

# GRAVEL ROAD MAINTENANCE POLICIES DEFINE THE SERVICE LEVEL OF THE UNPAVED ROAD NETWORK IN FINLAND

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## ABSTRACT

In Finland the length of the public road network totals 78 000 km, of which the share of gravel roads is one third, i.e. 28 000 km. The annual maintenance expenditure for public roads is approximately € 450 million, of which some € 35 million is used for gravel roads. Traffic performance on gravel roads is on average 939 million automobile km, whereas on the paved road network it is on average 5200 million automobile km annually. Although the traffic performance of the gravel roads is small, their importance is significant to the rural population, and commercial and industrial transport, such as transport of raw timber.

The first operational policies for gravel road maintenance in Finland were prepared in a project completed in 2008. These operational policies constitute one of the documents governing maintenance planning and they aim at ensuring a uniform service level for the entire gravel road network.

The operational guidelines classify gravel roads into three classes for operational planning, prioritisation of operations and service level requirements on the basis of traffic volume, importance of the road network, land use and road user needs. Gravel road classes are named according to the significance of their traffic (busy, basic and low-volume gravel roads).

Regular routine maintenance operations such as grading and dust binding are carried out to ensure the daily trafficability of gravel roads. Maintaining and rehabilitating the structural condition requires repair measures such as improving the bearing capacity through structural strengthening and drainage repair, which aim to keep the roads open for yearly traffic particularly through the spring thawing season

## 1. INTRODUCTION

In Finland the length of the public road network totals 78 000 km, of which the share of gravel roads is one third, i.e. 28 000 km. The annual maintenance expenditure for the public roads is € 450 million, of which some € 35 million is used for gravel roads. Traffic use on gravel roads is on average 939 million automobile km, whereas on the paved road network it is on average 5200 million automobile km annually. Although the traffic use of the gravel roads is small, their importance is significant to the rural population, and commercial and industrial transport, such as transport of raw timber for example.

Gravel road maintenance is included in the regional maintenance contracts implemented by selected contractors according to a defined service level in line with agreed principles. The daily trafficability of gravel roads is preserved through periodic maintenance measures such as grading and dust binding (surface condition). Repair measures are necessary for preserving and improving the structural condition of gravel roads. Such measures are

increasing bearing capacity by strengthening the road structure and improving drainage, which aim at securing trafficability, particularly during the spring thaw season.

The Finnish Road Administration (now Finnish Transport Agency) has not previously had uniform operational policies to use as a basis for defining the service level of gravel roads taking into account road user expectations in addition to the traffic volume. In 2008 a project was launched, which resulted in *Sorateiden kunnossapidon toimintalinjat* (operational policies for gravel road maintenance). They describe the service level of the road network achieved through daily and periodic maintenance. They also describe the principles and priorities of guidance, common terminology and parameters to be used, and the general principles for the daily maintenance and annual repairs of the road network. They set the bases for defining the maintenance classification (3 classes), programming of financing and planning activities. [1]

This paper describes the contents of the operational policies for gravel roads in Finland. The paper also explains the principles and methods used in taking into account the expectations of different road user groups and the activities in the road environment in defining the maintenance classes of the gravel road network. The first practical experiences from the impact of the operational policies on the gravel road condition and road user satisfaction are presented at the end of this paper.

## **2. OPERATIONAL POLICIES GUIDE MAINTENANCE PLANNING**

Previously the Finnish Road Administration and Road Regions were responsible for road management in Finland. In the road sector reorganization of 2010 road, rail and waterways administrations were merged and they became the Finnish Transport Agency. The nine regional road management units were merged into the Centres for Economic Development, Transport and the Environment as their own areas of responsibility for transport and infrastructure.

The task of the Finnish Transport Agency is to guide and monitor road management in Finland. The task of the Centres for Economic Development, Transport and the Environment is to implement in their areas of operation such as the transport strategy, which is defined by the Ministry of Transport and Communications, and for which guidelines are established by the Transport Agency. This steering activity is executed through different operational policies, which ensure a sufficient and equal service level for the road network all over Finland. The policies cover the most essential road network maintenance operations such as winter maintenance, maintenance of the paved road network and gravel roads, and management of the traffic environment as the most recent addition.

