ROADEX
Implementing Accessibility

Northern Periphery Programme
2007–2013

Innovatively investing in Europe's Northern Periphery for a sustainable and prosperous future

European Union
European Regional Development Fund

Ron Munro

THE ROADEX PROJECTS 1998-2012
Project History and Index of Reports

Project History and Index of Reports

PREFACE

The ROADEX Projects were a series of technical co-operations between a range of roads organisations across northern Europe that shared road related information and research. The collaboration started in 1998 as a 3 year pilot co-operation funded by the EU northern Periphery programme and ran for 14 years with successive projects aided by EU match funding until the funding ceased in 2012.

Over that period the collaboration grew from a simple agreement to share between four roads districts in Finland, Norway, Sweden and Scotland into an international network that spanned the whole of northern Europe encompassing Partners in Ireland, Iceland, Greenland, Scotland, Norway, Sweden and Finland.

In all the collaboration produced:

- An active website www.roadex.org
- 71 Reports
- 4 DVDs and project movies
- 37 demonstrations
- A host of seminars and workshops

This report summarises the main features of each of the four ROADEX reports and gives brief abstracts of the outputs produced. Each project is described in terms of Lead Partner, budget, steering committee members, project consultants, steering committee dates & locations, and project outputs, including an illustrated index of the reports produced.

Acknowledgements are due to too many people to list all in person at this point. The main players however in each respective task in the four ROADEX projects are listed in the chapters of this report and sincere thanks are extended to all. Apologies are given to those who have been omitted or missed. Memories dull with the passage of age and time.

An acknowledgement to the Secretariat of the Northern Periphery Programme must be an exception to this. The input and good advice of the Secretariat over the years is gratefully acknowledged here. Without their support the Project, and the Project outputs, would not be what they are. In this regard special thanks are offered to the members of the Secretariat who have guided ROADEX over the years - Niclas Forsling, Kirsti Mijnhijmer, Christopher Parker, Maxi Nachtigall and Rachel Burns

And finally all authors would like to thank the Project Steering Committees over the years for their guidance and encouragement in the work. Without their guidance ROADEX would not have happened.

Ron Munro
Project Manager, ROADEX IV project

ROADEX IV Lead Partner: The Swedish Transport Administration, Northern Region, PO Box 809, S-971 25 Luleå. Project co-ordinator: Mr. Krister Palo.

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BACKGROUND

The ROADEX Projects were a series of technical co-operations between a range of roads organisations across northern Europe that shared road related information and research.

The collaboration started in 1998 as a 3 year pilot co-operation between the districts of Finland Lapland, Troms County of Norway, the Northern Region of Sweden and The Highland Council of Scotland and was subsequently followed and extended with a second project, ROADEX II, from 2002 to 2005, a third, ROADEX III from 2006 to 2007 and a fourth, ROADEX IV from 2009 to 2012.

In order of execution, the four ROADEX projects were:

1. The ROADEX Pilot Project, 1998–2001 *"Creating an effective technical exchange & co-operation throughout the road districts of the European Northern Periphery"*	
2."ROADEX II", 2002–2005 *"Interactive and Innovative Road Management Practices for Low Traffic Volume Roads"*	
3. ROADEX III, 2006–2007 *"A Project to disseminate, transfer and use the new ROADEX knowledge across the Northern Periphery area"*	
4. ROADEX IV, "Implementing Accessibility", 2009–2012 *"The implementation of road maintenance practices developed in earlier ROADEX projects will be implemented"*	

This report gives a brief summary of the main features of each project and the outputs delivered.

All ROADEX reports are available on the ROADEX website at www.ROADEX.org.

THE ROADEX PILOT PROJECT, 1998-2001

"*Creating an effective technical exchange & co-operation throughout the road districts of the European Northern Periphery*"

First meeting of Partners: The Highland Council, Inverness, Scotland, 8-9 June 1998

Lead Partner: Lapland Region, Finnra

Budget: 541,071 EUR

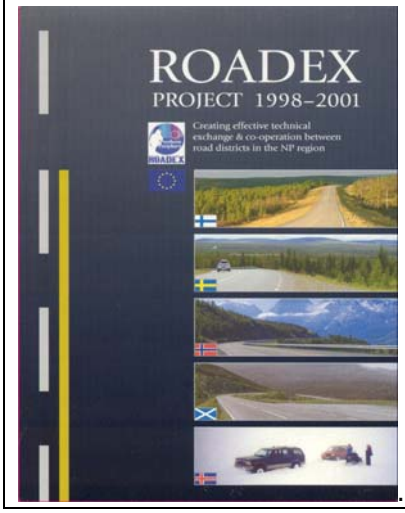
Steering Committee members:

Finland (Chairman)	Tapani Pöyry	The Finnish Road Administration, Lapland Region
Scotland	Ron Munro	The Highland Council
	Ian Ross	The Scottish Office Roads Directorate
Norway	Eilif Mathisen, Torbjørn Naimak	Norwegian Public Roads Administration
Sweden	Janeric Reyer, Åke Lindmark	Swedish National Road Administration, Northern Region
Finland	Olli Nordenswan	The Finnish Road Administration
Project Consultants:		
Task A	Timo Saarenketo	Roadscanners Oy
	Johanna Saari	Roadscanners Oy
Task B	Harald Norem	Norwegian University of Science and Technology
Graphics	Mika Pyhähuhta	Laboratorio Uleåborg Oy
Webmaster	Richard Evans	The Highland Council

Steering Committee dates & locations

Tromsø, Norway, 23 November 1998
Lahti, Finland 14 June 1999
Reykjavik, 25 January 2000
Malmo, 14 June 2000
Rovaniemi, 16.-17 June 2000
Oslo, 17.-18 September 2000
Rovaniemi, 18-19 June 2001

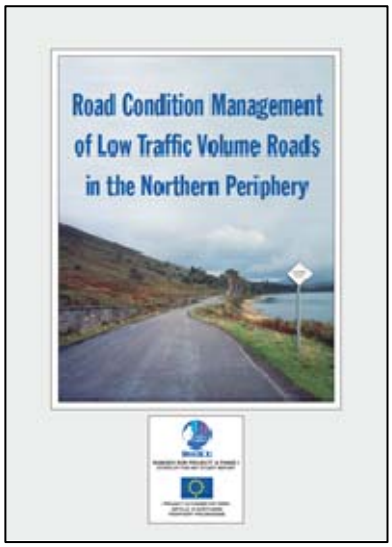
The ROADEX pilot project CD-ROM:



"Creating effective technical exchange & co-operation between road districts in the NP region", 2001.

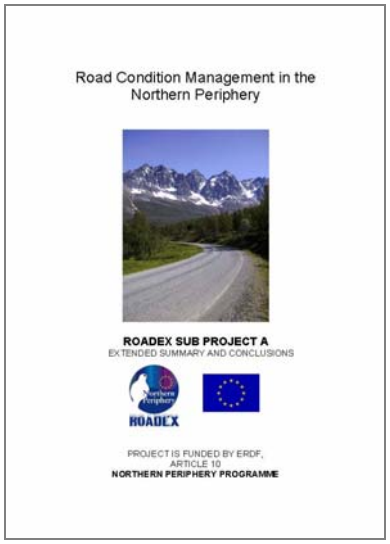
The ROADEX pilot project CD-ROM was an interactive CD that introduces the ROADEX project to new viewers. The first part summarises each of the ROADEX Partner districts by area, people and economy, environment, roads and transportation issues. The second part of the CD sets out the two tasks undertaken in the project – "Road Condition Management" and "Winter Maintenance"

ROADEX Pilot Project Reports:



"Road Condition Management of Low Traffic Volume Roads in the Northern Periphery", lead manager Timo Saarenketo, Roadscanners, 2000.

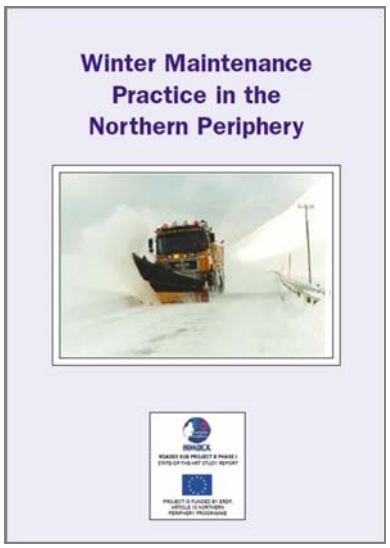
This report presents the results of a comparison study of each road district's policies and techniques in tackling road condition management. The data collection was carried out during 1999 through a large questionnaire, work group sessions, interviews and field excursions in each partner district. Besides presenting the operational conditions of the partner road districts and their practices in low traffic volume road management, the report also attempts to identify state-of-the-art practices from each partner road district. The identification of current and best practices has been worked out by individual partner districts following the guidelines established in the work group.



"Road Condition Management in the Northern Periphery – extended Summary and Conclusions", lead manager Timo Saarenketo, Roadscanners, 2001.

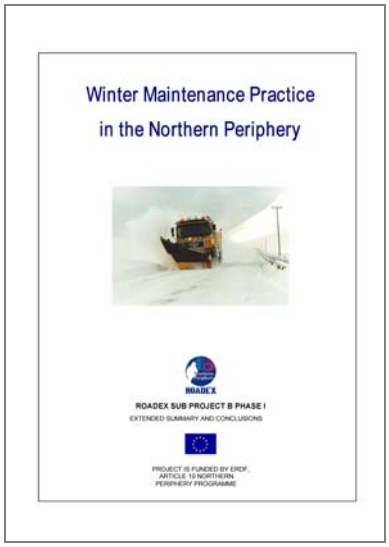
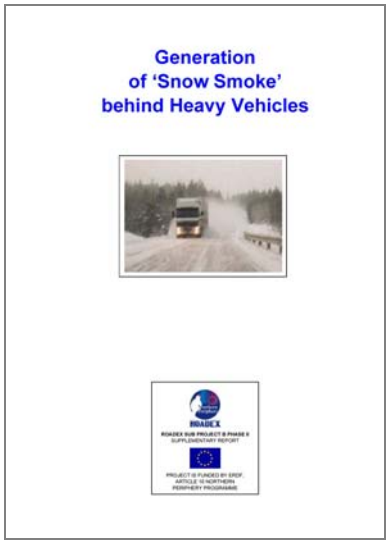
This extended summary report supplements the Road Condition Management State-of-the-Art report published in 2000 with some key results and observations made during the project based on questionnaire answers, interviews, field trips, literature reviews field tests conducted in each partner district.

Detailed results of ROADEX field tests were published in the ROADEX project CD-ROM "*Creating effective technical exchange & co-operation between road districts in the NP region*", 2001.



"Winter Maintenance Practice in the Northern Periphery", lead manager Harald Norem, Norwegian University of Science and Technology (NTNU), 2001.

This report presents the first output of Phase 1 of a task to compare winter maintenance practices across the Partner areas and is based on answers to questionnaires, interviews of supervisors, literature reviews, and field trips in the Partner districts. Five project meetings discussed the exchange of ideas, understanding of the differences in local conditions and finally defining best practices. The report gives references to written reports, and contains maps, drawings and photos to support the information presented.

	**"Winter Maintenance Practice in the Northern Periphery - extended Summary and Conclusions", lead manager Harald Norem, Norwegian University of Science and Technology (NTNU), 2001.** This extended summary report supplements the Winter Maintenance State-of-the-Art report published in 2000 with some additional key findings and observations. It condenses the main report and includes information on all topics dealt with by the project and the main conclusions. The report includes an appendix that lists other publications relating to winter maintenance in the ROADEX areas.
	**"Generation of 'Snow Smoke' behind Heavy Vehicles", lead manager Harald Norem, Norwegian University of Science and Technology (NTNU), 2001.** This report describes an experimental investigation of the spreading of 'snow smoke' around a downscaled, simplified model of a heavy vehicle. Different types of spoiler configurations are examined by means of smoke visualisation and drag measurements from a total of twelve different set-ups. The potential of spoilers as a means for visibility improvement in traffic on roads covered with water, dust or snow is illustrated. It was found that the optimal configuration for reduction of spreading of snow smoke is the combination of sideskirts, which cover most of the gap between the chassis and ground, a spoiler on the bottom rear part, and a spoiler on the top rear part of the vehicle. With this configuration, a reduction of the size of the snow cloud of approximately 50% was achieved.

