



# An introduction to asset management for resource roads

**March 2015 – Technical report no. 7**

**By:**

**Mark Partington, R.P.F., M.Sc. Senior Researcher**



FPInnovations is a not-for-profit world-leading R&D institute that specializes in the creation of scientific solutions in support of the Canadian forest sector's global competitiveness and responds to the priority needs of its industry members and government partners. It is ideally positioned to perform research, innovate, and deliver state-of-the-art solutions for every area of the sector's value chain, from forest operations to consumer and industrial products. FPInnovations' staff numbers more than 525. Its R&D laboratories are located in Québec City, Montréal and Vancouver, and it has technology transfer offices across Canada. For more information about FPInnovations, visit: [www.fpinnovations.ca](http://www.fpinnovations.ca).

301009295: Asset Management

## CONTACT

Mark Partington, R.P.F., M.Sc.  
Senior Researcher  
Resource Roads  
514-782-4525  
[mark.partington@fpinnovations.ca](mailto:mark.partington@fpinnovations.ca)

Follow us on:



© 2014 FPInnovations. All rights reserved. Unauthorized copying or redistribution prohibited.

Disclosure for Commercial Application: If you require assistance to implement these research findings, please contact FPInnovations at [info@fpinnovations.ca](mailto:info@fpinnovations.ca).

# Table of contents

- 1. Introduction..... 4
- 2. What is asset management ..... 5
- 3. What are assets..... 5
- 4. What is an asset management plan ..... 5
- 5. What are the benefits of an asset management plan ..... 7
- 6. How is it applied to resource roads ..... 7
- 7. Key considerations ..... 8
  - Inventory and inspections..... 8
  - Life cycle costs..... 9
  - Levels of service ..... 10
- 8. Conclusion..... 11
- 9. References ..... 13

# List of figures

- Figure 1. Scheduled maintenance can reduce long-term costs ..... 9
- Figure 2. Performance indices can be developed for resource road assets. .... 11

## 1. INTRODUCTION

The management of resource road network infrastructure such as roads, bridges, culverts in a cost-effective manner while ensuring that the required performance needs are met can be a challenge. The large road networks, low traffic volumes, heavy vehicle weights and often limited resources all contribute to the unique environment in which resource roads are managed. Often, due to limited resources, a road is allowed to deteriorate to a level where the performance needs are compromised before a repair or renewal is implemented. This approach, while it may offer lower short-term expenses, can be a much more expensive approach when considering the long-term needs. An approach that offers an alternative is that of asset management.

Asset management utilizes a combination of management, financial, economic, engineering, operational and other practices applied to physical assets with the objective of providing the required service in the most cost-effective manner (Managing Infrastructure Assets, 2005). It provides a system in which a reactionary system of infrastructure management, i.e. waiting until partial or complete failure in service, is replaced by long-term planning that considers the complete aspect of infrastructure management such as operational and financial needs and objectives. Asset management utilizes many factors such as an inventory and inspection protocol, life cycle costs and levels of service and performance measures to develop a strategic management approach. In general, an asset management plan can offer the following benefits:

- cost effective use of available financial resources
- increased focus on asset performance and effectiveness
- increased satisfaction of road users
- reduction in long-term maintenance and repair costs

Implementing an asset management plan can be a challenge and requires extensive knowledge on the factors and concepts involved as well as an intimate knowledge of the operational and financial components of managing a resource road network. This report introduces the key concepts of asset management and provides an overview of many of the key factors to implementing a successful asset management plan.

## 2. WHAT IS ASSET MANAGEMENT

Asset management is often referred to as a strategic approach to the management of an owner's infrastructure. Asset management utilizes a combination of management, financial, economic, engineering, operational and other practices applied to physical assets with the objective of providing the required service in the most cost-effective manner (Managing Infrastructure Assets, 2005).

In essence, asset management provides the means in which to make strategic, informed decisions on the use of a company's infrastructure. It provides a system in which a reactionary system of infrastructure management, i.e. waiting until partial or complete failure in service, is replaced by long-term planning that considers the complete aspect of infrastructure management such as operational and financial needs and objectives.