The policy requirements are realised in the regional maintenance contracts, when contractors implement the service level (quality requirements) defined by the client. The service level defined in the operational policy is adapted to regional needs, which are influenced for example by the volume and composition of traffic as well as the residential and industrial areas surrounding the road network. [3,4]

The adoption of the operational policies to the regions is carried out during the maintenance planning process, which has been described in Figure 1. The maintenance planning process takes into account traffic environment (e.g. residential areas and

businesses along the road), available finances and operational policies defined for the areas of activity. The objective of the process is to increase interaction with road users in the area and also to pay more attention to their needs in defining the service levels. An essential condition for the implementation of the operational policies is available finances, nevertheless with the main emphasis on the daily flow of traffic and safety even in sparsely populated areas. [2]

As a result of the planning process, a maintenance plan is prepared for the road management region, which defines the maintenance level of the road network in the area in line with the set policies. The plan is used in organizing competitive bidding for maintenance contracts and outlining the scope and quality requirements of the contract. The gravel road network has been divided into three maintenance classes in the gravel road operational policies. These classes have service levels specified for daily maintenance and periodic maintenance. The daily maintenance level describes the so called road surface attributes and the periodic maintenance level, for its part, describes factors connected to the structural condition. Nevertheless, measures affecting the structural condition also affect the surface condition, especially during the spring thaw season.

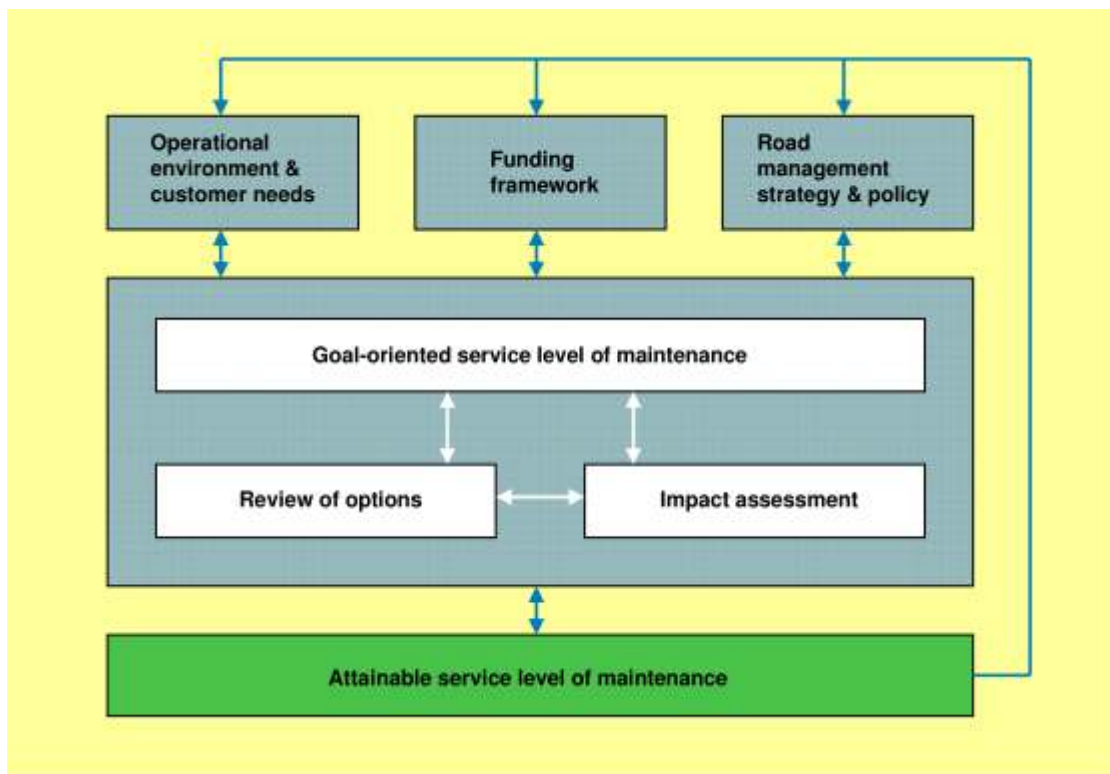


Figure 1: Principle of the Maintenance Planning Process [1]

### 3. OPERATIONAL POLICIES FOR GRAVEL ROAD MAINTENANCE

In Finland the new operational policies divide gravel roads for the purposes of activity planning, measurement prioritization and service level requirements into three classes based on traffic volume, importance of the road in the network, land use and customer needs, whereas the previous classification had only two levels. The new three-level classification better describes the gravel road's significance to the traffic in the area and the classes have been named accordingly busy, basic and low-volume gravel roads.