THE ROADEX II PROJECT, 2002-2005

"*Interactive and Innovative Road Management Practices for Low Traffic Volume Roads*"

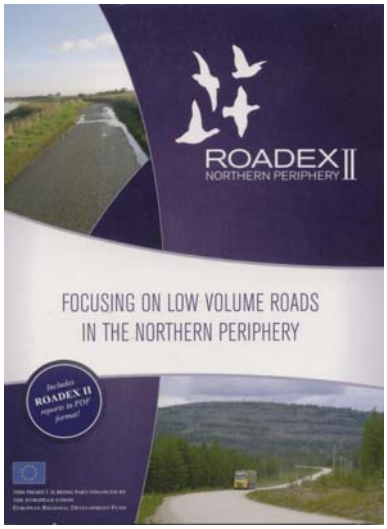
Lead Partner: The Highland Council, Scotland.
Budget: 511,250 EUR

Steering Committee members:

Scotland	Ron Munro	The Highland Council (Chairman)
International Co-ordinator	Richard Evans	The Highland Council
Project Accountant	Lorraine Scollie	The Highland Council
Norway	Eilif Mathisen	Norwegian Public Roads Administration
	Torbjørn Naimak	Norwegian Public Roads Administration
	Vidar Engmo	Norwegian Public Roads Administration
Sweden	Åke Lindmark	Swedish National Road Administration, Northern Region
Scotland	Frank MacCulloch	Forest Enterprise, Scotland
	Richard Evans	The Highland Council
	Donald MacRae	The Western Isles Council
Finland	Seppo Kosonen	The Finnish Road Administration, District of Keski-Suomi
	Hannu Keralampi	The Finnish Road Administration, District of Keski-Suomi
	Olli Nordenswan	The Finnish Road Administration, Central Administration
Project Consultant: Roadscanners Oy		
	Timo Saarenketo	Project Manager
	Johanna Saari	Project Administrator
	Mika Pyhähuhta	Graphics, Laboratorio Uleåborg Oy
Associate Partners		
	Norway	The Norwegian Road Haulage Association
	Finland	The Finnish Road Administration, Lapland District
		Metsähallitus Forestry
		Stora Enso Metsä
		Metsäliitto Osuukunta
		The Forestry Centre of Lapland

Steering Committee dates & locations
Inverness, Scotland, 5-6 April 2002
Jyväskylä, Finland, 29-30 November 2002
Finnsnes, Norway 19-20 September 2003
Jukkasjärvi, Sweden 23-25 March 2004
Tain, Scotland 29-30 October 2004

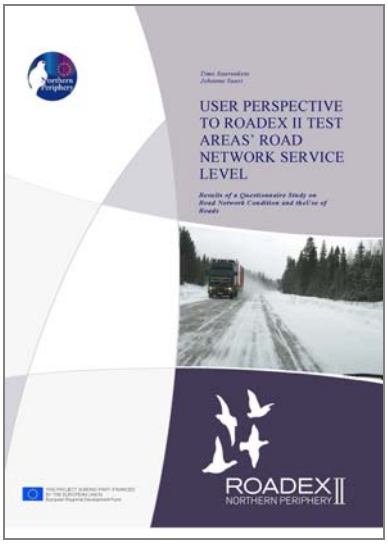
The ROADEX II Project DVD:



"Focussing on Low Volume Roads in the Northern Periphery", 2005

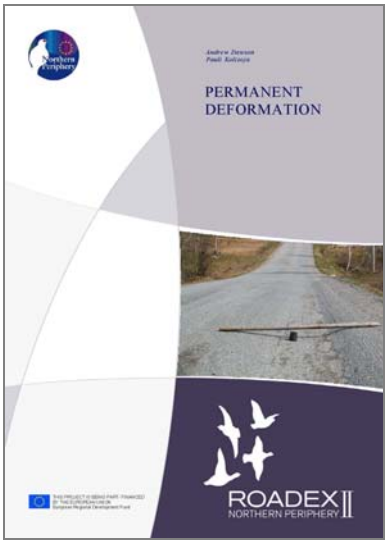
The ROADEX II Project DVD brought to life the special problems that road engineers and haulage companies face on the rural road networks of the European Northern Periphery. The movie was produced as an output for the ROADEX II project by Laboratorio Uleåborg Oy and presents the new policies and engineering techniques developed by the ROADEX II project to preserve and improve the condition of the rural low volume roads in the Partner areas. The DVD also includes the full suite of ROADEX II reports in pdf format.

ROADEX II Project Reports:



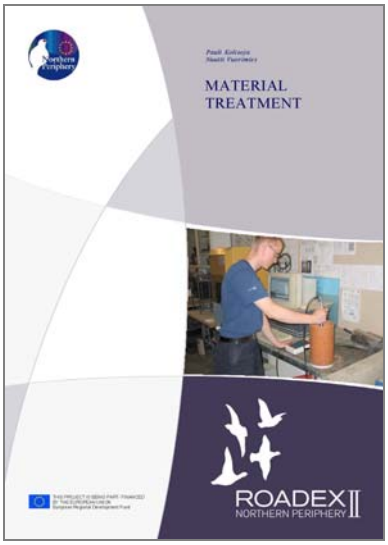
"User Perspective to ROADEX II Test Areas' Road Network Service Level" by Timo Saarenketo and Johanna Saari, Roadscanners,

This report summarises the results of a ROADEX questionnaire into respondent's transportation needs and views on the condition and management of their local road network in summer and winter. Respondents were asked to indicate problem road sections on maps of their area enclosed with the questionnaire. The test areas were Sutherland from Scotland, Island of Senja from Norway, Övertorneå-Överkalix from Sweden and Kemijärvi and Jämsä-Kuorevesi from Finland. Results showed that road users experienced similar road problems across the Northern Periphery despite differences history of the road networks and local topography,.



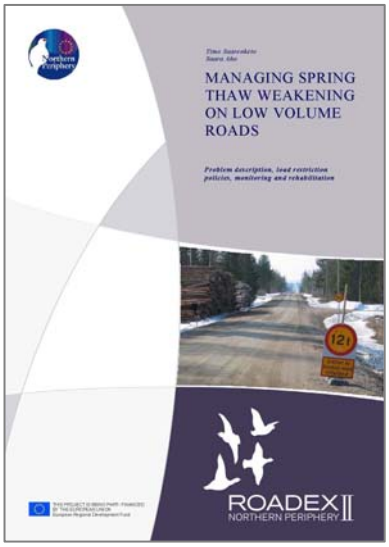
"Permanent deformation" by Andrew Dawson, Nottingham University and Pauli Kolisoja, Tampere University of Technology, 2004

This report considers the processes that cause rutting in low-volume roads and proposes improved ways of designing, assessing and maintaining them. The first part gives an explanation of why rutting is undesirable and describes the types and causes of distress seen. The second part reports on the results obtained from the programme of laboratory testing. The third part sets out a design and assessment strategy for implementation by road engineers. A method is presented which uses readily available insitu testing devices and chart-based interpretation so that both the assessment and computations can be carried out by local engineers with limited budgets.



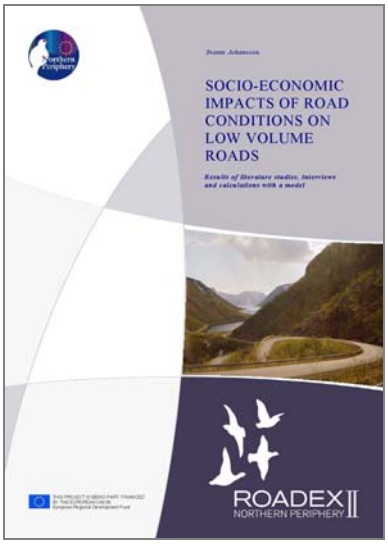
“Material Treatment” by Pauli Kolisoja, Nuutti Vuorimies, Tampere University of Technology, 2005.

This report considers methods for improving the performance of the structural layers of the low volume roads in the ROADEX area. The main emphasis is on the so called “non-traditional” treatment agents and methods that can potentially provide cost-effective alternatives to the traditional stabilisations performed using hydraulic and bituminous binding agents. The report makes a concise summary of the current knowledge concerning the types of non-traditional treatment agents available and assesses their applicability in treating the base course materials of low volume roads in the Northern Periphery area. It concludes that some of non-traditional treatment agents and methods tested have potential to become alternatives to traditional stabilisation methods.



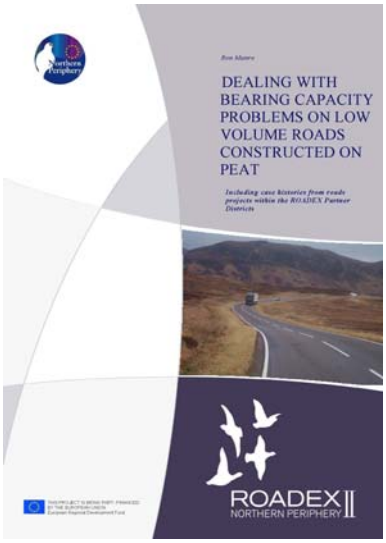
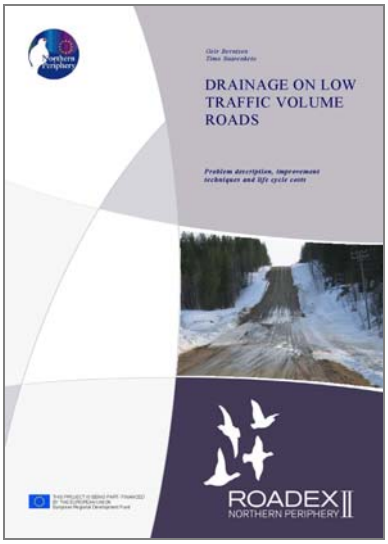
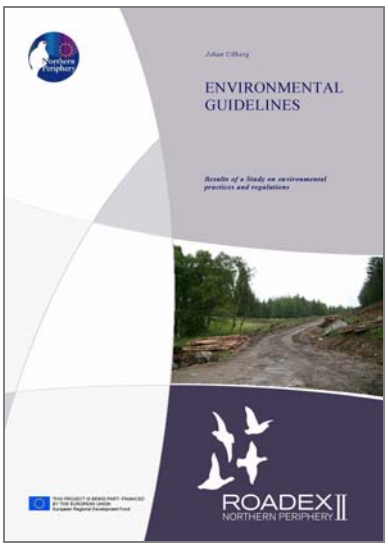
“Managing Spring Thaw Weakening on Low Volume roads” by Timo Saarenketo and Saara Aho, 2005.

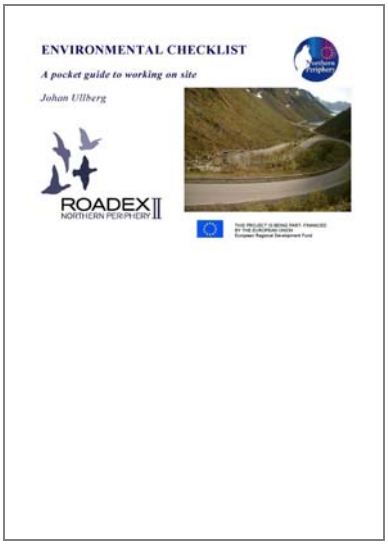
This report has six parts. The first part of the report presents the theory behind spring thaw weakening, the scope and the scale of spring thaw problems as well as the different load restriction policies used in the cold climate areas. The second part summarizes the key results from the ROADEX test sites. The third part presents a new classification for spring thaw weakening phases that can be used in monitoring and communication terminology. The fourth part presents a new classification for spring thaw weakening sites to enable the selection of an optimum strengthening method. The fifth part discusses new strengthening techniques and structures and their life cycle costs.. The sixth part offers new technologies and ideas for better spring thaw weakening management on low volume roads.



“Socio-economic impacts of road conditions on low volume roads” by Svante Johansson, Roadscanners AB, 2004.

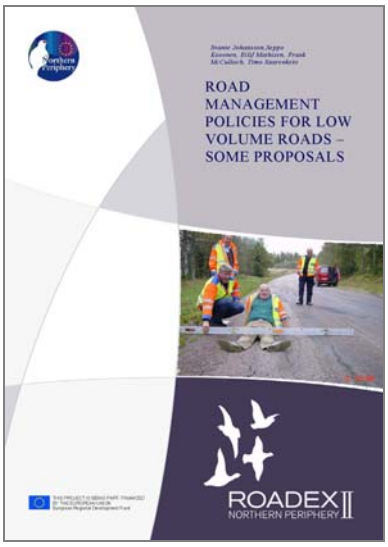
This report examines the socio-economic impacts of road conditions on low volume roads and argues that they have to be considered in the wider context when considering their importance for people, companies and societies in rural areas, dependent on them as lifelines. The present models favour high speed, high volume roads at the expense of the rural low volume road networks. These should be improved to better fit the low volume roads. It is recommended that the Scottish practice of identifying fragile areas and lifeline roads should be trialled and that lifeline roads should be treated with special care in maintenance and rehabilitation programs. A common standard for “shame levels” for road conditions in the partner countries should also be agreed.