## 3. WHAT ARE ASSETS

In the case of Resource Roads, physical assets or infrastructure may consist of not only the roads but also culverts, bridges, signage and any other physical assets that are part of the road network. Each of these assets may require or demand differing levels of management and attention depending on their service life expectations and costs. As a starting point for the implementation of asset management, and after an inventory and evaluation of current assets has been completed, the focus of an asset management plan may be on the highest cost and use items such as the road, bridges and major culverts. These assets, which may receive high levels of use and have high costs to install, maintain and replace may be the best area in which to focus what are often the limited capital and maintenance funding resources that are available. Lower cost and lower use assets such as secondary roads, signage and lighting may simply need to be accurately inventoried and inspected to ensure that they function as designed and intended.

Many road network managers may have accurate inventories of many of their existing road network assets but may not be using this information as part of an asset management plan. An asset inventory is a crucial component in implementing an asset management plan however utilizing this inventory in a strategic manner combining the various financial, operational and technical practices can help ensure that assets are managed in the most effective way.

## 4. WHAT IS AN ASSET MANAGEMENT PLAN

The consideration of the key practices of asset management can be used to create a long-term plan for the use of the infrastructure. There are seven principal components that comprise an asset management plan (International Infrastructure Management Manual, 2011). These components include, common in management plans includes:

- **Life cycle approach.** This recognizes that the life cycle costs of the identified infrastructure will be considered. Life cycle costs include such aspects as capital, maintenance, replacement and financing costs, throughout the service life of the asset.

- **Financial management strategy.** This strategy recognizes the financial aspects and considerations for various activities such as maintenance, rehabilitation and replacement in order to achieve cost-effectiveness.
- **Performance management.** The expected, current and optimal levels of service for the asset are identified as well as indicators on how that performance is measured.
- **Demand management.** The current and expected usage of the asset are identified and forecasted. Factors such as possible changes in usage and the type of users are recognized.
- **Risk Management.** The risks for changes in service and performance of the assets are identified. The impacts, operational and financial, have been considered if there is a change in the service or performance.
- **Sustainability.** The asset management plan considers that the asset services are to be delivered and are expected to perform in a sustainable and affordable manner.
- **Continual improvement.** The need for the implementation of a feedback loop to provide for evaluation and inspection of assets has been identified.

These components, though common in many asset management plans, may be implemented to varying degrees depending on the assets under management and the scope and financial resources that are available.

More specifically, an asset management plan is intended to answer the following questions of the assets under management (Managing Infrastructure Assets, 2005):

- **What do you have and where is it?** This refers to the requirement to have a detailed inventory of the asset being managed. The characteristics to be included in the inventory should at least be detailed enough to sufficiently identify the asset, i.e. culvert length, diameter, material, date of installation. The inventory will need to expand beyond these basic characteristics in order that performance expectations and service life analysis may be performed.
- **What is it worth?** The replacement value of the asset needs to be determined and should include factors such as purchase and installation price.
- **What is its condition and expected service life?** The condition of the asset and its ability to meet current performance expectations is a critical component to asset management. The implementation of an asset inspection procedure is essential to ensure that a strategic approach may be taken in the management of the asset. It is important that a structured inspection protocol is performed and documented. The frequency and necessary detail of the inspection can be determined, in part, in the value of the asset.
- **What is the level of service expectation and what needs to be done to achieve it?** Developing a plan for the asset must consider varying options on how long the asset is expected to perform and what maintenance and replacement interventions are required to achieve the service scenarios. Calculating the life cycle costs (maintenance, renewal and current and future replacement) is a key component of developing the plan.



- **When do you need to do it?** Estimating the remaining service life of an asset can be performed based on the current conditions and historic conditions extracted from inspection data. If long-term detailed inspection data exists, deterioration rates can be developed by comparing current conditions with those conditions which existed at previous inspection periods.
- **How much will it cost and what is the acceptable level of risk(s)?** Costs must be forecasted for the short and long term use of the asset. This forecasting will draw from the asset value, condition and service life that has been determined. Understanding the risk tolerance in the acceptable change or deterioration of an asset will influence the short and long term cost projections.
- **How do you ensure long term affordability?** Understanding the required budget forecasts based on the short and long term plans is important to ensure that future financial requirements can be met. Forecasting can also aid identifying the impacts during periods in decline of infrastructure budgets.

