GIS Applications in Forest Biomass Aquisition

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Bioenergy targets

- New Finnish government has set up an ambitious target of producing 40% of our total energy consumption using biofuels
- Only viable source of renewable energy is forest bioenergy
- Bioenergy can be obtained from small trees, branches, treetops and stumps

Many uses of wood biomass

- Pulp and paper industry uses practically all available timber with diameter > 6 cms
- Average price paid for forest owner is about 15 €/m3
- The total amount of roundwood consumption is 74 mill m3 (2005)
- Chips and fuelwood use 5.90 mill m3
- Residues from forest industry to energy use 12.9 mill m3

Many uses of wood biomass…

- Forest owner gets practically nothing from the harvest of branches, small-scale timber and stumps. No incentive to produce…
- Estimated potential is high: 15.5 mill m3
- The challenge is to aquire the biomass
- Targeted pricing through GIS analysis

GIS Applications

1. Regional inventory:

- Is there enough energy wood?
- Where to find suitable energy wood?
- Is it harvestable?
- Is it transportable?
- Who owns it?

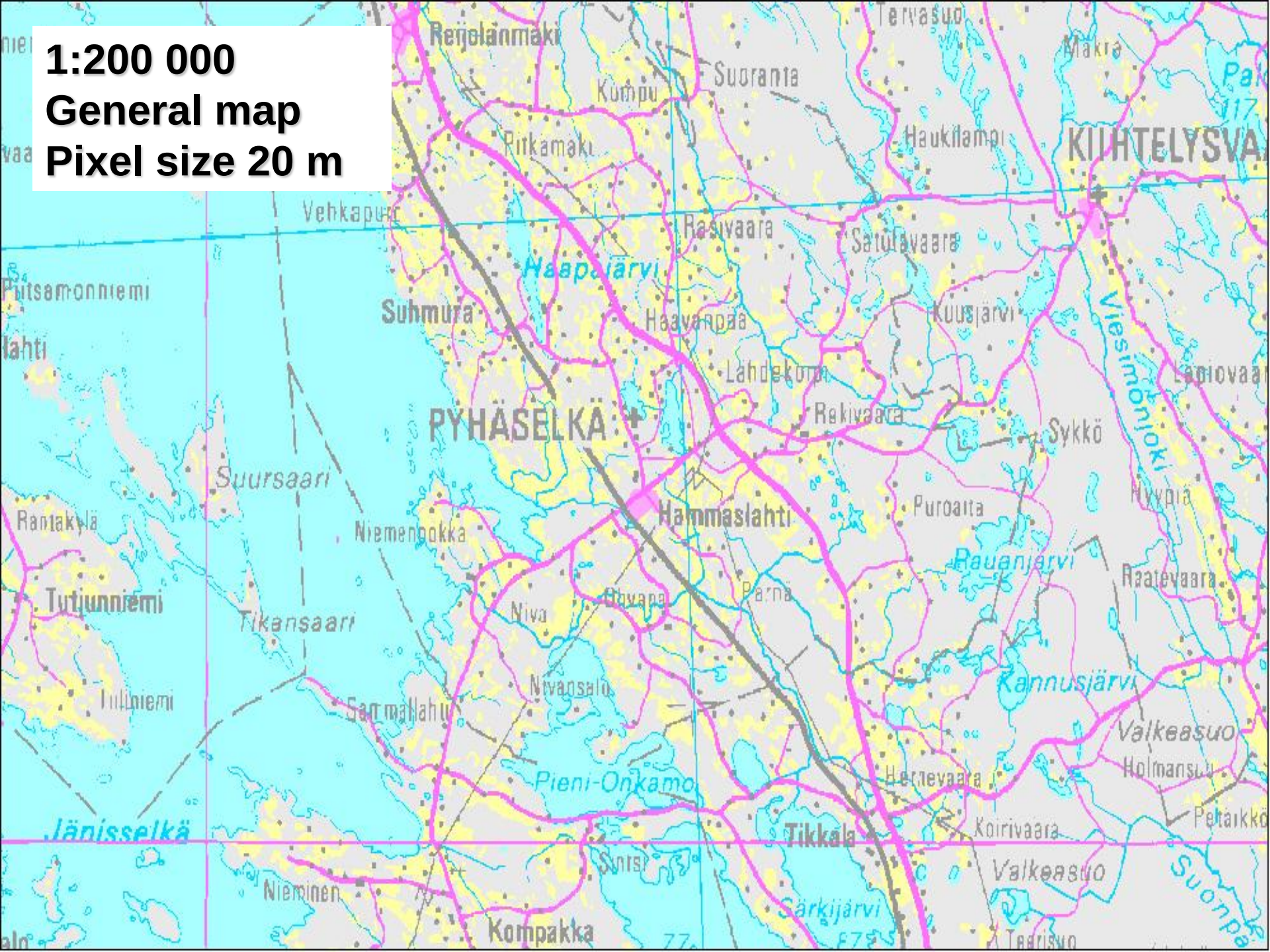
GIS Applications

2. Everyday operations:

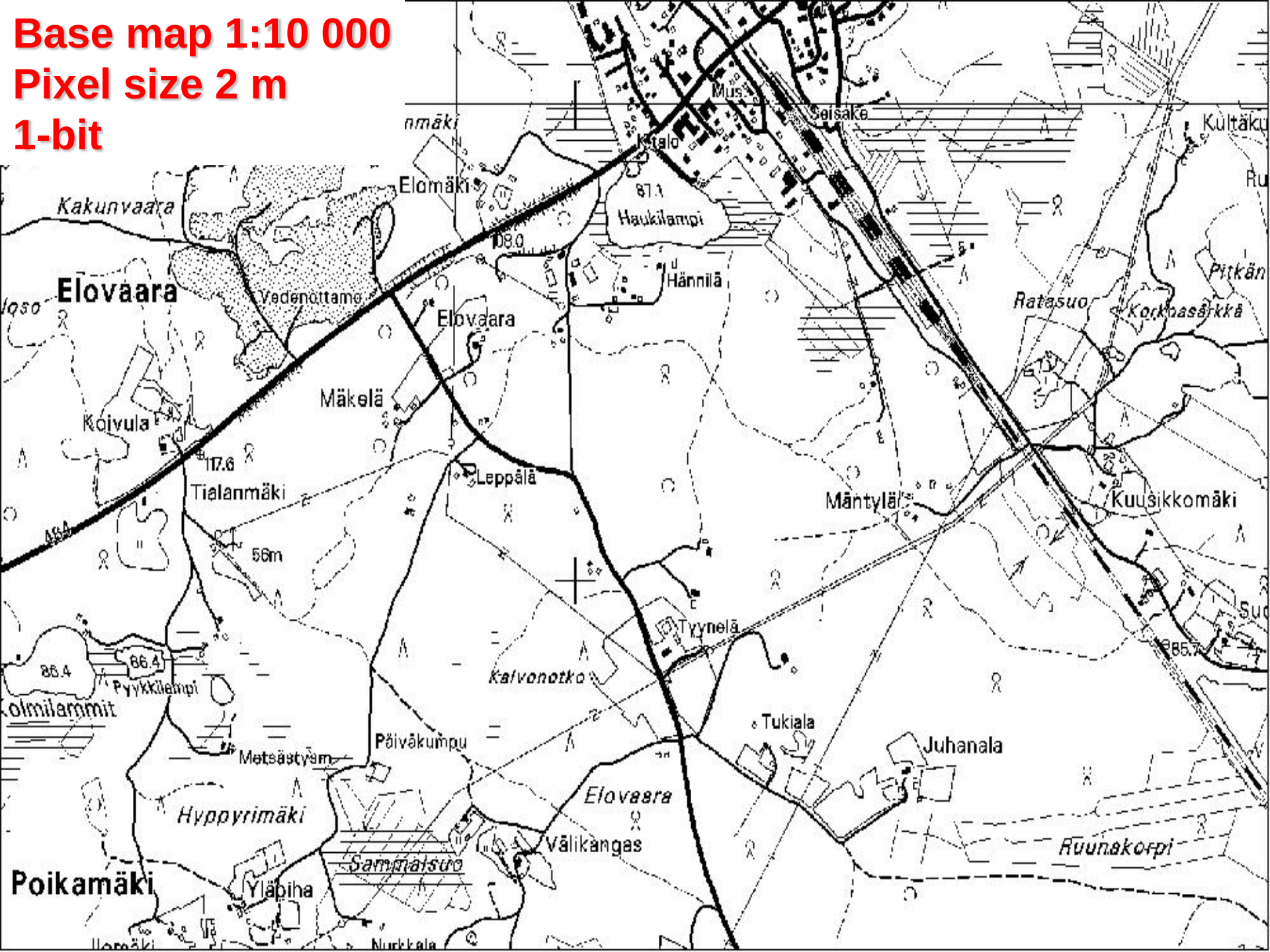
- Storage locations?
- Harvesting schedules
- Transportation schedules?
- Route optimisation
- Logistics control

1.Energywood availability analysis:

