Morice & Lakes IFPA

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Morice & Lakes Innovative Forest Practices Agreement

Project Summary

Ecosystem Management

Forest Productivity

Public Involvement

Adaptive Management

The ecosystem management component of the Morice & Lakes IFPA has embarked on several projects that assess biodiversity, ecological attibutes, and fish and wildlife habitat. These projects provide important ecological data used in learning scenario development for the IFPA.

Stream Crossing Quality Index Pilot Project

Introduction

An important goal of sustainable forest management (SFM) is to minimize negative impacts to water quality, the biggest often being accelerated sediment delivery to aquatic environments (MacDonald et al. 1991). Road building, maintenance and use, particularly in the vicinity of stream crossings, has been recognized as an important source of sediment delivery (Beaudry 2001, Beschta 1978, Bilby et al. 1989, Cafferata and Spittler 1998) (Figure 1).

The Morice and Lakes Innovative Forest Practices Agreement (IFPA) has recognized this as a potential issue and, in response, has developed two SFM indicators to help them monitor practices and ensure that water quality is indeed being protected (i.e. Indicators #7 and #52). Both of these indicators, described in detail in the SFM plans, are based on the use of a field-based inspection procedure that can evaluate the size and characteristics of road-related sediment sources at crossings and the potential for the eroded sediment to reach the stream environment. The intent of these indicators is to systematically identify the location and frequency of problematic stream crossings at the watershed level.

The IFPA has identified the Stream Crossing Quality Index (Beaudry 2004) as a procedure that could be used to complete the inspections required for indicators #7 and #52. In order to better understand the advantages and disadvantages of this tool, it was decided that a pilot project would be initiated in 2005 on a test case watershed, where the SCQI could be implemented. This report summarizes the methodologies used and the results of that pilot project.

Objectives

The objectives of the 2005 SCQI pilot project were to:

1. Complete SCQI surveys on 100 stream crossing within the Lamprey Creek watershed, which has been identified through the SFM planning process as being a sensitive watershed (Figure 2).
2. Analyse the SCQI data and present the results to the IFPA in a written document and an oral presentation.
3. Deliver a field-based training session on how to complete the SCQI surveys and what the results mean.

Figure 1. Sediment generated from a long ditch line that flows directly into a stream at a road crossing (this photo is not from the Lamprey Creek watershed).

Methods

Planning

As an SFM indicator, the basic assumption that underlies the SCQI is that if erosion and sediment delivery in the vicinity of stream crossings is minimized, through proper road building and maintenance practices, then the potential impact to water quality from increased sediment delivery is also minimized (Figure 3). The SCQI was developed as a systematic and repeatable procedure used to describe all sediment sources present at a stream crossing, evaluate the potential for each of these sediment sources to deliver sediment to the stream network, and generate a "sediment source" hazard score.

The execution of an SCQI survey begins with the mapping of current access within the watershed and planning an effective and efficient way of completing the field assessment. The intensity of sampling is usually determined by a combination of field access and project budget. For this particular project, the sampling intensity was mostly defined by budget, which allowed for the sampling of 100 stream crossings located throughout the Lamprey Creek watershed. During the planning phase of this project we identified approximately 150 stream crossings in the Lamprey watershed based on the stream network provided on the TRIM 2 maps. Since it was not possible to sample all stream crossings with the allocated budget, a sampling strategy was designed so that as much as possible of the variability across the entire watershed could be sampled. The selection of stream crossings to be sampled in 2005 was based on the following criteria:

1. Complete surveys on 100 stream crossings.
2. Complete the surveys throughout the watershed, not just concentrated in one or two operating areas.
3. Sample a full range of stream crossing types which would include streams of various sizes, crossings of various ages, different structure types and both active and non-active roads.
4. Concentrate the surveys where road access is reasonable (4X4 truck and ATV).
5. Avoid roads that are totally de-activated and are over-grown with shrubs, bushes and trees. There are two basic justifications for this particular criterion: 1) surveys of crossings on these types of roads are very time consuming because of poor access and thus less crossings get done in a given time and 2) access to these sites with ATVs often create the exact erosion problems that the good erosion control is actually trying to prevent (i.e. ATV caused erosion).

The 2005 SCQI surveys in the Lamprey Creek watershed successfully met all of these criteria. In total, 101 crossings were surveyed and they represented the full spectrum of crossing types in the watershed. Although the TRIM maps indicated about 150 crossings in total, there were in reality about 120 crossings in the field. Thus the actual sampling intensity represented about 85% of all crossings in the Lamprey Creek watershed.

