

# Erosion of Forest Roads due to Natural and Man Induced Processes

Progress Report for period  
October - December 1992

Institute of Hydrology

February 1992

Progress Report 368/1/W



**NRA**

*National Rivers Authority*



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**R C Johnson**

**Research Contractor:  
Institute of Hydrology  
Wallingford  
Oxon OX10 8BB**

**National Rivers Authority  
Rivers House  
Waterside Drive  
Aztec West  
Almondsbury  
Bristol BS12 4UD**

National Rivers Authority  
Rivers House  
Waterside Drive  
Almondsbury  
Bristol BS12 4UD

Tel: 0454 624400  
Fax: 0454 624409

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R C Johnson  
Institute of Hydrology (Scotland)  
Unit 2, Alpha Centre  
Innovation Park  
Stirling FK9 4NF

Tel: 0786 447612  
Fax: 0786 447614

NRA Project Leader

The NRA's Project Leader for R&D Contract 1431:

Roger Milne

Additional copies

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## **SUMMARY**

During the period October to December 1992 the project has advanced although problems are still being experienced in all areas. Following the changes in staff at the Institute of Hydrology in Scotland, especially the departure of the person carrying out the work for this project, the summer of 1992 was a period when little work could be carried out. The IH(Scotland) office came up to four person full strength in November 1992 so no further staff problems are anticipated.

The road inventory in the Aberfoyle area has almost been completed and is now waiting for an improvement in the weather, especially the melting of snow from the roads, before this can be completed. The regional survey is now in progress with contacts attempted with Forestry Commission engineers in southern Scotland and northern England. Letters have been sent to some 60 civil engineering firms who claimed to have capabilities for the construction of unmetalled roads; this revealed that none had experience in this. Consideration is also being given to contacting firms who advertise experience in geotextiles.

The intensive monitoring of the forest road in the Aberfoyle area has also given problems with the original section of road in the Stank Glen now no longer suitable due to a change in the Forestry Commission's felling programme. A review of the methodology was carried out which has resulted in a change of plan and the setting up of the instruments in the Kirkton catchment, Balquhidder. The road network in the Kirkton was surveyed and a site was instrumented successfully. Logger problems were then encountered resulting in the loss of the programme and further delays while the logger was repaired. Once the roads are free of snow it is hoped to re-start the monitoring.

## **1. ROAD INVENTORY**

The intention of this part of the project was to produce an inventory of all Forestry Commission unmetalled roads in the Aberfoyle area. This would include mapping, measuring gradients, sampling the material used in the construction and noting areas for stacking and turning. From this inventory a detailed analysis would show the range of roads in existence to help with the location of the site studies and put these studies into context.

To the end of December some 90% of the roads have been surveyed, a distance of some 60km. The remaining 10% is now delayed due to snow conditions. A full report on this survey is expected to be made in the next progress report.

## **2. REGIONAL SURVEY: management practices**

To establish a more widespread database on road construction and maintenance a regional survey is being carried out covering Scotland and parts of England and Wales. Forestry Commission engineers are being contacted as well as engineering firms who advertise an interest in unmetalled roads. The FC engineer in Aberfoyle has provided detailed background information for his area but others have still to be contacted. Permission was originally obtained from the FC to approach these people but IH has now been asked to make no more contacts until a meeting has been held with the Director of Engineering in Edinburgh (February 10th).

The results of the contacts with civil engineers was revealing with none having any experience of unmetalled roads. A total of 60 firms were contacted and 24 replied, all briefly saying they could not help. It is also intended to contact firms who are specialising in geotextiles to see what developments are relevant to forest roads.

## **3. SITE STUDY**

A set of instruments has been put together to investigate the processes of erosion on forest roads. The main agents of erosion on forest roads are considered to be rainfall impact, flowing water, frost action, maintenance and vehicles. Rainfall is being monitored by a Rimco tipping bucket raingauge at ten-minute intervals. This will determine the times of falling rain, rainfall intensity and total daily rain. Water draining off the road will be collected by plastic sheets and pipes which collect the water and channel it into a large drum. In the drum is a water depth sensor and a V-notch cut in the side to control the flow of water out of the drum. This has been calibrated so that the depth of water can be converted into a volumetric discharge. Water depths are recorded at ten-minute intervals.

Frost action is measured by a minimum thermometer placed on the forest road and read every visit. This reading is also related to the automatic weather station data from

the neighbouring stations. Vehicle movement is logged by a vehicle counter comprising two rubber tubes across the road which can detect the type of vehicle, in terms of the number of axles, the direction and speed of the vehicle. Finally, the amount of sediment coming off the road is sensed by a turbidity meter placed in a water pipe recording at ten-minute intervals. The draining water also passes through two settling tanks so bulk volumes of sediment are also determined.

The type of road to be monitored was initially a new section in the Stank Glen but is now a much older section in the Kirkton Glen, Balquhidder. This change was due to the original site no longer being suitable because the Forestry Commission changed its felling schedule. Consideration was given to whether a new or old road should be monitored, both options having advantages. It has finally been decided to start on an old section of road as these roads will probably be the most frequently used roads for logging lorries in the next decade. The design of the collectors and instruments has been deliberately chosen so that a number of different sites can be monitored. This will therefore not bias the results to one set of physical characteristics but a range should be monitored.

Calibration and testing of the sensors was carried out and the first site installed in November. Unfortunately, logger problems were encountered which delayed further work until January.

#### **4. FUTURE PROGRESS**

As part of the regional survey it is intended to make contacts with other regions in Scotland to discuss methods of road construction and maintenance. This replaces the original intention of a questionnaire which was tried in Aberfoyle but as replies were so narrative it was decided to visit and interview the engineers. Contacts will be initiated with engineers in England and Wales.

Instrumentation of the road section in the Kirkton forest should be carried out in January, weather permitting, which will enable data to be collected during snow and ice conditions.

## 5. FINAL NOTE

After this progress report was written a major storm affected central Scotland with widespread flooding caused by heavy rain and snow melt. Widespread damage and disruption resulted with houses flooded, roads closed, railway tracks washed away and sediment deposited over fields. In Central Scotland there were many instances of road drains becoming blocked causing the flooding and houses flooding which had never experienced flooding before. Two examples are of interest to this project:

1. In the town of Callander a stream drains off the hill behind the town, through various road drains and under several houses before entering the River Teith. No problems have been experienced with this stream before but during the event the volume of water was so great that the road drains could not cope and water flooded through gardens, through houses and down the main street to a depth of some 10 cm. This appears to have been caused by most of the drains in a newly constructed forest road above Callander becoming blocked. Eventually, only one culvert was free so water from the whole hillside was draining down the one channel. This could not cope and so flooded out of its channel. During the following day the culverts were inspected and found to be blocked by small branches and considerable amounts of sediment.
2. A similar story was heard from the Kings House Hotel at Balquhidder where a small stream flows next to the hotel. This has never flooded before, according to locals, but water was "2 feet deep in the bar". After several hours of fighting the rising water the water level suddenly dropped and the stream could contain the flow once more. Again, it was blocked culverts in a forest road which caused the problem, with the sudden drop thought to have been caused by a neighbouring culvert freeing itself.