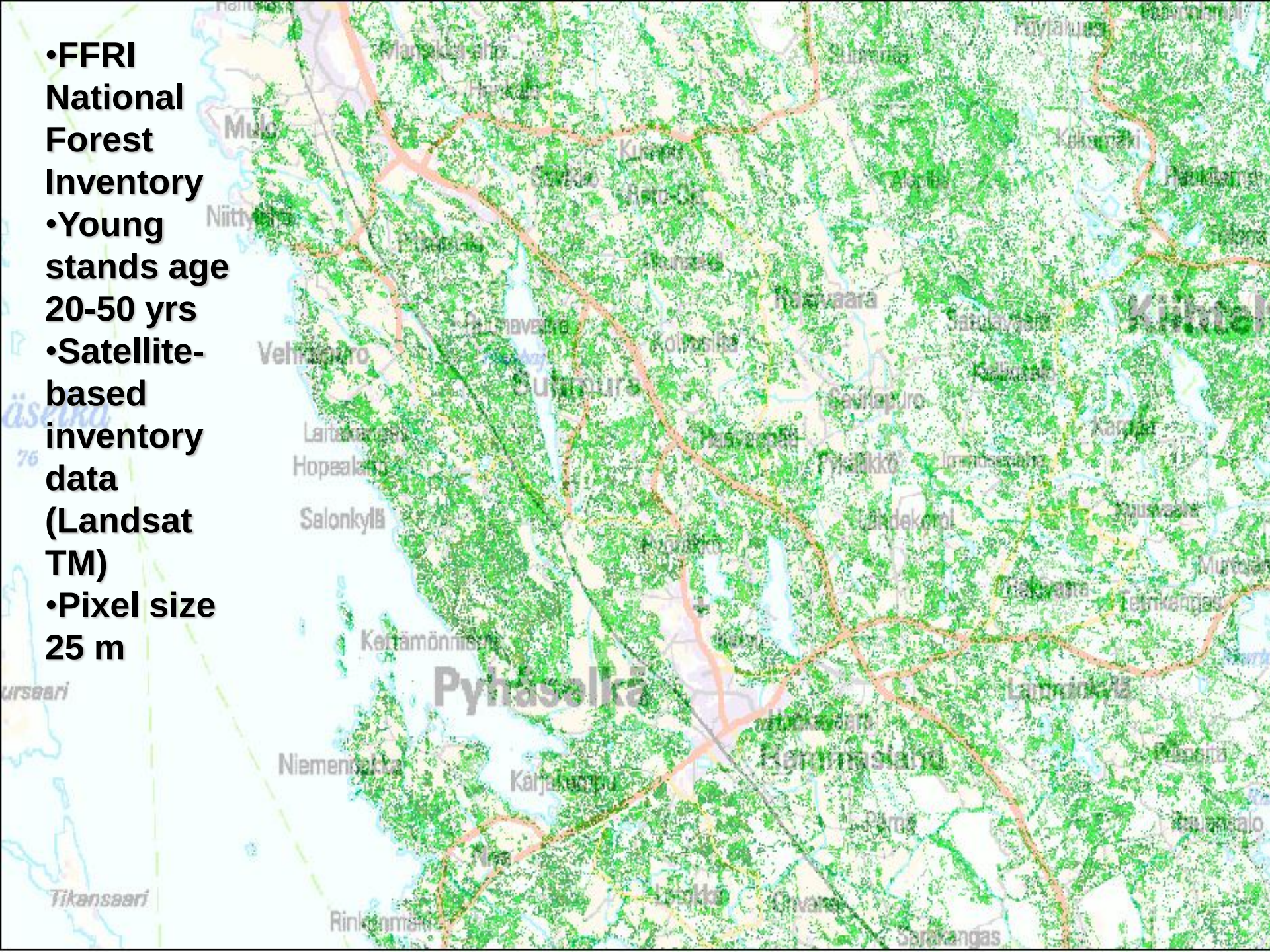
- **Find Forest Inventory Data**
- **Choose selection criteria**
  - **What is usable as energy wood?**
- **Choose distance criteria**
  - **End-use location**
  - **Road buffers**
- **Exclude unsuitable areas**
  - **Steeps from DEM**
  - **Soil quality, Restricted areas etc.**

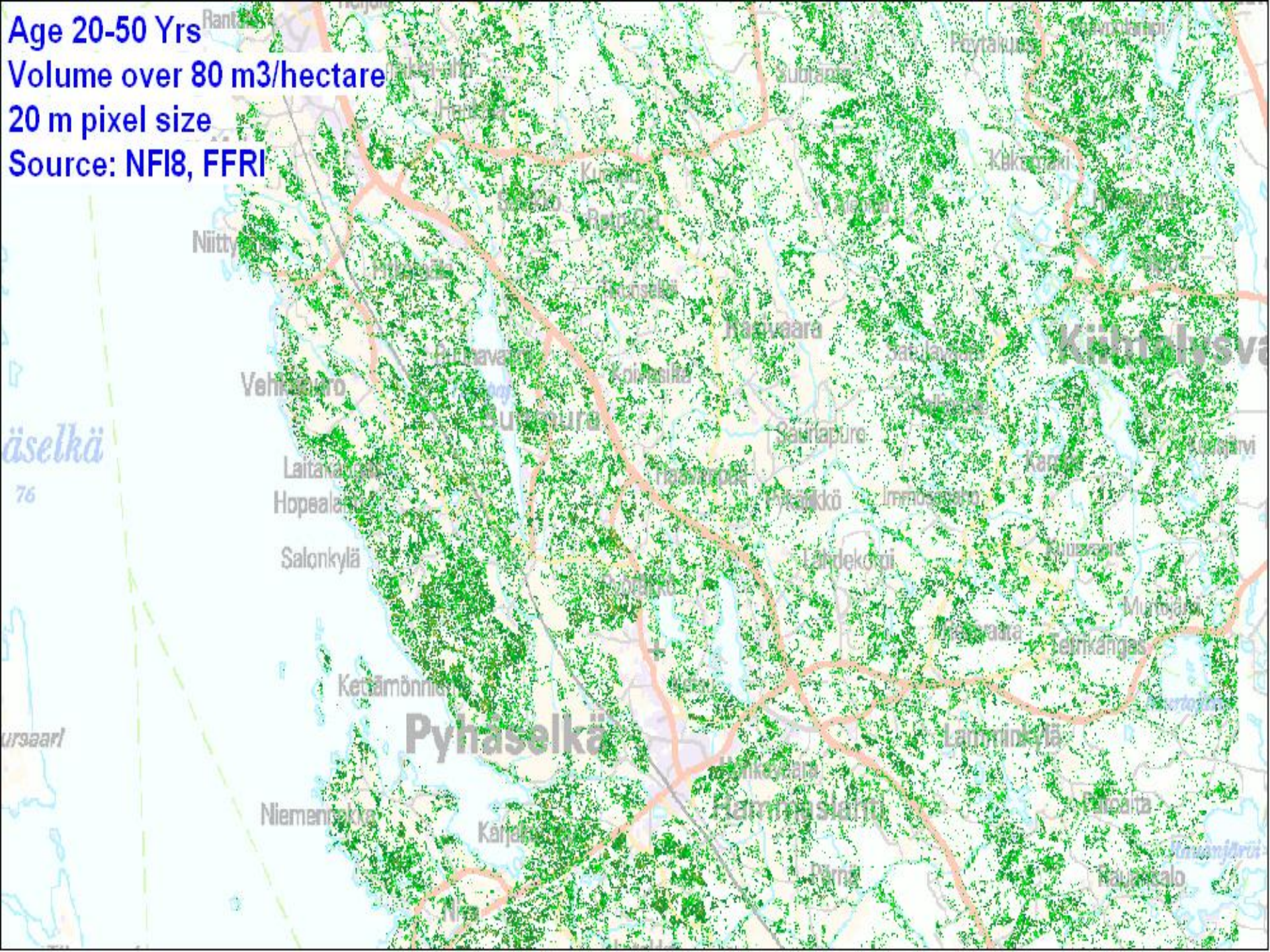

1:200 000
General map
Pixel size 20 m
Reijolanmäki
Kumpu
Suoranta
Ritkamäki
Haukilampi
KIIHTELYSVA
Vehkapuro
Rasivaara
Satulavaara
Haapajärvi
Suhmura
Haavanpää
Kuusjärvi
Viesimönjoki
Lahdekorpi
PYHÄSELKÄ
Rakivaara
Sykkö
Suursaari
Hammaslahti
Puroaita
Niemenpokka
Rauanjärvi
Raatevaara
Tutjunniemi
Tikansaari
Niva
Parna
Kannusjärvi
Nivansalo
Valkeasuo
Pieni-Onkamo
Holmansuo
Jänisselkä
Tikkala
Koirivaara
Valkeasuo
Nieminen
Kompakka
Särkijärvi

