SLOPE EROSION TRANSECTS
LAKE TAHOE BASIN

71-06

INTERIM REPO

July, 1971

STATE OF CALIFORNIA

BUSINESS AND TRANSPORTATION AGENCY

DEPARTMENT OF PUBLIC WORKS

DIVISION OF HIGHWAYS

MATERIALS AND RESEARCH DEPARTMENT

RESEARCH REPORT

NO. M & R 657078-1

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STATE OF CALIFORNIA—TRANSPORTATION AGENCY

RONALD REAGAN, Governor

DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
MATERIALS AND RESEARCH DEPARTMENT
5900 FOLSOM BLVD., SACRAMENTO 95819

July, 1971

Interim Report
No. M&R 657078

Mr. W. L. Warren
District Engineer

Dear Sir:

Submitted herewith is a report titled:

SLOPE EROSION TRANSECTS

LAKE TAHOE BASIN

Study Made By	Environmental Improvement Section
Under General Direction of	John Skog
Work Supervised By	Earl Shirley
Field Investigation By	Richard Howell
Report By	Richard Howell
Field Assistance	Donald Foster

Very truly yours,

JOHN L. BEATON
Materials and Research Engineer

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ABSTRACT

During June 1971, slope erosion transects were taken on state highway cut and fill slopes located within the Lake Tahoe Basin. The purpose of the transects was to identify the watersheds in the basin where erosion of state highway slopes was significant and where corrective action to reduce erosion should be concentrated.

The survey consisted of determining the annual quantity of erosion from slopes along State Highways 50, 89, 28 and 267. The quantity of sediment reaching streams and available for transport was also estimated.

Results of the transect surveys show that 96 percent of the annual highway slope erosion comes from 17 watersheds. These same 17 watersheds account for 94% of the highway slope sediment reaching streams and available for transport.

Approximately six watersheds of the 17 contain highway slopes undergoing major erosion. The six are:

Watershed	Location
44C Upper Truckee River	Old Meyers Grade
44D Grass Lake Creek	03-ED-89
58 Quail Lake	03-Pla-89
49A Unnamed (Emerald Bay)	03-ED-89
49B Eagle Creek (emerald Bay)	03-ED-89
49C Unnamed (Emerald Bay)	03-ED-89

The findings represent a relative relationship of slope erosion between watersheds. Refined erosion data will require supplementary measurements in the field.

KEYWORDS

Erosion, sedimentation, cuts, measurements.

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INTRODUCTION

Erosion of cut and fill slopes on State Highways 50, 89, 28 and 267 located within the Lake Tahoe Basin has been a source of sediment reaching lake waters. Various agencies studying eutrophication at Lake Tahoe, have cited the need for reducing sediment sources. It has been reported the sediment is a major source of nutrients now reaching the Lake.

The Division of Highways is in the process of developing programs that will reduce sedimentation from highway slope erosion in the Basin. The program will consist of slope improvement measures to be implemented within watersheds identified as being major sources of sediment contribution.

The purpose of taking slope erosion transects is to identify the watersheds where significant highway slope erosion is occurring and where improvement programs should be instituted to reduce the erosion and subsequent sedimentation.

CONCLUSIONS AND RECOMMENDATIONS

The slope erosion transects show that 96 percent of the highway slope erosion is attributable to 17 watersheds. Approximately 94 percent of the sediment from highway slopes reaching streams and available for transport comes from these 17 watersheds.

The 17 watersheds are divided into four groups according to the significance of their contribution. Each group represents approximately the following percentages of the 96 and 94 percent:

Group	% Annual Erosion Rate	% Sediment Reaching Stream
1	71.5	71.7
2	16.5	20.6
3	9.5	3.7
4	2.5	4.0
	100.0	100.0

The 17 watersheds according to Group are as follows:

Group 1

Watershed	Location
44C Upper Truckee River	Old Meyers Grade
44D Grass Lake Creek	03-ED-89
58 Quail Lake	03-Pla-89
49A Unnamed (Emerald)	03-ED-89
49B Eagle Creek (Emerald)	03-ED-89
49C Unnamed (Emerald)	03-ED-89

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Group 2

Watershed	Location
50 Unnamed	03-ED-89
5 Dollar Creek	03-Pla-28
47 Tallac Creek	03-ED-89

Group 3

Watershed	Location
10B Snow Creek	03-Pla-267
44C Upper Truckee River	03-ED-50
48 Cascade	03-ED-89
51 Rubicon Creek	03-ED-89

Group 4

Watershed	Location
63 Ward	03-Pla-89
54 Rubicon Units	03-ED-89
55A Meeks Creek	03-ED-89
55B Unnamed	03-ED-89

The survey procedures used to develop the estimated annual slope erosion quantities represent subjective interpretation. Signatures of various slope erosion indices, such as, differential coloration on exposed rock surfaces, plant root exposure, accumulation of sediment at toe-of-slope, pine needles buried in sediment, measurement of gully erosion, etc., were all used to interpret the annual quantity of slope erosion. A Comparison of slope erosion per mile of slope presented a relative condition to identify the major sources of sedimentation.

Recent construction activities along highway shoulders interfered with slope erosion estimates in areas near Tahoe City.

It is recommended that the findings of this study be utilized in the developement of an improvement program to reduce highway slope erosion in the Tahoe Basin.

OBJECTIVE

The purpose of the slope erosion transects is to identify the watersheds in the Tahoe Basin where erosion of State Highway slopes is significant and where corrective action to reduce erosion should be concentrated.

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METHOD OF INVESTIGATION

Slope erosion transects were conducted on State Highways 50, 89, 28 and 267 in the Tahoe Basin. In addition, the Old Meyers Grade was also included. A total of five days was used to conduct the field investigation over approximately 64 miles of state highways. About 193 slopes were analyzed.

