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ENVIRONMENTAL GUIDELINES

Results of a Study on environmental practices and regulations

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ENVIRONMENTAL GUIDELINES

RESULTS OF A STUDY ON ENVIRONMENTAL PRACTICES AND REGULATIONS

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Swedish Road Administration

PREFACE

This is the final report of the Phase 2:7 study of the Roadex II project, a technical transnational cooperation project between the Highland Council, the Western Isles Council, and Forest Enterprise from Scotland; the Northern Region (formerly Troms District) of the Norwegian Public Roads Administration and the Norwegian Road Haulage Association; the Northern Region of the Swedish Road Administration; and from Finland the Regions of Central Finland and Lapland of the Finnish Road Administration, as well as Metsähallitus Region of Eastern Lapland, the Forestry Centre of Lapland (Lapin Metsäkeskus), Stora Enso Metsä, and Metsäliitto, Procurement Area of Northern Finland. The Roadex project is partly financed by the Interreg IIIB Northern Periphery Programme. The lead partner in the project is the Highland Council from Scotland and project consultant is Roadscanners Oy from Finland. Roadex II project Chairman is Ron Munro from the Highland Council and project manager is Timo Saarenketo from Roadscanners.

The report, and the accompanying leaflet, was designated from an idea from Timo Saarenketo and Ron Munro of the Roadex II Road Condition Working Team, and Frank McCullough of the Forest Enterprise.

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Johan Ullberg of the Swedish Road Administration, Northern Region, wrote the report.

Finally the author would like to acknowledge the Roadex II Steering Committee for its encouragement and valuable guidance in this work

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CONTENTS

ABSTRACT

The goal for the Roadex II Phase 2:7 was to produce a guide to working environmentally as correct as possible on a road site. The idea was to produce a leaflet, pocket size, with advice and recommendations. Such a leaflet cannot, if it is meant for use, be very extensive. Thus this report gives a deeper view of the topics.

The first part of this report consists of an overview of how work is done in the participating countries. It gives a description of when and what level, in such cases, an environmental assessment must be done. The result was that all countries have a similar approach, at least in a general way. In the details there are differences due to basic laws, climate, geology and population.

As environmental assessments and protected nature areas are interconnected, a summary of the different levels of protection in the countries has been done. The highest level is Nature Reserves in Finland, which normally have restricted entry. In Norway, Scotland and Sweden the highest level is National parks. Sweden, Scotland and Finland also have Natura 2000 sites with a high level of protection. As this is a European Union network, Norway is not a part.

It may be difficult to meet all the requirements in every situation. However, assessments must also be made here from economic, social and other perspectives. The budget framework is often fairly tight, particularly on a road network carrying low traffic intensity, which is usually the case in the Northern Periphery, and there is therefore fairly limited scope for additional measures.

The second part of the report consists of advice and recommendations on environmentally sound practices on roadwork sites. It concentrates most on work on existing roads. The topics are Waste, Noise and vibrations, Dust and exhaust gases, Contaminated soil, Natural environment and Water and wetlands.

A conclusion of the report is that money can be saved through these measures. Sensibly organized routines and proper use of resources will lead to less material being needed. The risk of unpleasant surprises, such as worksite cleanups and legal action due to environmental damage, will be reduced. Machinery and equipment will function more efficient**y,** and this ultimately saves money.

KEY WORDS: Roadex, Environment, Guideline, Impact Investigation, Environmental Practises, Checklist.

1 Introduction

Growing interest in the environment in today's society has led to increasing focus on environmental issues. This also applies to the road sector. By its very nature, this sector involves appreciable loading on the environment, so there is every reason to take active measures to achieve more environmentally appropriate operations. Appreciable gains can be made, both environmentally and also economically.

The major environmental loading from the road sector originates principally from the exhaust gases and emissions from road traffic, although road building, rebuilding and maintenance of the road network can also cause significant environmental impact in certain cases.

This report deals only with those elements involved in the construction and rebuilding of road objects.

The report is aimed at giving an overview of how the project partners deal with environmental matters in road building, and to give advice on how good environmental management can be assured in road building. The report is based on contacts with the various road authorities concerned, and also a number of reports.

A small checklist for use on site accompanies the report. This guideline is a brief compilation of various items of advice that have been developed in part 2 of this report and is intended for various persons to have on site.

Figure 1. Environmental checklist.

2 Part one: National conditions

This part is intended to provide a general overview of how work is done in the participating countries. This is not an in-depth review, but is more of an overview of the policies and guidelines of the participating authorities. An attempt is also made to describe how they intend to implement them in projects. It also provides a description of the different types of protected areas for each country.

