forests and ponds, Vanuvuori, Haminavuori (FI0600002, SAC) and Korsumäki–Keinälänniemi (FI0600059, SAC) are located about 330 metres east and about 520 metres south, respectively, of the Hepomäki (VE1) district heating pipeline. In addition, Halmejoki-Karhonsaari-Potkunsaari (FI0600007, SAC) is located approximately 390 metres north of the district heating transmission line route in Sorsasalo (VE2). Other Natura and nature conservation areas are located at a distance of at least 725–800 metres from the project area. In the vicinity of the project area options, within a radius of two kilometres, there are regional nature reserves outside the boundaries of Natura areas, the closest of which, Pitkälahti (ERA255709), is located approximately 35 metres south of the Hepomäki (VE1) district heating transmission line.

Natura 2000 areas, regional nature reserves, conservation programme sites and properties dedicated to conservation around the project area options are shown on the maps (Figure 17-1 and Figure 17-2) and tables (Table 17-1 and Table 17-2) below.

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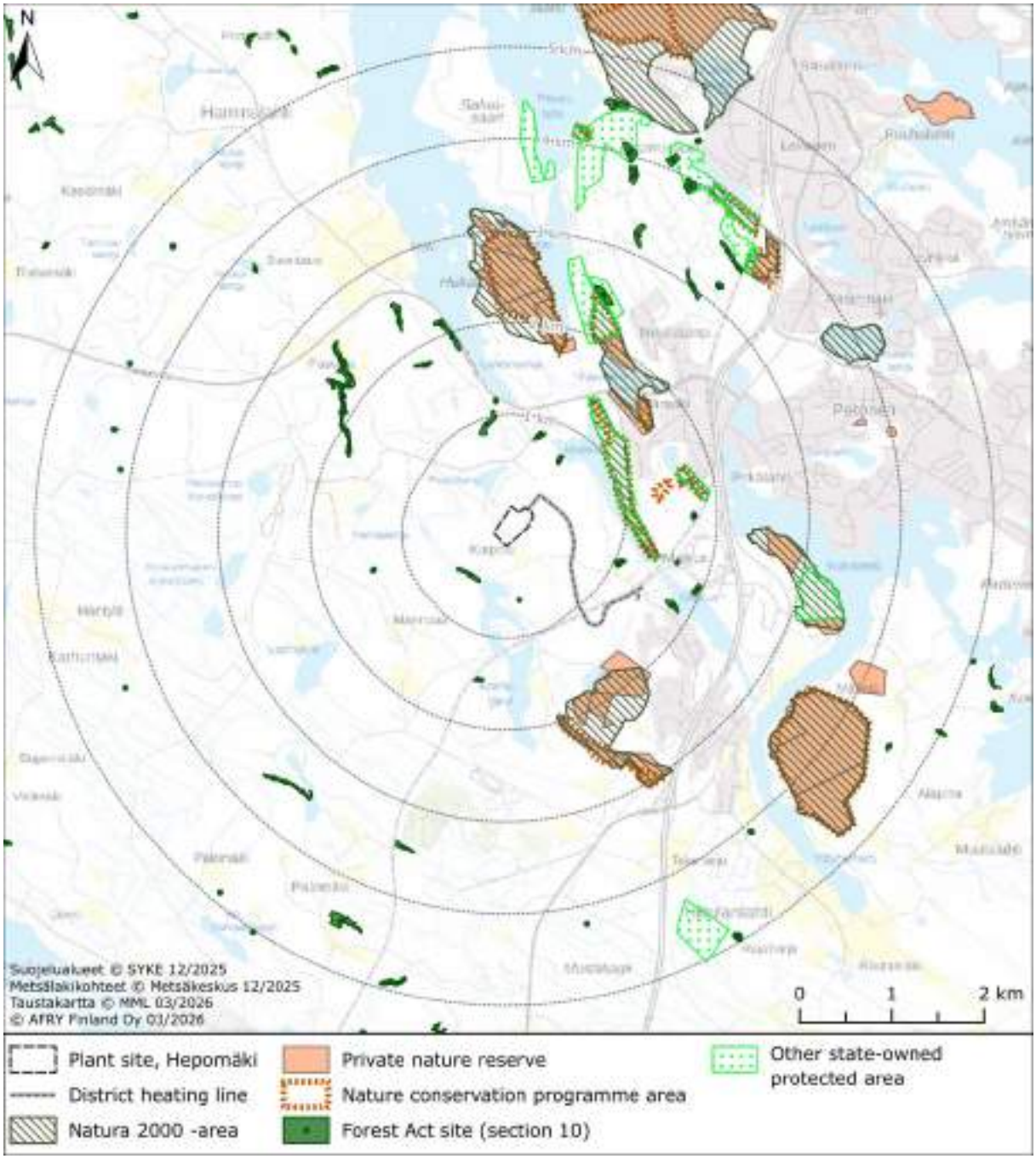

Figure 17-1. The Natura 2000 areas, nature conservation areas, conservation programme sites and properties dedicated to conservation located in the vicinity of the Hepomäki (VE1) project area.

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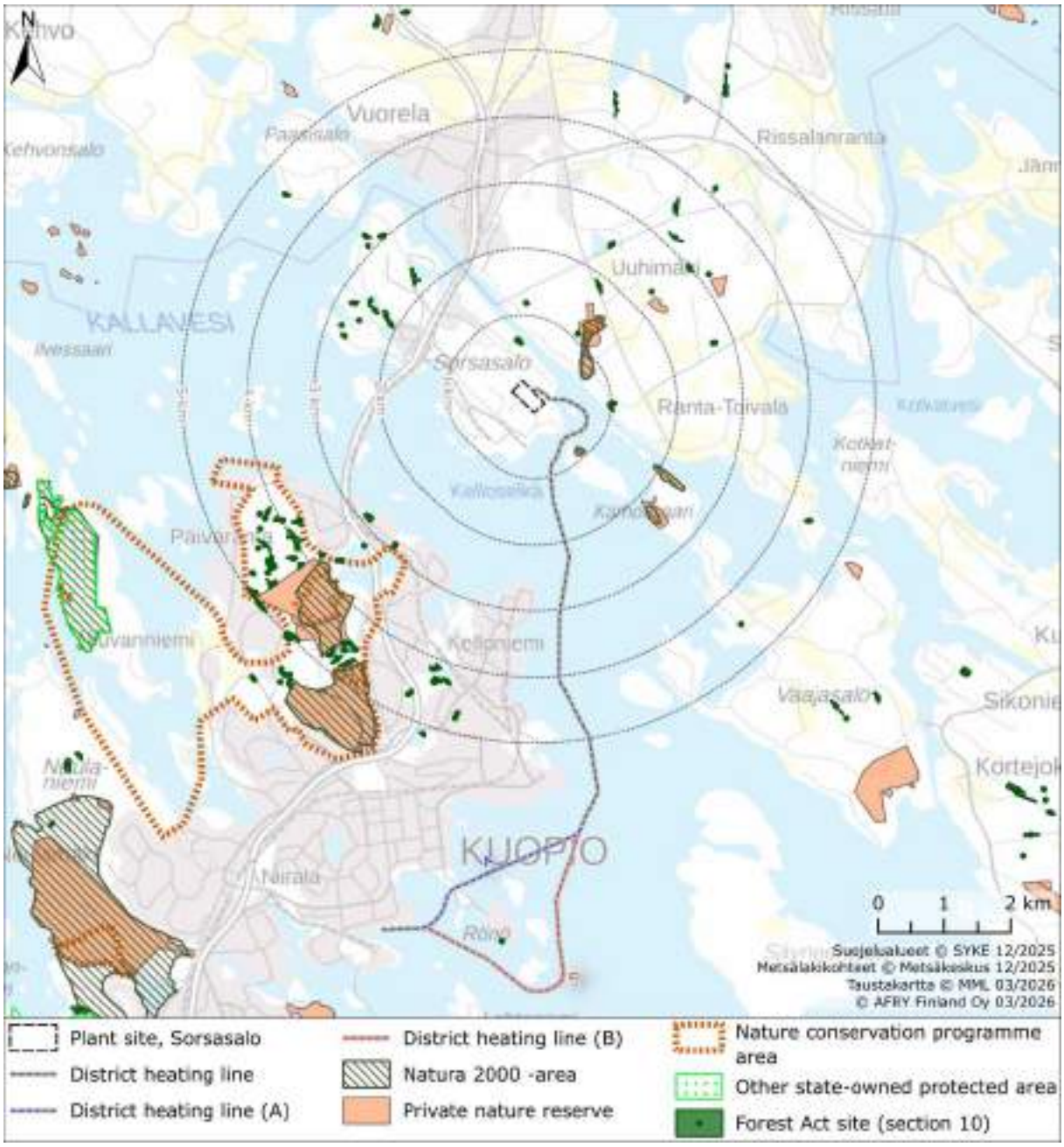