In the new operational policy, gravel road maintenance is divided into two parts: daily maintenance and periodic maintenance or structural rehabilitation. Daily maintenance targets the road surface condition, which has such attributes as evenness, consistency and dustiness. The differences of the classes vary according to how much the condition may fall below the basic service level. For example, the non-dustiness requirement is stricter for the road sections that include built-up areas, schools and other institutions, open-land cultivation of vegetables or berries or other activities vulnerable to dust. On the other hand, periodic maintenance aims to ensure the trafficability of the road network through all the seasons of the year. In Finland the spring thaw season causes a great deal of problems to the gravel road network and weight restrictions have to be imposed on the traffic on gravel roads. Trafficability of gravel roads is described by the road's susceptibility to weight restrictions, in other words in how many spring thaw seasons weight restrictions have been imposed on the particular road. Frost heave in the road structure (lack of bearing capacity in the spring), and frost heave of the road surface (softening of the surface 5 – 15 cm) have an effect on the susceptibility to weight restrictions.

In addition to taking into account traffic volumes, road user needs and the effect of varying conditions have played an essential role in determining gravel road operational policies.[1,4]

#### 3.1. Road User Expectations for the Condition and Maintenance of Gravel Roads

In Finland road user expectations and needs have been collected from road user feedback, client satisfaction polls and specific surveys. The analyses of the results have shown that road user expectations are higher than the service level defined for the road network by the road manager. The feedback from road users also reveals that gravel roads are considered so called second class roads, and a paved road in poor condition is considered better than a gravel road.

In Finland road users (customers) have been divided into different user groups, which aim to describe groups of travellers, for example people commuting to work, passenger service providers, forestry industry transports, school children or various transportation service providers. These groups travel using different means of transport, or without any of them. Generally, the different means of transport are divided into passenger cars, pedestrians & cyclists and heavy vehicles (trucks, busses). [2,3]

Customers using different means of transport have different expectations of gravel road condition and maintenance, which can be described as follows:

- passenger car users' main interest is in the surface condition of the gravel roads. The most significant requirements from the users' perspective concern the surface evenness and the car not getting dirty.

- needs of the heavy vehicle transport are connected with sufficient bearing capacity, reliable prognoses of weight restrictions and availability of information of existing weight restrictions. This user group emphasises requirements for gravel road structural condition, and not so much how badly the road raises dust or dirties the vehicle. The most important road attribute for their operations is the reliability of trafficability of the road regardless of the time of the year or day.
- for pedestrians & cyclists as well as for the built-up areas in the roadside the most detrimental gravel road characteristic both on the road and in the vicinity of the road is its dust raising tendency. For example, dust may cause a loss of crop for berry growers, or restricting outdoor activities of home dwellers for merely a part of the court yard and at the same time decreasing living comfort. [1]

These expectations and feedback from the road users have played a central role in the creation of new operational policies and the key policy definitions for gravel road maintenance are based on them. The policies aim to ensure their uniform implementation both regionally and locally all over Finland.

### 3.2. Central Policies of Gravel Road Maintenance

The central policies of gravel road maintenance are used for steering the planning and implementation of the gravel road network in both daily and periodic maintenance.

The project defined the following policies, which have to be taken into account when applying gravel road maintenance strategies and defining the gravel road classes in the regions:

- Gravel roads are divided into three classes, which are used to differentiate busy and low-volume gravel road sections from the general road network. It is typical for a basic gravel road that the most important spacings between junctions have sufficient bearing capacity in the spring and driving comfort is at least satisfactory.
- An evenness requirement is specified for the gravel roads, which must be met except for a small section of the gravel road. Attention must be paid to the gravel road's property to give off dust under traffic, especially where there are built-up and cultivated areas along the road and no significant spreading of dust is allowed beyond the road area.
- Daily and periodic maintenance of gravel roads must be systematic. Daily and periodic gravel road maintenance is implemented in line with the gravel road class and according to the requirements of the environment. The planning of daily and periodic maintenance measures is needs oriented. Daily and periodic maintenance is implemented as cost-effectively and uniformly as possible in the regional maintenance contracts. The objective is to offer a better service level on busy gravel roads, and at the same time, decrease the need to pave them. An additional objective is the elimination of the threat of weight restrictions.
- In targeting daily and periodic gravel road maintenance measures road user needs and existing road conditions are taken into account. Uniform gravel road classification is followed in daily maintenance quality requirements and periodic maintenance planning in the whole of Finland. Sufficient attention is paid to the road user needs, however, in such a way that uniform principles are applied also at regional level.
- Daily and periodic gravel road maintenance measures are harmonized in such a way that uniform service level is achieved on the targeted section. The target width (e.g. 6.5 m) in line with the traffic needs is taken into account when rehabilitating a