2.1 Sweden

2.1.1 Environmental Code

The environmental aspects of road building in Sweden are regulated by the Environmental Code. This includes the "consideration rules" during construction work:

- The **burden of proof** that adequate consideration has been shown rests with every player
- Every player must have sufficient **knowledge** for acting so that damage is counteracted
- All **reasonable measures** necessary for avoiding damage shall be taken
- The **caution principle** applies
- The **best possible technology** shall be selected as far as this is reasonable
- Measures shall be **located** at sites that are suitable for this purpose
- **Conservation** of materials and recycling shall be observed, wherever possible
- **Product selection** – the chemical products selected shall be those that are least harmful
- **Consideration requirements apply as far as this is reasonable**. It is up to the player to demonstrate what would be unreasonable
- It is always the **polluter who pays** for damage that may arise

2.1.2 Environmental policy of the Swedish Road Administration

Moreover, the Road Administration has its own environmental policy. The provisions of this policy include:

Aim

The Swedish Road Administration shall lead a process where the negative environmental impact of the road transport system decreases, while improving conditions for travel and transportation. In the first place we shall aim at the fields where the road transport system has greatest impact: green house gases, air quality, noise, water, nature and culture.

The policy is given at www.vv.se/om vv/policeng/environ.htm

2.1.3 Impact descriptions

To enable this to be implemented purely and practically in the operations, an environmental impact description shall be drawn up for all road objects. This shall include a description of the road project, alternative solutions, existing environmental qualities, land utilization and traffic conditions, Impacts of an action not being taken, expected environmental effects of the action, and measures aimed at minimizing the damage caused by the project. Differing emphasis is placed on different parts of the above, depending on the stage in the construction process to which the environmental impact description relates.

The environmental impact description shall be part of the decision information, and shall contribute to environmental assurance/environmental adaptation of a road project by integrating the environmental work with the planning.

2.1.4 Protected nature

General

It is important when planning and managing roadwork to know about protected nature areas. There are certain restrictions on what measures can be taken, and it is necessary to find out about these restrictions in advance.

National parks and nature reserves are found in all of the ROADEX member countries. There are a great variety of parks and reserves because each nation has developed its own approach to suit its own needs. But most have the following common features:

- they identify areas of land or sea - sometimes extensive areas - which are of the very highest value to the nation for their scenery and wildlife, and often for their cultural heritage value;
- they provide positive management and additional resources to safeguard the special qualities of these areas for the long term; and
- they provide opportunities for the public to enjoy these areas, because they are usually highly attractive places to visit.

National parks in Sweden

According to Swedish law, the national parks are to be representative biotopes which are preserved in their natural state, but also beautiful unique environments which offer experiences to the visitor. Another idea is also to give people the opportunity of getting into the forest and countryside.

The Environmental Protection Agency decides on the management of Sweden's national parks and suggests new parks. The decision to found a park is made by the parliament.

Figure 2. Färnebofjärden National Park, Sweden

Photo J. Ullberg 2004

The regulations vary in the national parks, but generally it is prohibited to disturb and destroy - which also applies to all Swedish countryside under the right of public access.

Nature reserves are the most used form of nature protection in Sweden

Nature reserves can be founded with the idea of:

- preserving biological variety, and biotopes for protected species
- preserving valuable natural environments
- providing people with the opportunity of getting into the forest and countryside

Culture reserves to protect valuable landscapes characterized by human culture

Natural monuments are individual objects, such as very old trees or very small areas with interesting nature topics.

Natura 2000 (EU), se description at 2.5

2.2 Finland

2.2.1 Environmental policy

The Finnish Road Administration – Tiehallinto – also has its environmental policy that can be found at http://www.tiehallinto.fi/ymparisto/envpol.htm:

ROAD ADMINISTRATION ENVIRONMENTAL POLICY

The Road Administration acts and develops its activities in accordance with the principles of sustainable development. The Administration is responsible for road management and its environmental impact and for its share of the environmental impact of road transport.

1

The Road Administration trains, guides and motivates its personnel to responsible action with regard to the environment, health, safety and economy. As employees, we bear responsibility for implementing the environmental obligations and objectives in our own activity.

2

The Road Administration participates in transport system planning, in extensive co-operation with all those involved. We aim at a transport system which supports functional travel and transport chains, and the development of a sustainable regional and community structure. In co-operation with regional and local authorities and inhabitants, we reduce the environmental damage caused by the present road network, road traffic and road keeping.

3

New and reconstructed roads are adapted to their surroundings and environment. The aim is a safe, functional and beautiful entity. A precondition for sustainable results is that the whole life cycle of the project or action is taken into account. In procurement of construction and maintenance, we require that our suppliers provide reliable information on the environmental quality of their products and services.