Figure 17-2. The Natura 2000 areas, nature conservation areas, conservation programme sites and properties dedicated to conservation located in the vicinity of the Sorsasalo (VE2) project area.

Table 17-1. The Natura 2000 areas located within five kilometres (5 km) of the project options VE1 and VE2, the nature conservation areas and conservation programme sites situated within their boundaries, as well as their distances and direction relative to the project area.

Site	Type	Closest distance and direction from the project area
South Kuopio herb-rich forests and ponds, Vanuvuori, Haminavuori (FI0600002, SAC) The nature reserve of the Matkus lake herb-rich forest (YSA086465), the nature reserve of the Kylmämäki herb-rich forest (YSA086467), the Valkealampi herb-rich forest (YSA082048), Haminavuori I, II, III, IV, V (YSA086438, YSA086439, YSA086445, YSA086458, YSA256127), Hovin-Hukansalo (YSA255354), Hukanpää (YSA255708), the Teppola herb-rich forest (YSA250411), the Rasinmäki herb-rich forest (YSA082964), Vanuvuori 1–3 (YSA083451, YSA083574, YSA083695) Haminavuori (AMO080442), Vanuvuori (AMO080443), the Väärälahti herb-rich forest (LHO080274), the Kylmälahti herb-rich forest (LHO080273), the Matkus lake herb-rich forest (LHO080270), the Riihilampi herb-rich forests (LHO080276), the Rasinmäki herb-rich forest (LHO080268), the Neulalampi herb-rich forest (LHO080269) The Matkus lake herb-rich forest (MLO352285), the Riihilampi herb-rich forests (MLO350584), the Väärälahti herb-rich forest (MLO351931), the component master plan for Pieni Neulamäki, SL areas (MKS358263), the Pilpa herb-rich forest (MLO351934), the Neulamäki herb-rich forest	**Natura area** Nature conservation area on private land Old-growth forest conservation programme Conservation programme for herb-rich forests Property dedicated to conservation by the state	Hepomäki (VE1) plant area: 800 m, east district heating pipeline: 330 m, east Sorsasalo (VE2) district heating pipe: 4 km, southwest

(MLO351933), the Rasinmäki herb-rich forest (MLO351932)		
Korsumäki–Keinälänniemi (FI0600059, SAC) The Korsumäki eutrophic fens (SSO080219) The Korsumäki canyon 1, 2 (YSA086379, YSA230430), Korsumäki 1–8 (YSA081961, YSA082365, YSA086385, YSA086393, YSA086398, YSA086416, YSA086461, YSA252530), Valo nature reserve (YSA264600), Gustaf Ranin nature reserve (YSA240080), Keinälänniemi nature reserve (YSA086402) Korsumäki–Keinälänniemi (MLO352720)	**Natura area** Mire protection programme Nature conservation area on private land Property dedicated to conservation by the state	Hepomäki (VE1) plant area: 1.7 km, south district heating pipeline: 520 m, south
Kolmisoppi–Neulamäki (FI0600062, SAC) The Tervaruukki spruce mire nature reserve (YSA086470), Kolmisoppi–Neulamäki nature reserve (YSA086468) Neulaniemi (ERA202484) The Kolmisoppi herb-rich forest area (LHO080267)	**Natura area** Nature conservation area on private land Conservation area for a specially protected species Conservation programme for herb-rich forests	Hepomäki (VE1) plant area/district heating pipeline: 4.2 km, northeast Sorsasalo (VE2) district heating pipe: 3 km, west
Central Kallavesi archipelago (FI0600036, SAC/SPA) Central Kallavesi archipelago 1– (YSA082055, YSA086462) My Nature Gift to the Hundred-Year-Old Central Kallavesi archipelago (YSA243784), the Sikosaari islands 1–2 (YSA083268, YSA202656), Saunasaari (YSA202120), Honkasalo (YSA201532) Central Kallavesi archipelago (RSO080082)	**Natura area** Nature conservation area on private land Shore conservation programme	Sorsasalo (VE2) district heating pipe: 3.9 km, southeast
Puijo (FI0600001, SAC) Puijo I, II, III (YSA080024, YSA086459, YSA086480) Puijo (MAO080087)	**Natura area** Nature conservation area on private land Landscape units	Sorsasalo (VE2) plant area: 3.9 km, southwest

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		district heating pipeline: 3.1 km, west
Halmejoki–Karhonsaari–Potkunsaari (FI0600007, SAC) The Halmejoki herb-rich forest I, II, III, IV (YSA083030, YSA086453, YSA086464, YSA086478) Potkunsaari (YSA082961) Karhonsaari I, II (YSA080098, YSA086460) The Halmejoki herb-rich forest (LHO080271)	**Natura area** Nature conservation area on private land Conservation programme for herb-rich forests	Sorsasalo (VE2) plant area: 725 m, northeast district heating pipeline: 390 m, north

Table 17-2. The site limits of protected areas located outside the Natura 2000 area boundaries within two kilometres (2 km) of the project options VE1 and VE2.

Site	Type	Closest distance and direction from the project area
Pitkälahti (ERA255709)	Conservation area for a specially protected species	Hepomäki (VE1) plant area: 1.3 km, southeast district heating transmission line: 35 m, south
Katiskaniemi nature reserve (YSA086469)	Nature conservation area on private land	Sorsasalo (VE2) district heating transmission line: 1.4 km, southwest
Uuhimäki (YSA204049)	Nature conservation area on private land	Sorsasalo (VE2) plant area: 2.1 km, northeast district heating transmission line: 1.8 km, southwest

A background survey on the location of ecological connections in the area has been prepared for phase 2 of the North Savo regional plan 2024 (Regional Council of Pohjois-Savo 2024c). No ecological connections have been identified in the current regional plans. Instead, the Kuopio region's regional plan identifies a green connection need northwards from Puijo to Puijonsarvi and Sorsasalo.

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17.2 Impact assessment and methodology

In the EIA report, the impacts on protected areas are assessed to the extent that the protected areas are within the project area's sphere of influence, and the conservation criteria of the areas may be affected by the project. In addition, the project's impacts on the area's ecological networks and how they are realised there are examined more extensively. The assessment work is based on existing source material. The assessment takes into account both direct and indirect impacts and assesses their significance.

