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EFFECTS OF TIMMR HARVESTING ON THE LAG TIME OF A CASPAR CREEK WATERSHED. . .  
A STUDY IN PROGRESS

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Caspar Creek, located on Jackson Demonstration State Forest, has been the subject of an on-going paired watershed study since 1962. Streamflow, precipitation, and sediment data have been continuously collected in a cooperative project between the California Department of Forestry and the Pacific Southwest Forest and Range Experiment Station/Redwood Sciences Lab.

The North Fork and South Fork watersheds of Caspar Creek (1,225 and 1,047. acres, respectively) were monitored for a calibration period of five years before a road network was constructed in the South Fork watershed in 1967. The watershed was selectively logged during 1971-1973. Tractor yarding methods were used to remove the, predominantly second-growth redwood and old-growth Douglas-fir. The North Fork watershed was not logged. Post-treatment data collection has continued to the present time.

What is Lag Time?

Lag time is defined as the time difference between the occurrence of precipitation on a watershed and the resulting streamflow increase that takes place. Two measurements of lag time are being analyzed in this study for each storm. One is the time separation between the center of mass of rainfall and the center of mass of total runoff; the other is the time separation between the center of mass of rainfall and the center of mass of rising limb runoff.

Lag time reflects the efficiency of basin channels and subsurface flow rates in the delivery of runoff to the stream channel. Analysis of any change in lag time after roadbuilding and logging, then, will indicate changes in the processes involved in stormflow through a watershed system..

The Problem

Researchers are not agreed on the effects of logging on lag time. Numerous studies have shown that the use of heavy equipment in logging operations can cause soil compaction. Also, associated roads alter natural drainage patterns by concentrating runoff and interrupting subsurface flow. As a result these researchers

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say, less infiltration into the soil takes place after treatment than in the undisturbed condition. In addition, the increased overland flow may be accelerated due to the development of waterways such as erosion rills or the removal of channel obstructions. A shorter lag time could then result.

On the other hand, some researchers report that infiltration rates of Pacific Northwest watersheds could be high enough that logging activity may not sufficiently compact the soil to cause a large scale change from subsurface to surface flow. Most of the precipitation could then continue to infiltrate and move normally toward the stream channel. The development of surface waterways would have less of an impact in this case, since overland flow would not be increased over that in the undisturbed state. Effects of the timber harvesting on lag time in this case would be minimal.

#### Methods of Analysis

Data for this study, collected from 1962 to the present, consist of a continuous precipitation record from a recording rain gauge near the North Fork and South Fork weirs and hydrographs provided by water-stage recorders at each weir. Continuous stream discharge measurements were obtained from the hydrographs with the application of a rating curve.

The hydrographs are being separated into individual storm events, and only those storms with complete records for both watersheds will be used. The volume and center of mass of quick flow runoff is being determined with a computer program, using incremental discharge over time. The time of occurrence of this centroid for each storm is recorded. Similarly, the volume of the rising limb to the hydrograph peak is being determined and the time of occurrence of this centroid recorded.

The onset and cessation of individual storm events corresponding to the complete hydrographs is being determined from the rain gauge charts. A storm event is defined as the total precipitation between periods of no precipitation for at least 24 hours. The time of occurrence of the rainfall volume centroid is then recorded.

The centroid lag time for each event is measured as the time separation between the occurrences of the rainfall centroid and the quick flow runoff centroid. The rising limb lag time is measured similarly, using the rising limb centroid instead of the total quick flow centroid.

The data will be analyzed in three segments: calibration, post-road construction and post-logging. The South Fork centroid lag time will be regressed on the North Fork centroid lag time for each of the three periods. The rising limb lag time of the two watersheds will also be regressed in this manner. Chow's test will be used to test for significant differences in both measurements of lag time after treatment.

To examine how any significant change occurs seasonally and chronologically after treatment, the ratio of differences in lag time between the South Fork and North Fork in comparison to the unlogged North Fork lag time will be plotted in time sequence for all three periods.

If a significant change is found after treatment, selected independent variables will be screened as predictors of the lag time ratio. These variables

include storm sequence, antecedent precipitation, storm size, peak flow, quick flow volume and rainfall pattern.

The results of this analysis will provide information geared towards a better understanding of water movement through a watershed system, and will indicate how the runoff process can be influenced by management activities in a north-coast watershed. Application of the results of studies such as this can be an important guide in planning for resource utilization with a minimum of adverse impacts.

Further information regarding the Caspar Creek Cooperative Watershed Study can be found in:

Krammes, J. S. and D. M. Burns. 1973. Road construction on Caspar Creek Watersheds. . . a 10-year progress report.- USDA Forest Serv. Res. Paper PSW-93. 10 pp.

Rice, R. M., F. B. Tilley, and P. A. Datzman. 1979. A watershed's response to logging and roads: South Fork of Caspar Creek, California, 1967-1976. USDA Forest Serv. Res. Paper PSW-146. 12 pp.

Tilley, F. B. and R. M. Ricer 1977. Caspar Creek watershed study - - a current status report. California Department of Forestry. State Forest Note 66. 15 pp.

Ziemer, R. R. 1981. Storm flow response to road building and partial cutting in small streams of northern California. Water Resources Research 17(4):907-917.