- gravel road, and at the same time drainage affecting the structural condition of the road is restored to correspond with the targeted condition level.
- Road user satisfaction and road asset preservation is improved and through interaction and communication. The idea is to restrict traffic on gravel roads in the spring thaw season in such a way that, for example timber transport is scheduled for the winter months, or after the spring thaw season.

The key policies help to further define gravel road classification and prioritization of measures. Quality criteria are included in the regional maintenance contracts as quality requirements. These quality requirements are specified separately for each gravel road class.

### 3.3. Classification Principles for Gravel Roads

Gravel roads are divided into three classes according to the spacings between junctions. The classification based on spacing between junctions ensures the flow of traffic and takes into account the routes important for traffic.

Basic classification of gravel roads is based on average daily traffic (ADT). When considering the classification of a specific road feedback, and expectations of the road maintenance received from the users are checked. In addition, the road's importance in relation to other roads in the area is compared. The importance of a gravel road is based on the key customer groups of the area and their needs. When preparing the classification it has to be ensured that the division of the road network into different gravel road classes is in balance in relation to the situation in the whole of Finland, role of the gravel roads in the maintenance area and the position of the low-volume road network in the entire network. In addition to the general average daily traffic also the average daily traffic during the summer months (average daily traffic in June, July and August) will be taken into account, which may raise the gravel road class of some sections between junctions. [1,3,4]

### 3.4. Gravel Road Classes and Classification Principles

Previously in Finland gravel roads were divided into two classes (I and II) according to traffic volume. The operational policies prepared in 2008 are also based on traffic volume, but in line with the principles of customer orientation more attention has to be paid to road user expectations and wishes in the classification process.

The idea of the new operational policies is to improve the daily maintenance of gravel roads and structural condition of the spacings between junctions with busy traffic, which however, cannot be paved. Road management financing in Finland is not going to increase, which has to be taken into account in the classification.

The policy objective was to divide the road network more clearly than currently into three classes: gravel road class I (busy gravel roads), gravel road class II (basic gravel roads) and gravel road class III (low-volume gravel roads). The classification principles have been described in accordance with the classes in order to make the classification process easier and accomplish a uniform practice for the entire gravel road network.

Table 1 describes, at a general level, the decision-making criteria for raising or lowering a gravel road category. Additional descriptive wording has been added to the specifications as follows:

Gravel road class/Gravel road network/Basic classification/Other criteria (Raising category/Lowering category)

Busy roads/ approx. 10 %/ADT >200/short section is combined with a class-2 road

Basic gravel roads/approx. 70%/ADT 50-200/road user needs taken into account/significant role in the network/significant land use in the close vicinity of the road/part of a long connecting section/summer ADT >250/side road not used for long journeys/no land use in the vicinity of the road

Low-volume roads/approx. 20%/ADT < 50/road user needs taken into account/significant role in the network/land use in the close vicinity of the road

Gravel Road Class	Gravel Road Network	Basic Classification	Other Criteria	
			Raising the Category	Lowering the Category
I Busy gravel roads	approx. 10%	ADT > 200		<ul style="list-style-type: none"> <li>• short section annexed to a class II road</li> </ul>
II Basic gravel roads	approx. 70%	ADT 50-200	<ul style="list-style-type: none"> <li>• road user needs taken into account</li> <li>• important role in the network</li> <li>• significant land use in the close vicinity of the road</li> <li>• part of a long connecting section</li> <li>• summer ADT &gt;250</li> </ul>	<ul style="list-style-type: none"> <li>• side road not used for long journeys</li> <li>• no land use in the vicinity of the road</li> </ul>
III Low-volume gravel roads	approx. 20%	ADT < 50	<ul style="list-style-type: none"> <li>• customer needs taken into account</li> <li>• important role in the network</li> <li>• land use in the close vicinity of the road</li> </ul>	