In conducting the investigation, the post mile limits of the cut or fill slope under study were recorded and the area of the slope undergoing erosion computed. A Brunton-Style Compass was used to determine the average slope angle. On many slopes, the configuration was too irregular because of extreme erosion or protrusion of rocks to record an average slope angle. In these cases, the angle was noted as VAR (variable).

The aspect of the slope was determined (north facing, south facing, east facing or west facing). In the Tahoe Basin, the slope aspect has importance insofar as exposure to the sun, temperature, time period of extreme climatic conditions such as snow cover, and type of vegetation covering slopes are concerned.

In estimating the quantity of eroded material from a slope, a dual procedure was used. First, an estimate of the amount of erosion occurring over an annual period was made. This involved probing the slope surface for evidence of annual movement of material over the slope. In the Alpine environment, a common signature is pine needles. Frequently, pine needles were found buried under fractions of an inch of loose slope material. A change in the color of the needle from bright yellow (first year) to deep black (third or fourth year) gave an indication of the annual rate of sediment deposition. Exposure of fresh plant roots of vegetation also was used to determine annual rates of erosion as was the occurence of coloration on rocks and boulders in the slope as material was eroded. Skewness of the main stem on woody plant specimens also gave clues as to the movement of material down-slope.

In some cases, Maintenance forces removed deposited slope eroded material to disposal areas. A quick check of quantities at the disposal site also gave an indication of annual quantities of material from slopes.

The second procedure followed was to determine the amount of erosion occurring over a long period of time. Such a period might be anywhere from two to 15 years. The longer term periods such as 10 or more years are very difficult to ascertain and much reliance must be made on as-built plans, maintenance records, and memories of personnel working in the area. Long term erosion quantities were then reduced to

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average annual rates for comparison with the annual rates as determined under the first procedure. Sometimes, the two annual quantities were of the same order of magnitude which probably indicates a stabilized erosion rate. Other times, the annual rate was lower than the average annual rate which indicates initial erosion on the slope was extreme. The third case found is where the annual erosion rate was higher than the average annual rate which indicates changing conditions are accelerating the erosion on the slope. In the third case, it is important to look for the factors causing the accelerated erosion and perhaps to instigate remedial action to reduce the erosion. In most cases where this condition occurred, the cause was related to recent construction activity near or on the slope, such as the sewer line construction.

The over-hang near the top of a cut slope was frequently observed to assist in developing the long term erosion quantity. Clumps of rooted vegetation were also noted at the top of cuts and provided a good indication of former slope profile.

In addition to estimating the long term erosion quantities and the annual erosion rates, the quantities of material reaching drainages tributary to Lake Tahoe were also estimated. The normal procedure to determine these quantities is to proceed from the erosion source to the drainage facility and walk the drainage to its confluence with a stream tributary to the Lake. Streambank erosion quantities can be estimated as one performs this function.

However, this procedure was modified in the determination of sediment quantities reaching streams and available for transport because streambank erosion was not a concern and time was of the essence.

The modified procedure used was to follow the sediment to a highway drainage facility, identify the discharge location, and visually follow the drainage to the nearest stream tributary.

For highway slopes located away from major stream tributaries, it was found in several cases that none of the sediment reached the stream. Deposition over the natural terrain occurred in these cases. As slope location approached closer to the stream tributaries, the percentage of sediment reaching the streams increased from 1 to 10 percent. On the other extreme, several locations of highway slopes are adjacent to Lake Tahoe and the sediment issuing from eroding road slopes had very little difficulty reaching the Lake. These percentages ranged from 50 to 100 percent reaching streams or the Lake.

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An interesting condition was observed in some instances. As eroded material reached the base of a cut slope along the highway, the maintenance procedure was to scoop the material up and carry it across the road and dump it along the shoulder (shoulder build-up process). However, in some cases the fill slope was located adjacent to a stream tributary and thus as raindrop impact started to erode the stock-piled material, the sediment was transported directly into the tributary. The sediment to stream rate in these cases was greatly accelerated.

SLOPE TRANSECT RESULTS

The estimates of the slope erosion transects are reported in Table 1. In order to compare one watershed to another, it was necessary to determine the rate of erosion by mile of slope and by mile of highway in the watershed.

In Table 1, the watersheds are ranked according to the annual rate of erosion (cubic yards per year) for the 1970-71 period. The Long-Term column signifies the estimate of erosion for several years expressed as an average annual rate. The columns headed CY/Mi.-Slope/Yr. indicate the erosion rate per mile of slope in the watershed, and the CY/Mi.-W.S./Yr. indicates the erosion rate per mile of road in the watershed. The rate displaced is given under DISPL and the rate reaching streams and available for transport is given by STR.

Due to recent construction of a sewage line along the highway slope in 03-Pla-89, it was difficult to estimate erosion rates for watersheds such as Madden (60), Unnamed (60A), Unnamed (61), and Blackwood (62). Consequently, the erosion rates are recorded as zero although there has been erosion on the slopes. It is recommended that observance of these slopes be maintained over the next several years to confirm their erosion resistance.

The erosion rates reported for watersheds 49A, B and C, which are located near Emerald Bay, do not reflect quantities of the slide material itself.

INTERPRETATION OF RESULTS

From Table 1, it appears there are 17 watersheds that should receive immediate attention for corrective action to reduce highway slope erosion and subsequent sediment contribution to Lake Tahoe. These areas are broken down into four major groups, with Group 1 receiving highest priority.