	**"Dealing with bearing capacity problems on low volume roads constructed on peat" by Ron Munro, Highland Council, 2004.** This report presents the results of the research intoroad construction and maintenance of low volume roads on peat in the ROADEX Partner areas and gives a 'snapshot in time' of local thinking within the Northern Periphery. It gathers together existing and past practices to give as full an insight as possible into current thinking. The result of the research is a snapshot of the Partner area practices in dealing with bearing capacity problems in roads on peat that covers such topics as the classification and engineering properties of peat, local field survey methods, testing, design considerations, risk management, methods of construction supplemented by local case studies from across the Partner areas..
	**"Drainage on low traffic volume roads" by Geir Berntsen, Norwegian Public Roads Administration and Timo Saarenketo, Roadscanners, 2005.** This report focuses on the problems that inadequate drainage cause on low volume road networks in the Northern Periphery. Typical drainage problems in the area are addressed and proposals made on how to improve the problems. Many of the problems mentioned are the same across the ROADEX area except for in Scotland where there are problems caused by grass verges on the road shoulder. The report concludes that maintaining the drainage system is the single most cost effective activity on roads and must be prioritised above other maintenance activities. The first step in strengthening a road should be to make sure that the drainage system functions properly and this should be done 1-2 years before paving.
	**"Environmental guidelines" by Johan Ullberg, Swedish Road Administration, 2004.** This report presents the results of a study on environmental practices and regulations across the ROADEX Partner areas. The first part consists of an overview of how work is done in the participating countries. It gives a description of when and what level an environmental assessment must be done. All countries had a similar approach, in the general sense, but had differences due to differing national laws, climate, geology and population. The second part consists of advice and recommendations on environmentally sound practices on roadwork sites for Waste, Noise and vibrations, Dust and exhaust gases, Contaminated soil, Natural Environment and Water and Wetlands. The report concludes that sensibly organized routines and proper use of resources will lead to savings in money and resources.



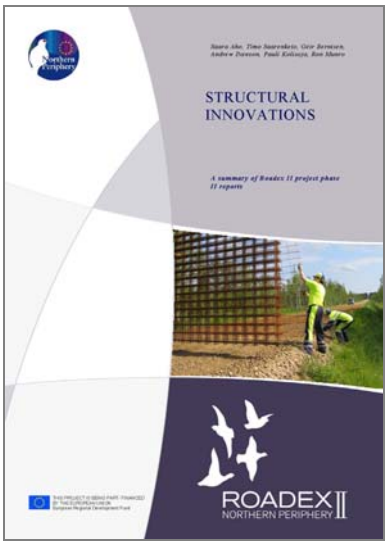
"Environmental Checklist – a pocket guide to working on site". Johan Ullberg, Swedish Road Administration, 2004.

This pocket checklist set outs a range of good practice measures on how to carry out road construction without harming the environment. It provides guidance on dealing with Waste, Noise and vibrations, Dust and exhaust gases, Contaminated soil, Natural environment, and Water. It is produced in the form of a pocket guide and is written particularly for roadwork in the Northern Periphery. Its contents are a concise summary of the measures recommended in the report "Environmental guidelines. Results of a Study on environmental practices and regulations".



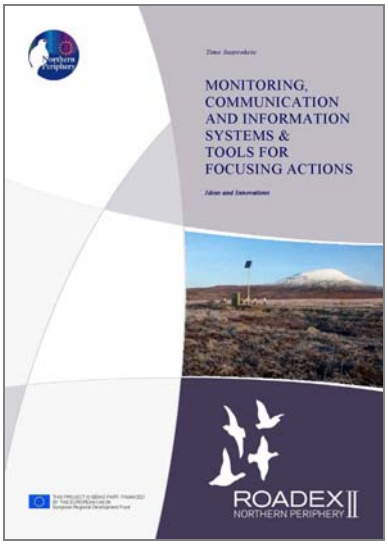
"Road management policies for low volume roads – some proposals" by Svante Johansson, Roadscanners AB, (assisted by Seppo Kosonen, Eilif Mathisen, Frank McCulloch, Timo Saarenketo)

This report sets out a step by step approach for introducing new road condition management policies for low volume roads in the Northern Periphery area. These steps are (1) any identify fragile areas in decline. These need extra care. (2) identify "lifeline roads" that are essential for the communities they serve. (3) identify the road user needs, both people and industry. (4) use these to determine the "transportation need index". (5) agree lowest acceptable road service levels and intervention trigger values for maintenance actions on each service level (6) develop procurement strategies and policies to secure the required service level. (7) follow up and refine as necessary.



"Structural Innovations – A summary of ROADEX II project phase II reports" by Saara Aho, Timo Saarenketo, Geir Berntsen, Andrew Dawson, Pauli Kolisoja, Ron Munro, 2005.

This report summarizes the new structural innovations and best practise methods developed in ROADEX II. The first part reviews the problem analyses and diagnoses that should be done when starting to improve road condition. The second part classifies typical drainage problems and suggests proposals for improving them. The third part considers the types of rutting caused by permanent deformation and offers a method description for strengthening design. The fourth part discusses treatment methods for poor road materials. The fifth part presents a new classification method for spring thaw damage sites and structural solutions for repairing them. The sixth part presents structural solutions for the construction and maintenance of roads on peat.



“Monitoring, communication and information systems & tools for focusing actions”, by Timo Saarenketo, Roadscanners, 2005.

This report summarizes the current and future monitoring and sensor technology and presents ideas for new monitoring systems that could be used in low volume road condition management in the Northern periphery area. The main advantages of these systems are that the maintenance and rehabilitation measures can be focused exactly on the correct place. The methods also allow better timing of measures as well as providing good basic information for problem diagnosis and selection of an optimum measure for each location. This work is based on a literature review and web search as well as discussions with experts in the field of road condition management, sensors technology and monitoring techniques.

THE ROADEX III PROJECT, 2006-2007

"*A Project to disseminate, transfer and use the new ROADEX knowledge across the Northern Periphery area*"

Lead Partner: The Swedish National Road Administration

Budget: 703,333 EUR application, 797,030 EUR outturn

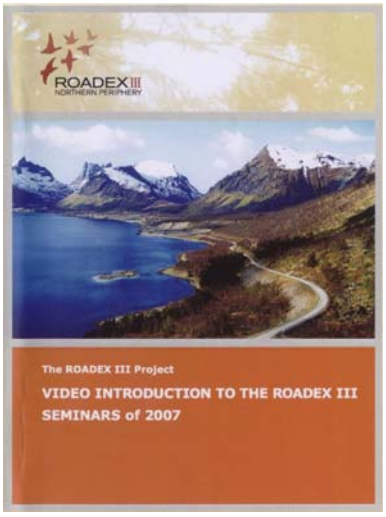
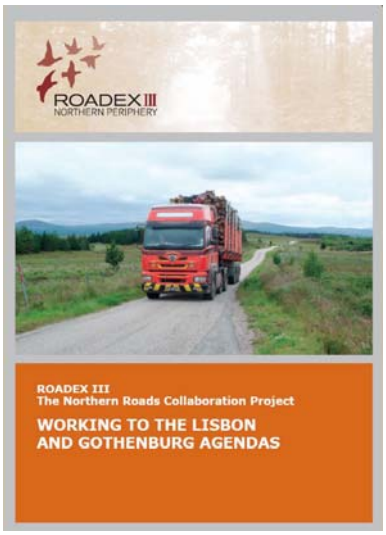
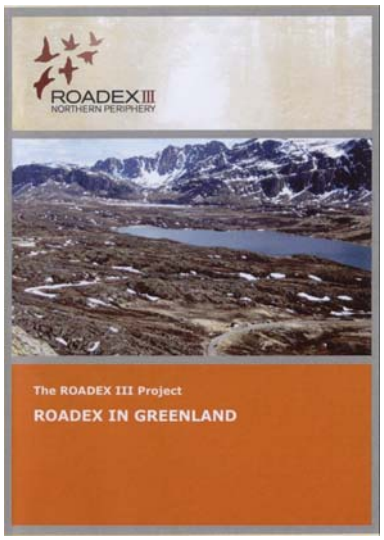
Steering Committee members:

Sweden	Per-Mats Ohberg	Swedish National Road Administration, Northern Region (Chairman)
International Co-ordinator	Krister Palo	Swedish National Road Administration, Northern Region
Project Accountant	Maria Sundin	Swedish National Road Administration, Northern Region
Norway	Vidar Engmo	Norwegian Public Roads Administration
	Irena Jonsson	Norwegian Public Roads Administration
Sweden	Johan Ullberg	Swedish National Road Administration, Northern Region
	Per Eriksson	Swedish National Road Administration, Northern Region
	Fredrik Ekedahl	Swedish Board of Forestry, Dalarna/Gävleborg
	Stefan Gunnarsson	Swedish Board of Forestry, Dalarna/Gävleborg
Scotland	Frank MacCulloch	Forest Enterprise, Scotland
	Richard Evans	The Highland Council
	Sam MacNaughton	The Highland Council
	Donald MacRae	The Western Isles Council
	Murdo Gray	The Western Isles Council
Finland	Jukka Karjalainen	The Finnish Road Administration, District of Savo-Karjala
	Pasi Patrikainen	The Finnish Road Administration, District of Savo-Karjala
Iceland	Haraldur Sigursteinsson	Icelandic Road Administration
	Daniel Arnason	Icelandic Road Administration
Greenland	Laust Lögstrup	Municipality of Sisimiut
Project Consultant: Roadscanners Oy		
	Timo Saarenketo	Main Consultant
	Ron Munro	Project Manager
	Virpi Halttu	Project Administrator
	Mika Pyhähuhta	Graphics, Laboratorio Uleåborg Oy
Associate Partners		
	Finland	The Finnish Road Administration, Lapland and Keski-Suomi Districts
	Russia	RADOR

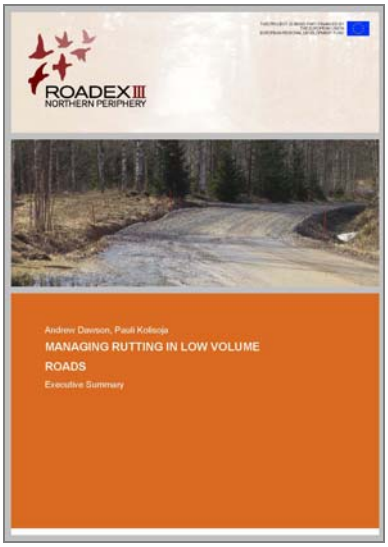
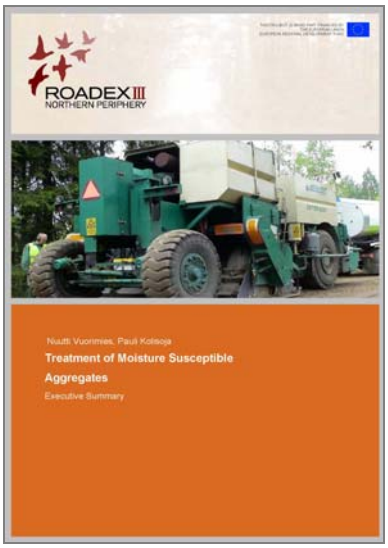
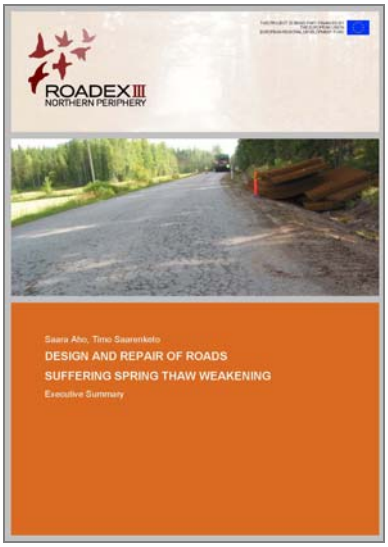
Steering Committee dates & locations

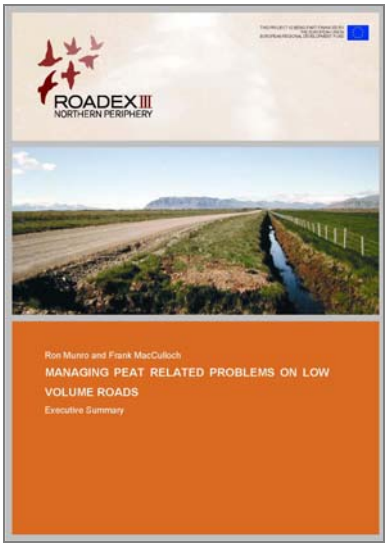
Luleå, Sweden, 10–11 February 2006,
Stornoway, Scotland, 29-30 September 2006
Kangerlussuaq and Sisimiut, Greenland, 1 – 2 March 2007
Inverness, Scotland, 7-8 November 2007

ROADEX III Project DVDs

	**"Video Introduction to the ROADEX III Seminars of 2007", 2007** The ROADEX III Project had the aim of taking the substantial body of information collected during the ROADEX projects out into the Partner areas in local language reports and seminars to have the new information used on the road networks. This 10 minute video introduction is part of that "implementation" process and was designed to introduce the ROADEX Project to seminar audiences and give a brief overview of the phases of the Project before commencing the detailed presentations of the seminar..
	**"Working to the Lisbon and Gothenburg Agendas", 2008** This video was a requested output of the ROADEX III Project. It showed how the ROADEX Project and network was actively contributing to the goals of the European Union's Lisbon and Gothenburg Agendas of transforming Europe into the world's most competitive, and largest knowledge based, economy.
	**"ROADEX in Greenland", 2007** The "ROADEX in Greenland" video gave an introduction to the particular roads problems encountered in trying to build and maintain roads in the special conditions of Greenland. It explains how the ROADEX Partnership is working together with the local engineering staff to try to overcome these problems through sharing knowledge and experience gained from the other Partner areas.