## 5. WHAT ARE THE BENEFITS OF AN ASSET MANAGEMENT PLAN

Asset management provides a means in which to take a long-term strategic approach to current procedures and to continuously evaluate how business and operational decisions are made. An asset management approach enforces the need to take a business approach to infrastructure management decisions. The implementation of an asset management plan can allow for infrastructure to be built and maintained in a cost-effective manner that improves operational performance, assigns the best value for financial resources and ensures continuous improvement.

The benefits of implementing an asset management plan can vary depending on the degree and scope in which the plan is implemented. A plan that focuses on a few principal assets will have a differing organizational impact than an asset management plan that encompasses all resource road assets. In general, an asset management plan can offer the following benefits:

- cost effective use of available financial resources
- increased focus on asset performance and effectiveness
- increased satisfaction of road users
- reduction in long-term maintenance and repair costs

## 6. HOW IS IT APPLIED TO RESOURCE ROADS

The management of low-volume gravel resource roads can offer unique challenges as compared to those road networks that are managed under a public system such as at the federal, provincial or municipal road management level. There are both operational and financial differences that can impact the degree, scope and benefits that can be derived from the implementation of an asset management plan.

The costs to construct and maintain resource roads are typically much less than the public road system and this would indicate that perhaps there are fewer financial gains to be made in implementing an asset management plan. However, the lack of harmonized design and construction standards, decreased focus on performance management and large road networks shared by many users can create strong benefits with the implementation of an asset management plan on resource roads.

Asset management planning does not need to be applied to all assets under management and does not need to be applied all at one time. The principal pieces of infrastructure to ensure the highest costs may be of primary focus. This can include the implementation of a bridge asset management system where the objective is to manage bridges in a cost-effective manner. Implementing a strategic decision making process may also be considered of principal importance to the primary or class 1 road segments. These road segments which are intended for long-term use, with high-traffic volumes and potentially multiple users can be very costly to maintain. The application of asset management principles can help to optimize the often limited financial resources while meeting the service levels and needs of the users.

## 7. KEY CONSIDERATIONS

### **Inventory and inspections**

An asset management plan must be based on a reliable, detailed inventory of the assets that need to be managed. A detailed inventory provides the required information of the asset in which service life, life cycle costs and performance expectations can be determined.

Knowing where assets are located is just the start to an effective asset inventory. The characteristics (material, dimensions) and performance (environmental and operational) of the asset must be recorded and through an inspection protocol. This information can identify the asset performance details to determine average service life and when maintenance or replacements are required. This information can then be used to develop short and long term budgets.

When a detailed inventory and performance database exists, this information can be analyzed to identify trends and to aid in developing a cost-effective asset management plan. For example, by analyzing and comparing the characteristics of an asset, such as culvert material and culvert performance, an understanding of materials that provide for the longest service life can be realized. The knowledge of service life can then be combined with the life cycle costs and service requirements to identify the best culvert material for a given situation and location.

Creating a detailed inventory for all resource road related assets can be a large task for any organization. The most important assets with the highest significant operational and financial impacts should be considered as a first step for inclusion in an asset management plan. Assets such as bridges, culverts would be expected to take priority over lower cost infrastructure such as signage.