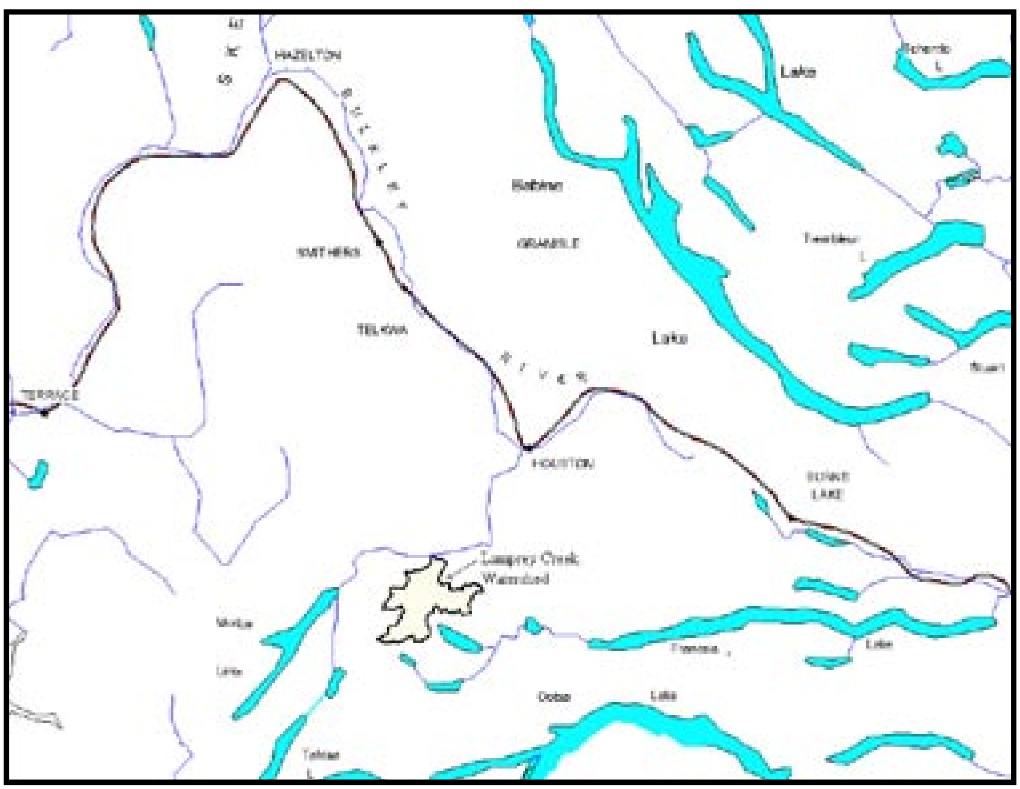

Figure 2. Location of the Lamprey Creek watershed.

Figure 3. Hay mulch and seeding used for erosion control at a stream crossing.

Survey Execution

Stream crossings are typically accessed using 4X4 trucks, ATVs or by walking. Once the surveyor has arrived at the stream crossing, the procedure begins by evaluating the size and characteristics of all sediment sources that can potentially contribute sediment to the aquatic environment. Each stream crossing is divided into eight distinct and independent "elements". These include four road ditches that run into the stream, two road fill slopes and two road running surfaces, each of these potential sediment sources being assessed independently. The sediment source hazard score for each individual element is a product of the erosion potential and the delivery potential of that source. A detailed description of the methodology used to compute the scores is provided in P. Beaudry and Associates Ltd (2005).

The first step in the computation of the score is the evaluation of the erosion potential, which is calculated as a function of several physical characteristics of the sediment source and includes:

1. the size of the sediment source,
2. the soil texture of the source,
3. the slope gradient of the source,
4. the percentage of non-erodible cover,
5. the level of road use (for road surface), and
6. the shape of the ditch (for ditch elements).

The cornerstone of the SCQI procedure is the measurement of the size of the sediment source (m^2) that can potentially deliver sediment to the stream. The other variables that are measured act as modifiers to increase or decrease the score associated with the size of the sediment source. The size of the sediment source (m^2) is multiplied by the value of each modifier to generate an erosion potential score for the particular element being assessed. The erosion potential is then multiplied by the delivery potential (scaled from 0 to 1) to obtain the element score.

The delivery potential is computed based on the actual physical characteristics of the sediment control structures that are present downslope of the sediment source, which include:

1. the type of sediment control structures (retention or filtration),
2. the size of the sediment control structure relative to the size of the sediment source,
3. the effectiveness of the sediment control structure to impede delivery of suspended sediment to the stream, and
4. the spatial location of the sediment control structure in relation to the stream.

The total score for the crossing is the sum of the scores for each of the eight individual elements. The final SCQI crossing score is used to classify the crossing into one of five sediment source hazard classes, called Water Quality Concern Ratings (WQCR) (Table 1).

The SCQI procedure is a useful management tool because it identifies the specific location and magnitude of erosion problems. If hazards are high (i.e. high score), the crossing can be improved through remedial actions and current practices can be altered to

Table 1 Correspondence between SCQI score, water quality concern rating (WQCR), expected increase in turbidity and risk to fish habitat.

SCQI crossing score	Water Quality Concern Rating (WQCR)	Expected increase in turbidity caused by the crossing for a stream of approximately 1 m in width (NTU)	Risk to fish habitat (DFO 2000)
0	None	None	None
$0 < \text{score} < 0.4$	Low	1 to 8	Very low
$0.4 \leq \text{score} \leq 0.7$	Moderate	8-70	Low to moderate
$0.8 \leq \text{score} \leq 1.6$	High	70-130	High
Greater than 1.7	Very High	> 130	Unacceptable

Figure 4. Old de-activated crossing – site PC022.

