

MARA NORD PROJECT 2010-2011

Proposal for Nordic Recommendations

Johan Ullberg, Swedish
Transport Administration
johan.ullberg@trafikverket.se



**INTERREG
IV A NORD**



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Finnish Transport Agency



Centre for Economic Development,
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Work package 2

- To work in the same way, widen the market
- Recommendations
- Different topics



The recommendations

- Rehabilitation
- Bridge decks
- Site investigation
- Construction quality control
- Asphalt quality control



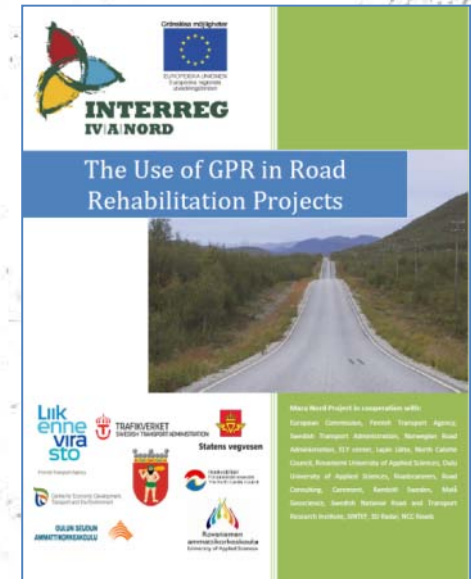
How we worked

- Roadscanners made a draft
- Sent out for comments
- Adjusted
- Finalized



The Use of GPR in Road Rehabilitation Projects

- Principles on GPR measurement
- Survey equipments
- Investigation of existing roads
 - Planning
 - Digital images
 - Reference coring
- Processing of data and interpretation
- Reporting and delivery of data



Type	Cross-line sampling	Description	Output Data	Application examples	Position accuracy	Survey speed
2D	> 75 cm	1 – 3 channels. Multiple passes with single antenna.	Single in-line profiles	Network level surveys, Rehabilitation, QC.	< 5 m	High (Traffic speed)
2D+	20 – 75 cm	> 3 channels	Coarse 3D layer model	QC, Rehabilitation.	< 1 m	High/medium
3D	< 20 cm	Multi-channel / antenna arrays	Full 3D layer model/ Low res. image	QC	< 20 cm	Medium / low
HD3D	< 10cm*)	Multi-channel / antenna arrays	High resolution image	Detection of cracks, reinforcement bars, individual boulders,	< 5 cm	Low