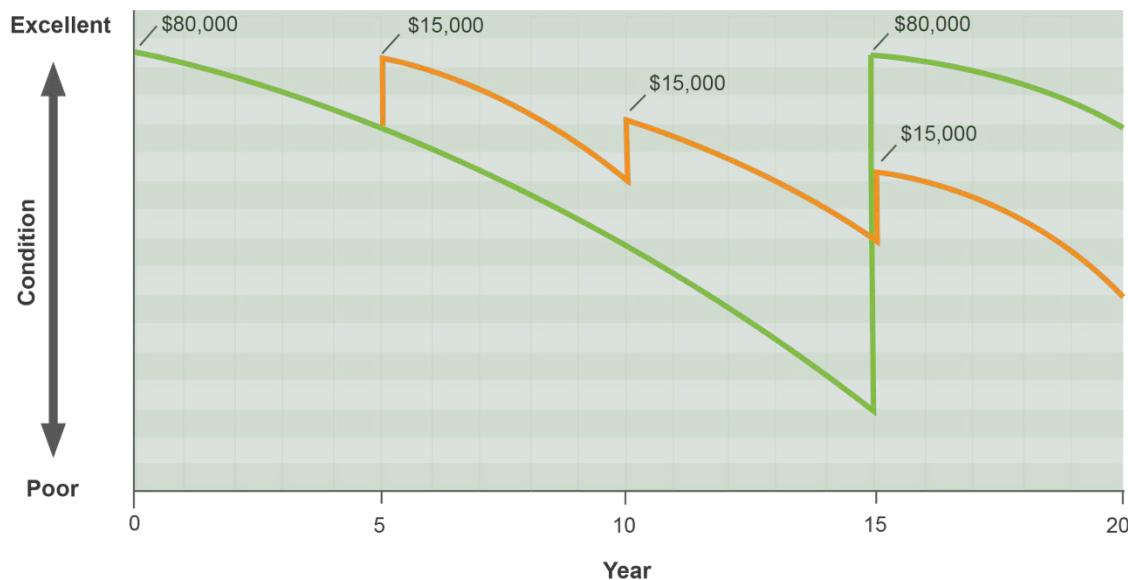


## Life cycle costs

Life cycle costs include the total cost of the asset that would be anticipated throughout the lifespan of the asset. The total costs include all costs from the initial planning through to the period in which the asset is removed and disposed; this can include costs attributed to planning, installation, maintenance, rehabilitation and replacement. The implementation of life cycle costs re-focuses the financial management of an asset away from the direct costs for purchase and installation to include other aspects such as maintenance costs and usable service life of the asset.

By considering life cycle costs a resource road manager may identify that it to be more cost effective to install a higher cost product such as a bridge instead of a culvert when a longer service life is expected with lower maintenance costs. Or it may be found that by increasing spending by 10% in yearly maintenance that the service life of the asset can be extended to a much greater degree, thereby delaying asset replacement and reducing the overall costs for an asset at a given location.

An example of the impacts of scheduled maintenance activities is shown in figure 1. Two scenarios are shown, one where no scheduled maintenance is planned and where the road is completely rehabilitated at year 15 and a second scenario where scheduled maintenance is planned every 5 years. In this first scenario, when no scheduled maintenance is performed, a cost of \$80 000 is incurred to rehabilitate the road, in the second scenario, renewing the road every 5 years at an expense of \$15 000 saves \$35 000 in total costs.



**Figure 1. Scheduled maintenance can reduce long-term costs**

Without formally recognizing an asset management plan, many resource road managers are already implementing some of the key principles of life cycle costs and levels of service. This includes such practices as installing low cost water crossing structures on short-term roads and prioritizing the use of crushed gravel on primary or class 1 roads. Without having performed the complete life cycle costs analysis, many of the basic decisions of allocating resource road funding have already been made.

## **Levels of service**

The core principal of asset management is balancing the desired levels of service and performance of an asset with the complete life cycle costs of servicing the asset to the desired levels. It is identifying the quality of service that the users desire with costs to obtain the level of service.

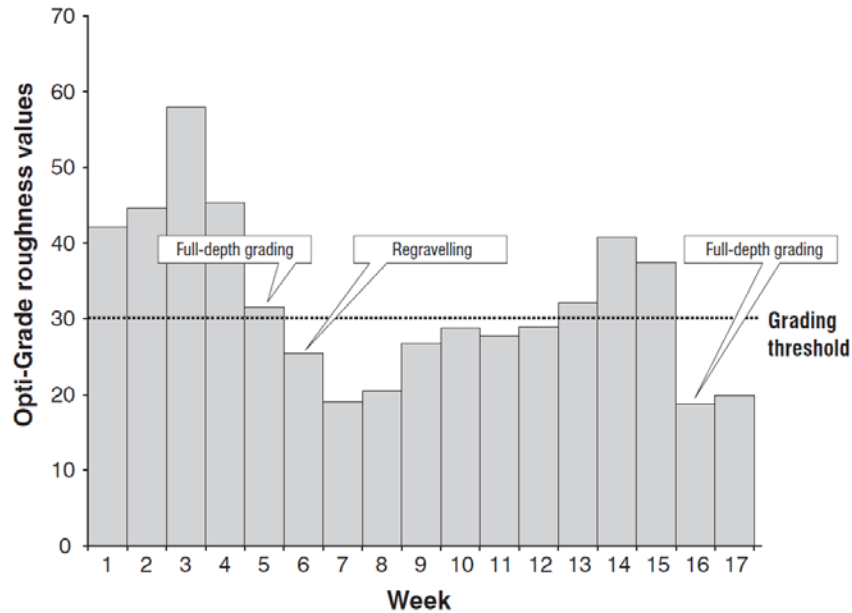
In general, for a higher level of service expect to have a higher total life cycle cost and a lower risk of that asset not performing to the required level of service. With a lower level of service, the life cycle costs may be less but there will be a higher risk of that asset underperforming and negatively impacting other resource road assets.

