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APPENDICES

1. INTRODUCTION

1.1 Scope of Investigation

Following a request from the Forestry Commission on 18th June 1992 to investigate logging activities and associated road construction in compartments 168 - 170 of the Oakes State Forest (Figure 1), a consultancy brief was prepared by the Department of Conservation and Land Management and accepted by the Forestry Commission.

The brief specifically focused on the following three Terms of Reference.

i) to report on the recent logging activities in compartments 168 - 170 of Oakes State Forest within the context of the July, 1990 Standard Erosion Mitigation Conditions for Logging (SEMC's);

ii) to compile recommendations necessary to rehabilitate any soil conservation problems identified in i) above; and

to prepare recommendations for the Forestry Commission to consider when it proposes to carry out logging in areas of a similar nature to Oakes State Forest.

This report will discuss each of these items in turn.

The scope of the brief required that, in addition to the documenting of any soil erosion, an engineering report would be prepared and a soils investigation would be undertaken. This work is documented in Sections 3 and 4 - 6 respectively.

Because of the comprehensive data collected, this study will allow logging practices and policies employed in the area to be assessed to determine their appropriateness.

1.2 Methodology

To report within the Terms of Reference, it was essential to collect physical data from the three compartments in the forest and evaluate it against the nominated standards.

Field measurements and data collection were undertaken, with staff from the Forestry Commission in attendance, in August 1992. A total of 250 hours was spent by the team collecting information in the three forest compartments.

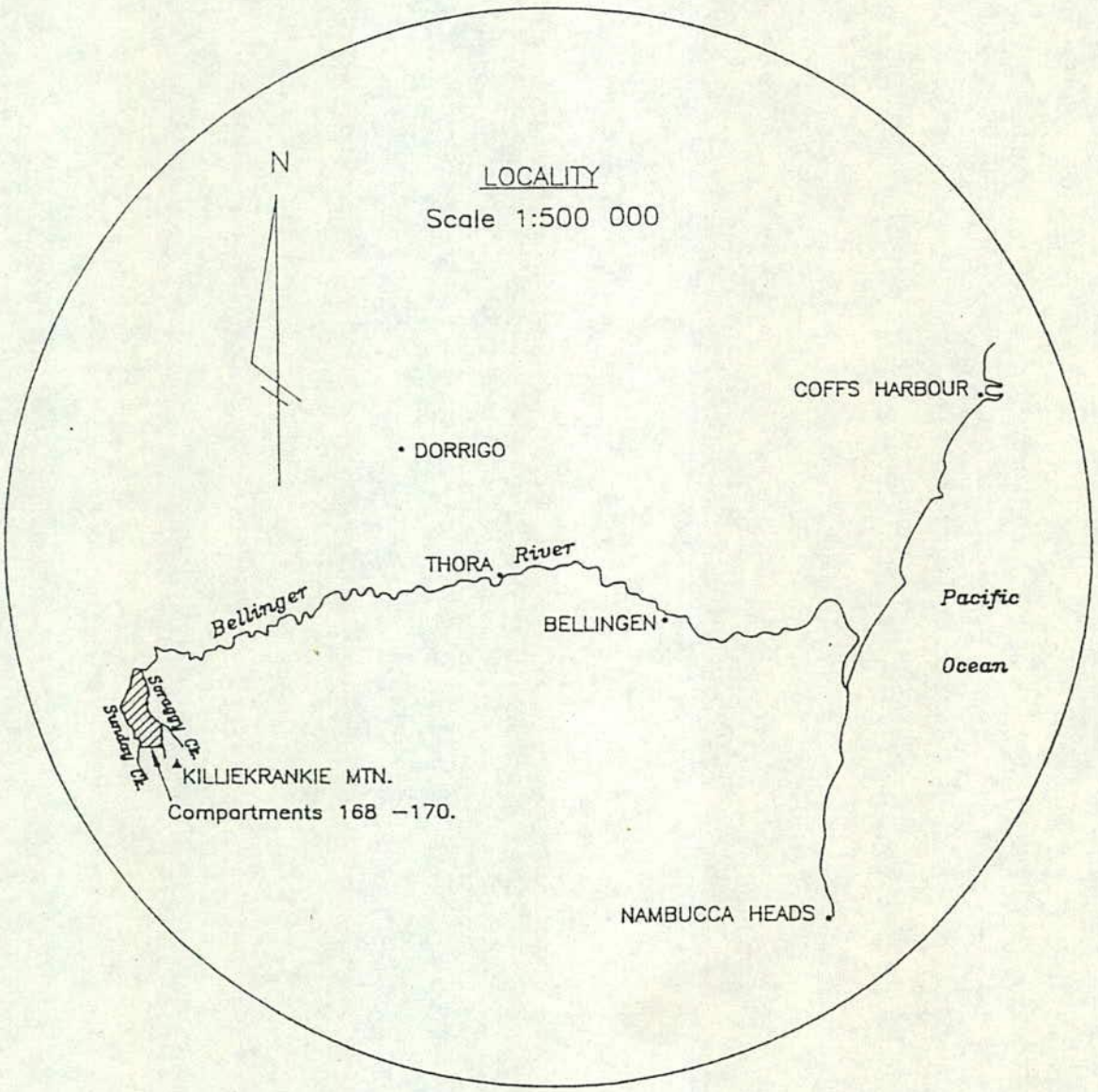
The Harvesting Plans for the compartments indicated the proposed extension of Catbird Road and the proposed snig tracks. Variations to the Harvesting Plan were observed in the field so a key diagram was prepared to locate the haul road, log dumps and snig tracks correctly. This was based on a topographic map over which the Harvesting Plan was overlayed (Figure 2). Additional diagrams were drawn to indicate the detailed location of snig tracks and the log dumps servicing the tracks (Appendix 1).

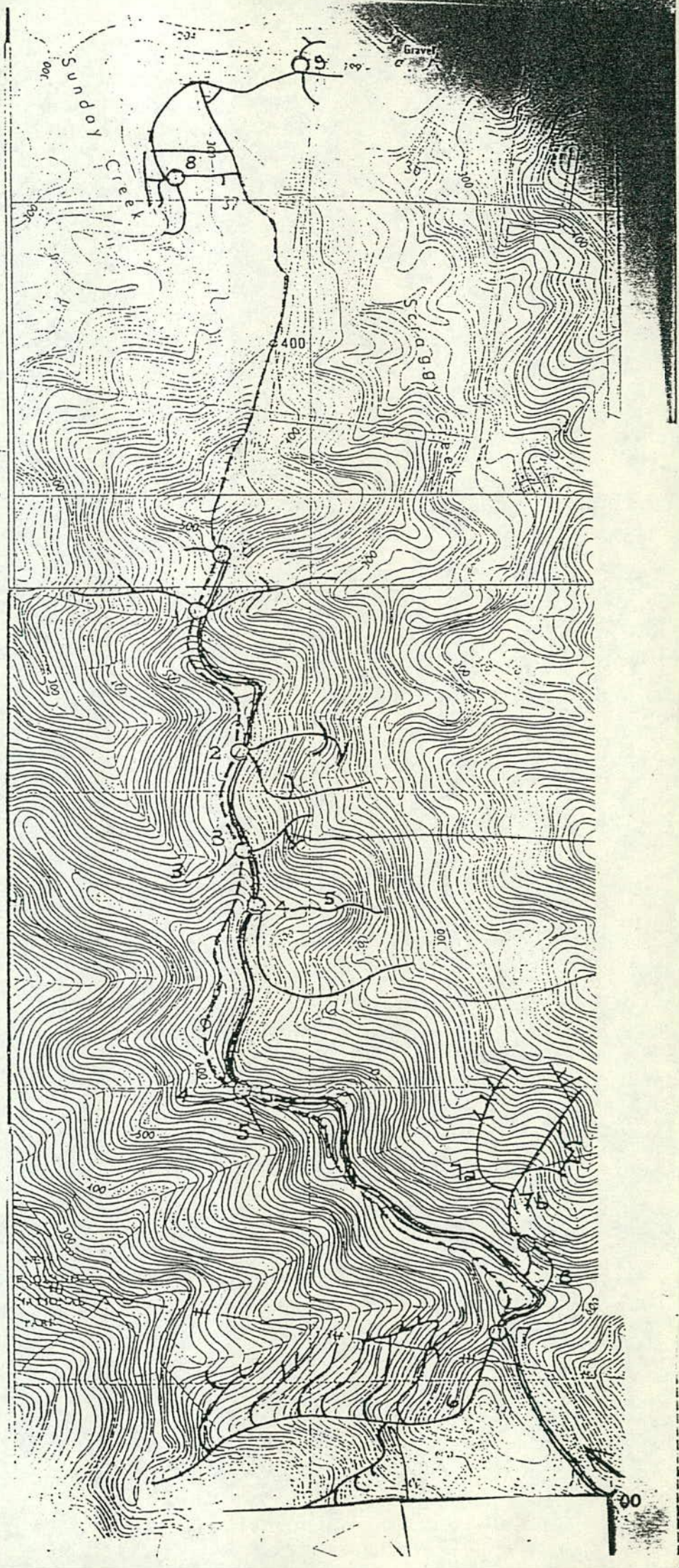
The method selected to document and describe the harvesting system was developed to enable any site to be relocated readily. It evolved as the scope of the operation became apparent in the course of the field inspection. This was necessary to locate areas requiring rehabilitation as specified under Item (11) in the Terms of Reference.

FIGURE 1

OAKES STATE FOREST

Compartments 168 – 170.





LEGEND

Log Dumps O G

Catbird Road

Other Snig Tracks

Ridge Snig Track — — — 6626000mN

TRACKS NOT TO SCALE
(Diagrammatic)

MAP SHEETS

Darkwood 9437-111-S

Girralong 9431-1V-N

SCALE 1:18000 approx.

Figure 2 Location Catbird Road and Major Snig Tracks

Catbird Road was divided into 100 metre segments from the point where the new construction commenced. These points were marked on site for reference.

Slopes and distances were measured using a 30 metre tape, optical clinometer and staff.

Snig tracks were measured:

- in 30 metre segments; or
- between banks; or
- at the junction of other tracks; or
- at water exit points; or
- at pronounced change of track slope; or
- at the end of the track.

Up hill ground slopes were measured:

- at the appropriate position listed above where snig tracks were measured.

Other features noted were:

- the location of snig tracks
- the width of snig tracks
- the type of track construction
- the height of the cut batter
- the height of track windrows
- the soils observed on cut batters.

Bank information was recorded as:

- height (the difference between the lowest point in the bank and the outlet)
- crossfall (the grade in the channel of the bank)
- outlet (was it scouring or stable; had it been extended past the bank was the outlet high, thus affecting capacity, ability to discharge and bank stability)
- location (the location of the bank to be effective)
- workability (was the bank working).

The results of the measurements are presented in Appendix 2. The methodology for investigation and assessment of soils is explained in Section 4 and the engineering observations in Section 3.

1.3 Standards of Operation

Item 1 in the Terms of Reference cites the "SEMC's for Logging, July 1990" as the standard by which performance is to be judged.

This document differs from the June 1984 SEMC's, the version that it replaces, in some important aspects. In the 1990 document bank spacings and heights in section 2.4. (11) are nominated for the site whereas they are fixed in the 1984 SEMC's. No copies of the 1990 SEMCs, giving specifications for Oakes, appear to exist and they do not appear to have been used. The harvesting plans for the three compartments refer to the June 1984 copy and specifications for banks in the harvesting plans are the same as those in the 1984 version.

In the harvest plan for each compartment (point 6 General Prescriptions), reference is made to "The Code of Logging Practices for Crown Timbered Lands in

the Port Macquarie Region" dated June, 1988. Therefore this document must also be used as a standard against which operations are judged. All three documents are interrelated and contain similar statements when determining standards. Throughout the report therefore, specific reference will be made to the SEMC's the Harvesting Plan or the Code of Practice as logging standards.

These standards are not static and have been reviewed over time. The SEMC's for logging were reviewed in July, 1990, the Code of Logging Practices in July, 1992 and the Harvest Plan in May, 1992. However, the primary document specified in Item 1.(11) of the brief and the one which is the basis for assessment is the "SEMC's for Logging, July 1990".

2. PHYSIOGRAPHY

2.1 Location

Compartments 168 - 170 of Oakes State Forest lie in the upper Bellinger River catchment (Figure 1). The compartments are serviced by Catbird Road which is located on the upper eastern slopes of a ridge separating Scraggy Creek to the east from Sunday Creek to the west. New road works commence about 2 km NW of Mekrankie Mountain and continue for 4.7 km. The area is commonly known as Catbird Road. Access is from Horseshoe Road. The lower section of compartment 170 is accessible from the Bellinger River.

2.2 Terrain

Catbird Road lies along a single ridge striking NW falling from an elevation of 800 m to less than 500 m at the northern end (Figure 2). Relief to Scraggy and Sunday Creeks is approximately 300 m and average slopes exceed 50%. This places the terrain into the "very steep mountains" class (McDonald et. al, 1989). Slopes are relatively straight with no lower slope concavities. Slopes measured at 100 m intervals along Catbird Road averaged 72.5% or 36 degrees.

2.3 Climate

The nearest official climate station to Catbird Road is at Dorrigo, 25 km to the north east. Rainfall readings are also taken at Thora Post Office. Monthly totals for the previous 20 months and annual totals for the previous 10 years for Thora are presented in Table 1. The autumn, winter and spring of 1991 were relatively dry followed by above average rains in the summer and early autumn of 1992.

Simulated climatic data has been generated for the site using the ESOCLIM climate model (Table 2). A rainfall intensity - frequency -duration table has been generated for the site from Australian Rainfall and Runoff data (Table 3). The calculated rainfall erosivity is 6400, placing the area in one of the highest rainfall erosivity zones in NSW. Rainfall is summer dominant peaking in late summer and early autumn. Summer rainfall is more reliable than winter and spring rainfall and is more likely to be from intense storms. Soil moisture is maintained at a high level throughout the year. Soil water storage capacity is frequently exceeded resulting in high runoff potential despite high infiltration rates of the soils.

Table 1a - Annual Rainfall, Thora Post Office (1983 - 1992)

1983	1399 mm (dry year)
1984	1702 mm
1985	2255 mm
1986	955 mm (dry year)
1987	2638 mm
1988	2078 mm
1989	2492 mm
1990	1815 mm
1991	1346 mm (dry year)
To end of August 1992	936 mm (dry year so far)

Table 1b - Monthly Rainfall, January 91 - August 92

1991	Month	1992
241.4	January	196.2
196.2	Febuary	226.6
79.6	March	230.7
49.2	April	198.5
93.5	May	31.6
255.6	June	32.4
29.6	July	14.4
0.2	August	6.0
1.2	September	
18.8	October	
49.5	November	
331.2	December	
Total 1346mm		

Source: Obtained from Thora Post Office 3/9/92

Table 2. - Climatic Data for Catbird Road Using ESOCLIM

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
MAX TEMP (C)	28.8	28.6	27.6	25.6	22.0	19.7	19.1	20.4	22.9	25.1	26.9	28.1	24.6
MIN TEMP (C)	18.1	18.5	16.6	13.6	10.0	8.1	6.0	7.2	9.4	12.9	14.8	16.8	12.7
RAINFALL (mm)	184	161	160	82	63	116	56	77	37	92	96	146	1271
RADIATION	23.1	20.4	17.9	15.6	11.9	10.2	11.9	14.2	18.0	20.6	23.9	24.3	17.7
EVAP'N (mm)	6.17	5.62	4.97	3.89	2.7	2.37	2.51	3.34	4.5	5.19	6.01	6.6	4.49
RAINYDAY (no)	13.6	13.3	13.0	9.9	8.9	9.2	6.3	7.2	7.9	11	10.8	12.2	123.2
WINDRUM (km/DAY)	146	133	120	107	111	120	118	130	135	142	144	140	129

Table 3. - Rainfall Intensity - Frequency - Duration table for Catbird Road

Rainfall Intensities (mm/hr) at Standard Average Recurrence Intervals (ARI) and Durations

DUR ARI	6min	10min	20min	30min	1h	2h	3h	6h	12h	24h	48h	72h
1	97	79	58	46.9	32.0	22.9	18.7	13.2	9.4	6.58	4.51	3.53
2	123	100	73	60	40.7	29.4	24.2	17.3	12.4	8.73	6.03	4.74
5	151	123	90	74	50	37.3	31.1	22.9	16.8	12.1	8.52	6.8
10	167	137	100	82	56	41.9	35.3	26.3	16.6	14.3	10.2	8.17
20	189	155	114	93	64	48.2	40.9	30.8	23.3	17.1	12.3	9.92
50	218	179	131	107	74	57	48.4	37.6	28.3	20.9	15.2	12.4
100	246	197	145	118	81	63	54	41.8	32.3	24.0	17.6	14.4
200	263	216	158	129	89	70	60	46.8	36.4	27.3	20.1	16.5
500	293	241	177	145	100	79	68	54	42.3	31.9	23.7	19.6

Data from *Australian Rainfall and Runoff, Vol.2.*
Estimated Rainfall Erosivity Factor R = 6384

2.4 Geology

The main ridge through the compartments runs parallel to a structural lineament along Taylors Arm known as Taylors Arm Fault (Brownlow et. al, 1988). This strikes NW (150 degrees) but in the northern compartments the ridge turns to the NNE paralleling the general lineament directions in this area. Fracture planes strike 60 degrees with vertical dip and 150 degrees with 60 degree dip to the east and 40 degree dip to the west.

The rocks consist dominantly of phyllites and slates with minor fine grained lithic sandstones and conglomerates. These rocks are highly metamorphosed with schistose foliation especially in shear zones. Talus, consisting of old debris avalanche deposits, mantles segments of the slope to depths of up to 4 m.

2.5 Mass Movement

Landslips observed along Catbird Road and on snig road side cuts are of two types:

(i) Those caused by the reactivation of old debris avalanche deposits (talus) by the undercutting of the supporting toe by road and snig batter cuts. These are generally less common but demonstrate that landslips are an infrequent but natural part of the slope formation process in these steep areas.

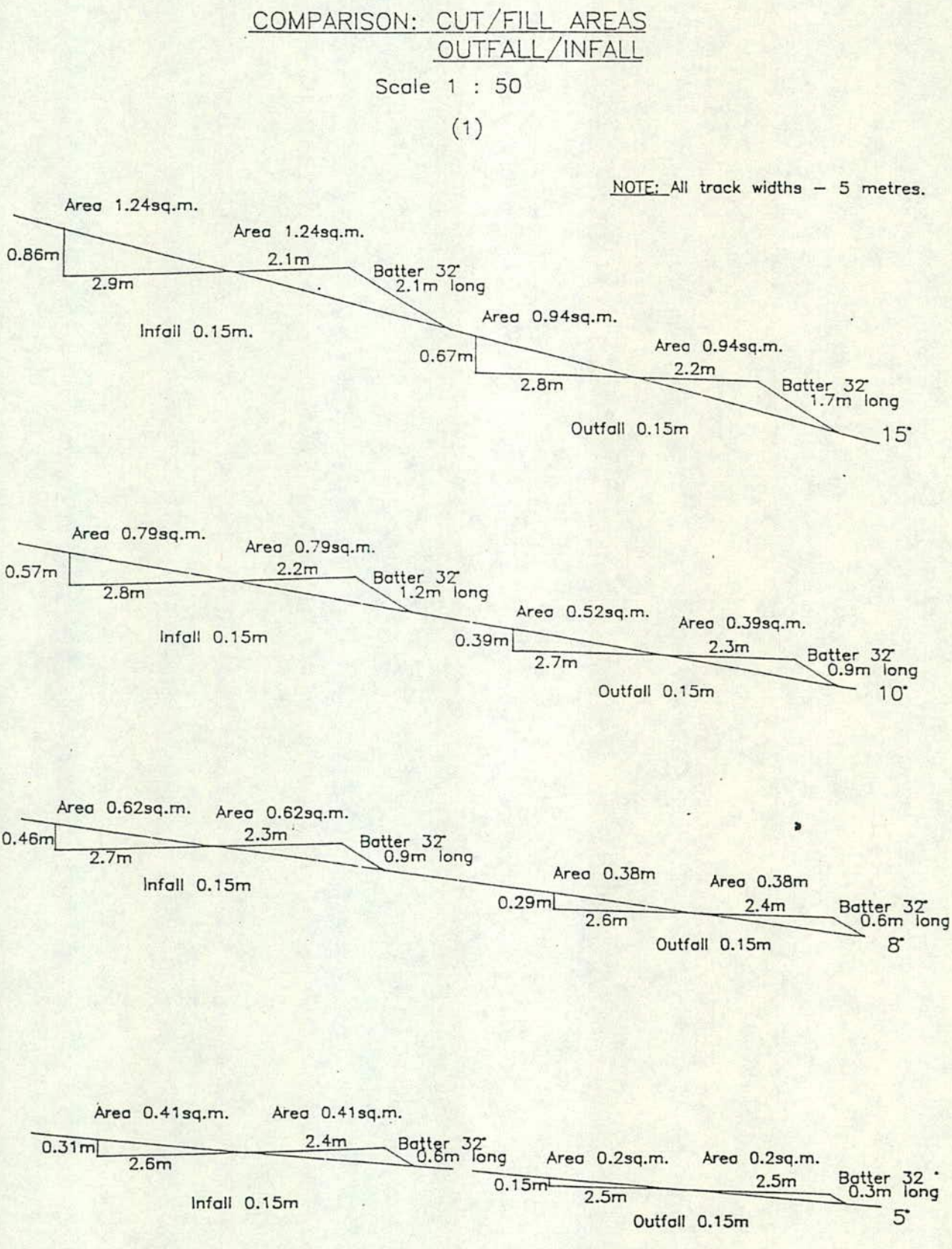
(ii) The more common type is caused by shear failure of the steeply dipping or jointed platy rocks. Slip failure is much more common in the slates and phyllites than the lithic sandstones. This is because of the interlocking nature of the sandstone blocks. However, with the platy rocks the parallel platy joints become lubricated with water and have little shear resistance parallel to the plates so that when toe support is removed by road cuts they fail, initially by block gliding and then by rock avalanche. There are fewer batter slips in the northern end of the road for this reason.

Road batter failures due to landslip have occurred at locations along Catbird Road indicated in Table 4. In many cases the debris from these slips has been bulldozed over the lower side of the road increasing the size of talus deposits on the lower slopes and increasing the amount of unstable material susceptible to erosion by road drainage water. The unconsolidated material composing the fill batters may also be subject to further slip failure.

Rock debris, such as the spoil from road construction, lies at a natural angle of repose of 30 - 32 degrees (58% - 62%). This is the angle beyond which the material will slip under gravity alone, but below which it will remain relatively stable unless it is lubricated by water, physically undercut or eroded. When road spoil is pushed over the low side of the road it comes to rest at approximately this angle. If the hillslope angle is significantly lower than 30 degrees then the talus or fill batter is relatively short. Consequently there is a relatively short length of slope disturbed by the sum of the cut batter, the road surface and the fill batter. However, when the hillslope is steeper than the stable angle,the road debris spreads as a mantle over the slope burying a substantially larger area of forest soil and consequently exposing a considerably larger area of unconsolidated material to a very severe erosion hazard (see Figure 3). Tree debris can be packed against standing vegetation on the toe of the fill to act as a revetment. This prevents the initial movement of fill downslope, but ultimately it assumes the natural angle of repose.

In the case of Catbird Road, the road was cut across steep sideslopes averaging 36 degrees and in places up to 45 degrees. The spoil was dumped over the low side

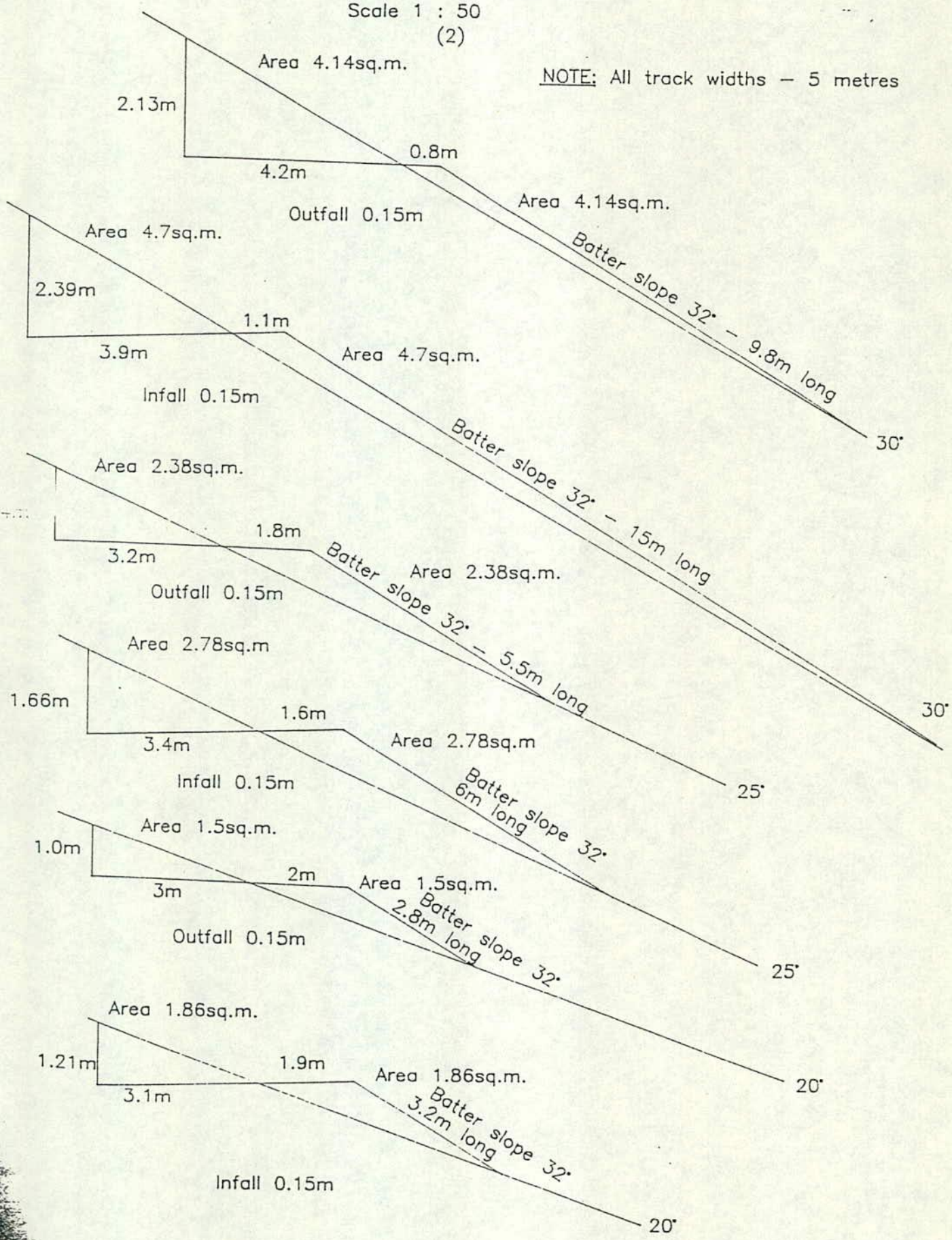
Figure 3 Cross Section Showing Effect of Slope and Road Construction Methods on Fill Batter Length



COMPARISON: CUT/FILL AREAS
OUTFALL/INFALL

Scale 1 : 50

(2)



NOTE: All track widths – 5 metres

and it appears that no attempt was made to carry the spoil back to safe dump sites. The resulting talus has mantled the slopes below the road for over 100 metres in many sections. The problem has been exacerbated by the need to excavate large head batters on these steep slopes and then has been compounded in areas where the head batters failed due to landslip and the extra debris was pushed over the side.

A conservative estimate of the area of exposed talus along Catbird Road is 4.7 km x 50 m = 23.5 ha at an average slope of 36 degrees.

Upslope cut batters and downslope fill batters adjacent to sidecut snig tracks commonly have similar problems to those described for Catbird Road itself. In many cases these tracks have batter cuts as big as those on Catbird Road. As a consequence, fill spills down slope forming talus mantles in the same way as described above.

One example of this is the western snig track from the log dump at 0.6 km (Dump 7). This is on a NW facing sideslope ranging in gradient from 80% to 95% (39 to 43 degrees). Boulders from previous debris avalanches mantle the hillside and should have been an indication of a very significant risk of further slope failure. Batter cuts have been made into this material up to 10 m high. The slips have reactivated and are continuing to retreat up the hillside without any indication that they will stabilise naturally. Rafting of live plants on soil debris indicates that the slip is still active despite being one of the oldest sidecuts in the compartment. This area was not mapped as being in excess of 35 degrees in the Harvesting Plan.

Table 4 Road Batter Failures

Location km	Head Height m	Slope %	Notes
0.28	8	86	Straight slope, Slate
0.30	10	80	Straight slope, Slate
0.35	10	75	Straight slope, Slate
0.36	10	75	Straight slope, Slate
0.45	12	85	Straight slope, Slate bedding
0.48	15	85	Straight slope, Slate
1.10	12	75	Disturbed slope,Talus
2.55	12	80	Concave slope, adverse slate dip
2.82	8	86	Straight slope, adverse slate dip
2.87	10	80	Disturbed concave slope, large
2.90	15	84	Large slip cont.of 2.90
3.20	25	80	Black slate adverse dip of 45 d
3.75	10	80	Straight slope, C3 type soil

3. ENGINEERING OBSERVATIONS

3.1 Road Location and Construction

The location of Catbird Road relative to the downslope distance from the ridgetop has resulted in:

* Construction across steep grades of between 33 degrees (65%) and 45 degrees (100%);
* Excess road cut and fill with resulting slippage problems;
* Extensive catchment above the road resulting in problems with management of increased runoff.

Too much emphasis was placed on the location of the road, to avoid its visual impact from Point Lookout. If placed on or near the ridge, the dense bush would have obscured its view from Point Lookout or any other part of the National Park. (A road on the western side would not have been suitable as it would have encountered similar slopes to those on the eastern fall and may have been noticeable from the lookout.)

From an engineering perspective the positioning of the road is not satisfactory. The road should have been constructed to be graded upslope between log dumps. Instead it has been graded downslope from the log dump and this results in all the negative consequences of steeper side slopes with more cut and slippage and greater runoff to deal with.

The road appears to have been constructed to the letter of the SEMCs rather than the spirit of the document by keeping strictly to Clause 2.1.1(v) which limits maximum grades on "roads" to below 10 degrees (17.5%). Grades greater than 10 degrees would have resulted in far less environmental damage while allowing logging trucks to operate effectively. A road rising 12 degrees instead of 10 degrees would be 3.6 m higher up the hill for every 100 metres of road distance. Grades of 12 degrees or even 14 degrees are possible and less environmental damage would have occurred.

3.2 Road Batters

The road cut batters of up to 3 m vertical height have small slips (refer to S. 2.5) and occasional loose material is deposited on the road. Cut batters higher than 3 m have the potential for large slips to occur resulting in the road blockage (refer to Table 4).

Given that the dip of the rock strata is similar to the ground slope, the lubrication of the soil/rock interface leads to large slips along the rock plane. Explosives would have increased the risk of slips.

Fill batters have contributed to forest sediment in the past and will continue to do so.

Longitudinal road cracks exist at some locations and the fill batter at these locations could slip in the future.

Road observations were made after and during an extremely dry period (see Table 1). Heavy rainfall early this year resulted in slips which required the dozer to clear the road. The road was closed to the public shortly after this period.

4. SOILS

4.1 Soil Survey Methods

Soil profiles were described at 7 locations (labelled C1-C7) along Catbird Road to document the range of soil variation present. They were described using NSW Soil Data Cards and the data was entered into the NSW Soil Data System. In order to cover the range of geological parent materials present, two sites were located on slate (C2 and C5), two on talus (C4 and C7), two on lithic sandstone (C1 and C3), and one on lithic sandstone on the lower (northern) end of the Catbird Road ridge (C6). Additional observations were made at 100 m intervals along the length of Catbird Road to verify that the sites described are representative of the soils of the study area.

The soils are described in terms of their dominant soil materials (Atkinson, 1991), their occurrence and relationships and their limitations. They are classified into Great Soil Groups (Stace et al.,1968) and Principal Profile Forms (Northcote, 1971). Soil classifications are listed in Table 5. Laboratory tests were conducted on 14 samples at the Scone Research Services Centre Laboratory of CaLM which is a NATA registered laboratory.

Terminology used follows McDonald *et al.* (1989) and Morse, Atkinson and Craze (1982). Definitions of terms, classes and methods follow practices prescribed for the 1:100,000 Soil Landscape Mapping Program of CaLM (Atkinson, 1991).

The site falls within the McAllisters Peak soil landscape **(mp)** of the Dorrigo 1:100 000 Soil Landscape map currently under preparation by CaLM (Milford, in prep.).

4.2 Soil Profile Descriptions

The soils data for the seven described profiles has been entered into the NSW Soil Data System and the Plain English Reports are presented in Appendix 3.

4.3 Dominant Soil Materials

mp1 - Moderately pedal, brownish black clay loam. This material consists of whole coloured brownish black to very dark brown (10YR2/3 - 7.5YR2/3) sandy clay loams and clay loams (sandy) with rough faced, moderate to well developed crumb or fine (2-5 mm) polyhedral peds. pH is moderately to slightly acid (pH 5.5 - 6.0) and stone content is usually <10% of angular gravel. The material occurs as a topsoil.

mp2 - Gravelly, light brown clay loam. This material consists of whole coloured light brown to brown (7.5YR4-5/6) clay loams (sandy) or sandy light clays with rough faced 2-10 mm weak polyhedral peds. pH is moderately to slightly acid (pH 5.0 - 6.0) and stone content is high with angular gravel comprising 50 - 90%. The material occurs as a subsoil.

mp3 - Dark, pedal, gravelly clay loam. This material consists of whole coloured brownish black to dark brown (10YR2/2 - 7.5YR3/4) clay loam to silty light clay with a strong 2-5 mm granular or crumb structure with rough faced peds. pH is slightly acid (pH 6.0) and a stone content of 10 - 50% angular fine gravel. This material usually occurs as a topsoil.

mp4 - Reddish brown, gravelly light clay. This material consists of whole coloured brownish black to dark brown (10YR2/2 - 7.5YR3/4) sandy or silty light clays depending upon the relative dominance of lithic sandstone or slate respectively in the parent material. Structure is moderate 5-10 mm polyhedral, rough faced peds. pH is moderately to slightly acid (pH 5.0 - 6.0) and angular stones of 20-60 mm are common. This material usually occurs as a subsoil.
Variant. With increasing depth **mp4** often becomes paler in colour and increases in stone content (50-90%) and size to angular stones up to 600 mm.

mp5 - Brownish black, granular clay loam. This material consists of whole coloured brownish black (5YR2/2) clay loam with a strong 2-5 mm, rough faced, granular structure. A few (2-10%) small stones are present and pH is moderately acid (pH 5.5). This material occurs as a topsoil.

mp6 - Dark reddish brown pedal clay loam. This material consists of whole coloured dark reddish brown clay loam with a moderate, 10-20 mm rough faced polyhedral structure. A few (2-10%) small stones are present and pH is moderately acid (pH 5.5). This material occurs as a subsoil.

4.4 Occurrence and Relationships

Steep sideslopes on Lithic Sandstone and Slate.

Up to 30 cm of moderately pedal, brownish black clay loam **(mp1)** overlies up to 50 cm of gravelly, light brown clay loam **(mp2)** with a gradual boundary between them. Total soil depth over shattered rock is 60 cm. [Lithosol (Um6.23, Um6.12, Um6.13)]. With sufficient texture difference between A and B horizons these form Chocolate Soils (Db3.11)

Steep Sideslopes on Talus.

Up to 35 cm of dark, pedal, gravelly clay loam **(mp3)** overlies up to 55 cm of reddish brown, gravelly light clay **(mp4)** and up to 3 m of the paler gravelly light clay **(mp4 variant)**. Soil depth is approximately 60 cm with up to 4 m of unconsolidated talus. [Lithosol (Uf5.12), Xanthozem (Gn4.31)]

Footslopes on Lithic Sandstone.

Up to 25 cm of brownish black, granular clay loam **(mp5)** overlies over 65 cm of dark reddish brown pedal loam **(mp6)** with a gradational boundary [Krasnozem (Um6.13)].

Table 5 Summary of Soil Types

Site	Great Soil Group	Northcote Code (PPF)	Depth cm	Slope %	Parent Material
C1	Lithosol	Um6.23	50	70	Lithic Sandstone
C2	Lithosol	Um6.12	60	75	Slate
C3	Lithosol	Um6.13	53	70	Lithic Sandstone
C4	Xanthozem	Gn4.31	60	85	Colluvium/Slate
C5	Chocolate Soil	Db3.11	60	65	Slate
C6	Krasnozem	Um6.13	90+	15	Lithic Sandstone
C7	Lithosol	Uf5.12	70	65	Colluvium/Slate

4.5 Landscape Limitations

Mass movement hazard
Rock fall hazard
Very steep slopes
Extreme erosion hazard
Shallow soil depth

4.6 Laboratory Testing

The following soil tests were undertaken at the Scone Research Service Centre.

Laboratory Test	Symbol	Units	Laboratory Code	References
Dispersion Percentage	(D)	%	P8A/2	(Ritchie, 1963)
Organic Carbon	(OC)	%	C6A/2	(Black, 1965)
Particle Size Analysis	(PSA)	%	P7B/1	(SCS lab procedures)

The laboratory results are presented in Table 6.

5. SOIL EROSION

5.1 Erosion Hazard and Erodibility

The amount of soil lost from a site is related to both the erodibility of the soil and other environmental factors. The two terms "erodibility" and "erosion hazard" require clarification in this regard as they appear to be used interchangeably in the interpretation of SEMC's.

Erodibility - Erodibility is the susceptibility of a soil to erosion. It is based solely on soil properties. Other properties such as slope gradient, slope length, landform element, plant cover and rainfall characteristics are not included in the assessment (see Houghton and Charman, 1986).

Erosion Hazard - Erosion hazard on the other hand is a measure of the susceptibility of an area of land to all of the prevailing agents of erosion including those related to climate, topography, and land use as well as the soil erodibility. Erosion hazard is defined in Houghton and Charman, 1986 and in the glossary to the SEMCs. The use of the term erosion hazard therefore in the SEMCs refers to all of the prevailing agents of erosion, not just erodibility. All of these factors must therefore be taken into account in assessing the erosion hazard of an area.

The appropriate erosion hazard for the Catbird Road area is evaluated in Section 7.1.

5.2 Methods of Soil Loss Estimation

The amount of soil that is lost from any parcel of land can be either measured empirically or predicted using reliable models. Both methods have their short comings. Empirical measurements are better at determining actual losses at a known location and time but clearly require intensive and representative field

Table 6. - Laboratory Data and Derived Soil Loss Prediction Data.

Lab No.	Sample Id.	Particle Size Analysis (%)						Gravel %	OM%	Disp. %	Struct Grade	Perm Class	K Factor
		clay	silt	vfs.	fs.	c.sand	si + vfs						
1	C1/2 3-10cm	16.8	27.4	17.9	9.5	28.4	45.3	5	5.45	16.0	3	3	0.027
2	C1/3 10-50cm	19.1	28.7	10.6	9.5	34.0	39.3	6	1.24	45.0	3	4	0.038
3	C2/1 0-15cm	25.3	34.2	7.6	5.0	27.8	41.8	21	5.09	14.0	3	3	0.027
4	C2/2 15-60cm	23.4	31.3	4.7	4.7	35.9	36.0	36	1.26	42.0	3	4	0.033
7	C3/1 0-23cm	28.3	24.2	17.2	7.0	23.2	41.4	1	5.85	11.0	3	3	0.019
8	C3/2 23-53cm	22.2	21.2	10.1	5.0	41.5	31.3	1	0.69	41.0	3	4	0.027
10	C4/1 0-35cm	17.4	26.0	10.1	5.8	40.6	36.1	31	13.36	10.0	3	3	0.009
9	C4/3 60-150	23.0	33.3	3.8	2.6	37.2	37.1	22	3.15	27.0	2	3	0.026
11	C5/1 0-30cm	21.6	35.2	12.2	5.4	25.7	47.4	26	8.30	11.0	3	3	0.015
12	C5/2 30-60	21.5	38.5	7.7	4.6	27.7	46.2	35	2.04	32.0	3	4	0.040
5	C6/1 0-25cm	30.3	39.4	16.2	4.0	10.1	55.6	1	7.69	11.0	3	4	0.018
6	C6/2 25-90cm	42.4	36.4	10.1	4.0	7.1	46.5	1	2.17	8.0	3	4	0.026
13	C7/1 0-25cm	22.1	46.3	15.8	4.2	11.6	62.1	5	4.50	18.0	3	3	0.036
14	C7/3 70-280	23.5	48.2	9.4	3.5	15.3	57.6	15	1.93	54.0	3	3	0.043

Table 6. - Laboratory Data and Derived Soil Loss Prediction Data (Cont.)

Lab No.	Sample Id.	Particle Size Analysis (%)						Gravel %	OM%	Disp. %	Struct Grade	Perm Class	K Factor
		clay	silt	vfs.	fs.	c.sand	si + vfs						
Total	Average	22.0	32.9	11.0	5.4	29.0	43.5	17.0	4.40	24.3	3	3-4	0.025
	S.D	3.2	8.3	4.4	1.9	9.4	9.0	13.2	3.70	15.6			0.012
	C.V%	14.5	25.3	40.6	34.5	32.4	20.7	77.8	82.70	64.4			0.50
Top-Soil	Average	21.9	32.2	13.5	6.2	26.2	45.7	14.8	7.10	13.0	2-3	3-4	0.021
	S.D	4.4	8.2	4.2	1.9	9.4	8.9	12.7	3.30	3.0			0.009
	C.V%	20.3	25.5	30.9	30.6	35.6	19.5	85.7	14.00	23.5			0.42
Sub-Soil	Average	22.1	33.5	9.1	4.7	31.9	42.0	19.2	1.70	40.1	3	3-4	0.033
	S.D	1.7	9.2	3.9	2.1	9.3	11.0	14.6	1.30	9.5			0.007
	C.V%	7.5	27.3	42.5	43.7	29.0	26.2	76.1	6.30	23.8			0.21

monitoring. Limited measurements may be misleading when used predictively as both rainfall and soil losses display high temporal variability with 10% of runoff events causing 90% of total soil loss (Edwards,1987). Models give better estimates of expected or predicted soil losses and therefore better estimates of the erosion hazard associated with an activity.

It is not possible to measure the actual amount of soil lost from the site in Compartments 168 - 170 because no baseline data exists and no process monitoring was carried out. However, even if this were to have been carried out, the measured soil loss would have been a consequence of the actual rainfall events that occurred at the site over the monitoring period. It would have given little indication of the relative risk of erosion except by investigating the probability of the causal events recurring.

A more appropriate approach is to use an empirical model, such as SOILOSS to predict the likely amount of erosion under a known set of soil, slope, rainfall and cover conditions. It is therefore a more valuable predictive tool than field measurements for evaluating the potential consequences of a forest management activity, either prior to the activity as a planning tool or subsequent to it as an evaluation tool.

In this study the SOILOSS program will be used retrospectively to estimate the average annual soil loss of soil material exposed at the surface over the first 12 months of logging operations due to sheet and rill erosion. The results do not take into account:

1) the substantial increase in erosion caused by concentrated flows such as occurs when road drainage is discharged onto unprotected soil;

2) erosion in subsequent years. It is generally accepted that sheet and rill erosion will diminish until adequate protective ground cover becomes established within about three years;

3) the actual rainfall conditions that occurred at the site over the period that the soil was exposed. The soil loss figures are a simulation based on average rainfall conditions for the area. In practice the soil loss may have been less due to dry conditions and may have been considerably higher in a wet year.

4) Erosion within the logged areas not associated with road and track construction.

5) Other forms of soil and land degradation such as soil compaction.

The results are however a reasonable estimate of erosion hazard that exists at the site and can be validly employed to compare the relative soil loss from different slopes, soil types or to compare different locations.