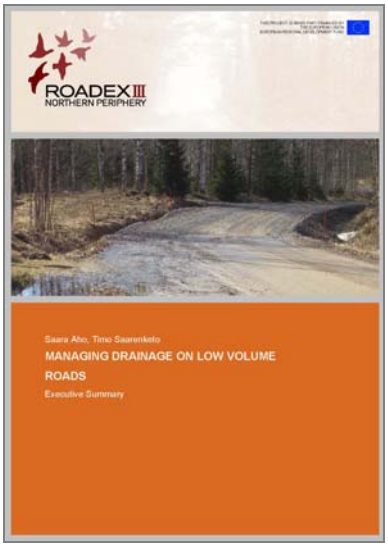
ROADEX II Executive summaries

	**"Managing Rutting in Low Volume Roads- Executive Summary" by Andrew Dawson, Nottingham University and Pauli Kolisoja, Tampere University of Technology, 2006.** This report is an executive summary of the 2005 ROADEX II report on "*Permanent Deformation*". It is a working manual that explains why rutting occurs on low volume roads, the factors that influence it, and how it may be addressed by road owners and operators so that it becomes less significant. The report also gives advice to road owners and operators on the means of overcoming rutting in newly constructed or reconstructed pavements by design and how to assess the likely future rutting in existing pavements.
	**"Treatment of Moisture Susceptible Aggregates" by Nuutti Vuorimies and Pauli Kolisoja, Tampere University of Technology, 2006.** This report is an executive summary of the 2005 ROADEX II report "*Material Treatment*" by Pauli Kolisoja and Nuutti Vuorimies of Tampere University of Technology. It is a working manual that concentrates on the testing methods and practices that should be carried out for low volume roads suffering from moisture susceptible material problems during periods of seasonal change, especially spring thaw weakening.
	**"Design and Repair of Roads Suffering Spring Thaw Weakening" by Saara Aho and Timo Saarenketo, Roadscanners, 2006.** This report is an executive summary of the 2005 ROADEX II report "*Managing Spring Thaw Weakening On Low Volume Roads - Problem Description, Load Restriction Policies, Monitoring And Rehabilitation*" by Timo Saarenketo and Saara Aho. It is a practical guide that sets out a systematic step-by-step analytical approach for the design and repair of roads suffering spring thaw weakening. A classification system for spring thaw damaged road sections is included, as well as the basic theory relating on the spring thaw weakening to give a better understanding the process behind the problems. The report also provides a short review for rehabilitation structures and their suitability for repairing different types of damages.



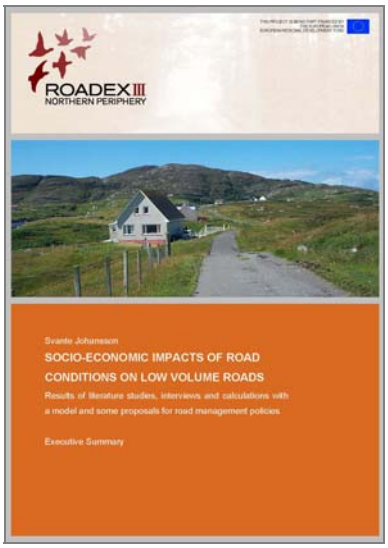
"Managing Peat Related Problems on Low Volume Roads by Ron Munro, Munroconsult Ltd, and Frank MacCulloch, Forestry Commission, 2006.

This report is an executive summary of the two ROADEX II reports "*Dealing with bearing capacity problems on low volume roads constructed on peat*" (Munro 2005) and "*Guidelines for the risk management of peat slips on the construction of low volume/low cost roads over pea*t" (MacCulloch, 2006), both of which are available on the ROADEX website. The report draws on both documents, discussing the main issues to be considered when planning rehabilitation measures for floating roads over peat and offering guidance to recognisable problems where possible. It aims to be a working manual concentrating on the main factors that have to be considered in the construction and maintenance on low volume roads on peat.



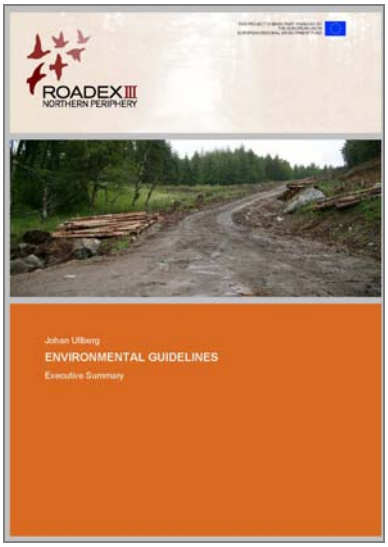
"Managing Drainage on Low Volume Roads" by Saara Aho and Timo Saarenketo, Roadscanners, 2006.

This report is an executive summary of the 2005 ROADEX II report "*Drainage on Low Traffic Volume Roads – Problem description, improvement techniques and life cycle costs*" by Geir Berntsen and Timo Saarenketo. It aims to be a working manual, concentrating on presenting the problems that inadequate drainage causes for low volume roads in the Northern Periphery area of Europe. It also discusses the monitoring methods that can be used when evaluating the drainage condition and proposes possible improvement techniques for different drainage problems. In addition, the effects of drainage on the pavement lifetime and life cycle costs of the pavement structure are studied as a part of the report.



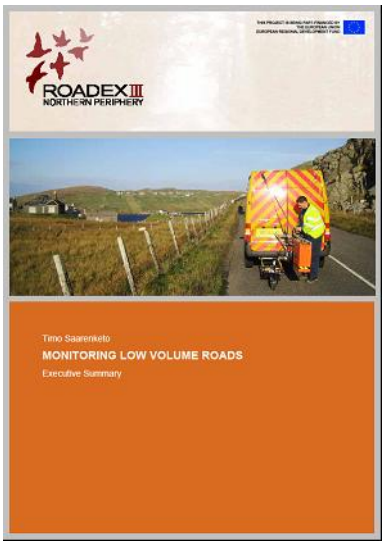
"Socio-economic Impacts of Road Conditions on Low Volume Roads" by Svante Johansson, Roadscanners AB, 2006.

This report is an executive summary of the 2005 ROADEX II reports "Socio-economic impacts of road conditions on low volume roads" by Svante Johansson and "Road management policies for low volume roads – some proposals" by Svante Johansson, Seppo Kosonen, Eilif Mathisen, Frank McCulloch and Timo Saarenketo. It aims to improve the understanding of the significance of low volume roads and road conditions for people living in the rural areas of the Northern Periphery of Europe. It also gives some draft proposals for new road management policies to upgrade the most fragile roads. Through thi sit is hoped that more resources can be allocated to low volume roads.



"Environmental Guidelines – Executive Summary" by Johan Ullberg, Swedish Road Administration, 2006.

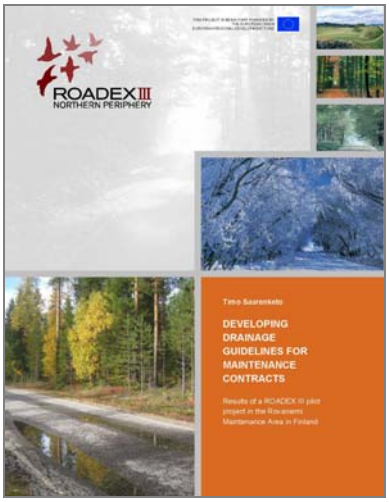
The report that follows is an executive summary of the 2005 ROADEX II report "*Environmental Guidelines - Results of a Study on Environmental Practices and Regulations*" by Johan Ullberg of the Swedish Road Administration. It aims to be a working manual, concentrating on the environmental practices that should be carried out for road works on low volume roads.



"Monitoring Low Volume Roads – Executive Summary" by Timo Saarenketo, Roadscanners, 2006.

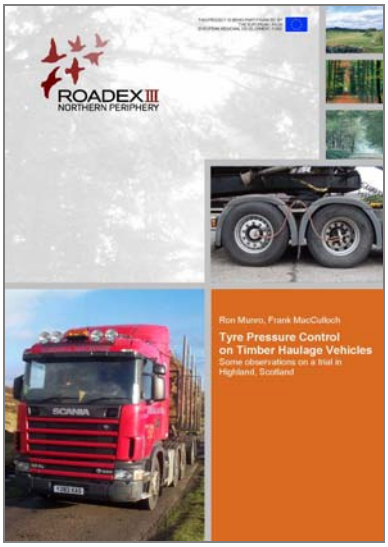
This report is an executive summary of the 2005 ROADEX II report "*Monitoring, Communication and Information Systems & Tools for Focusing Actions*" by Timo Saarenketo. It provides a general description of the main areas for monitoring road condition and summarizes current and future processes, including vehicle mounted sensor technology. The report examines the possibilities of using the new sensor technology to collect real time information on road condition, vehicle loads, traffic safety hazards etc, and then transmit the data for further processing and analysis – and, if necessary, then pass the resulting information on to local maintenance crews and road users.

ROADEX III Project Reports:



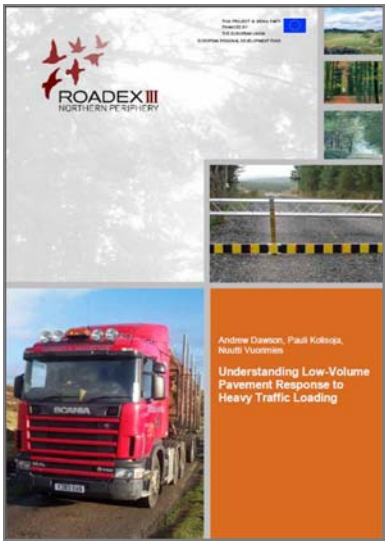
"Developing Drainage Guidelines for Maintenance Contracts" by Timo Saarenketo, Roadscanners, 2007.

This paper presents the results of a survey into drainage in the Rovaniemi maintenance area where rutting and roughness values were compared with the drainage condition. The analysis showed that rut development on main roads was 1.52 times faster in sections with the poorest drainage, and on local roads with thinner pavement structures the pavement lifetime ratio was 2.32. Poor drainage was shown to have a similar effect on roughness (IRI) values. Cost benefit calculations showed that it was possible to save 12% of the annual paving costs if the drainage was improved to a Class 1 level. The results of this analysis demonstrate the economic benefits of investments in improving drainage and maintaining it in good condition.



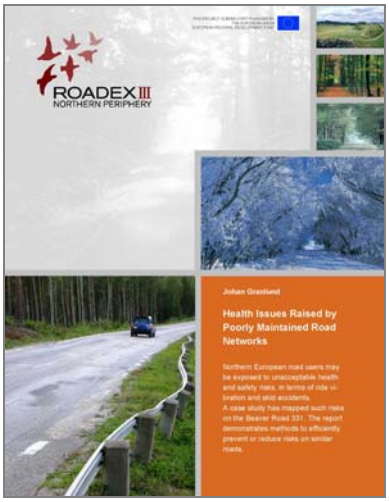
"Tyre Pressure Control on Timber Haulage Vehicles" by Ron Munro, Munroconsult Ltd, and Frank MacCulloch, Forestry Civil Engineering, 2008.

This report presents the preliminary results of a trial of tyre pressure control on a timber haulage vehicle at Kinbrace in northern Scotland from 2006 to 2007. This was the first trial of its kind in the UK and the information obtained was expected to have a considerable effect on hauling in the Scottish timber harvesting industry over the coming years. This report gives a general introduction to tyre pressure control systems, the background to the commissioning of the Highland trial, and the conduct and results of the trial. It concludes with a discussion on the performance obtained from the perspective of the vehicle owner, operator and driver rather than that of the road owner with some possible ways forward.