When considering the levels of service in which the asset is managed it is important to determine:

- Current levels of service of the asset.
- User expectations on the performance and quality of service from the asset.
- Measurable indicators of performance.
- Annual costs to provide current and projected levels of service.

When implementing an asset management plan and determining the desired levels of service it is necessary to track the performance of the asset through performance measures or key performance indicators. These performance measures can then be tracked through operational indicators which can be collected through field based inspection and inventory protocols or through financial indicators. For example, the performance of a road segment and the quality of service it provides could be indicated by road roughness measurements, grading frequency or maintenance cost per kilometer of road, user feedback, amongst others.

The use of road roughness as a performance measure for resource roads is illustrated in Figure 2 (Légère and Mercier 2004). In this example, road roughness, as measured by FPIInnovations Opti-Grade™, is used as a performance measure to determine when grading and other maintenance activities such as gravelling are performed. In this chart, a road roughness value has been defined as a threshold on when grading should occur and the impacts on the roughness performance measure can be seen by the grading and gravelling activities.



**Figure 2. Performance indices can be developed for resource road assets.**

Key components to the desired levels of service of an asset are the requirements to meet environmental or safety regulations. These regulations are often strict requirements that need to be met and can be more critical than the desired levels of service from the user. For example, a culvert may continue to provide the necessary water passage levels (an operational requirement) for a given location but if it is no longer able to provide for fish passage (an environmental requirement) then a repair or replacement of that culvert will need to be considered. When determining the levels of service for an asset, the operational, environmental and safety factors must all be considered.

## 8. CONCLUSION

The implementation of an asset management plan for resource road infrastructure can offer significant long-term financial and operational benefits. Asset management provides a framework in which long-term strategic decisions can be made with the objective of providing the required service in the most cost-effective manner. It allows a process in which the resource road manager uses factors such as life cycle costs and levels of service, amongst others, to make informed decisions on the best way to spend the available financial resources while meeting the asset performance needs and expectations of the user. In its simplest form asset management moves away from the “fix it when broken approach” to a strategic preventative maintenance and renewal strategy.

The basis for an effective management plan is a detailed inventory of the asset. This inventory, when linked with an accurate and repeatable inspection protocol, is the basis in which asset performance and current and forecasted conditions can be developed.

Implementing a complete asset management plan for all resource roads assets can be a challenge for a user who desires to implement this management system. It would be recommended that the highest value assets (bridges, primary roads with high traffic volumes) be considered first when evaluating whether to implement an asset management plan.

## 9. REFERENCES

Federation of Canadian Municipalities (FCM) and National Research Council (NRC). 2005. Decision Making and Investment Planning, Managing Infrastructure Assets. InfraGuide.

INGENIUM and IPWEA. 2011. International Infrastructure Management Manual (IIMM), Association of Local Government Engineering New Zealand Inc. and National Asset management Steering Group, Thames, New Zealand.

Légère, G., Mercier, S. 2004. Material and performance specification for wearing-course aggregates used in forest roads. In A. Dawson (Ed.), *Pavements Unbound, Proceedings of the 6<sup>th</sup> International Symposium on Pavements Unbound* (345-353). Nottingham, England. A.A. Balkema Publishers.



## Head Office

### Pointe-Claire

570, Saint-Jean Blvd  
Pointe-Claire, QC  
Canada H9R 3J9  
T 514 630-4100

### Vancouver

2665 East Mall  
Vancouver, BC.  
Canada V6T 1Z4  
T 604 224-3221

### Québec

319, rue Franquet  
Québec, QC  
Canada G1P 4R4  
T 418 659-2647



OUR NAME IS INNOVATION