The land use used to calculate the predicted soil loss and therefore assess the erosion hazard in this study is the construction of logging snig tracks and the construction of cut and fill batters during road construction. Soil loss from logging operations away from the tracks is difficult to estimate due to the difficulty in making accurate area measurements and so is not evaluated in the following discussion. However, Lacey (1992) estimates the area of exposed mineral soil (AEMS%) to be 30% and the area of deep disturbance (ADD%) of the soil to be 24% from an evaluation of 81 studies and if this data were to be extrapolated to this study it would indicate significant additional areas of disturbed soil which have not been evaluated.

5.3 SOILOSS Program

Soil losses for the first 12 months of logging operations were estimated using the "SOILOSS" computer program of Rosewell and Edwards (1988). "SOILOSS" is based on the Universal Soil Loss Equation of Wischmeier and Smith (1978). The Universal Soil Loss Equation (USLE) is designed to predict the long term soil loss from sheet and rill erosion. It was empirically derived from the analysis of over 10,000 plot years of data from small plots in the eastern states of the USA. Over 4,500 plot years of records have been used to validate the use of the USLE in NSW. The USLE is the most widely used soil loss equation in the world and the most thoroughly validated for NSW conditions. USLE does not predict sediment yield either from a plot or a catchment as it does not take into account subsequent deposition. Neither does it account for soil loss which occurs in areas of concentrated flow such as gullies.

> *"Despite uncertainties about the validity of all aspects of this model in our local environment where a few isolated storms cause the bulk of soil loss (Edwards, 1986), the model does have its uses. It is applicable to areas such as crop land, pasture land, rangelands, forests, and construction sites. It provides a means of ranking the effect of various management practices on soil loss and in so doing allows the selection of those practices that will cause least erosion. When estimated soil losses are compared with soil loss limits based on either soil formation rates, decline in soil productivity due to erosion or offsite sediment control requirements the USLE can be used to see whether or not the soil loss resulting from any one practice is excessive. Various components can be used independently to aid in highlighting areas, soils or practices which have particular problems. Relative values of soil loss can certainly be established using the equation."* (Rosewell & Edwards 1988).

SOILOSS is based on the following formula:

$$A = R \times K \times S \times L \times C \times P \quad \text{where}$$

A = Soil loss in tonnes /hectare/year
R = Rainfall erosivity
K = Soil erodibility
S = Slope angle
L = Slope length
C = Cover factor
P = Management factor

Appendix 4 and Rosewell and Edwards (1988) provide further details.

5.4 SOILOSS Input Variables and Assumptions

5.4.1 Erosivity Factor - R

The erosivity factor, calculated from 18 years of data from Dorrigo, is 8020. Dorrigo is the nearest major gauging station and is at a similar elevation and distance from the coast. Catbird Road is expected to have a slightly higher R than Dorrigo because Dorrigo lies a few kilometres from the edge of the escarpment and the rain shadow effect is well recognised. A more conservative value of R can be calculated by correlating between 28 other coastal rainfall stations and Australian Rainfall and Runoff data which predicts an R value of 6188 for Dorrigo and 6384 for Catbird Road. This relatively conservative value rounded to 6400 has been used for all calculations. (This value may in fact be up to 30% higher due to the impact force of larger raindrops falling from the leaves of tall trees).

5.4.2 Soil Erodibility Factor - K

Soil erodibility factors have been calculated from topsoil and subsoil samples collected during the soil survey. They have been calculated from the laboratory results. The average topsoil K factor is 0.021 and the average subsoil K factor is 0.033. These values are on the upper limit of 'low' and of 'moderate' erodibilities respectively. The subsoil value of 0.033 is used to calculate soil loss from cut batters, fill batters and snig tracks.

5.4.3 Slope Angle Factor - S

This factor is allowed to vary across a range of values whilst the others remain fixed to demonstrate the effect of increasing slope angle on soil loss. Although the USLE was developed for relatively flatter slopes it has been verified recently in the USA for short slope lengths with angles up to 45 degrees (100%) and is therefore appropriate for use at this site (Rosewell, pers comm.).

5.4.4 Slope Length Factor - L

All calculations where generalisations are made are based on a slope length of 10 metres. This is shorter than any measured snig track bank spacing and underestimates fill batter slope lengths by a factor of up to 10 times. As an indication of the relative effect of a longer slope length the difference in LS factor for a 100 m 70% slope compared with a 10 m 70% slope is a factor of 3.16. Calculations for measured snig track bank spacings use the measured spacing when on scale. If the spacing is too long for the program, a simple additive result is quoted. This is therefore also a conservative underestimate.

5.4.5 Cover Factor - C

It was assumed that, on average, each snig track or batter is completely denuded of vegetation cover for 6 months during logging. After 6 months, vegetation cover and litter begin to re-establish and the surface is armoured by exposed stones. It was also assumed that exposure was equally likely to commence at any time of year. Soil losses for logging during summer and autumn can be expected to be significantly greater than during spring. The cover factor varies from 0.0001 for undisturbed fully vegetated cover to 1.0 for cultivated bare soil. The value chosen for soil loss calculations is 0.45 (Rosewell, pers comm.). This value takes into account stone armouring and increasing litter and vegetative cover during the year.

5.4.6 Management Factor - P

The P factor is taken as 1. The opportunity may exist to modify management practices so as to reduce this factor but these have not been applied in Compartments 168 - 170.

5.5 Background Soil Loss Values

Background values were calculated using R = 6400, K = 0.021, S = 72%, L = 10 m, C = 0.0001, and P = 1. The result of 0.2 t/ha/yr is consistent with published values of soil formation rates and background soil loss rates of 0 - 1.0 t/ha/yr (Edwards, 1991).

5.6 Acceptable Soil Loss

Acceptable soil loss figures vary depending on the criteria being considered. To maintain water quality of adjacent streams, more than 2 t/ha/yr may not be acceptable. However, acceptable soil losses for cropping lands may vary from 1

to 10 t/ha/yr depending on the depth and fertility of the soil. Soil formation rates of the order of 0.5 - 1.0 t/ha/yr are consistent with the calculated background soil loss.

Accelerated erosion can be considered to be any figure above 1 t/ha/yr. Therefore the units t/ha/yr can be read as "times natural background" or "equivalent years of natural soil formation/erosion". Thus 1000 t/ha/yr for 1 year is the equivalent of 1000 years of normal soil erosion. To equate these figures to a depth of soil lost 100 t/ha is 1 cm of topsoil or 7 mm of subsoil.

6. RESULTS OF FIELD MEASUREMENTS

The principal results of this study are the field observations and measurements recorded along the snig tracks. These are presented in Appendix 2. The following sections attempt to summarise the field data in a series of graphs.

6.1 Hillslope Gradients

Hillslope measurements were taken at 81 sites at 100 m intervals along Catbird Road. The average slope angle along the road is 72.5% (36 degrees). This statistic has a standard deviation of 12 and coefficient of variation of 8%. The low CV shows the consistency of the slopes in the area.

In addition, another 580 hillslope readings were taken at each cross bank along 17 km of snig tracks. Figure 4 is a histogram of the frequency of ground slope classes as measured at each snig track bank. This graph is positively skewed as would be expected with slope data. The modal (or most common) slope value is 32 degrees. This is only marginally less than the average figure of 36 degrees recorded for Catbird Road and shows that logging took place in similarly steep terrain. (Snig tracks would generally be selectively located along the lowest slopes in the logged area, therefore this data would be an underestimate of typical slope values).

6.2 Snig Track Slope Gradients

Similarly the slope of segments of snig track were measured above each cross bank. This data is displayed in Figure 5. The track slope data is also skewed with the modal (or most common) track slope occurring at 24 degrees, just one degree below the limit placed by the SEMC's.

6.3 Snig Track Bank Spacing

Measured bank spacing has been plotted against track slope in Figure 6 to illustrate the degree of compliance with the SEMC's. The stepped solid line represents the conservative bank spacings applicable if the erosion hazard were taken as "average". All points to the upper right of the line therefore represent breaches of the SEMC's (see Section 8.2.1 for details). Five points exceed the scale limits of the plot. Had the banks been constructed in accordance with the SEMC's the scatter plot would have shown a concentration of points along a diagonal line below the stepped solid line in the graph. In fact the points are randomly distributed with no correlation between slope angle and bank spacing (r^2 = 0.12). In other words the bank spacings are completely random; there is no evidence of any relationship between the constructed bank spacings and the track slopes as would have been expected were Clause 2.4(ii) of the SEMC's implemented.

Figure 4 Frequency Distribution of Ground Slope Classes Above Snig Tracks

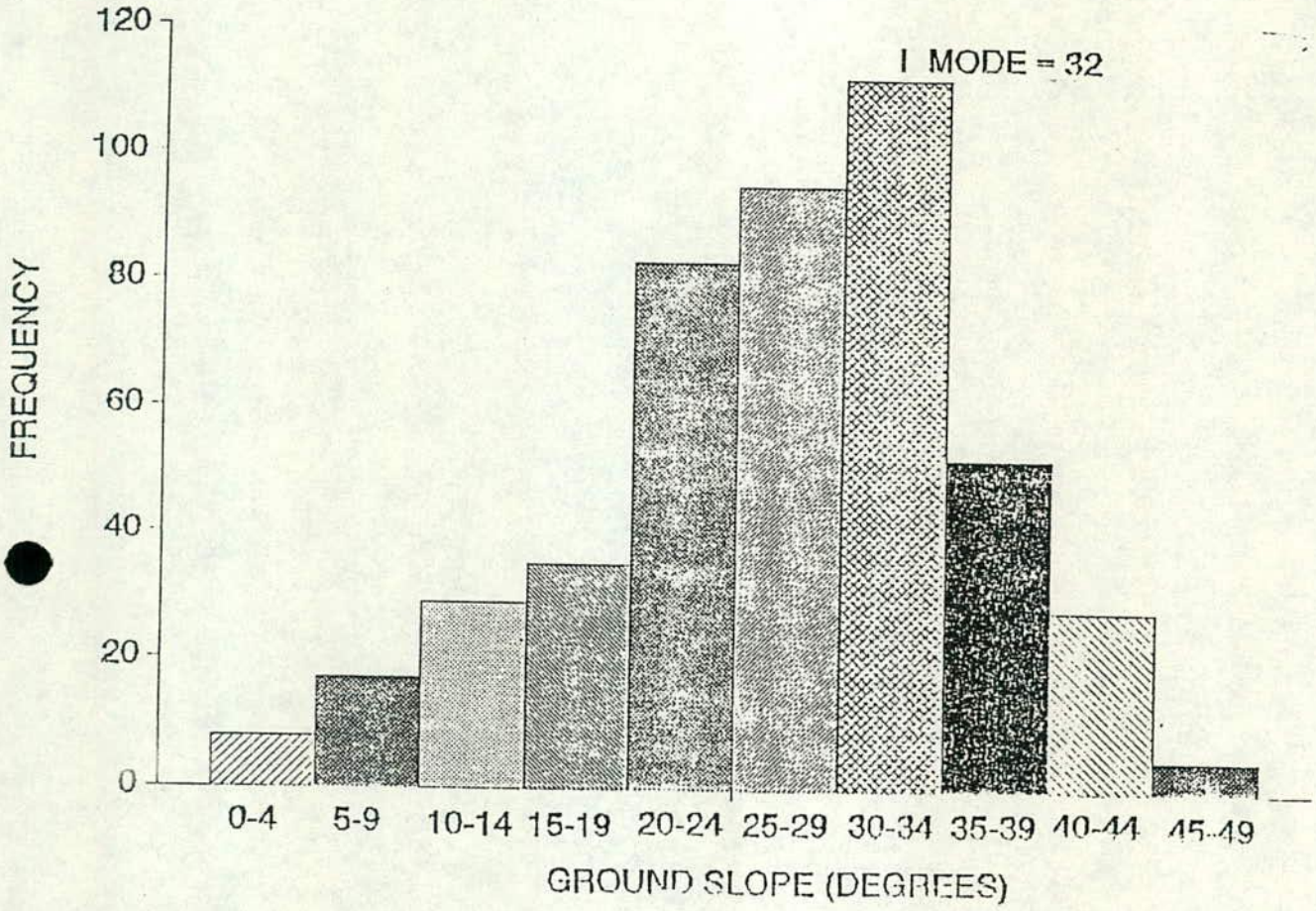


Figure 5 Frequency Distribution of Snig Track Slope Classes

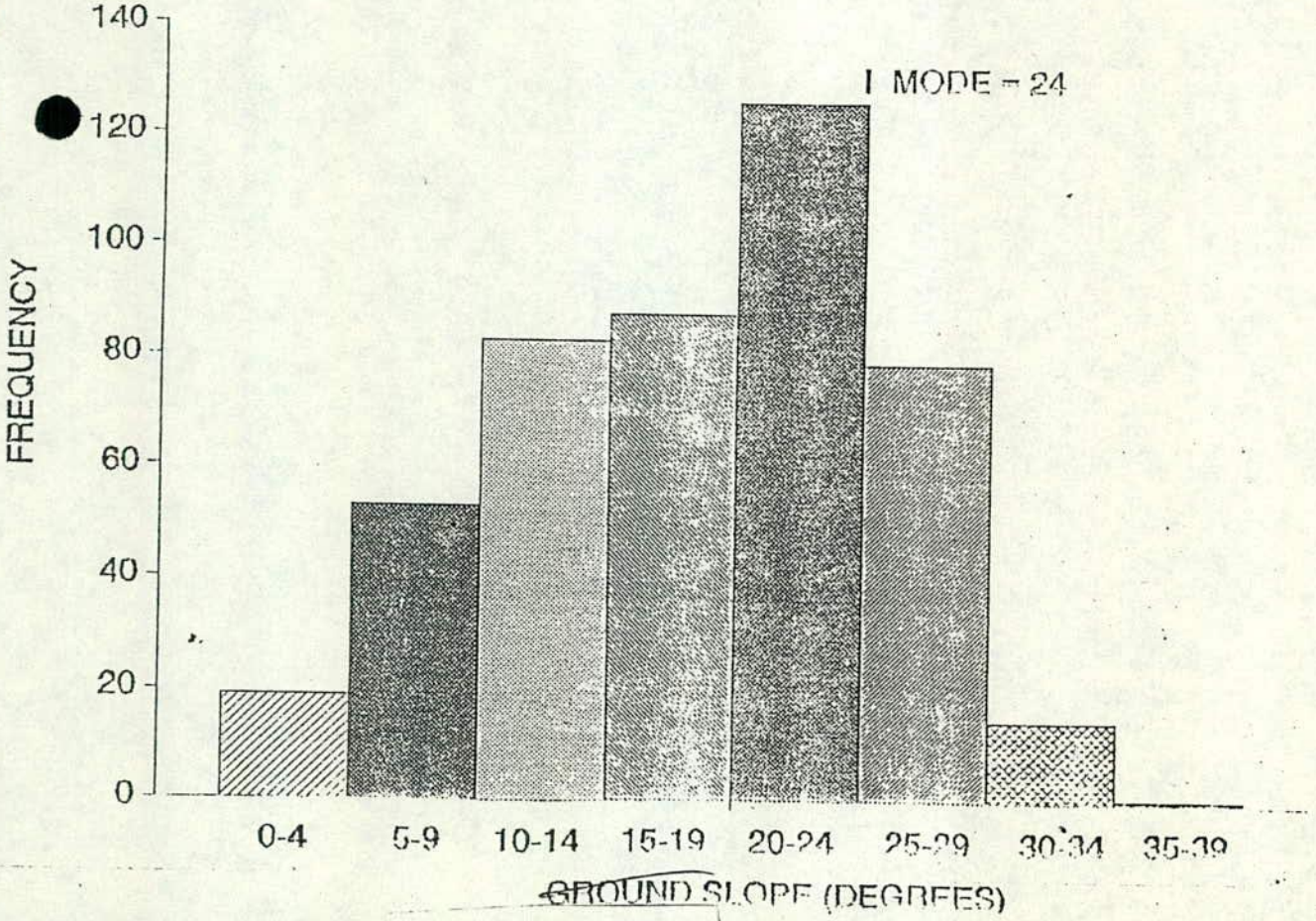
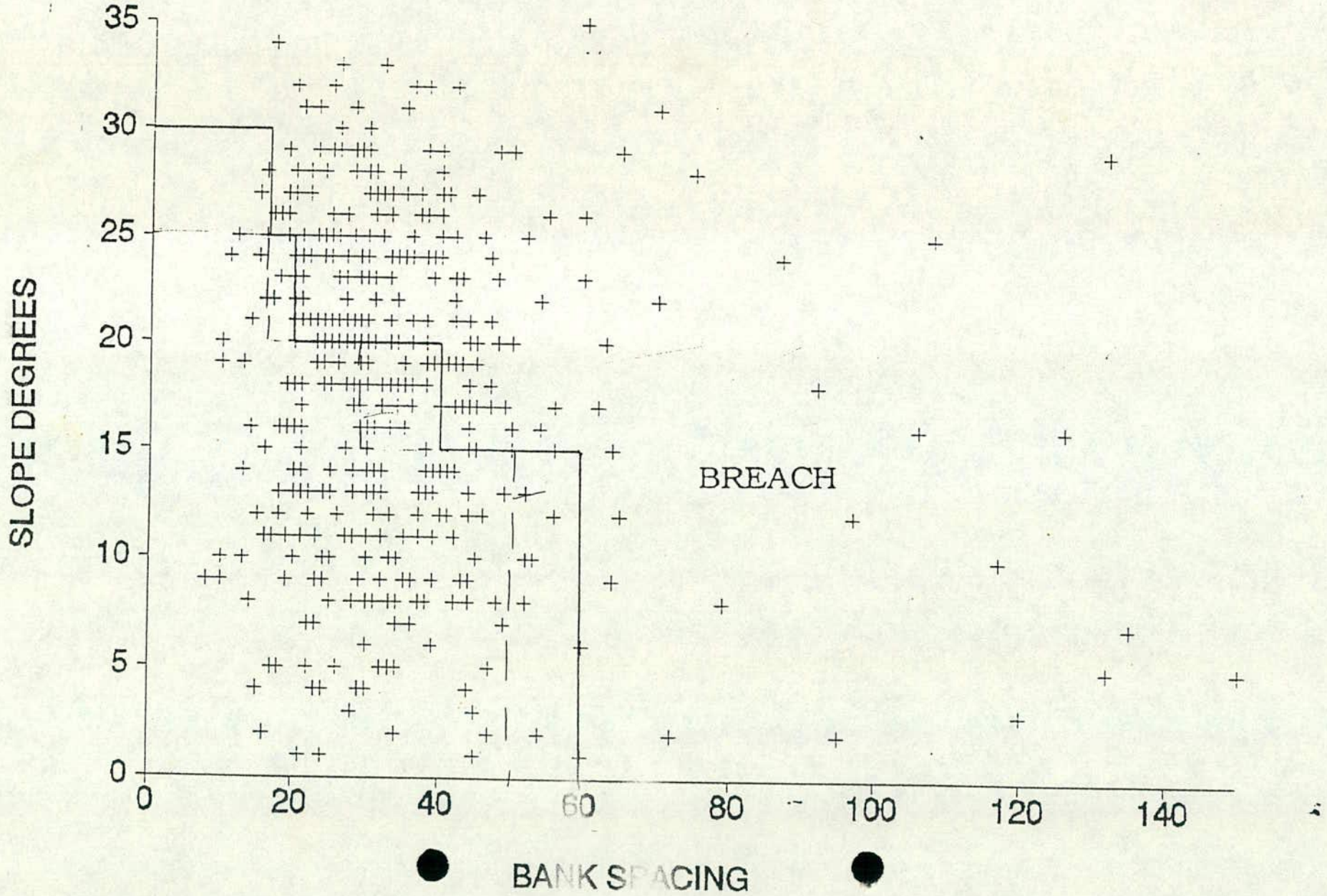


Figure 6 Snig Track Compliance with SEMC's



7. RESULTS OF SOIL LOSS ESTIMATES

7.1 Erosion Hazard Assessment

Using the parameters discussed in Section 5, curves were derived for the area for soil loss over a range of slopes for average topsoil and average subsoil values. This is presented in Figure 7. At the average slope of 72% (36 degrees) the corresponding soil losses are 918 t/ha/yr for topsoil and 1440 t/ha/yr for subsoil respectively. Figure 7 shows that some slope segments along Catbird Road have the potential to lose 2000 tons of soil per hectare per year (note that this is for a 10 m long segment, for a 100 m segment this would in fact increase to over 6000 t/ha/yr.)

On any scale of acceptable soil loss this can only be considered to be extreme. The data required to make this evaluation is easily available (Rosewell and Edwards, 1988, Institution of Engineers, 1987) and can in no way substantiate the assessment of average (low to moderate) erosion hazard in the Harvesting Plan.

7.2 Soil Loss from Snig Tracks

Measured values of snig track slope, and bank interval were taken and with an assumed track width of 5 metres the soil loss from each segment of track was calculated in both tons per hectare to give a comparative rate and tons per segment to give the actual soil loss figure. The results are documented in Appendix 5.

These results are summarised in Figure 8. The curved lines in Figure 8 represent lines of equal soil loss off a combination of track slope and length. Note that most of the measured track segments are losing in excess of 5 tons of soil and that many segments are losing in excess of 40 tons. This highlights the lack of success of structural earthworks alone in successfully combating erosion and indicates the need for improvements in cover management.

The data used to derive these curves is presented in Tables 7 and 8.

If the measured total snig track length is 16.96 km, with an area of 8.48 ha then the total soil loss from this source is 3,300 tons.

7.3 Soil Loss from Road Batters

From the estimated area of 23.5 ha of fill batters, the calculated soil loss is 1440 x 2.0 (increase in LS factor for a 50 m slope length) x 23.5 = 67,700 tons. This figure does not take into account concentrated runoff from road drains.

7.4 Soil Loss from Snig Track Batters

A similarly large amount of exposed material lies on the fill slopes below side cuts, however measurements of sidecut length, as distinct from snig track length, are not documented. It is estimated that 70% of tracks were sidecuts. Allowing an average fill batter length of 10 m at an average slope of 70% gives a soil loss of 1440 t/ha/yr x 11.9 ha = 17,140 tons. This is a conservative estimate.

In total this represents an estimated 88,140 tons of soil lost from the batters and tracks of these compartments. If it were necessary to carry that tonnage out of the forest in trucks it would take 8,814 loads or at one truck per hour over a 40 hour week it would take over 7 months to remove that volume of soil.

Figure 7 Predicted Soil Loss vs Slope for Average Topsoil and Subsoil

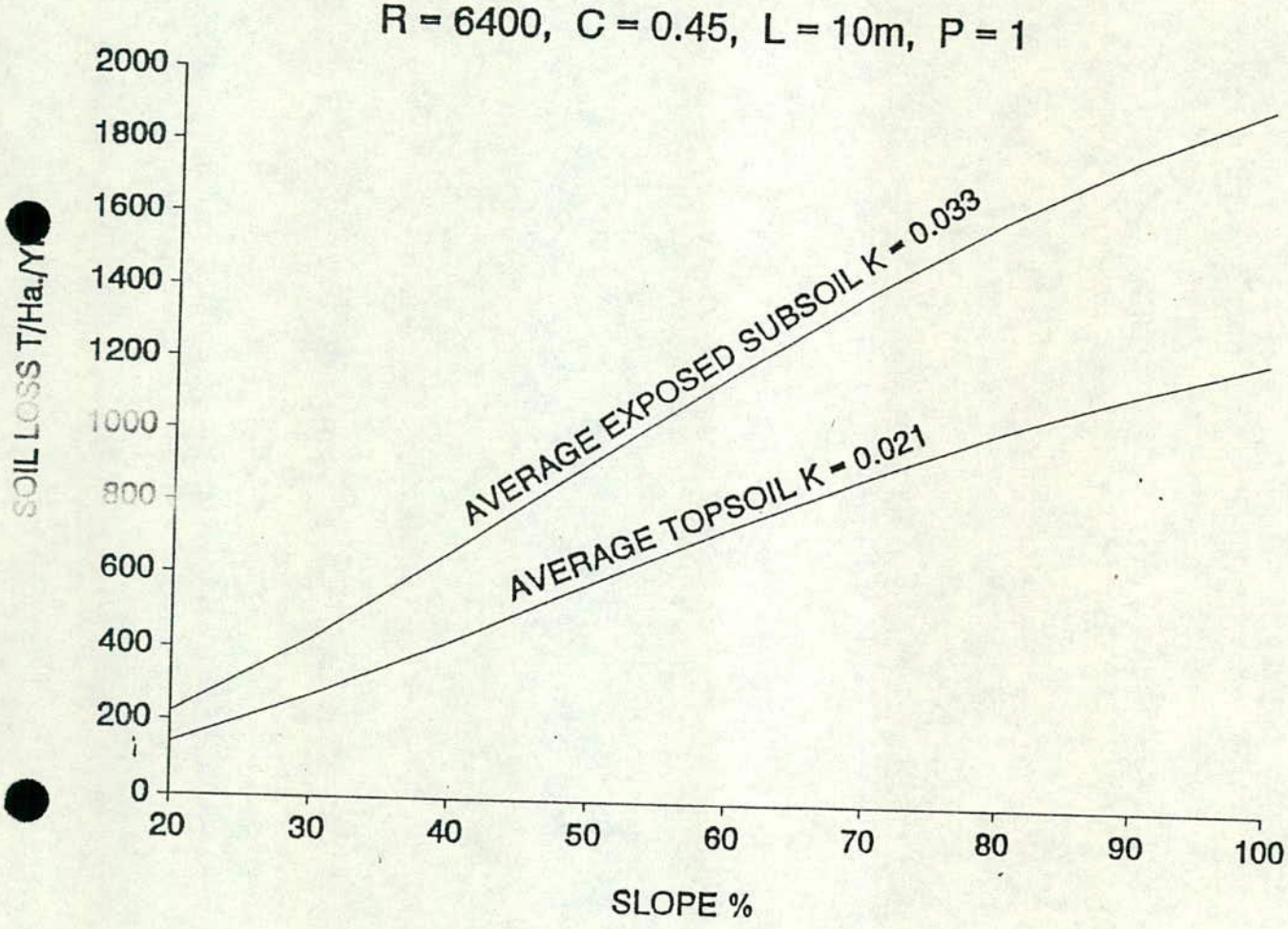


Figure 8 Predicted Soil Loss per Track Segment

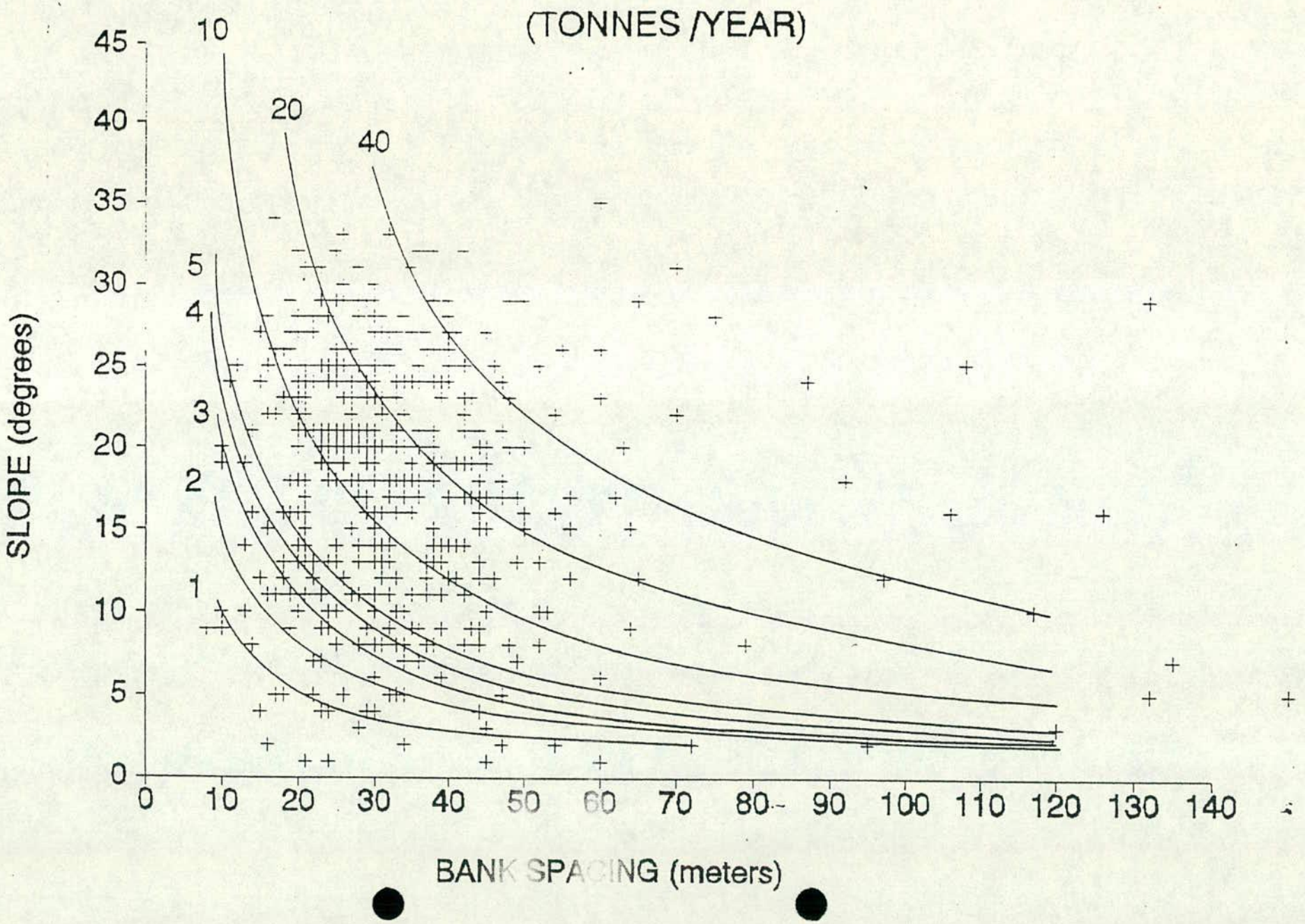


Table 7. - Predicted Soil Loss (T/Ha./Year)

BANK				SLOPE (degrees)					
SPACING	5	10	15	20	25	30	35	40	45
10	59	173	343	557	806	1077	1356	1628	1875
15	72	212	420	682	987	1319	1661		
20	83	245	485	788	1140	1523	1918		
25	93	274	542	881	1274				
30	102	300	594	965	1396				
35	110	324	641	1042	1507				
40	118	347	685	1114	1611				
50	132	388	766	1246					
60	144	425	839	1365					
70	156	459	907						
80	166	490	969						
100	186	548	1084						
120	204	601	1187						

Table 8. - Predicted Soil Loss per Track Segment (T/Year)

BANK				SLOPE (degrees)					
SPACING	5	10	15	20	25	30	35	40	45
10	0.3	0.9	1.7	2.8	4.0	5.4	6.8	8.1	9.4
15	0.5	1.6	3.2	5.1	7.4	9.9	12.5		
20	0.8	2.5	4.9	7.9	11.4	15.2	19.2		
25	1.2	3.4	6.8	11.0	15.9				
30	1.5	4.5	8.9	14.5	20.9				
35	1.9	5.7	11.2	18.2	26.4				
40	2.4	6.9	13.7	22.3	32.2				
50	3.3	9.7	19.2	31.2					
60	4.3	12.8	25.2	41.0					
70	5.5	16.1	31.7						
80	6.6	19.6	38.8						
100	8.4	27.4	54.2						
120	10.2	36.1	71.2						
140	13.2	45.4	89.7						

8. COMPLIANCE WITH LOGGING STANDARDS

8.1 General Comments

The activity of forestry must comply with the provisions of the EP&A Act 1979. The Act demands that suitable environmental standards be set and implemented to avoid any adverse impacts on the forest.

A suite of environmental controls apply to State Forests to satisfy the EP&A Act 1979, and on Oakes those used were:-

* Forest Policies in the form of Management Plans
* Codes of Logging Practice
* Harvesting Plans and
* SEMC's

The use of the SEMC's and the other documents are also validated legally by timber harvesting licence provisions under the Forestry Act (1916).

The management plan for the Macksville Management Area (1983), which includes the Oakes State Forest, outlines prescriptions which are derived in the context of the Commission's statement of Indigenous Forest Policy (October, 1976).

One of the policy objectives from the plan (2.1.1.5) is:

"To maintain natural forest vegetation cover to an extent adequate to conserve the soil resources and water catchment capabilities."

Whether this objective was attained and is attainable will be the subject of recommendations as requested in Item 1.1 (iii) of the brief.

The other three documents are considered operational and used by the Forestry Commission as appropriate standards on which to undertake the activity of timber harvesting. As explained in Section 1.3 the three sets of conditions to a large degree are inter-related and should be examined together.

In addition, a supervisor is available to decide on those conditions where a discretionary choice exists. The supervisor also has a role to monitor operations and change conditions that are not appropriate for the activity.

The activities observed, measured and documented in the field have been compared with the standards in the three documents. Before undertaking that task, it is necessary to gain an understanding of the role of the three standards. These are explained in the following sections.

8.1.1 The Harvesting Plan

The stated Forestry Commission objectives for harvesting plans are:

- Improving the standard of planning and administration of harvesting;
- Minimising the disparity between stated intent and field performance;

- Establishing a systematic, administrative basis for the enforcement of conditions on harvesting operations which may be readily demonstrated to third parties; and

- Playing an integral part in the environmental impact assessment process to assist in satisfying the requirements of the EP&A Act.

A plan comprises two sections:

1. A map of the area (compartment) to be harvested;

2. A text with a description of the area, forest products to be harvested and prescriptions for harvesting.

The plan can be a document in which physical data is collected and recorded at a large scale for site specific purposes. Appropriate standards for timber harvesting which consider all relevant management requirements and environmental factors can be determined. Copies of the harvest plans for compartments 168-170 were provided for this brief and the maps are attached as Appendix 6.

Important features illustrated on the map which were considered in this report are:

- compartment boundary
- logging area boundary
- filter strips
- other stream protection
- forest types
- areas possibly too steep
- areas reserved from logging
- contractor boundary
- excessive sideslope >35 deg. (estimated only)
- special emphasis areas
- wet weather dumps
- feeder road, dump site

The sections of the plan which are of major importance to this brief for evaluation purposes are:

- The map
- The Text
  - Point 5 - Tree Marking and Harvesting Prescription
  - Point 6 - General Prescription
  - Point 7 - Erosion Control Prescription
  - Point 8 - Additional Prescriptions:

    i) Filter strips
    ii) Visually sensitive areas
    iii) Protection strips
    v) Logging roads
    vi) Snig tracks
    vii) Steep areas

  - Point 8a - (a) Catchment Protection (c)

8.1.2 Code of Logging Practices (June, 1988)

These were instigated across NSW to ensure:-

* good standards of workmanship
* safe working practices
* protection of the forest and its environment
* adequate accountability for products obtained

Section 2.2.2 of the Code states:

Arising from 2.2.1, the Commission in conjunction with the Catchment Areas Protection Board has prescribed Standard Erosion Mitigation Conditions for Logging and Clearing in New South Wales and all operations shall conform to these conditions. Nothing expressed in this Code shall effect these Standard Conditions, the latest edition of which is dated June, 1984.

It is obvious that the SEMC's have more power than the code and this was acknowledged in the method of evaluation.

8.1.3 Standard Erosion Mitigation Conditions

This document was formulated in 1975 by officers from the Forestry Commission and Soil Conservation Service under the direction of the Catchment Areas Protection Board. The conditions were applied to all forest operations within protected land (Soil Conservation Act) and Crown timber land (Forestry Act) including State Forests. In 1989 with amendments to the Soil Conservation Act, the CAP Board was replaced by the Commissioner of the Soil Conservation Service.

Review of the SEMC's has been undertaken on two occasions, the last document in July, 1990. Another review is currently in progress because in their present form [illegible] short of the standards required by the Department of Conservation and [illegible]anagement for administration of Protected Land on private property.

On protected land, owing to the general nature of the SEMC's detailed site specific conditions are attached to the authority, a legal document to ensure appropriate standards are determined and adhered to. On State Forests, the detailed information and conditions are normally included in the harvest plan.

The language used in the SEMC's and the discretionary nature of many of the clauses indicate their intent as an extension or advisory document based on soil conservation principles, not a set of enforceable conditions in a legal document.

It is also acknowledged that the SEMC's function as minimum standards and they are to be strengthened when conditions warrant.

8.1.4 Evaluation

When comparing the standards in the three documents prior to evaluating compliance, it was apparent that they could be grouped into three categories which are:

- stream protection;
- snigging and timber extraction; and
- log dumps.

These three categories have been used to group the relevant statements from the Harvesting Plan, Code of Practice and SEMC's for assessment of compliance.

8.2 Stream Protection

The provision of suitable buffer areas for stream protection is essential to prevent the movement of medium and coarse sediment from the soil profile into the drainage system.

It is first necessary to establish how step-back distances on streams/watercourses are measured before studying data. In legal terms, under the requirements of stream bank protection in the Soil Conservation Act, 1938, distances are measured horizontally from the mean water level of the bed or bank. Slope has an enlargin[illegible]

effect on distance determination (Figure 9). For example a 60 metre buffer on a 50 degree slope becomes a 93 metre distance across the ground surface. This effect is significant when assessing compliance distances to filter, protection and buffer strips.

It was difficult to determine location on the ground in relation to position on the map on steep slopes adjacent to watercourse areas. It was also difficult to know if an accurate determination was required because of the various constraints that applied in the harvesting conditions. Consequently, the distance from the water channel edge was conservatively estimated in most cases, where the relevant condition at that point was unclear and measured when it was clear.

A professional judgement on the intrusion of harvesting equipment into a protection or filter strip was made. These cases were given a symbol (IRA) denoting machinery intrusion into a reserved area. These cases occurred in this investigation on 26 occasions.

The determination was sufficiently accurate, to determine that the machinery or track construction or spoil from earthworks was too close to the watercourse edge. Frequently, material from the track construction had been deposited into the watercourse, when the bulldozer may have stopped outside the area. This constitutes a more serious problem than the machine entering the area, although technically it is not a case of non compliance.

Further detailed assessment of these areas could be undertaken if it is considered necessary.

An outline of the relevant clauses relating to stream protection in the three compartments follows:

8.2.1 Harvesting Plans

Compartment 168/169

(i) Filter Strips

a) Are defined as a strip 20 metres wide on either side of watercourse having a catchment area of at least 100 hectares.
b) No trees shall be felled so as to fall across the watercourse.
c) No harvesting machinery shall enter the designated filter strip.
d) Any area sown on the harvesting plan map, or otherwise indicated as a filter strip.
e) Any trees judged likely to damage rainforest trees within filter strips shall not be felled.

(iv) Protection Strips

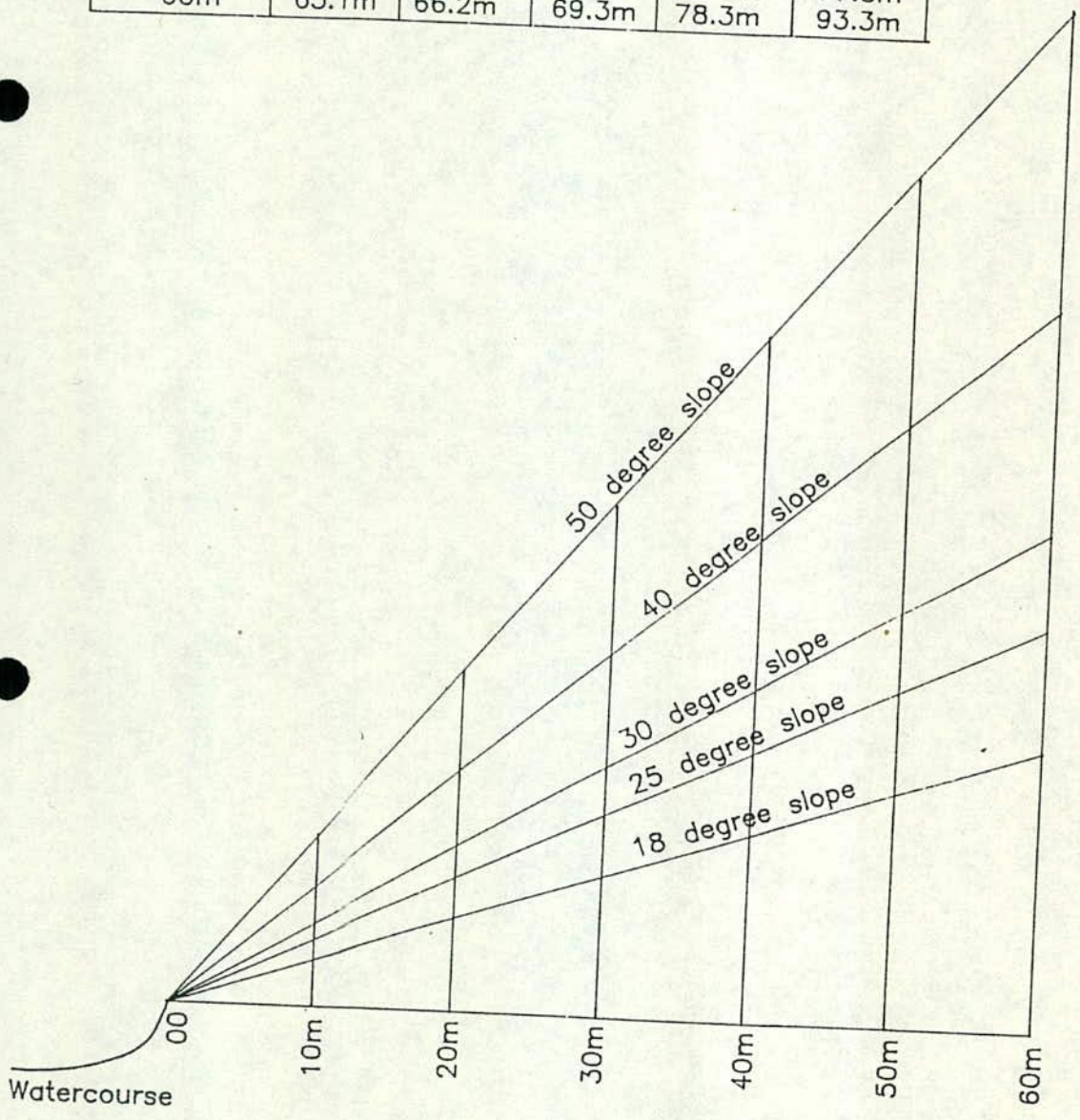
a) 10 metres minimum width on watercourse areas shown on the plan.
b) Harvesting machinery excluded.

(vi) Snig Tracks

d) Where slopes exceed 30 degrees tractors shall not come closer than 60 metres from filter strips.

Figure 9 Comparative Distances on the Horizontal and on a Slope

Horizontal Distance	Slope Distance				
	18°	25°	30°	40°	50°
10m	10.5m	11.0m	11.5m	13.0m	15.5m
20m	21.0m	22.1m	23.1m	26.1m	31.1m
30m	31.5m	33.1m	34.6m	39.2m	46.7m
40m	42.1m	44.1m	46.2m	52.2m	62.2m
50m	52.6m	55.2m	57.7m	65.3m	77.8m
60m	63.1m	66.2m	69.3m	78.3m	93.3m



COMPARATIVE DISTANCES HORIZONTAL/SLOPE

Compartment 170

All the above plus:

8a. Additional Prescriptions

(i) Special Emphasis Areas

a) Catchment Protection

No trees to be felled within 50 metres of the Bellinger River.

No harvesting machinery to encroach within 50 metres of the Bellinger River

In addition to the area designated as Special Emphasis - Catchment Protection, no tree shall be felled and no harvesting equipment shall enter within 30 m of Sunday Creek.

** Note: This does not apply in compartments 168 - 169.*

(vii) Steep Areas

Operations should not commence in any section of the harvesting plan area until the location of areas of steep sideslopes to be excluded from logging have been identified in the field jointly by supervising Foreman and contractor. (Possible sites have been marked on the sketch.)

These are marked on the harvesting plan in purple and given a title of excessive sideslope 35 degrees +. Many exist adjacent to or above watercourses and it appears no criteria exists on what buffer distances apply.

Reserved from Logging (on Harvest Plan diagram)

On the harvesting plan, areas are designated "reserved from logging". No explanation exists in the text for this protection. They are adjacent to watercourses and they all appear to have class 23 or class 6 vegetation which is rainforest. Brushbox is in association with rainforest on the edges in this forest and brushbox was logged.