4

The Road Administration supports transport intermodality. We manage road network use to reduce road traffic energy consumption and environmental damage.

5

We monitor and evaluate the implementation of our goals, our performance and its environmental impact. We report on the results to the public and the authorities. We ensure the participation of all those concerned in discussing our activities and projects. On the basis of the evaluation, we develop our activity continuously.

2.2.2 Laws and routines

Provisions for environmental impact descriptions, plans and programmes are made in a number of laws, ordinances, decisions and standards. These are usually very general and do not provide guidelines on how the assessment should be carried out. As a result, different authorities apply these regulations in widely varying ways.

2.2.3 Impact descriptions

The Road Administration has investigated the environmental impacts of its long-term plans since the end of the 1980s, and work has been pursued in a direction towards clearly linking the assessments to the long-term plan of the Road Administration.

Work is also pursued so that efforts are made to improve the environmental adaptation throughout the operations by:

- Reducing the energy consumption at work sites
- Increasing the sorting of waste
- Ensuring better planning of the road transport system in cooperation with other road authorities and players
- Carrying out environmental adaptation of existing roads
- Specifying the requirements during procurement
- Specifying the requirements for construction and maintenance
- Controlling road traffic

2.2.4 Protected nature

National parks

The basic idea of national parks is to preserve the nationally and internationally most valuable natural areas of Finland. The parks are also open to the public. Facilities and services, such as guides, are often available.

Nature reserves

Nature reserves are mostly for preservation of the environment and for scientific research, with the ambition of keeping these nature areas in, as much as possible, their original state.

The regulations are stricter than those for national parks, and entry is normally restricted without special permission.

Some other types of reserves can also be found.

- **Bogs** can be protected separately. Normally access is unrestricted, but there can be restrictions on hunting and fishing.
- **Bird habitats**, mostly water, can have regulations on drainage, water control and such
- **Protected eskers**
- **Protected groves** with a rich biological variety
- **Protected shores**
- **Protected forests**, virgin forests
- **Natural monuments**
- **Natura 2000 (EU)**, se description at 2.5

2.3 Norway

Norway is similar to Sweden and Finland in many respects. The climate is similar, although the influence of the Atlantic is greater in Norway. The terrain is more dissimilar, and Norway has a somewhat different geology.

The laws and ordinances are similar to those in Sweden in some respects, even though there are naturally some differences.

2.3.1 Environmental impacts studies and notification

The purpose of the regulations concerning environmental impact studies is to "shed light on the effects of measures that may have significant Impacts on the environment, natural resources and society". Environmental impact studies shall ensure that these effects are taken into account during the planning of the measures and when a decision is made on whether and under what conditions the measure can be carried out.

To enable this to be implemented purely and practically in the operations, the authority responsible shall be notified of all road objects. This shall contain a description of the road project, alternative solutions and the technical solutions and design, and shall describe problems related to the environment, natural resources and society. This shall always contain a proposal for an investigation programme.

The investigation programme shall describe the available alternatives and define the problems that are important to the environment, natural resources and society, and that must be investigated.

2.3.2 Environmental impact description

An environmental impact description shall then be drafted to provide answers to the questions in the investigation programme. The description shall be brief, shall be written in easily understandable language, and shall contain good illustrations and maps. The impact description shall serve as part of the source information in the decision process.

2.3.3 Protected nature areas

National parks

A large, more or less virgin natural area, created with the idea of preserving nature values for the present and the future. The destruction or disturbance of cultural sites and nature is generally prohibited.

In many parks another idea is also to provide people with the opportunity to access the forest and countryside.

A distinctive or beautiful natural or cultural area can be conserved in a **preserve area** without hindrance of normal use and agriculture.

Nature reserves are normally small, more or less virgin areas, created to save special biotopes

2.4 Scotland

2.4.1 General

The Highland Council in Inverness administers the public roads in Scotland. However, the road sector is formally governed from the Department for Transportation in London.

There are also several other roads in Scotland, such as forest roads, farm tracks, roads to windmills etc. Responsible for those roads can be the Forestry Commission, private farmers and others.

Regardless of the road owner, the same regulations apply. All must make environmental considerations; the level of these considerations is dependent on several things (see below).