For the purpose of the impact assessment, the information presented in the EIA programme on the valuable natural environment sites closest to the project area is reviewed. Other impact assessments to be prepared during the assessment work are available for evaluation and marking the limits of the impact area. The marking the limits of the impact areas for each identified impact mechanism will be specified as the EIA procedure progresses, based on modelling and impact assessments of other components, so that impacts on protected areas can be assessed as reliably as possible and with sufficient scope. The impacts on protected areas are assessed by an experienced biologist who has carried out similar impact assessments.

The Natura areas closest to the project area, the South Kuopio herb-rich forests and ponds, Vanuvuori, Haminavuori (FI0600002, SAC) and Korsumäki–Keinälänniemi (FI0600059, SAC), are located about 330–520 metres from the Hepomäki project area (see Table 17-1). In addition, Halmejoki-Karhonsaari-Potkunsaari (FI0600007, SAC) is located approximately 390 metres north of the district heating transmission line in Sorsasalo (VE2). Natura areas are protected as Special Areas of Conservation (SACs), i.e. their conservation criteria can be the habitat types and Annex II species of the Habitats Directive.

Impacts on habitat types and species in Annexes IV and II of the Habitats Directive (SACs) are limited to the immediate vicinity of Natura areas. According to the preliminary assessment, it is not necessary to prepare Natura assessments for the project in accordance with Section 35 of the Nature Conservation Act.

For the Natura areas of South Kuopio herb-rich forests and ponds, Vanuvuori, Haminavuori (FI0600002) and Korsumäki–Keinälänniemi (FI0600059), a self-assessment in accordance with Section 35 of the Nature Conservation Act will be carried out. For the Halmejoki–Karhonsaari–Potkunsaari (FI0600007) Natura area, a Natura needs assessment is not considered necessary because the district heating pipeline will be constructed in the water areas of Kallavesi and the Natura area is located on land, so the conservation criteria are not expected to be affected by known impact mechanisms.

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18 CLIMATE

18.1 Current status

18.1.1 Climate

The project areas are located in the southern boreal climate zone in North Savo. The average temperature for the year is about 2–4 degrees Celsius, and the warmest month is July, when the average temperature is usually 17 degrees Celsius. On average, there are 10–13 hot days in summer. Annual precipitation ranges from 550 to 650 millimetres. The rainiest month is usually July with an average rainfall of more than 90 mm. The length of the growing season varies from five months in the Kainuu border to six months in the southwestern part of the region. (Climate guide 2022)

The first snow in North Savo usually arrives at the end of October, and the permanent snow cover at the end of November. The thickness of the snow cover is between 50 and 80 centimetres in mid-March. Permanent snow cover lasts for about four to five months, persisting longest on high hilly areas. (Climate guide 2022)

The average temperature for 2015–2024 was about 4.8 degrees Celsius at the Kuopio Airport observation station (Finnish Meteorological Institute 2025a). The average temperatures for the comparison periods 1991–2020 and 1981–2010 were 4.0 degrees Celsius (Finnish Meteorological Institute 2025b) and 3.4 degrees Celsius (Pirinen et al. 2012). The average temperature has risen from one reference period to another by 0.6 degrees Celsius and the period 2015–2024 was about 0.8 degrees Celsius warmer than the reference period 1991–2020. Average temperatures have risen in all months (Figure 18-1).

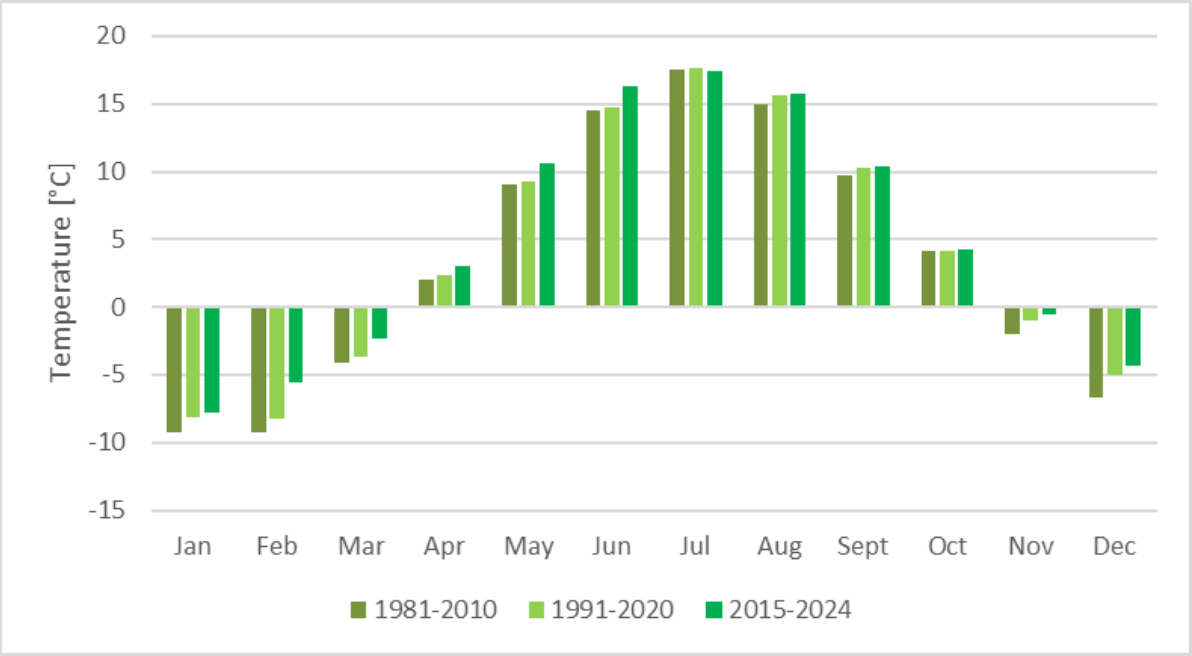

Figure 18-1. The average monthly temperature at Kuopio airport observation station for the reference periods 1981–2010 and 1991–2020 and for 2015–2024. (Finnish Meteorological Institute 2025a, Finnish Meteorological Institute 2025b & Pirinen et al. 2012).

Rainfall statistics are comprehensively available from the Savilahti (Kuopio) and Maaninka observation stations. At the Savilahti station, the average annual rainfall for 2015–2024

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was 644 millimetres (Finnish Meteorological Institute 2025a). The corresponding rainfall for the reference period 1991–2020 was 617 millimetres at Maaninka station (Finnish Meteorological Institute 2025c) and the rainfall for the reference period 1981–2010 at Savilahti station was 630 millimetres (Pirinen et al. 2012). Precipitation has decreased by 2.1% from one reference period to another and increased by 4.3% from the reference period 1991–2020 to 2015–2024. The average monthly rainfall amounts have not changed significantly (Figure 18-2).