No definitive distance for reservation is mentioned on the harvesting plan to protect watercourses.

8.2.2 Standard Erosion Mitigation Conditions

Section 2.2 Filter Strips

A filter strip shall be retained where the catchment area of a stream or drainage line exceeds 100 hectares or such lesser area as otherwise specified. The minimum width of any filter strip shall be 20 metres along each side of a drainage line or banks of a stream. Both the width of the filter strip and catchment area may be varied if, in the opinion of the Forestry Commission or the Commissioner, shape, erosion hazard or stream conditions so warrant.

Section 2.3.(i) states:

"No tree shall be deliberately or negligently felled into a stream within a filter strip except as provided in 2.3(ii)" which refers to conifer plantations, so it is not relevant to this report.

Section 2.3(iv):

Trees may be felled into or within a filter strip. Extraction machinery shall not enter a filter strip to remove logs. (Other information refers to conifer plantations.)

Section 2.3(v)

Logging operations shall be carried out so that there is minimal disturbance within any drainage line.

Section 2.4(vi)

Snig or timber extraction tracks shall not intrude into filter strips, except as provided in 2.3(iii), 2.3(iv) and 2.4(v). Section 2.3(iii) and 2.3(iv) refer to conifer plantations.

Section 2.4(v)

Snig or timber extraction tracks shall not cross the beds of streams without application of the same conditions which apply to minor roads. i.e. roads shall not cross running streams unless a causeway, bridge or piped culvert has been provided. Roads can cross dry stream beds via causeways, temporary culverts or temporary log crossings provided there is minimal disturbance.

Protection Strips - not mentioned in the SEMC's.

8.2.3 Code of Practice (1988)

7.1 All operations shall be carried out in such a manner as to minimise soil disturbance, water pollution and environmental damage generally. Disturbance to drainage lines not designated as filter strips should be afforded special protection, and on completion of operations crossings of dry streams by minor roads or snig tracks shall have the sites of the crossing restored to its original condition as closely as possible.

7.4 Mechanical logging equipment shall not enter filter strips except to provide access for approved crossing points of drainage lines.

6.10 Filter strips as defined in the SEMC's shall be identified in harvesting plans together with any additional constraints or conditions, (often associated with felling), deemed necessary.

6.11 No tree shall be deliberately or negligently felled into a stream within a filter strip. Accidental cases of heads lodging into such a stream shall be reported to the Commission to determine whether their removal is justified. Any removal of the head should minimise disturbance to the bed and the bank of the stream.

8.2.4 Compliance With the Conditions

The following examples of non-compliance were observed and documented in the data sheets in Appendix .

2.3(iv) and (c) Harvesting machinery did enter the filter strips.

(e) Rainforest trees were damaged/destroyed by the felling of brushbox trees and by harvesting machinery.

(b) Harvesting machinery entered the protection strips as did spoil and vegetation from the operation.

(d) Tractors intruded into the 60 metre reserve on slopes over 30 degrees.

8a(vii) Operations took place in areas of steep sideslope identified on the harvesting plans. We have not been given evidence that a meeting occurred to identify these areas.

2.3(i) and 6.11 At least one tree was felled into Sunday Creek and one on the immediate bank of Scraggy Creek. There is no evidence to suggest that the action was not deliberate or negligent.

2.3(v) and 7.1 Drainage lines, not designated as filter strips were largely ignored as a landscape feature and did not obtain special protection such as minimal soil disturbance, water pollution and environmental damage generally.

2.4(vi) and 7.4 Snig tracks did enter filter strips.

8.3 Snigging and Timber Extraction

The removal of trees from the forest, in compartments 168-170 was by snigging over the ground surface behind a bulldozer. The snig track is either formed or unformed during the operation and on completion re-established, drained and revegetated. The relevant clauses in the three documents that determine the conditions are as follows:

8.3.1 Harvesting Plan

Compartments 168 - 170

7. Erosion Control Prescriptions - Cross Banks

As per Standard Erosion Mitigation Conditions for Logging - June 1984. For Minor Roads and Snig Tracks the following minimum standard for Cross Banks is required:

a) Assessed erosion hazard - average.
b) Cross banks to be 60 cm high uncompacted.

Maximum Spacing

Grade	*<15 deg*	*15 to 20 deg*	*20 to 25 deg*	*25 to 30 deg*
Average Erosion Hazard	*60 m*	*40 m*	*20 m*	*15 m*

When comparing the data collected in Oakes with the above standard it became apparent that snigs with slopes of 15 deg, 20 deg and 25 deg could be grouped in two categories with a variation in interbank spacing of 100%.

As the lower slope range indicated <15 degrees it is assumed that the other groups are <20, <25 and <30 degrees. i.e. 19, 24 and 29 degrees.

The table then becomes:

Grade	<15 deg	15 to 19 deg	20 to 24 deg	25 to 30 deg
Average Erosion Hazard	60 m	40 m	20 m	15 m
High Erosion Hazard	50 m	30 m	15	not permitted

For working practically a 10 percent tolerance factor was allowed.

Results

Using this system and examining the data based on an "average" erosion hazard nominated in the Harvesting Plan, the results are:

Total number of banks constructed - 356

Interbank spacings exceeded the standard - 165

The positions where cross banks were required but banks were not constructed - 86

The variation in the interbank spacings, when measured in the field were totally inconsistent. It was apparent that the operator had no understanding of the standards with which he was obliged to comply.

The supervisor, likewise

- had no understanding; or
- did not check or see the operation; or
- if he did understand, was not prepared to enforce the conditions.

On a level ridge track the spacing was 20 metres on one occasion, the same as that is required on a 25 degree slope. On one very steep track (35 degrees), the spacing was 60 metres and on another track (28 degrees) the spacing was 75 metres. On a 15 degree track slope the spacing was 16 metres instead of 60 metres. This randomness is displayed in Figure 6.

If the erosion hazard is high, not average, then the bank spacing criteria would be closer and interbank spacings on site would exceed the standard more often.

Bank Height

The specified bank height is 60 cm uncompacted. As most of the cross banks had settled, a height of 45 cm was considered acceptable.

The number of banks with a height -<10 cm	22
The number of banks with a height 10 - 20 cm	22
The number of banks with a height 20 - 30 cm	57
The number of banks with a height 30 - 40 cm	50
The number of broken banks	28
Total of inadequate or failed banks	179

If banks were working at the time of inspection, this was indicated with the symbol OK. It did not indicate the future stability of the structure .

Snig Tracks

Where there is a high erosion hazard, the grades of snig tracks, extraction tracks and minor roads shall be limited and shall be specified according to the erosion hazard, and in any event shall not exceed 25 degrees. Where the erosion hazard is less, the grade shall exceed 25 degrees only where specified.

The grade of snig tracks exceeded 25 degrees on 82 readings. If the area has a high erosion hazard this is not permitted, if the erosion hazard is less, the construction must be specified.

Snig track erosion was noted in the depth of the rills and the distance downslope from the previous bank. Track erosion was not recorded systematically from dumps 1 - 4. Rills were recorded up to 50 cm deep.

8a. Additional Prescriptions

(vi) Snig Tracks

(a) Due to the overall steepness of the area, special emphasis will be placed on adherence to the Standard Erosion Mitigation Conditions.

Appears to be more of a statement of rhetoric than fact. Statistics on non-compliance of conditions support this view.

(b) Where slopes exceed 30 degrees, track construction must be approved by the supervising Foreman.

This approval is presumed, but no documentary evidence has been sighted.

(c) Track construction for short distances through 35 degree plus slopes to reach areas of slope less than 35 degrees must be approved on site by the supervising Foreman.

This approval is presumed, but no documentary evidence has been sighted. (see SEMC's 2.4(iv).)

(d) Where slopes exceed 30 degrees tractors shall not come closer than 60 metres from filter strips.

Discussed in Section 8.2. The tractor intruded into the filter strip on Sunday Creek.

(e) Snig tracks leading onto, or away from, log dumps will have drains constructed as close as possible to the dump.

Acceptable.

(f) In visually sensitive areas trees must be retained below a sidecut so that their crown helps reduce the visual impact of the cutting.

Acceptable.

(g) On the completion of work in any section of the harvesting plan area, operations must not commence in another section until the supervising Foreman has checked and approved snig track drainage work.

The snig track drainage work is unacceptable and the data supports this statement. It is incongruous that this work could be approved by a supervisor when the statistical data indicates the majority of the work does not comply with the standards.

(x) *Dump Sites and Snig Tracks*

Location for all dump sites and snig tracks needs to be approved by the supervising Foreman.

If the snig track sites were approved, training is required for the supervisor. Once again there does not appear to be any documentary evidence of approval.

8.3.2. Standard Erosion Mitigation Conditions

Section 2.4(i)

As far as practicable snigging and timber extraction shall be uphill. In any event, downhill movement of timber shall not be practised in areas with high erosion hazard or as specified.

Some downhill snigging occurred infrequently but the result was satisfactory. Timber extraction in general was uphill.

Section 2.4(ii)

The drainage of snig or timber extraction tracks shall be carried out in the same way as for minor roads. The height and spacing of the cross banks shall be specified. The following table shows the maximum bank spacing required for each grade and degree of erosion hazard. These maximum spacings may be varied where difficult or inappropriate drainage disposal areas are encountered. Any variation requires the concurrence of the Regional Forester or his representative.

Refer to Harvest Plan information for bank spacings.

Where there is a high erosion hazard, the grades of snig tracks, extraction tracks and minor roads shall be limited and shall be specified according to the erosion hazard, and in any event shall not exceed 25 degrees. Where the erosion hazard is less, the grade shall exceed 25 degrees only where specified.

This has been discussed under Harvesting Plan criteria (Section 8.3.1). I presume that no concurrence to the interbank spacing changes were given by a representative of the Regional Forester.

Section 2.4(iii)

As far as is practicable, slash shall be retained on extraction tracks, timber extraction by walk-over techniques shall be used, and the construction of snig tracks shall be minimised. In any event the use of a blade shall only be permitted for removal of soil from a snig or timber extraction track during initial track construction and during track drainage. "Blading-off" shall be permitted only where track damage is minimal and subsequent drainage and repair is possible. Each "blading-off" operation must be specifically approved.

"Slash shall be retained on extraction tracks, timber extraction by walk over techniques shall be used".

This condition was not adhered to. In those instances where it was practised, disturbance and subsequent erosion was minimal and revegetation has developed to prevent any further movement.

This condition was observed to be successful on track slopes up to 28 degrees yet other tracks in close proximity had been cut 0.5 metres deep on lesser ground slope of 22 degrees. In the foregoing case, the rapid revegetation of the area disturbed by the dozer tracks and snigged logs prevented ongoing erosion, which is still occurring on most of the cut tracks.

"Construction of snig tracks shall be minimised".

The basic philosophy in harvesting on steep slopes should be to only construct snig tracks when the winch rope, wound out to its extremity, will not reach the log. This may require the employment of another person to run out the rope.

Snig tracks have been constructed to locate the bulldozer as close as possible to the felled tree and consequently there are far too many snig tracks.

"A blade shall only be permitted for removal of soil etc...".

It is unclear whether much "blading-off" occurred or whether the initial construction was so severe as to lower the track surface below ground surface by up to a metre on ridge lines and deeper on side cuts.

On nearly every occasion the side cut tracks were located on cut material only, not on cut and fill (Figure 3). With a 4.5 metre bull blade on the dozer, large quantities of soil material were moved, consequently, more spoil was left sitting as an unstable windrow or moved downslope to find the natural angle of repose.

There is evidence of "blading-off".

Again, it is presumed the operation was specifically approved.

Section 2.4(iv)

Where there is high erosion hazard, snigging and extraction of timber from areas with slopes over 30 degrees shall not be permitted if track construction is required. Where there is low or moderate soil erosion hazard, snigging and extraction of timber from areas with slopes over 35 degrees shall not be permitted if track construction is required. Where specifically approved by the supervising officer, tracks may be constructed on slopes in excess of these limits where it is necessary to traverse these slopes for short distances to enable timber to be extracted from areas of lesser slope.

"Where there is less erosion hazard, snigging and extraction of timber from areas with slopes over 35 degrees shall not be permitted if track construction etc.....".

Snig tracks were measured on ground slopes over 35 degrees on 96 occasions.

"Where there is high erosion hazard, snigging and extraction of timber from areas with slopes over 30 degrees shall not be permitted if track construction is required".

Tracks were measured on ground slopes between 30 and 35 degrees on 124 occasions.

"Where specifically approved by the supervising officer, tracks may be constructed on slopes in excess of these limits where it is necessary to traverse these slopes for short distances to enable timber to be extracted from areas of lesser slope".

The data indicates that the intent of this condition was not followed. In some instances, areas of lesser slope would have been accessed by snig tracks which traverse slopes over 30 or 35 degrees but generally, much of the area serviced by these steep tracks was of similar slope.

Section 2.4(v)

Snig or timber extraction tracks shall not cross the beds of streams without application of the same conditions which apply to minor roads.

In this area, this item is not relevant.

Section 2.4(vi)

Snig or timber extraction tracks shall not intrude into filter strips, except as provided for in 2.3(iii), 2.3(iv), and 2.5(v).

Previously covered in Section 8.2.4 Stream Protection.

Section 2.4(vii)

The use of snig or timber extraction tracks in wet conditions shall not be permitted if "blading off" is required.

There is evidence, such as glazing of skid marks and accumulation of homogenous debris, to indicate that snig tracks were used in wet conditions. There is also evidence of "blading off" in wet conditions. This condition was violated.

Section 2.4(viii)

Where required surface material shall be returned to the track immediately after logging ceases on that track to aid in revegetation, and at the same time crossfall drainage shall be re-established. In circumstances where it is considered necessary the method of revegetation shall be specified.

As is evidenced on the data sheets windrows existed on most snig tracks due to the method of construction and the size of the bulldozer used. Most tracks were constructed in a manner which resulted in excessive cutting of the profile and as a bull blade was attached to the dozer, windrow/s resulted.

On very few of the tracks, if any, was any attempt made to replace or remove the windrow or re-establish natural crossfall drainage on the track, or recover the exposed surface. The inter-bank spacing could have been adequate, had the surface material been returned to the track. In many instances, as previously mentioned, a walk over technique could have been effectively used to avoid the need for major disturbance of surface material.

There are cases where the windrow is up to one metre deep or more. This indicated that the construction of the track resulted in the removal of all surface material to rock in these instances. Walking on these tracks was very difficult as most of the loose fine material had gone.

The topsoil contains all the organic matter, most of the elements and all the seed source for re-vegetation. If it is buried with sub-strata, and left in a windrow or downslope, then re-vegetation of the exposed surface is substantially slower and it continues to be vulnerable to erosion.

There are numerous examples where revegetation could be aided by spreading appropriate seed mixtures (see Section 10 on rehabilitation recommendations).

8.3.3. Code of Practice (1988)

7.2 Snig track construction is not permitted on slopes over 35 degrees, (30 degrees for High Erosion Hazard) unless specifically authorised.

Previously addressed

7.3 Grades on snig tracks shall not exceed 25 degrees unless specifically authorised.

Previously addressed

7.5 Where possible, surface vegetation shall not be removed from snig tracks, and as far as is possible snigging shall be uphill.

Previously addressed

7.6 "Blading Off" on minor roads and snig tracks is prohibited unless specifically authorised.

Previously addressed

7.10 Drainage of snig tracks and minor roads, other than permanent fire trails, shall be carried out in conformity with the Standard Erosion Mitigation Conditions. The required frequency of cross drainage banks will be prescribed in the harvesting plan. Drainage shall be carried out progressively on each track upon completion of, or temporary cessation of, operations.

The first two conditions were previously addressed.

Evidence on-site suggests that some cross banks were installed after the tracks had been eroded, in some cases to 0.3 and 0.4 metres. Clearly, this condition was not adhered to and more importantly, no attempt was made to reconstruct the track and crossfall drain it, before the cross banks were installed.

8.4 LOG DUMPS

Dumps are constructed for the storage and loading of logs for transport from the site.

8.4.1 Harvesting Plan

Compartments 168 - 170

(x) Dump sites

Location for all dump sites needs to be approved by the supervising foreman.

In general, the location of the dumps was satisfactory for the terrain on which they were constructed.

Dump No. 6 was constructed on a site that necessitated large cut/fill earthworks and this has created revegetation problems.

Dump No. 8 is located close to a drainage area and run-off flows are crossing the dump. ~~No attempt has been made to divert runoff.~~

8.4.2 Standard Erosion Mitigation Conditions

Section 2.5(i)

Log dumps shall be located as far as practicable in accordance with an uphill extraction pattern. Debris from log dump operations shall not be located closer than 10 metres from a filter strip or drainage line.

Acceptable except dump 8 is located in a drainage line and no attempt has been made to divert runoff.

Section 2.5(ii)

When ungravelled dumps are constructed and unless otherwise specified, topsoil is to be stockpiled in a recoverable position, and either -

(a) upon temporary termination of logging, where further logging is contemplated in the near future, the dumps are to be levelled unless otherwise authorised, drained so that runoff is directed onto surrounding vegetation and ripped where specified, or

(b) upon completion of logging the dumps are to be levelled unless otherwise authorised, drained so that runoff is directed onto surrounding vegetation, and the topsoil spread evenly over the dump. The dump shall be revegetated and/or ripped where specified.

Although the topsoil on the ridges at Oakes is shallow, no attempt has been made to stockpile it in a recoverable position.

8.4.3 Code of Logging Practice (1988)

7.12 Log dumps shall be located as specified in the harvesting plan and shall not be located closer than 10 metres from a filter strip or drainage line. The location of additional or alternative dumps require specific approval.

Acceptable.

7.13 Dump size will be minimised subject to efficient operations.

Acceptable.

7.14 On completion of operations dumps are to be drained, ripped if directed and unless otherwise authorised shall be levelled and have stockpiled topsoil replaced.

No topsoil has been saved and no ripping has been conducted.

9. GENERAL ISSUES OF COMPLIANCE WITH SEMC's

9.1 Appropriateness of SEMCs as a Standard

It is not possible to determine whether some clauses within the SEMC's have been correctly complied with because they allow for discretionary approval and it is not known whether this approval was given or not. Similarly some clauses refer to the intent of the operator, and this cannot be judged . For example *"no tree shall be deliberately or negligently felled into a stream..."* In other cases the clauses are worded loosely, reflecting their intent as guidelines not prescriptive regulations against which performance can be measured. For example the terms *"as far as practicable"*, *"only where damage is minimal"*, and *"where it is considered necessary"* are appropriate advisory terms but cannot form the basis of a judgement of compliance.

9.2 Logging and Track Construction on Steep Slopes

Clause 2.4(iv) specifies that where there is a low or moderate erosion hazard then snigging or extraction of timber shall not be permitted on slopes over 35 degrees and when the erosion hazard is high then the restriction applies at 30 degrees.

The detailed discussions regarding the definition of erosion hazard and the calculation of soil loss in Section 5 together with the presentation of soil loss results in Section 7 serve to indicate that the area has a high erosion hazard. The main contributing factors to this high erosion hazard are the steep slopes and high rainfall erosivity. It is not appropriate to speak of an erosion hazard independent of slope, as if the two were independent variables, as is done in the SEMCs. It is not logical to suggest that the area might have an average erosion hazard when the slopes are in excess of 35 degrees and the rainfall erosivity is among the highest in NSW.

It would seem that "soil erodibility" has been incorrectly substituted for erosion hazard in the interpretation of this clause. (Refer to Glossary of Terms in SEMC's)

This clause allows specific approval for tracks to traverse small areas in excess of the prescribed slope limit to reach other (by implication larger) areas of lesser slope. This cannot be justified in this situation as most of the length of Catbird Road and much of the logging areas exceed the 35 degree value, let alone the more appropriate 30 degree limit.

The Harvesting Plan identifies some areas of *"excessive sideslopes"* to be excluded from logging (coloured purple on the map). Had these been accurately mapped in the first instance the decision may reasonably have been made not to proceed with logging in these compartments. The forest types were mapped from aerial photographs at a scale of 1:15000. It would have been possible to accurately map slopes in the same way. The 1:25000 contour maps significantly underestimate slope angles in this very steep terrain and this fact should have been recognised. If it wasn't recognised prior to preparation of the Harvesting Plan then it should have been recognised during the early stages of construction of Catbird Road. The Harvesting Plan specifically requires that *"operations should not commence in any section of the harvesting plan area until the location of areas of steep sideslopes to be excluded from logging have been identified in the field jointly by the supervising foreman and the contractor"*. Clearly this either did not take place or the conscious decision was taken to continue operations.

10. RECOMMENDATIONS FOR REHABILITATION

At the time of inspection of compartments 168 - 170, many cases of active erosion existed which require stabilisation and rehabilitation.

Erosion processes are dynamic and since the assessment, changes to the status of erosion and revegetation will have occurred. Consequently, it is difficult now to give specific recommendations for rehabilitation which may already have changed or will change before implementation.

10.1 Appropriate Rehabilitation Standards and Works

The standards described in the three operational documents discussed in this report are acknowledged as minimum standards for erosion and sediment control. Many of them were not met.

Our objective now is to attempt to restore stability to unstable areas and in some instances, this could mean going beyond the minimum standards. On the other hand it could mean doing less.

Extensive earthworks constructed now could re-activate loose material and deposit large sediment loads into the drainage system. Any revegetation which may have established, could be destroyed with the construction.

If the Forestry Commission decides to proceed with rehabilitation and we presume this will occur, officers from CaLM will conduct a field assessment to establish the current erosion status and the minimum rehabilitation requirements to achieve stability.

This information will then be made available to the Forestry Commission. The implementation of any works should be in consultation with officers from CaLM.

10.2 Rehabilitation of Snig Tracks and Dumps

The following factors will be considered in the rehabilitation program:

1) Timing of the Operations

   This should avoid periods of high rainfall erosivity and should promote the establishment of perennial vegetation.

2) Hand Methods

   Some earthwork rehabilitation can be achieved without using a bulldozer. It would have limited application such as diverting water off tracks, opening up bank ends and topping up banks because sending a bulldozer back would be difficult or not warranted.

3) Machinery

   A suitable wide track machine, preferably in the D5 Class with angle and tilt blade and rippers is required. This would:

   - Re-instate cross fall drainage
   - Remove windrows, back onto the track
   - Fill gullies
   - Construct additional banks where required
   - Reconstruct inadequate or ineffective banks.

4) Revegetation

Appropriate seed and fertiliser mixtures will be necessary on some areas.

The recommendations would consider the long term environmental effects of any introduced species and balance this with the immediate needs to revegetate exposed, vulnerable areas.

10.3 Rehabilitation of Catbird Road

Slips should be managed as they occur. There is no simple or economical way to minimise the slip potential along road batters. Construction of drains, open or slotted, along the ridge above the worst slip areas will help to minimise slip problems but are not practical in this instance due to steep slopes and the added environmental damage that would occur during construction.

The geology of the area is such that it is impossible to generalise on what should have been the maximum cut into the hillslope. However, cuts up to approximately 3 m vertical height generally show only minor slip problems. One reference book suggests shales and argillaceous rocks should have a minimum cut batter of 1.5 to 1 (33 degrees). A lot of the natural ground slope along the new Catbird Road is around 33 degrees so this is not possible.

Any further logging should be restricted to dry conditions as extreme care would need to be taken during wet weather or after wet weather because of rock slides and slumping that could occur without warning and could be set off from the vibrations of moving trucks or vehicles. There would be a significant danger to personnel if logging operations take place during this time.

The entire road should be regraded as an outfall road with roll-over banks placed at the approximate positions detailed in Appendix 7. Discharges over the fill batters will result in soil loss but the rocky nature of the fill should minimise any slip failure of the road batters themselves.

Seeding, fertilising and watering of suitable grass and plant species should be undertaken, as a minimum, on the cut batter/road interface, on roll-over banks and at discharge points on the fill batter.

Propex (R) silt stop or equivalent suitable product should be placed clear of the existing fill batter toe, at positions immediately below road drainage exit points. The fabric could be cut in 10 m lengths and placed in a quarter moon shape to join the batter toe at either end. This should ensure that some sediment is trapped close to the point of erosion.

Sections of the road where wheel tracks have damaged the surface should be reworked.

Reconstruct or close the section from 4.50 to 4.70.

If it is decided that the road is not to be used for access, logging or fire-control, then a large block bank is recommended at the chainage of 0.0. to prevent vehicular damage to the road and encourage a ground cover.

11. RECOMMENDATIONS FOR FUTURE ACTION

When proposing logging in areas of a similar nature to Oakes State Forest (Terms of Reference Item iii), the following recommendations must be considered.

11.1 Physical Resource Inventory

The Management Plan for the district is the planning and policy document on which local forest management is based. It should comprise an inventory of physical resources at an appropriate scale, which enables informed policy decisions to be made.

The information collected should include:

* Climate, particularly rainfall erosivity
* Slopes. These can be accurately mapped by aerial photographic interpretation and areas of steep slope excluded from logging.
* Soils. Erodibility classes for forest soils should be determined.
* Vegetation. The use of forest typing will assist the effective management of ground cover and other vegetation.

Forest Capability - A forest capability system should be developed which combines the various resource attributes. A capability system identifies forested land capable of sustained production.

11.2 Erosion Assessment

Better methods need to be adopted to determine the potential erosion hazard of a proposed logging operation. It is suggested that the SOILOSS program be employed because it can immediately place the area in a Statewide context as to the relative erosion hazard. The erosivity factor (R) and erodibility factor (K) are unchangeable natural constraints. The slope angle (S) is a natural constraint but an informed opinion can then be made on what slope angles are appropriate. The other factors are a function of management and can be varied as required. Slope length (L) can be adjusted with earthworks. The cover factor (C) offers the greatest opportunity for improvement. The formula shows that it is the factor with the greatest range and is one of the easiest to change. In the natural forest this factor is very low. Good management only requires an effort to maintain these low values by maintaining good ground cover. If this is achieved then rehabilitation work is kept to a minimum. The SOILOSS equation allows the impact of a proposed variation in practice or location to be immediately evaluated.

11.3 Mass Movement Hazard Assessment

The repercussions of locating roads and tracks in mass movement prone areas without adequate provision for the mass movement processes are serious land degradation and erosion.

An assessment of areas proposed to be logged should be undertaken during the colleciton of the physical resource data. This information can then be used to correctly locate roads and tracks to avoid serious problems.

11.4 Cover Management

The bank spacing vs slope graph in Figure 7 indicates that earthworks solutions to erosion problems are not sufficient in themselves. The biggest opportunity for improvement is in cover management, both in reducing the amount of exposure and in re-establishing cover more quickly. This is achieved by 1) minimum disturbance, 2) maintaining trash on tracks and 3) seeding and fertilizing bare areas.

11.5 Operational Standards

The SEMCs are inadequate as operational conditions, but they are very useful as extension principles or quidelines for use by contractors and supervisors. This was their original intended use in 1975.

It appears to be more appropriate to use the harvesting plan, for conditions that are specific to the site as the document that fixes the operational standards.

11.6 Auditing Procedures

A system should be developed which ensures the ongoing failure to comply with the conditions which occurred at Oakes State Forest is not repeated.

This system could have checks and blocks, similar to the Forest Protocol jointly developed with Forestry Commission input.

11.7 Staged Approvals

A system should be put in place to improve the accountability of operators and Forestry staff, whereby authority to log is based on a rolling sequence of compartments. Continuation of the authority would be conditional on successful erosion control and rehabilitation practices having been implemented in the first compartment before logging can commence in the subsequent compartment. This practice is commonly used by the mining industry and in private forests under the authority of the Department of Conservation and Land Management.

11.8 Snig Track Length

There was an excessive length of snig tracks in this area. The length could be substantially reduced by identifying the location of the main snig tracks on the Harvest Plan or identifying their locations in the field in consultation with the field supervisor. Cable winching logs to the limit of available cable should be used to retrieve logs in preference to constructing extra snig tracks. Walk over techniques are preferred to construction of snig tracks.

11.9 Slope Limits For Fill Batters

As illustrated in figure 3, fill batters on slopes over 25 degrees become extremely difficult to stabilise.

At slopes over 25 degrees consideration should be given to removal of fill from the area, rather than depositing it as a scree slope. The track would then all be on cut material.

11.10 Training and Accreditation

Forestry Commission Supervisors and private contractors and supervisors should be given extra training by means of a short course in:

1) Environmental awareness.

2) Planning and positioning of roads and snig tracks to minimise environmental damage;

3) Dozer operation to minimise soil loss and environmental damage;

4) Supervision of road construction.

A certificate should be presented to successful trainees on completion of the course similar to the Earthmovers Training Course developed by CaLM.
Forestry Commission dozer drivers, private dozer drivers and supervisors should not be involved in road construction in State Forests unless they have received a certificate.

11.11 Future Forestry Roads

Roads should be constructed on or close to the ridge line. Where the ridge rises greater than the optimum road slope the road should still follow the rise in the ridge line as close as possible keeping the road slope as steep as practicable. In most cases the slope could be 12 degrees to 14 degrees. When the ridge drops down to the next saddle the road should dip at the optimum grade to meet the ridge at the saddle. This method would ensure slippages are kept to a minimum and catchment area is the minimum possible leading to controllable drainage techniques.

Half round corrugated pipes should be installed within the fill batters of highly erosive soils to limit soil loss from road batters. A dissipater at the bottom of the chute constructed out of large rocks would help break up the flow. Grouted rock would be an alternative to larger rock. Various dissipators have been trialled with the Forestry Commission at Dalmorton State Forest.

Sediment control works should be emplaced as road construction commences and left in place on completion. Propex (R) silt stop or equivalent suitable sediment control fabric should be placed clear of the expected fill batter toe with other means of sediment control used within watercourses where the fabric would be washed away. Spreading of the water course flow or excavations within the watercourse are options in these situations.

Road gradients should be kept below 10 degrees wherever possible but can be increased to 14 degrees if the soil is not highly erodible and if the increase in grade assists in location of the road to an area of less side slope or smaller catchment area.

11.12 Operational Aspects

The following practical aspects of logging should be implemented in future operations.

- Snigging on ridgelines - position the snig track alternatively either side of the ridge at intervals to aid drainage. On broad ridges, zig zag the track at 10 - 15 degrees to flatten the grade. This exposes more bare areas but aids drainage and avoids excessive disturbance by machinery lugging up steep inclines.

- Machinery - the correct machine should be chosen for the activity.

  Only bulldozers with angle and tilt blades should be allowed in the forest. It is not possible to comply with the roading and snig track conditions if the machine is fitted with a bull blade.

  Only use a machine that has the correct capacity for the work. Large machines disturbe excessively large areas of vegetation.

- Road Construction - no roads or tracks should be constructed on slopes over 30 degrees. This upper limit can be revised downwards.

  On slopes over 25 degrees, fill should be removed from the site and deposited in a safe position. Log bridges and pipes should be used instead of temporary stream crossings.

- Filter/Protection Strips - should be of adequate width to be effective in their role. Minimum widths either side of the watercourse should be as follows:

Catchment area <40 hectares		
filter strip	-	10 metres
protection strips	-	10 metres
Catchment area >40 hectares		
filter strip	-	20 metres
protection strips	-	10 metres

  Filter and protection strips should be "no logging" and "no machinery" areas.

11.13 Economic Assessment

An economic assessment audit should establish the most efficient log recovery strategy and avoid environmental problems that develop when contractors attempt to cut costs.

12. ACKNOWLEDGMENTS

The authors wish to acknowledge the considerable contribution made by Gavin Pryde in the preparation of this report. Gavin did much of the data entry, spreadsheet manipulations, erosion calculations using SOILOSS, report collation and preparation the graphs and tables. The helpful assistance of Forestry Commission officers in the field is appreciated. Word processing for Mr Attwood and Mr Kingman was by Sandra Smidt and map drafting was by Alan Boman.

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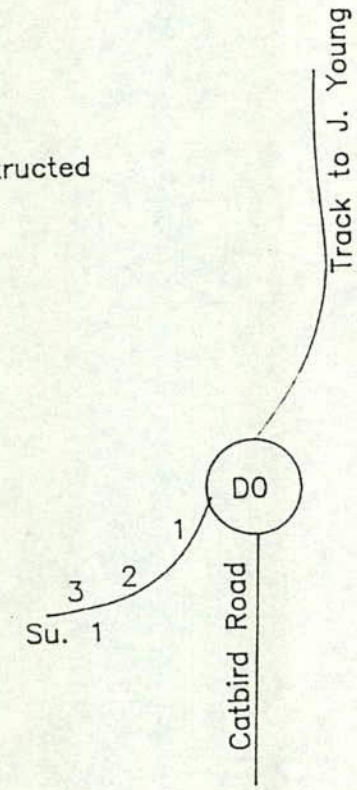
APPENDICES

Appendix 1 Diagrams of Snig Track Locations

DIAGRAMS OF SNIG TRACKS
OAKES FOREST CONSULTANCY
Compartment 170

DUMP 0
No Dump constructed
Snig Track 1



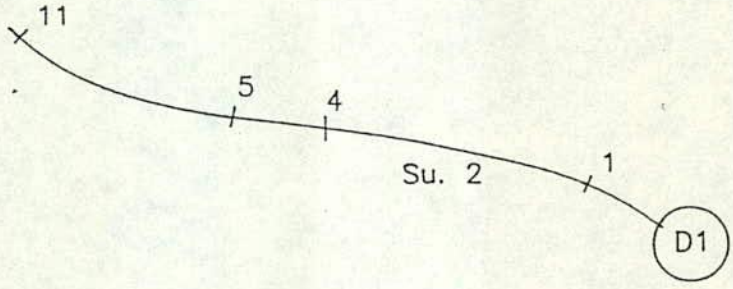
Catchment: Sunday Creek

DIAGRAM OF SNIG TRACKS
OAKES FOREST CONSULTANCY

Compartment 170

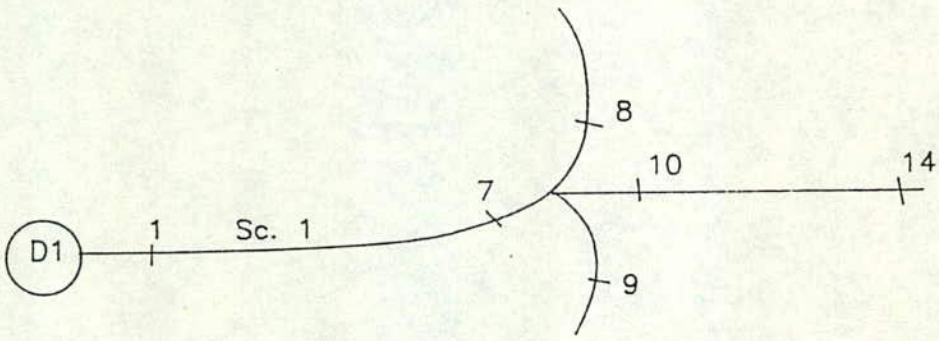
DUMP 1
Snig Track 2

Catchment : Sunday Creek



DUMP 1
Snig track 1

Catchment : Scraggy Creek



DIAGRAMS OF SNIG TRACKS

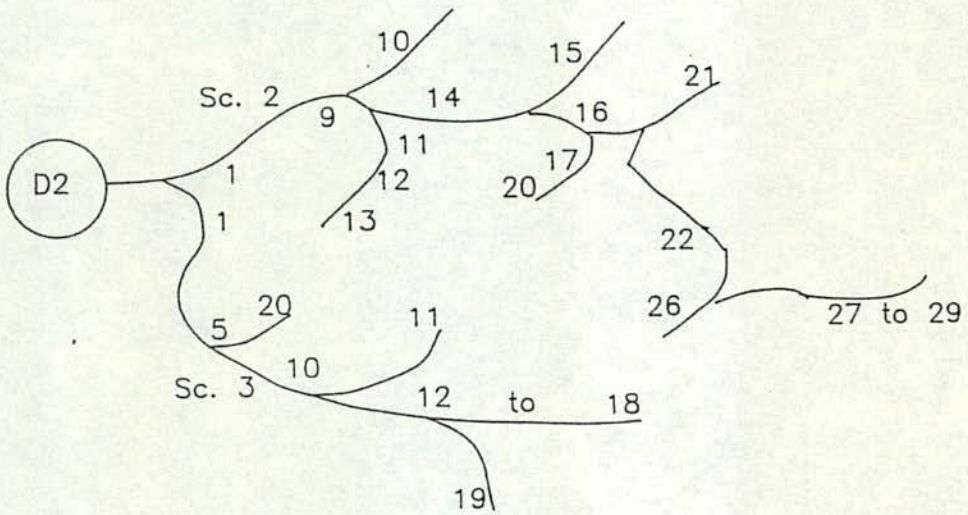
OAKES FOREST CONSULTANCY

Compartment 169

DUMP 2

Track 2

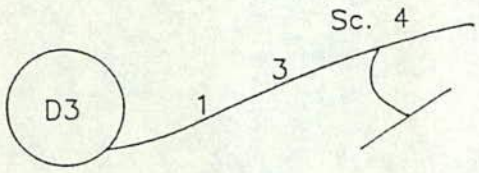
Catchment : Scraggy Creek



DIAGRAMS OF SNIG TRACKS
OAKES FOREST CONSULTANCY

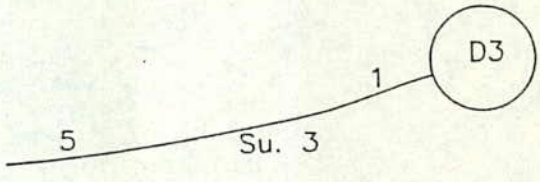
DUMP 3
Track 4

Catchment : Scraggy Creek



DUMP 3
Track 3

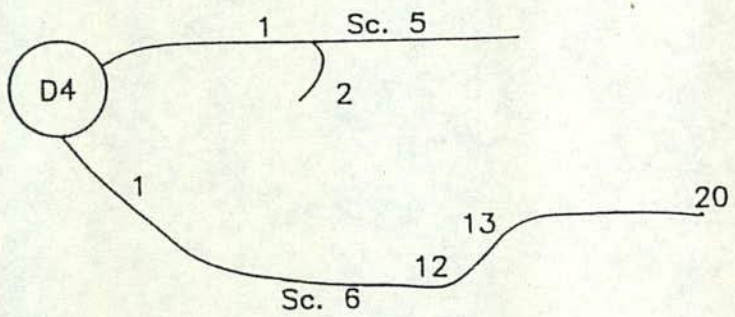
Catchment : Sunday Creek



DIAGRAMS OF SNIG TRACKS
OAKES FOREST CONSULTANCY

Catchment : Scraggy Creek

DUMP 4
Track 5 & 6



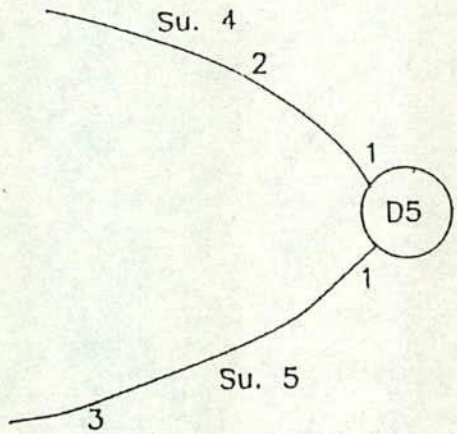
DIAGRAMS OF SKID TRACKS

OAKES FOREST CONSULTANCY

DUMP 5

Track 4 & 5

Catchment : Sunday Creek



DIAGRAMS OF SNIG TRACKS
OAKES FOREST CONSULTANCY

Catchment : Scraggy Creek

DUMP 6
Track 7, 7a, 7b & 8.