Recommendations for guidelines for the use of GPR in bridge deck surveys

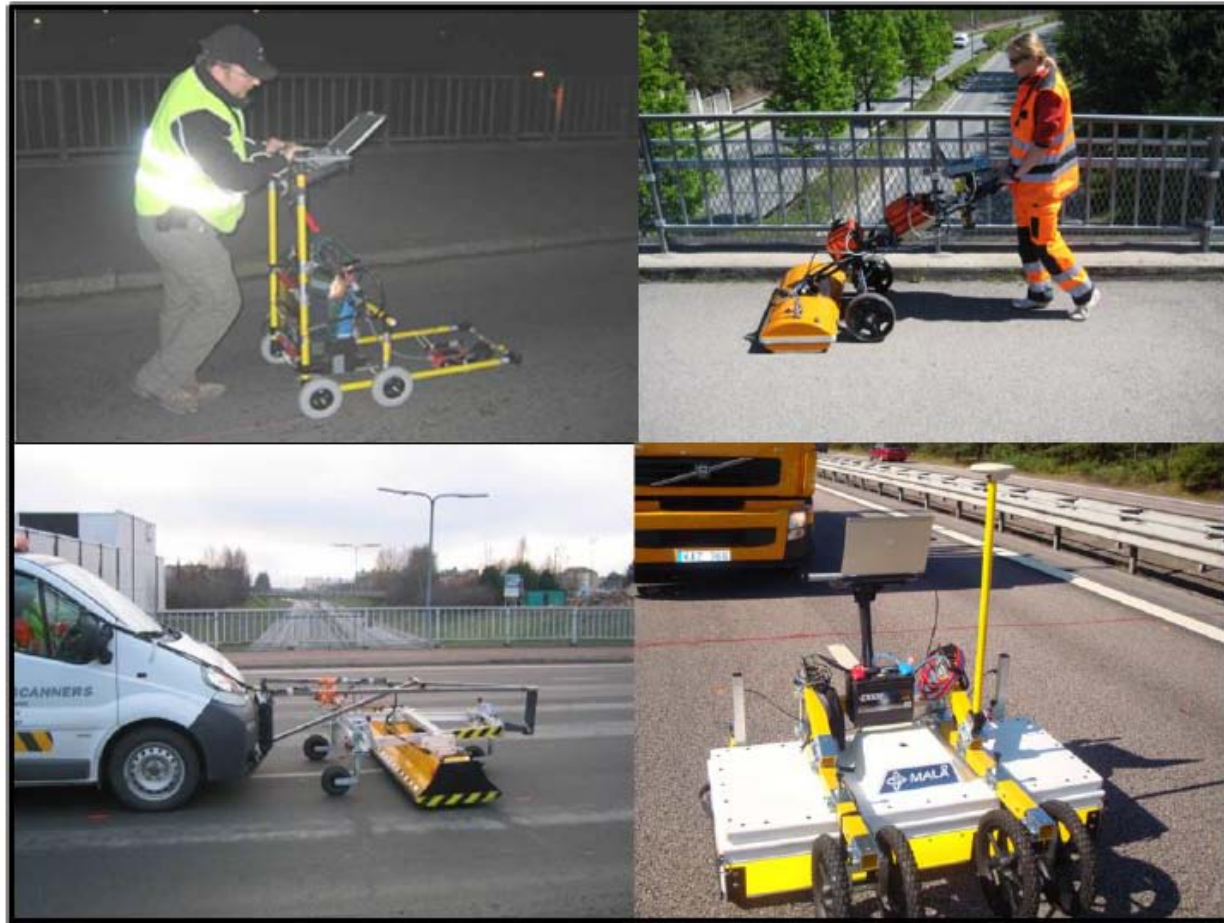


Figure 3. Different GPR systems used in bridge surveys in Nordic countries. Upper left: GSSI 1,5 GHz ground coupled system, Upper right: IDS Hi-Britt 2,0 GHz ground coupled system, Lower left.3d Radar 100 – 2,0 GHz stepped frequency system and lower right Malå MIRA 3D ground coupled system.

Bridge decks cont'd

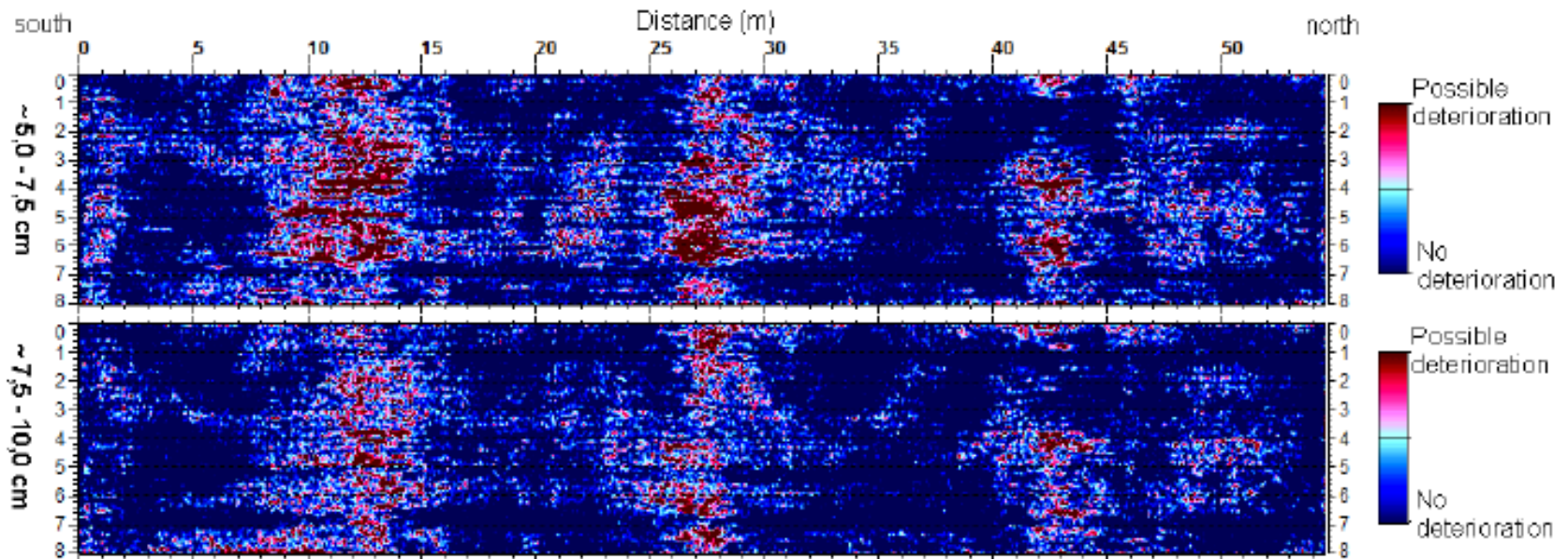


Figure 7. An example of deterioration maps calculated from two different depths in the bridge concrete deck.