2.4.2 Environmental Assessment

When building or rebuilding roads, it is important to check if an environmental assessment is necessary. The necessity for an assessment depends on several factors, such as the size of the road site, location of the road, type of nature etc. The following flow chart may give an idea how this is determined in the case of a small road or a track:

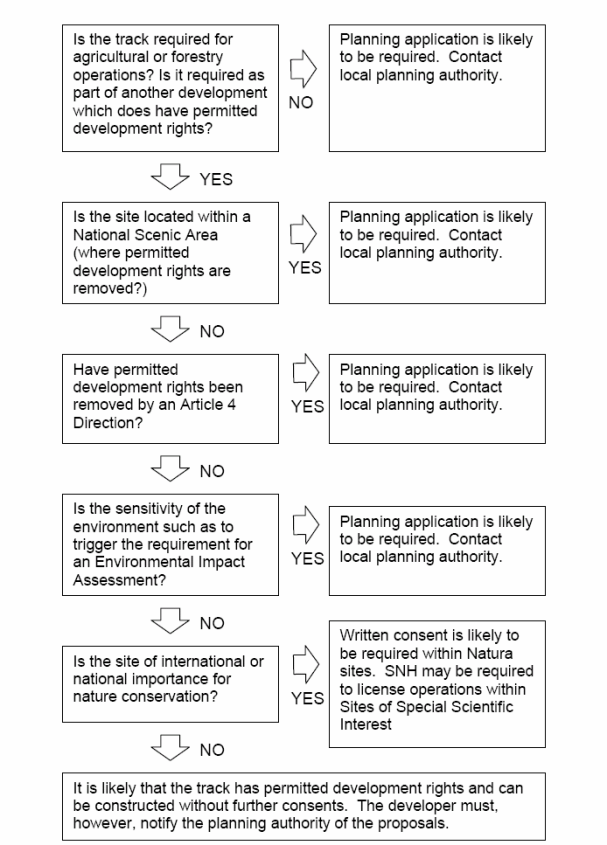

Figure 3. Flow chart for making environmental planning decisions.

From Scottish Natural Heritage 2004

Chapters 10 and 11 of the Design Manual for Roads and Bridges give rules for how environmental assessments are to be made.

An assessment should be done in a few steps. The level of detail and the coverage of the assessment should be appropriate to the magnitude of decision that can reasonably be made at each stage.

Stage 1 – sufficient assessment to identify the environmental advantages and disadvantages with the project.

Stage 2 – sufficient assessment to identify the factors and effects to be taken into account in choosing the road option, and to identify the environmental advantages and disadvantages associated with the chosen solution.

Stage 3 – prior to the publication of an Environmental Statement – an assessment in accordance with the requirements of certain Sections of the Roads Act.

This should lead to an Environmental Statement.

2.4.3 Low volume roads

Just like in the other countries, it may be difficult to meet all these requirements in every situation, but the direction is clear. However, assessments must also be made here from economic, social and other perspectives. The budget framework is often fairly tight, particularly on a road network carrying low traffic intensity, which is usually the case in the Northern Periphery, and there is therefore fairly limited scope for additional measures.

Normally when working with an existing low volume road, only minor environmental problems should arise. Usually all work is done inside the existing road, and work that has to been done outside the road (such as ditches, depositing of material etc.) can easily be managed in an environmental acceptable way.

However one thing that often happens is that widening of the road or other unplanned measures are done in the building process "when we already are here". This will be done without the supervisory authorities' knowledge or approval, and can in some cases do serious damage

2.4.4 Protected nature

Scotland has several types and levels of protected nature. The authority for supervision of this is the Scottish Natural Heritage (SNH). For work in SSSI and Natura 2000 SNH must be contacted, and for other protected areas the SNH can give advice how to make sound environmental decisions. The SNH normally will be a part in the planning process.

The basic idea is "don't destroy, is it possible to improve?", which can further be interpreted to mean that most work done on an existing road is acceptable. In other cases, with widening of a road, new (sections of a) road etc. one should always try to find ways to improve the environmental conditions.

Site of Special Scientific Interest (SSSI) is the main nature conservation designation in Great Britain. These sites are special for their plants or animals or habitats, their rocks or landforms or a combination of these. There are about 1200 SSSI in Scotland.

Figure 4. Scottish Natural Heritage.

Photo J.Ullberg 2004

National Nature Reserves (NNR) are areas of land, set aside for nature, where the main purpose of management is the conservation of habitats and species of national and international significance.

National Scenic Areas (NSA) are Scotland's only national landscape designation. They are those areas of land considered of national significance on the basis of their outstanding scenic interest which must be conserved as part of the country's natural heritage.

Wetlands of International Importance. Ramsar sites are designated under the Convention of Wetlands of International Importance.

A **Local Nature Reserve** is a place with special local natural interest, set up to protect nature, and for people to enjoy and appreciate.

Local Nature Reserves (LNRs) can be all sorts of places - woodlands, wetlands, meadows or coastal sand dunes.