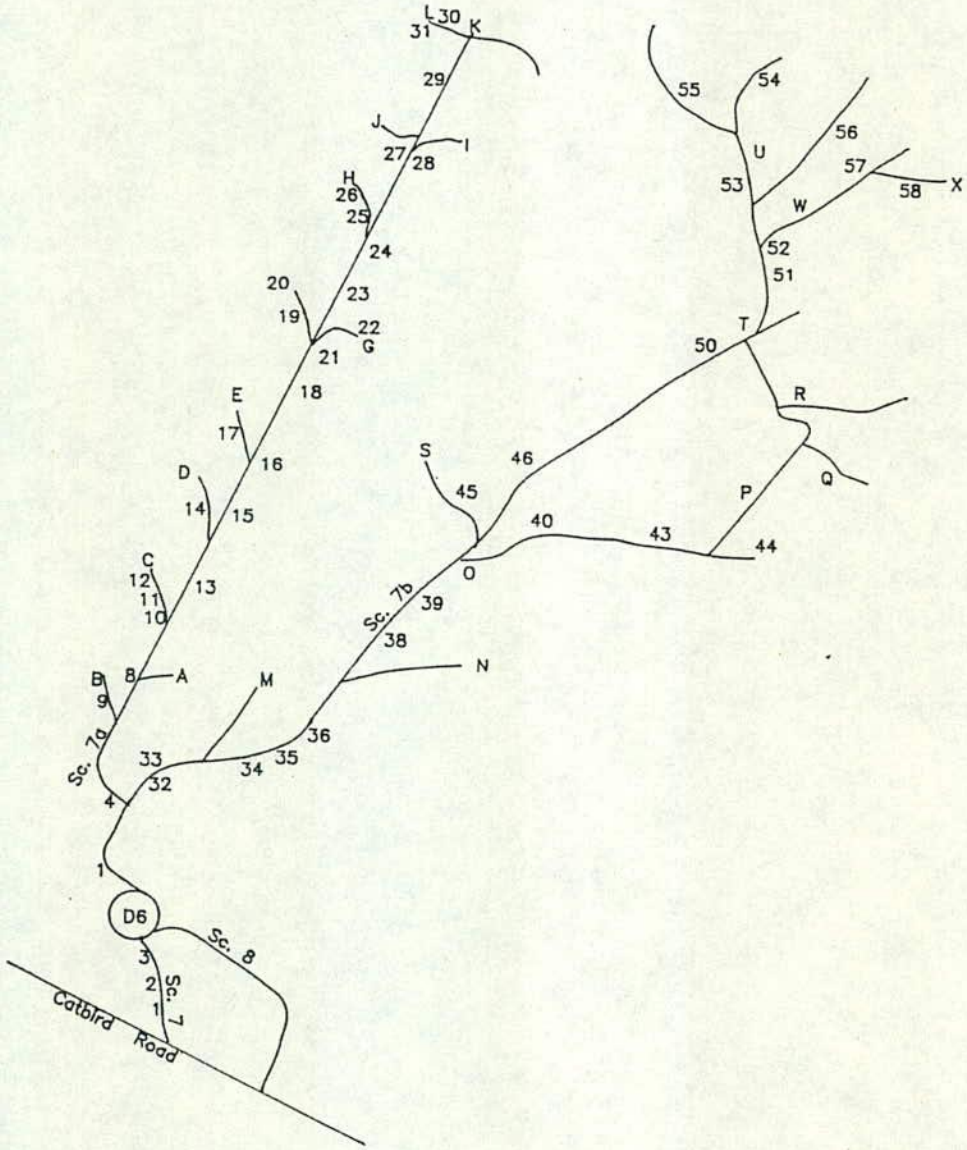


DIAGRAM OF SNIG TRACKS
OAKES FOREST CONSULTANCY
Compartment 168

DUMP 7
Track 6

Catchment : Sunday Creek

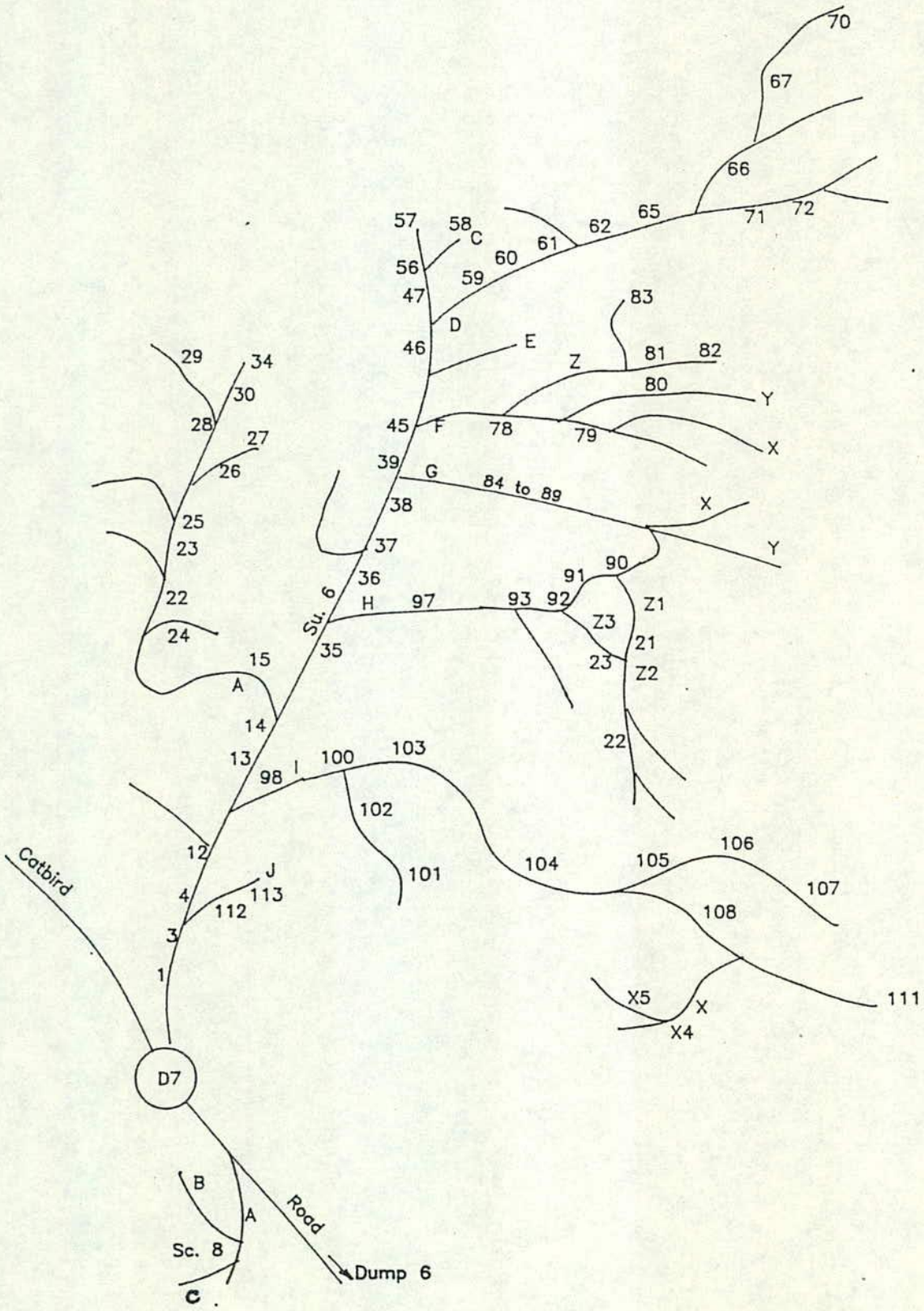


DIAGRAM OF SNIG TRACKS
OAKES FOREST CONSULTANCY
Compartment 170

DUMPS 8 & 9

Catchment : Sunday Creek

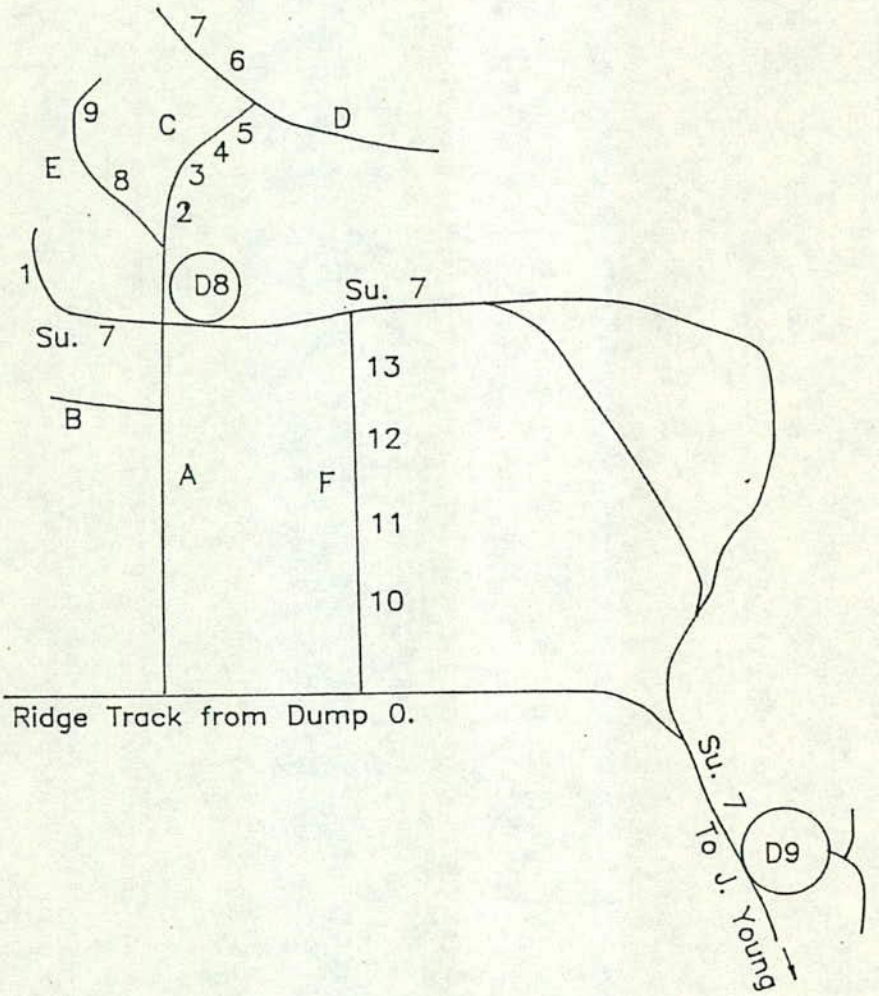
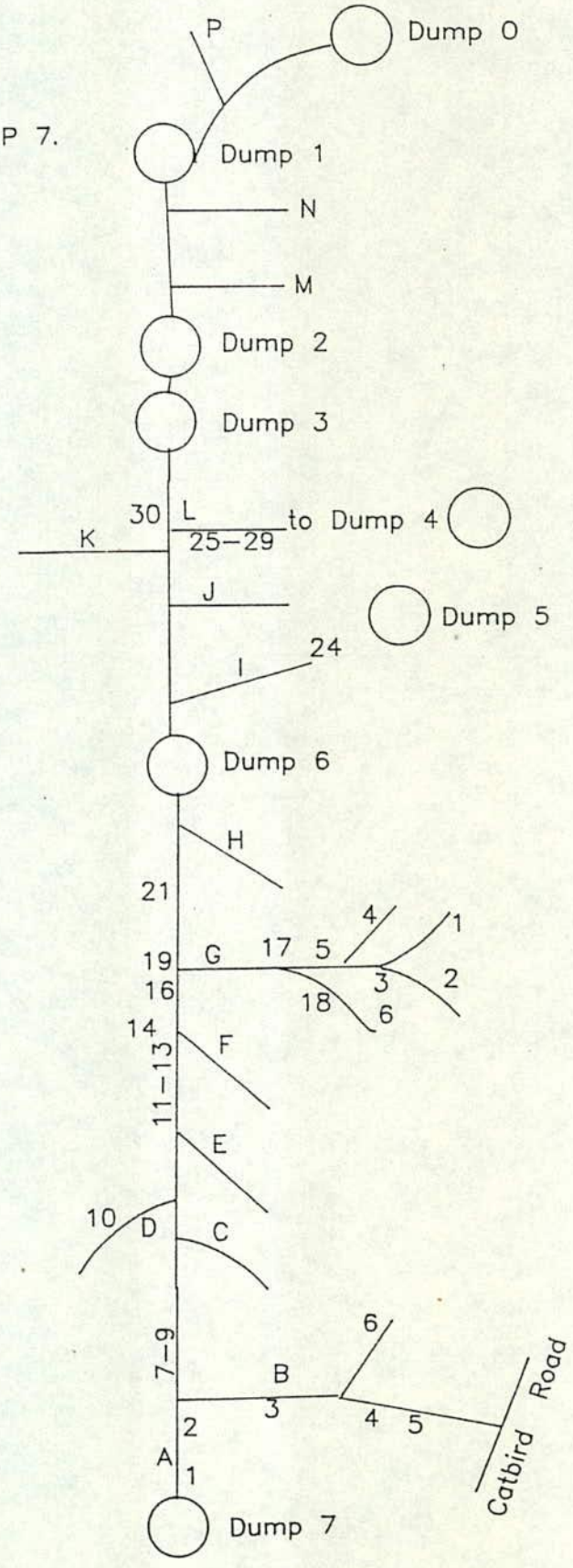


DIAGRAM OF SNIG TRACKS
OAKES FOREST CONSULTANCY
RIDGE ROAD – DUMP 0 / DUMP 7.



Appendix 2 Results of Field Measurements and Observations Along Snig Tracks

Measurements of:

- Ground Slope
- Snig Track Slope
- Track Windrow
- Cross Banks including:
  - bank height
  - bank interval
  - channel crossfall
- Erosion Rills

Identification of:

- Log Dumps
- Snig Tracks
- Cross Banks
- Bank spacing exceeding the Standard(*)
- Intrusion into reserved area (IRA)

Comments on:

- Erosion and Sedimentation
- Bank Effectiveness
- Road Crossfall Drainage
- Soils, Geology
- Cut Batters/ stability
- Bank Outlets/stability

Abbreviations:

CB - Cut Batter
OL - Bank Outlet
WD - Track Windrow
NB - No bank at this measured distance
OK - Bank, working effectively at the time of inspection
- Track, working effectively at the time of inspection
- Bank outlet, working effectively at the time of inspection

TS - Track surface
OF - Outfall drainage
PS - Protection Strip
FS - Filter Strip

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
				COMPARTMENT 170			
Catchment - Sunday Creek (Dump 0) Snig Track SU. 1							
1	-	-	10.4	0.45			Measured from top of hill OK
2 *	31	25	18.7	variable		.3	No defined channel. Poorly constructed. OK outlet. Scoured. No visible erosion (Outside windrow all the way.)
3	34	22	20	0.45		.30	OK working. Scree falling into adjacent drainage line 10m + 0.30cm c/f. Silt within 10m.
Snig Track SU. 2 - (Dump 1)							
1	32	15	15.7	.9		.25	From dump. Some sediment. OK. Windrow OK. Side cut with c/f drainage. Batter stability OK.
2	33	5	26	.6	.3	.4	Outlet OK Windrow could be removed.
3	33	5	47	.6		.35	Outlet OK. On rock. Windrows OK. 2 photos up and down 16/17
4	33	13	38.0	.6		10	On rock Outlet OK 10cm c/f. Snig to the right - 30 metres no need to drain. OK.
5 *	23	23	47.5	.55		.5	.30cm outfall OK. Windrow .5 on top side.
NB	23	23	21				Attempt at Windrow off - unsuccessful.
7 *	23	23	31	.4		.25	Track washed. Windrows B/S. OK. Rock. Photo 17 up, 18 down.
8 *	25	25	71	.45	.5-.6	.45	Outlet OK.
9 *	23	23	43	.55		.75	Outlet OK. Rock. Photo down.
10 *	21	21	44	.70		.30	Windrows B/S.
11 *	20	20	35.5	.6		.20	
NB *	29	29	65				No bank. No windrows. No rill or gully erosion.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Catchment - Scraggy Creek (Dump 1)							
Snig Track SC. 1							
1	20	20	10	.6		45	OK. Pedestals. Side cut.
2 *	30	20	27	0			Ineffective down both wheel tracks s/c
3	38	22	20	0			Washed down track. High windrows - spoil down side. Photo up and down 22/23.
4	41	16	20	.1		.40	Silted from batter slip. High deposition over side. Track slumped on outside for 50 odd metres through depression.
5	44	9	32	.4		.45	Outlet onto spoil. Photos (2) of slumping 24/25.
6	43	5	33	.65		.35	Outlet washed.
7	33	8	52	.45		.60	Tree debris on track. Spoil over the side.
							Hand work only no dozer restoration. Seed?
8	36	18	21	.7		.10	
NB	37	18					Spoil into P.S. 4 photos 4 & 5, 6 & 7. Track slumped. 1 Brushbox, 1 Tallowwood.
IRA1							
9 *	41	24	24	.3		.25	Track ends 15m.OK. Spoil from road above intruded into RF gully.
IRA2							
10 *	31	31	35	.7		.25	Bank OK. Scouring in outlet and deposition. Track scour above.
11	32	27	15	0			Ineffective - log dragged over bank. Photo 11.
12 *	29	29	28	.3			Tree over bank. Bank OK.
13 *	32	32	42	.45			Debris over bank. No outlet. No visible erosion. Photo No. 13 up track Debris covered.
14 *	33	33	32	.55			Outlet U/S. Scouring above. Windrows on outside. Topsoil pushed into bottom bank. Track erosion to bottom bank. Photo 14 up.Track ends. 15 metres

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
				COMPARTMENT 169			
Catchment - Scraggy Creek (Dump 2)							
Snig Track SC 2							
1	19	19	10	.45		.40	OK on rock. Small windrow.
2	26	17	28.5	.6		10	Rock OK.
3 *	38	21	25.0	.5	.4	.25	OK.
4	37	12	46.0	.4		.35	OK. Interbank rill.
5	38	19	43.0	.45		.15	Outside track slump. OK. Rock.
6 *	38	17	47.0	.25		.20	3m batter. OK. Slumped fill.
7	40	17	36	.4		.25	OK. Columnar. 4 m batter upright. Slump fill. Next to no windrow
8	35	14	40	.45		.45	OK
9	32	17	32	.3	.45	.2	2m batter. OK.
Left Branch							
10	29	18	20	.45	.5	.4	4 m track width. Rock OK. 1.5m batter.
Right Branch							
11 *	39	24	34	.4	.4	.4	Rock. 2m batter. .4 windrow c/fout. OK
12	40	13	28	.3		.5	2m batter slump failure onto bank. Untidy bank. No windrow. OK
13	41	11	19		.6	.50	3m batter. Rock. OK Track for another 15 metres - close to protection strip on 10m horizontal. Appears to have intruded into area reserved from logging.
IRA3							
14 *	28	28	31	.45			Mitred outlet. Track erosion. Up to 1 metre windrow. Rock, mottled. Yellow sandstone. Excessive c/f. OK just.
15 *	28	28	31	1.0m		0.5	Outlet to track to left? Track left + 10 metres extra.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
16	32	25	12	.70	.5	.45	Rock. OK.
17 *	36	20	38	.6			Track erosion. Mitred bank leading to 18.
NB	36	20	20				Scouring over the side, bank of debris at end.
19 *	31	31	28	.6	.4		Extended mitred outlet. Track rills to 30cm. Topsoil in spoil dump off track. No good. Requires work.
20 *	35	35	60	.55			Bad scouring between banks. Debris over track. Spillway scoured. More erodible, dispersible deeper talus. Quartz in profile. 3m cut batter
Left Branch							
21	33	24	15	.8		.5	OK.
Right Branch							
22 *	29	29	23	.2			.2 F/B. 1.0 cut batter Sandstone. Not OK.
23 *	35	27	22	.3			Level OK. 2.0 cut batter fractured rock. Quartz.
24	36	0	20 av	.3			Cross banks on contour track to P.S.
25	36	0		.3		.3	Soil change due to wet drainage area.
26	36	0		.3		.3	Profile had mottled yellow clays - podzolic. C/F drainage in general no windrows. Track 3 metres wide and 8 Brushbox removed. Photo of tree hollow reference.
Switch Back IRA4							Appears to intrude into area reserved from logging.
27 *	31	26	31	.7		.1	OK. 2m cut batter
28 *	31	27	33	.3		.25	P Strip narrow.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Catchment - Sunday Creek (Dump 3)							
Snig No. SU3							
1	28	12	26	.8	.3	.35	2m batter. Eroded outlet. O/F. OK.
2	35	4	30	.6		.20	2m batter. No windrow. OK. Scoured outlet.
3	35	7	36	.55		.15	2.5m batter. OK. Fractured rock, shales.
4	36	8	31	.55		.6	Slump on outside road. Slip on batter 2m. OK.
5 *	30	10	45+25	.8		.4	Slump on outside road edge. Red soil profile. + 25 metres to drainage line -unfinished. Fill in drainage line? Photos 11, 12 Intruded into P.S.
IRA6							
Catchment - Scraggy Creek (Dump 4)							
Snig Track SC5							
1	9 31	9 21	10 + 23	.5	.4	.15	Onto rock. 1.5m batter.OK. Track extends for 25 metres past - scours through track fill at end.
2	9	9	35	.5		.15	OK. Track extends for another 30 metres. Dozer on dump when blockade imposed. T.B.C. Photo 2 of dump - to be restored.
Snig Track SC6							
1	32	14	13	.35		.5	1.5 metre cut batter. OK
2	38	18	32	.3	.6		Rills on track to .1 Growsers visible. Level OK. Sediment in bank.
3	46	18	35	.5	.5/.6	.2	3m cut batter .2CF. Unstable cut batter. OK Photo 3 and 4
4 *	41	20	30+ 29	.4	.5	.35	Crosses drainage line and major fill above R/F area Appears to have intruded into area
IRA7							
NB	33	9	23				OK. No bank - water runs off naturally on corner.
5	35	10	24	.45	.5	.2	OK. 2m batter - small talus.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
6	32	13s (8av)	49	.3	.5	.5	2m batter. On rock batter slumped. OK
7 *	36	21	38	.3	.3	.1	2m batter. OK
8	37 36	10 16	30+ 35	.5	.5	.4	OK Rock 2m batter. No visible erosion
9 15	33	6 13	30+ 25	.3		.3	Some water exits where. 1m batter
10	28	8	44	1.05		.25	1.5 m c/b. No windrow. OK
11	15	11	37	.5		.45	Rock, no windrow. OK
12	18	18	27	.5		.2	No windrow. OK - no water reaches bank.
13 *	34	24	30	.55		.5	OK. Rock. Spills into protection strip.
14	34	24	11	.4		.5	OK
15 *	21	21	26	.5		.35	Rock OK
16 *	24	24	25	.85	.2	.15	Rock OK
17 *	29	29	25	0			Ineffective - outlet dozed out. Photo water falls into 18
18	28	28	16	.3	.3	.2	OK No visible erosion. Fines gone, pedestals left.
19 *	27	27	20	.6	.4	.4	Rock OK
20 *	25	25	28	.4		.7	OK. 15 metres to track end. Close to protection strip. May have intruded into RA.
IRA8							

Catchment - Sunday Creek (Dump 5)

Snig Track SU4

1 *	38	27	20	.3		.15	Rills into bank. Outlet ordinary. OK
2 *	37	24	27	.1	1	.5	Requires top up by hand. 3/2m CB. Rilling to .2 prior to the top bank.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
NB *	36	17	49				Dozer track 2.4m outside grousers. Track width 4.5m. 2m cut batter. Photo 4 Water off road at 25m. No erosion. Slump on outside fill. Dump still in operation. OK.
Sniq Track SU5							
1	30	19	23	.55		.2	OK. 2m batter. Rock
2 *	38	23	33	.35	.7	1.5	OK Scoured from approx 20. OF Drainage 2m batter, Slight slump of batter.
3 *	41	23	43	.45	.3-.9	.4	Windrow maintained to next bank. 3m batter failing. Rill .2m. Scoured down growser tracks. batter slumped at bank and 10 metres above. Next to no outlet. Scouring on fill batter. Track rills to .2m.
NB *	45	20	30	up to 1.3			Track scoured to .3/.4. Big slump. Tree bowl in channel.
NB *	49up 41down	27	30				Large rock in talus up to .4 diameter. Scoured and refilled. Cut batter to 4m Track scoured to .3/.5m
NB	45up 44down	14	30 + 6				Track ends at Ground slope continues until next drainage line appoximately 100 metres. Would have been advisable to blaze and walk track higher up slope. Too steep. Hand work, extra banks, cut windrow etc. Finished film roll 5 - 400 ASA. 1-5 ASA/roll 6
				COMPARTMENT 168			
Catchment - Scraggy Creek (Dump 6) **Track from road to dump Sniq Track SC7**							
1	35	13	18	.35		.25	OK. Outlet OK. 2m batter
2	35	11	28	.2			2.5m cut batter. 6m track width on corner. Rock OK.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
3	34	13	32	.2		.2	OK on rock. 3m batter. 16m to dump. Dump levelled. Dump on 1km mark.
Snig Track 7A							
1	0	0	0	.3		.4	On edge of log dump OK. Outlet OK.
2 *	30	19	30	0	.5	.4	Rilled from bank down. Silted bank OK.
	28	23	22	.2			
3 *	27.5 Ridge	27.5	30+ 28	.2	.5	.05	Silted. Extended outlet - ineffective. Deep rills to .3. Dozer tracks scoured. 16 metres to split. More dispersible soils sandy/sandstone
4 *	36	25	16+ 19	.3		.1	OK
5 *	37 35	23 22	30+ 21	.15	.8	.1	Rilled to .3. Photo 12. 2.5m CB Outlet washed badly. Photo 13 Bank OK. Washed outlet.
6	26	17	43	.2	.3	.15	Track rilled to .3m. Silted
7 *	22	22	34	.25	.5	.75	On rock. OK. Track rilled .2
8 *	24	24	25	.45		.25	Outlet onto next track. Washed out bank diverts to track both sides.
Right Branch (A)							
NB	25	8	34				Once grade lessened track stable. Started regenerate. Rilled from outlet. Photos 14/15
Left Branch (B)							
9 *	29	20	31	.3	.5	.2	Bank OK
NB* IRA9	33	23					2m cut batter. Some rills .1m discharge into Protection Strip
10 *	23	23	29	.3	.3	.3	Some rills .1, .2. Bank OK

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Left Branch (C)							
11	24	21	21	.35		.35	Rills .1. OK
12	30	17	32	.7	.3	.7	Bank OK. No rills.
NB *	34	26	40		.4		Better soils. Rilled to .3. Material pushed in protection strip - breach of HP. Stump in protection strip. Track on edge of gully. Plenty of revegetation. Photos 18/19.
	IRA10						
Snig Track 7A							
13 *	22	22	42	.35		.25	Rilled to .3 on rock - dispersible bank OK. Untidy. Outlet OK
Left Branch D							
14 *	32 25.5	24	47	.4	.5	.1	Dispersible rilled. Bank OK Rock. +26m to end of track - some rills .1. 1m CB
Snig Track 7A							
15 *	27	27	40	.6	.5	.25	Rilled to .3 on rock. Photo 22.
16 *	24	24	35	.6			Rilled .2. Extended outlet mitred of track. Bank OK
Left Branch E							
17 *	31	24	29	.55	.5	.35	1 metre cut batter.
NB	33	13	37				Water off track into depression. No obvious rills.
NB	33	13	39				Rills to .3. Rock. 1m c Batter. Intruded into protection strip. Silt into protection strip. Photos 23 - 26.
IRA11							
Snig Track 7A							
18 *	21 23	21 23	30 21	.4		.10	Rilled to .2 on rock OK

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Left Branch F							
19 *	32	21	28	.4	.5	.5	OK. Rilled on outside .1 outlet right.
20	36	18	36	.4	.5	.5	30m to end, intruded into protection strip .9CB.
IRA12							
Right Branch G							
21 *	31	27	32	.05		.15	Rilled to .3. at 15m. Just working top up. Photo 4 roll 7
22 *	31	29	38	.5	.5		Bank level OK. Rills to .3.
NB	6	3	28				Water drains to hollow OK
Snig Track 7A							
23 *	30	29	19	.15	1		Level just OK. .1 rills OK
24 *	30	29	23	0	1		Rilled to .2. Ineffective
Left Branch H							
25	31	23	18	.2	.4	.2	OK Rilled to .20
26 *	33	23	26	.6	.4	.1	OK. Rilled. 26 metres to end of track. Sediment into protection strip pulled up right on edge of batter.
IRA13							
Snig Track 7A							
27 *	28	28	20	0	1		Ineffective
28 *	32	32	25	0			Track washed to .5m. Silted up ineffective. Photo 5. Track splits.
Right Branch I							
NB	32	14	30				No bank - no rills
Left Branch J							
NB	32	5	32				No bank - Similar sandy dispersible soil on ridges - more clays in drainage areas.
Snig Track 7A							
29 *	30	30	30	0			Ineffective, no capacity, badly rilled to .2m.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Right Branch K							
NB *	35	31	21 (intersection)				Rilled to .2 to 15 intersection. Stable after that.
Left Branch L							
30 *	32	28	24	.3	.4	.1	Rilled to .2. OK. .7CB
31 *	32	32	36	.5		.35	30m to Scraggy Creek. Debris intruded within 60m filter strip. Some dropped down high bank of Scraggy.
Sniq Track 7B							
32 *	25	25	52	.7	.4	.3	Rilled to .2. Bank OK. Bank silted. Extended spill - washed. Track to right 25m 20 degree grade -rough but stable close to drainage line - ends short.
Left Branch M							
33 *	23	20	24	.25			Level Track infall. No rills.
NB *	30	27	35				Rills visible to .05.
Sniq Track 7B							
34	17	17	44	.7	.2	.4	Good bank outlet OK. OK on rock.
35 *	19 24	19 24	30 30	.4	.4	level	Track rilled from 25m extra bank needed. Rilled to .5. Quartz in PF. Extended outlet. Bank OK. Water past. Photos 16/18
36 *	27	27	33	.35	.5	.05	Rilled from 15m to .3. Scoured, extended O/L. OK
Right Branch N							
37 *	27 30	27 22	30 11	.25			Rilled .2 from 20m. Holding .1 water - on rock. Scoured. Spillway OK
NB	35	13	28				Track OK - spills at end OK

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Snig Track 7B							
38 *	27	26/28	34	.4	.5		Rilled to .4 from 15m. Extended spill - bank level Spill NO. Photo 19
39 *	28	28	40	.35	.5	.15	Rilled to .4 from 15m. Water diverted onto side track. Bank in wrong place. Outlet scoured.
Right Branch O							
40	35	17	28	.6		.4	Rilled to .4. Bank OK
41 *	39	20	34	.75	.3	.3	2m CB. OK
42	40	18	24	1.0m		.45	Slips on side 2m CB. Bank OK
43 *	38	23	27	.5		.3	2m CB Dispersible rilled .1 from 20. OK? Outlet scoured
NB	35	10	13				Water off OK
NB	34	1.5	24				Turns downslope Track P
44	32	16	19	.7		.2	OK spill OK .2m CB
NB *	32	27	30				Deposition within 10m of protection strip. Track rilled to end - TS (Track Surface) well vegetated now.
IRA14							
Snig Track P							
NB *	31 26	31 26	30 40				Photo 21 up track rilled to rock at .3. Debris over track - sediment at the bottom in debris.
Right Branch Q							
NB	34	8	28				15 metres extra towards protection strip. Track OK, DS OK
Right Branch R							
NB	27	7	23				Track OK. Intruded into protection strip.
IRA15							
NB	27	7	22				Silt straight into protection strip.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
NB	32	1.5	47				Outfall drainage track OK Photo 23
NB	32	9	44				Outfall drainage track OK
Snig Track 7B							
Left Branch S							
45 *	29	24	30	.45		00	No rills. Quartz in profile 1m CB OK
NB *	38	20	29		.5		No rills, track outlets OK
Snig Track 7B							
46	24	24	20	.6	.3	.15	No rills on rock OK Bank OK.
47 *	26	26	37	.3	.5		Rills .2 from 18m. Sediment in bank holding .15. Extended spill OK
48 *	26	26	30+				Rilled from 20m to .2
	32	21	25	.9	.7	.4	Outfall track rilled when windrows present. No W/D - water off. OK spill washed.
49 *	33	21	36	0	.7		Rill 15m to .4 quartz. Bank through middle silted up, gullied below Photo 24 bank washed over centre. Spillway was working.
50 *	33	25	30	.3	.6	.4	Silted and washed road end onto next track. Rilled from bank. Photo 2. Outfall.
Left Branch T							
NB *	27	1.5	30 30 12				Outfall track stable
NB *	22	20	31				Stable topsoil intact.
51	30	18	33	.5	.4	.2	Rilled all the way to .3. Water misses bank. Spillway scoured.
52 *	32	23	29	.4		00	Rilled from 20m. Level bank OK
NB	30	13	44		.4		No rills, c/f out, 1.5m cut batter

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
53	36	9	24	.3		.4	1m cut batter OK
54	27	17	40	.6	.3	.4	1m WB Spillway washed. Bank OK
NB *	27	27	37				Rilled from 20m to .2 1m cb. Well vegetated TS. Debris into protection strip. Photo 3. Scraggy Creek 3. Pedestals No. 4
IRA16							
NB	35	10	52				Outfall drainage OK
55	30	13	24	.1			Outfall drainage on snig - good. .7 batter cut. No windrow.
			10				10m to end of track.
Right Branch U							
56 *	28	25	28	.2	.4		Holding .2 OK on rock. more depth in profile.2. Better soils.
NB	32	20	34				Rilled but revegetated. Fell 2 trees into filter strip on Scraggy Creek - Photo 5. Appears to intrude inside filter strip. Has 60m buffer.
IRA17							
Right Branch W							
57 *	25	25	42 + 20	.5		.35	Less depth, more topsoil more vegetation. + 20 metres covered in debris. Coachwood near creek.
Right Branch X							
58	26	22	20	.4		00	Level bank slightly rilled track O/L OK. Bank OK. covered in debris. Red soil better structure. Track close to protection strip - distance OK
Dump 6 - Snig Track SC 8							
NB	42	1.5	45				Outfall drainage OK
NB	35	11	30		.5		2m CB
NB *	37	17	20				Across slope
NB *		34/35	35	59			Rilled at bottom to .3 + no banks. Washed. Photos 10/11

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Catchment - Sunday Creek							
Dump 7 - Snig SU6							
1	36	14	30	.55	.1	.3	Slumps on CB. Bank OK, spill Ok. Slumped for 4m on CB. No rills
2	40	11	35	.45	.3	.3	Outside edge slumped. No rills, OK, O/L scoured on fill. CB slumped 6m. Tension cracks.
3	42	11	32	.8	.2	.4	Outlet scoured on fill. Photo 12 - OK
4	30	9	36	.4	.2	.3	No rills, outlet scoured.
5	35	6	39	.45	.2	.3	OK. Spill scoured, OK
6	45	11	39	.35	.3	.1	Water off at 20, tension cracks. 6m CB, dispersible, unstable soils. OK, O/L scoured. Spoil over the side.
7	38	7	49	.6	.4	.25	Tension cracks 2m CB Rilled from 25 .1 Spoil scoured.
8	40	8	48	.70	.3	.4	Tension cracks. Scoured from 30m, OK. O/L scoured Spoil over side. 3.5 CB slumped. Photo 13
9	38	13	52	.8	.3	.35	Tension cracks, rills .1 near outlet OK, Spill scoured
10	32	9	43	.7	.3	.15	Rilled .1 from 30, OK, Spill scoured.
11	42	13	39	.5	.4	.4	Infall drainage. Tension cracks, 6m slumped batter, OK. Rilled .1 from 30.
12	24	12	56	0	.5		Tensions cracks 2m CB. Rilled .3 from 25. Bank failed. Over top.
13	31	15	50	.1	.3	.4	Spill scoured. Bank repair required. Rilled to .3.
14 *	17 15	17 15	56	.25	1	.2	Track scoured to .3. OK. Outlet OK

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Left Branch A							
15	12 43	12 21	31	0			Scoured at 15m to .1 ineffectiive, 2.5m CB
16 *	42	25	26	.25	.3		Batter collapsed. Slight rilling, 4m batter.
17	41/55	19	24	.25	.3	.3	Talus over the side. Batter collapse 3m. Outlet scoured, bank OK. Track rilled to .1 from 13m.
18 *	43	26	25	.2	.4	.55	Bank OK. Scoured from 13, batter failure 3m
19	44	17	32	.35	.1	.25	CB failure. Spillway washed. Slight rilling. OK
20	40	16	30	.25		00	Infall drainage CB failure level just OK, 2.5m CB.
NB *	43	21	24				No bank - OK
			23		.2		Water leaves track - tension cracks
21	40	10	20	.25		.15	Outlet scoured. CB 3m slumped. OK
22	38	14	28	.6	.2	.45	Tension cracks. 2m CB OK. Slight rill from 20. Small snig to left - 10 - log diverts water off at 20
23 *	38	20	44	.7	.2	.35	2m CB more rock fractured OK
24	18/33	18	25	.7	.2	.75	Infall drainage. OK. Outlet and bank OK
25	17	17	32	.8	.2	.25	Outfall. Bank and spill OK
NB	35	20	22				OK no bank
26 *	21	21	41	.35	.3	.5	Rilled to .2m from 20
27 *	22	20	33	.4	.3	0	Level, bank OK, Debris on track.
NB *	32	17	62		.2		Outfall in 2 places water off. Debris over road, track OK. R/F gully. Photo to end No. 9 Roll 8.
	IRA18						Spoil dozed into drainage area.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
28	12	12	15	.35		.25	Spill OK, bank OK
29	20	20	20	.45	.3	.15	Bank OK. Debris over track and bank.
NB *	29	24	35		.3		Dispersible. Track scoured from end downslope 35 deg.
30 *	24	21	27	.35	.4	00	Track rilled from 20m .1 level
31 *	25	25	24	.10	.4		Rilled from 16m .1. .5mCB Just working OK
32 *	28	28	22		.4		Ineffective. CB .4m.
33 *	28	23	26	.5	.5	00	1m CB level, 2m CB rilled to .2
34 *	31	21	27	.45	.4	.25	Outfall drainage on track OK
NB	25	8	42	.6			Spoil into DL. No wash on track. Structured soils near brush. Photo 9/10 into DL.
IRA19							
Snig Track SU6							
35	20	16	31	.7	.2		Photo 12 of log on track. Branch at AB join. OK 3mCB
36	29	19	30	.5	.2		Rilled .1 from 25. Extend O/L OK, Track OF
37 *	24	24	34	.25	.8	.25	Scour .1 from 20m. EX O/L. Bank OK. Dispersible soils.
38 *	24	24	39	.05	.5		Scoured .1 from 20m. Top up necessary - hand work. Extended O/L
39 *	20	20	48	.45	.4	.1	Rilled to .2 from 25. Extend O/L scoured. OK
40	26	17	36	.15	.4	.05	Hand work just OK. Big bloodwood across track.
41	31	19	29	.05	.2	.3	Rilled .1 from 20. O/L OK. Hand work
42 *	22	22	.33	.45	.4	.1	Rilled form 10m .2 OK
NB	10	10	37				Some water leaves track
43	10	10	53	.85	.4	.5	OK 1m CB. Skid mark from log drag, no rills

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
44	4	4	44	.6	.2	.25	Worked in the wet. No visible rills. OK. No bank required.
45	3	3	45	.85	.4	.45	No rills
46	12	12	40	.1	.4	.05	OK. No rills
47	10	10	33	.4	.1	.2	Ok No rills
48 *	22	22	27	.1	.5	.45	Just OK, needs hand work
49 *	33	33	26	0	.7		Broken winch rope - tracks .2m dug in, rill in bank .3, bank broken. 8m track width under bank
50 *	26	26	27	.7	.2	.45	Bank OK. Saddle quartz in profile - rilled above to .2.
51	11	11	21	.25		.15	OK. No windrow
52 *	26	26	25	.75	.3	.4	OK
53 *	22	21	28.5	.1	.1	.75	OK
54	18	18	33.5	.7	.2	.3	OK just, more F/B required.
55	12	12	44	.9		.6	OK double width
56	7	7	34	.6	.2	.3	OK Water follows track at 13m
57 *	20	20	30 + 10	0			Ineffective + 10m to end of track above protection strip - OK, lot of coachwood and R/F
Right Branch C							
58 *	25	25	23	.35		.05	Extended O/L. No rills OK
NB *	24	24	38				Tree fallen into Sunday Creek. Debris still in creek, and understory flattened. Slope to creek 30 degrees +. 60m filter strip.
IRA20							
Right Branch D							
59	14	14	20	.2	.5		OK
60 *	21	21	38	.4	.6	.2	On rock OK
61 *	24	24	33	.4	1	.2	Drains into side track OK

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
62 *	29	20	33	1.0	.5	.8	2m CB. Scoured O/L. Track scoured to .1 at 30m. Dispersible OK
63	30	14	39	.65	.3	.45	OK
64 *	35	22	31	.7	.5	.5	Track washed to .3 before banks. Banks built when wet. OK
65 *	21	21	30	.6	.7	.3	Ok. Spill OK. Slight movement
66	20	17	34	.4		.4	OK. No visible scours
NB	30	8	33				Off track into protection strip. Crossed with track
NB	30	8	14				Water off naturally
67							Water off before band - bank not in use OK
68	33	11	42	.75	1	.55	Outfall drainage, debris dropped into PS OK
69 *	33	27	23+10	.1	1		Better structured soils close to gully. OK. Back into coachwood. Heads close to it. Maybe 20 m to Sunday Creek. Heads to edge of bank. Intruded into filter strip. 60m filter strip.
IRA21							
NB	32	8	27				No bank, no rills
70	37	6	30+ 22	.6	.5	.2	C/F outfall. No bank required. + 22m to end of track
71 *	27	16	29	.7	.4	.2	Bank and track OK
NB	30	18	30		.3		
72 *	32	32	20	.35		.15	Track washed .3, bank OK
NB *	32	24	40				Spoil into PS at 2 sites. Heads also into PS.
IRA22							Pristine area. Appears to have intruded into RLA.
<u>Right Branch E</u>							
73 *	22	20	23	.4		.15	Bank OK.
NB	22	20	30				No blade work. OK, topsoil intact

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Right Branch F							
74	20	13	22	.25	.3	.05	OK, no rills
75	24	12	22	.6	.4	.2	OK, no rills
76	25	13	44	.45	.4	.1	OK, no rills
77	28	14	41	.3	.6		OK, no rills
77(a)	36	17	45	.7	.8		Worked in wet, no rills, OK
78	14	10 13	30 35	.25	.8		OK, no rills
NB	14	13	15				Water off
79	26	15	27+ 30	1.0		.4	Outfall bank not required Outfall drainage on track OK
Left Branch X							
NB *	30	16	50				Outfall drainage, no rills, OK
Left Branch Y							
80	22	22	20	.2		.3	Bank OK
NB IRA23	41	19	35				Dropped tree into PS 41 deg. No wash visible.10m.
Left Branch Z							
81 *	26	26	27	.5	.3	.2	Spilling down snig OK, no rills
82	23	22	17	.6	.5		Dozer track .2 rilled
NB *	25	25	25				Spills outside PS - no erosion
83	29	24	22	.7	.5	.2	OK
NB	31	11	30				Spoil close to depression, not directly in
Right Branch G							
84	26	23	20	.3	.8	.15	Debris on track OK, no visible erosion
85	17	16	21	.35	.4	.05	Deep dozer tracks .3 OK
86	13	13	28	.2	.3	-	Deep dozer tracks .3 OK
87 *	26	20	28	.4	.3	.35	Deep dozer tracks .3 OK
88	28	18	38	.15	1.0	.15	Slight scour. OK

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
28	12	12	15	.35		.25	Spill OK, bank OK
29	20	20	20	.45	.3	.15	Bank OK. Debris over track and bank.
NB *	29	24	35		.3		Dispersible. Track scoured from end downslope 35 deg.
30 *	24	21	27	.35	.4	00	Track rilled from 20m .1 level
31 *	25	25	24	.10	.4		Rilled from 16m .1. .5mCB Just working OK
32 *	28	28	22		.4		Ineffective. CB .4m.
33 *	28	23	26	.5	.5	00	1m CB level, 2m CB rilled to .2
34 *	31	21	27	.45	.4	.25	Outfall drainage on track OK
NB	25	8	42	.6			Spoil into DL. No wash on track. Structured soils near brush. Photo 9/10 into DL.
IRA19							
Snig Track SU6							
35	20	16	31	.7	.2		Photo 12 of log on track. Branch at AB join. OK 3mCB
36	29	19	30	.5	.2		Rilled .1 from 25. Extend O/L OK, Track OF
37 *	24	24	34	.25	.8	.25	Scour .1 from 20m. EX O/L. Bank OK. Dispersible soils.
38 *	24	24	39	.05	.5		Scoured .1 from 20m. Top up necessary - hand work. Extended O/L
39 *	20	20	48	.45	.4	.1	Rilled to .2 from 25. Extend O/L scoured. OK
40	26	17	36	.15	.4	.05	Hand work just OK. Big bloodwood across track.
41	31	19	29	.05	.2	.3	Rilled .1 from 20. O/L OK. Hand work
42 *	22	22	.33	.45	.4	.1	Rilled form 10m .2 OK
NB	10	10	37				Some water leaves track
43	10	10	53	.85	.4	.5	OK 1m CB. Skid mark from log drag, no rills

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
44	4	4	44	.6	.2	.25	Worked in the wet. No visible rills. OK. No bank required.
45	3	3	45	.85	.4	.45	No rills
46	12	12	40	.1	.4	.05	OK. No rills
47	10	10	33	.4	.1	.2	Ok No rills
48 *	22	22	27	.1	.5	.45	Just OK, needs hand work
49 *	33	33	26	0	.7		Broken winch rope - tracks .2m dug in, rill in bank .3, bank broken. 8m track width under bank
50 *	26	26	27	.7	.2	.45	Bank OK. Saddle quartz in profile - rilled above to .2.
51	11	11	21	.25		.15	OK. No windrow
52 *	26	26	25	.75	.3	.4	OK
53 *	22	21	28.5	.1	.1	.75	OK
54	18	18	33.5	.7	.2	.3	OK just, more F/B required.
55	12	12	44	.9		.6	OK double width
56	7	7	34	.6	.2	.3	OK Water follows track at 13m
57 *	20	20	30 + 10	0			Ineffective + 10m to end of track above protection strip - OK, lot of coachwood and R/F
Right Branch C							
58 *	25	25	23	.35		.05	Extended O/L. No rills OK
NB *	24	24	38				Tree fallen into Sunday Creek. Debris still in creek, and understory flattened. Slope to creek 30 degrees +. 60m filter strip.
IRA20							
Right Branch D							
59	14	14	20	.2	.5		OK
60 *	21	21	38	.4	.6	.2	On rock OK
61 *	24	24	33	.4	1	.2	Drains into side track OK

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
62 *	29	20	33	1.0	.5	.8	2m CB. Scoured O/L. Track scoured to .1 at 30m. Dispersible OK
63	30	14	39	.65	.3	.45	OK
64 *	35	22	31	.7	.5	.5	Track washed to .3 before banks. Banks built when wet. OK
65 *	21	21	30	.6	.7	.3	Ok. Spill OK. Slight movement
66	20	17	34	.4		.4	OK. No visible scours
NB	30	8	33				Off track into protection strip. Crossed with track
NB	30	8	14				Water off naturally
67							Water off before band - bank not in use OK
68	33	11	42	.75	1	.55	Outfall drainage, debris dropped into PS OK
69 *	33	27	23+10	.1	1		Better structured soils close to gully. OK. Back into coachwood. Heads close to it. Maybe 20 m to Sunday Creek. Heads to edge of bank. Intruded into filter strip. 60m filter strip.
IRA21							
NB	32	8	27				No bank, no rills
70	37	6	30+ 22	.6	.5	.2	C/F outfall. No bank required. + 22m to end of track
71 *	27	16	29	.7	.4	.2	Bank and track OK
NB	30	18	30		.3		
72 *	32	32	20	.35		.15	Track washed .3, bank OK
NB *	32	24	40				Spoil into PS at 2 sites. Heads also into PS. Pristine area. Appears to have intruded into RLA.
IRA22							
Right Branch E							
73 *	22	20	23	.4		.15	Bank OK.
NB	22	20	30				No blade work. OK, topsoil intact