Table 1: Gravel road classes and classification principles in Finland.[1]

- **Gravel road class I**
  - Average daily traffic of the section between junctions is over 200 vehicles/day.
  - The spacing between junctions plays an important role in the road network, there is significant land use in the close vicinity of the road, the spacing between junctions is part of a longer connecting section, or there is significant increase of traffic in summer time.
  - In addition, there is traffic on the road whose access has to be secured throughout a given year/week, such as transport of different kinds of food products.
  - A small percentage (approx. 10%) of the gravel road network belong to this class in Finland.
  
- **Gravel road class II**
  - Spacings between junctions, which have average daily traffic 50 – 200 vehicles/day belong to this class.
  - A section with lower average daily traffic volume may belong to this class, if it plays a clearly significant role in the area's road network, or the land use of the road area sets special requirements for the road condition, for example there is heavy traffic on the spacing between junctions because of a large agricultural or cattle farm.
  - Also a spacing between junctions with higher average daily traffic volume than the limit value may belong to this class, if it has no significant role in the road network, or it's distance is short and no special requirements has been set for its condition.
  - Most gravel roads belong to this class in Finland (approx. 70 %)
  
- **Gravel road class III**
  - Spacings between junctions, which have average daily traffic less than 50 vehicles/day belong to this class.
  - This is the lowest gravel road class, where a higher service level cannot be justified by a high traffic volume.

The service level for gravel roads is defined based on different condition parameters, such as road surface evenness, consistency and dustiness. These parameters are assessed using five-step condition classification (1...5), where class 1 describes the poorest condition class and class 5 the best. Each gravel road class has a so called minimum level for the condition of the road surface and structure.

### 3.5. Elements of Gravel Road Condition

In Finland gravel roads play an important role in providing transport services for primary production (e.g. agriculture and forestry) and in tourism, which is why nearly as much attention is paid to gravel road maintenance as to the condition of paved roads.

Figure 2 illustrates how to determine gravel road condition.