Local Authorities have exclusive statutory powers to set up and manage LNRs.

National Parks

In Scotland, National Parks have been established to deliver better management of some of Scotland's most special areas of outstanding natural and cultural heritage. They have the following aims:

- to conserve and enhance the natural and cultural heritage
- to promote the sustainable use of the natural resources of the area
- to promote understanding and enjoyment (including enjoyment in the form of recreation) of the special qualities of the area by the public
- to promote sustainable social and economic development of the communities of the area

These aims will be pursued collectively, so that the achievement of one aim for the area will not undermine the achievement of another but should contribute to it. In this way, social and economic development will be addressed alongside the proper protection of the natural heritage. However, in cases where there appears to be irreconcilable conflict between these aims, priority will be given to the protection of the area's natural and cultural heritage. To minimise the scope for conflict between the aims, it may apply different policies to different areas of the Park ('zoning').

There is one National Park in the north of Scotland

2.5 Natura 2000

Natura 2000 is a network of the most valuable natural habitats of the European Union. Areas are to be found in every member country, with the purpose of ending the extinction of species and biotopes. There are about 3500 areas in Sweden, 140 in Scotland (but many more are planned) and about 1800 in Finland.

All member countries will ensure that valuable biotopes and species have a favourable status of protection.

More than 900 species and 170 biotopes are listed as threatened from a European perspective.

Every single Natura 2000 area shall have a management plan, which presents, in detail, what to protect.

A Natura 2000 area can be any type of biotope, from meadows to mountain areas, the management plan must be made according to the guidelines given for Natura sites. From a road building perspective it is important to consider what measures will be permitted since those with a considerable impact on the environment in a Natura 2000 area will have to be sanctioned by the supervisory authority.

2.6 Summarizing all countries

All the participating countries have a similar approach to environmental issues, although there are differences due to geography, climate and basic laws.

All countries demand that some type of environmental assessment should be done. The purpose of this assessment is to shed light on the effects of those measures that may have significant consequences for the environment, natural resources and society.

Environmental impact investigations shall ensure that these effects are taken into account during the project planning stages and when a decision to proceed is made; under what conditions the measure can be carried out.

When dealing with low volume roads, as often is the case in the Northern Periphery, the level of the assessment, for economical reasons, often must be somewhat simplified. On the other hand, smaller roads should give a smaller impact on the environment, which also would simplify the process.

Regarding protected areas, all countries have several levels of protection. The highest level is National Parks in Sweden, Norway and Scotland, and nature reserves in Finland. All countries have the legal right to impose very strict regulations, such as prohibited entry, but at the same time maintain the option to allow unrestricted public access.

As Natura 2000 is a European Union network, Norway is not a part of it.

3 Part two: Advice and recommendations on site

This part of the report is aimed at providing recommendations on how the work on site can be adapted to environmental requirements. Recommendations are given for various types of problem, such as waste, oil spillage, noise, etc.

This report is accompanied by a small handbook intended for use on site. The handbook summarizes what is outlined below and is largely based on publications from CIRIA in England (4, 5). These publications also deal with other types of construction.

The handbook has been adapted to northern conditions and is limited to road work

3.1 Waste

3.1.1 General

Waste is defined as “any substance or object which the holder discards, intends to discard, or is required to discard”. Note that this may include unexpected objects, such as excavated soil that will not be used.

For natural reasons, there is always surplus material in road building work. This may be of different types:

- Packaging material
- Residual road structure material
- Dangerous waste, oil from machines, etc.

From a different perspective, waste can be classified according to how it affects the environment:

- Inactive waste, i.e. material that is not modified by any physical, chemical or biological reaction in a normal landfill site.
- Active waste, i.e. the opposite of the preceding. This may be, for example, oil residues and batteries. A special case is waste that is dangerous to life, e.g. explosive or flammable waste.

The principal conclusion is that it pays to reduce the waste quantities. Most countries now levy a charge on waste that goes to the landfill, which also applies to the countries participating in the project. In addition to the landfill charges, the costs of the landfill area are often also included.

Costs are also involved in transporting material to and from a work site. Reduced transport leads to reduced need for vehicle and personnel resources. In addition to costs in time and equipment, this also includes various taxes and charges.

Although reduced quantities of materials going to landfill reduce the revenues for the state, the result from the national economy viewpoint is still a net gain. Waste going to landfill results in environmental loading that must be managed. The higher concentration of materials at the landfill site may cause emissions, and the increase in transport work will lead to effects such as higher emissions and increased noise pollution.

3.1.2 Waste reduction

The amount of waste can be reduced in several ways. The amount of waste material can naturally be reduced, i.e. by putting everything that is transported to use on the work site. This can seldom be fully achieved, but a target in this direction is a good point of departure.