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Right Branch F							
74	20	13	22	.25	.3	.05	OK, no rills
75	24	12	22	.6	.4	.2	OK, no rills
76	25	13	44	.45	.4	.1	OK, no rills
77	28	14	41	.3	.6		OK, no rills
77(a)	36	17	45	.7	.8		Worked in wet, no rills, OK
78	14	10 13	30 35	.25	.8		OK, no rills
NB	14	13	15				Water off
79	26	15	27+ 30	1.0		.4	Outfall bank not required Outfall drainage on track OK
Left Branch X							
NB *	30	16	50				Outfall drainage, no rills, OK
Left Branch Y							
80	22	22	20	.2		.3	Bank OK
NB IRA23	41	19	35				Dropped tree into PS 41 deg. No wash visible.10m.
Left Branch Z							
81 *	26	26	27	.5	.3	.2	Spilling down snig OK, no rills
82	23	22	17	.6	.5		Dozer track .2 rilled
NB *	25	25	25				Spills outside PS - no erosion
83	29	24	22	.7	.5	.2	OK
NB	31	11	30				Spoil close to depression, not directly in
Right Branch G							
84	26	23	20	.3	.8	.15	Debris on track OK, no visible erosion
85	17	16	21	.35	.4	.05	Deep dozer tracks .3 OK
86	13	13	28	.2	.3	-	Deep dozer tracks .3 OK
87 *	26	20	28	.4	.3	.35	Deep dozer tracks .3 OK
88	28	18	38	.15	1.0	.15	Slight scour. OK

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
89	25	13	30	.5	.3	.35	OK
NB	27	9	39				Water leaves track OK. Some scour down dozer tracks to ridge
NB	27	9	19				
90	17	17	18	.5	.3	.25	OK outfall
91	21	21	14	.5		.2	Outfall
NB	18	18	44				Outfall rilled .1 in log track
Snig Track X							
NB	30	17	42				Close to PS. Track covered in debris. No further erosion. Quantity of brushbox taken - big trees 1.5m butt
IRA24							
Snig Track Y							
NB	25+	10	30				Small dump area covered in debris. No visible wash
Snig Track Z2							
NB	3	2	30				Minimal distance - no erosion filled in crossings - now compacted. stable
	29	6	24				
Snig Track Z1							
NB	28	15	30				Outfall stable. Total above area covered with prostrate vine.
Snig Track Z3							
NB *	22	20	25				Washed down log snigs to .4m but now covered in debris and stable
Snig Track H							
92	23	14	28				30m from bank to dump. Ineffective. Hand Work. Log through bank.
93	23	19	29	.55	.4	.25	OK Wash in dozer track
NB	20	8	38				Outfall drainage
94	23	14	27	.65	.4	.35	Debris over track OK.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
95	23	21	22	.6	.4	.2	Scoured spill OK. Scoured dozer tracks
96	23	16	33	.35	.4		Track scoured dozer .2
97 *	30	30	26	.25	.4	.15	Track scoured dozer .3 -.4 Bank filled with sediment. Hand work.
Right Branch I							
98	22	11	17	.75	.3	.4	OK. O/L OK. Deep tracks .4m
99	26	8	37	1.0	.5	.6	OK for bank
100	33	12	41	.75	1.0	.35	OK for bank
	22	5	18				Distance to right branch
101	32	18	28	.45	.3	.2	Deep dozer tracks - no wash OK. No track construction
102	31	13	20	.45		.15	OK for bank
103 *	32	21	42	1.0	.3	.4	OK for bank
NB	34	2	16				Water off. Outfall
NB	27	5	22				Water off. Outfall. Stable although in D/L
NB	16	14	25				Stable back to DL
104	14	13	21	1.0	.3	.25	Extended spill rock OK
105 *	21	21	33	.4	.4	.1	Extended spill OK. Tracks below scoured in dozer tracks to .5m
106 *	27	27	30	.7	.6	.25	Track stable. Extended O/L. OK
107 *	23	20	45	.55	1.0	.3	Little scour? Stable soils OK
NB	26	16	35				Outfall. Debris/soil in drainage line - check P.S. End of track. 10m.
IRA25							
NB	23	4	24				
NB	23	4	23				
108	32	10	34	.5	.3	.45	Better structured soils, outfall. Deep dozer tracks .5
109	32	12	37	.15		.1	Outfall just OK no rills
110 *	27	27	31	.55	1.0	.3	Rilled to .1 from 25m

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
111	27	27	19	.45	.6	.2	End of Track T/C
X4 *	25	25	80m				No cut track - runover the top.
X5 *	25	25	28m				Little scour at bottom .1m. Most has revegetated. Deep rills to .3 on dozer tracks and log snigs.
Snig Track J							
112*	37	34	17	.85	.3	.45	Extended outlet OK
113*	41	23	26	.65	.4	.25	OK Rocky road 2.5m CB
NB	35	18	25		.4		Water off OK
Catchment - Scraggy Creek (Dump 7)							
Snig Track 8A							
NB	34	9	30		.5		Rilled .1 to track B
NB	34	9	17		.5		intersection.
NB *	25	13	30		.3		
NB	18	14	30				Outfall rills and sediment.
NB	10	8	22				Water off - track rises
NB *	6	5	30				Track down
NB	13	7	30				C/F Outfall
1	13	13	28	.50			C/F Outfall OK on rock.
2 *	20	20	29	.6		.35	Walked over top track, bank OK
3 *	24	24	38	.2	.1		OK - Extended outlet
4 *	26	26	37				Extended spill, back on track - no wash
Snig Track C							
5 *	29	29	26		.3		Broken through middle, stable. Hand work.
Snig Track B							
6	39	16	21	.45	.2	.6	OK. Wash on track above, water off. OK.
7 *	40	23	29	.4	.5	.3	OK

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
NB	40	5	34		1.0		Scoured and covered with debris. 3m CB collapsed. Scoured down dozer tracks .3. Debris in drainage line under dump 7 about 100m down, mixed sizes fines and large.
RLA26							
Ridge Road from Dump 7 Back to Dump 6							
Snig Track A							
1 *	15	24	27	.4	.3	.2	Log skid scoured .3. Sediment. Interval too long. Extra bank required. OK
2 *	30	26	19	.5	.2	.3	Just OK, not much FB
Snig Track B							
3	13	13	31	.7	.1	.3	OK
4	15	15	44	1.0	.2	.1	Rilled .2 from 25m. Active erosion. Bank OK
5	16	16	44	.7	.2	.25	Bank OK - extended outlet
6	30	17	44	1.0	.2		OK
NB	33	19	39				Track stops, no rills but dozer track .4m
Snig Track A							
7	8	8	44	1.0	.2	.2	OK. Water off
8	6	6	51	.55	.1	.25	OK
9	14	14	38	.45	.2	.1	C/F OK
NB	6	6	30				
NB *	4	4	30				Outfall Water off track
NB	6	6	30				track
NB *	7	7	30				
NB	3	3	30				
NB *	8	8	30				
NB	5	5	23				
Right Branch C							
NB	31	15	39		.6		Stable
	5	5	25				

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Left Branch D							
10	33	19	13	.45	.3	.1	OK. Deep dozer tracks below .5. Rilled
NB *	40	26	38		.6		
Snig Track A							
NB	6	6	30				CF. OK
Right Branch E							
NB *	27	24 28	30 28				Track on ground surface no cut, some minor rill - now stable and vegetated.
Snig Track A							
NB	7	7	30				CF
NB *	5	5	30				
11	5	5	17	.6	.3	.4	OK on rock
12	14	14	42	.8	.1	.3	OK on rock
13	19	19	41	.55	.3	.25	OK
Right Branch F							
NB *	15	32	38				OK no rills
Snig Track A							
NB *	10	10	30				Of drainage and spoon drains
NB	4	4	30				
NB *	1	1	30				No rills
NB	4	4	30				
				12			
14	15	15	38	.6	.3	.3	Slight rills OK at bottom deeper upslope OK
15 *	12	27	40	.3	.4	.5	
16	3	10	27	.7	.3	.4	OK, outfall
NB *	2	10	30				
NB	1	10	30				
NB *	5	10	30				

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Right Branch G							
17	21	21	20	.1	.3		Level
18	29	23	20	.4	.3	.2	OK Revegetated. All stable
NB *	33	20	38		.3		No rills revegetated CF
NB	31	8	30		.4		" " " "
NB *	24	24	30		.4		
NB *	29	20	30				Deep dozer ruts .4
NB *	22	20	27				
NB *	35	20	23				Stable
Snig Track A							
19 *	21	21	28	.45	.5	.7	OK deep log scour .5 below track. On rock slight scour on outlet
20 *	24	24	25	.3	.7		Rilled .1 OK
21	20	19	38	.65	.2	.2	Rilled .1 OK below
NB	16	16	30				Water off at 34m
NB *	2	2	34				Deep log scour .6 - .7m. High windrow
NB	2	2	30				Outfall OK
NB	0	0	15				Water off
Snig Track H							
NB *	29	15	56				Rill .1 OK - reveg. Outfall
Snig Track A							
NB	1	1	24		.4		Outfall OK. Spoon drain.
NB	8	8	30		.2		OS Growsers 3m, OS Track 5.5m
22	11	11	23	.6	.3	.25	Deep log scour .4. Sediment. Rill .1. OK
23	15	15	31 14	.8	.7	.35	Deep log rut .4 to log dump (6)

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Dump 6							
NB *	16	16	54			.3	Rills to .1. Outfall
NB	1	1	21				OK
Snig Track I							
NB	30	11	30				Dozer track to road Outfall
24 *	39	20	26	.0		.6	Ineffective over middle. Tractor job. + 12 to Catbird road cut batter. Track on rock 1m CB
Snig Track A							
NB	7	7	23				*SEVERE
NB *	21	21	8				Track scoured to .2 deep
NB *	24	24	30			.2	dozer tracks .4
NB *	28	28	30			.2	Scoured to top of hill
NB *	26	26	18			.2	Scoured to top of hill
NB	5	5	30				Outfall OK
NB *	6	6	30				" "
NB	3	3	30				" "
NB *	6	6	30				" "
NB	6	6	30				" "
Snig Track J							
NB *	24	24	30				Rilled from here
NB *	30	24	30				
NB *	33	33	30				
NB *	33	33	30				.3 both tracks
NB	33	33	12				.4 at bottom. Track used to recover dozer - banks required either machine or by hand
Snig Track A							
NB	9	9	30				Outfall OK
NB *	8	8	30				
NB	1	1	30				
NB *	4	4	30				
NB	3	3	30				Top of ridge
NB *	18	18	30			.1	
NB	15	15	30			.2	No rills OK
NB *	12	12	30				
NB	7	7	30			.1	OK
NB *	4	4	30				OK

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
NB	5	5	14		.3		Turnoff for K
Snig Track K							
NB *	32	30	30				No banks washed to .3
NB *	33	27	20		.5		Track should have been cut shallower 2 banks required
Snig Track A							
NB	11	11	16				Top of hill
Track L							
25	21	17	21	.2	.3	.2	Outlet back on track just OK
26 *	25	25	19	.3	.3	.2	OK
27 *	30	29	30		.5		Outfall Track
	25	25	15	.3		.25	washed on dozer rut. OK
28 *	25	25	32	.1	.5		Needs more FB
29 *	25	25	31	.7	.4	.3	OK
	18	18	23				Track to road and dump 4
Snig Track A							
30	18	18	19	.5	.3	.7	OK
31 *	25	25	31	0	.3		Outlet extended ineffective following track back
32 *	26	26	33	.35	.3		Track sheeted and rilled .1m. OK
33 *	23	23	43	.45	.3	.7	OK
NB	11	11	42				Track extends to log dump 3 rilled, slightly.
Dump 3							
NB	14	14	30				Walk over OK
NB *	7	7	30				" "
NB	4	4	30				" "
NB *	1	1	30				OK Outfall
NB	3	3	30				" "

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
NB *	6	6	30		.2		" "
NB	6	6	7				
NB	1	1					
NB *	11	11	33				Intact at Dump 2
Dump 2							
34	14	14	30	.9	.4	.75	Outlet scoured .1. Dispersible. Rilled .2 on top
NB *	7	7	30				Deep log scour .4
NB	2	2	30				OK
NB *	0	0	30				OK Deep track scours
NB	3	3	30				
35	11	11	27	.55	.3	.3	Falls into bank. OK on rock. Sediment. Worked in the wet.
36	16	16	37	.85	.3	.5	OK Quartz in profile. Drains off C/F OK. Saddle under bank 37. Deep dozer tracks .2
NB	7	7	35				
NB	12	12	25				
37 *	19	19	45	.55	.2	.4	Rilled 1. Sediment
Snig Track M							
38	17	17	16	.6	.4	.3	
NB	15	15	30				Run over - no cut track
NB *	15	15	30				BNR
NB	18	18	30				Untidy
NB *	25	25	32				Photo 3/4, rills .1 stable revegetated
Snig Track A							
39	8	6	30				Side cut. Photo 5
	16	12	15	1.0	.4	.7	OK
NB	4	4	30				Outfall water off
NB *	2	2	30				" " " Stable
NB	4	4	30				" " "

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
Snig Track N							
NB	24	20	17				Stable
NB *	0	0	30				Walk over
NB	10	10	30				" "
NB *	23	23	30				Photo 6. Walk over
NB *	28	28	30				Walk over. Stable
NB *	28	28	30				Photo 7. Walk over. Dozer tracks .3
NB *	28	28	30				Forest Oak trees pushed up slope
NB *	27	27	30				
NB *	23	23	30				Road at dump 1
Dump 1							
NB *	24	24	33				Below bank 40 rilled .1.
40	26	26	17	.4	.4	.7	Rilled .1 OK
41	22	22	16	.4	.5	.8	OK rilled .1 rock
42	16	16	14	.10	.2	.3	Bank wants top up
Snig Track P							
43	13	13	20	.4	.3	-	OK
44	24	24	21	.55	.3	.1	Rilled .1 on rock
45 *	24	24	30	.5	.4	.5	Rilled to .1 and sediment in channel. Photo 9. Growser marks dispersing.
Snig Track A							
47	4	4	15	.9	-	-	Level OK. Up 20 to bank.
NB	2	2	33				At bottom wheel tracks, rills and ruts to .3. Change of slope.
NB	15	15	25				
NB *	27	27	30				
NB *	30	23	23				
48 *	32	32	28	.9	.2	.7	OK
49 *	31	31	23	.15	.1	.1	OK. Photo 12
50 *	29	29	29	.1	.2	.25	Clean outlets. Photo 13

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
51	23	23	18	.35	.1	.4	OK
52	9	9	8	.1		.2	OK - Hand work Photo 13. Topsoil and subsoil mixed up by tractor, should revegetate rapidly.
				Compartment 170			
Catchment - Sunday Creek (Dump 8)							
Snig Track 7U							
NB	30	2	20				20 metres to snig to dump. Flows into dump
NB	32	1	60			.3	No bank. OK
NB	24	5	18				No bank falls back into previous hollow
NB	24	10	10			.5	Small snig to right - stable small bank. OK
NB	24	8	25		.3	.5	No Bank. No depression
NB *	25	12	18		.5	.5	Some rills down dozer tracks. Topsoil mixed into snig. Re-veg started - no bank. 1 photo
NB	30/25	14	32		.15		No bank track discharges into drainage line. Crossfall on track, at top, rill at bottom .2. Sediment in crossing. 2 photos. OK
NB	18	18	20		.2		No bank into filter strip - debris as detention - OK Photo 13 up
1	18	18	24	.45		.1	OK Outlet OK. Red/Yellow podsolic. Tree over bank
NB *	18	18	92				No bank, water turned off track with mitre drain. Topsoil present, regeneration started. Track rilled
Snig Track A							
NB	16	16	30				No banks - water flows down dozer all the way past the dump. Snig
NB	21	21	30				
NB	24	24	30				

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments
NB	19	19	30				still in use. Banked
Snig Track B bottom, ineffective.							Snig still in use. Banked at
NB	20	2	20				
Snig Track C							
NB	13	13	30				
NB *	9	9	30				
2	10	10	25	.5	.3		OK. No Windrow. Re-veg still T/S on surface.
3	14	14	30	.4	.2	.5	OK
4	16	16	30	.35		.4	OK
5	16	16	21	.3		.25	OK Track extends 10m to bottom track
Snig Track D							
6	18	0	47	.65		.1	Track stable, no windrows OK
7	19	4	29	.5	.2	.1	OK
Snig Track E							
8	12	12	31	.25	.3	.05	
9	17	16	18	.3	.3	.25	
Snig Track F							
10	9	9	29	.1			Effective but insufficient height. Infall drainage - rills down track. Dispersible high sandy soils with quartz.
11	18	18	21	0		.5	Infall drainage - bank failed, litter good, reveg good. Photo up 22..
12 *	18	21	27	0			Bank failed same as above. Rilled .2, .3. Photo down 23
13 *	14	23	39	0			Ineffective - original .2 height. Banks too low. Still active erosion. 18 metres to road.

Bank No.	Ground Slope (deg)	Track Slope (deg)	Bank Interval (metres)	Bank Height (metres)	W/D	C/F	Comments

Road back to dump OK - requires drainage with additional banks and more outfall to ridge. From ridge to dump 9 infall of .3, .4 - rilled, requires outfall and banks. Minor scours. Access track to right up hill requires drainage.

Bank on road - effective. Drainage on road required but road still in use. Most of the length is OK, some small sections are rilling.

Dump 8 - Still in operation. Logs on ground. Bed log collapsed. Soil churned up. Road out - 1st snig to right up hill.

Dump 9 - Still in use. Logs on dump. Numerous tracks, all with outfall - no need for banks now. Stable.

Snig from dump to terrace involving cut through the high bank. Infall, some erosion. Can be stabilised.

Plain English Reports of Soil Profile Data

r status:dry

grade:moderate pedality
ant peds: 2-5 mm, crumb
fabric:rough-faced peds
A ACTIVITY:
degree:low (< 10%)
type:cyl. burrows/krotovinas, ant channelling
AGMENTS:
type:as parent material amount:few(2-10 %)
entation:reoriented
athering:weakly weathered
shape:sub-angular
size:fine gravel(2-6 mm), gravel(6-20 mm)

type:not evident
ONS:
type:not evident

ine (<1 mm):common(10-25/10x10cm)
TY: high
TS:
pH:5.5
TY TESTS:
crumb:no change
KEN: disturbed

inctiveness:sharp (<5 mm) shape:smooth

2 A2 Depth (m): .03 to .10
moist:10YR 3/4 (dark brown) value/chroma:5a
dry:10YR 6/3 (dull yellow orange)
Dominant: type:not evident
clay loam,sandy
CE:
icity:non plastic
ive test:moderately weak force
ater status:dry

grade:moderate pedality
ant peds: 5-10 mm, polyhedral
fabric:rough-faced peds
CTIVITY:
degree:low (< 10%)
type:cyl. burrows/krotovinas, ant channelling
AGMENTS:
type:as parent material amount:abundant(50-90%)
entation:reoriented
weathering:weakly weathered
shape:angular
size:coarse gravel(20-60 mm), cobbles(60-200 mm)

type:not evident
:
type:not evident

in (<1 mm):common(10-25/10x10cm)
high
ESTS:
pH:6.0
TESTS:

[illegible]: dominant. type:not evident

TEXTURE: clay loam,coarse sandy

CONSISTENCE:

plasticity:non plastic

disruptive test:very weak force

soil water status:dry

STRUCTURE:

grade:weak pedality

dominant peds: 10-20 mm, polyhedral

fabric:rough-faced peds

SOIL FAUNA ACTIVITY:

degree:low (< 10%)

type:cyl. burrows/krotovinas, ant channelling

COARSE FRAGMENTS:

type:as parent material

orientation:reoriented

weathering:weakly weathered

shape:angular

size:stones(200-600 mm), boulders(> 600 mm)

PANS:

type:not evident

SEGREGATIONS:

type:not evident

ROOTS:

very fine (<1 mm):common(10-25/10x10cm) coarse (>5 mm):common(2-5/10x10cm)

ERODIBILITY: high

CHEMICAL TESTS:

pH:5.0

ERODIBILITY TESTS:

crumb:no change

SAMPLE(S) TAKEN: none

BOUNDARY:

distinctiveness:diffuse (>100 mm)

CATBIRD ROAD OAKES STATE FOREST Profile No. 2

MAP REFERENCES:
1:100 000 sheet no:9436 MACKSVILLE
AMG Eastings:452650
AMG Northings:6625500
Scale of Mapping:1:25 000
AMG Zone:56

SURVEY DETAILS:
Described by:G Atkinson
Site Location:CATBIRD RD 4.3 KM
Photo taken:profile
Date:05/08/92
No of layers described: 2
Methods of exposure:batter

SOIL and MAP CODES:
Great Soil Group:L, Lithosol
Factual Key:Um6.12
Geology Map Code:Penf

TOPOGRAPHY:
Slope:75%, measured
Aspect:N
Elevation (m):460

LANDFORM:
Site Process:transportational
Site Morphology:mid-slope
Local Relief:very high(> 300 m)
Landform Pattern:mountains
Landform Element:hillslope

VEGETATION:
Crown Sep. Ratio:dense(<0.25:1-overlap)
Vegetation Community:dry sclerophyll forest
Upper Stratum Height:> 35 m
Vegetation Form:tree, shrub, tussock grass, fern/cycad

SITE CONDITION:
Ground Cover:100%
Expected Dry Condition:loose

LITHOLOGY:
Rock Outcrop:nil
ID Method:personal assessment
Substrate Material:solum parent mat.
Substrate Strength:weak
Weathering & Alter:slightly weathered rock
Upper Solum PM:slate
Substrate:slate

LAND USE:
Site:logged native forest
General Area:logged native forest

HYDROLOGY:
Run Off:very high
Run On:very high
Permeability:highly permeable
Profile Drainage:rapidly drained
Free Water Presence:none
Free Water Depth(m): 0.00

EROSION:
minor sheet

EROSION HAZARD: extreme

SALINITY: no salting evident

FIELD NOTES:
Gneissic fabric in coarser bands
especially conglomerate.

LAYER: 1 A1
Depth (m): .00 to .15

COLOUR: moist:7.5YR 2/3 (very dark brown)
value/chroma:5a

MOTTLES: Dominant:
type:not evident

TEXTURE: clay loam,sandy

CONSISTENCE:
disruptive test:moderately firm force
soil water status:dry

STRUCTURE:
grade:strong pedality
dominant peds: 2-5 mm, polyhedral
subdominant peds: 5-10 mm, polyhedral
fabric:rough-faced peds

COARSE FRAGMENTS:
type:not identified amount:many(20-50%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:angular, angular platy
size:gravel(6-20 mm), coarse gravel(20-60 mm)
type:not identified amount:abundant(50-90%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:angular platy
size:coarse gravel(20-60 mm), cobbles(60-200 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):common(10-25/10x10cm) coarse (>5 mm):few(1-2/10x10 cm)
ERODIBILITY: low
CHEMICAL TESTS:
pH:5.5
ERODIBILITY TESTS:
crumb:no change
SAMPLE(S) TAKEN: disturbed
BOUNDARY:
distinctiveness:gradual (50-100 mm) shape:irregular

LAYER: 2 B Depth (m): .15 to .60
COLOUR: moist:7.5YR 4/6 (brown) value/chroma:5b
dry:7.5YR 6/4 (dull orange)
MOTTLES: Dominant: type:not evident
TEXTURE: clay loam,sandy
CONSISTENCE:
disruptive test:moderately weak force
soil water status:dry
STRUCTURE:
grade:strong pedality
dominant peds: 2-5 mm, polyhedral
subdominant peds: 5-10 mm, polyhedral
fabric:rough-faced peds
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):common(10-25/10x10cm) coarse (>5 mm):few(1-2/10x10 cm)
ERODIBILITY: moderate
CHEMICAL TESTS:
pH:5.5
ERODIBILITY TESTS:
crumb:aggregates slake
SAMPLE(S) TAKEN: disturbed
BOUNDARY:
distinctiveness:diffuse (>100 mm) shape:irregular

CATBIRD ROAD OAKES STATE FOREST Profile No. 3

MAP REFERENCES:
1:100 000 sheet no:9436 MACKSVILLE
Scale of Mapping:1:25 000
AMG Eastings:452600
AMG Zone:56
AMG Northings:6625650
SURVEY DETAILS:
Described by:G Atkinson
Date:06/08/92
Site Location:CATBIRD RD 4.4 KM 100M WEST
Photo taken:profile
No of layers described: 3
Methods of exposure:batter
SOIL and MAP CODES:
Great Soil Group:L, Lithosol
Factual Key:Um6.13
Geology Map Code:Penf
TOPOGRAPHY:
Slope:70%, measured
Aspect:SW
Elevation (m):470
LANDFORM:
Site Process:transportational
Site Morphology:mid-slope
Slope Morphology:waxing
Local Relief:very high(› 300 m)
Landform Pattern:mountains
Landform Element:hillslope
VEGETATION:
Crown Sep. Ratio:dense(‹0.25:1-overlap)
Vegetation Community:wet sclerophyll forest
Upper Stratum Height:› 35 m
Vegetation Form:tree, shrub, fern/cycad
SITE CONDITION:
Ground Cover:95%
Expected Dry Condition:loose
Current Condition:soft
Site Disturbance:limited clearing
LITHOLOGY:
Rock Outcrop:nil
ID Method:personal assessment
Substrate Material:solum parent mat.
Substrate Strength:moderately strong
Weathering & Alter:slightly weathered rock
Upper Solum PM:sandstone-lithic
Substrate:sandstone-lithic
LAND USE:
Site:logged native forest
General Area:logged native forest
HYDROLOGY:
Run Off:very high
Run On:high
Permeability:highly permeable
Profile Drainage:well drained
Free Water Presence:none
Free Water Depth(m): 0.00
EROSION:
minor, partly stabilised gully, gully depth 1.5-3.0 m
EROSION HAZARD: extreme
SALINITY: no salting evident
FIELD NOTES:
Deeper and wetter than C1.

LAYER: 1 A1
COLOUR: moist:7.5YR 2/3 (very dark brown)
Depth (m): .00 to .23
MOTTLES: Dominant:
value/chroma:5a
TEXTURE: clay loam,coarse sandy
type:not evident
CONSISTENCE:
disruptive test:moderately weak force
soil water status:moderately moist
STRUCTURE:
grade:strong pedality
dominant peds: 5-10 mm, polyhedral
fabric:rough-faced peds

SOIL FAUNA ACTIVITY:
degree:high(> 50%)
COARSE FRAGMENTS:
type:as parent material amount:common(10-20%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:sub-angular
size:coarse gravel(20-60 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):many(25-100/10x10cm)
ERODIBILITY: low
CHEMICAL TESTS:
pH:5.5
ERODIBILITY TESTS:
crumb:no change
SAMPLE(S) TAKEN: disturbed
BOUNDARY:
distinctiveness:gradual (50-100 mm)

LAYER: 2 B Depth (m): .23 to .53
COLOUR: moist:5YR 3/6 (dark reddish brown) value/chroma:5b
MOTTLES: Dominant: type:not evident
TEXTURE: sandy light clay
CONSISTENCE:
disruptive test:moderately weak force
soil water status:moderately moist
STRUCTURE:
grade:moderate pedality
dominant peds: 10-20 mm, polyhedral
fabric:rough-faced peds
SOIL FAUNA ACTIVITY:
degree:moderate(10 - 50%)
COARSE FRAGMENTS:
type:as parent material amount:many(20-50%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:sub-angular
size:coarse gravel(20-60 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):many(25-100/10x10cm)
ERODIBILITY: moderate
CHEMICAL TESTS:
pH:5.5
ERODIBILITY TESTS:
crumb:aggregates slake
SAMPLE(S) TAKEN: disturbed
BOUNDARY:
distinctiveness:diffuse (>100 mm)

LAYER: 3 C Depth (m): .53 to .90
COLOUR: moist:7.5YR 5/6 (bright brown) value/chroma:4
MOTTLES: Dominant: type:not evident
TEXTURE: clay loam,coarse sandy

CONSISTENCE:
disruptive test:moderately weak force
soil water status:dry
STRUCTURE:
grade:moderate pedality
dominant peds: 5-10 mm, polyhedral
fabric:rough-faced peds
SOIL FAUNA ACTIVITY:
degree:low (< 10%)
COARSE FRAGMENTS:
type:as parent material amount:abundant(50-90%)
distribution:dispersed orientation:reoriented
weathering:strongly weathered
shape:sub-angular
size:coarse gravel(20-60 mm), cobbles(60-200 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):common(10-25/10x10cm) coarse (>5 mm):common(2-5/10x10cm)
ERODIBILITY: moderate
CHEMICAL TESTS:
pH:5.0
ERODIBILITY TESTS:
crumb:aggregates slake
SAMPLE(S) TAKEN: none

LAYER: 99 Substrate Depth (m): .90 to

CATBIRD ROAD OAKES STATE FOREST Profile No. 4

MAP REFERENCES:
1:100 000 sheet no:9436 MACKSVILLE
Scale of Mapping:1:25 000
AMG Eastings:452800
AMG Zone:56
AMG Northings:6624400
SURVEY DETAILS:
Described by:G Atkinson
Date:06/08/92
Site Location:CATBIRD RD 2.8KM
Photo taken:both site & profile
No of layers described: 4
Methods of exposure:batter
SOIL and MAP CODES:
Great Soil Group:X, Xanthozem
Factual Key:Gn4.31
Geology Map Code:Penf
TOPOGRAPHY:
Slope:85%, measured
Aspect:E
Elevation (m):570
LANDFORM:
Site Process:transportational
Site Morphology:mid-slope
Local Relief:very high(> 300 m)
Landform Pattern:mountains
Landform Element:hillslope
VEGETATION:
SITE CONDITION:
Ground Cover:80%
Expected Dry Condition:loose
Current Condition:soft
Site Disturbance:limited clearing
LITHOLOGY:
Rock Outcrop:nil
ID Method:personal assessment
Substrate Material:solum parent mat.
Substrate Strength:weak
Weathering & Alter:faintly weathered rock
Upper Solum PM:colluvium
Substrate:slate
LAND USE:
Site:logged native forest
General Area:logged native forest
HYDROLOGY:
Run Off:very high
Run On:very high
Permeability:highly permeable
Profile Drainage:rapidly drained
Free Water Presence:none
Free Water Depth(m): 0.00
EROSION:
evident, active mass movement
EROSION HAZARD: extreme
SALINITY: no salting evident
FIELD NOTES:
Batter slip failure in talus and lower down in shattered slate slipface 2m scarp over 8m.

LAYER: 1 A1
Depth (m): .00 to .35
COLOUR: moist:10YR 2/2 (brownish black)
value/chroma:1
MOTTLES: Dominant:
type:not evident
TEXTURE: clay loam
CONSISTENCE:
disruptive test:moderately weak force
soil water status:dry
STRUCTURE:
grade:moderate pedality
dominant peds: < 2 mm, crumb
fabric:rough-faced peds
COARSE FRAGMENTS:

type:as parent material amount:abundant(50-90%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:angular tabular
size:gravel(6-20 mm)

PANS:
type:not evident

SEGREGATIONS:
type:not evident

ROOTS:
very fine (<1 mm):many(25-100/10x10cm)

CHEMICAL TESTS:
pH:6.0

SAMPLE(S) TAKEN: disturbed

BOUNDARY:
distinctiveness:diffuse (>100 mm) shape:irregular

LAYER: 2 B
COLOUR: moist:10YR 4/4 (brown) Depth (m): .35 to .60
MOTTLES: Dominant: value/chroma:5a
TEXTURE: sandy light clay type:not evident

CONSISTENCE:
disruptive test:moderately weak force
soil water status:dry

STRUCTURE:
grade:moderate pedality
dominant peds: 5-10 mm, polyhedral
fabric:rough-faced peds

COARSE FRAGMENTS:
type:as parent material amount:abundant(50-90%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:angular tabular
size:gravel(6-20 mm)

PANS:
type:not evident

SEGREGATIONS:
type:not evident

ROOTS:
very fine (<1 mm):many(25-100/10x10cm)

CHEMICAL TESTS:
pH:6.0

BOUNDARY:
distinctiveness:diffuse (>100 mm) shape:irregular

LAYER: 3 C
COLOUR: moist:10YR 6/4 (dull yellow orange) Depth (m): .60 to 1.50
MOTTLES: Dominant: value/chroma:2b
TEXTURE: sandy light clay type:not evident

CONSISTENCE:
disruptive test:moderately weak force
soil water status:dry

STRUCTURE:
grade:weak pedality
dominant peds: 5-10 mm, polyhedral
fabric:rough-faced peds

COARSE FRAGMENTS:
type:not identified amount:common(10-20%)
size:stones(200-600 mm)
type:as parent material amount:abundant(50-90%)
distribution:dispersed orientation:reoriented

weathering:weakly weathered
shape:angular tabular
size:gravel(6-20 mm)

PANS:
type:not evident

SEGREGATIONS:
type:not evident

ROOTS:
very fine (<1 mm):common(10-25/10x10cm) coarse (>5 mm):few(1-2/10x10 cm)

CHEMICAL TESTS:
pH:6.0

SAMPLE(S) TAKEN: disturbed

BOUNDARY:
distinctiveness:diffuse (>100 mm) shape:irregular

LAYER: 4 Depth (m): 1.50 to 4.00

MOTTLES: Dominant: type:not evident

COARSE FRAGMENTS:
type:as parent material amount:abundant(50-90%)
orientation:reoriented
weathering:weakly weathered
shape:angular
size:stones(200-600 mm)

ROOTS:
ROOTS: coarse (>5 mm):few(1-2/10x10 cm)

FIELD NOTES:
Talus.

CATBIRD ROAD OAKES STATE FOREST Profile No. 5

MAP REFERENCES:
1:100 000 sheet no:9436 MACKSVILLE
Scale of Mapping:1:25 000
AMG Eastings:452950
AMG Zone:56
AMG Northings:6624000
SURVEY DETAILS:
Described by:G Atkinson
Date:06/08/92
Site Location:CATBIRD RD AT 2.25 KM
Photo taken:profile
No of layers described: 2
Methods of exposure:batter
SOIL and MAP CODES:
Great Soil Group:C, Chocolate soil
Factual Key:Db3.11
Geology Map Code:Penf
TOPOGRAPHY:
Slope:65%, measured
Aspect:N
Elevation (m):590
LANDFORM:
Site Process:transportational
Site Morphology:upper slope
Slope Morphology:waxing
Local Relief:very high(> 300 m)
Landform Pattern:mountains
Landform Element:hillslope
VEGETATION:
Crown Sep. Ratio:dense(<0.25:1-overlap)
Vegetation Community:dry sclerophyll forest
Upper Stratum Height:> 35 m
Vegetation Form:tree
SITE CONDITION:
Ground Cover:80%
Expected Dry Condition:loose
Current Condition:loose
Site Disturbance:limited clearing
LITHOLOGY:
Rock Outcrop:nil
ID Method:personal assessment
Substrate Material:solum parent mat.
Weathering & Alter:faintly weathered rock
Upper Solum PM:slate
Substrate:slate
LAND USE:
Site:logged native forest
General Area:logged native forest
HYDROLOGY:
Run Off:very high
Run On:high
Permeability:highly permeable
Profile Drainage:well drained
Free Water Presence:none
Free Water Depth(m): 0.00
EROSION:
minor sheet
EROSION HAZARD: very high
SALINITY: no salting evident

LAYER: 1 A1
Depth (m): .00 to .30
COLOUR: moist:7.5YR 2/2 (brownish black)
value/chroma:1
MOTTLES: Dominant:
type:not evident
TEXTURE: loam
CONSISTENCE:
plasticity:non plastic
stickiness:non-sticky
texture modifier:no change
disruptive test:moderately weak force
shearing test:crumbly
soil water status:dry
STRUCTURE:
grade:moderate pedality
dominant peds: < 2 mm, crumb
subdominant peds: 2-5 mm, polyhedral

fabric:rough-faced peds
SOIL FAUNA ACTIVITY:
degree:moderate(10 - 50%)
COARSE FRAGMENTS:
type:as parent material amount:abundant(50-90%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:angular tabular
size:gravel(6-20 mm), coarse gravel(20-60 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):many(25-100/10x10cm)
CHEMICAL TESTS:
pH:6.0
ERODIBILITY TESTS:
crumb:no change
SAMPLE(S) TAKEN: disturbed
BOUNDARY:
distinctiveness:gradual (50-100 mm) shape:smooth

LAYER: 2 B Depth (m): .30 to .60
COLOUR: moist:7.5YR 4/6 (brown) value/chroma:5b
MOTTLES: Dominant: type:not evident
TEXTURE: sandy light clay
CONSISTENCE:
stickiness:non-sticky
texture modifier:increase < 2 Grades
disruptive test:moderately weak force shearing test:crumbly
soil water status:dry
STRUCTURE:
grade:weak pedality
fabric:rough-faced peds
SOIL FAUNA ACTIVITY:
degree:low (< 10%)
COARSE FRAGMENTS:
type:as parent material amount:very abundant(> 90%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:angular
size:coarse gravel(20-60 mm), cobbles(60-200 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):common(10-25/10x10cm)
CHEMICAL TESTS:
pH:6.0
ERODIBILITY TESTS:
crumb:aggregates slake
SAMPLE(S) TAKEN: disturbed

CATBIRD ROAD OAKES STATE FOREST Profile No. 6

MAP REFERENCES:
1:100 000 sheet no:9437 DORRIGO
Scale of Mapping:1:25 000
AMG Eastings:452500
AMG Zone:56
AMG Northings:6627100
SURVEY DETAILS:
Described by:G Atkinson
Date:07/08/92
Site Location:LOGDUMP WEST END COMP.170A SUNDAY CK
Photo taken:both site & profile
No of layers described: 2
Methods of exposure:batter
SOIL and MAP CODES:
Great Soil Group:K, Krasnozem
Factual Key:Um6.13
Geology Map Code:Penf
TOPOGRAPHY:
Slope:15%
Aspect:SW
Elevation (m):250
LANDFORM:
Site Process:transportational
Site Morphology:lower slope
Slope Morphology:waning
Local Relief:high(90-300 m)
Landform Pattern:mountains
Landform Element:footslope
VEGETATION:
Crown Sep. Ratio:dense(<0.25:1-overlap)
Vegetation Community:wet sclerophyll forest
Upper Stratum Height:> 35 m
Vegetation Form:tree, fern/cycad, vine
SITE CONDITION:
Ground Cover:90%
Current Condition:soft
Site Disturbance:extensive clearing
LITHOLOGY:
Rock Outcrop:nil
ID Method:personal assessment
Substrate Material:solum parent mat.
Substrate Strength:strong
Weathering & Alter:faintly weathered rock
Upper Solum PM:sandstone-lithic
Substrate:sandstone-lithic
LAND USE:
Site:logged native forest
General Area:logged native forest
HYDROLOGY:
Run Off:moderate
Run On:high
Permeability:moderately permeable
Profile Drainage:well drained
Free Water Presence:none
Free Water Depth(m): 0.00
EROSION:
moderate, active sheet
EROSION HAZARD: moderate
SALINITY: no salting evident
FIELD NOTES:
Log dump.

LAYER: 1 A1
Depth (m): .00 to .25
MOTTLES: Dominant:
type:not evident
TEXTURE: clay loam
CONSISTENCE:
disruptive test:moderately weak force
soil water status:moderately moist
STRUCTURE:
grade:strong pedality
dominant peds: 2-5 mm, granular
fabric:rough-faced peds
SOIL FAUNA ACTIVITY:

degree:moderate(10 - 50%)
type:cyl. burrows/krotovinas, earthworm casts
COARSE FRAGMENTS:
type:as parent material amount:few(2-10 %)
distribution:dispersed orientation:reoriented
weathering:non-weathered
shape:sub-angular
size:gravel(6-20 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):many(25-100/10x10cm) coarse (>5 mm):common(2-5/10x10cm)
ERODIBILITY: low
CHEMICAL TESTS:
pH;5.5
ERODIBILITY TESTS:
crumb:no change
SAMPLE(S) TAKEN: disturbed
BOUNDARY:
distinctiveness:diffuse (>100 mm) shape:smooth

LAYER: 2 B
COLOUR: moist:2.5YR 3/6 (dark reddish brown) Depth (m): .25 to .90
MOTTLES: Dominant: value/chroma:5b
TEXTURE: clay loam type:not evident
CONSISTENCE:
disruptive test:moderately weak force
soil water status:moderately moist
STRUCTURE:
grade:moderate pedality
dominant peds: 10-20 mm, polyhedral
subdominant peds: 2-5 mm, polyhedral
fabric:rough-faced peds
ped coatings:few (< 10%) clay
SOIL FAUNA ACTIVITY:
degree:low (< 10%)
type:cyl. burrows/krotovinas
COARSE FRAGMENTS:
type:as parent material amount:few(2-10 %)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:sub-rounded tabular
size:gravel(6-20 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):common(10-25/10x10cm) coarse (>5 mm):common(2-5/10x10cm)
ERODIBILITY: low
CHEMICAL TESTS:
pH:5.5
ERODIBILITY TESTS:
crumb:aggregates slake
SAMPLE(S) TAKEN: disturbed

CATBIRD ROAD OAKES STATE FOREST Profile No. 7

MAP REFERENCES:
1:100 000 sheet no:9436 MACKSVILLE Scale of Mapping:1:25 000
AMG Eastings:453800 AMG Zone:56
AMG Northings:6622850
SURVEY DETAILS:
Described by:G Atkinson Date:
Site Location:CATBIRD ROAD 0.3 KM
Photo taken:profile No of layers described: 3
Methods of exposure:batter
SOIL and MAP CODES:
Great Soil Group:L, Lithosol
Factual Key:Uf5.12
Geology Map Code:Penf
TOPOGRAPHY:
Slope:65%, measured Aspect:NE
Elevation (m):650
LANDFORM:
Site Process:transportational Site Morphology:mid-slope
Local Relief:very high(› 300 m) Landform Pattern:mountains
Landform Element:hillslope
VEGETATION:
Crown Sep. Ratio:dense(‹0.25:1-overlap)
Vegetation Community:wet sclerophyll forest Upper Stratum Height:› 35 m
Vegetation Form:tree, shrub, fern/cycad, vine
SITE CONDITION:
Expected Dry Condition:loose
LITHOLOGY:
Rock Outcrop:nil
ID Method:personal assessment
Substrate Material:lower solum parent mat. Substrate Strength:weak
Weathering & Alter:mod. weathered rock
Upper Solum PM:colluvium
Substrate:slate
LAND USE:
Site:logged native forest
General Area:logged native forest
HYDROLOGY:
Run Off:very high Run On:high
Permeability:highly permeable Profile Drainage:well drained
Free Water Presence:none Free Water Depth(m): 0.00
EROSION:
none
EROSION HAZARD: very high
SALINITY: no salting evident
FIELD NOTES:
Redder talus, relatively stable batter.