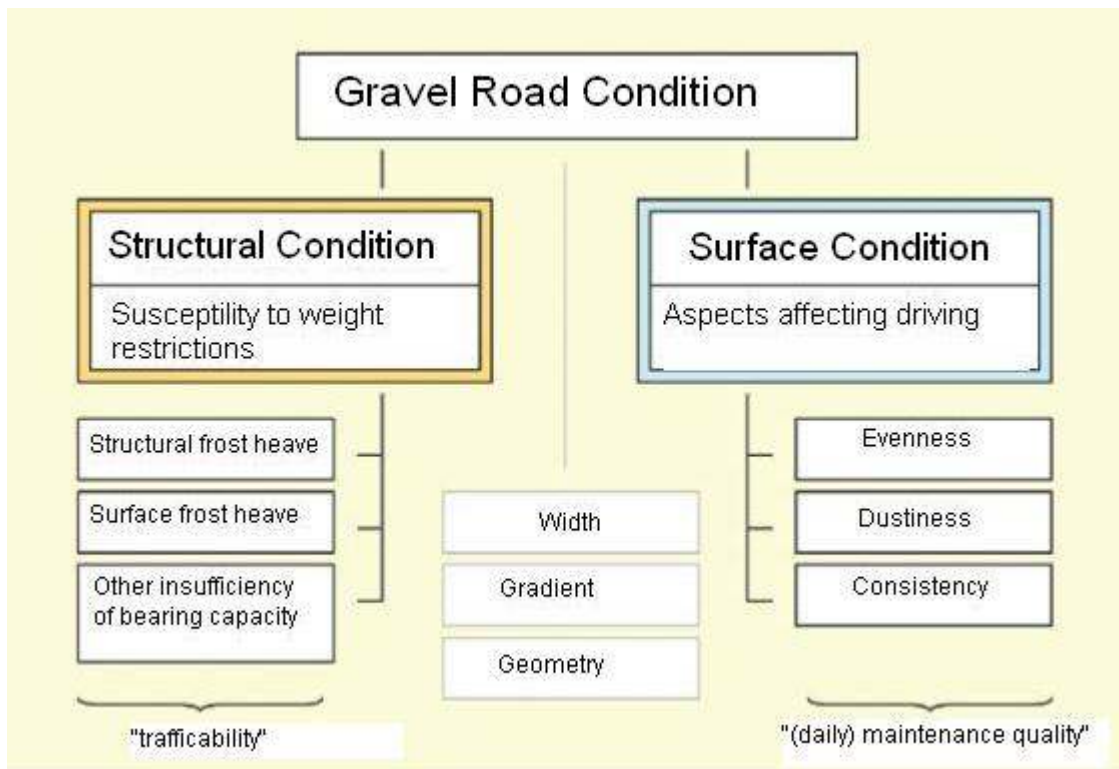


Figure 2: Elements affecting gravel road condition.[1]

To make it easier to plan maintenance measures and specify quality requirements, the operational policy divides gravel road condition into two parts: surface condition and structural condition of gravel roads.

The surface condition of gravel roads aims to ensure daily maintenance quality and structural condition requirements aim to ensure the bearing capacity of roads and accessibility through all the seasons of the year.

### 3.5.1. Gravel Road Surface Condition

The elements of gravel road surface condition are evenness, dustiness and consistency of the surface. Each element has a different quality level requirement. Evenness has the most important impact on driving comfort.

The quality level is assessed visually using a five-step condition category (1...5) based on photographs. Quality assessment is made for a randomly selected one-kilometre road section on each surface condition requirement (evenness, dustiness and consistency). Surface condition has to meet the minimum requirement level in all circumstances. Tables 2, 3 and 4 present the minimum level for each surface condition requirement.

Gravel Road Class	Basic Requirement for the Entire Road Network (Condition Category)	Condition Category 2 (Maximum Length)
I	3	0%
II	3	10%
III	3	20%
Special requirements: <ul style="list-style-type: none"> <li>• condition category 1 not accepted in any class</li> <li>• potholes &gt; 7 cm in depth not accepted</li> <li>• on road sections with poor visual clearance, potholes must not prompt a change in the driving line resulting in the use of the on-coming lane</li> <li>• maximum length of continuous section of condition category 2 is 20 m (classes II and III)</li> </ul>		

Table 2: Minimum levels for evenness in different gravel road classes.[1]

Gravel Road Class	Basic Requirement for the Entire Road Network (Condition Category)	Condition Category 2 (Maximum Length)
I	3	0%
II	3	10%
III	3	20%
Special requirements: <ul style="list-style-type: none"> <li>• condition category 1 not accepted in any class</li> <li>• the road has to meet consistency requirements in the class I within one week, in the class II within two weeks and in the class III within three weeks</li> <li>• single stones &gt; 30 mm in size not accepted</li> </ul>		

Table 3: Minimum levels for consistency in different gravel road classes.[1]

Gravel Road Class	Basic Requirement for the Entire Road Network (Condition Category)	Separate Land Use Sites
I	3	4
II	3	4
III	2	3
Separate land use sites (closer to the road than 100 m): <ul style="list-style-type: none"> <li>• residential area on the road</li> <li>• open-field cultivation of vegetables and berries</li> <li>• schools, institutions etc</li> <li>• other special sites</li> </ul>		

Table 4: Minimum levels for dust in different gravel road classes.[1]

The quality requirement level for all gravel road classes can be set higher than the aforementioned requirement levels. The requirements can be further specified based on the requirements of the road users and road area. Especially in the case of dust, attention is paid to detrimental effects to people. Road dust causes problems in places where residential areas and cultivated fields are within close vicinity of the road.

### 3.5.2. Gravel Road Structural Condition

Gravel road structural condition is affected by structural frost heave, surface frost heave and other factors connected to the bearing capacity such as the drainage system of the road (side ditch, drainage ditch and culverts). Each of these factors may cause weight restrictions. [1]

In Finland the majority of the gravel roads are unconstructed, and their structural condition is a sum of many factors. The structure condition of gravel road has several requirements the most important of which is year-round trafficability. Ensuring trafficability requires rehabilitation of the road structure, and management and prioritization of problem sections based on customer needs.

Repairs of the road structure are prioritized in such a way that the threat of weight restrictions can be systematically removed section by section. In line with operational policies, repairs are targeted to the gravel road classes I and II, where the traffic volume is the greatest, and which serve as a so called trunk network for different kinds of transport.

Table 5 presents structural requirements for different gravel road classes.