Another matter that is very common in roadwork, and probably in the maintenance of existing roads in particular, is that a great deal of residual material will be left over. Efforts are often made to change unsatisfactory superstructure materials, which may be material that was crushed or materials that were approved in earlier standards but are unable to meet the current quality requirements which have changed due to the increased loads carried by the road network.

A sensible handling of material often enables all residual materials to be put to use in one way or another. If the quality of such material is too poor to use in the road structure, it can usually be employed as backfill material, e.g. to level out steep slopes.

Some waste will always occur, e.g. packaging material, oil residues and the like. All countries participating in the project have made requirements on how waste should be dealt with. It is particularly important for environmentally harmful waste to be transported to landfill or incineration plants intended for this purpose. Information on where such plants are located can be obtained from the local or regional supervisory authority.

Another problem that may arise but is not common in the Northern Periphery is polluted soil, where it may be necessary to remove and dispose of a certain amount of such materials. For further particulars, see below 3.4.

3.1.3 Economic aspect

An important reason why waste should be avoided is basically economic. Poor waste management costs time and money.

- Initially poor waste management may give rise to high costs at a later stage. Such costs can be avoided if the waste is managed correctly right from the start.
- Costs of storage, transport and disposal of waste.
- Time (costs) for handling the waste
- Increase in costs due to usable material being scrapped.

All of this together clearly demonstrates that it is beneficial to have a thought-out strategy for waste management.

3.2 Noise and vibrations

3.2.1 General

Noise is defined as sound that is undesirable to the listener. The disturbance caused by sound and vibrations depends on their extent and intensity, and on the sensitivity of the persons affected.

Vibrations may also cause damage to buildings and sensitive equipment. Noise and vibrations can also affect the surrounding fauna. Moreover, vibrations can cause damage to geological and archaeological objects.

3.2.2 Northern Periphery

Noise and vibrations are not normally a major problem in the Northern Periphery. Since the region is generally sparsely populated and the roads predominantly run through uninhabited or lightly populated areas, the risk of disturbances is relatively limited.

Work is thus usually done outside built-up areas, and no special consideration need therefore be given to the surroundings. However, the standard working environment measures must naturally be observed.

Figure 5. Roller at work in northern Sweden.

Photo: J.Ullberg 2002

3.2.3 Avoiding disturbances

However, some work must inevitably be done in communities and the like. Greater consideration must then be given when the work is being done. Noise disturbances may cause irritation and also more serious reactions, such as agitation and stress of livestock. Vibrations can also be a source of irritation, and may also cause damage to buildings and installations.

Work should then be done somewhat differently. A simple but fairly effective measure is to notify the persons affected that work is about to start. This can be done by delivering information leaflets through letterboxes and by posting notices on notice boards. For major work, it may be sensible to convene an information meeting. If people are notified, their acceptance of the disturbance is usually higher.

It is wise to work within normal working hours as much as possible. If this is impossible, the persons affected should be given special notification.

There are only limited ways of reducing the noise level. The noise can obviously be “enclosed” by noise fences or the like, but this is often impracticable on roadwork sites, particularly for minor works of short duration.

Vibrations should also be avoided in built-up areas. Heavy vibrations may cause damage to buildings and installations, which would thus give rise to damage claims. Methods and equipment that minimize vibrations should therefore be employed. However, this is often difficult in practice, since roadwork demand equipment such as diggers, heavy trucks, etc.

A general piece of advice that applies to both noise and vibrations is to use modern equipment wherever possible. Such equipment normally has better noise and vibration attenuation than older machines. Modern machinery also offers other benefits, such as reduced emissions, etc.

3.3 Dust and exhaust gases

3.3.1 General

Dust is an almost inevitable consequence of roadwork. Gravel contains a certain amount of fine material, and if the material is dry, a fairly heavy dust cloud can be raised. This dust can disturb both the population and the environment in the surroundings. Since various machines are used, exhaust gases are also inevitable. In high concentrations, these exhaust gases may also pose a health hazard.

As mentioned earlier, since the region is fairly sparsely populated, dust from "clean" materials seldom represents a serious problem, even though it should not be ignored. Dust from geological material is not inherently environmentally harmful to the terrain and is deposited either naturally or by the next rain shower. However, it should be borne in mind that if the dust is spread to watercourses and lakes, it may cause cloudiness of the water. Greater care should therefore be taken in such cases.

Exhaust gases also affect a limited number of people. However, the problem it two-fold: Pollutants may make less of a local impact, although emissions that spread to the atmosphere may have a regional impact, i.e. the emissions may have an appreciably greater spread.