LAYER: 1 A Depth (m): .00 to .25
COLOUR: moist:7.5YR 3/4 (dark brown) value/chroma:5a
MOTTLES: Dominant: type:not evident
TEXTURE: silty light clay
CONSISTENCE:
stickiness:moderately sticky
texture modifier:increase ‹ 2 Grades
disruptive test:moderately weak force shearing test:crumbly
soil water status:moderately moist
STRUCTURE:
grade:strong pedality
dominant peds: 2-5 mm, granular
subdominant peds:granular

fabric:rough-faced peds
SOIL FAUNA ACTIVITY:
degree:moderate(10 - 50%)
type:cyl. burrows/krotovinas
COARSE FRAGMENTS:
type:as parent material amount:common(10-20%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:angular tabular
size:coarse gravel(20-60 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):common(10-25/10x10cm) coarse (>5 mm):few(1-2/10x10 cm)
ERODIBILITY: low
CHEMICAL TESTS:
pH:6.0
ERODIBILITY TESTS:
crumb:no change
SAMPLE(S) TAKEN: disturbed
BOUNDARY:
distinctiveness:gradual (50-100 mm) shape:smooth

LAYER: 2 B Depth (m): .25 to .70
COLOUR: moist:5YR 4/6 (reddish brown) value/chroma:5b
MOTTLES: Dominant: type:not evident
TEXTURE: silty light clay
CONSISTENCE:
stickiness:moderately sticky
texture modifier:increase < 2 Grades
disruptive test:moderately weak force shearing test:crumbly
soil water status:moderately moist
STRUCTURE:
grade:moderate pedality
dominant peds: 5-10 mm, polyhedral
subdominant peds: 5-10 mm, polyhedral
fabric:rough-faced peds
SOIL FAUNA ACTIVITY:
degree:moderate(10 - 50%)
type:cyl. burrows/krotovinas
COARSE FRAGMENTS:
type:as parent material amount:many(20-50%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:angular tabular
size:coarse gravel(20-60 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):common(10-25/10x10cm) coarse (>5 mm):few(1-2/10x10 cm)
ERODIBILITY: moderate
CHEMICAL TESTS:
pH:5.0
ERODIBILITY TESTS:
crumb:no change
SAMPLE(S) TAKEN: none
BOUNDARY:

distinctiveness:gradual (50-100 mm) shape:smooth

LAYER: 3 C Depth (m): .70 to 2.80
COLOUR: moist:5YR 4/6 (reddish brown) value/chroma:5b
MOTTLES: Dominant: type:not evident
TEXTURE: silty light clay
CONSISTENCE:
stickiness:moderately sticky
texture modifier:increase < 2 Grades
disruptive test:moderately weak force shearing test:brittle
soil water status:dry
STRUCTURE:
grade:weak pedality
dominant peds: 20-50 mm, polyhedral
subdominant peds: 20-50 mm,
fabric:rough-faced peds
SOIL FAUNA ACTIVITY:
degree:low (< 10%)
type:cyl. burrows/krotovinas
COARSE FRAGMENTS:
type:as parent material amount:abundant(50-90%)
distribution:dispersed orientation:reoriented
weathering:weakly weathered
shape:angular tabular
size:coarse gravel(20-60 mm), cobbles(60-200 mm)
PANS:
type:not evident
SEGREGATIONS:
type:not evident
ROOTS:
very fine (<1 mm):few(1-10/10x10cm) coarse (>5 mm):few(1-2/10x10 cm)
ERODIBILITY: high
CHEMICAL TESTS:
pH:5.0
ERODIBILITY TESTS:
crumb:aggregates disperse
SAMPLE(S) TAKEN: disturbed

Appendix 4 Details of the SOILOSS Equation

Soil loss is determined by multiplying six factor values together. The six factors are rainfall erosivity (R), soil erodibility (K), slope length (L), slope steepness (S), support practice (P) and crop management (C).

The soil loss equation is

A = R * K * L * S * P * C

where,

A, is the computed soil loss per unit area, expressed in the units selected for K and for the period selected for R. Traditionally these have been selected so that they compute A in tons per acre per year, but other units can be selected. Accepted SI units are now t/ha/y.

R, the rainfall and runoff factor, is the number of rainfall erosion index units, plus a factor for runoff from applied water where such runoff is significant.
Units now used are MJ.mm/(ha.h.y)

K, the soil erodibility factor, is the soil loss rate per erosion index unit for a specified soil as measured on a unit plot, which is defined as a 22.1 m length of uniform 9-percent slope maintained in continuous clean-tilled fallow. Units are t.ha.h/(ha.MJ.mm)

L, the slope-length factor, is the ratio of soil loss from the field slope length to that from a 22.1 m length under otherwise identical conditions.

S, the slope-steepness factor, is the ratio of soil loss from the field slope gradient to that from a 9 percent slope under identical conditions.

P, the support practice factor, is the ratio of soil loss with a support practice like contouring or stripcropping to that with straight-row farming up and down the slope.

C, the cover and management factor, is the ratio of soil loss from an area with specified cover and management to that from an identical area maintained in continuous clean-tilled fallow.

An example of the output from the SOILOSS program follows:

Appendix 5 Soil Loss Calculations for Snig Track Segments

GROUND SLOPE DEGREES	TRACK SLOPE DEGREES	BANK INTERVAL METERS	AREA Ha.	SOIL LOSS T/HA.	SOIL LOSS T/YEAR
31	25	19	0.01	422	4.0
34	22	20	0.01	352	3.5
32	15	16	0.008	170	1.4
33	5	26	0.013	46	0.6
33	5	47	0.024	61	1.4
33	13	38	0.019	209	4.0
23	23	48	0.024	586	14.1
23	23	21	0.011	388	4.1
23	23	31	0.016	471	7.3
23	23	43	0.022	555	11.9
21	21	44	0.022	484	10.6
20	20	36	0.018	404	7.3
29	29	65	0.033	992	32.2
20	20	10	0.005	213	1.1
30	20	27	0.014	350	4.7
28	22	20	0.01	352	3.5
41	16	20	0.01	211	2.1
44	9	32	0.016	111	1.8
43	5	33	0.017	51	0.8
33	8	52	0.026	119	3.1
36	18	21	0.011	261	2.7
41	24	24	0.012	444	5.3
31	31	35	0.018	810	14.2
32	27	15	0.008	425	3.2
29	29	28	0.014	651	9.1
32	32	42	0.021	933	19.6
33	33	32	0.016	855	13.7
19	19	10	0.005	196	1.0
26	17	29	0.015	279	4.0
38	21	25	0.013	365	4.6
37	12	46	0.023	203	4.7
38	19	43	0.022	407	8.8
38	17	47	0.024	356	8.4
40	17	36	0.018	311	5.6
35	14	40	0.02	241	4.8
32	17	32	0.016	293	4.7
29	18	20	0.01	254	2.5
39	24	34	0.017	528	9.0
40	13	28	0.014	180	2.5
41	11	19	0.01	115	1.1
28	28	31	0.016	648	10.0
28	28	31	0.016	648	10.0
32	25	12	0.006	335	2.0
36	20	38	0.019	416	7.9
36	20	20	0.01	301	3.0
31	31	28	0.014	724	10.1
35	35	60	0.03	1284	38.5
33	24	15	0.008	351	2.6
29	29	23	0.012	590	6.8
35	27	22	0.011	514	5.7
31	26	31	0.016	575	8.9
31	27	33	0.017	630	10.4
31	28	28	0.014	615	8.6

22	15	21	0.011	195	2.0
30	20	29	0.015	363	5.3
13	12	33	0.017	172	2.8
30	23	30	0.015	463	6.9
25	19	26	0.013	316	4.1
35	19	42	0.021	402	8.4
33	19	42	0.021	402	8.4
30	25	36	0.018	581	10.5
24	24	39	0.02	566	11.0
23	23	42	0.021	548	11.5
28	28	75	0.038	1007	37.8
29	29	40	0.02	778	15.6
29	29	30	0.015	674	10.1
29	29	48	0.024	853	20.5
24	24	38	0.019	559	10.6
25	25	46	0.023	657	15.1
25	25	30	0.015	530	8.0
25	25	21	0.011	444	4.7
25	25	40	0.02	612	12.2
24	24	36	0.018	544	9.8
31	24	87	0.044	845	36.8
33	21	24	0.012	357	4.3
30	14	21	0.011	175	1.8
28	22	31	0.016	438	6.8
31	23	60	0.03	655	19.7
28	12	26	0.013	153	2.0
35	4	30	0.015	37	0.6
35	7	36	0.018	82	1.5
36	8	31	0.016	92	1.4
30	10	45	0.023	153	3.4
30	10	25	0.013	114	1.4
9	9	10	0.005	62	0.3
31	21	23	0.012	350	4.0
9	9	35	0.018	116	2.0
32	14	13	0.007	137	0.9
38	18	32	0.016	322	5.2
46	18	35	0.018	336	5.9
41	20	30	0.015	369	5.5
41	20	29	0.015	363	5.3
33	9	23	0.012	94	1.1
35	10	24	0.012	112	1.3
32	13	49	0.025	238	5.8
36	21	38	0.019	450	8.6
37	10	30	0.015	125	1.9
36	16	35	0.018	278	4.9
33	6	30	0.015	61	0.9
15	13	25	0.013	170	2.1
28	8	44	0.022	110	2.4
15	11	37	0.019	160	3.0
18	18	27	0.014	295	4.0
34	24	30	0.015	496	7.4
34	24	11	0.006	301	1.7
21	21	26	0.013	372	4.8
24	24	25	0.013	453	5.7
29	29	25	0.013	615	7.7
28	28	16	0.008	465	3.7
27	27	20	0.01	491	4.9
25	25	28	0.014	512	7.2

27	27	41	0.021	702	14.4
35	13	28	0.014	180	2.5
27	28	34	0.017	678	11.5
28	28	40	0.02	736	14.7
35	17	28	0.014	274	3.8
39	20	34	0.017	393	6.7
40	18	24	0.012	279	3.3
38	23	27	0.014	440	5.9
35	10	13	0.007	82	0.5
34	2	34	0.017	19	0.3
32	16	19	0.01	203	1.9
32	27	30	0.015	601	9.0
31	31	70	0.035	1145	40.1
34	8	28	0.014	87	1.2
27	7	23	0.012	66	0.8
27	7	22	0.011	64	0.7
32	2	47	0.024	21	0.5
32	9	44	0.022	130	2.9
29	24	30	0.015	496	7.4
38	20	29	0.015	363	5.3
24	24	20	0.01	405	4.1
26	26	37	0.019	628	11.6
26	26	55	0.028	765	21.0
33	21	36	0.018	438	7.9
33	25	30	0.015	530	8.0
27	2	72	0.036	24	0.9
22	20	31	0.016	375	5.8
30	18	33	0.017	327	5.4
32	23	29	0.015	455	6.6
30	13	44	0.022	255	5.6
36	9	24	0.012	96	1.2
27	17	40	0.02	328	6.6
27	27	37	0.019	667	12.3
35	10	52	0.026	164	4.3
30	13	24	0.012	166	2.0
28	25	28	0.014	512	7.2
32	20	34	0.017	393	6.7
25	25	42	0.021	628	13.2
26	22	20	0.01	352	3.5
42	2	95	0.048	26	1.2
36	14	30	0.015	209	3.1
40	11	35	0.018	135	2.4
42	11	32	0.016	149	2.4
30	9	36	0.018	117	2.1
35	6	39	0.02	70	1.4
45	11	39	0.02	164	3.2
38	7	49	0.025	96	2.4
40	8	48	0.024	114	2.7
38	13	52	0.026	245	6.4
32	9	43	0.022	127	2.7
42	13	39	0.02	212	4.1
24	12	56	0.028	225	6.3
31	15	50	0.025	300	7.5
17	17	56	0.028	388	10.9
12	12	31	0.016	406	6.3
42	25	26	0.013	494	6.4
41	19	24	0.012	304	3.6
43	26	25	0.013	516	6.5

33	29	50	0.025	870	21.8
11	11	16	0.008	105	0.8
21	17	21	0.011	238	2.5
25	25	19	0.01	422	4.0
28	27	45	0.023	736	16.6
25	25	32	0.016	548	8.8
22	22	54	0.027	578	15.6
18	18	19	0.01	248	2.4
26	26	33	0.017	593	9.8
23	23	43	0.022	555	11.9
11	11	42	0.021	170	3.6
6	6	220	0.11	166	18.3
14	14	30	0.015	209	3.1
3	3	120	0.06	47	2.8
11	11	27	0.014	137	1.8
12	12	97	0.049	293	14.2
19	19	45	0.023	416	9.4
16	16	106	0.053	485	25.7
7	7	135	0.068	160	10.8
21	21	257	0.129	1170	150.3
24	24	33	0.017	521	8.6
26	26	17	0.009	425	3.6
22	22	16	0.008	315	2.5
16	16	14	0.007	176	1.2
13	13	20	0.01	152	1.5
24	24	21	0.011	415	4.4
24	24	30	0.015	496	7.4
4	4	15	0.008	28	0.2
16	16	126	0.063	528	33.3
31	31	23	0.012	657	7.6
29	29	29	0.015	663	9.6
23	23	18	0.009	359	3.2
9	9	8	0.004	55	0.2
20	9	189	0.095	227	21.5
13	13	28	0.014	180	2.5
20	20	29	0.015	363	5.3
24	24	38	0.019	559	10.6
26	26	37	0.019	628	11.6
29	29	26	0.013	627	8.2
39	16	21	0.011	216	2.3
40	23	29	0.015	455	6.6
40	5	34	0.017	52	0.9
18	18	92	0.046	543	25.0
18	18	24	0.012	279	3.3
18	18	20	0.01	254	2.5
30	14	32	0.016	216	3.5
25	12	18	0.009	127	1.1
24	8	25	0.013	83	1.0
24	10	10	0.005	72	0.4
24	5	18	0.009	38	0.3
32	1	60	0.03	15	0.5
12	12	31	0.016	167	2.6
17	16	18	0.009	200	1.8
19	4	29	0.015	36	0.5
18	18	47	0.024	390	9.2
16	16	21	0.011	216	2.3
16	16	30	0.015	258	3.9
14	14	30	0.015	209	3.1

10	10	25	0.013	114	1.4
9	9	29	0.015	105	1.5
18	18	21	0.011	261	2.7
18	21	27	0.014	379	5.1
14	23	39	0.02	528	10.3
TOTAL		16,962	8.481		3206.4

Appendix 6 Harvest Plan Maps for Compartments 168-170

Thora
Up River / DB

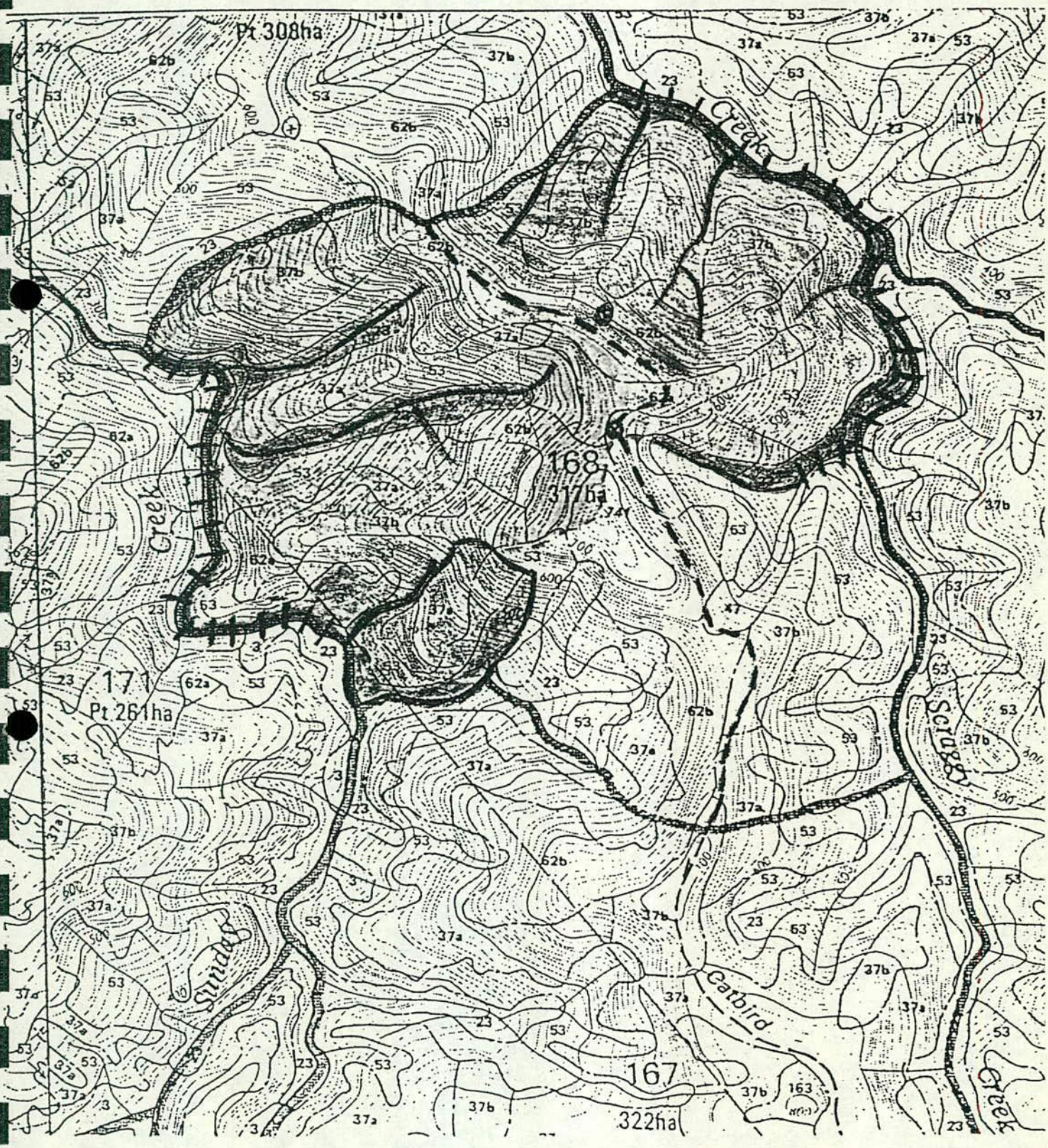
Compartment 168

Scale — 1:15 000

0 0·5 1 km

STATE FOREST: OAKES

S.F. BOUNDARY SHOWN IN GREEN



Compartment boundary .....

Logging Area boundary .....

Filter strips (20m wide) .....

Other stream protection .....

Reserved from logging .....

Ammended Area as of 27/6/91

Feeder road, dump site .....

Special emphasis (visual) .....

Forest types .....

Wet weather dumps shown in red

Possibly too steep (>35°)

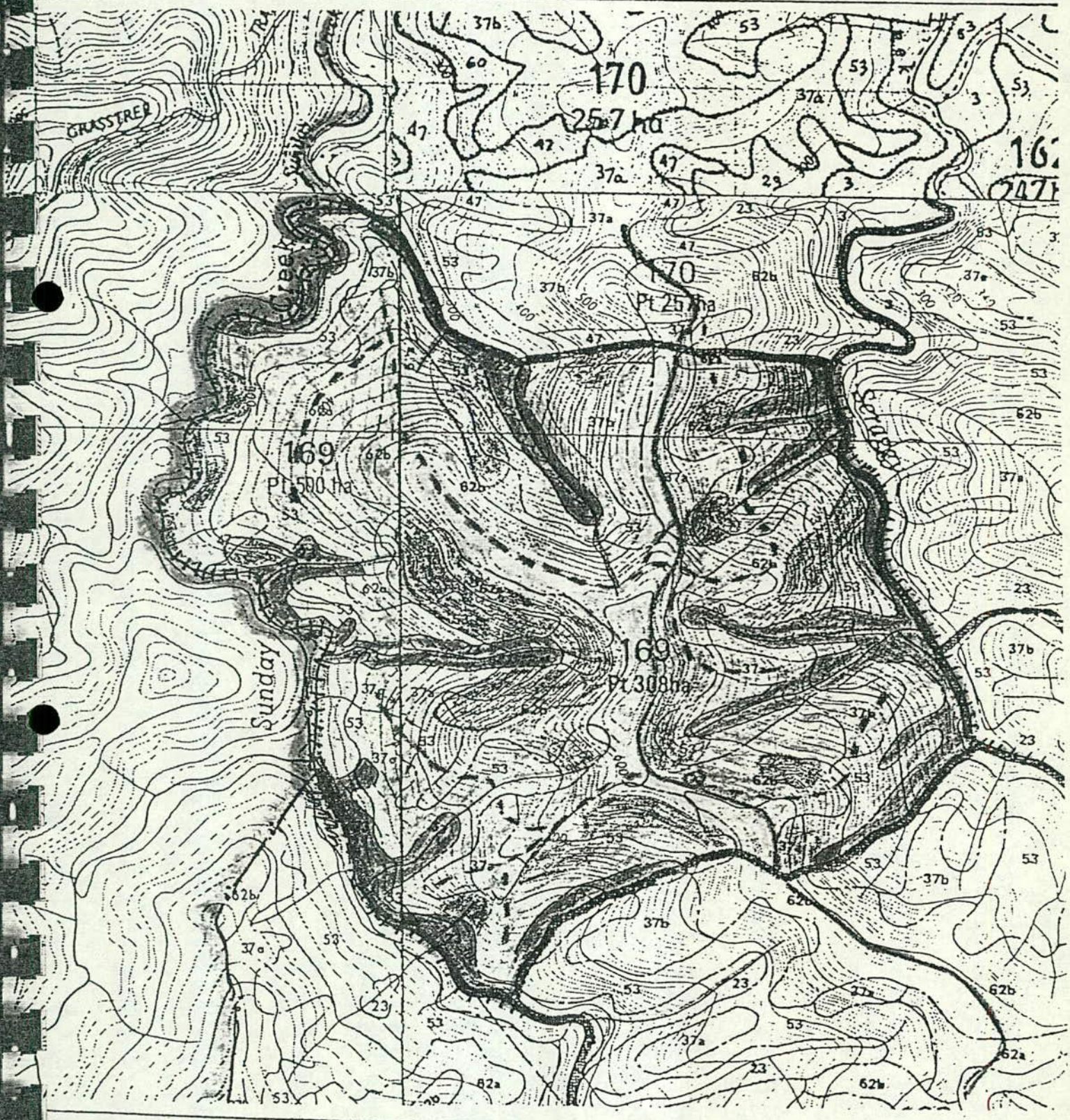
Compartment 169

Scale — 1:15 000

0 0·5 1 km

STATE FOREST: OAKES No. 609

S.F. BOUNDARY SHOWN IN GREEN



Compartment boundary .....

Logging Area boundary .....

Filter strips (20m wide) .....

Other stream protection .....

Reserved from logging .....

Feeder road, dump site .....

Special emphasis - Visual ....

Forest types ..... 37 | 53 | 62

Wet weather dumps shown in red

Excessive sideslope - 35° + (Estimated only)

Forester

Compartment 170

Scale — 1:15 000

0 0·5 1 km

STATE FOREST: OAKES No. 60

S.F. BOUNDARY SHOWN IN GREEN

Compartment boundary .....

Logging Area boundary .....

Filter strips (20m wide) .....

Other stream protection .....

Reserved from logging .....

Contractor Boundary

Feeder road, dump site .....

Special emphasis Visual/Catchment V/C

Forest types 37 47 60 6

Wet weather dumps shown in red

Excessive Sideslope - 35°+

Appendix 7 Proposed Roll-Over Bank Locations

Chainages taken from the start of the Catbird Road extension. Chainage 0.0 marked on a tree. Chainages marked at 100m intervals for a length of 4.7km.

Chainage	General Description
0.14	-
0.22	Up the road from large slip
0.26	Down the from large slip
0.37	-
0.42	-
0.60	Up the road from log dump
0.70	-
0.78	On bend
0.86	-
0.94	-
1.02	-
1.15	On bend
1.22	-
1.30	-
1.38	
1.45	-
1.52	-
1.60	-
1.69	-
1.78	-
1.87	On bend
1.95	-
2.01	-
2.08	-
2.15}	{Two rollover banks capturing
2.15}	{water from both directions
2.25	-
2.40	Down road from log dump
2.60	Up road from slip
2.65	-
2.70	-

2.75	-
2.80	-
2.86	-
2.90	-
3.05 }	Just around bend and
3.05 }	top of north side logging track
3.10	-
3.13	-
3.16	-
3.20}	In dip in country. Two rollover
3.20}	banks capturing water from both directions
3.23	-
3.30	-
3.40	-
3.50	Up road from log dump
3.60	Snig road below
3.70	Mark on stump
3.80	Mark on rock
3.90	Mark on rock
3.96	
4.00	
4.06	Near large tree on bend
4.10	-
4.15	-
4.17	Direct gulley flow to this bank
4.23	-
4.28	Near stump
4.33	-
4.38	-
4.47	Just up road from log dump
4.52	-
4.60	-

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

PHOTOGRAPHS

COMPARTMENTS 168-170

OAKES STATE FOREST

Prepared for the Forestry Commission of NSW

NOVEMBER 1992

By G. Atkinson
R.D. Attwood
J.J. Kingman
R.S. Saul

CALM
DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

SNIG TRACK SU5 FROM DUMP 5
STEEP SIDESLOPE, TRACK IMPEDED BY ROCK

SNIG TRACK SU6
HIGH CUT BATTER AND HIGH WINDROW

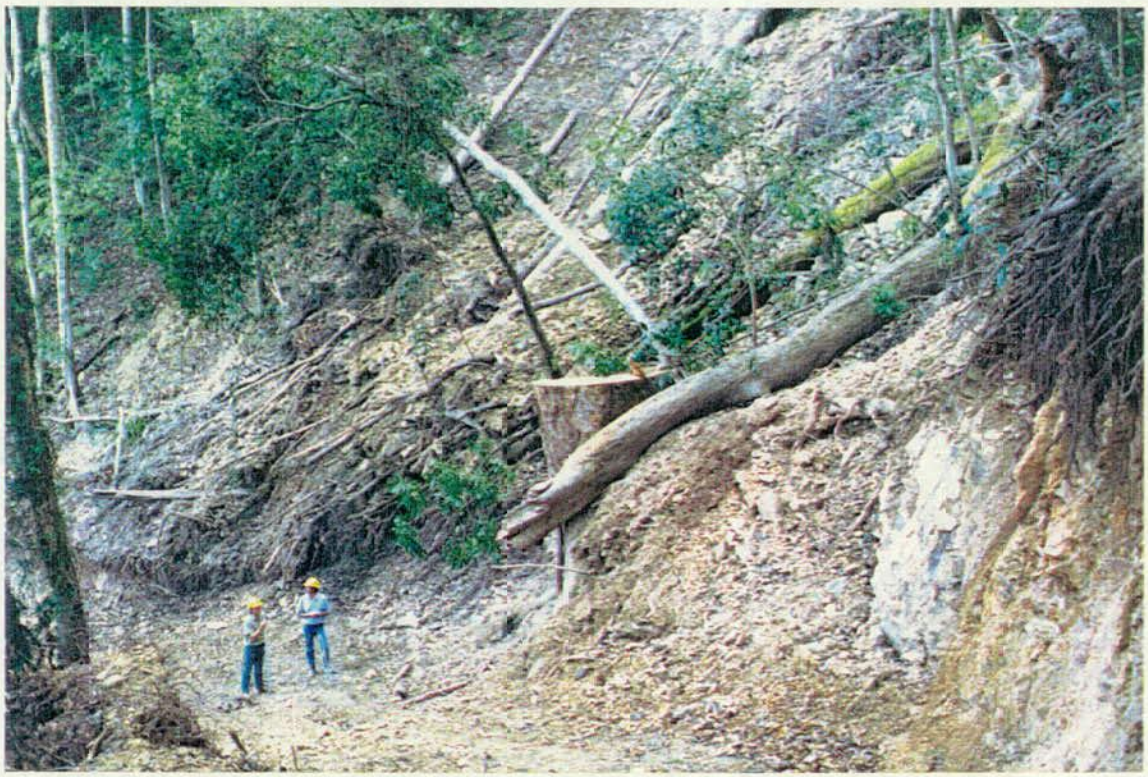
LARGE CUT BATTER AND SLIP ON SNIG TRACK SU6 FROM DUMP 7 DOWNSLOPE.

LARGE CUT BATTER AND SLIP ON SNIG TRACK SU6 FROM DUMP 7 UPSLOPE.

SLIP OF ROCK ON SNIG TRACK SU5 FROM DUMP 5 DOWNSLOPE.

SLIP OF ROCK ON SNIG TRACK SU5 FROM DUMP 5 UPSLOPE.

SLIP ON SNIG TRACK SU6 FROM DUMP 7
DOWNSLOPE. NOTE WINDROW



TALUS COVERED. SLOPE FROM CATBIRD ROAD TO
SNIG TRACK SC6 FROM DUMP 4

BOX CUT SIDECUT SNIG TRACK WITH HIGH WINDROW PREVENTING
WATER EXIT. RILL ON WINDROW TOE.

BOX CUT RIDGE LINE SNIG TRACK
HIGH WINDROWS

SIDECUT SNIGTRACK, UPSLOPE WITH HIGH WINDROW
AND DEEP RILL

BOX CUT RIDGE LINE SNIG TRACK SC5 WITH INEFFECTIVE BANK.
TRACK RILLS FOLLOWING RIGHT BRANCH TRACK.

INEFFECTIVE BANK ON SIDECUT SNIG TRACK. RILLED DOWN TRACK AND THROUGH OUTLET.

SIDECUT SNIG TRACK RILLED AS ABOVE. HIGH WINDROW

PEDESTALS AND RILLS OF SNIGTRACK SURFACE. SOME RE-VEGETATION COMMENCED.

SIDECUT SNIG TRACK, RILLED TO 30cm. LEAF LITTER AND SOME RE-VEGETATION.

SIDECUT SNIG TRACK SU6 FROM DUMP 7
INEFFECTIVE BANK.

ERODED OUTLET ON CROSS BANK.

RIDGE SNIG TRACK,
NOT BANKED AND RILLED.

SNIG TRACK UPSLOPE FROM
CATBIRD ROAD EXCAVATED
TO ROCK, FINES GONE.

BOX CUT RIDGE TRACK SC5 HIGH WINDROWS AND RILLED.

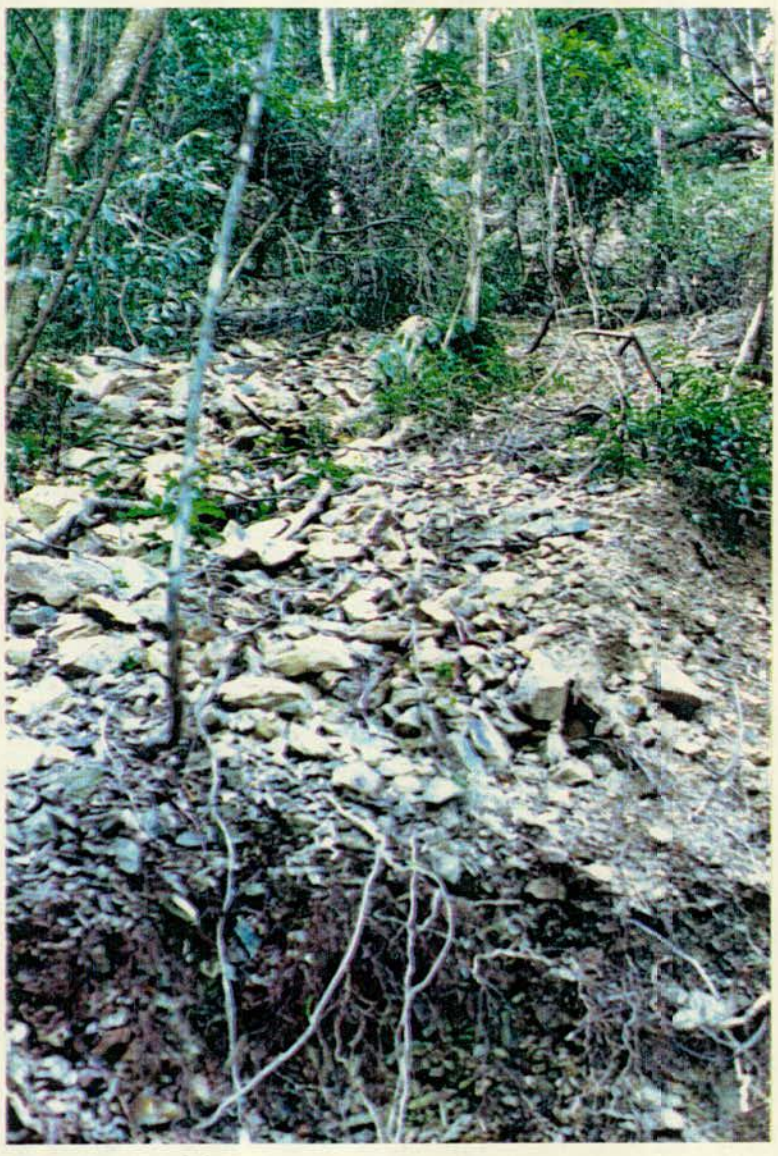
BOX CUT RIDGE TRACK SC5 HIGH WINDROWS RILLED DOWN DOZER TRACKS.

SNIG TRACK INTRUSION INTO FILTERSTRIP ON SUNDAY CREEK
DAMAGE TO COACHWOOD STAND.

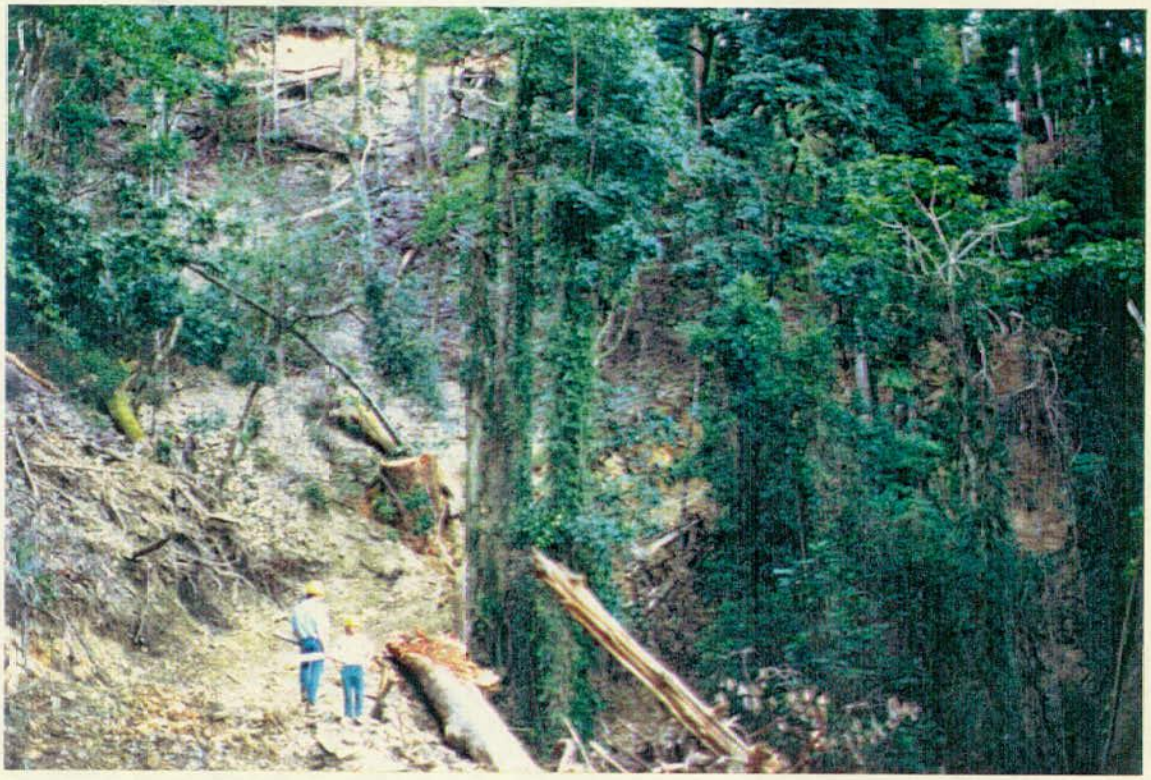
SNIG TRACK INTRUSION INTO FILTER STRIP ON
SCRAGGY CREEK.

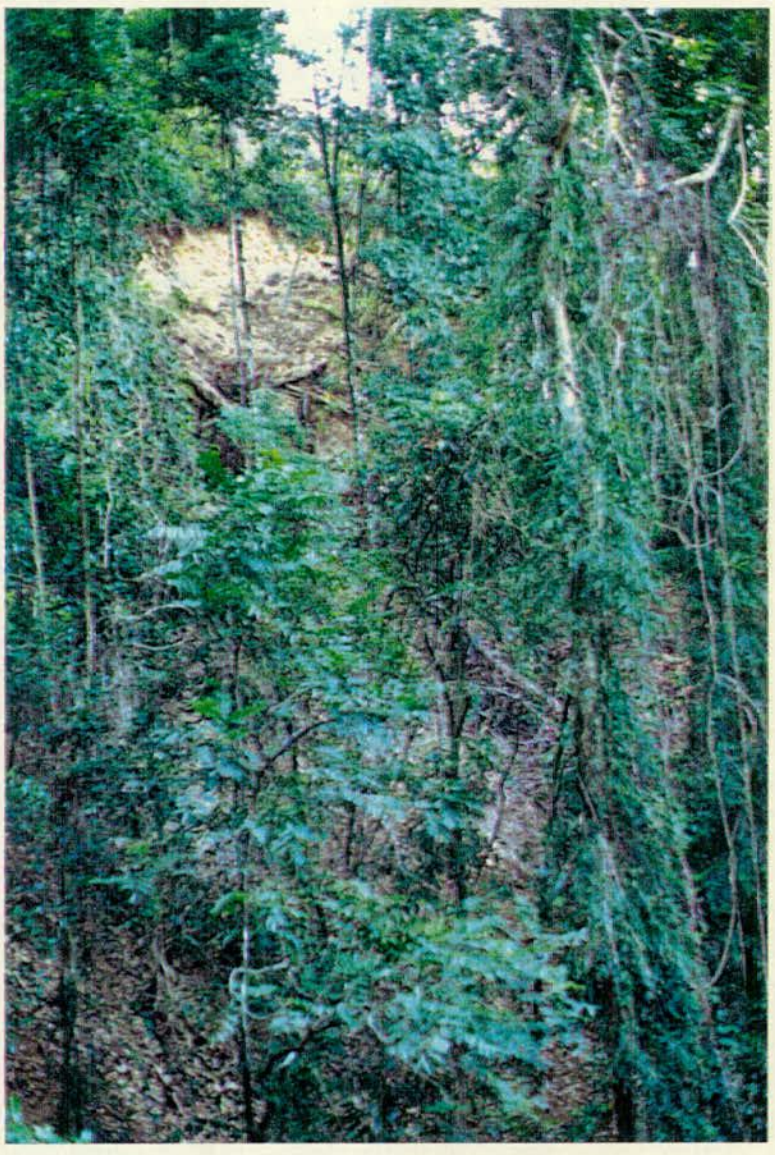
'SNIG TRACK INTRUSION INTO PROTECTION STRIP IN SCRAGGY CREEK CATCHMENT.

'SNIG TRACK INTRUSION INTO FILTER STRIP ON SCRAGGY CREEK. TREE FELLED INTO CREEK.

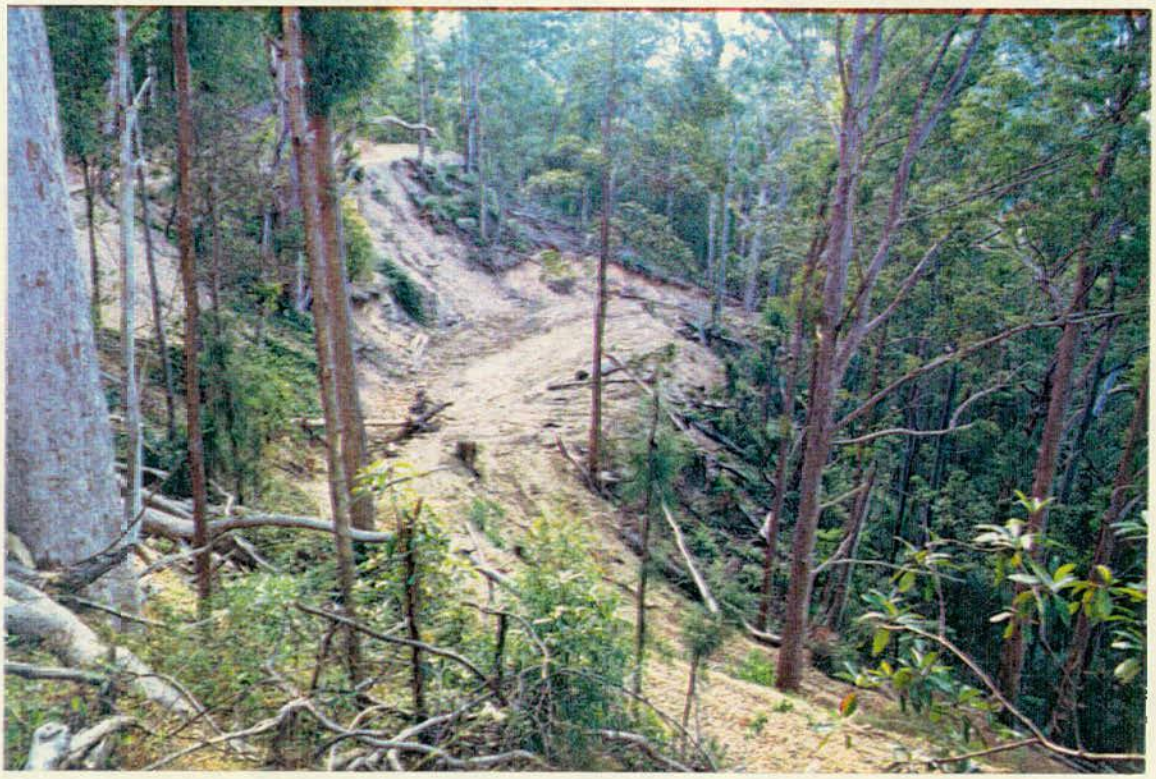


TALUS COVERED STEEP SLOPE
UNDER CATBIRD ROAD ABOVE
SNIGTRACK SC6

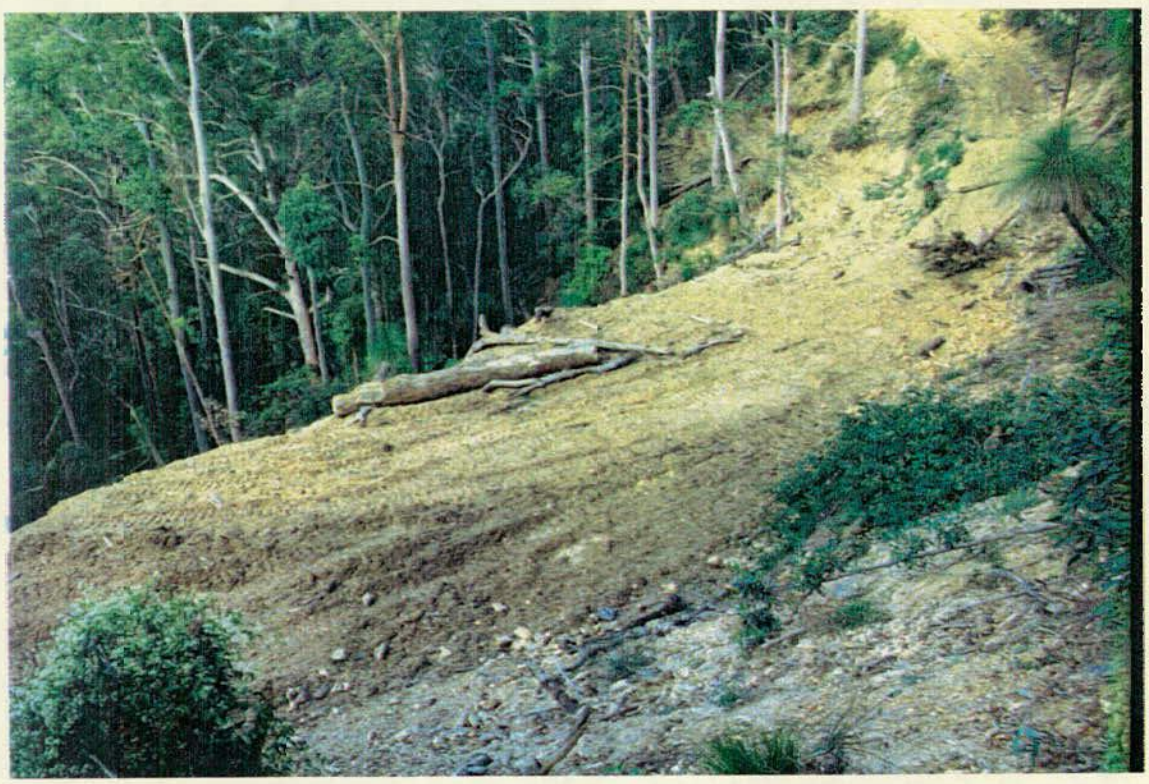




TALUS COVERED STEEP SLOPE UNDER CATBIRD ROAD ABOVE SNIGTRACK SC6.



CATBIRD ROAD AND DUMP 6. ILLUSTRATING LARGE TALUS COVERED SLOPE AND EXCAVATION.