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TABLE 1

EROSION RATES FROM SLOPE EROSION TRANSECTS

WATERSHED	ROUTE	NO.	1970-71 CY/YR DISPL	1970-71 CY/YR STR	LONG TERM CY/YR DISPL	LONG TERM CY/YR STR	1970-71 CY/MI - SLOPE/YR DISPL	1970-71 CY/MI - SLOPE/YR STR	1970-71 CY/MI - WS/YR DISPL	1970-71 CY/MI - WS/YR STR
Grass Lake Cr.	03-ED-89	44D	297	115	303	122	231	90	107	41
Upper Truckee R.	Old Meyers	Grade	237	22	604	51	252	23	158	15
Unnamed (Emerald)	03-ED-89	49A	126	82	140	91	185	120	105	68
Quail Lake	03-Pla-89	58	79	55	54	38	292	203	120	83
Unnamed	03-ED-89	50	76	46	76	35	98	59	98	45
Unnamed (Emerald)	03-ED-89	49C	65	15	20	5	231	54	66	15
Tallac	03-ED-89	47	60	4	219	6	61	4	29	2
Snow (Hwy. 267)	03-Pla-267	10B	60	6	34	3	33	3	19	2
Dollar	03-Pla-28	5	54	39	137	67	80	57	93	67
Upper Truckee R.	03-ED-50	44C	35	6	24	4	21	4	11	2
Eagle Creek	03-ED-89	49B	21	20	38	24	160	154	20	19
Upper Truckee R.	03-ED-89	44C	17	1	7	1	41	2	4	.2
Cascade	03-ED-89	48	10	1	48	3	27	2	10	1
Ward	03-Pla-89	63	9	7	96	33	11	9	3	2
Unnamed	03-Pla-28	6	9	5	7	3	18	10	6	4
Rubicon Units	03-ED-89	54	9	7	41	22	9	8	6	5
Meeks	03-ED-89	55A	8	2	44	19	17	5	6	2
Unnamed	03-Pla-28	3	7	4	7	3	41	23	15	9
Carnelian	03-Pla-28	9A	5	1	6	1	42	8	6	1
Unnamed	03-Pla-28	9B	5	4	5	4	15	13	4	3
Rubicon Cr.	03-ED-89	51	5	3	23	5	20	13	3	2
Unnamed	03-ED-89	52B	5	1	7	1	17	2	5	1
Watson	03-Pla-28	7	4	3	5	3	20	15	19	14
Unnamed	03-Pla-28	8	3	2	6	4	23	15	23	15
Unnamed	03-ED-89	55B	3	1	12	3	12	4	13	4
Paradise Flat	03-ED-89	52A	2	1	1	.2	9	3	6	2
Unnamed	03-Pla-28	12	1	.5	1	.3	6	3	1	.4
McKinney	03-Pla-89	57	1	1	1	1	33	33	2	2
General	03-ED-89	56	1	1	2	1	5	4	.4	.4
Taylor	03-ED-89	46	1	.1	4	.3	45	5	2	.2
Tahoe City	03-Pla-28	1	1	.3	3	.1	8	3	1	.4
Burton	03-Pla-28	2	.7	.5	.5	.4	18	13	1	1
Upper Truckee	03-ED-50	44B	.5	0	2	.1	2	0	.3	0
Lonely Gulch	03-ED-89	53	.2	.2	1	.5	3	3	.7	.7
Unnamed	03-Pla-89	10A	.2	.2	.4	.4	1	1	.5	.5
Unnamed	03-Pla-28	4	.1	0	.3	0	2	0	.2	0
Homewood	03-Pla-89	59	0	0	0	0	0	0	0	0
Unnamed	03-Pla-89	60A	0	0	0	0	0	0	0	0
Madden	03-Pla-89	60	0	0	0	0	0	0	0	0
Unnamed	03-Pla-89	61	0	0	0	0	0	0	0	0
Blackwood	03-Pla-89	62	0	0	0	0	0	0	0	0
Griff	03-Pla-28	11	0	0	0	0	0	0	0	0
Unnamed	03-Pla-28	13	0	0	0	0	0	0	0	0
Trout	03-ED-50	43	0	0	0	0	0	0	0	0

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Group 1	Watershed	Location
44C	Upper Truckee R.	Old Meyers Grade
44D	Grass Lake Creek	03-ED-89
58	Quail Lake	03-Pla-89
49A	Unnamed (Emerald)	03-ED-89
49C	Unnamed (Emerald)	03-ED-89
49B	Eagle (Emerald)	03-ED-89

Group 2	Watershed	Location
50	Unnamed	03-ED-89
5	Dollar	03-Pla-28
47	Tallac	03-ED-89

Group 3	Watershed	Location
10B	Snow	03-Pla-267
44C	Upper Truckee R.	03-ED-50
48	Cascade	03-ED-89
51	Rubicon Creek	03-ED-89

Group 4	Watershed	Location
63	Ward	03-Pla-89
54	Rubicon Units	03-ED-89
55A	Meeks Creek	03-ED-89
55B	Unnamed	03-ED-89

These 17 watersheds constitute about 96 percent of the annual erosion rate of road slopes in the Tahoe Basin. They also account for about 94 percent of the total sediment quantity reaching streams and available for transport from highway slopes. Of the 96 percent and 94 percent respectively, each Group represents approximately the following:

	% Annual Erosion Rate	% Sediment Reaching Stream
Group 1	71.5	71.7
Group 2	16.5	20.6
Group 3	9.5	3.7
Group 4	2.5	4.0
	100.0	100.0

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WATERSHED DESCRIPTIONS

The following 17 watersheds in the Tahoe Basin appear to be the most significant in terms of erosion of the State highway slopes. A description of the watershed, erosion rates, and slope information follows:

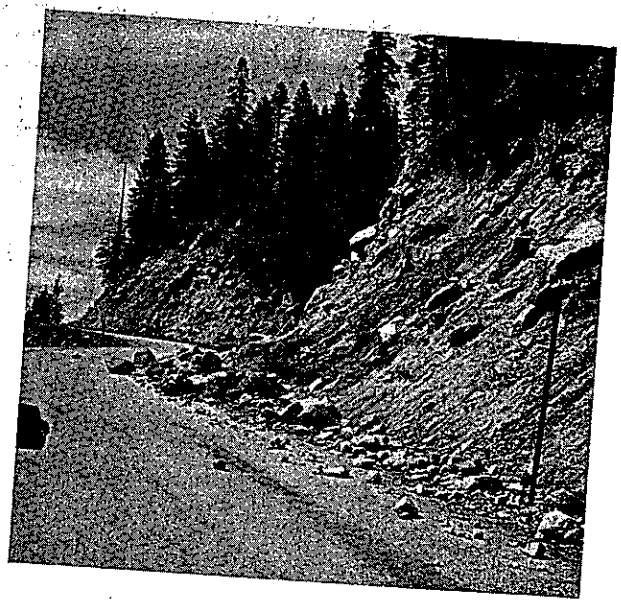
44C Old Meyers Grade

Old Meyers Grade runs parallel to Highway 50 near the lower portion of Echo Summit in the Upper Truckee River Watershed. It is used in the winter months occasionally as a by-pass when the normal Route 50 is blocked by a snow slide, etc. The post mile limits are 0.00 to 1.50.

1970-71 CY/Yr		Long Term Cy/Yr		1970-71 CY/Mi.-Slope/Yr		1970-71 Cy/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
237	22	604	51	252	23	158	15

There are six cut slopes located on the left with south and southeast facing aspects that appear to account for the erosion rates listed above. The physical descriptions of these slopes are:

P.M.	to P.M.	DIST.	ANGLE	CY/YR EROSION
0.31	0.36	300'	35°	5
0.42	0.63	1,110'	44°	30
0.63	0.74	580'	45°	80
0.77	0.92	790'	41°	60
0.92	1.12	1,060'	41°	60
1.12	1.26	740'	37°	40



44C Old Meyers Grade. 03-ED

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44D Grass Lake Creek

Located in El Dorado County, the creek drains from Grass Lake near Luther Pass and parallels Highway 89 for nearly 5 miles before emptying into the Upper Truckee River near the Alpine Campground. The post mile limits are 1.87-4.64.

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
297	115	303	122	231	90	107	41

There are eight cut slopes on the right, six cut slopes on the left, and one fill slope on the right and left, respectively, that appear to account for the erosion quantities listed above. The physical descriptions of these slopes follows:

PM	to PM	DIST.	C/F	R/L	ASPECT	ANGLE	CY/Yr EROSION
1.87	1.97	530'	C	R	S	35°	54
1.93	1.97	200'	F	L	S	35°	1
2.04	2.11	420'	C	R	S	34°	32
2.14	2.20	320'	C	R	S	39°	25
2.36	2.52	840'	C	R	S	34°	108
2.59	2.64	260'	C	R	S	45°	5
2.72	2.81	480'	C	R	S	39°	4
2.93	2.99	320'	C	L	N	35°	20
3.10	3.17	370'	C	L	N	30°	3
3.13	3.14	50'	C	R	S	25°	1
3.30	3.54	1260'	C	L	N	35°	6
3.81	3.87	350'	C	L	N	45°	0
3.99	4.09	530'	C	L	NE	35°	1
4.30	4.45	800'	C	R	SW	35°	36

44D Grass Lake Creek. 03-ED-89

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58 Quail Lake

Located in Placer County along Highway 89 on the West shore of Lake Tahoe, the watershed lies between McKinney Creek to the south and Homewood Canyon to the north. The post mile limits are 1.13 to 1.79.

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
79	55	54	38	292	203	120	83

There are three cut slopes located on the left with an east aspect that appear to account for the erosion quantities listed above. Listed below are physical descriptions of these cuts:

P.M.	to	P.M.	DIST.	ANGLE	CY/Yr EROSION
1.13		1.18	260'	vertical	32
1.18		1.27	470'	45°	37
1.27		1.40	700'	32°	10

58 Quail Lake. 03-Pla-89

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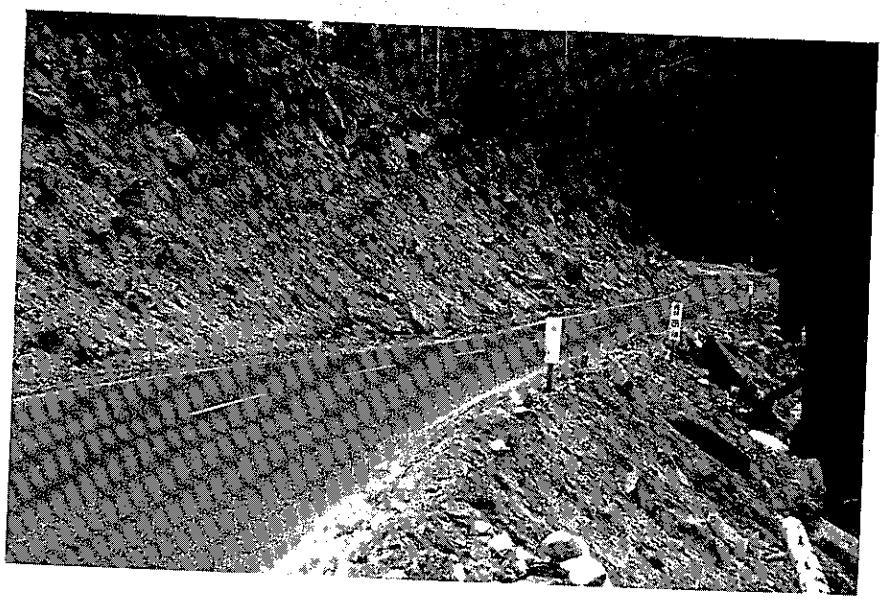
49A Unnamed (Emerald Bay)