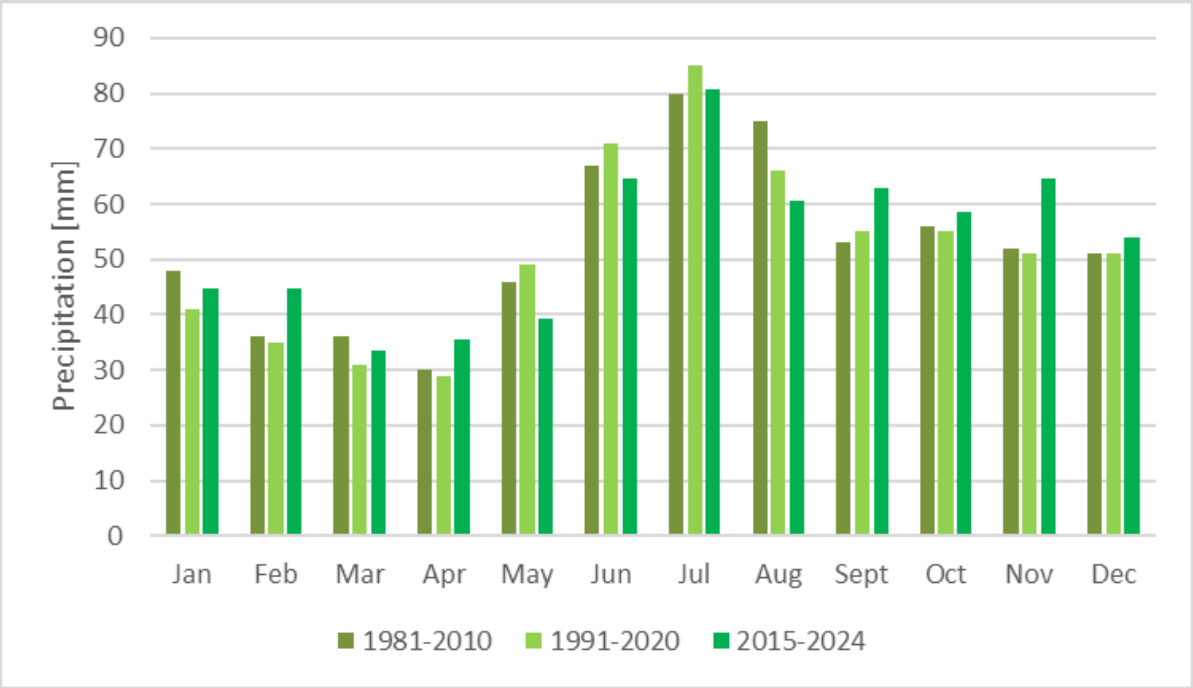

Figure 18-2. Monthly precipitation at the Kuopio Savilahti observation station for the reference period 1981–2010 and for 2015–2024. The data for the reference period 1991–2020 are from the Kuopio–Maaninka observation station. (Finnish Meteorological Institute 2025a, Finnish Meteorological Institute 2025c & Pirinen et al. 2012)

Climate in the project area is estimated to warm during the current century by approximately 1.8–5.4 degrees Celsius compared to the reference period 1991–2020 (Figure 18-3). Annual precipitation is estimated to increase by 5–14% (Figure 18-4). The changes will depend on the evolution of global greenhouse gas emissions projected under the so-called SSP scenarios. (Finnish Meteorological Institute 2023)

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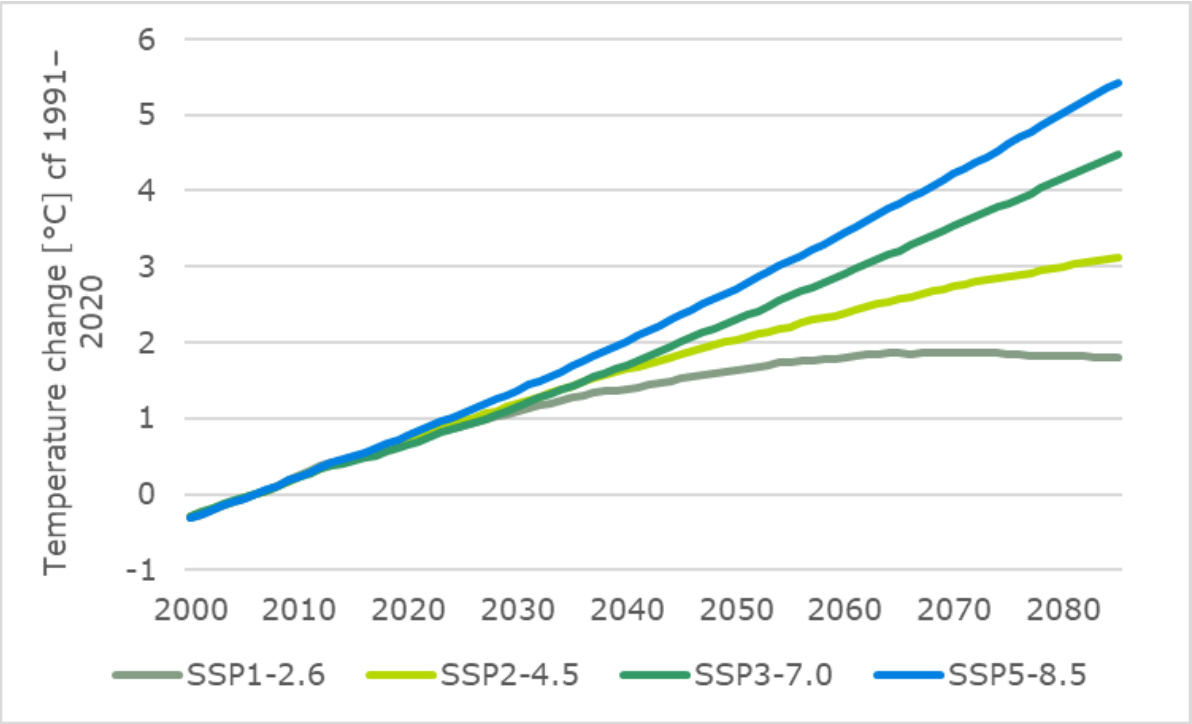

Figure 18-3. Estimated change in average annual temperature in Kuopio under different greenhouse gas emission scenarios up to 2085. The changes are compared to the period 1991–2020. (Finnish Meteorological Institute 2023)

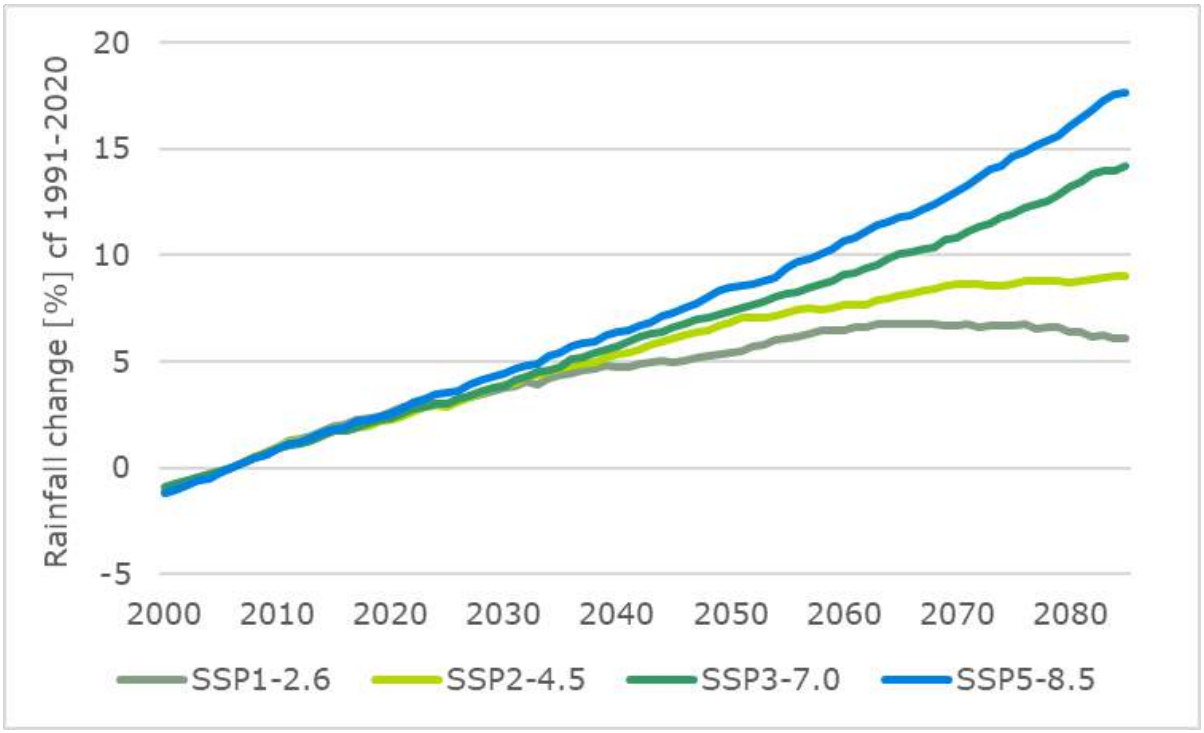

Figure 18-4. Estimated change in the average annual precipitation in Kuopio under different greenhouse gas emission scenarios up to 2085. The changes are compared to the period 1991–2020. (Finnish Meteorological Institute 2023)