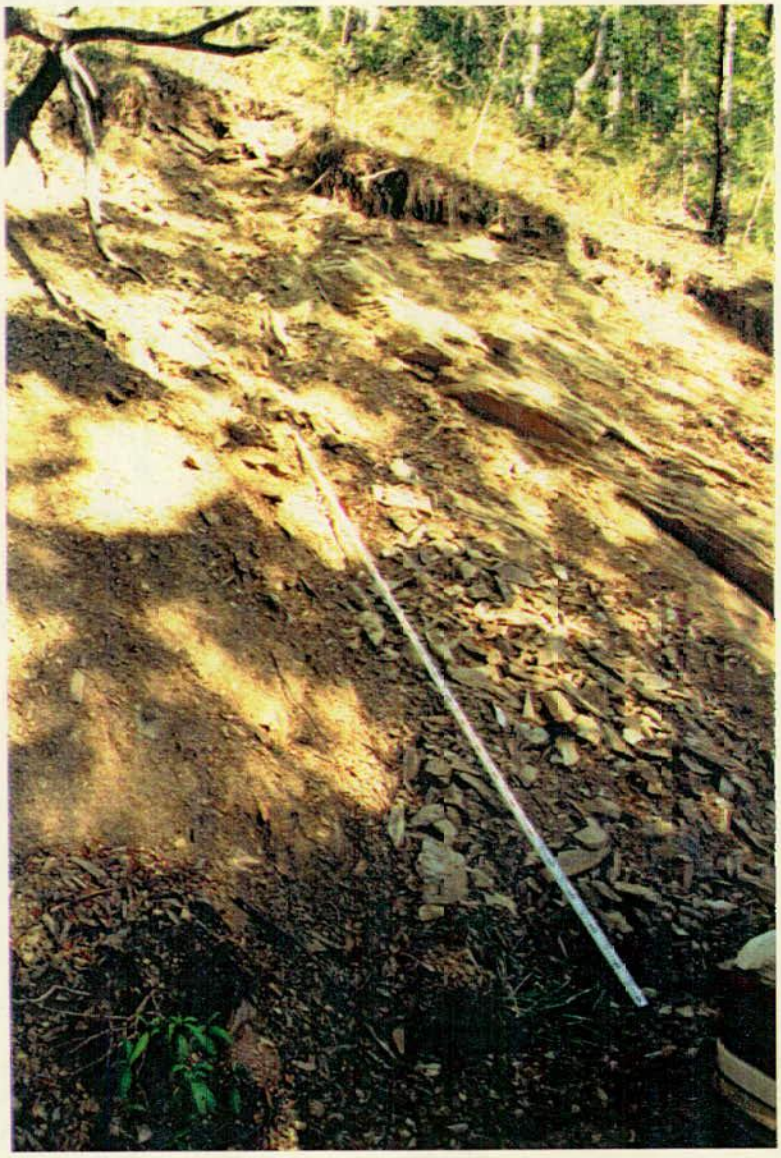


RESHAPED DUMP 6 AFTER THE LOGGING EXTRACTION CEASED.

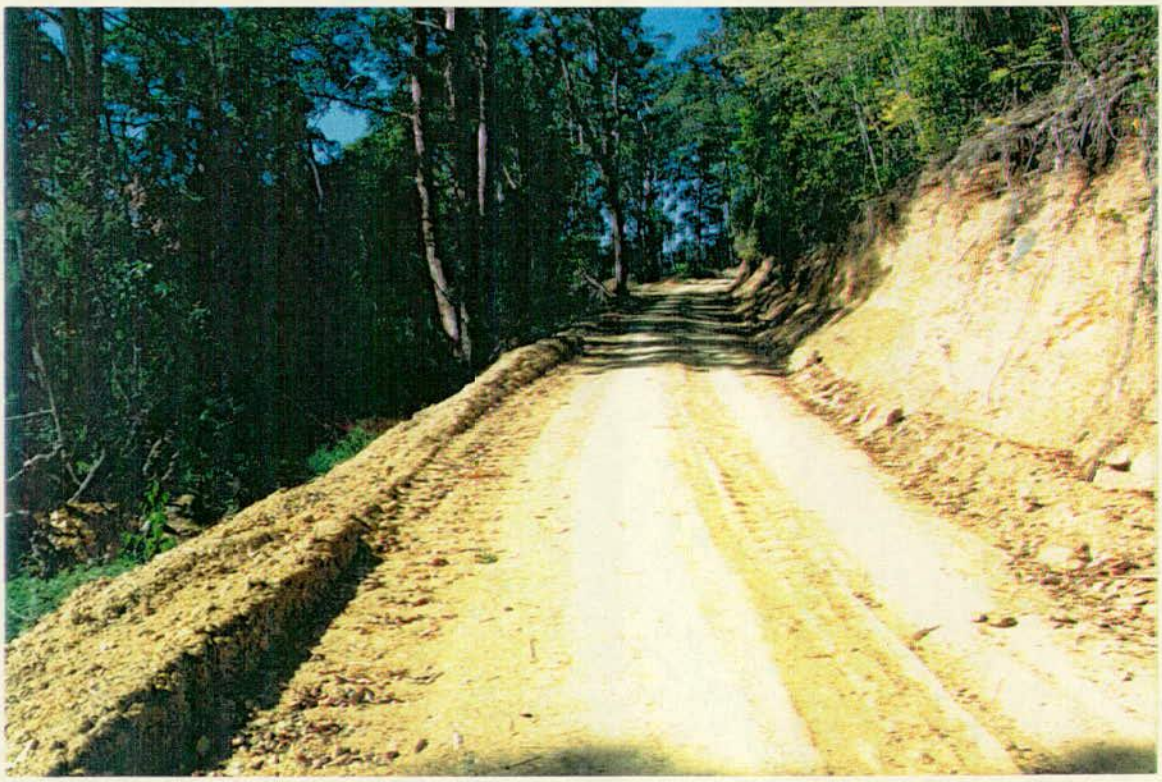
RIDGE SNIG TRACK WITH DEEP LOG SCOUR.

SNIG TRACK 7a INTRUDED INTO PROTECTION STRIP.

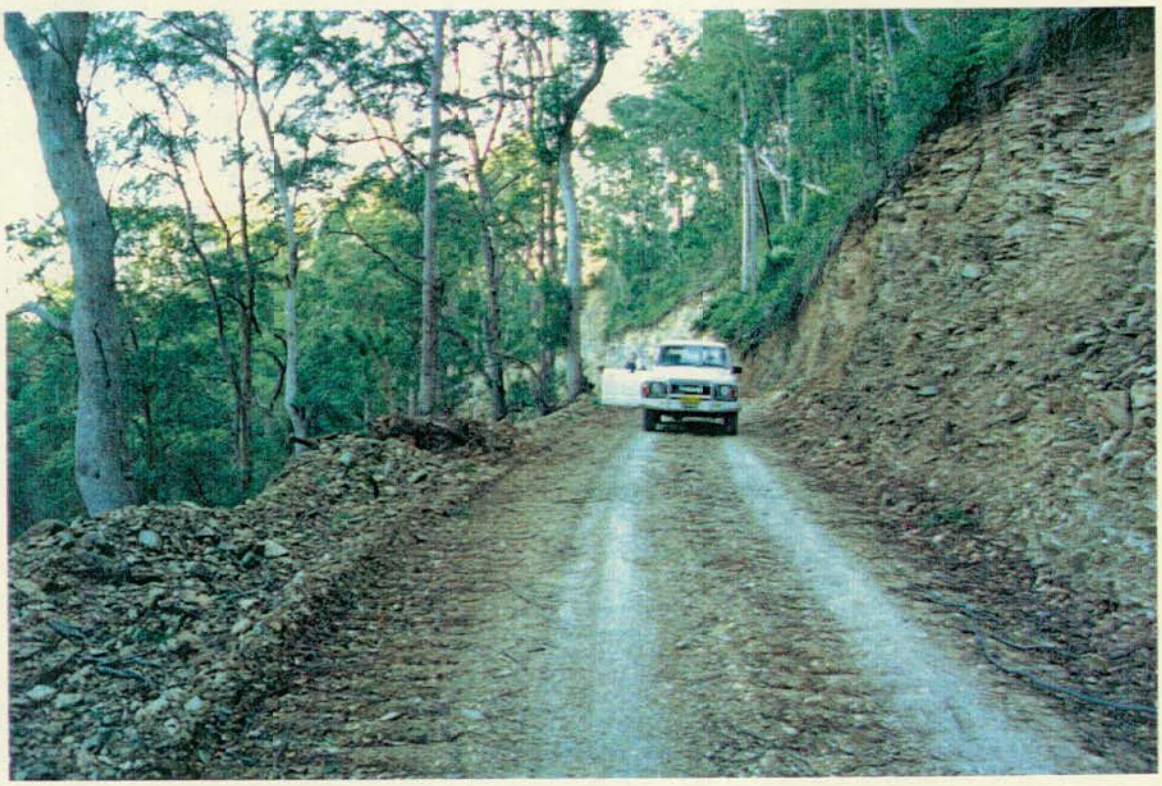
CATBIRD ROAD WITH SLIPS



CATBIRD ROAD AT 0.25kms
SLIP ON ROCK.

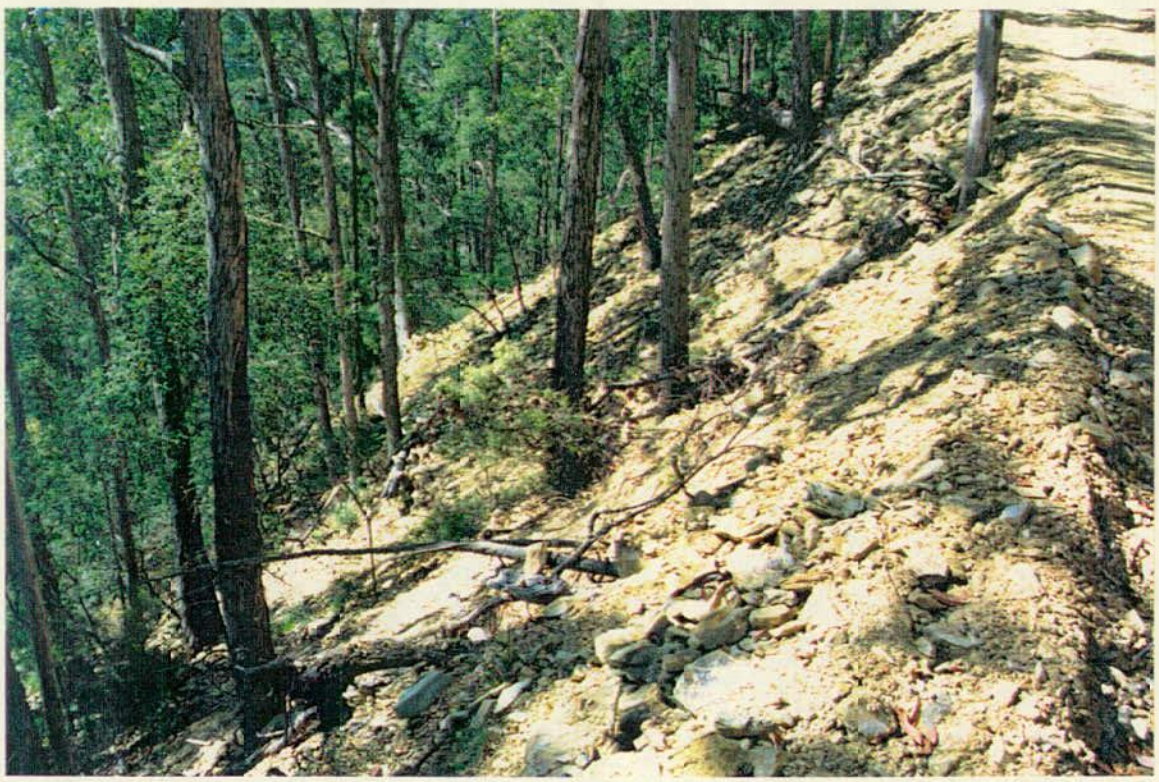


CATBIRD ROAD AT 0.9kms



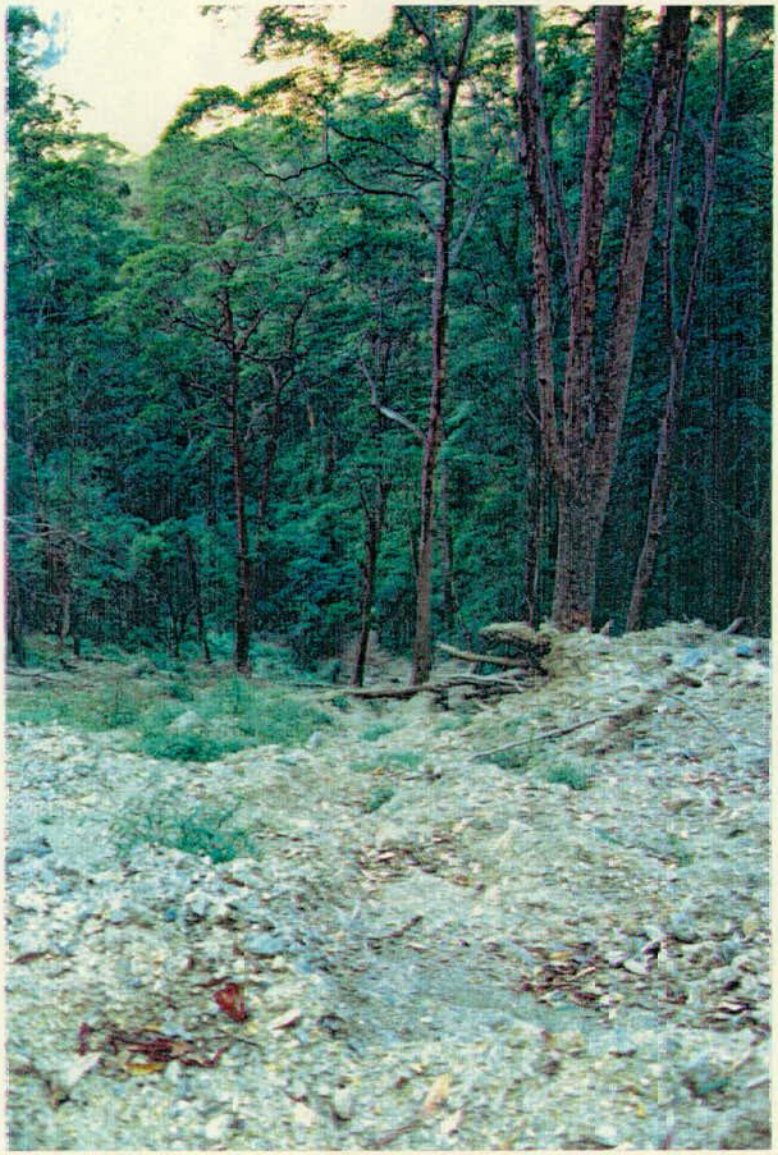
CATBIRD ROAD AT 2.6kms

CATBIRD ROAD WITH SLIP



CATBIRD ROAD WITH TALUS OVER THE EDGE AT 2.45kms.

CATBIRD ROAD WITH TALUS
AT 2.49kms



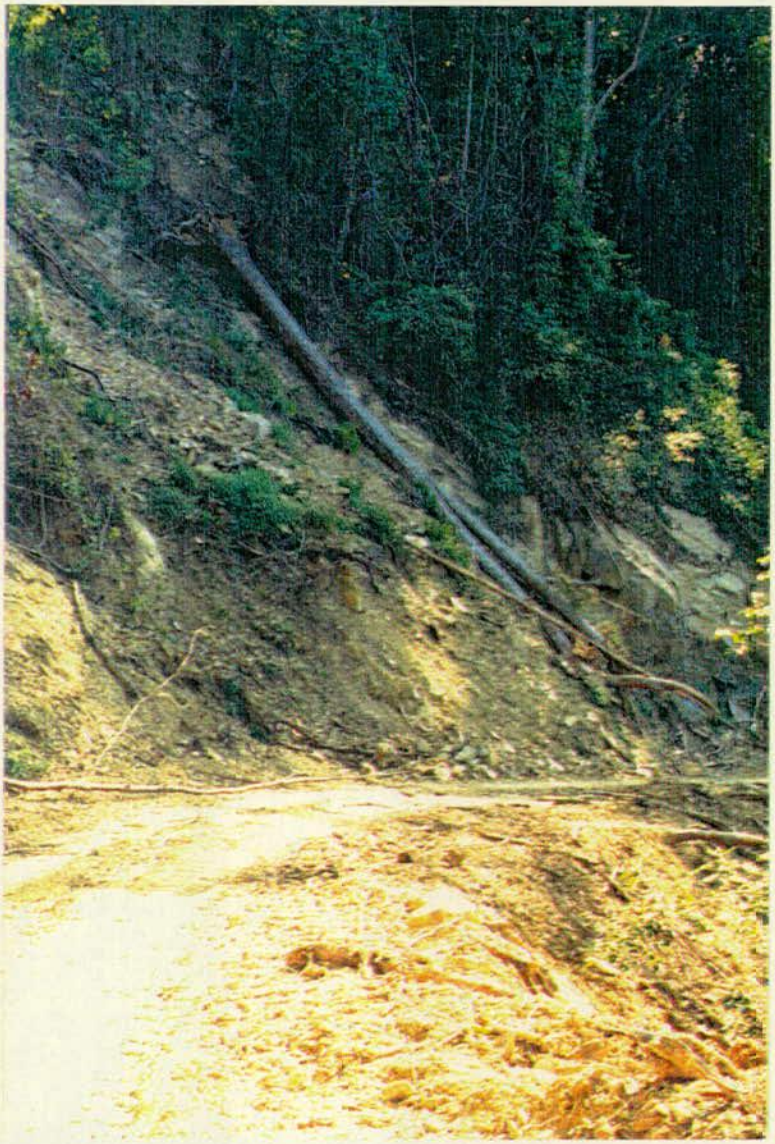
CATBIRD ROAD WITH TALUS
AT 4.17kms.

SLUMPS OF SNIG TRACK PAVEMENT.

CUT BATTER FAILURE ON SNIG TRACK SC1

CUT BATTER FAILURE ON SNIG TRACK SU5

CUT BATTER FAILURE
ON CATBIRD ROAD

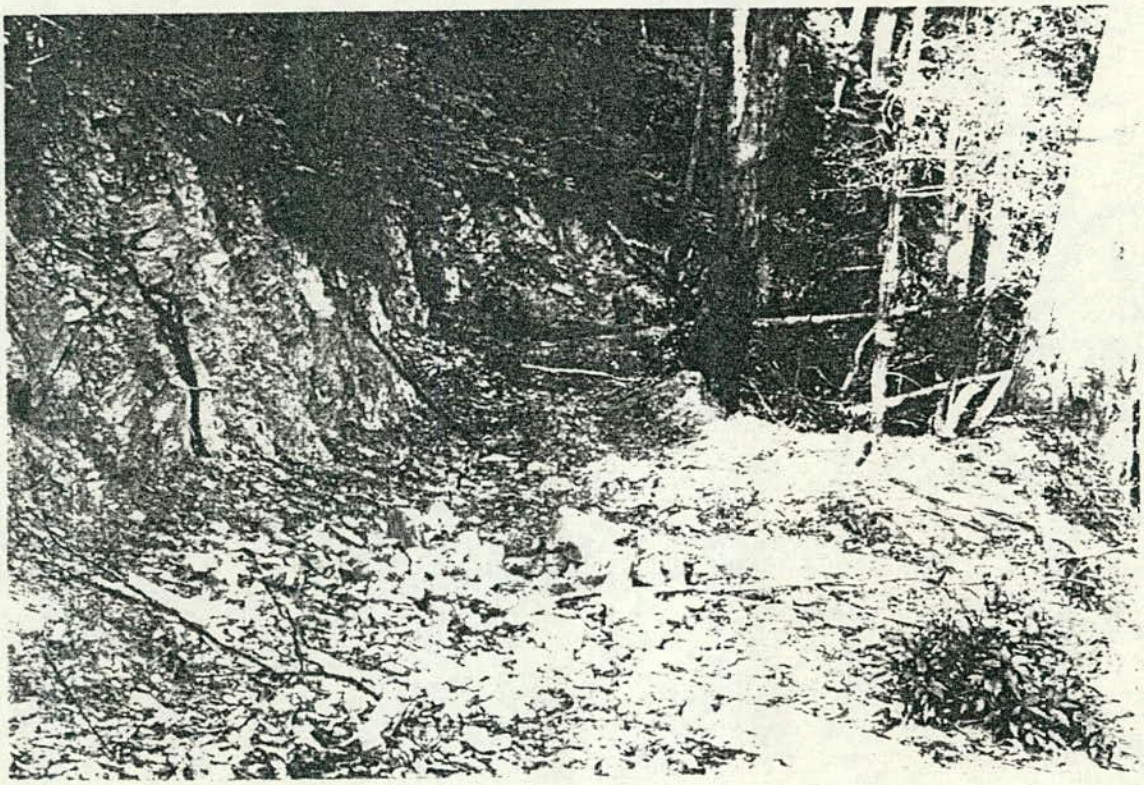


SIDECUT SNIG TRACK
WITH HIGH WINDROW
ON SC1

DEBRIS DOZED INTO PROTECTION STRIP ON SC7a

TREE DEBRIS BURIED ON LOG DUMP 7

SNIG TRACK SU5 FROM DUMP 5
STEEP SIDESLOPE, TRACK IMPEDED BY ROCK

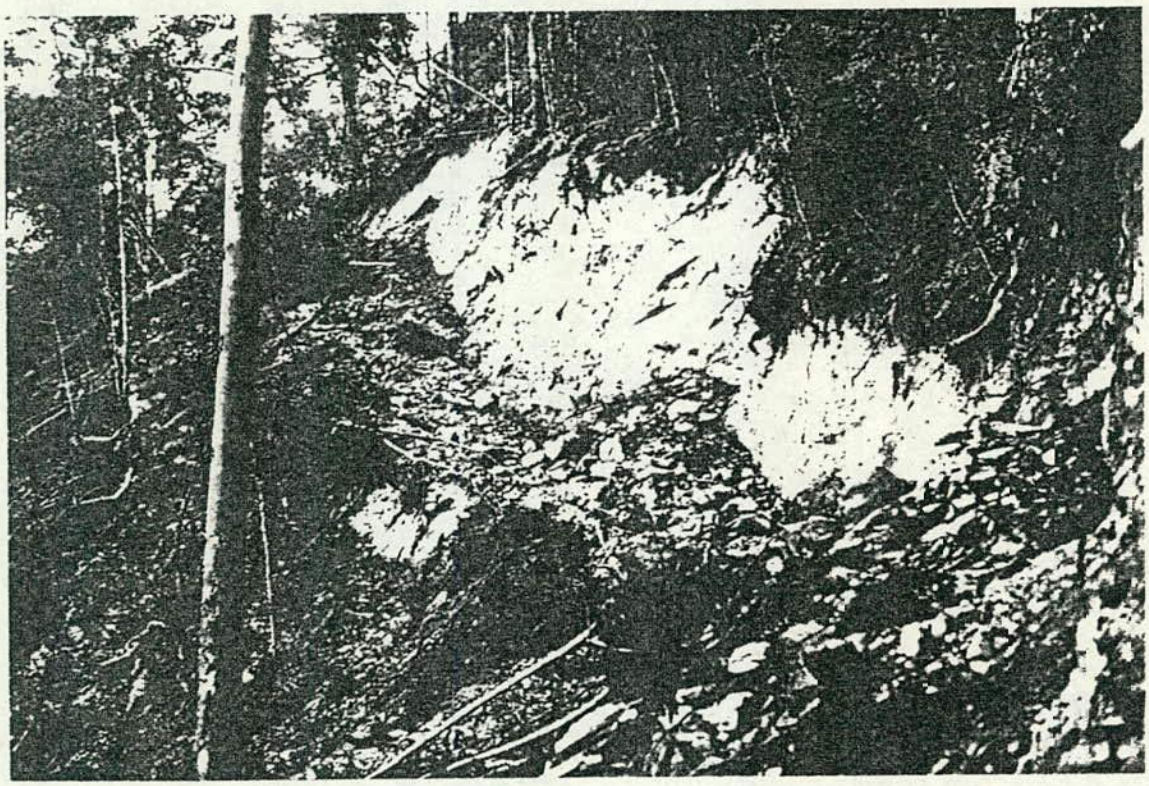


SNIG TRACK SU6
HIGH CUT BATTER AND HIGH WINDROW

LARGE CUT BATTER AND SLIP ON SNIG TRACK SU6 FROM DUMP 7 DOWNSLOPE.

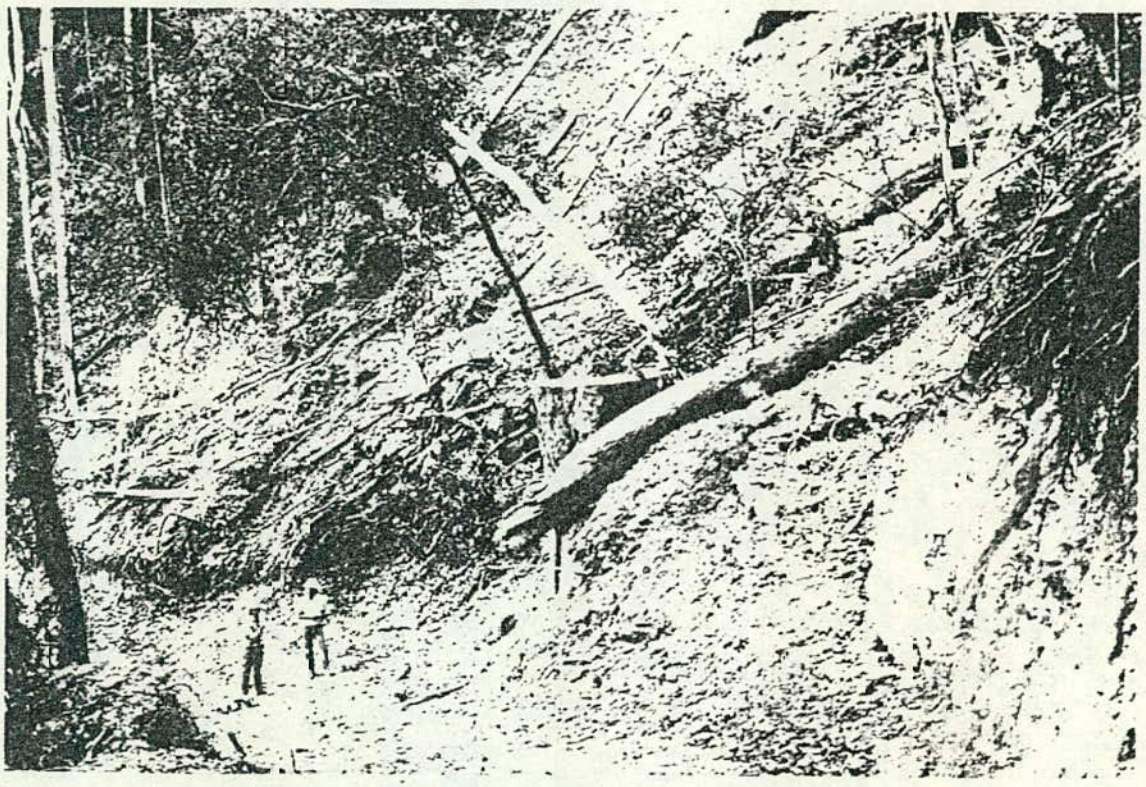
LARGE CUT BATTER AND SLIP ON SNIG TRACK SU6, FROM DUMP 7 UPSLOPE.

SLIP OF ROCK ON SNIG TRACK SU5 FROM DUMP 5 DOWNSLOPE.



SLIP OF ROCK ON SNIG TRACK SU5 FROM DUMP 5 UPSLOPE.

SLIP ON SNIG TRACK SU6 FROM DUMP 7
DOWNSLOPE. NOTE WINDROW

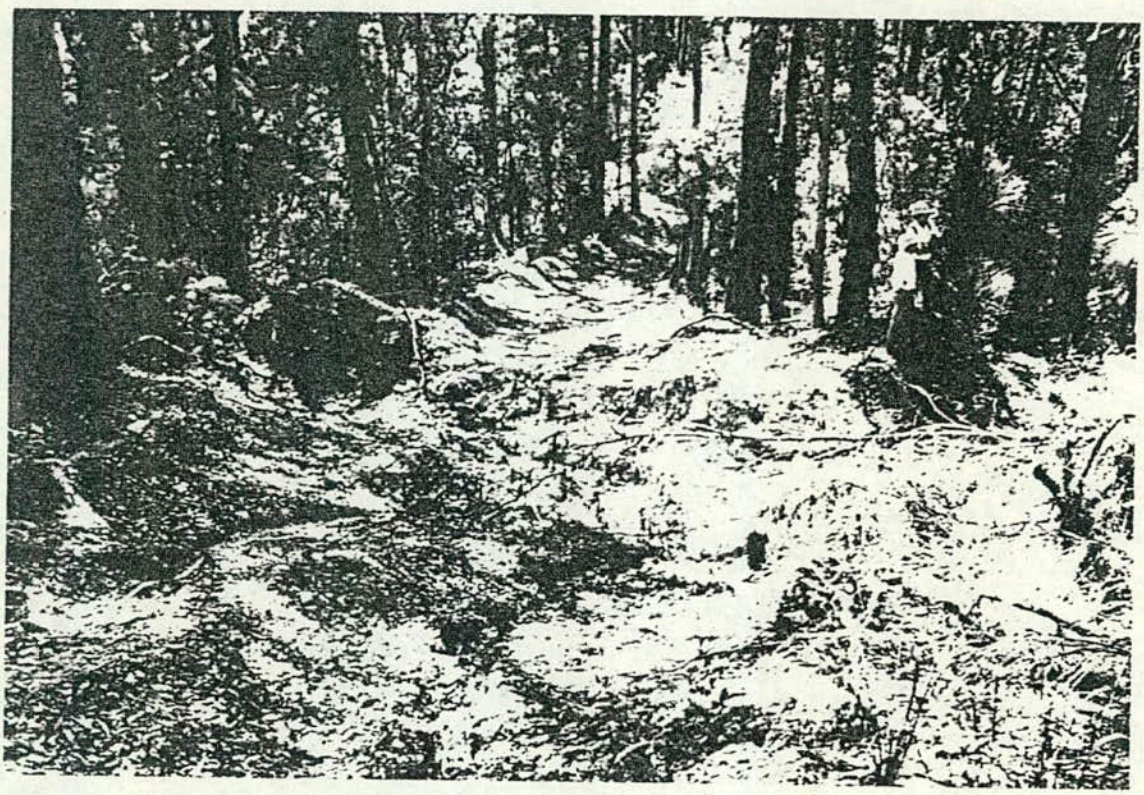


TALUS COVERED. SLOPE FROM CATBIRD ROAD TO
SNIG TRACK SC6 FROM DUMP 4

BOX CUT SIDECUT SNIG TRACK WITH HIGH WINDROW PREVENTING WATER EXIT. RILL ON WINDROW TOE.

BOX CUT RIDGE LINE SNIG TRACK
HIGH WINDROWS

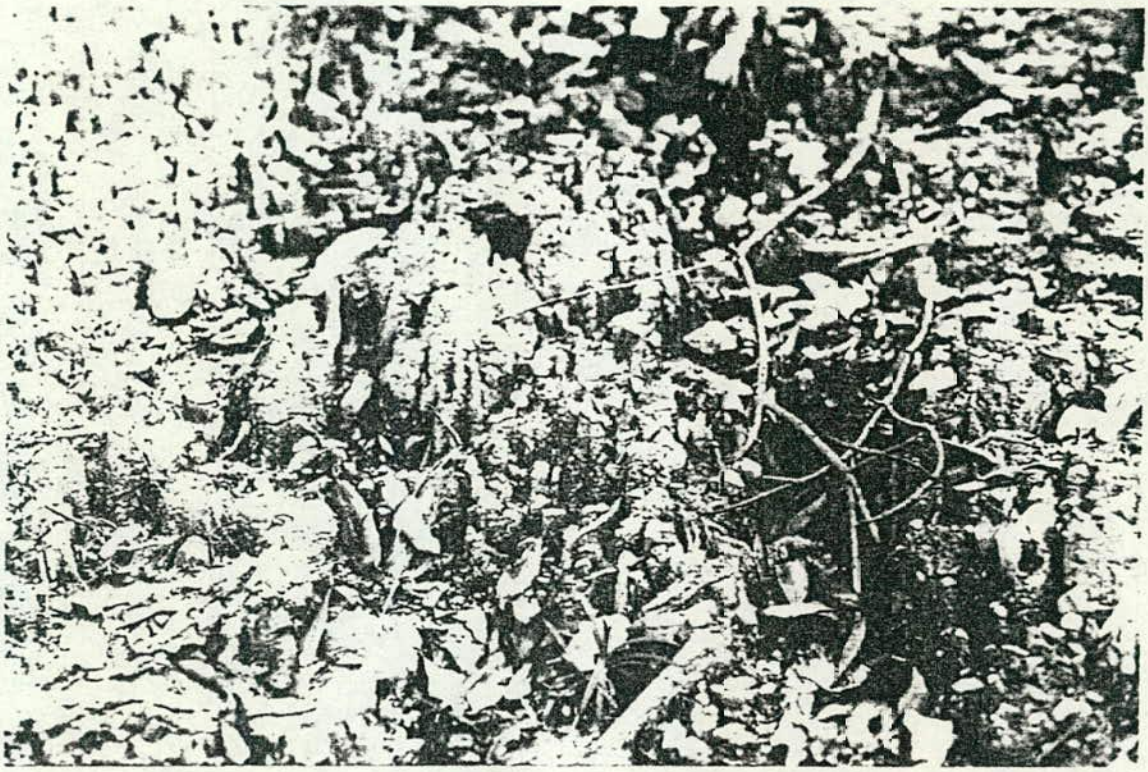
SIDECUT SNIGTRACK, UPSLOPE WITH HIGH WINDROW
AND DEEP RILL



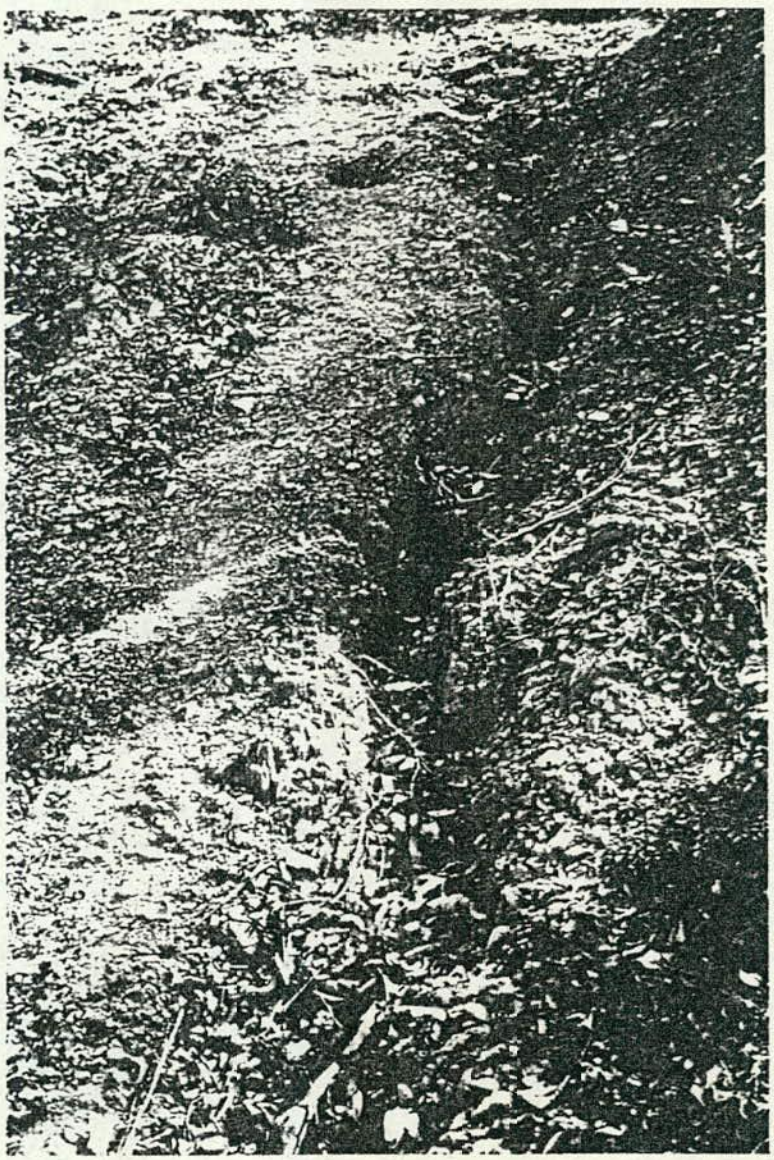
BOX CUT RIDGE LINE SNIG TRACK SC5 WITH INEFFECTIVE BANK.
TRACK RILLS FOLLOWING RIGHT BRANCH TRACK.

INEFFECTIVE BANK ON SIDECUT SNIG TRACK. RILLED DOWN TRACK AND THROUGH OUTLET.

SIDECUT SNIG TRACK RILLED AS ABOVE. HIGH WINDROW



PEDESTALS AND RILLS OF SNIGTRACK SURFACE. SOME RE-VEGETATION COMMENCED.

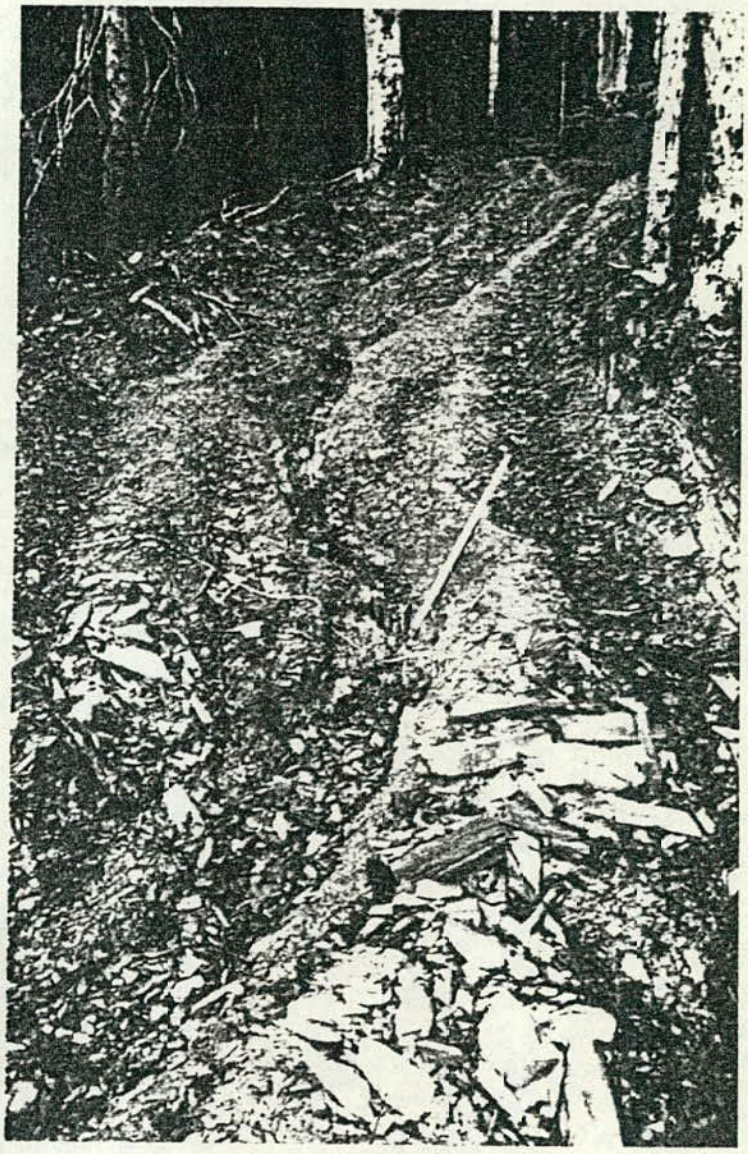


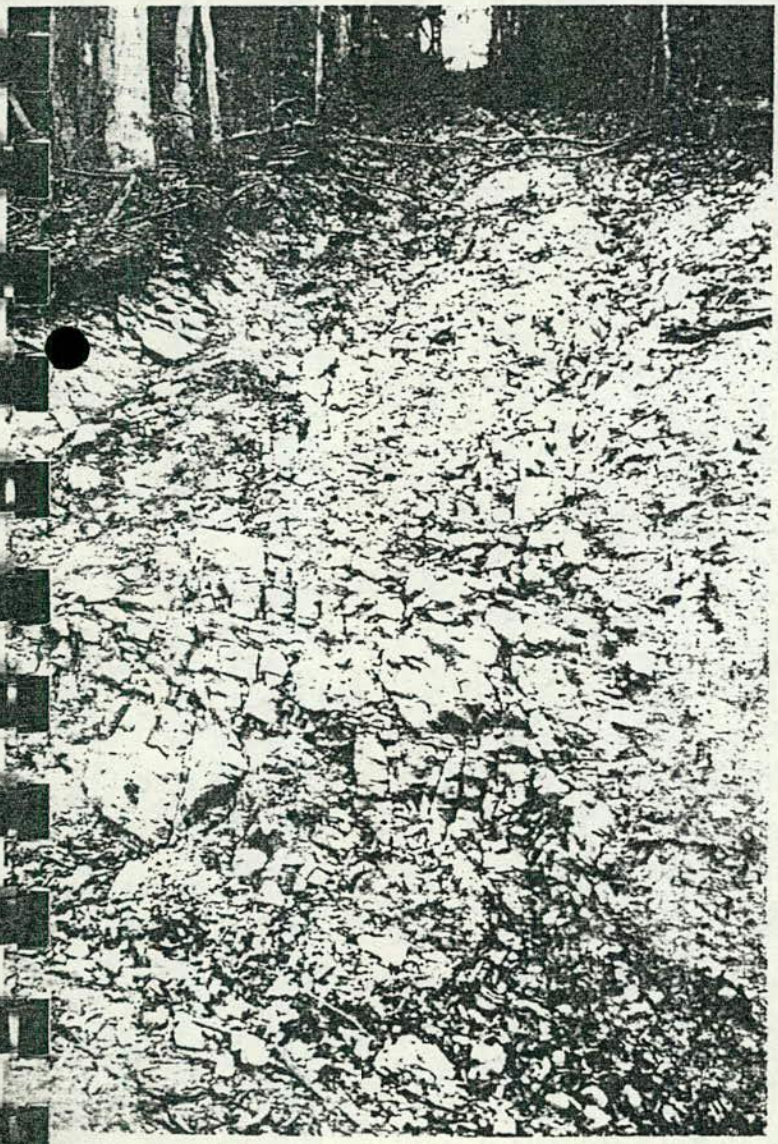
SIDECUT SNIG TRACK, RILLED TO 30cm. LEAF LITTER AND SOME RE-VEGETATION.

SIDECUT SNIG TRACK SU6 FROM DUMP 7
INEFFECTIVE BANK.

ERODED OUTLET ON CROSS BANK.

RIDGE SNIG TRACK,
NOT BANKED AND RILLED.





SNIG TRACK UPSLOPE FROM
CATBIRD ROAD EXCAVATED
TO ROCK, FINES GONE.