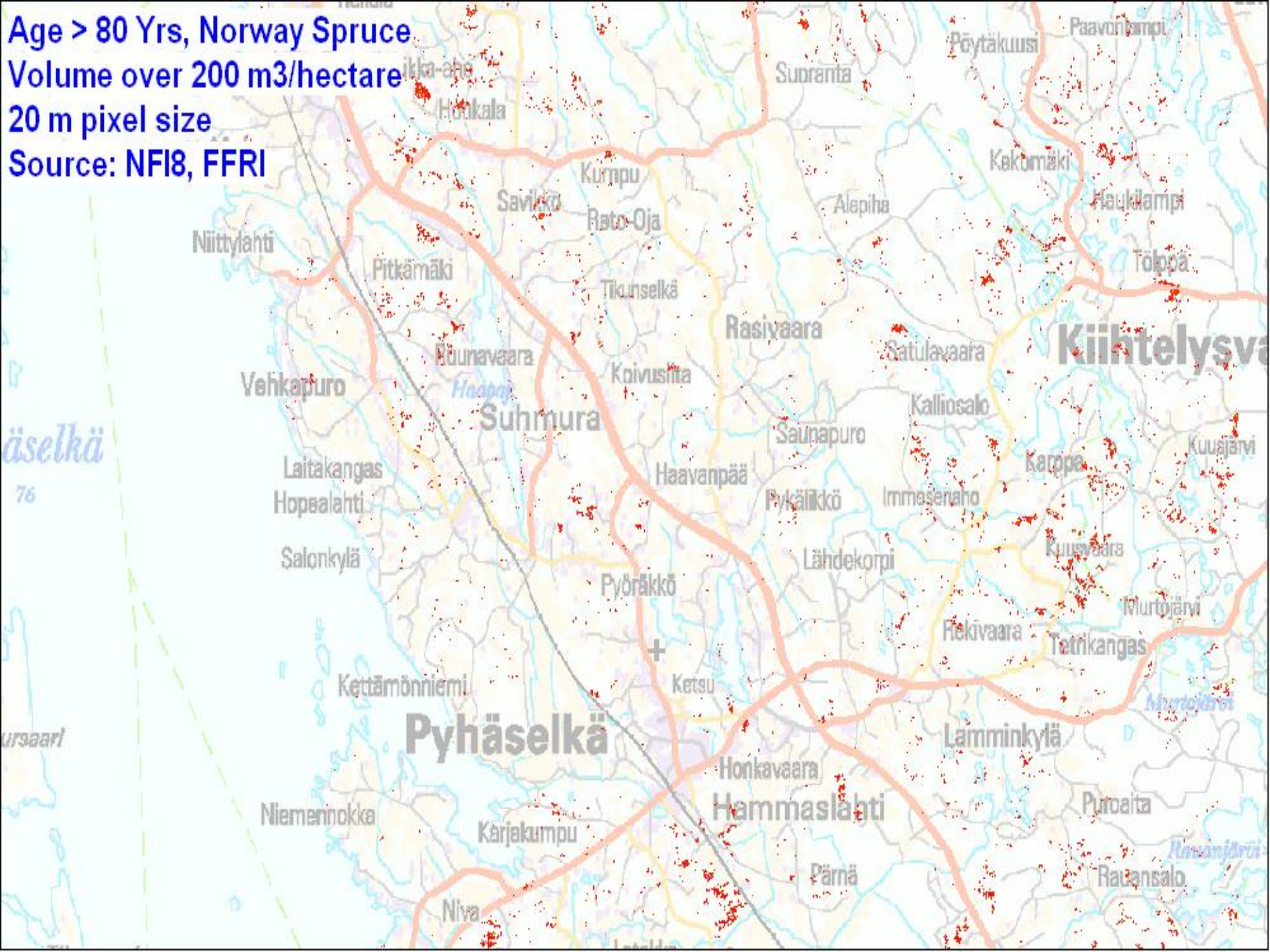
Base map 1:10 000
Pixel size 2 m
1-bit



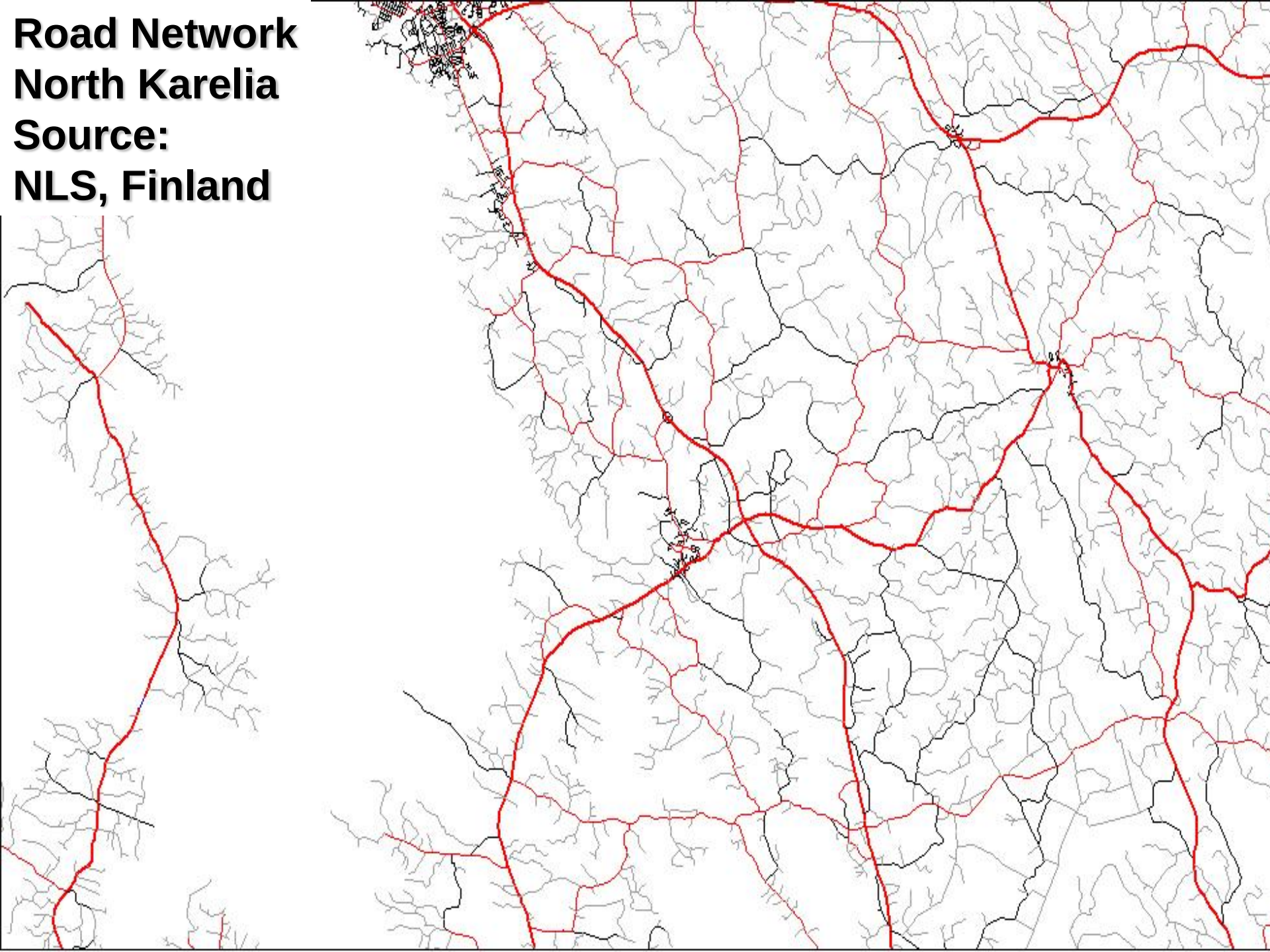
- FFRI National Forest Inventory
- Young stands age 20-50 yrs
- Satellite-based inventory data (Landsat TM)
- Pixel size 25 m




Age 20-50 Yrs
Volume over 80 m3/hectare
20 m pixel size
Source: NFI8, FFRI
Pyhäselkä


Age > 80 Yrs, Norway Spruce
Volume over 200 m3/hectare
20 m pixel size
Source: NFI8, FFRI
Pöytäkuusi
Paavontempi
Suoranta
Honkala
Kekomäki
Kumpu
Savikko
Reto-Oja
Alapiha
Haukilampi
Niittylahti
Pitkämäki
Tikunselkä
Tolppa
Rasivaara
Satulavaara
Kiihtelysva
Ruunavaara
Koivusilta
Vehkapuro
Haapaj
Suhmura
Kalliosalo
Saunapuro
Kuusjärvi
Laitakangas
Haavanpää
Karppa
Hopealahti
Pykälikkö
Immosenaho
Salonkylä
Lähdekorpi
Kuusvaara
Pyöräkkö
Murtojärvi
Rekivaara
Tetrikangas
Kettämönniemi
Ketsu
Pyhäselkä
Lamminkylä
Honkavaara
Hammaslahti
Puroaita
Niemennokka
Karjakumpu
Pärnä
Rauansalo
Niva
äselkä
76