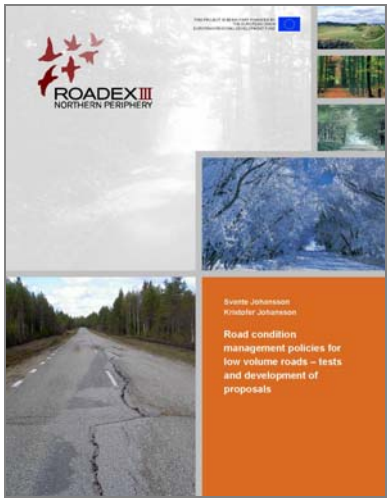
"Understanding Low Volume Pavement Response to Heavy Traffic Loading" by Andrew Dawson, Nottingham University, and Pauli Kolisoja and Nuutti Vuorimies, Tampere University of Technology, 2008.

This report summarizes the continuing work performed at the University of Nottingham and at the Tampere University of Technology into the causes and development of rutting in low volume roads, and the ROADEX method of designing low volume pavements against rutting. The report describes the use of the method in more detail than earlier reports and sets out a practical method of designing pavements against rutting. The work was carried out in close collaboration with the ROADEX task on "*Tyre Pressure Control on Timber Haulage Vehicles*" the results of which are presented in a separate report



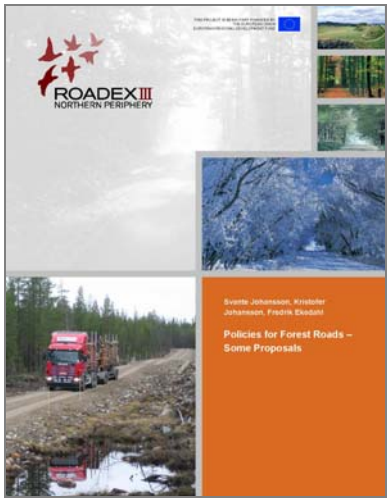
"Health Issues Raised by Poorly Maintained Road Networks" by Johan Granlund, Swedish Road Administration, 2008.

This report sets out to increase the understanding of road user's health risks when travelling on roads in poor condition. The report commences with generic descriptions of how safety and health can be affected by ride vibration, how truck suspension systems isolate and amplify vibration at various frequencies, and how pavement properties, such as cross slope, control the important forces at work. A case study is reported from the Beaver Road 331 in northern Sweden. A heavy timber logging truck was instrumented to measure ride vibration and direction. It was found that the driver's daily exposure to Whole-Body Vibration and bumps was unacceptably high, and over internationally recognised limits for health and safety.



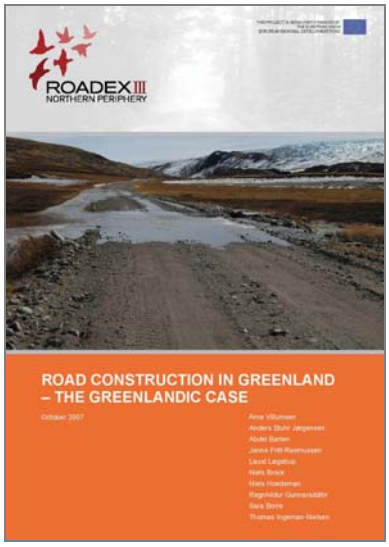
"Road Condition Management Policies, Tests and Development of Proposal" by Svante Johansson and Kristofer Johansson, Roadscanners AB, 2007.

This report describes a series of trials of the ROADEX socio-economic model in the Partner geographical areas of Finland, Highlands, the Western Isles and Sweden to see how the new Transportation Need Index could work in practice. The results show that the identification and mapping of fragile areas, lifeline roads and transportation needs for people and business is an effective way of showing rural road user needs. Combining fragility, lifeline class and accessibility needs for people and business to a Transportation Need Index, and using the information to set service levels, will give a better ranking for low volume roads.



"Policies for Forest Roads - Some Proposals" by Svante Johansson and Kristofer Johansson, Roadscanners AB, Fredrik Ekedahl, Swedish Forest Agency, 2007.

This report describes a simple method for forest road condition surveys using a pocket PC programmed for the purpose with GPS included. A number of typical road defect types are described and shown on photos in an enclosed defect catalogue and on the PC screen. The survey data is delivered to a data base server and from there data can be acquired and visualized in a computer using e g the software Road Doctor. The results can be shown on different types of GIS maps as classified defects in different colours. The report also describes a classification system for forest roads based on practicability and accessibility, and some proposals for road standard levels.



"ROADEX III Case Study in Greenland" by Arne Villumsen and members of the Arctic Technology Centre, Sisimiut, 2007.

This report sets out to summarise the issues concerning road construction in Greenland. The first section discusses the geology, nature and climate of Greenland, including precipitation, permafrost and vegetation. The second section considers the ROADEX reports and their applicability to Greenland. The third section deals with the existing roads in towns and villages in Greenland, and their road networks. The fourth section focusses on the proposed Sisimiut-Kangerlussuaq road and its likely engineering issues, such as the environmental and conservation aspects, the route proposal, geology and availability of road-building materials, drainage and the seismic studies proposed. The report concludes that their involvement with ROADEX had provided a good basis for the exchange of ideas and experience.

THE ROADEX IV PROJECT, 2009–2012

"*Implementing ROADEX technologies across the Partner areas*"

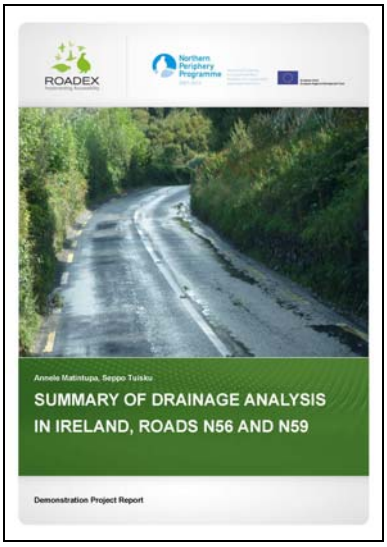
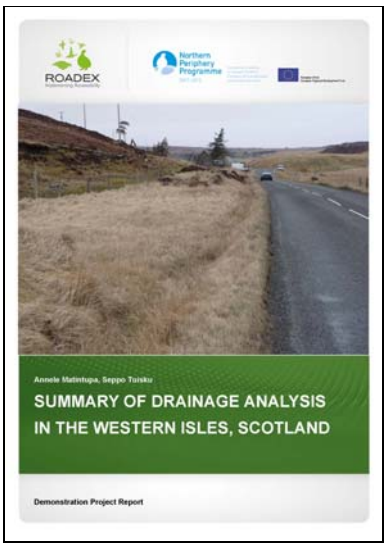
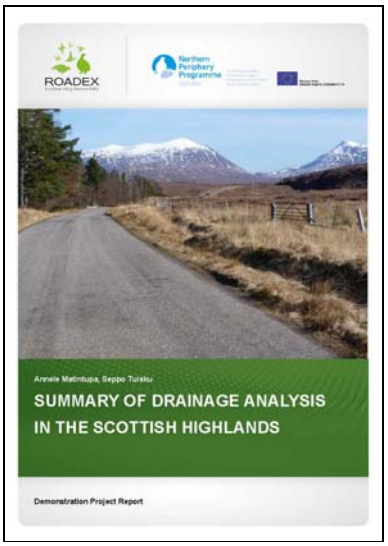
Lead Partner: The Swedish National Road Administration
Budget: 2,163,473 EUR

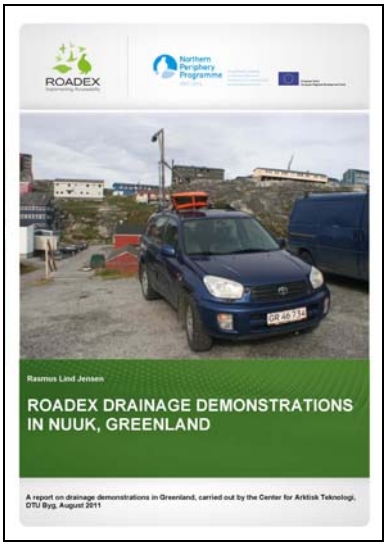
Steering Committee members:

Sweden	Per-Mats Öhberg	Swedish Transport Administration, Northern Region (Chairman)
International Co-ordinator	Krister Palo	Swedish Transport Administration, Northern Region
Project Accountant	Maria Sundin	Swedish Transport Administration, Northern Region
Norway	Vidar Engmo	Norwegian Public Roads Administration
	Per Otto Aursand	Norwegian Public Roads Administration
Sweden	Johan Ullberg	Swedish National Road Administration, Northern Region
	Per Christoffersson	Swedish Forest Agency
Scotland	Frank MacCulloch	Forest Enterprise, Scotland
	Richard Evans	The Highland Council
	Donald MacRae	The Western Isles Council
Finland	Ari Kilponen	Centre for Economic Development, Transport and the Environment, Lapland
Iceland	Haraldur Sigursteinsson	Icelandic Road Administration
	Daniel Arnason	Icelandic Road Administration
Ireland	John McCarthy	Department of Transport
	Tom Casey	National Roads Authority
	Dominic Mullaney	Department of Transport
Greenland	Ruben Svendsen	Government of Greenland
Project Consultant: Roadscanners Oy		
	Timo Saarenketo	Main Consultant
	Ron Munro	Project Manager
	Hanne Sarajärvi	Project Administrator
	Mika Pyhähuhta	Graphics, Laboratorio Uleåborg Oy
Associate Partners		
	Canada	FERIC
	Ireland	Coillte Teoranata

Steering Committee dates & locations
Luleå, Sweden, 5–6 November 2009
Westport, Ireland, 6-7 May 2010 (cancelled due to the Eykjafjallajökull eruption)
Copenhagen, Denmark, 16-17 June 2010
Westport, Ireland, 1–2 November 2010
Reykjavik, Iceland, 12–13 May 2011
Bodø, Norway, 13–15 October 2011
Inverness, Scotland, 21 & 23 May 2012

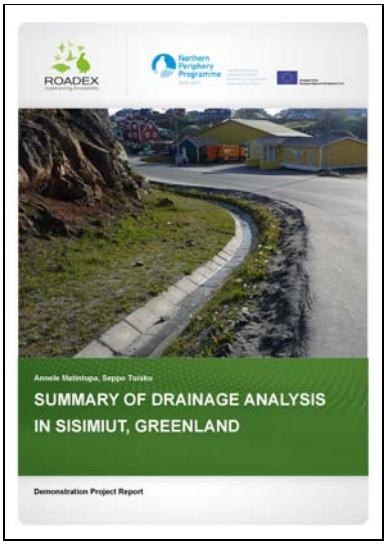
ROADEX IV Project Demonstration reports:

	**"Summary of Drainage Analysis in Ireland, Roads N56 And N59" by Annele Matintupa and Seppo Tuisku, Roadscanners, 2012.** Demonstrations of the ROADEX drainage analysis were carried out on roads N56 and N59 in Ireland. The total length of the roads analysed was approximately 438km. The demonstrations showed that, compared to Nordic countries, Ireland has different drainage features, such as grass verges and a lack of traditional open ditches. These make the improvement of drainage more difficult. In renewed road sections however the existing drainage works well and usually open ditches have been provided. It was found that the poorer the drainage or verge class, the bigger the IRI and rut depth values. Rut depths were found to be almost two times higher in road sections with drainage Class 3 than in road sections with drainage Class 1.
	**"Summary of Drainage Analysis in the Western Isles, Scotland" by Annele Matintupa and Seppo Tuisku, Roadscanners, 2012.** Demonstrations of the ROADEX drainage analysis in Western Isles were carried out on selected sections of three of the main roads in Lewis and Harris and one secondary road (a section of the B8011). The total length of the roads analysed was approximately 88km. A laser scanner was also for the first time in drainage analysis to test if the data collected could provide useful. The tests showed that the data could be very useful in drainage evaluation. The demonstrations showed that, compared to Nordic countries, the Western Isles had a number of different drainage features, such as grass verges and in some cases a lack of traditional open ditches. These features make the improvement of drainage more difficult on established roads.
	**"Summary of Drainage Analysis in the Scottish Highlands" by Annele Matintupa and Seppo Tuisku, Roadscanners, 2012.** This report describes the results of a series of drainage analysis surveys in the Lochalsh and Wester Ross area of Scotland. The total length of the roads analysed was approximately 127km. Typical drainage problems in the test area included high grass verges and road sections constructed on side sloping ground. Well performing sections were noted on sections where the drainage had been improved and the road condition was flawless.