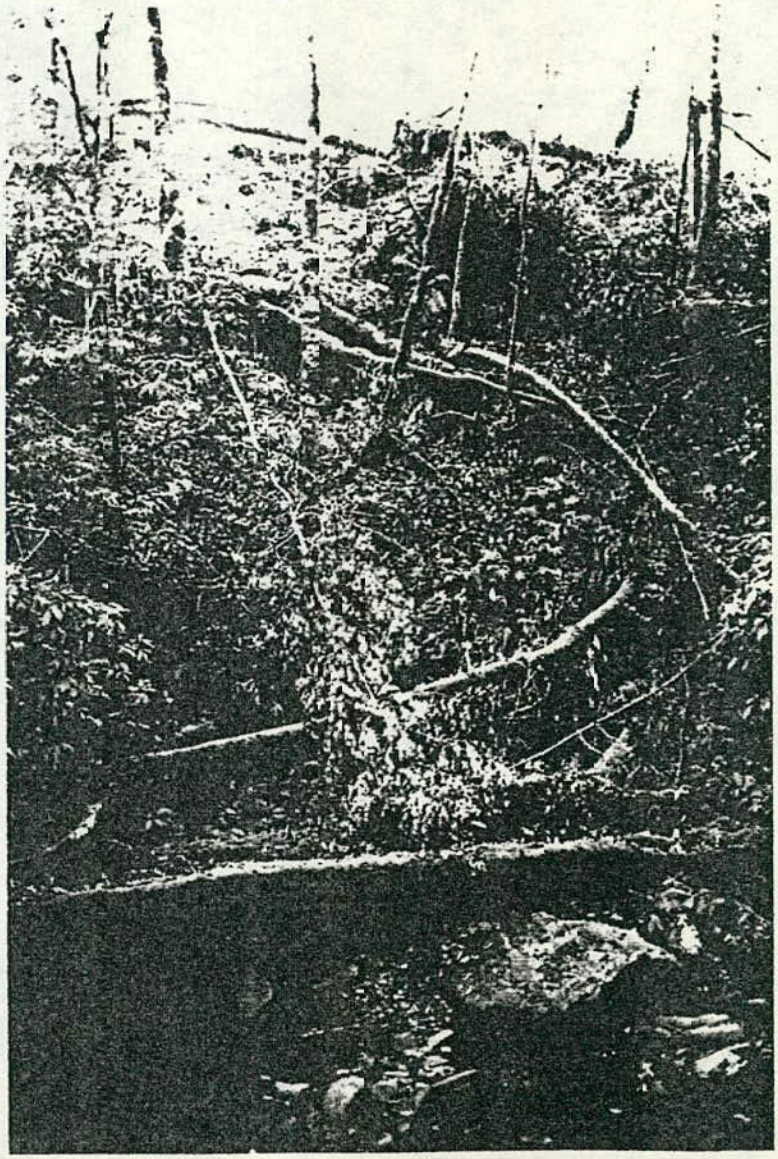
BOX CUT RIDGE TRACK SC5 HIGH WINDROWS AND RILLED.

BOX CUT RIDGE TRACK SC5 HIGH WINDROWS RILLED DOWN DOZER TRACKS.

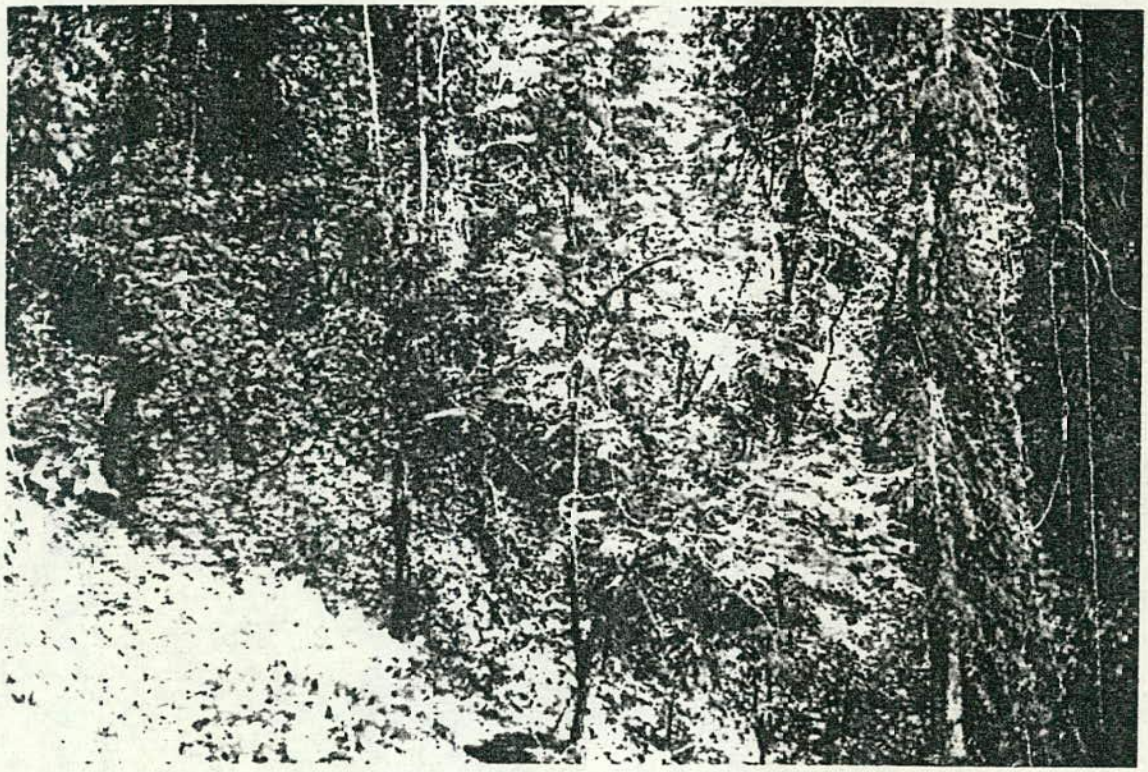
SNIG TRACK INTRUSION INTO FILTERSTRIP ON SUNDAY CREEK
DAMAGE TO COACHWOOD STAND.

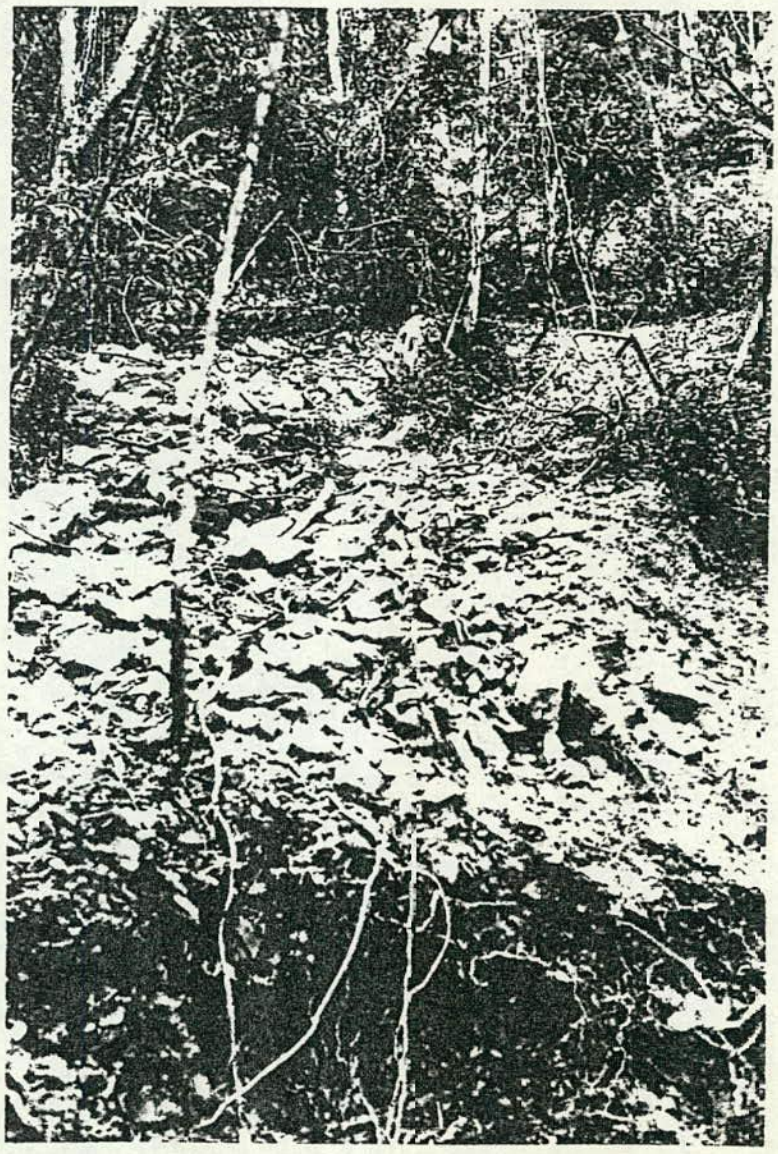
SNIG TRACK INTRUSION INTO FILTER STRIP ON
SCRAGGY CREEK.

SNIG TRACK INTRUSION INTO PROTECTION STRIP IN SCRAGGY CREEK CATCHMENT.

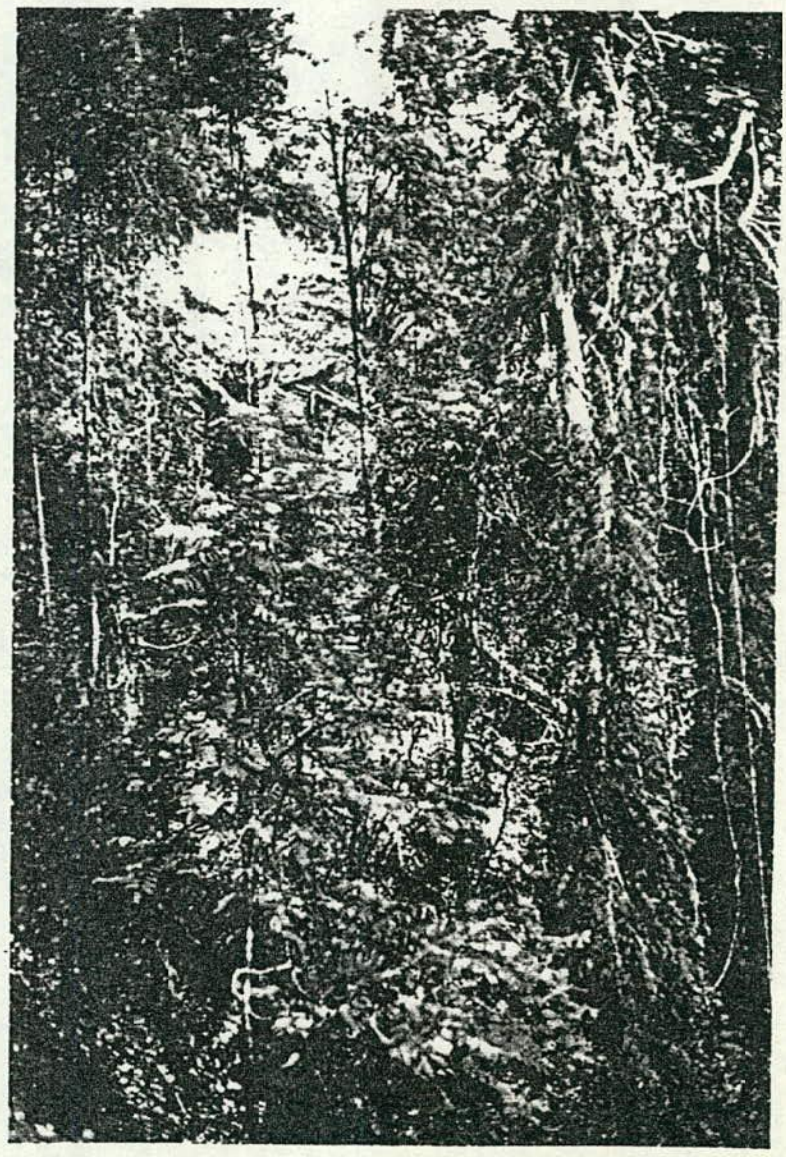


SNIG TRACK INTRUSION INTO FILTER STRIP ON SCRAGGY CREEK. TREE FELLED INTO CREEK.





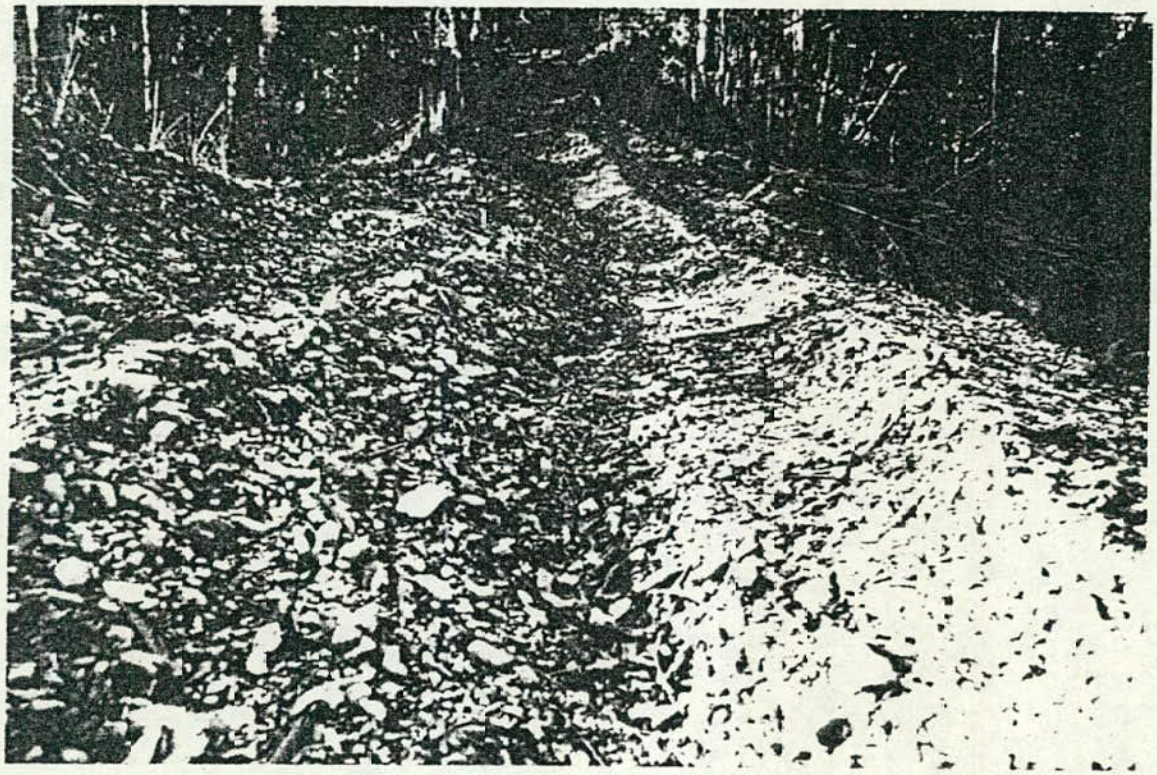
TALUS COVERED STEEP SLOPE
UNDER CATBIRD ROAD ABOVE
SNIGTRACK SC6



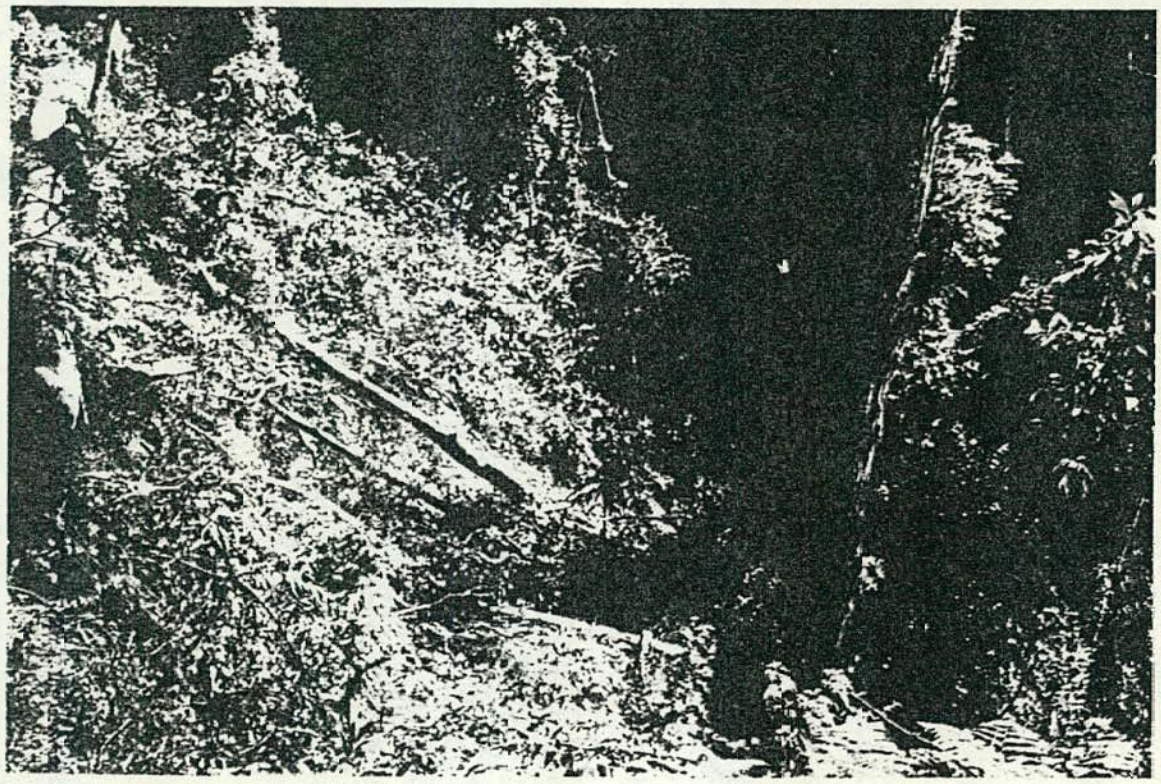
TALUS COVERED STEEP SLOPE UNDER CATBIRD ROAD ABOVE SNIGTRACK SC6.

CATBIRD ROAD AND DUMP 6. ILLUSTRATING LARGE TALUS COVERED SLOPE AND EXCAVATION.

RESHAPED DUMP 6 AFTER THE LOGGING EXTRACTION CEASED.

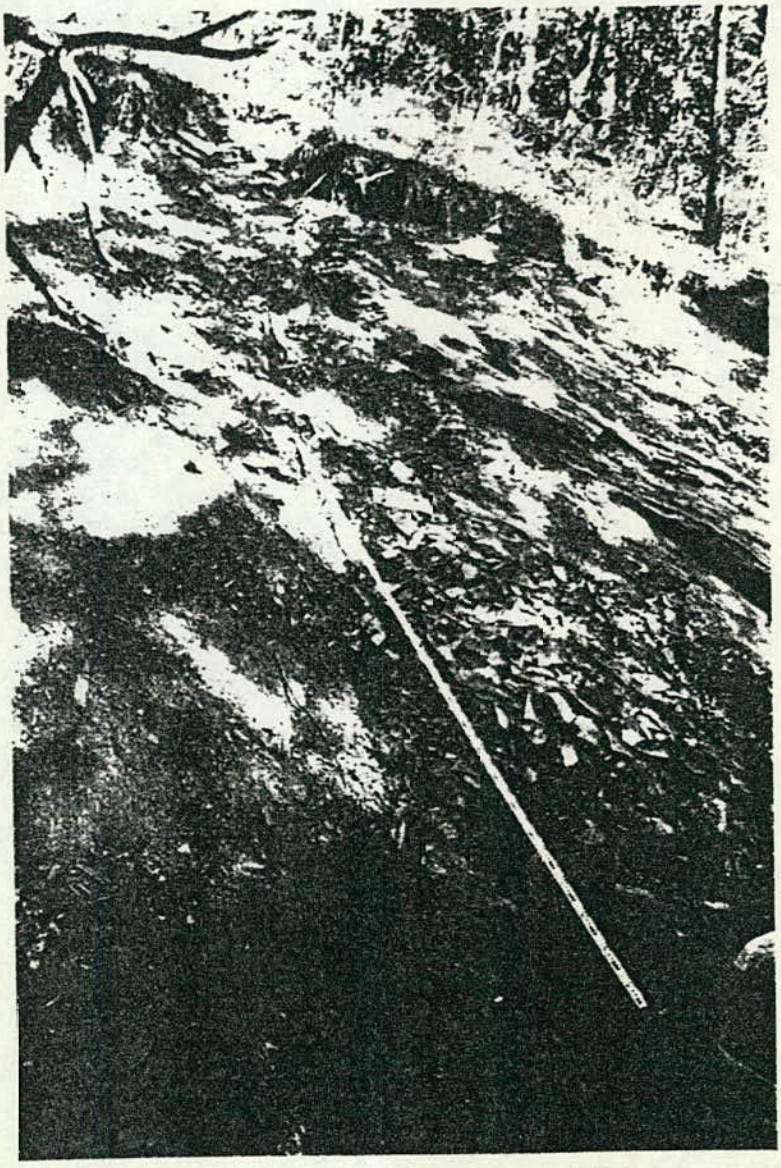


RIDGE SNIG TRACK WITH DEEP LOG SCOUR.

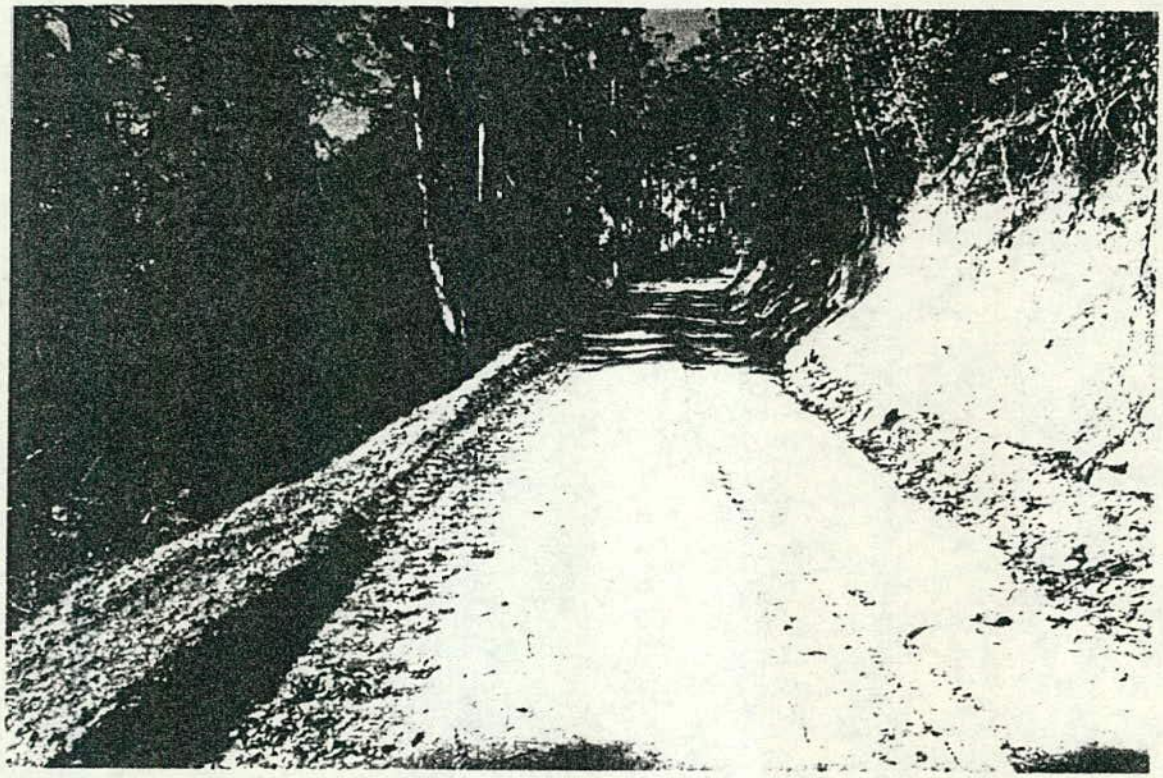


SNIG TRACK 7a INTRUDED INTO PROTECTION STRIP.

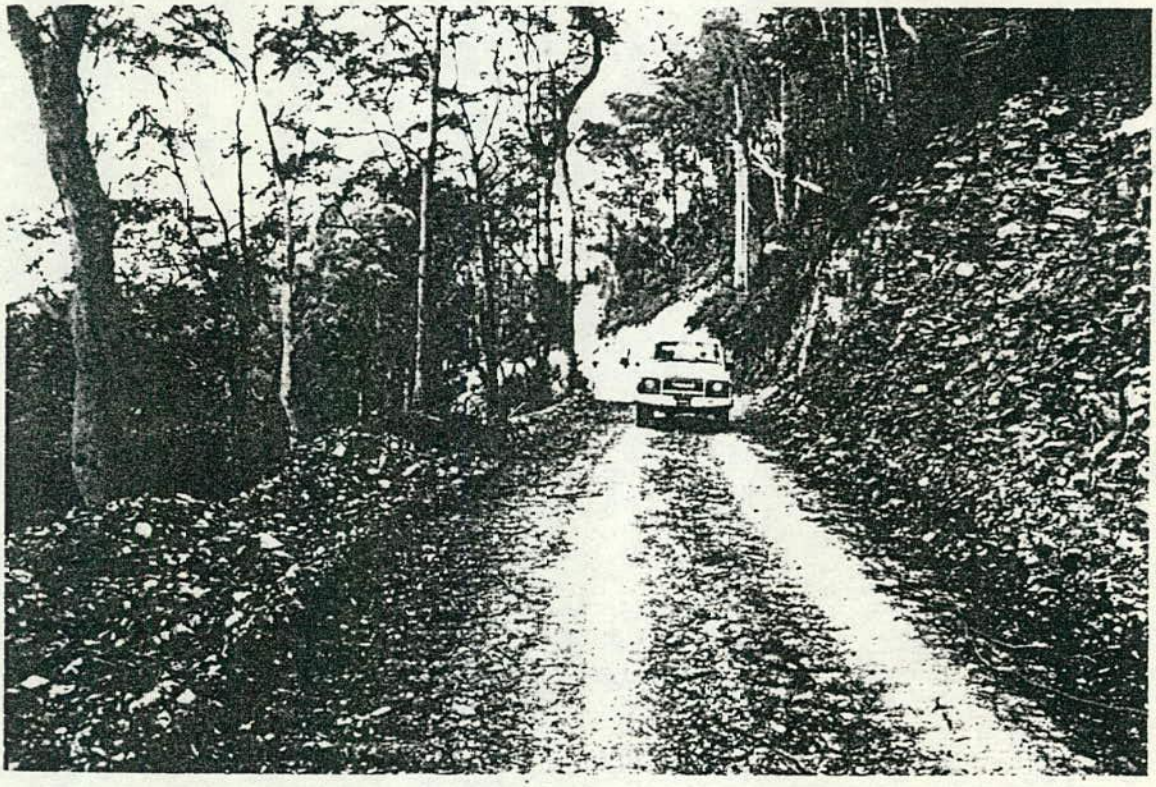
CATBIRD ROAD WITH SLIPS



CATBIRD ROAD AT 0.25kms
SLIP ON ROCK.

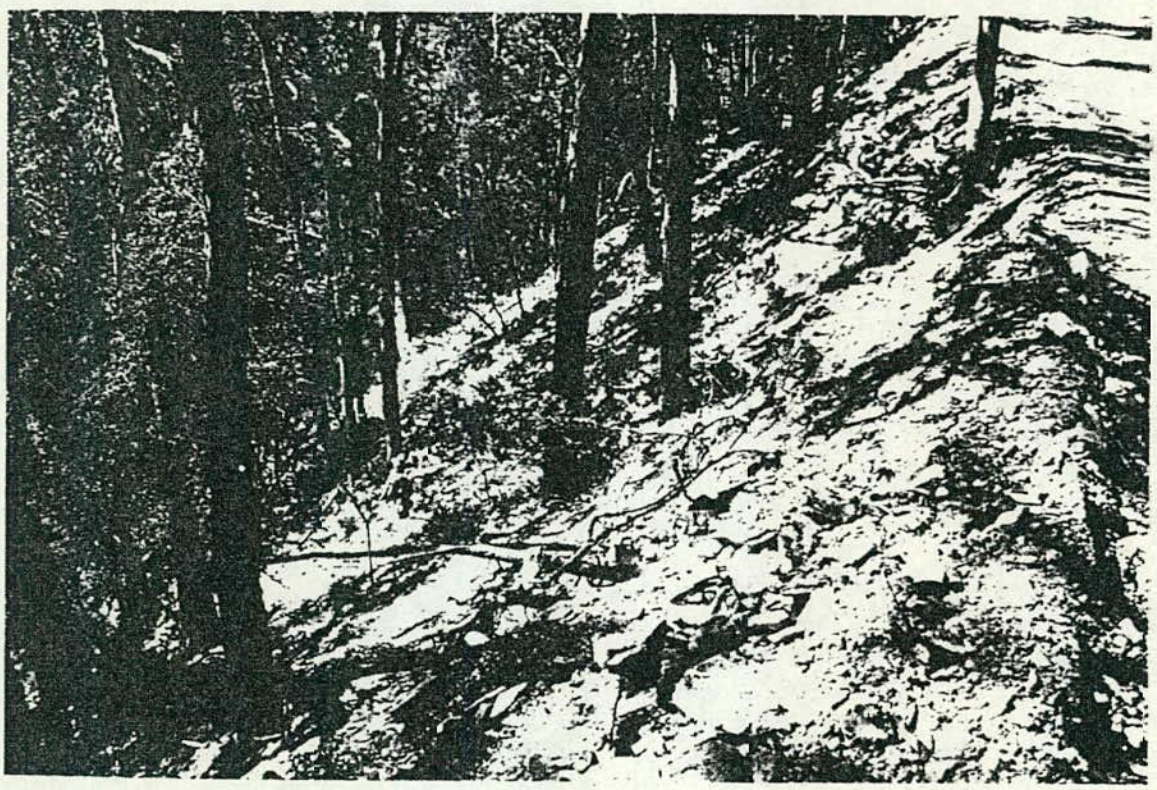


CATBIRD ROAD AT 0.9kms



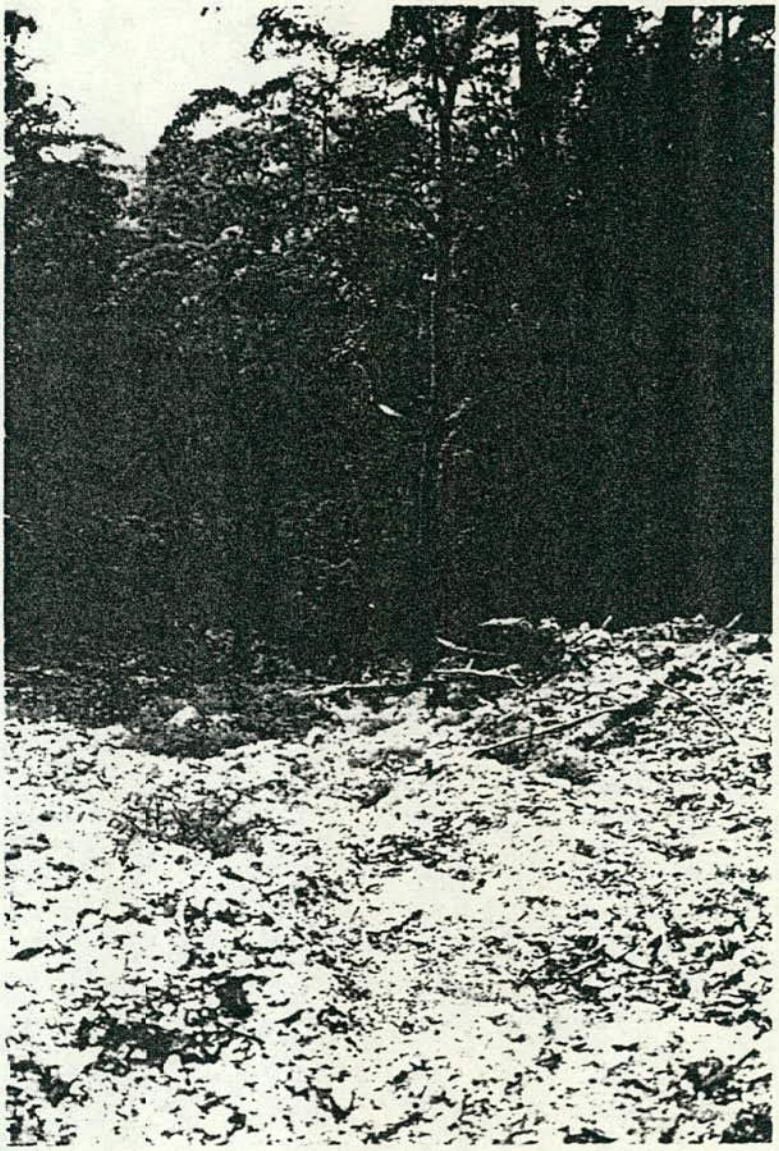
CATBIRD ROAD AT 2.6kms

CATBIRD ROAD WITH SLIP



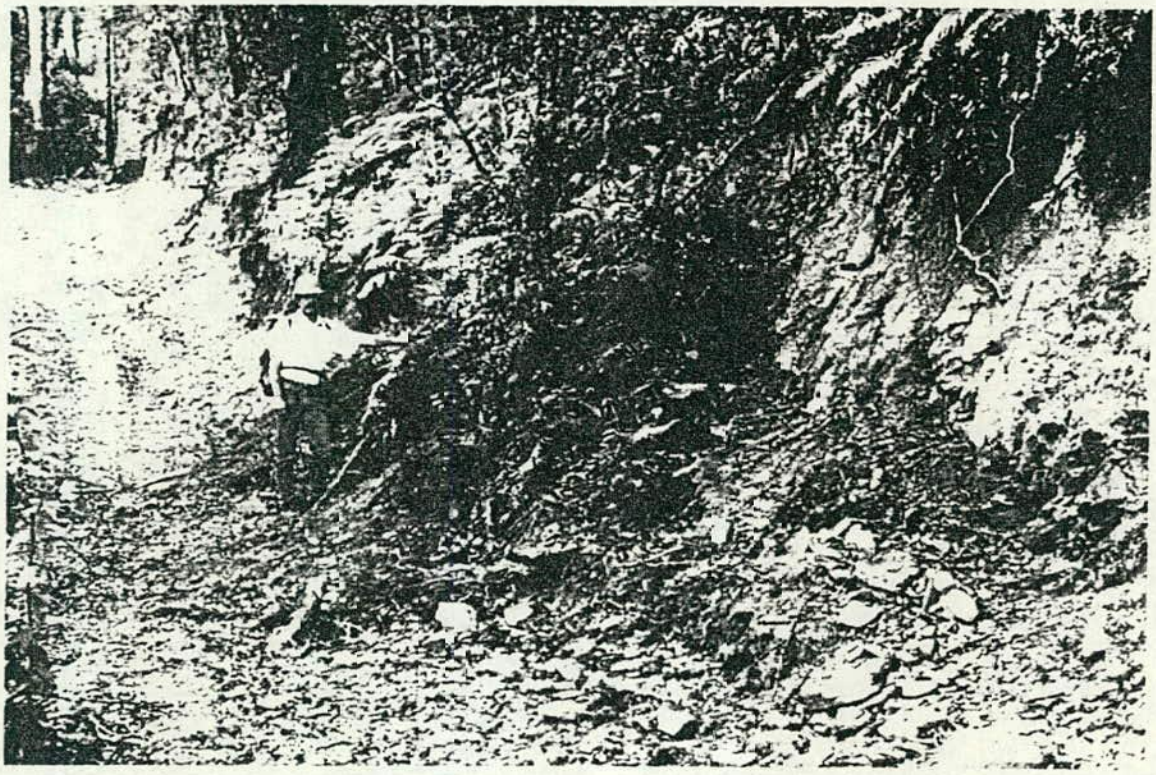
CATBIRD ROAD WITH TALUS OVER THE EDGE AT 2.45kms.

CATBIRD ROAD WITH TALUS
AT 2.49kms

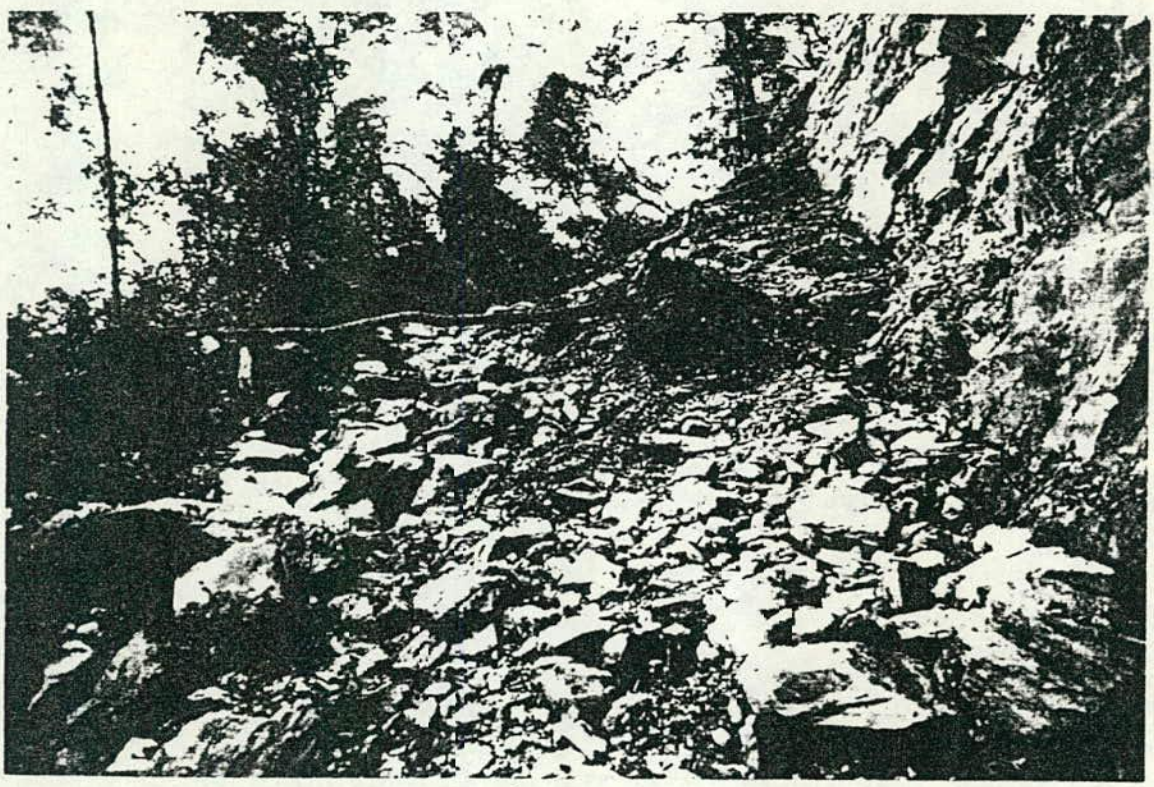


CATBIRD ROAD WITH TALUS
AT 4.17kms.

SLUMPS OF SNIG TRACK PAVEMENT.

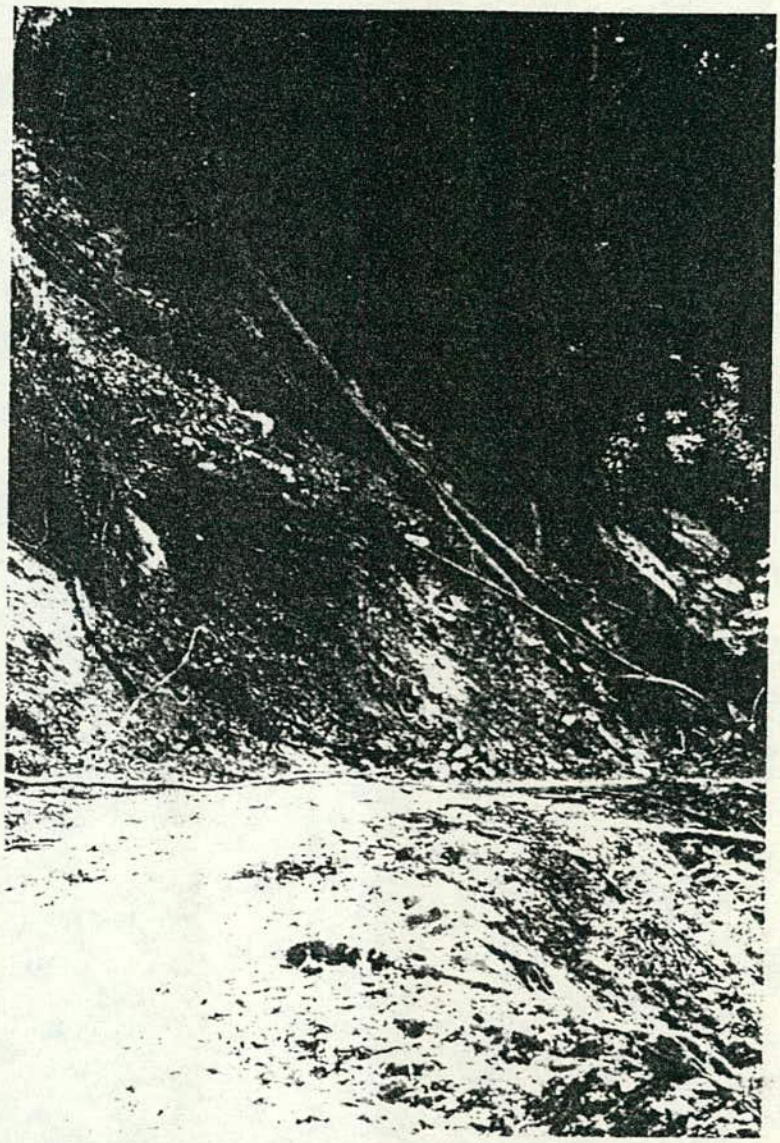


CUT BATTER FAILURE ON SNIG TRACK SC1

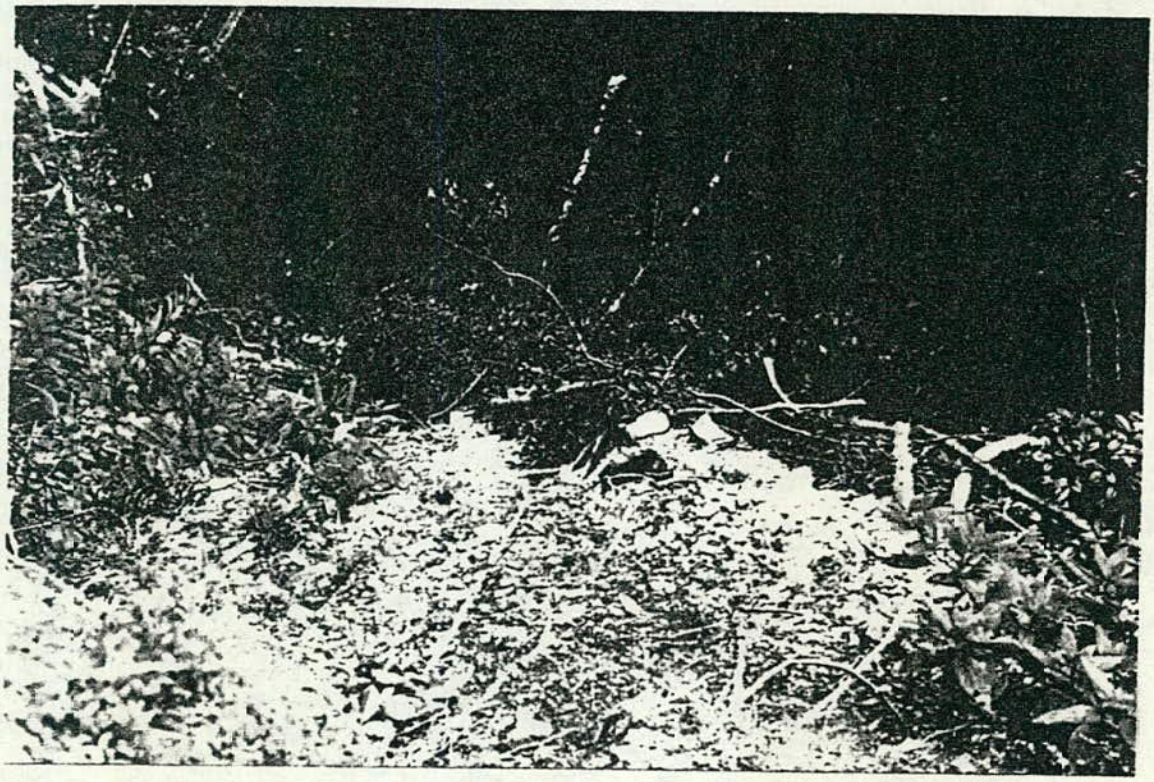


CUT BATTER FAILURE ON SNIG TRACK SU5

CUT BATTER FAILURE
ON CATBIRD ROAD



SIDECUT SNIG TRACK
WITH HIGH WINDROW
ON SC1



DEBRIS DOZED INTO PROTECTION STRIP ON SC7a

TREE DEBRIS BURIED ON LOG DUMP 7