Road Network North Karelia Source: NLS, Finland

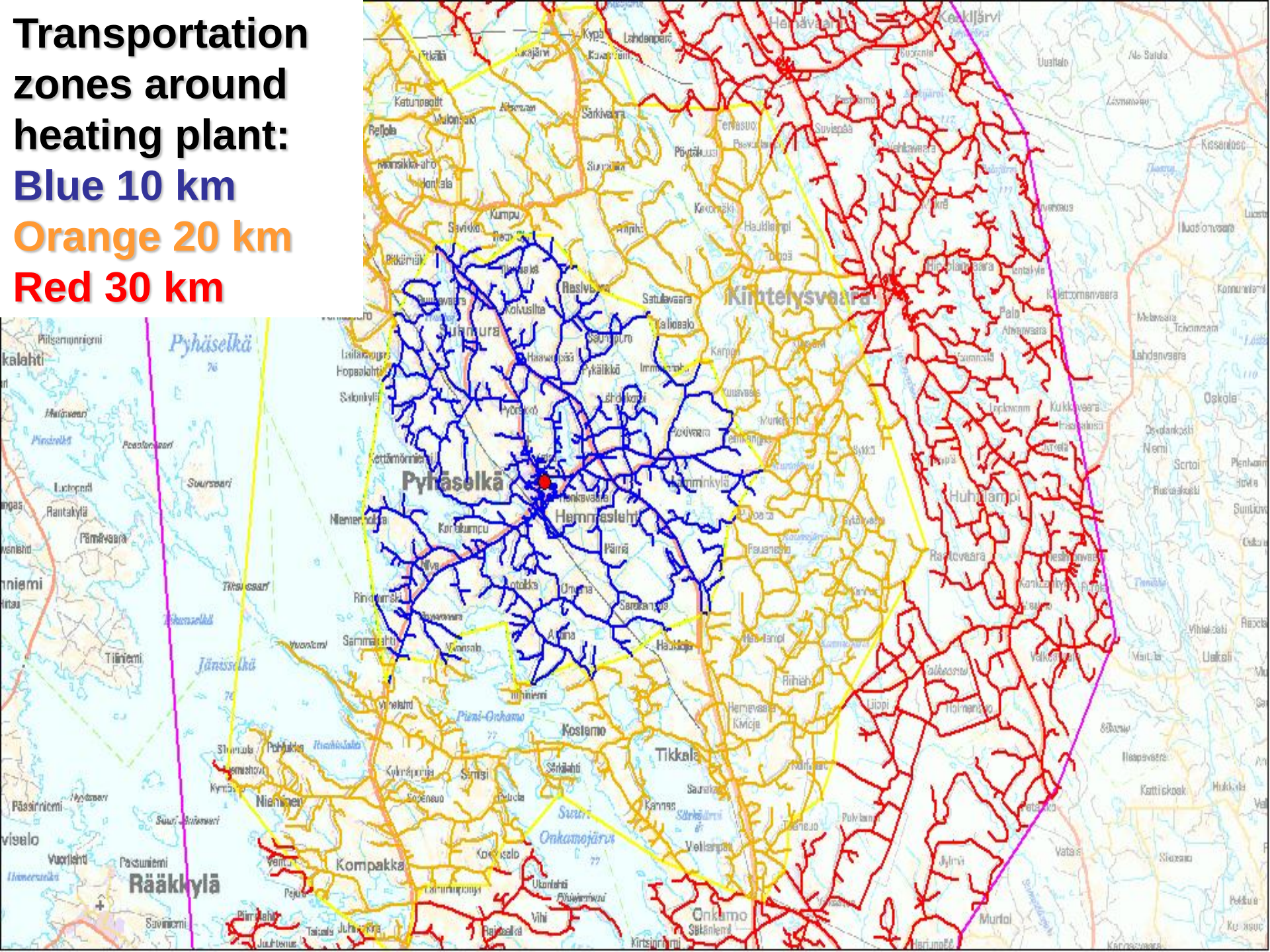


Transportation zones around heating plant:

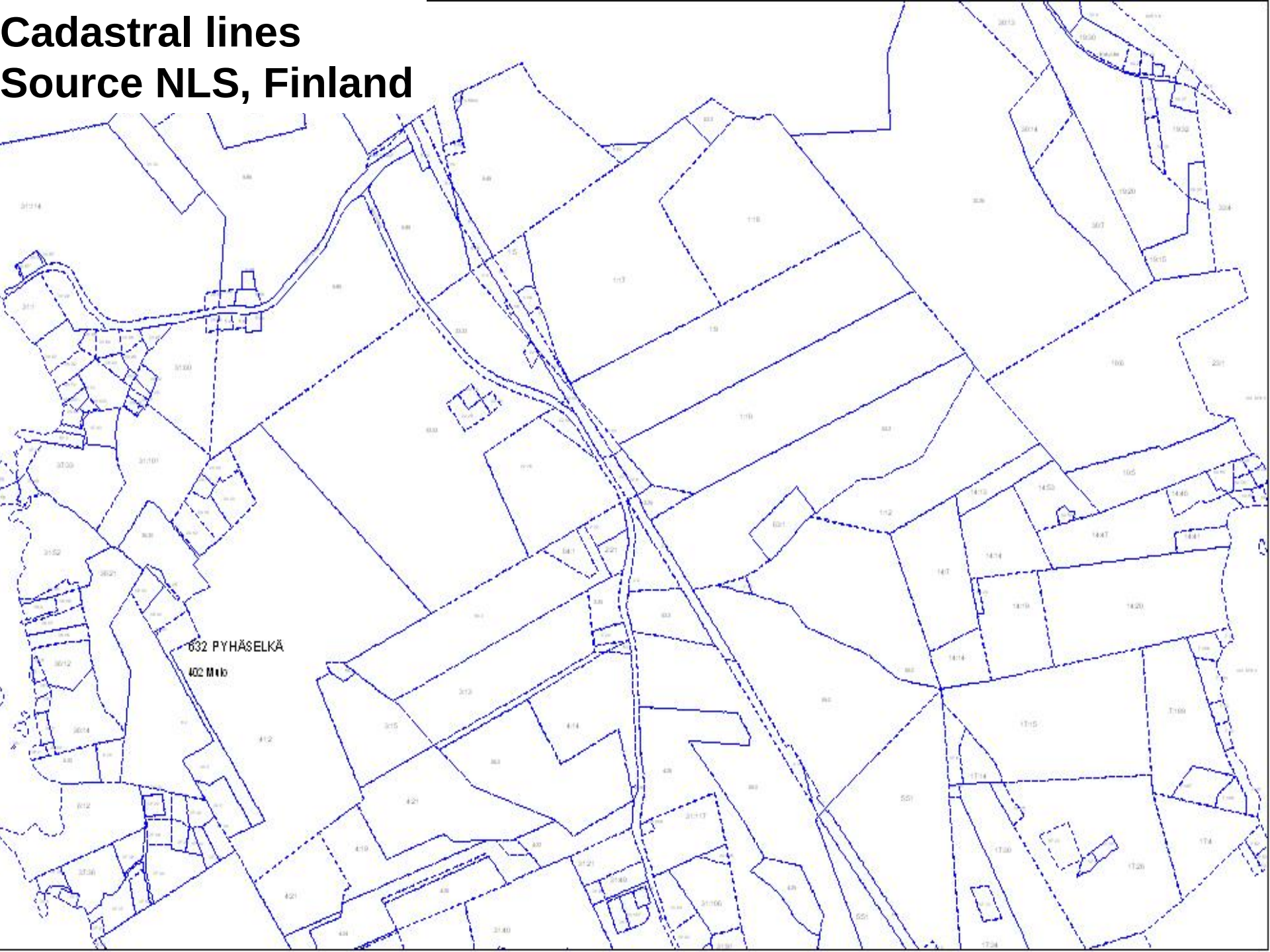
Blue 10 km

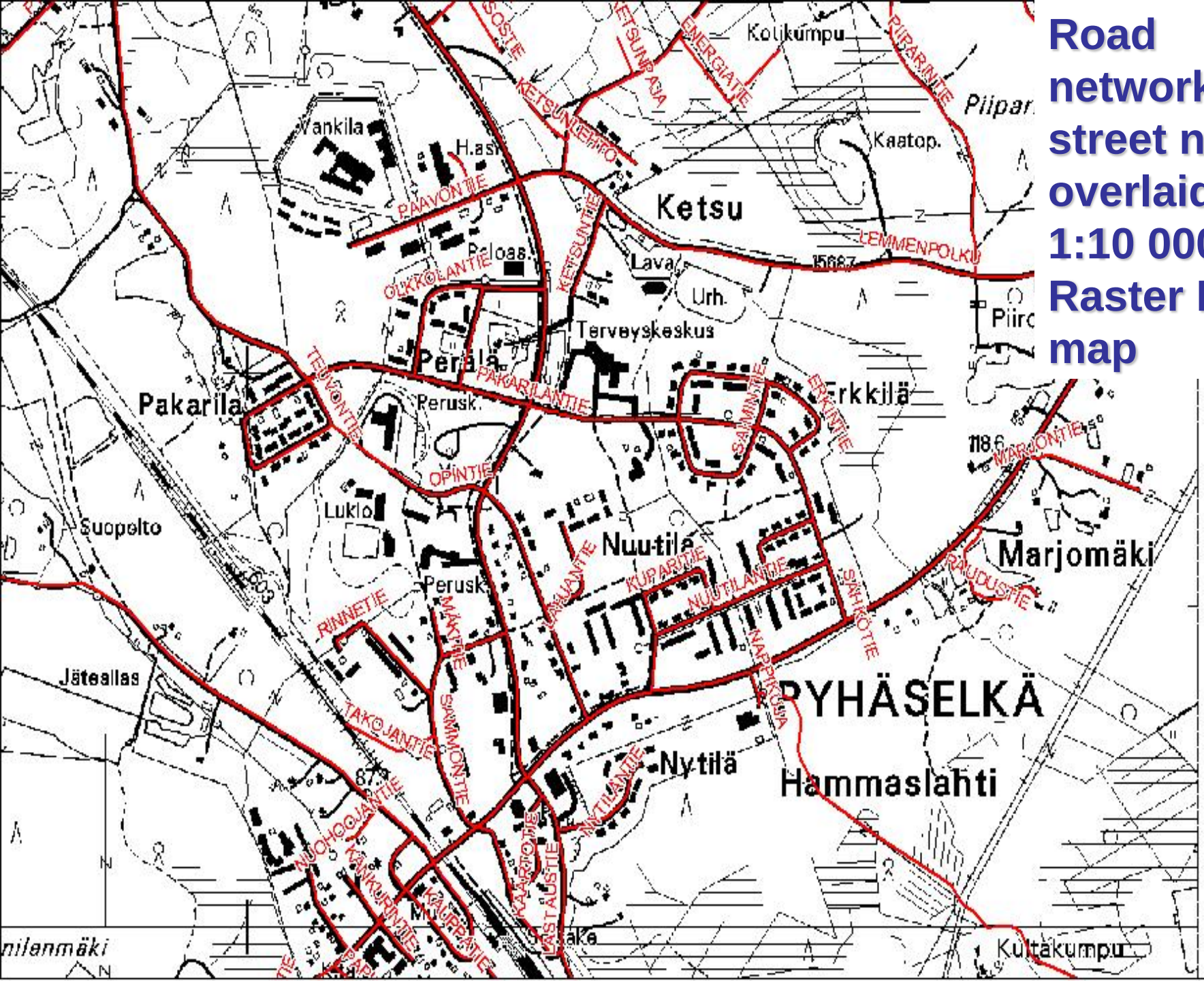
Orange 20 km

Red 30 km



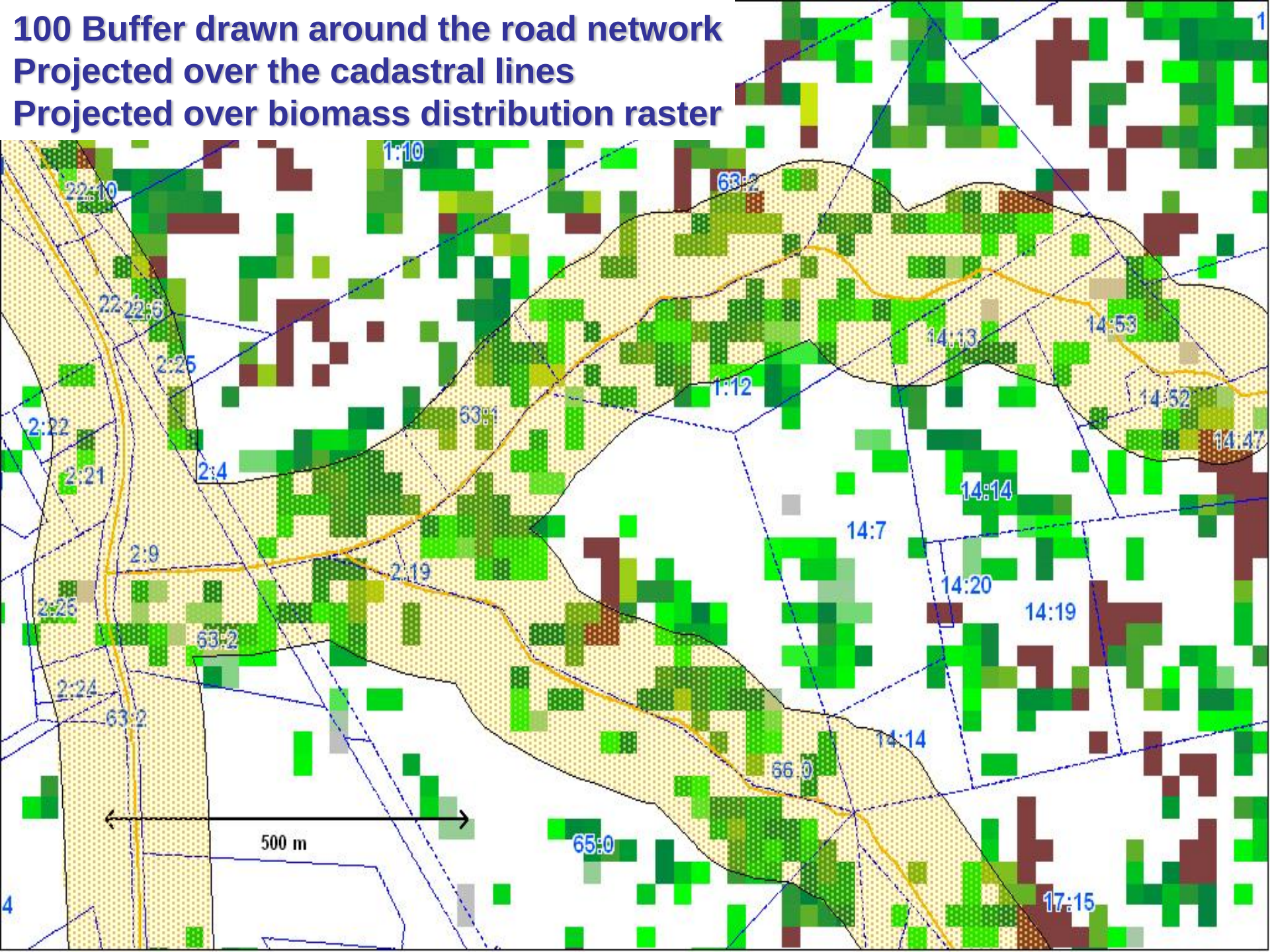
Cadastral lines
Source NLS, Finland

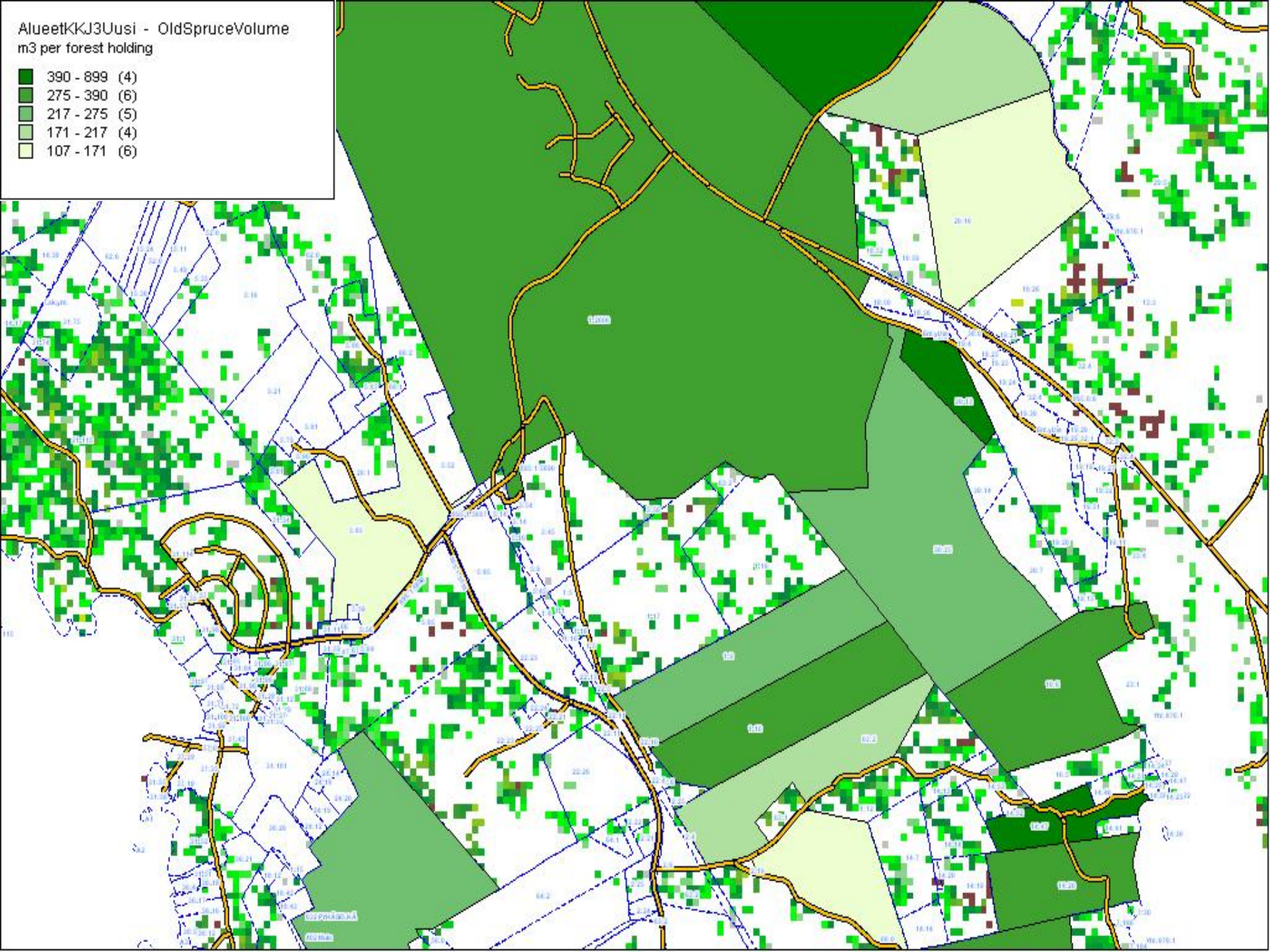


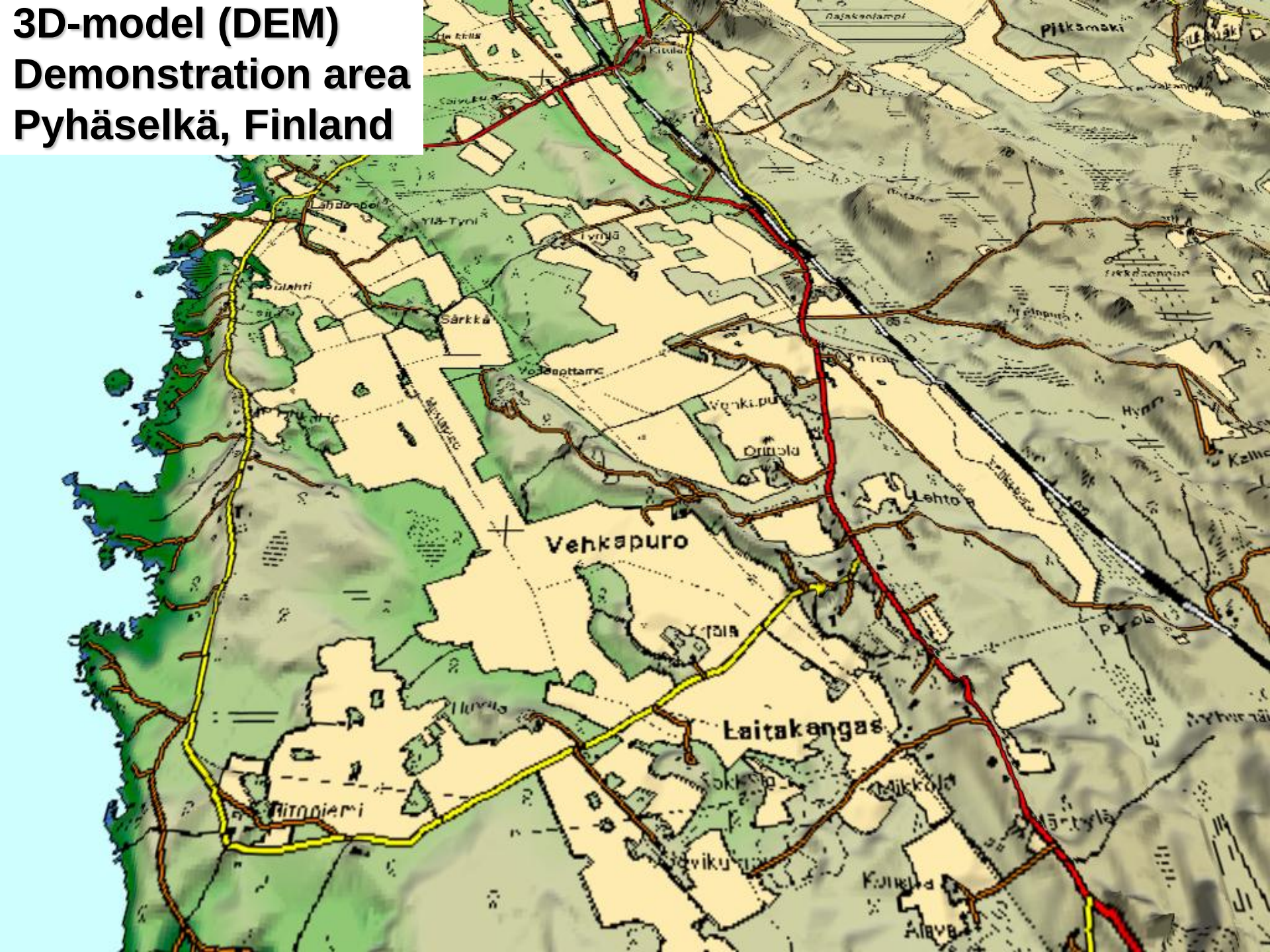


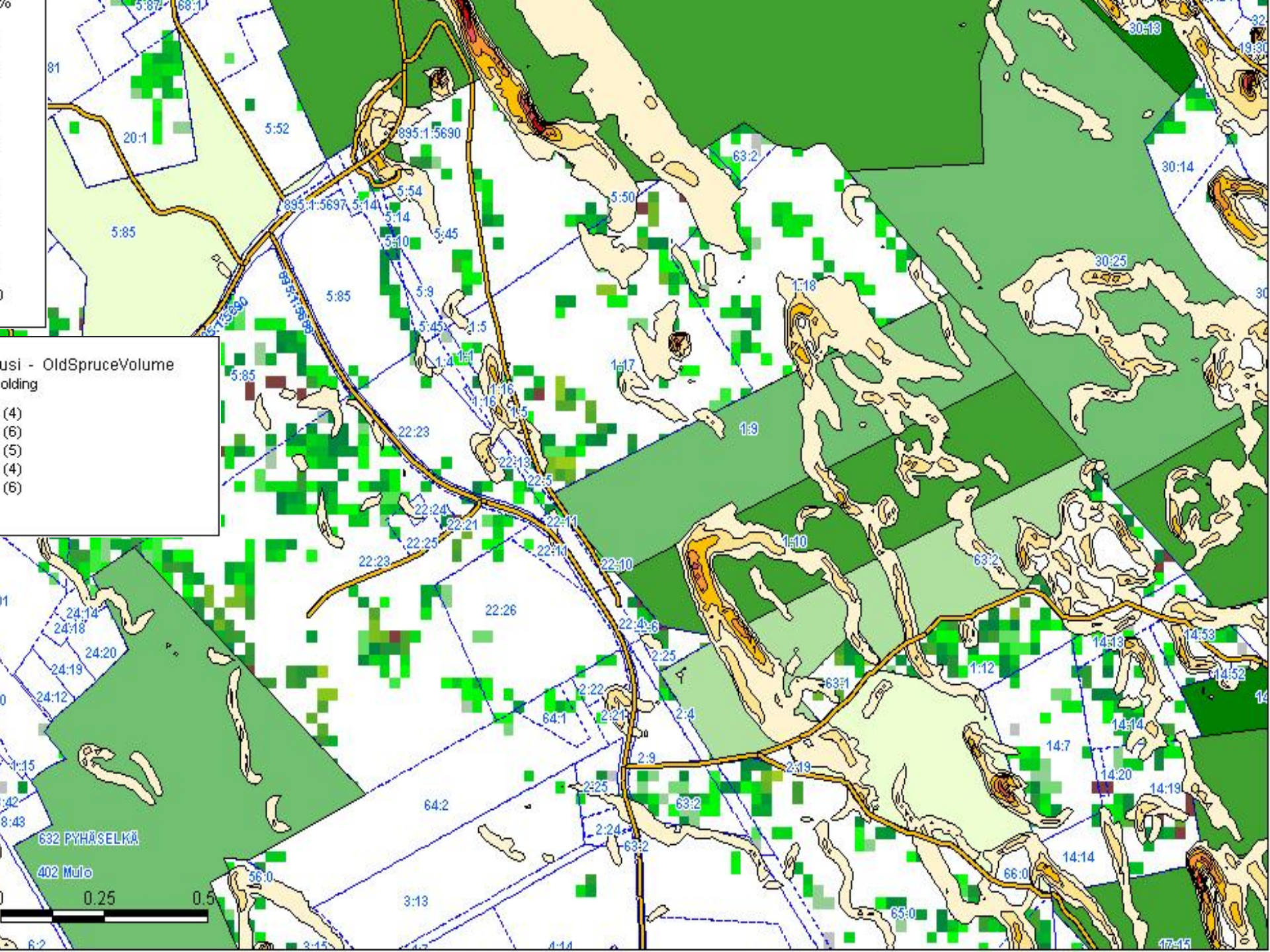
Road network with street names overlaid on 1:10 000 Raster Base map

100 Buffer drawn around the road network
Projected over the cadastral lines
Projected over biomass distribution raster




AlueetKKJ3Uusi - OldSpruceVolume
m3 per forest holding
390 - 899 (4)
275 - 390 (6)
217 - 275 (5)
171 - 217 (4)
107 - 171 (6)