Recommendations for guidelines for the use of GPR in Site investigations



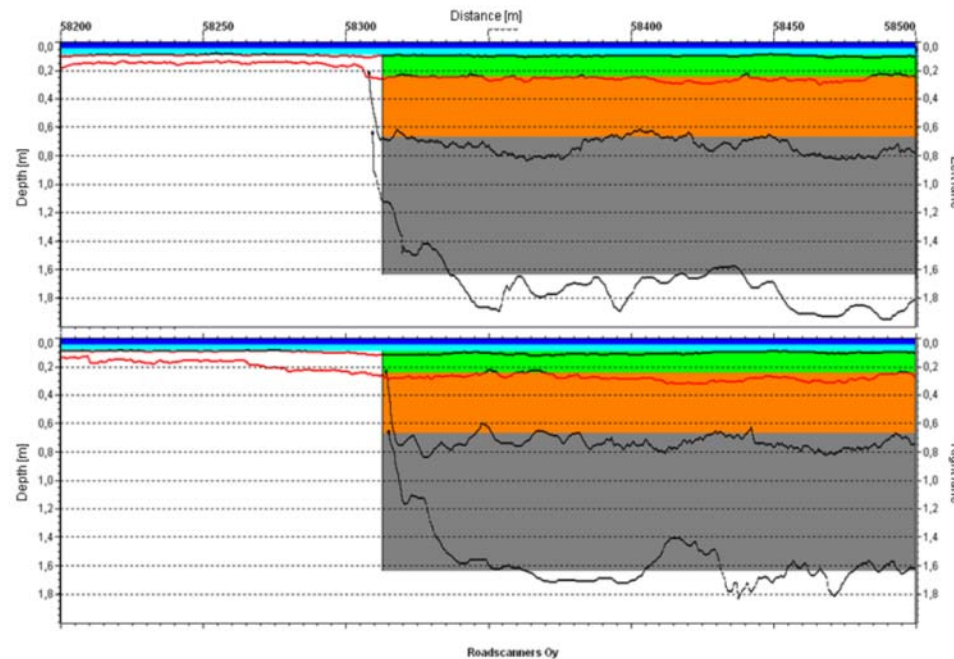
Figure 5. Typical GPR systems for site investigations

Table 2. Different ground penetrating radar antenna qualities in site investigations. The table depicts general characteristics and it must be remembered that depth penetration and resolution depends on electrical properties of subgrade and it should also be noted that the resolution of wide band antennas close to the surface is significantly higher than the antenna centre frequency would suggest.

Antenna	Central Frequency (MHz)	Depth - penetration (m)	Resolution (mm) (ϵ_r , 6)	Applications
Ground coupled antennas				
medium frequency	400 – 600	1,5 – 4,0	80 – 150	overall thickness of road structure, low embankments, subgrade soil < 3m
Low frequency	50 - 200	3 - 30	250 - 500	overall structure thickness, embankment, subgrade soil < 20 m (excl. clay and silt)
Broadband antennas (for stepped-frequency radar)	200 – 3000 [±]	1,0 – 3,0	30 - 100	overall structure thickness, subgrade soil < 3m, locating special objects like pile hats, etc

Recommendations for guidelines for the use of GPR in road construction quality

- Non-destructive testing
- The whole construction, not only spots
- "Contractor-friendly" interpretation



Road QC cont'd

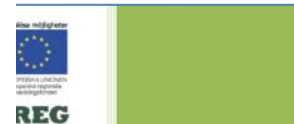
- Quality Control Survey Packages
 - Basic package I: Bound layer thickness
 - Basic package II: Top part of pavement structure
 - Basic package III: Pavement structure
 - Basic package IV: Road structure



Recommendations for guidelines for the use of GPR in asphalt air voids content

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I. Construction quality:

If the client needs to get information regarding the construction quality the following quality information can be identified / calculated from the GPR data.

- i. Asphalt air voids content
- ii. Asphalt segregation
- iii. Homogeneity of bituminous pavement
- iv. Quality of unbound base course
- v. Moisture anomalies in the structure



Conclusions

- Both for consultants and administrations
- Dealing with all antennas etc.
- Can be used "across the borders"
- May need translation

Thank you for listening