Located in El Dorado County, this watershed empties into Emerald Bay. The post mile limits along Highway 89 are 15.34 to 16.54

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
126	82	140	91	185	120	105	68

There are seven cut slopes located on the left side of the highway that account for the erosion quantities listed above. The following is a description of the cuts:

P.M.	to	P.M.	DIST.	ASPECT	ANGLE	CY/Yr EROSION
15.34		15.47	680'	N	42°	2
15.47		15.52	260'	E	29°	2.5
15.62		15.72	500'	N	30°	.1
15.97		16.15	900'	N	44°	55
16.31		16.44	700'	N	50°	27
16.44		16.50	350'	N	50°	14
16.50		16.54	200'	E	var.	25



49A Unnamed (Emerald Bay). 03-ED-89

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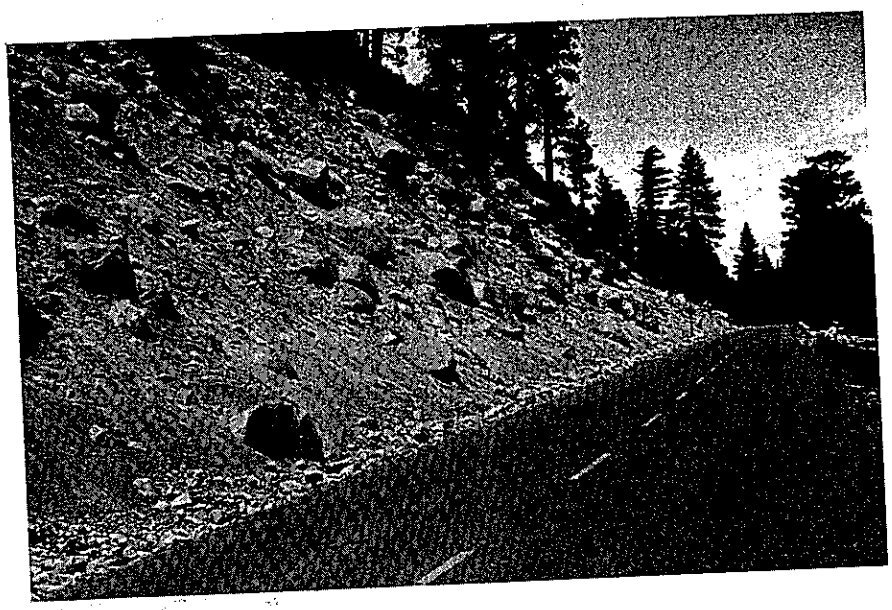
49C Unnamed (Emerald Bay)

Located in El Dorado County, this watershed drains into Emerald Bay. The post mile limits along Highway 89 are 17.60 to 18.58.

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
65	15	20	5	231	54	66	15

There are three cut slopes located on the left side of the highway that account for the erosion quantities listed above. The following is a description of the cuts:

P.M.	to	P.M.	DIST.	ASPECT	ANGLE	CY/Yr EROSION
17.58		17.69	580'	S	var.	35
17.75		18.02	370'	S	var.	30
8.40		18.50	530'	E	var.	0



49C Unnamed (Emerald Bay). 03-ED-89

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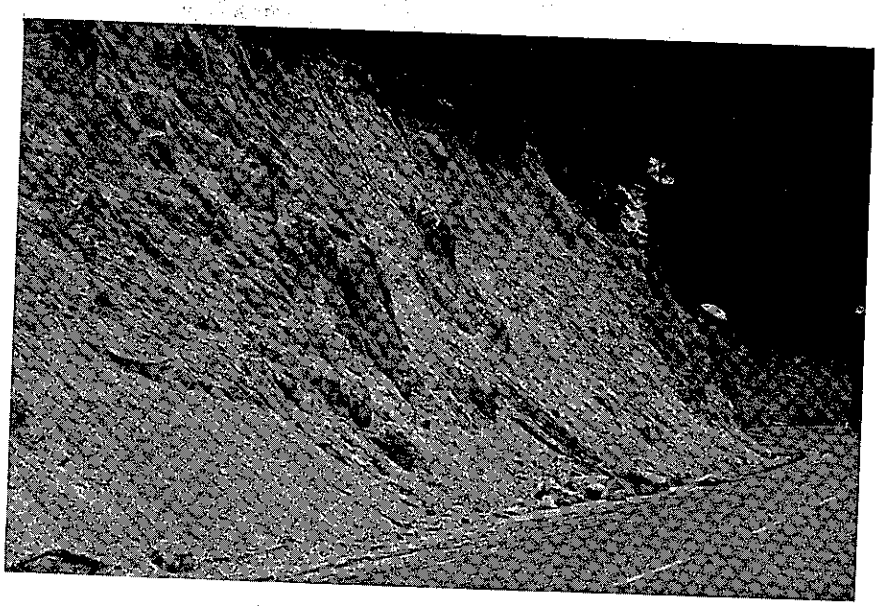
49B Eagle Creek

This watershed is located in El Dorado County and includes the Emerald Bay slide. The post mile limits along Highway 89 are 16.54 to 17.60.