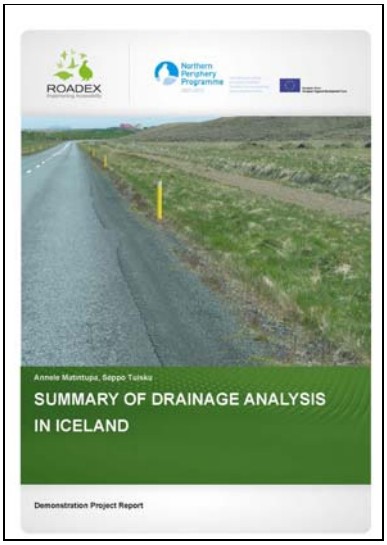
"ROADEX Drainage Demonstrations in Nuuk, Greenland" by Rasmus Lind Jensen, The Danmarks Tekniske Universitetet (DTU) Arctic Technology Centre (ARTEK), 2011.

This report describes the results of the ROADEX drainage demonstration project in the Nuuk are of Greenland. The project was a supplementary project to the initial ROADEX demonstration project in Sisimiut and was carried out by staff and students of the The Danmarks Tekniske Universitetet (DTU) Arctic Technology Centre (ARTEK). Overall the surveyed drainage sections proved to be in relatively good condition. Mainly the problems were related to a side sloping street profile and/or clogged access road culverts. Other specific reasons for poor drainage were also detected. The data collected by the laser scanner was useful for detecting the depth and form of the ditches, and changes in road cross sections.



"Summary of Drainage Analysis in Sisimiut, Greenland" by Annele Matintupa and Seppo Tuisku, Roadscanners, 2012.

The Sisimiut demonstration project was the first project to use the ROADEX drainage analysis solely in an urban area. In addition to visual evaluations a laser scanner was also used. Overall the surveyed drainage sections proved to be in moderate condition. Mainly the problems were related to a side sloping street profile and/or clogged access road culverts. Other specific reasons for poor drainage were also detected. The data collected by the laser scanner was useful for detecting the depth and form of the ditches, and changes in road cross sections. The report concludes with recommendations on road sections that should receive immediate maintenance attention and sections that will need attention eventually.

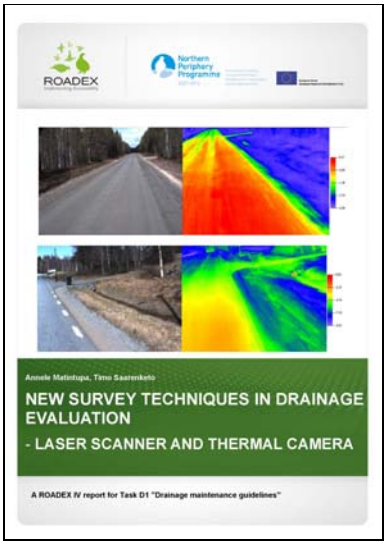


"Summary of Drainage Analysis in Iceland" by Annele Matintupa and Seppo Tuisku, Roadscanners, 2012.

Demonstrations of the ROADEX drainage analysis in Iceland were carried out on several paved roads selected by Icelandic Road Administration. The total length of the roads analysed was approximately 175 kilometres. The drainage analysis revealed that the drainage condition on the surveyed roads was clearly better than the other ROADEX countries surveyed. The main reason for this was the terrain which is quite different in Iceland than in other ROADEX areas. The terrain in Iceland is quite dry and a large part of the surveyed chainage was on even ground. The majority of the roads surveyed were constructed on embankments, while in other ROADEX countries the greatest proportion has been located on side sloping ground.

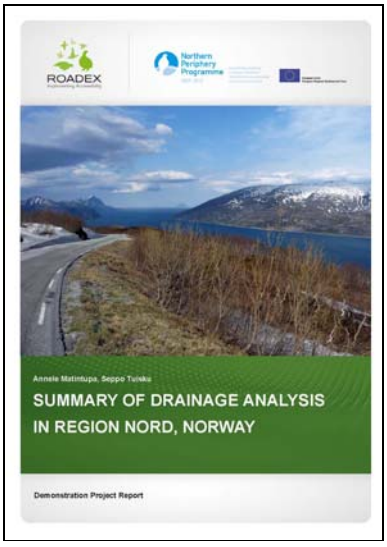
"Summary of Drainage Analysis in the Umeå Area, Sweden" by Annele Matintupa and Seppo Tuisku, Roadscanners, 2012.

This report describes the results of a ROADEX drainage analysis in the Umeå Södra maintenance area in 2010, together with some results of tests of new tools to improve the analysis. Tests were also carried out to identify the effects of the timing of surveys on results. Comparisons were made on the results of the springtime inventory and the late fall inventory. These tests were made on seven selected roads. The tests showed that the drainage analysis could be performed satisfactorily in autumn. In addition to the above work, the project also aimed to find tools to improve the surveys of outlet ditches. It was found that a third camera, aimed at an 90° angle from the road towards the side, proved to be an excellent tool for checking the condition of outlet ditches.



"New Survey Techniques in Drainage Evaluation, Laser Scanner and Thermal Camera" by Annele Matintupa and Seppo Tuisku, Roadscanners, 2012.

This report describes trials of the new survey techniques of digital thermal camera and laser scanner in drainage analysis surveys in late spring 2010 by Roadscanners Oy. The surveys were carried out on selected roads in Umeå Södra maintenance area in Sweden in conjunction with routine drainage analysis being carried out in the area. The results obtained during the tests showed that thermal camera imaging could prove to be a very effective tool for detecting access road culverts and their condition. Culverts that were impossible to see in digital videos were found to be relatively easy to find in thermal camera images. The report concludes that laser scanner measurements should be included in drainage analysis in the future



"Summary of Drainage Analysis in Region Nord, Norway by Annele Matintupa and Seppo Tuisku, Roadscanners, 2012."

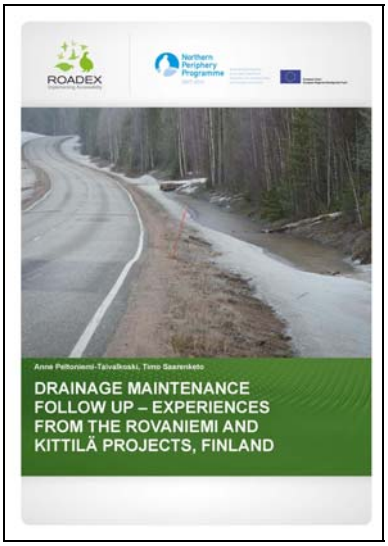
Demonstrations of the ROADEX drainage analysis in northern part of Norway were carried out on selected sections of four paved roads and on two gravel roads. The total length of the roads analysed was approximately 185 kilometres. Significant variations in elevation were present within the sections and these had a great effect on the local drainage circumstances. In general the project showed that the ROADEX drainage analysis can be applied to the road network in Norway. Laser scanner data was also collected during the drainage surveys to enable the depth of the ditches to be calculated for some selected sections. These tests showed that laser scanner data can be very useful in drainage evaluation.

"Monitoring of the Special Drainage Maintenance Sections in the Rovaniemi area" by Anne Peltoniemi-Taivalkoski and Timo Saarenketo, Roadscanners, 2011.

This report presents the main results of a drainage maintenance contract in the Rovaniemi area in 2011. The aim of the work was to monitor the performance of the drainage contractor and at the same time evaluate the impact of the measures of road condition. 29,766 m of special maintenance works were identified in 2010- The report also considers the most commonly used ROADEX project ideas on how to cure poor drainage condition, the design of solutions, treatment processes, and the key issues raised within the contract.

"Monitoring of the Special Drainage Maintenance Sections in the Kittilä area" by Anne Peltoniemi-Taivalkoski and Timo Saarenketo, Roadscanners, 2011.

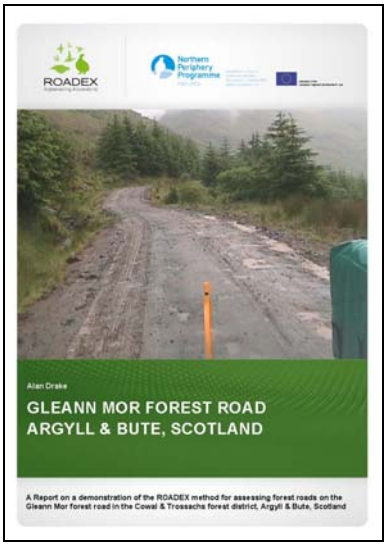
This report presents the main results of a drainage maintenance contract in the Kittilä area in 2011. The aim of the work was to monitor the performance of the drainage contractor and at the same time evaluate the impact of the measures of road condition. 29,766 m of special maintenance works were identified in 2010- The report also considers the most commonly used ROADEX project ideas on how to cure poor drainage condition, the design of solutions, treatment processes, and the key issues raised within the contract.



"Drainage Maintenance Follow Up – Experiences from the Rovaniemi and Kittilä Projects, Finland" by Anne Peltoniemi-Taivalkoski and Timo Saarenketo, Roadscanners, 2012

This report summarises the follow up monitoring work carried out on the Rovaniemi and Kittilä drainage demonstration projects in spring 2010 and 2011. The results showed that improving the drainage had been successful in 75 – 79 % of the special drainage maintenance class sections in the Rovaniemi maintenance area and in 20 – 40 % of the sections in the Kittilä area. This was considered to be an excellent result as follow up sections had been the most critical sections for the condition of the roads. It was recommended that the analyses and follow up techniques should be further developed for the future.

	**"Stynie Wood Demonstration Project, Mosstodloch, Scotland" by Nuutti Vuorimies, Heikki Luomala and Pauli Kolisoja, Tampere University of Technology, and Ron Munro, Munroconsult Ltd, 2012** This report gives a summary of a local demonstration of the benefits of the use of tyre pressure control (TPC) on timber haulage vehicles on forest roads in northern Scotland. The work included a GPR survey, installation of instrumentation, testing using two timber haulage vehicles, interpretation and assessment of the measured data, and some conclusions.
	**"Niinisalo and Ivalo Traction Demonstrations Projects, Finland" by Nuutti Vuorimies, Heikki Luomala and Pauli Kolisoja, Tampere University of Technology, 2012.** This report records two demonstrations of the benefits of the use of tyre pressure control (TPC) on timber haulage vehicles on a slippery surface and snowy hillside in Finland. The work includes traction testing of a timber haulage vehicle with load cell measurement at Pohjois Satakunta's test driving track in Niinisalo, (Kankaanpää) and on a snowy hill test at Nokian Tyres testing centre in Ivalo. The reports summarises the interpretation and assessment of the measured data, and some conclusions.
	**Rehabilitation of the Timmerleden Forest Road - Condition survey, design proposals, construction and quality control" by Per Christoffersson, Skogsstyrelsen, and Svante Johansson, Roadscanners AB, 2012,** This report gives a summary of a local demonstration of ROADEX methods for assessing forest roads for heavy timber traffic and based on the results making a rehabilitation design proposal. The report also gives a short description of the construction of the rehabilitation and the quality control. The results demonstrate that making a more careful road condition investigation and an analytical road rehabilitation design based on the road condition analyses, can reduce the overall rehabilitation costs and the environmental impacts significantly. The demonstration project has shown that the use of the ROADEX method in this case reduced the costs between 15 and 50 %.



"**Gleann Mor forest road, Argyll & Bute, Scotland" by Alan Drake, Forestry Commission, 2012.**

This report gives a summary of a local demonstration of ROADEX methods for assessing forest roads for heavy timber traffic. The work was carried out by the road condition survey team of the Forestry Commission's Civil Engineering Central Services on the Gleann Mor forest road in Cowal & Trossachs Forest District, Argyll & Bute, Scotland over the period June 2009 to June 2010. The assessment was carried out as part of the preparation for an upgrading and strengthening of the road and informed the specification for the planned rehabilitation. The paper discusses the methods of survey involved, the interpretation of the collected data, the development of assessment methods and the presentation of the resulting information to managers.

"Glenfiddich forest road, Moray, Scotland" by Alan Drake, Forestry Commission, 2012.

This report gives a summary of a local demonstration of ROADEX methods for assessing forest roads for heavy timber traffic. The work was carried out by the road condition survey team of the Forestry Commission's Civil Engineering Central Services on the Glen Fiddich forest road in the Moray & Aberdeenshire Forest District, Moray, Scotland in October 2010. The assessment was carried out as part of the preparation for an upgrading and strengthening of the road and informed the specification for the planned rehabilitation. The paper discusses the methods of survey involved, the interpretation of the collected data, the development of assessment methods and the presentation of the resulting information to managers.

"Road 16583 Ehikki-Juokslahti I, Demonstration of a possible drainage solution for an eroding sideslope and ditch" by Iikka Hyvönen, Nuutti Vuorimies and Pauli Kolisoja, Tampere University of Technology, 2012.

