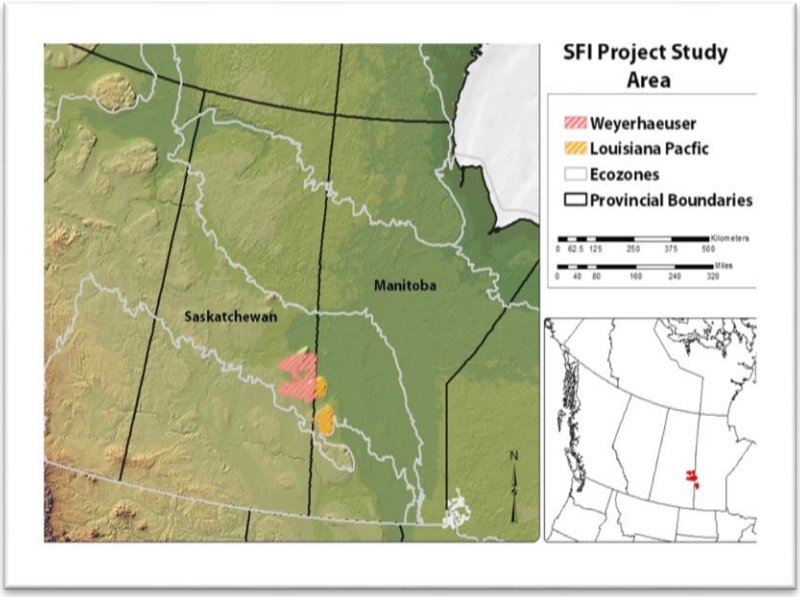
Best Management Practices for Wetland Crossings

Results of Hydrological Monitoring

Synthesis of: Badiou, P. and B. Page. 2014. SFI Wetland Crossing BMP Project Hydrological Monitoring Design and Data Summary: Final Report

ABOUT THE PROJECT

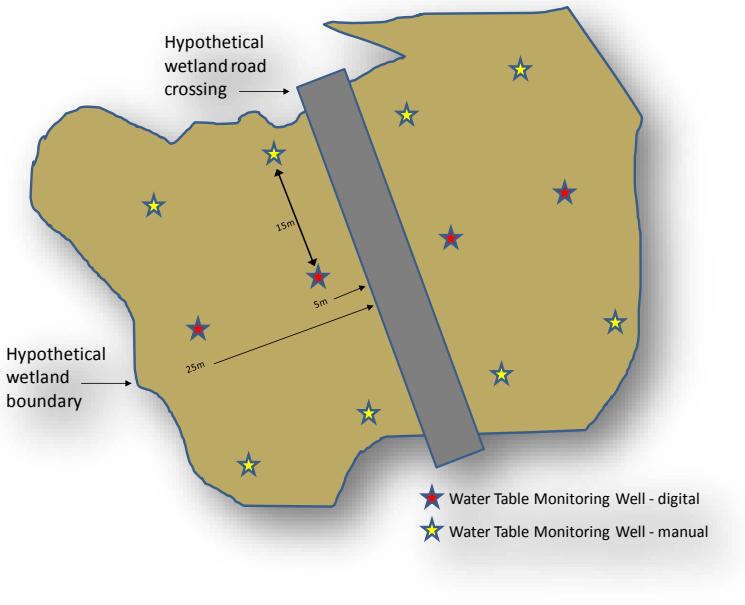
Road networks, both temporary and permanent, are necessary for accessing natural resources in the boreal forest. Forest roads can alter hydrology by 1) affecting the movement of water 2) reducing the amount of water that enters soils, 3) capturing and channelizing surface runoff, and 4) modifying subsurface flow paths. These changes to water quantity and flow characteristics can also result in changes to water quality through sedimentation and erosion. Compared to understanding of potential impacts of forest roads on creeks, streams, and rivers, effects of roads on boreal wetlands are less well understood. Further, very little guidance is available for the practitioner to mitigate these effects. As a starting point to resolving some of these challenges, a three-year project supported by a conservation grant from the Sustainable Forestry Initiative and by Ducks Unlimited Canada, FPInnovations, Louisiana-Pacific Canada Ltd., Weyerhaeuser Canada and Spruce Products Ltd (Project Partners) was initiated (2010-2013).



Based on a combined understanding of wetland ecology, operational requirements, local conditions, and road construction techniques, the Project Partners developed crossing designs to accommodate predicted flow characteristics of stagnant, slow moving and seasonally fluctuating wetland types in the Pasquia Hills and Duck and Porcupine Mountains straddling the Manitoba Saskatchewan border. Crossings were constructed based on the new designs for each of three wetland classes: shrub swamp (fluctuating), conifer swamp (stagnant) and treed fen (slow moving) [1]. In addition, hydrologic monitoring took place at one conventional single culvert

crossing through a treed fen, in place for at least 10 years. Each of these three classes was selected to be representative of a broader suite of wetland classes with similar water flow characteristics[1].