3.3.2 Remedial action

Greater consideration should be given in communities and in cultivated areas and the like. But no major problems should arise if certain basic rules are observed. A great deal can be achieved by protecting (covering) loose materials and sweeping away any clay and similar materials before they have dried and could be blown away.

If alternative materials are used for road construction, such as ash and the like, it is important to prevent these products from being blown away. These materials may contain substances that, if correctly treated, cause no problems, but may give rise to unknown Impacts if allowed to spread in an uncontrolled manner.

Figure 6 clearly illustrates how dry fly ash can behave when spread in a road object. In such a case, it may advisable to use humidified materials.

Figure 6. Spreading fly ash from the forest industry on road BD694, Vitåfors, Sweden. Photo T.Nilsson 2002

Exhaust gases originate from vehicles and are unavoidable using today's technology. On the other hand, they can be minimized significantly.

The best way of minimizing the exhaust gases is to ensure that the machines and vehicles are in good condition. The advice given above that modern machines should be used is also applicable here. A relatively new and well-maintained machine poses a far lower risk of emissions, and is also less likely to incur operating disturbances. Another good way is to avoid letting the machines run unnecessarily at idling speed, particularly in built-up areas.

3.4 Ground contamination

3.4.1 Signs of contaminated soil

The Northern Periphery is a “clean” region. The risk of finding previously polluted soil is not particularly great, although it is conceivable. There are a number of warning signals here.
Oily ditch water is a clear warning sign. The reason may naturally be spillage from the ongoing operations, but it may also be due to existing old pollutants.

The nose or rather the sense of smell is an excellent instrument. Care should be taken if the smell of oil, sulphur, etc. is detected.

The pollutant can also be more tangible, such as if rubbish is found in the soil. The soil may also be discoloured.

Figure 7. Polluted stream near Sunderbyn outside Luleå, Sweden. Photo: J Ullberg 2004

3.4.2 Remedial measures

Specialist competence must be retained if polluted soil is found. These specialists must know how the material should be treated, disposed of, etc.
There are also good reasons for avoiding new pollution. Pollution is the result of poor resource management, and can also give rise to high cleanup costs.

In order to avoid new pollutants, the materials used must be closely controlled. The pollutants are mainly various solvents and oil products.

Leakage from vehicles and other equipment is the most obvious but also the most insidious pollution source. This can generally be avoided by regular service work, although some leakage is unavoidable.

If leakage cannot be avoided, care must be taken to collect it. Above all, it is vital to prevent it from spreading further, principally to the groundwater.

“Rubbish” is normally easier to deal with. It is naturally best to prevent it from ending up on the ground, but if it does, it is fairly simple to collect it. If sorting at sources is employed, a sorting station can easily be arranged on the site.

Collected pollutants should be handed over to a satisfactory collecting station. Liquid pollutants should also be handed over for disposal. Note that polluted water must also be treated as waste, and should not normally be discharged into the ordinary sewage system.

3.5 Natural environment

3.5.1 Protecting nature

The greatest possible effort should be made to protect the surrounding natural environment, which includes everything from individual animals and plants as well as rocks and the landscape and the natural processes that affect them all.

So why should we conserve nature? Animals and plants are vital to quality of life and healthy surroundings. If care is taken, there will generally be fewer protests against a project. A contractor also has legal responsibility for damage that may occur and the consequential costs.

Figure 8. Road B871 in Scotland.

Photo A.Dawson 2003

The main sources of problems that arise, with regard to protecting nature, are:

- Identification of species or areas within the project before construction work is started
- Protected species identified during the construction process.

3.5.2 Measures that can be taken

For known "problems", care should be taken mainly to ensure that all parties involved are aware of them, their type and location. If there are special directives for how they should be dealt with, this must also be made known.

Another important measure is to actually protect the objects physically. An ordinary fence may sometimes be sufficient, whereas clearer protection must be provided for other objects.

The time of the year may be important for various animal species. A bird that is sitting on eggs or has chicks during the early summer may be very sensitive to disturbances, whereas the same bird will already have migrated in the autumn.

Road objects may also run through terrain that, for a variety of reasons, is, in its entirety, protected under a nature conservation order. In this case, it is particularly important that work not be done outside the road area unnecessarily, and care must be taken to ensure that everyone involved is aware of this.

Existing parking sites should be used for parking vehicles and storing equipment, preferably in consultation with nature conservation authorities.

Common sense is often enough for dealing with these matters. If assistance is needed, the authorities responsible can be consulted and they, in turn, will pass the matter on to the appropriate centres of competence.