18.1.2 Greenhouse gas emissions

The objective of the region of North Savo is to be carbon neutral in 2035 (North Savo ELY Centre 2021). This objective is achieved by reducing greenhouse gas emissions by 80%

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compared to 2007 levels and by capturing or compensating for the remaining emissions. The City of Kuopio aims to achieve the same objectives in 2030 (City of Kuopio 2024).

In accordance with the Hinku calculation rules of the North Savo region and the City of Kuopio, greenhouse gas emissions were 1,632.5 $ktCO_2e$ and 533.8 $ktCO_2e$ in 2023 (Finnish Environment Institute 2025b). Emissions have decreased by about 40 per cent in North Savo and by about 51 per cent in Kuopio compared with the reference year 2007. In order to achieve the target of an 80% emission reduction, emissions should be reduced to 547.8 $ktCO_2e$ by 2035 for the region and 216.0 $ktCO_2e$ by 2030 for the City of Kuopio.

District heating was Kuopio's third largest source of greenhouse gas emissions in 2023, accounting for 16% (Figure 18-5). The biggest sources of emissions were road traffic and agriculture, accounting for 30% and 22% respectively. Total emissions from district heating amounted to 85.6 $ktCO_2e$, and they have decreased by about 73% since 2007. Most of the district heat consumed was used for heating residential buildings. North Savo's district heating emissions were about 162 $ktCO_2$in 2023. (Finnish Environment Institute 2025b)

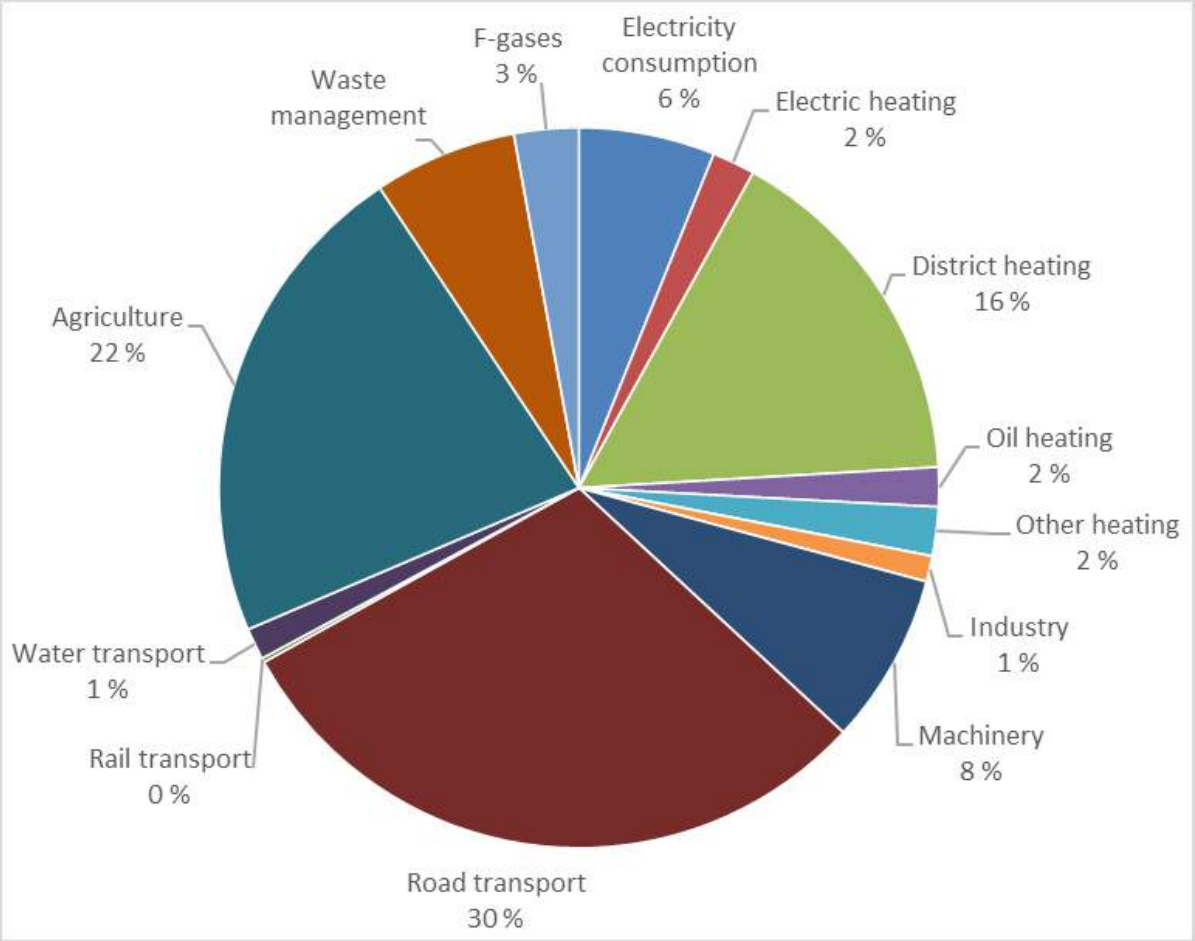

Figure 18-5. The City of Kuopio's greenhouse gas emissions in 2023 divided into categories according to the regional emissions calculation model of the Finnish Environment Institute. The calculations are based on Hinku calculations without carbon offsets. (Finnish Environment Institute 2025b)

According to data published by the company, Kuopion Energia's direct greenhouse gas emissions from its own energy production were about 86.0 $ktCO_2e$ in 2024 (Kuopion Energia 2025a). In addition to the sale of district heat, the number includes the sale of

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electricity. The emissions target for 2025 is 48.7 $ktCO_2e$ (Kuopion Energia 2025a), and the goal is to phase out the use of fossil fuels by 2028 (Kuopion Energia 2025b). The emission coefficient for district heat sold by Kuopion Energia was 56.7 $kgCO_2/MWh$ in 2024 (Finnish Energy/Local Power 2025).

18.2 Impact assessment and methodology

The assessment report qualitatively and quantitatively examines the effects of the project on climate change and the effects of climate change on the project. In addition, the significance and impact of the project will be examined in terms of the EU, national and regional climate objectives. The assessment draws, where applicable, on the Ministry of the Environment's report Ilmastovaikutusten arviointi YVAssa ja SOVAssa (Assessment of climate impacts in EIA and SEA) (Hildén et al. 2021).