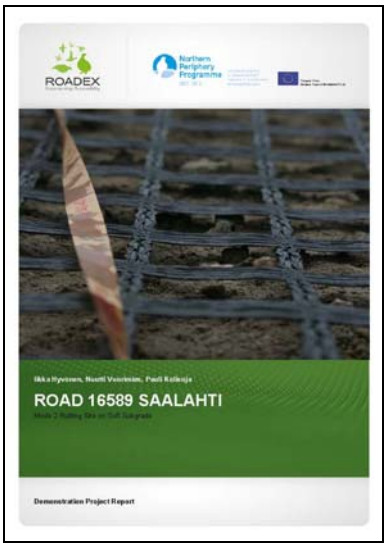
This report describes a ROADEX demonstration exercise carried out on a low volume road section of Road 16583 from Ehikki-Juokslahti in Jämsä, Central Finland. The work comprised a drainage improvement of a low volume road site suffering from spring time bearing capacity problems. The rehabilitation structure consisted of a geotextile and layer of coarse grained aggregate installed into a cleaned and prepared roadside ditch. Now, after experiencing the first spring thaw, the improved drainage system has been found to be in excellent condition. In addition, there were no spots on the road that had significant spring time bearing capacity loss, unlike the situation before.

“Road 16583 Ehikki-Juokslahti II, Demonstration of a possible drainage solution for a sloping and rocky terrain” by Iikka Hyvönen, Nuutti Vuorimies and Pauli Kolisoja, Tampere University of Technology, 2012.

This report describes a ROADEX demonstration exercise carried out on a low volume road section of Road 16583 Ehikki-Juokslahti in Jämsä, Central Finland. The demonstration consisted of a drainage improvement using an innovative ROADEX solution. This comprised a combination of a French drain and an outer slope protection structure consisting of a geotextile and a layer of coarse grained aggregate. A year later, following the first spring thaw, the improved drainage system has been found to be in very good condition and, as a result, no areas of spring time bearing capacity loss have been observed on the road.

“Road 16583 Ehikki-Juokslahti III, Mode 2 rutting site on peat” by Iikka Hyvönen, Nuutti Vuorimies and Pauli Kolisoja, Tampere University of Technology, 2012.

This report describes a ROADEX demonstration exercise carried out on a low volume road section of Road 16583 from Ehikki to Juokslahti in Jämsä, Central Finland. The section was located on a peat subgrade and was reinforced with a geogrid. The road had been deforming and widening significantly over the section mainly due to clogged side ditches, a low outlet ditch, and settlement of the road structure into the peat subgrade. After the first year of service, it only can be concluded that both the test structure and the reference structure have been performing equally well, and that the road is still in very good condition. Further monitoring of the settlement tubes installed in four cross sections of the road will reveal any differences in the future.

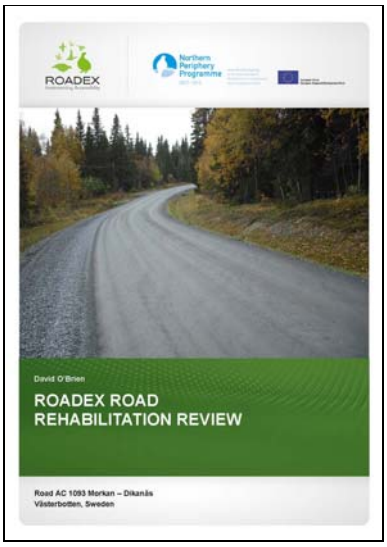


“Road 16589 Saalahti, Mode 2 rutting site on a soft subgrade” by Iikka Hyvönen, Nuutti Vuorimies and Pauli Kolisoja, Tampere University of Technology, 2012.

This report describes a ROADEX demonstration exercise carried out on a low volume road section of Road 16589 Saalahti in Jämsä, Central Finland. A geogrid reinforcement was used in the demonstration to retard the development of permanent deformations of a gravel road section located on a silty subgrade. The reinforced structure consisted of two subsections in addition to which there was a reference section. After one year of service it only can be concluded that both of the test structures and the reference structure have been performing equally well, and that the road is still in very good condition. Further monitoring of the settlement tubes installed in six cross sections of the road will reveal any differences in the future.

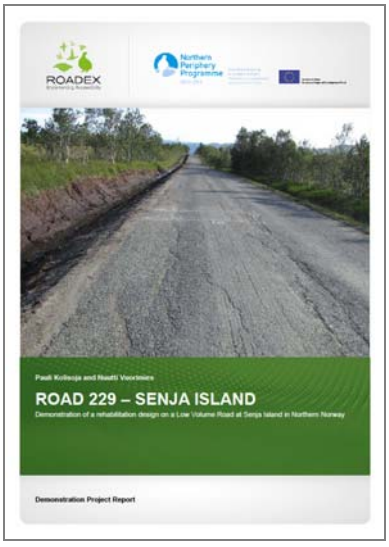
"Road 16681 Humalamäki, coarsening the base/sub-base course layers using only local stones" by Iikka Hyvönen, Nuutti Vuorimies and Pauli Kolisoja, Tampere University of Technology, 2012.

This report describes an innovative rehabilitation method carried out on a low volume road section of Road 16681 Humalamäki in Jyväskylä, Central Finland. The method is not especially designed to improve a road suffering from rutting. Rather the aim is to carry out an overall improvement of the road. The method consists of coarsening the base/sub-base course layers using local stone from the road and its surroundings, and improving the drainage. In the case of the Humalamäki road described in the report, the depth of base course layer was observed to be about 0.10 metre deeper following the rehabilitation.



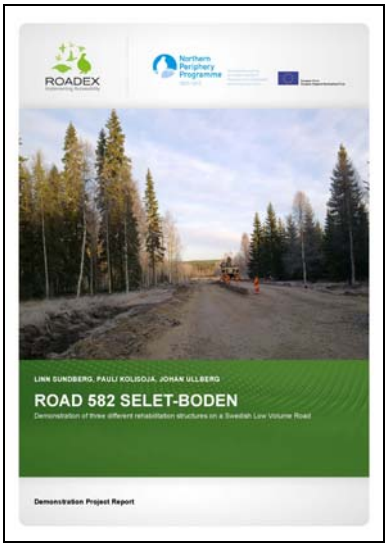
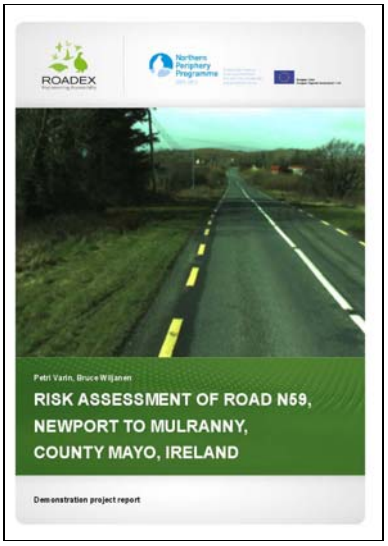
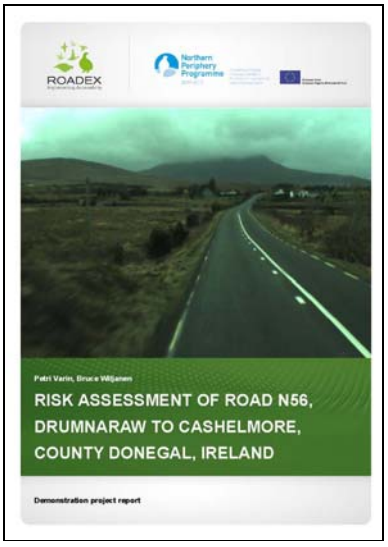
"ROADEX Road Rehabilitation Review of Road AC 1093 Morkan – Dikanäs, Västerbotten, Sweden" by David O'Brien, Trafiverket, 2010.

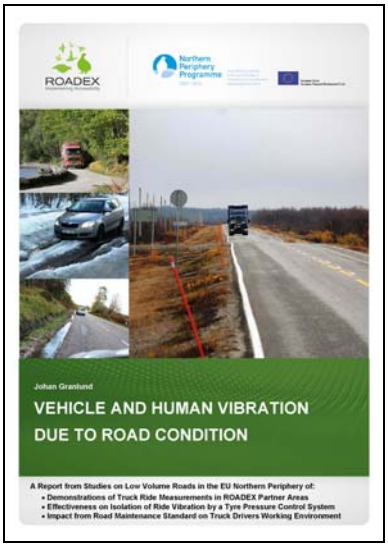
This report documents a series of rehabilitation works that were carried out on road AC 1093 Morkan – Dikanäs during the summer of 2009 as part of pilot trials of the design method contained in the ROADEX report "Managing rutting in low volume roads". The road was re-examined in October 2010 to see how successful each of the rehabilitation methods used were with over a year of the original traffic loading. The report gives a brief introduction into the techniques used in the rehabilitation works and the results seen on the road at that date.



"Road 229 Senja Island, Demonstration of the rehabilitation design on a Low Volume Road at Senja Island in Northern Norway" by Pauli Kolisoja and Nuutti Vuorimies, Tampere University of Technology, 2012.

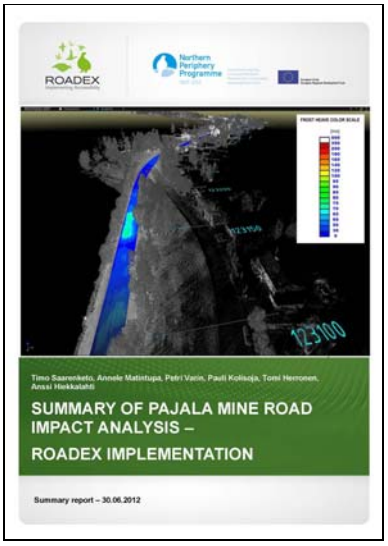
This report describes the rehabilitation design of two ROADEX demonstration sites on Road 229, a low volume road at Senja Island near to the town of Troms in Northern Norway. Both of the demonstrations sites are located on soft subgrade area consisting of a layer of peat that is underlain by clay and silt type of subgrade soils. An extensive series of laboratory tests was conducted at the Tampere University of Technology on the materials from both sites and rehabilitation measures were recommended.

	**"Road 582 Selet-Boden, Sweden" by Linn Sundberg of Luleå University of Technology, Pauli Kolisoja of Tampere University of Technology and Johan Ullberg of Trafikverket, 2012.** This report describes three ROADEX demonstration exercises carried out on Road 582 from Selet to Boden, a low volume road north-west of Luleå in Northern Sweden. The total length of rehabilitation of the road suffering from various types of distresses was about 17 km. Three demonstration sections, each of approximately 80 metres long, were selected for closer follow up. Section 1 comprised an addition of 300mm of new base and sub-base layers, Section 2 involved a partial addition and partial mass replacement of base and sub-base course with a total thickness of 500 mm, and Section 3 was similar to Section 1 except that a steel net reinforcement was also installed in the new layers.
	**"Risk Assessment of Road N59, Newport to Mulranny, County Mayo, Ireland" by Petri Varin and Bruce Wiljanen, Roadscanners, 2011.** This report was the interim report on the risk assessment surveys on the N59 road from Newport to Mulranny section carried out by Roadscanners Oy in March 2011. The goal of the exercise was to demonstrate the ROADEX risk analysis techniques on Irish roads. The measurements were performed in cooperation with PMS Pavement Management Services Ltd, which provided the measurement vehicle and driver as well as performing the Falling Weight Deflectometer (FWD) measurements. The exercise was commissioned by the Department of Transport and the National Roads Authority and organised by ROADEX.
	**"Risk Assessment of Road N56, Drumnaraw to Cashelmore, County Donegal, Ireland" by Petri Varin and Bruce Wiljanen, Roadscanners, 2011.** This report was the interim report on the risk assessment surveys on the N56 Drumnaraw to Cashelmore section carried out by Roadscanners Oy in March 2011. The goal of the exercise was to demonstrate the ROADEX risk analysis techniques on Irish roads. The measurements were performed in cooperation with PMS Pavement Management Services Ltd, which provided the measurement vehicle and driver as well as performing the Falling Weight Deflectometer (FWD) measurements. The exercise was commissioned by the Department of Transport and the National Roads Authority and organised by ROADEX.