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
21	20	38	24	160	154	20	19

There are three cut slopes located on the left side of the highway and one fill slope on the right that accounts for the above erosion quantities. A description of these slopes follows:

P.M.	to	P.M.	DIST.	C/F	ASPECT	ANGLE	CY/Yr EROSION
16.54		16.61	370'	C	E	var.	7
16.79		16.81	100'	C	E	var.	10
16.85		16.87	100'	C	E	var.	3
17.13		17.15	100'	F	E	var.	1



49B Eagle Creek (Emerald Bay). 03-ED-89

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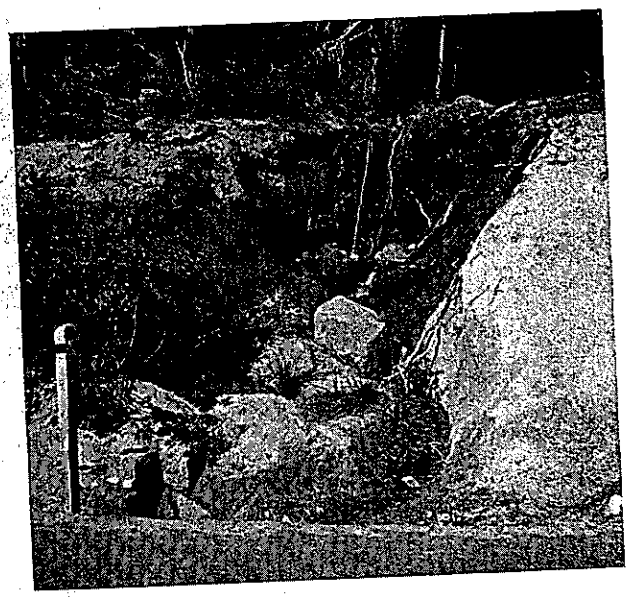
50 Unnamed

This watershed is located in El Dorado County near DL Bliss State Park. The post mile limits along Highway 89 are 18.58 to 19.36.

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
76	46	76	35	98	59	98	45

There are four cut clopes that account for the erosion quantities listed above. A description of the cuts follows:

P.M.	to	P.M.	DIST.	R/L	ASPECT	ANGLE	CY/Yr EROSION
18.75		19.20	2400'	L	E	var.	40
18.75		19.00	1300'	R	W	var.	6
19.29		19.32	160'	L	E	var.	10
19.29		19.34	260'	R	W	var.	20



50 Unnamed. 03-ED-89

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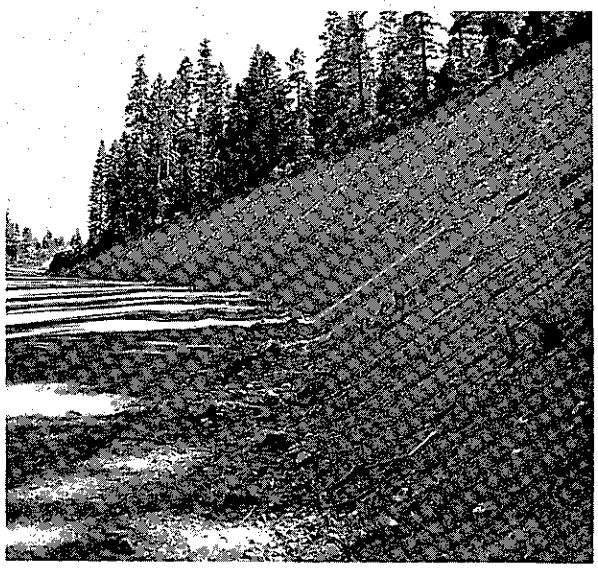
5 Dollar Creek

This watershed is located at the north end of the Lake in Placer County. The post mile limits along Highway 28 are 3.03 to 3.54.

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
54	39	137	67	80	57	93	67

There are five cut slopes and two fill slopes that account for the erosion quantities listed above. A description of the slopes follows:

P.M.	to	P.M.	DIST.	C/F	R/L	ASPECT	ANGLE	CY/Yr EROSION
3.00		3.14	750'	C	R	NE	36°	1
3.00		3.14	750'	C	L	SW	35°	12
3.20		3.28	400'	C	R	NE	43°	12
3.21		3.38	550'	C	L	SW	39°	17
3.38		3.44	300'	C	L	SE	40°	10
3.44		3.50	300'	F	L	NE	34°	1
3.44		3.54	500'	F	R	SW	36°	1



5 Dollar Creek. 03-Pla-28

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47 Tallac

This watershed is located in El Dorado County between Taylor Creek to the south and Cascade Creek to the north. The post mile limits along Highway 89 are 12.24 to 14.30.

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
60	4	219	6	61	4	29	2

There are six cut slopes located on the left side of the highway that account for the erosion quantities listed above. A description of these cut slopes follows:

P.M.	to	P.M.	DIST.	ASPECT	ANGLE	CY/Yr EROSION
12.83		12.94	600'	E	vert.	.9
13.44		13.73	1500'	E	30°	2.5
13.73		13.77	200'	E	33°	7
13.77		14.18	2150'	E	35°	16
14.18		14.22	220'	E	32°	27
14.22		14.30	420'	E	36°	3

47 Tallac. 03-ED-89

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10B Snow Creek

The upper reaches of the Snow Creek Watershed are traversed by Highway 267 from Brockway Summit to Kings Beach. The post mile limits on Highway 267 are 6.69 to 9.07.

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
60	6	34	3	33	3	19	2

10B Snow Creek. 03-Pla-267

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A description of the slopes that account for these quantities are listed below:

P.M.	to P.M.	DIST.	C/F	R/L	ASPECT	ANGLE	CY/Yr EROSION
6.69	6.83	740'	C	L	SW	38°	6.3
6.69	6.75	310'	C	R	NE	40°	9
6.83	6.88	270'	C	L	S	37°	1.5
6.88	6.96	420'	C	L	S	38°	1.8
6.96	7.06	530'	C	L	S	44°	16
7.06	7.13	370'	C	L	S	30°	.9
7.13	7.16	200'	C	L	S	36°	.2
7.21	7.23	140'	C	L	S	34°	0
7.23	7.35	630'	C	L	S	34°	5.8
7.35	7.37	120'	C	L	S	29°	.1
7.50	7.61	580'	C	L	S	30°	2.8
7.61	7.73	630'	C	L	S	32°	1
7.81	7.86	285'	C	L	S	37°	3
7.94	8.03	480'	C	L	S	39°	6
7.96	8.00	260'	C	R	N	39°	2
8.26	8.43	900'	C	L	S	38°	1
8.29	8.43	740'	C	R	N	32°	.2
8.75	8.80	220'	C	L	S	34°	1
8.76	8.80	250'	C	L	S	35°	2
8.93	9.07	740'	C	L	S	36°	.5
8.93	9.07	740'	C	R	N	31°	.2