The project's climate impacts are assessed by calculating the carbon footprint during the project's life cycle, adapting the Finnish Transport Infrastructure Agency's low-carbon assessment method for infrastructure construction (Finnish Transport Infrastructure Agency 2023). The carbon footprint consists of material- and energy-based greenhouse gas emissions during construction and operation, and after operations have ended. During the construction phase, emissions are caused, for example, by the manufacture and transport of building materials, as well as the use of machinery and the transport of soil. During operations, emissions are generated indirectly from the production and supply chain of nuclear fuel, as well as from the handling of conventional and hazardous waste and nuclear waste. The test operation of emergency diesel generators generates small amounts of conventional emissions into the air. In connection with decommissioning, they arise from the dismantling of structures and the transport and handling of dismantled materials. In addition, activities affecting trees and soil during the construction phase cause losses of carbon sinks and storage.

In terms of construction and decommissioning, greenhouse gas emissions from the manufacture and transport of main building materials, construction site operations and the processing of dismantled materials at the end of the life cycle are calculated based on the information available at the reporting phase. Emission coefficients from the national emissions database (Finnish Environment Institute 2025c) as well as the One Click LCA software can be used in the assessment. The impacts of construction on the carbon balance of soil and trees are assessed with the help of the Carbon Map tool (Carbon Map 2025) compiled by the Finnish Environment Institute, Natural Resources Institute Finland and Avoin ry. In addition, the public spatial datasets of the Finnish Environment Institute and the Natural Resources Institute Finland can be used.

The calculation of greenhouse gas emissions during operation takes into account, for example, the manufacture and transport of nuclear fuel and chemicals consumed in the process, as well as the plant's energy consumption and the fuel consumption of emergency diesel generators. It also includes the transport and treatment of nuclear waste and other possible waste generated during operations. For example, the Ecoinvent database and the national emissions database are used as data sources for the calculation. The assessment of impacts during the operational phase is carried out on the basis of information available at the reporting phase.

The positive climate impacts of the project are assessed by comparing the emission intensity of the district heat produced in the project with the emission intensity of the district heat produced in other ways. Thermal energy produced by nuclear power causes

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no direct greenhouse gas emissions during operation, apart from minor emissions from emergency backup generators, making it a better option for the climate than energy production based on combustion processes. The overall climate impacts of the project are also examined from the perspective of regional and national emission reduction and climate targets.

The impacts of climate change on the project are assessed by examining the risks caused by extreme weather events and the adaptation measures required by them. Risks can be caused, for example, by rising temperatures and increasing precipitation. Rising temperatures can affect, among other things, the sizing of cooling processes, while increasing rainfall places demands on stormwater treatment. Research publications and public spatial datasets are used as data sources for the analysis.

The EIA report describes in more detail the assumptions, calculation methods and parameters used in the assessment, as well as the associated uncertainties. The data obtained from the project and previous surveys are used as input data for the calculation and, if necessary, research data is used. One factor of uncertainty in the calculation is the reliability of the pre-estimated input data. Possible measures to mitigate adverse climate impacts are also described in connection with the assessment.

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19 EXPLOITATION OF NATURAL RESOURCES AND CONVENTIONAL WASTE

19.1 Current status

19.1.1 Hepomäki

An active rock aggregate extraction area is located on the SMR plant area (Hepomäki, permit number 3567). The permit expired on 31 December 2025. (Finnish Environment Institute 2025d) In December 2025, Rudus Oy has applied for a permit for stone quarrying, a stone crushing plant and a material terminal (City of Kuopio 2025o) in accordance with the Act on Soil Excavation and the Environmental Protection Act. The City of Kuopio has leased the area as an extraction, processing and storage area for rock aggregates until 31 December 2030 (Board of Urban Planning and City Infrastructure 2024). The same area has also held aggregate extraction permits in 1994–1997, 2002–2007 and 2013–2018, and a gravel and sand extraction permit in 1990–1997. Operational extraction sites are also located 900 metres west of the project area (Heinälamminrinne, 3547) and 1.6 kilometres northwest (the Halla-ahonrinne extraction site, 3610) (Finnish Environment Institute 2025d). There is also some tree cover on the SMR plant area, concentrated on the southeastern edge of the area up to the boundary of the existing extraction area (Figure 19-1). The trees of Hepomäki are widely used in forestry (City of Kuopio 2025l). Forested areas in the vicinity of the plant area can also be used for recreational purposes. Typical natural resources in a forested area are the forest itself, as well as the berries and mushrooms that grow there. The areas surrounding the SMR plant comprise forests and fields where natural resources can be used in forestry and agriculture, as well as for recreational purposes. The field south of the SMR plant area is approximately 120 metres from the area boundary at its closest point. (Finnish Environment Institute 2025e)

The district heating transmission connection is located in a forested area (Figure 19-1), where natural resources can be used in forestry or for recreational use of forests (Finnish Environment Institute 2025e).

No other business activities that use natural resources or significant resources, such as peat production, mining or identified aggregate reserves, are located in or near the project area (Finnish Environment Institute 2025d, Finnish Environment Institute 2023, TUKES 2023).

In its current state, the project area generates waste typical of aggregate extraction, such as waste related to the maintenance of machinery (e.g. oil filters, lubricating oil), mixed waste and surplus material.

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Figure 19-1. Aerial view of the Hepomäki (VE1) project area.

19.1.2 Sorsasalo

The SMR plant area is a forested area where natural resources can be used for forestry and recreational purposes (Finnish Environment Institute 2025e). Of the other operators in Sorsasalo, NG Nordic Metals' metal recycling activities, located approximately 200 metres from the SMR plant area, are closely linked to the sustainable use of natural resources.

The district heating transmission connection is located in a forested area in Sorsasalo, where there are also opportunities for forestry and recreation (Finnish Environment Institute 2025e). The transmission connection continues from the southeast side of Sorsasalo via Kallavesi to Haapaniemi. Natural resources in the lake can be used for fishing and for recreational purposes on the water. The district heating transmission connection has two alternative routes that differ at the Rönö island, which is passed either from the north or the south side. Route A, located to the north, lies in Väinölänniemi in the Kuopio ridge area, where sandy aggregate reserves are estimated at 5,400,000 solid cubic metres

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(Finnish Environment Institute 2025d). The aggregate reserve area in question is located within the Kuopio urban area, so exploiting these reserves is generally very unlikely or impossible.

No other economic activities using the natural resources of the area are located in or near the project area, such as agriculture, soil or aggregate extraction, peat production or mining (Finnish Environment Institute 2025d, 2025e, 2023, TUKES 2023).

The project activities are entirely new to a currently forested, undeveloped area, so no waste is generated in the current state.

Figure 19-2. Aerial view of the Sorsasalo (VE2) plant area. Unlike the figure, a selective logging area is located in the southern part of the plant area.

19.2 Impact assessment and methodology

The EIA report describes the impacts on natural resources that may arise from enabling or restricting their use.

The assessment takes into account economic activities that use natural resources and recreational activities, identified on the basis of spatial data available for the project area and its surroundings. The project is based on the exploitation of the natural resource uranium, the need for and procurement of which are described in general terms based on the project's technical description and on information from other similar projects. Other materials required by the project, and those released by it—such as rock and soil materials and dredged material—and their quantities are also considered at the level enabled by the planning phase.

Conventional waste is considered part of the impacts on the exploitation of natural resources, since waste management plays an essential role in their sustainable use. The quality and quantity of non-hazardous and hazardous waste arising from the operation and maintenance of the project, as well as further processing and compliance with the waste hierarchy are described at a general level. Waste is assessed on the basis of the information available from the project's technical design and previous similar projects. The impacts are assessed based on the properties of the waste and the treatment possibilities.