3D-model (DEM)
Demonstration area
Pyhäselkä, Finland
Vehkapuro
Laitakangas
Pitkämäki

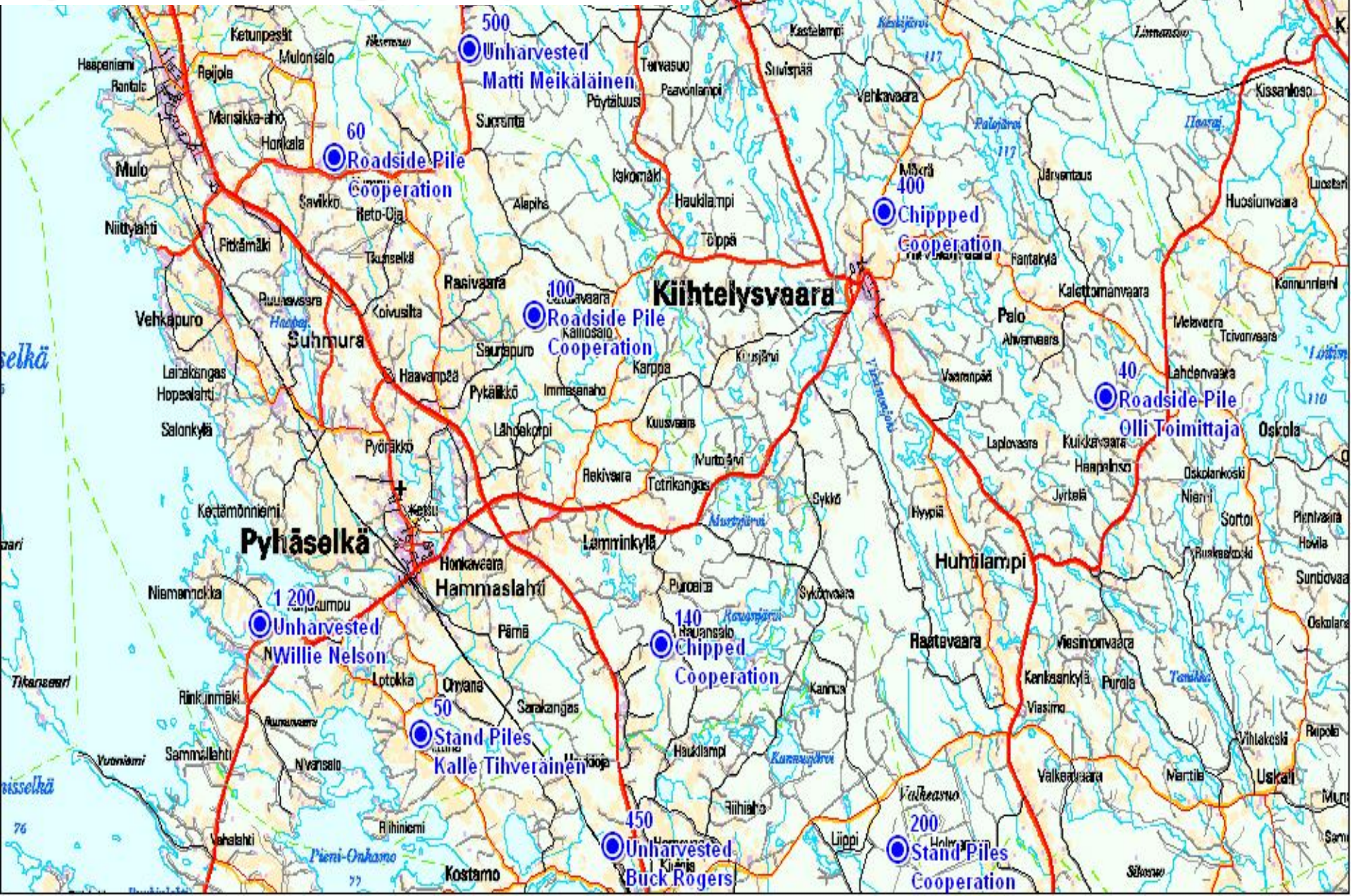

usi - OldSpruceVolume
olding
(4)
(6)
(5)
(4)
(6)
632 PYHÄSELKÄ
402 Mulo
0.25
0.5

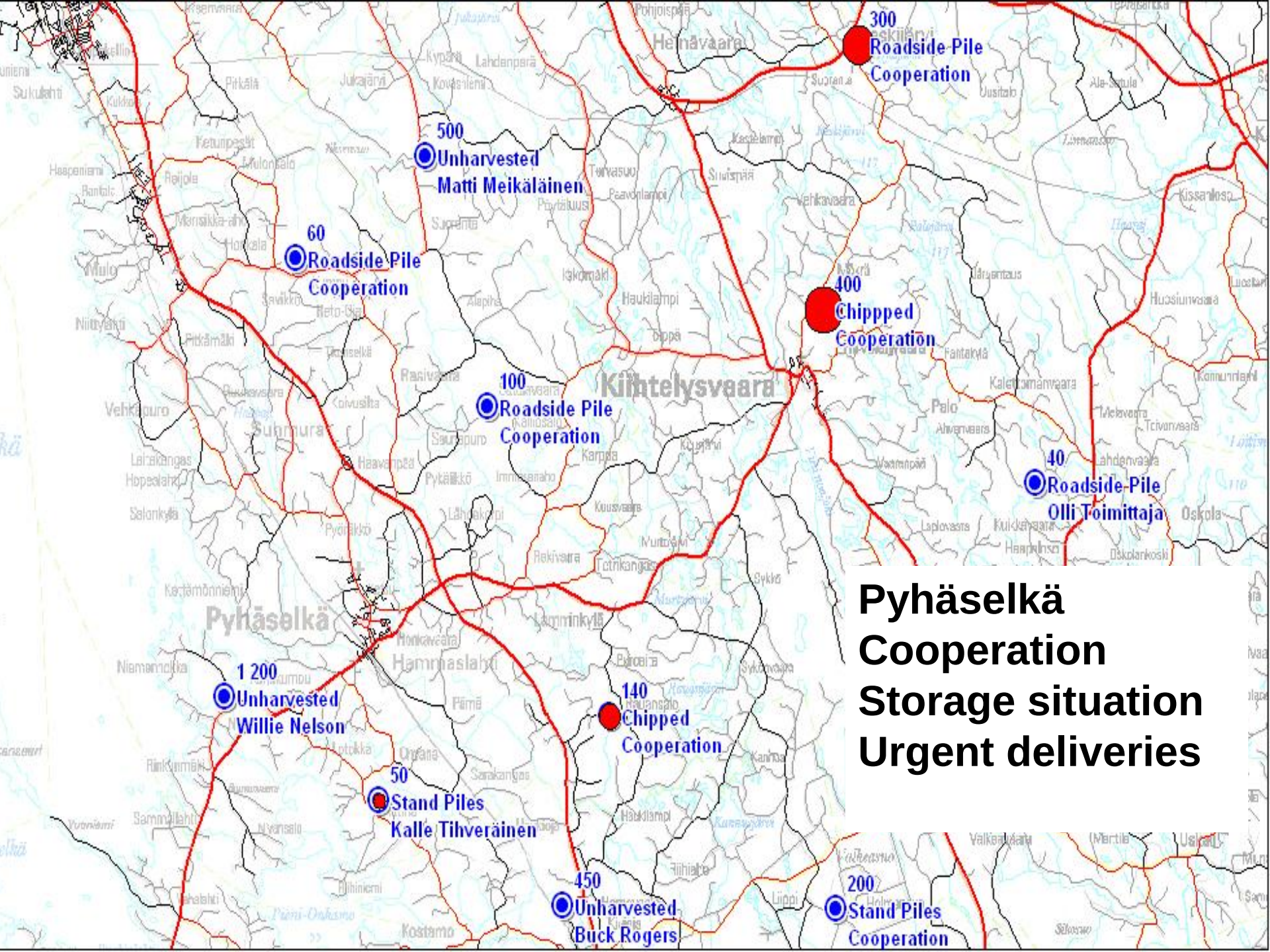
GIS Applications

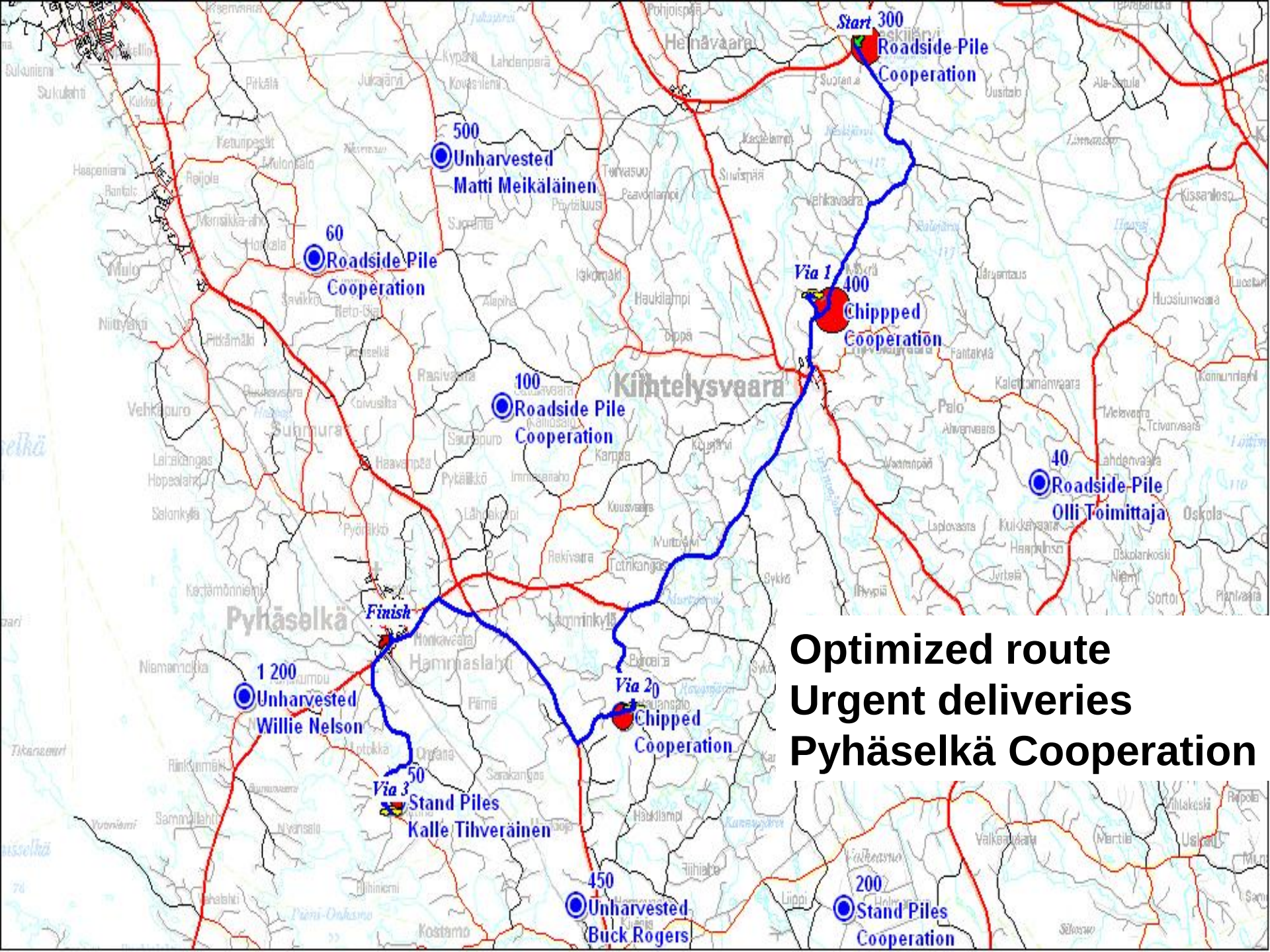
2. Everyday operations:

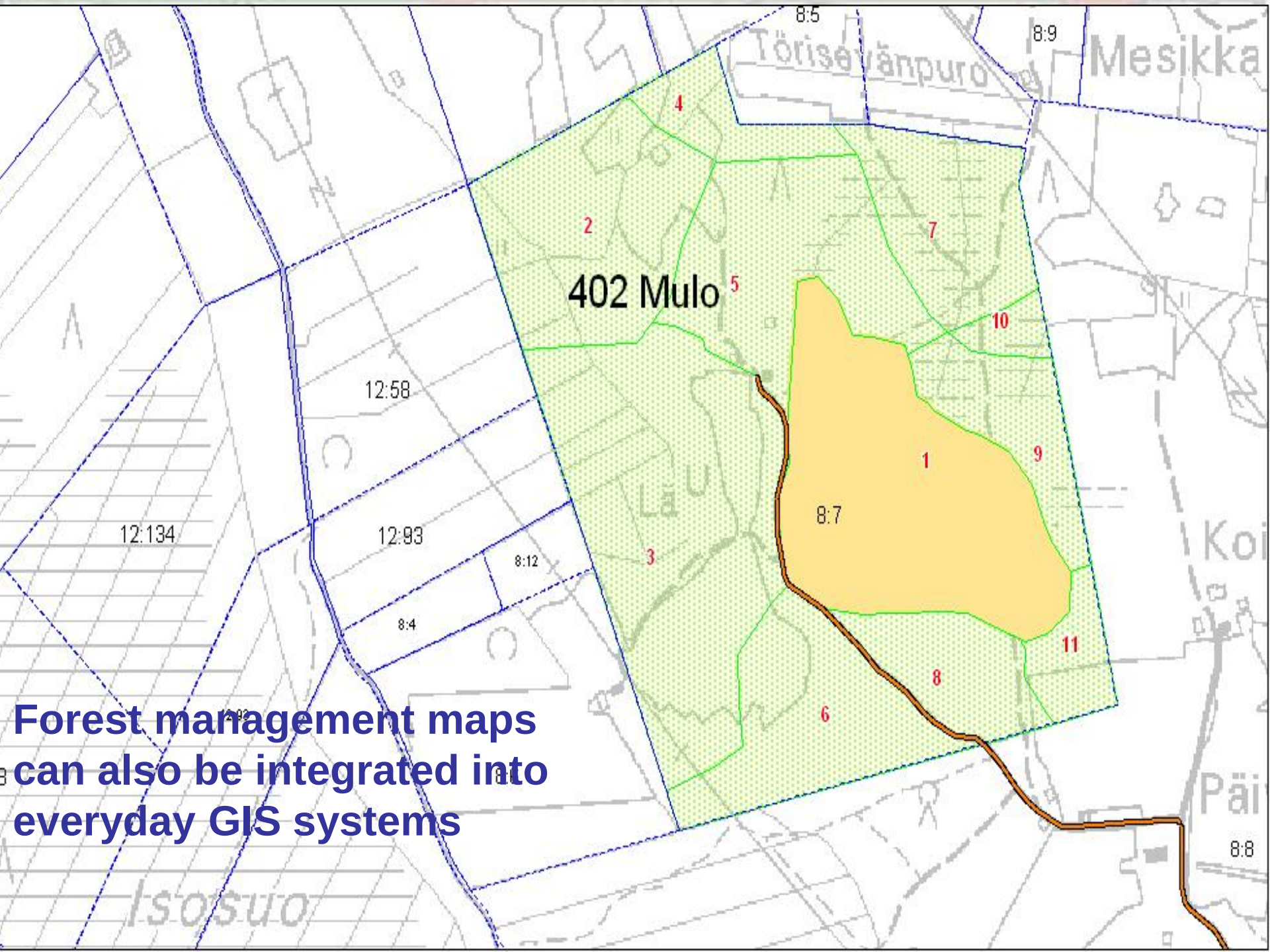
- Storage locations?
- Harvesting schedules
- Transportation schedules?
- Route optimisation
- Logistics control

Storage Situation 10.11.2006
Pyhäselkä Energy Cooperation




300
Roadside Pile
Cooperation
500
Unharvested
Matti Meikäläinen
60
Roadside Pile
Cooperation
400
Chippped
Cooperation
100
Roadside Pile
Cooperation
40
Roadside-Pile
Olli Toimittaja
Pyhäselkä
Cooperation
Storage situation
Urgent deliveries
1 200
Unharvested
Willie Nelson
140
Chipped
Cooperation
50
Stand Piles
Kalle Tihveräinen
450
Unharvested
Buck Rogers
200
Stand Piles
Cooperation


Start
300
Roadside Pile
Cooperation
500
Unharvested
Matti Meikäläinen
60
Roadside Pile
Cooperation
Via 1
400
Chippped
Cooperation
100
Roadside Pile
Cooperation
40
Roadside-Pile
Olli Toimittaja
Finish
1 200
Unharvested
Willie Nelson
Via 2
0
Chipped
Cooperation
Via 3
50
Stand Piles
Kalle Tihveräinen
450
Unharvested
Buck Rogers
200
Stand Piles
Cooperation
Optimized route
Urgent deliveries
Pyhäselkä Cooperation



Forest management maps can also be integrated into everyday GIS systems

GIS Options

- **Own GIS System**
  - Computer, programs, base materials, operator
- **WWW-based GIS**
  - WWW service bought from a provider
  - Programs, materials on providers' servers

OWN GIS

Pros:

- **Flexible, capable system**
- **Analysis capacity**
- **Powerful tool**

Cons:

- **Expensive programs and materials**
- **Requires skill**
- **Results often poorly published**
- **Data quality maintenance?**

WWW GIS

Pros:

- No program or material costs
- Little skill needed
- Easy access to data
- Easy updating of data and maps

Cons:

- Limited analysis capacity
- Tailoring probably expensive
- Fixed contract lengths

Future scenarios

- **Standardised forest inventory methods for energywood**
- **Annual results with regular laser/radar scanning or hi-res SV images**
- **LIDAR good in estimating the total amount of biomass.**
- **Low-cost standardised WWW GIS-services adapted from other fields e.g waste management**