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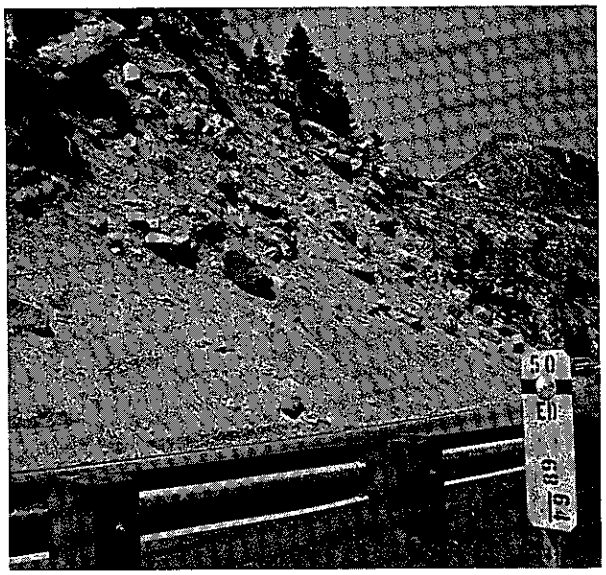
44C Upper Truckee River

Highway 50 traverses the Upper Truckee River Watershed from Echo Summit, and then follows Meyers Grade to the town of Meyers at the junction with Highway 89. The post mile limits for 44C are 66.94 to 70.03.

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
35	6	24	4	21	4	11	2



44C Upper Truckee River. 03-ED-50

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A description of the slopes that appear to be the main contributors of this erosion follows:

P.M.	to	P.M.	DIST.	C/F	R/L	ASPECT	ANGLE	CY/Yr EROSION
67.06		67.08	100'	C	L	E	45°	5
67.15		67.20	260'	C	L	E	Var.	1
67.89		67.98	460'	C	L	E	40°	6
68.00		68.07	370'	C	L	E	35°	2
68.18		68.21	160'	C	R	W	43°	1
68.15		68.21	320'	C	L	E	Var.	4
68.36		68.37	50'	C	L	E	40°	.5
68.50		68.56	320'	C	L	E	Var.	1
68.64		68.68	250'	C	L	E	45°	5
68.76		68.97	1100'	C	L	E	Var.	3
69.25		69.28	150'	C	L	E	Var.	2
69.40		69.57	900'	C	L	E	Var.	.1
69.62		69.77	800'	C	L	E	35°	3
69.96		70.03	360'	C	L	S	Var.	1

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48 Cascade Creek

Highway 89 crosses Cascade Creek watershed in El Dorado County from post mile 14.30 to 15.34. The erosion rates are:

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
10	1	48	3	27	2	10	1

A description of the slopes that appear to be the main contributors of the erosion rates listed are:

P.M.	to	P.M.	DIST.	C/F	R/L	ASPECT	ANGLE	CY/Yr EROSION
14.30		14.36	200'	C	L	E	41°	3.1
14.41		14.46	270'	C	L	N	28°	1.2
14.48		14.49	60'	C	L	N	45°	.1
15.00		15.26	1400'	C	L	S	32°	5.5

48 Cascade Creek. 03-ED-89

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51 Rubicon Creek

Highway 89 traverses Rubicon Creek watershed in El Dorado County from post mile 19.36 to 21.22. The erosion rates are:

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
5	3	23	5	20	13	3	2

A description of the slopes contributing the bulk of the erosion rates listed above are:

P.M.	to	P.M.	DIST.	C/F	R/L	ASPECT	ANGLE	CY/Yr EROSION
19.47		19.52	500'	C	L	E	25°	2
19.83		19.85	120'	C	L	E	46°	1
19.90		19.94	100'	C	L	E	Var.	.5
20.00		20.03	150'	C	L	E	42°	.3
20.11		20.16	260'	C	L	E	38°	2
20.14		20.16	100'	C	R	W	35°	.7

51 Rubicon Creek. 03-ED-89

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63 Ward Creek

Highway 89 in the Ward Creek watershed located in Placer County lies between post mile 4.01 to 7.43. The erosion rates are:

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
9	7	96	33	11	9	3	2

A description of the slopes contributing most to these erosion rates is as follows:

P.M.	to	P.M.	DIST.	C/F	R/L	ASPECT	ANGLE	CY/Yr EROSION
6.03		6.06	150'	C	L	E	32°	1
6.03		6.06	150'	C	R	W	26°	.3
6.14		6.16	100'	C	L	E	Var.	.3
6.80		6.81	50'	C	L	E	Var.	.5
6.83		7.00	900'	C	L	E	Var.	1
7.00		7.09	480'	C	L	E	Vert.	3
7.18		7.43	1300'	C	L	E	28°	3

It was noted that from post mile 4.13 to 5.73, construction of a sewer line along the road shoulder precluded obtaining any meaningful data on slope erosion.