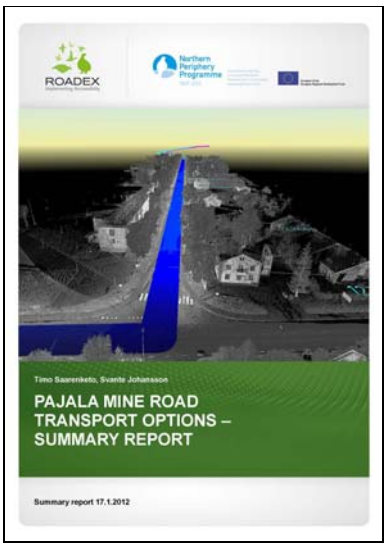
"Vehicle and Human Vibration due to Road Condition" by Johan Granlund, Vectura Consulting AB, 2012

A report summarising a programme of studies on low volume roads in the EU Northern Periphery to research vehicle and human vibration incurred by road condition. The work includes summaries of ROADEX demonstrations of truck ride measurements in Finland, Norway, Scotland and Sweden, the effectiveness of tyre pressure control systems on isolation of ride vibration, and the impact of road maintenance standards on truck drivers working environment. The report is a joint publication of Demonstration Task D6 "The Analysis of Health Problems due to Vehicle Vibration" and Research Task RE3 "Differences in Vehicle and Human Vibration due to Road Maintenance Standard"



"Summary of Pajala Mine Road Impact Analysis – ROADEX Implementation" by Timo Saarenketo, Annele Matintupa, Petri Varin, Pauli Kolisoja, Tomi Herronen, Anssi Hiekkalahti

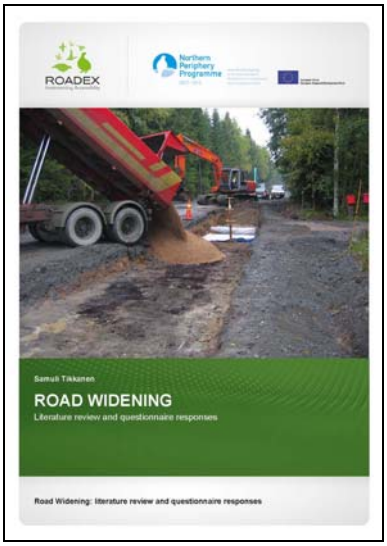
This summary report summarizes the surveys and research carried out on the Kaunisvaara to Svappavaa road in 2011 for a proposal to open a new iron ore mine and annually haul five million tonnes of mined ore along the route. The report sets out the information on the existing road structures in three dimensions (3D), and gives remaining lifetime predictions for road sections once the haulage starts. The report discusses new design structures and cost estimates for road strengthening that should be carried out before transportation starts.



"Pajala Mine Road Transport Options – Summary Report" by Timo Saarenketo and Svante Johansson, Roadscanners, 2012.

This summary report summarizes the analyses carried out for the road transport options on the Kaunisvaara – Svappavaara road and is combination of the ROADEX "Pajala Road Impact Analysis" report and 3 unpublished reports in Swedish:

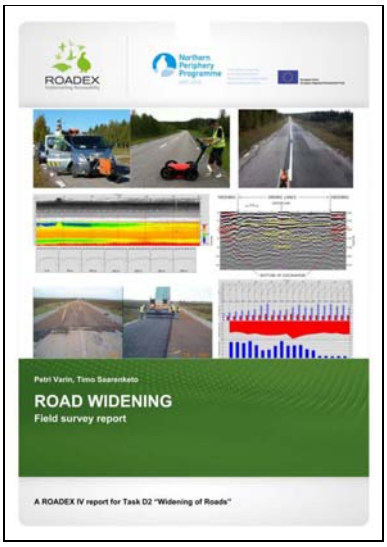
- "Vägbroar på sträckan mellan gruvan och Svappavaaram – Utredning av broarnas kapacitet att klara kommande transporter" by Anders Stenlund, Trafikverket, Luleå
- "Buller – malmtransporter Kaunisvaara- Svappavaara" by Gunbritt Mariedahl, Trafikverket, Luleå
- "Optimering av lastbilskonfigurationer for gruvtransporter i Pajala – Trafikekonomiska övervägande" by Jouko Säisä, Vectura



“Road Widening - Literature review and questionnaire responses” by Samuli Tikkanen, Roadscanners, 2010.

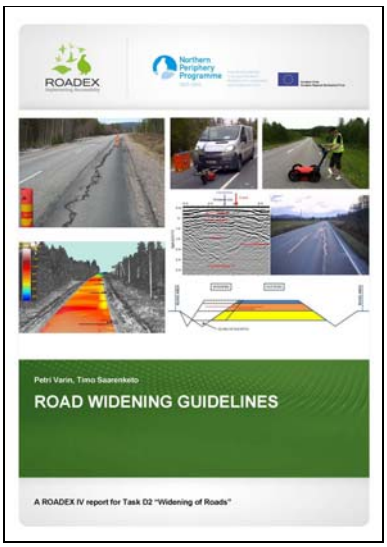
This report was the first output of the ROADEX research project on road widening. It consists of three parts:

- The first part considers the national road widening guidelines of the ROADEX countries. These are reviewed and compared with each other.
- The second part reviews test roads and research reports. For this, a road widening questionnaire was produced and circulated to experts in the Partner countries to get their knowledge of local practices in road widening.
- The third part deals with the questionnaire responses.



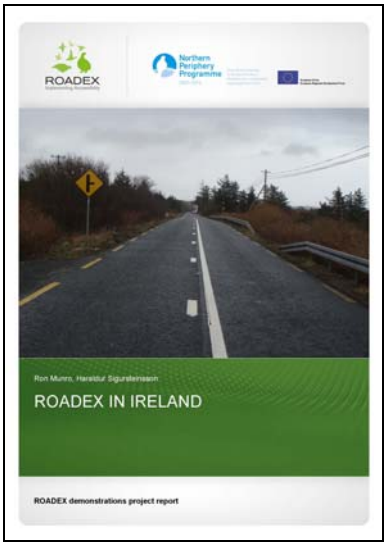
“Road Widening - Field Survey Report” by Petri Varin and Timo Saarenketo, Roadscanners, 2012.

This report was the second output of the ROADEX research project on road widening. It highlights the findings and results of the field surveys on the widening test sites in the ROADEX countries. The main goal of the surveys was to provide more information on road widening, that could be used as a basis for writing the ROADEX road widening guidelines. Surveys were carried out in Finland, Sweden, Norway and Scotland. A range of widened roads were surveyed using multiple technologies such as ground penetrating radar, video, laser scanners, thermal analysis and falling weight deflectometer. Some of the sites of the first pilot ROADEX project (1998 – 2001) were visited again as a part of this work.



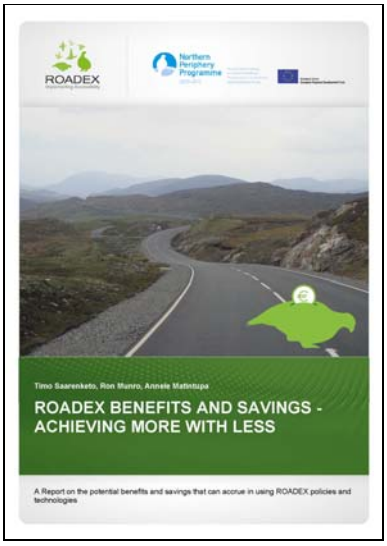
“Road Widening Guidelines” by Petri Varin and Timo Saarenketo, Roadscanners Oy, 2012.

This report was the third and final output of the ROADEX research project on road widening. It sets out the recommended ROADEX guidelines for the road widening of low volume roads. It combines the good practices identified from across the various Partner countries into one package. The main purpose of the report is to act as a practical ‘pocket book’, to be used alongside the national guidelines, on what to keep in mind in road widening projects and in repairing widened roads with structural problems.



“ROADEX in Ireland” by Ron Munro, Munroconsult Ltd, and Haraldur Sigursteinsson, Icelandic Road Administration, 2012.

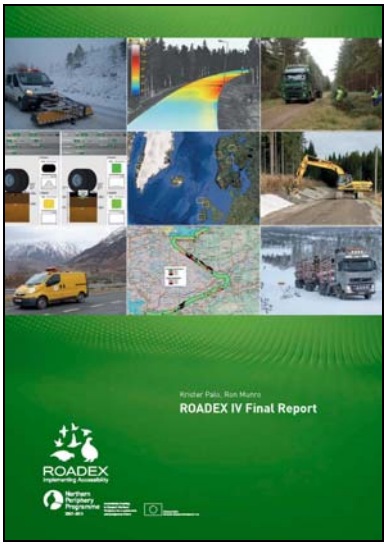
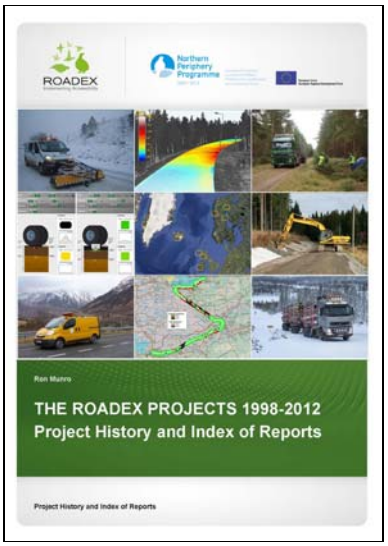
This report was a summary report of demonstrations in Ireland. Ireland was a new Partner to ROADEX and requested demonstrations of the ROADEX methods for drainage analysis and road construction over peat. Two road sections were selected for the drainage demonstrations: 156km of the N56 from Donegal town to Letterkenny and 297km of the N59 from Sligo town to Galway city, and two sections were selected for peat risk assessment: 10km of the N56 from Drumnaraw to Cashelmore in County Donegal and 15km of the N59 from Newport to Mulranny in County Mayo. The report also documents the Derrydonnel forest road assessment demonstration in Kilcornan Forest, Galway.



“ROADEX BENEFITS AND SAVINGS - achieving more with less” by Timo Saarenketo and Annele Matintupa, Roadscanners Oy, and Ron Munro, Munroconsult Ltd, 2012.

This report summarised the benefits and savings that can be achieved in using the ROADEX policies and technologies, including example case studies calculations. The report concludes by recommending four examples of ROADEX best practices: drainage, diagnostics based focused road strengthening, road friendly vehicles, and managing seasonal change.

Additional Non-Project Reports:

	**"ROADEX IV Final Report" by Krister Palo, Swedish Road Administration, and Ron Munro, Munroconsult Ltd, 2012.** This report was prepared as an illustrated final report as part of the final documentation for the ROADEX IV project for the Secretariat of the Northern Periphery Programme. The report is a light, non-technical summary of the ROADEX IV project and outputs that can be used as an easy-to-read introduction to the project for non-engineers.
	**"THE ROADEX PROJECTS 1998-2012, Project History and Index of Reports" by Ron Munro, Munroconsult Ltd, 2012.** This report was a summary of the main features of four ROADEX reports from 1998 to 2012 and gives brief abstracts of the various outputs produced along the way. Each project is described in terms of Lead Partner, budget, steering committee members, project consultants, steering committee dates & locations, and project outputs, including an illustrated index of the reports produced.

ROADEX
Implementing Accessibility

ROADEX PROJECT REPORTS (1998–2012)

This report is one of a suite of reports and case studies on the management of low volume roads produced by the ROADEX project over the period 1998-2012. These reports cover a wide range of topics as below.

- Climate change adaptation
- Cost savings and benefits accruing to ROADEX technologies
- Dealing with bearing capacity problems on low volume roads constructed on peat
- Design and repair of roads suffering from spring thaw weakening
- Drainage guidelines
- Environmental guidelines & checklist
- Forest road policies
- Generation of 'snow smoke' behind heavy vehicles
- Health issues raised by poorly maintained road networks
- Managing drainage on low volume roads
- Managing peat related problems on low volume roads
- Managing permanent deformation in low volume roads
- Managing spring thaw weakening on low volume roads
- Monitoring low volume roads
- New survey techniques in drainage evaluation
- Permanent deformation, from theory to practice
- Risk analyses on low volume roads
- Road condition management of low volume roads
- Road friendly vehicles & tyre pressure control
- Road widening guidelines
- Socio-economic impacts of road conditions on low volume roads
- Structural innovations for low volume roads
- Treatment of moisture susceptible materials
- Tyre pressure control on timber haulage vehicles
- Understanding low volume pavement response to heavy traffic loading
- User perspectives on the road service level in ROADEX areas
- Vehicle and human vibration due to road condition
- Winter maintenance practice in the Northern Periphery

All of these reports, and others, are available for download free of charge from the ROADEX website at www.ROADEX.org.

TRAFIKVERKET · Forestry Commission Scotland · NAALAKKERSUISUT Government of Greenland · Centre for Economic Development, Transport and the Environment · ROADSCANNERS · The Highland Council Comhairle na Gaidhealtachd Serving The Highland Community · Department of Transport An Roinn Iompair · VEGAGERÐIN · Northern Periphery Programme 2007–2013 Innovatively investing in Europe's Northern Periphery for a sustainable and prosperous future · European Union European Regional Development Fund · NRA An tÚdarás um Bóithre Náisiúnta National Roads Authority · SKOGSSTYRELSEN Swedish Forest Agency · Statens vegvesen