THESIS

STREAMFLOW RESPONSE TO FOREST MANAGEMENT: A META-ANALYSIS USING PUBLISHED DATA AND FLOW DURATION CURVES

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ABSTRACT OF THESIS

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The effects of forest management on streamflow have long been a concern for land managers. A clear understanding of this relationship is difficult because studies on the hydrologic influences of forests are highly variable in their conclusions. This project was undertaken to help reduce the confusion by evaluating results from these studies.

An initial analysis of changes in peak and low flows was conducted using reported results from approximately 160 papers. The effects of logging on peak flows ranged from -36% to 563% relative to pre-treatment flows. Most changes were less than 35% and approximately one-third were reported as not significant. Large relative increases were uncommon and associated with severe site disturbance and smaller peak flows. The largest peak flows were typically little affected by timber harvest. Afforestation studies generally showed a decrease in the size of peak flows as the trees matured. Low flows typically increased after logging and decreased after afforestation.

Mean daily flows from paired basins were used to generate flow duration curves for a second analysis of streamflow changes after forest management. Absolute and relative changes in flow were determined for 11 flow percentiles after adjusting for climatic differences between pre- and post-treatment periods. This consistent methodology was used to minimize variability between studies and to determine the changes in runoff over time due to forest management.

The flow duration curve data showed that the highest flow had the smallest relative increase (median = 12%) while the lowest flow increased the most (59%) Low flows recovered within three to four years after logging while increases for larger flows persisted ten or more years. Afforestation studies again showed streamflow decreasing with regrowth.

There were few strong relationships between the changes in flow after logging and basin characteristics or management activities. Significant basin characteristics included annual precipitation, hydrologic regime, mean elevation, mean basin slope, drainage density, and vegetation type. Significant management activities included percent area harvested, silvicultural method, yarding method, and the use of buffer strips around waterways. Insufficient data precluded a similar analysis using afforestation results.

This study shows the complexity and variability of the hydrologic response to forest management. Despite the lack of strong predictive relationships, the results do show a difference in how high and low flows respond to logging and afforestation. The results also provide an indication of which basin characteristics and management activities influence the observed changes. This information should provide a better basis for determining the effects of forest management on streamflow.

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