Gravel Road Class	Requirements for Road Structure
I Busy gravel roads	No weight restrictions in principle.
II Basic gravel roads	No weight restrictions in principle on network trunk routes.
III Low-volume gravel roads	The threat of weight restrictions is removed from the most important routes for heavy transport, for example a timber transport route, or connecting route to road-side landing/terminal area. Insufficiencies in bearing capacity repeated over several years are repaired.
Other rehabilitation measures: <ul style="list-style-type: none"> <li>• systematic drainage is used as a preventive measure, especially to reduce the softening of road structure, and consequently it lessens the threat of weight restrictions</li> <li>• frost heaves causing vehicle damage, or frost heaves occurring in unexpected places in terms of the traffic safety, are not acceptable</li> </ul>	

Table 5: Condition requirements for gravel road classes. [1]

As shown in the table, the poorest structural condition is accepted in gravel road III, where, nevertheless e.g. the most important wood production and storage areas are taken into account.

The structural condition of gravel roads is measured by two parameters: number of gravel roads in poor condition, and rehabilitation needs.

- **number of gravel roads in poor condition** means the total length of the sections between junctions on which weight restrictions are imposed often or annually.
- **rehabilitation need** means the total length of the road sections, which have to be repaired in order to avoid re-imposing weight restrictions on them.

The amount of rehabilitation needs of gravel roads in poor condition can be separately defined based on structural frost heave, surface frost heave or other measures affecting bearing capacity. Repair measures may include adding crushed material on the wearing course and improving drainage for example, or increasing bearing capacity using geotextile and crushed aggregate.

### 3.6. Quality Requirement Control and Implementation

Implementation of the quality requirements presented in the operational policies in regional maintenance contracts are controlled using the contractors' own quality systems, by a representative of the client and by an external quality controller employed by the client.

Quality implemented in the road network is assessed visually using specific pictures and by making single measurements. For example road evenness is assessed by measuring the depth of potholes on the road (maximum depth 7 cm), and the number of potholes in a specific length of a gravel road (1 km) for example. Road surface consistency is assessed by comparing the amount of loose gravel to sample pictures. Dustiness is also visually

assessed based on visibility. Special requirements for surface condition are presented in Tables: 2, 3 and 4. [1]

#### **4. OPERATIONAL POLICIES' IMPACTS ON GRAVEL ROAD CONDITION**

##### **4.1. Impact Assessment of the Operational Policies**

In preparing the policies, their potential impacts on the condition and maintenance of gravel roads were assessed. The assessment was made as a qualitative assessment by the experts participating in the project.

It was found that when introduced into practice, the operational policies will for example

- improve the condition of busy gravel roads
- maintain the current quality level of the main part on the gravel road network
- make it easier to identify special sites and offer better service level for them
- increase systematisation in planning repairs and defining quality levels
- target rehabilitation measures locally and regionally
- implement more measures with the same amount of money
- change the analysis perspective from a single target to spacing between junctions
- increase the use of salt in order to meet the consistency requirements of the road surface
- increase costs through improved structural bearing capacity in order to decrease susceptibility for weight restrictions.[1]

##### **4.2. Experience from Implementation of the Operational Policies**

Quality requirements of the new operational policies for gravel roads were introduced in part of the regional maintenance contracts in 2009. The new quality requirements were introduced into 13 regional maintenance contracts opened to tender. The total number of regional maintenance contracts is 82 in Finland. The first quality control in accordance with the new policies took place in the summer of 2010.

###### **4.2.1. *Experience from Contracts***

During the tendering process for the maintenance contracts, the contractors raised the issue of how difficult it is to meet the quality requirements in regard to evenness and dustiness for example. However, no clear increase in the costs was seen in the tenders for gravel road maintenance. The problems of dustiness and evenness have been recognized in the implementation of maintenance contracts.

The summer 2010 was hotter than usual in Finland and drought troubled many areas. Consequently, contractors had difficulties in preserving road surface evenness and consistency at the required level. In addition, the change in the assessment of the implementation of the quality requirements caused problems, because the so called old

quality requirements were applied to a part of the contracts, and consequently there was no uniform concept for assessment.

There is not yet a clear picture of the change of quality in the maintenance level of gravel roads after the first summer. The customer assessment implies that contractors have not yet internalized the new quality requirements and quality difference of different gravel road classes.