The impacts of using natural resources and conventional waste are examined both in terms of the resources present within the project area and those required for the project's implementation. Therefore, the assessment area is the project area and, from a material perspective, the project's life-cycle value chain.

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20 RADIOACTIVE WASTE

20.1 Impact assessment and methodology

The formation, quality and quantity of radioactive waste arising during the operation and maintenance of the project, and its treatment and storage, are described, taking into account the waste's activity levels (very low-level, low level, intermediate level and high level waste). The alternatives for the final disposal of waste are also described, but the assessment of the impacts of the final disposal of spent nuclear fuel and other radioactive waste fractions is not part of this EIA procedure. Shipments of waste from the plant site to final disposal are taken into account at a general level. The impacts are assessed based on the properties of the waste and the treatment methods. The assessment is carried out on the basis of the technical design of the project, as well as existing information about the projects and studies that have already been carried out.

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21 EXCEPTIONAL AND EMERGENCY SITUATIONS

21.1 Impact assessment and methodology

21.1.1 Methods used for modelling severe accidents

As part of the environmental impact assessment, a hypothetical severe accident at an SMR plant is assessed. The radioactive release is scaled in accordance with section 22 b of the Nuclear Energy Decree (161/1988), using the reference release of 100 TBq of caesium-137 and the thermal power of Olkiluoto 3 (4300 MW) to derive a release level corresponding to an SMR plant with a thermal power of 150 MW. Accordingly, the radioactive release applied in the modelling is 3.5 TBq of caesium-137. The Olkiluoto 3 nuclear power plant has been selected as the reference plant due to its modern design and advanced safety systems, which are considered representative of the accident management capabilities of new nuclear power plants. If preliminary estimates of accident release quantities are available from plant suppliers, these estimates will be compared in the EIA report with the radioactive release applied in the modelling.

The impacts of an accident are assessed up to a distance of 300 kilometres from the SMR plant. The preliminary size of the SMR plant's precautionary action zone and emergency planning zone is assessed on the basis of the requirements set out in STUK Regulation Y/2/2024 (Radiation and Nuclear Safety Authority 2024).

The examination of a 300-kilometre impact area is based on environmental impact assessments for large nuclear power plants, in which the impacts of a severe accident have been assessed using a reference radioactive release of 100 TBq of caesium-137. The table (Table 21-1) presents the radiation doses assessed for a one-year-old over a lifetime, up to a distance of 1,000 kilometres, in the environmental impact assessment report for the service life extension of the Loviisa nuclear power plant (Fortum Power and Heat Oy 2021) and in the environmental impact assessment report for the service life extension and thermal power uprating of the Olkiluoto 1 and Olkiluoto 2 units (Teollisuuden Voima Oyj 2024), as a consequence of a severe accident.

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Table 21-1. Lifetime (70 years) radiation dose to a one-year-old at various distances in other environmental impact assessments using a 100 TBq caesium-137 release.

Distance (km)	Lifetime dose to a one-year old (mSv)	
	Loviisa 1 and 2	Olkiluoto 1 and 2
1	267	76.0
5	60.1	36.4
10	27.7	27.9
15	21.3	19.8
20	14.5	14.8
50	3.91	5.6
100	0.41	2.6
300	0.16	0.6
500	0.09	0.2
700	0.06	0.1
1,000	0.03	0.08

Based on assessments in earlier EIA procedures (Table 21-1), the lifetime radiation dose at 50 kilometres from a 100 TBq caesium-137 release is lower than the average annual radiation dose in Finland (5.9 mSv) (Radiation and Nuclear Safety Authority 2025a), and the dose decreases markedly with increasing distance. With the modelling release set at 3.5 TBq of caesium-137, the impact assessment area is conservatively limited to 300 kilometres.

For the preliminary definition of the precautionary action zone and emergency planning zone, the dispersion of a radioactive release into the environment resulting from a severe accident at an SMR plant is modelled, and the radiation doses to the population exposed near the incident location are calculated. With regard to the licensing process of an SMR plant, STUK processes the designation of a precautionary action zone and an emergency planning zone as part of the emergency plans for the construction and operating licence phases referred to in the Nuclear Energy Decree (161/1988, Sections 35 and 36).

The objective of marking off the precautionary action zone is to create a zone where the necessary evacuation measures can be effectively carried out in the event of an accident in order to prevent or limit serious radiation impacts on the population. In the event of an accident, evacuation of the population outside the precautionary action zone is unlikely to be required. The precautionary action zone is determined so that the radiation dose to an unprotected person outside it does not exceed 1 Sv within 10 hours from the start of exposure. (Radiation and Nuclear Safety Authority 2024)

The emergency planning zone is an area where, in the event of an accident, it is highly likely that sheltering of the people located outside the zone will not be necessary. The emergency planning zone is defined so that the radiation dose to an unprotected person outside it does not exceed 10 mSv within 48 hours of the start of exposure. In addition, the emergency planning zone extends up to 20 kilometres from the power plant. (Radiation and Nuclear Safety Authority 2024)

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The atmospheric transport of radionuclides is assessed using the Lagrangian Particle Dispersion Model (LPDM). The characteristics of the selected dispersion model are particularly well-suited to an SMR plant located in variable terrain and in the vicinity of industrial buildings. In addition, LPDM is an excellent model for applications that look at both local and regional meteorological phenomena.

The AUSTAL (German Environmental Agency 2024) air dispersion model is used in the local-scale calculations of the precautionary action zone and the emergency planning zone. On a regional scale, the HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) model is used (Stein et al. 2015). Both the AUSTAL and HYSPLIT models are widely validated and verified.

21.1.2 Assessment of radiation doses to the population in the event of an accident

The atmospheric transport of radionuclides released in a hypothetical accident is calculated using atmospheric dispersion modelling software. Activity concentrations in air and ground deposition generated by the modelling software are used to estimate radiation doses to an unprotected population, and these radiation doses are used to determine the precautionary action zone and the emergency planning zone. Population dose calculations are performed using AFRY's AISM software modelling tool (AFRY Intelligent Scenario Modelling AISM 2024).

The exposure pathways to be taken into account in the calculation of the precautionary action zone and the emergency planning zone are:

- External exposure received within 10 and 48 hours from the start of exposure consists of two components.
    1. Gamma radiation resulting from a radioactive plume passing overhead.
    2. Gamma radiation caused by radionuclides deposited on the ground as a result of dry or wet deposition.
- The effective dose from inhalation accumulated within 10 hours and 48 hours from the start of exposure.

In the assessment of dispersion and deposition impacts up to a distance of 300 kilometres, radiation exposure to the population from the consumption of food is also taken into account.

For the results, lifetime radiation doses are assessed for a one-year-old child, a ten-year-old child and an adult, in accordance with the recommendations of the International Commission on Radiological Protection (ICRP). Exposure durations of 70 years for a one-year-old child, 60 years for a ten-year-old child and 50 years for an adult are used in the calculations. In addition, the general impacts of radioactive fallout and radiation are examined.

21.1.3 Consideration of uncertainties related to dispersion modelling

21.1.3.1 Impacts of varying terrain, buildings and release height

Buildings located in and near the power plant area can have a significant impact on the dispersion of the release plume, so any structures in the vicinity whose height or placement may affect the behaviour of the plume will be included in the model.

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In addition to the buildings located near the SMR plant, the dispersion model includes terrain elevation data for the entire modelled area. In addition, the modelling takes into account the land cover of the modelled area. Different land covers affect the dry deposition of radionuclides.