3.6 Water and wetlands

By its very nature, a road affects the flow of water. The road structure itself acts as a barrier and involves the need to dig ditches along the road and drainage ditches as well.

In drier terrain (moraine ground, sand, etc.), the effect will not normally be great, but the impact will be greater in wetlands. Particular care should therefore be taken to act appropriately.

Figure 9. Ditch in wetland with roadside rich in species *Photo: Vägverket 2002*

3.6.1 Road ditches

When work is being done on the reconstruction of an existing road, as is often the case, some ditches and other surface water drainage structures are already present. This means that primary impact has already occurred, and minor changes to ditches are a normal, usually uncontroversial measure.
However, it should be borne in mind that a certain amount of residual soil will have to be disposed of, and care must be taken when dealing with it.

Priority should naturally be given to reusing the soil. This soil is not normally usable for the road itself, but can very well be used as backfill for steep slopes or the like.

A secondary option is to use the soil as landfill. It is then important to ensure that the material does not end up in places where it could cause harm. It is reasonable to assume that there are some pollutants in the ditches, and it is therefore inadvisable to place the soil on land on which there is a large through-flow of water. Solid ground should therefore be selected as disposal places, such as till areas.

3.6.2 Drainage ditches

Sooner or later, ditch water must be drained away from the road. This is no problem if the road runs on an embankment, although it may be a problem if the road runs for long distances in a cut and through marshland.

It is often difficult to drain the water away from the road in marshland. Marshes are often relatively flat, and the water therefore remains in the area. A drainage ditch may therefore have to be fairly long and the machines used to excavate it may have an undesirable impact on the terrain. In addition, there are limitations to the amount of work that may be done in the area (protected wetlands). If possible, the water should therefore mainly be drained along the road to existing streams.

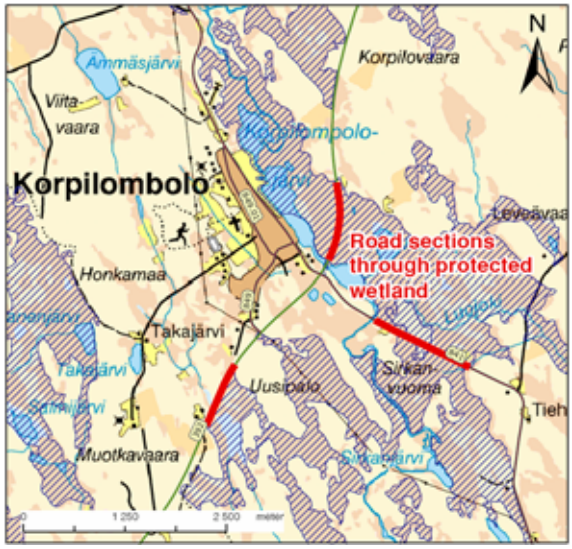

Figure 10. Road sections through protected wetlands.

3.6.3 Culverts

In order to facilitate water flow through a road, it is necessary to have culverts in the road. For obvious reasons they must be as wide as the water flow demands. But it is also necessary to keep the environment in mind. First of all a road can act as a barrier for the wildlife. Land animals can of course more or less easily pass over the road, while fish, frogs etc. will have more problems.

If the culvert is the passage for a brook, the depth of the water in the culvert must be sufficient for fish to be able to swim. It must also be ensured that the water in the culvert is level with the surface of the brook, that is, no extra “waterfall” at the end of the culvert.

This is also necessary for other culverts. Even though frogs can jump, the bottom of the culvert must be more or less in the same level as the surrounding ditches.

To avoid clouding of the water downstream from a culvert, a silt trap can be constructed. If the material in the ditches is silty, some erosion will occur, especially before the vegetation has stabilized the material. To prevent the water from disturbing this material and becoming clouded by it and then depositing it in an undesirable place, a hole can be made at the intake side of the culvert. Some of the silt will be deposit here, with the result of less clouding and so on.

3.7 Summarizing comments

It will be noted that a great deal must be kept in mind in these scenarios and that, if all of these procedures are followed, there will not be any resources left for the actual road building.

In actual fact, money can be saved through these measures. Sensibly organized routines and correctly used resources will lead to less material being needed. The risk of unpleasant surprises, such as an unplanned extra cleaning of the work site and legal action due to environmental damage, will be reduced. Machinery and equipment will function more efficiently, and this ultimately saves money.

It is also good advice to maintain all machines and equipment in good condition. It is not possible to always use new equipment, but a well-maintained machine can be expected to be less noisy, crate less exhaust gases and so on.

A good relationship with the people affected by the roadwork is crucial. If the persons affected by the roadwork are notified that work is about to start, their acceptance of the disturbance is usually higher.

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