One objective of this project was to determine if the proposed best management practices used to construct wetland road crossings maintained the hydrologic properties of wetlands crossed. Hydrological monitoring[2, 3] took place at each crossing for two seasons during the frost-free seasons in 2012 and 2013. Water quality and water movement was assessed at water table monitoring wells located very close to and further away from each of the crossings both upstream and downstream (schematic right). This research note briefly summarizes results and some take home messages based on hydrologic monitoring[2].



RESULTS

The design of this field trial did not allow for statistical comparison among the various sites that were monitored or between new and old crossing designs. Interpretation of results is qualitative and based on limited sample sizes.

Water table elevation – If the new crossings were interfering with water movement we would have expected differences in water quantity upstream and/or downstream of the crossing. At most sites, water table response and net change in water table elevation was similar upstream and downstream of each of the crossing sites. When differences were observed – they occurred immediately next to the crossing and appeared to dissipate with distance from the crossing. Noticeable differences in water table elevation, as well as pooling upstream of the road, did occur at the one conventional culvert crossing in the Pasquia Hills. However, even at this site the differences observed seemed fairly minor although they did extend further from the crossing relative to the new designs used at the crossing that were monitored in the Porcupine Hills and Duck Mountains. In addition there was evidence of dead trees upstream. Therefore new crossing designs generally appeared to maintain natural flow regimes and water table elevations in the first two years of use.

For new crossings, regardless of flow characteristics, changes in water table elevations appeared to be driven more by local precipitation events than the actual road crossing. Other topographic differences, such as the presence of a channel also appeared to play a larger role in water table elevation differences than the influence of the crossing.

Water quality – Changes in water quality, as indicated by nutrients and minerals were measured upstream and downstream of each crossing (immediately adjacent the road and away from the road). For example increases in nutrients such as nitrogen, phosphorous, magnesium and calcium could indicate an impact of the crossing as a result of erosion or reduction in flow.

In general differences in water quality was only observed in samples taken immediately adjacent to crossings. For example, at one crossing, increases in both magnesium and calcium were detected. On numerous occasions, precipitation was observed to cause erosion of the road base material indicating that erosion of road base material likely caused many of the differences in water quality parameters observed. Soil material used to cover the corduroy at the crossing may be increasing concentrations of these constituents whether through dissolution or erosion.

FUTURE RESEARCH

- Single crossings, individually, may have a very small impact. However the effects of multiple crossings may have cumulative impacts within a boreal watershed that are greater than the sum of its parts. Therefore future studies should assess landscape and watershed effects of a network of crossings.
- Though it was impossible to do so for this study, future studies should strive to measure pre-construction reference conditions, as well as pre and post-construction monitoring to fully understand how the new crossing designs being implemented function at the watershed level.

THE TAKE HOME

- New crossing designs appeared effective in minimizing hydrologic effects of roads by allowing water to flow through and reducing effects on water quality.
- When impacts on water quality were observable these occurred immediately adjacent the road and were likely a result of erosion of road base material. Therefore, additional effort to reduce erosion from the crossings, including ensuring geotextile is extended beyond the toe of the slope to the end of the corduroy, could mitigate some of the water quality differences that were observed.
- Impacts of any one crossing, conventional or newly designed, were fairly minor overall however an examination of cumulative effects may reveal watershed level effects of multiple crossings.
- Based on the results of the monitoring, construction of wetland crossings that have been designed to accommodate predicted water movement (such as those designed and constructed for this project) should be continued. However, the effectiveness of these new designs for different wetland classes with similar flow characteristics has not been tested.
- It is possible that the impacts of the crossings on hydrology and water chemistry may become detectable after a number of years (older crossing had more differences). Crossings should be examined regularly to confirm they appear to be working as expected

Technical information regarding installations, methods and results are available in 3 documents available upon request. Monitoring design and data interpretation provided by Ducks Unlimited Canada.

1. *Operational Guide: Forest Road Wetland Crossings learning from field trails in the Boreal Plains Ecozone of Manitoba and Saskatchewan, Canada.*
2. *Badiou, P. and B. Page. 2014. SFI Wetland Crossing BMP Project Hydrological Monitoring Design and Data Summary: Final Report*
3. *Philip Kochuparampil. 2013. Field Note: Installation of water table monitoring wells at resource road wetland crossings. https://fpinnovations.ca/ResearchProgram/Documents/resource-roads-and-wetlands/water-table-wells-fn-11-13.pdf*