#### *4.2.2. Customer Experience from Planning*

Gravel road classification was established in the whole country by the end of 2009. The maintenance regions made an analysis of their gravel roads with the help of traffic volumes and different kinds of geographical information such as the property register, which specifies the purpose of the inhabited real estates, for example farms, holiday homes and permanent housing.

Based on expert assessment, it can be said that the objective of dividing gravel roads into different gravel road classes was attained as planned. Surface condition requirement is considered easier to satisfy than structural condition requirement (no weight restrictions, or seldom in the gravel road class 1). To satisfy the structural condition requirement would mean increasing the current level of funding, which is not possible in the short term. More focused planning makes it possible to pay attention to the special features of the areas and customers' special needs. Customer satisfaction can also be increased by paying attention to their needs.

The results from the road user satisfaction survey made in the summer 2010 did not yet reveal noticeable impacts from the new gravel road operational policies on customer satisfaction. Satisfaction remained at the same level as in the previous years and greatest dissatisfaction was caused by gravel road condition during the spring thaw season. In the summer gravel road unevenness and dustiness were experienced as problems. [5]

## **5. CONCLUSIONS**

In Finland the total length of the public road network is 78 000 km of which the share of gravel roads is one third, i.e. 28 000 km. In 2008 a project was launched to prepare policies for gravel road maintenance with the objective of standardising gravel road maintenance in Finland. The policies divide the classification principles of gravel roads into three categories (busy, basic and low-volume gravel roads) and the condition requirements for the surface and structure. The classification takes into consideration gravel roads' traffic volume, importance of the road network, roadside land use, and customer (road user) needs.

Surface condition requirements for gravel roads cover evenness, consistency and dustiness, which are assessed using a five-step scale. The best condition level is 5 and the poorest 1. The average level of condition requirement is 3. Condition level is assessed on a randomly selected gravel road section, and a uniform gravel road class and condition level is determined for a spacing between junctions at a minimum. The assessment is

made based on a uniform catalogue, which illustrates each surface condition requirement in different condition classes.

In regard to the structural condition, the objective is good bearing capacity and trafficability throughout the year. In Finland spring time causes most problems for gravel roads during the frost thawing season, which brings about the biggest deficiencies in bearing capacity. Structural condition on gravel roads is assessed based on the length (km) of sections with weight restrictions and bearing capacity rehabilitation targets. Susceptibility to weight restrictions is determined based on how many kilometres of the gravel road network have to have weight restrictions in the spring and early summer. Rehabilitation need, for its part, describes the gravel road length, which should be repaired in order to remove susceptibility to weight restrictions.

Classifying gravel roads into three gravel road classes has made maintenance planning more efficient in the maintenance regions. The impacts on the level of maintenance can be best assessed in regard to materialised surface condition. Rehabilitating structural condition to the desired level in different gravel road classes takes a longer time because of financial constraints

The experience from the new gravel road policies in Finland has been gathered just for one summer. The financial tenders for regional maintenance contracts have not yet shown cost impacts, which would result from the change in the quality requirement levels for the gravel roads. On the other hand, no clear change can yet be seen in the quality level between different gravel road classes, which fact is also supported by the results from the road user satisfaction survey of 2010.

## 6. TERMINOLOGY

**Road structural condition** describes the bearing capacity of a gravel road. A structurally sound gravel road has good bearing capacity and there is no need for weight restrictions. Structural condition is determined based on susceptibility to weight restrictions, which is classified into four categories (A,B,C,D).

**Susceptibility to weight restrictions** refers to the number of annual weight restrictions on a spacing between junctions. Weight restriction limits the mobility of heavy traffic on the road network under weight restriction. Weight restriction is usually set at 8 or 12 tons. Susceptibility to weight restrictions is classified into four categories:

- A = road has no weight restrictions
- B = road has seldom weight restrictions
- C = road has often weight restrictions
- D = road has annual weight restrictions

**Spacing between junctions** refers to a road section, which is bordered by two road junctions.

**Structural frost heave** refers to decrease in the bearing capacity of a road due to thawing of the road structure or subsoil. The problem is common in the whole of Finland.

**Surface frost heave** refers to the softening of the road surface (5 -15 cm), which substantially impedes traffic. Softening may be due to the thawing of the road surface, silting of the wearing course or big water content in the structure caused by exceptionally heavy rains.

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