21.1.3.2 Uncertainties in release characteristics

The uncertainties related to the release characteristics are addressed by simulating different release temperatures, volume flows and ventilation chimney dimensions. The release height of the SMR plant's radioactive release will be examined at ground level and at the height of the ventilation chimney (initially about 40 metres).

21.1.3.3 Handling different weather conditions

Because the timing of a potential accident cannot be predicted, the modelling accounts for variations in local weather conditions throughout the year. Meteorological data from nearby weather stations is used in the modelling to identify the wind and stability conditions that would lead to plume dispersion and result in the highest radiation doses to the population. This information is also used to determine the extent of the precautionary action zone and the emergency planning zone. In addition, periods of heavy precipitation and their impact on the dispersion of radionuclides and their deposition on the ground in the accident area are examined. Local weather is typically fairly stable as averaged over a substantial period of time. Because year-to-year variability may occur, the modelling analyses a minimum of five consecutive years of local meteorological data (EPA 2020). This reduces the risk of overlooking important local weather conditions that can significantly affect plume dispersion.

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22 EFFECTS ON SAFETY AND ENVIRONMENTAL RISKS

The EIA procedure initially identifies the project's environmental risks and assesses their potential impacts on the environment and public health. The environmental risk assessment examines the risks posed by major process disruptions, fires and chemicals, as well as those related to weather conditions and traffic. The assessment also considers potential risks to the project arising from activities in its vicinity.

Accidents and incidents, their impacts and likelihood, are assessed during construction and operation (for nuclear safety, exceptional and emergency situations are discussed in chapter 21). The review includes all activities of the entire project, including road traffic. Accident risks caused by extreme weather phenomena that increase with climate change are also taken into account.

Based on the results of the assessment, measures are proposed to prevent the identified accident and disruption risks and mitigate the consequences. The results of the impact assessment will be taken into account in further operational planning.

The assessment is carried out by experts familiar with accident and disruption risks in nuclear energy and industrial processes. The assessment is based on the planning information available for the project and any hazard assessments or risk analyses carried out.

23 CUMULATIVE IMPACTS WITH OTHER PROJECTS

23.1 Other projects

VolagHy is planning a synthetic jet fuel production project in Sorsasalo, Kuopio. In the project, the plan is to produce renewable synthetic aviation fuel (eSAF) from biogenic carbon dioxide, water and electricity. The carbon dioxide used as a raw material for the process is recovered from the flue gases of the Mondi Powerflute Oy fluting mill's power plant in Sorsasalo. The project area lies in the eastern part of Sorsasalo, northwest of the SMR plant area, on land owned by the City of Kuopio, from which an 18.9-hectare plot reservation has been made for the plant project. The waste heat of the electrolysis unit related to the VolagHy's production process, and partly the waste heat from other process units, is intended to be used for district heating. The waste heat is directed in a transmission pipeline from Sorsasalo to the Haapaniemi power plant area, where it can be used and distributed to the existing district heating network. The project is currently undergoing an EIA procedure. The construction of the waste heat pipeline is addressed as part of the EIA procedure for the synthetic jet fuel production project, and the building of the district heating transmission connection for the SMR plant is included in the same procedure.

YIT Oyj is planning a data centre in Hepomäki. YIT has reserved a plot of approximately 45 hectares from the City of Kuopio in an area where local detailed planning is ongoing. The waste heat produced by the data centre can be used in Kuopio's district heating network (YIT Oyj 2025).

23.2 Cumulative impact assessment

The EIA procedure examines the potential cumulative impacts of the SMR project in conjunction with other projects in the vicinity. In the assessment of cumulative impacts,

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consideration is given to activities planned for the area that the project may interact with and for which sufficient information is available for the assessment.

To support the assessment of cumulative impacts, a cumulative noise modelling will be carried out as part of the EIA procedure, covering the combined noise impacts of the existing operations located in Sorsasalo (e.g. Mondi Powerflute Oy's fluting mill) and the planned industrial activities (Kuopion Energia's SMR plant and VolagHy's eSAF plant). In the combined noise modelling, the situation during operations is examined.

24 ASSESSMENT OF TRANSBOUNDARY IMPACTS

Finland is a party to the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention), which aims to promote transboundary cooperation and opportunities for public participation when a project planned in a particular country (the party of origin) is likely to have transboundary environmental impacts on the territory of another country (the affected party). Nuclear power plants are mentioned in the Espoo Convention as projects in connection with which an international consultation must be carried out as part of the EIA procedures.

Within the EIA procedure, the assessment covers both the impacts occurring within Finland and any potentially harmful transboundary impacts caused by the project. In accordance with the Espoo Convention, certain countries are notified of the project and given the opportunity to participate in the procedure. Annex 1 to the EIA programme contains the international consultation document for the programme phase, which is submitted to these countries.

A summary of the assessment of transboundary impacts is included in the EIA report material.

Preliminary assessment indicates that the project is not likely to cause significant transboundary impacts. Only a severe reactor accident and the resulting radioactive release could potentially have harmful transboundary impacts. However, in this regard, the preliminary estimate is that the impacts are likely to remain within Finland's borders. The assessment area for radioactive release dispersion modelling in the event of an accident, carried out during the EIA report phase, is 300 kilometres (see chapter 21.1.1).

25 IMPACTS OF DECOMMISSIONING

The planned service life of the SMR plant is at least 60 years. The impacts of the decommissioning of the plant are assessed at a general level in accordance with the life cycle approach required by the EIA Act. Impacts will be assessed on the basis of the available data.

A decommissioning permit in accordance with the Nuclear Energy Act will be applied for in due course and an EIA procedure in accordance with the EIA Act will be carried out.

26 IMPACTS OF THE ZERO OPTION

As the zero option (VE0), the option of not implementing the project is considered, that is, a situation where an SMR plant is not built. In this case, district heat production will continue in its current form using a combustion-based solution. In the zero option, the environmental impacts of the construction and operation of an SMR plant do not materialise, nor do the project's positive impacts. The assessment report presents the

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current state of the environment in the project's impact area and its likely development in a situation where the project is not implemented.

27 UNCERTAINTIES IN THE IMPACT ASSESSMENT

Available environmental information and impact assessment always involve assumptions and generalisations. Likewise, the available technical details of the project will become more precise as the planning progresses after the EIA procedure. The available technical information is still preliminary during the pre-planning phase of the project. Lack of information can cause uncertainty and inaccuracy during the assessment work. For this reason, in accordance with the precautionary principle, impact assessments are aimed to be carried out according to the so-called worst-case scenario in terms of environmental impacts.

During the assessment work, potential uncertainties are identified as comprehensively as possible, and their significance for the reliability of impact assessments is assessed. These are described in the assessment report.

28 HARM PREVENTION, MITIGATION AND IMPACT MONITORING

One of the purposes of the environmental impact assessment procedure is to examine the possibilities of preventing and mitigating the harm caused by the project. During the assessment work, the possibilities of preventing or limiting the adverse effects of the project on, for example, water, nature and people are investigated and presented. With regard to mitigation measures, safety standards and publications on good practices related to operations are taken into account. The results of this assessment will also have an impact on the planning of the project during the EIA procedure.

According to the Environmental Protection Act, the operator must be aware of the environmental impacts of its operations. In connection with the impact assessment, a proposal is drawn up to form the content of the project's environmental impact monitoring programme. The objective of monitoring is:

- Produce information about the impacts of the project.
- Find out which changes are a consequence of implementing the project.
- Find out how the results of the impact assessment correspond to reality.
- Find out how successful the mitigation measures have been.
- To initiate necessary actions in case unforeseen significant harm occurs.

A more detailed proposal for the environmental impact monitoring programme will be presented later in connection with the environmental permit application.

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