Figure 5. New bridge crossing – site PC030.

avoid high scores in the future. If hazards are low, then it shows that good erosion and sediment control practices are being implemented and by extension water quality is being protected. The procedure was presented to IFPA field practitioners in a series of field workshops (October 19 and 20, 2005) and received a favourable response because it clearly identifies the specific location of the problem and the practice that generates the problem (if problems actually do exist).

Results

Sampling was conducted throughout the roaded portion of the Lamprey Creek watershed. SCQI surveys were conducted on a full range of crossing types, ranging from old de-activated crossings to newly built bridges (Figures 4 and 5). Access to all stream crossings was done on 4X4 ATVs.

A total of 101 stream crossings were surveyed in the Lamprey Creek watershed in 2005, of which only 6.8% (7 crossings) received a WQCR of High or Very High (Figure 6). Of the 7 crossings that were classed as high or very high, three of them were in areas with newly exposed mineral soil, either new roads or newly maintained roads. Most of the crossings surveyed (86%) were located over small streams (less than 1.5 m in width) and only 3% of crossings surveyed were located over large streams (greater than 5 m in width). Overall, water quality concerns (i.e. potential increases in stream turbidity caused by road crossings) were very low in the Lamprey Creek watershed with 93% of the crossings surveyed generating a score of 0.7 or less (i.e. moderate or lower concern).

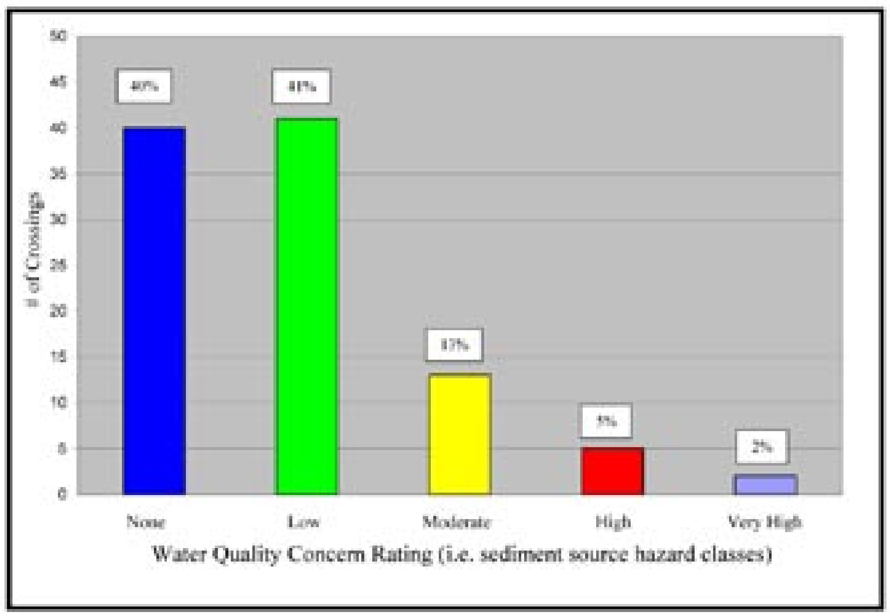

Figure 6. Distribution of Water Quality Concern Ratings for the 101 stream crossings surveyed in the Lamprey Creek watershed in 2005.

Discussion

The SCQI procedure was initially designed and validated for the kind of rolling terrain that is dominant in the central interior area of British Columbia (and which is well represented by the terrain of the Lamprey Creek watershed). Consequently, the application of the SCQI procedure in this pilot project was very successful and did not identify any implementation problems or issues. The results appear to have provided the kind of information that IFPA forest licensees were looking for. The results of the survey show that there was a very low percentage of stream crossings that had a high sediment source hazard rating. This was expected because most of the roads in the watershed were built many years ago and are now stable with minimal erosion occurring. For rolling type topography, road related erosion problems typically occur in one of the following situations: 1) new roads where large surface areas of soil have been recently exposed, 2) recently de-activated roads that are still accessed by 4X4 vehicles and ATVs, 3) active roads that are dominated by fine textured soils and where there is limited coarse materials for surfacing (e.g. the Peace area) and 4) stream crossings that are located in dips where long stretches of roads flow directly into the stream from both sides of the crossing. In the Lamprey Creek watershed we encountered only a few occurrences of these challenging situations. Of the 101 crossing sampled, there were three that represented situation #1, and four crossings that represented situation # 2 described above. The remainder of the streams crossings did not present any significant erosion and sediment delivery problems, which suggests that water quality is reasonably well protected in this watershed. Thus the SCQI tool served well as an *indicator* of water quality.

Recommendations

The results suggest that the SCQI procedure works well as an objective, repeatable and transparent methodology that can be used to assess the extent and location of road related sediment source hazards as they relate to possible negative impacts to water quality. It is a good procedure to use for Indicators 7 and 52 and was well received by the forestry practitioners attending the October 19 and 20th field workshops. It is recommended that its application be focused on sensitive watersheds, as suggested in Indicator 52, so that implementation costs can be controlled to an acceptable level.

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