63 Ward Creek. 03-Pla-89

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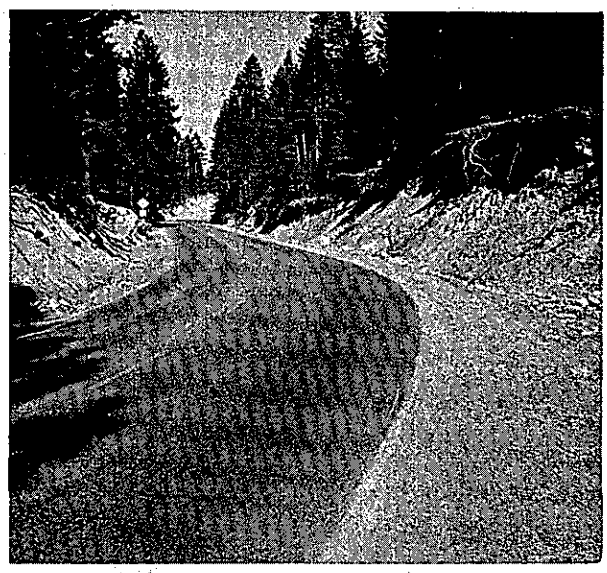
54 Rubicon Units

Highway 89 traverses Rubicon Units watershed in El Dorado County from post mile 22.71 to 24.16. The erosion rates are:

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
9	7	41	22	9	8	6	5

A description of the slopes for this watershed which appear to be the main contributors follows:

P.M.	to	P.M.	DIST.	C/F	R/L	ASPECT	ANGLE	CY/Yr EROSION
22.71		22.73	100'	C	R	W	Var.	.5
22.73		22.85	300'	C	L	N	40°	5
22.85		22.87	100'	C	R	S	34°	2
23.23		23.28	300'	C	L	E	29°	2
23.31		23.42	580'	C	L	E	30°	.5
23.43		24.11	3600'	C	L	E	30°	.2



54 Rubicon Units. 03-ED-89

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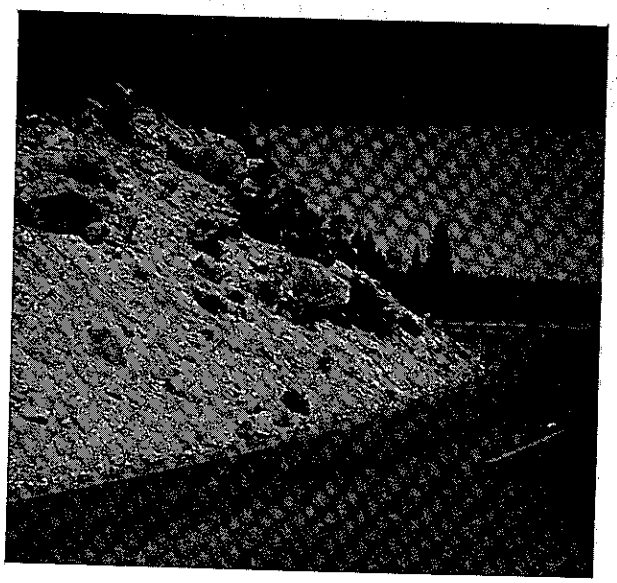
55A Meeks Creek

Highway 89 traverses Meeks Creek watershed in El Dorado County from post mile 24.16 to 25.55. The erosion rates are:

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
8	2	44	19	17	5	6	2

A description of the slopes that appear to contribute to this quantity is as follows:

P.M.	to	P.M.	DIST.	C/F	R/L	ASPECT	ANGLE	CY/Yr EROSION
24.24		24.44	1000'	C	L	E	35°	1.5
24.53		24.64	580'	C	L	E	35°	2
24.53		24.55	100'	C	R	W	Var.	1
25.13		25.19	320'	C	L	E	Var.	1
25.13		25.16	160'	C	R	W	Var.	.1
25.24		25.26	100'	C	L	E	Var.	.1
25.38		25.44	320'	C	L	E	34°	3



55A Meeks Creek. 03-ED-89

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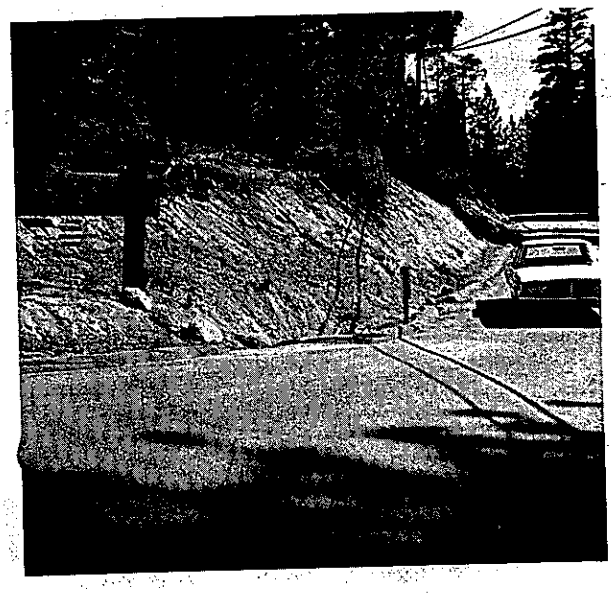
55B Unnamed

This unnamed watershed lies between Meeks Creek and General Creek watersheds. Highway 89 crosses through the watershed in El Dorado County between post mile 25.55 and 25.78. The erosion rates are:

1970-71 CY/Yr		Long Term CY/Yr		1970-71 CY/Mi. Slope/Yr		1970-71 CY/Mi. Hwy/Yr	
Displ.	Str.	Displ.	Str.	Displ.	Str.	Displ.	Str.
3	1	12	3	12	4	13	4

A description of the slopes within the watershed that appear to account for these rates are as follows:

P.M.	to	P.M.	DIST.	C/F	R/L	ASPECT	ANGLE	CY/Yr EROSION
25.55		25.56	60'	C	L	E	Vert.	.5
25.58		25.62	250'	C	L	E	30°	.5
25.58		25.60	100'	C	R	W	Vert.	1
25.63		25.75	600'	C	L	E	Var.	1



55B Unnamed. 03-ED-89

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APPENDIX

1. Location Map
2. Slope Erosion Transect Form and Instructions

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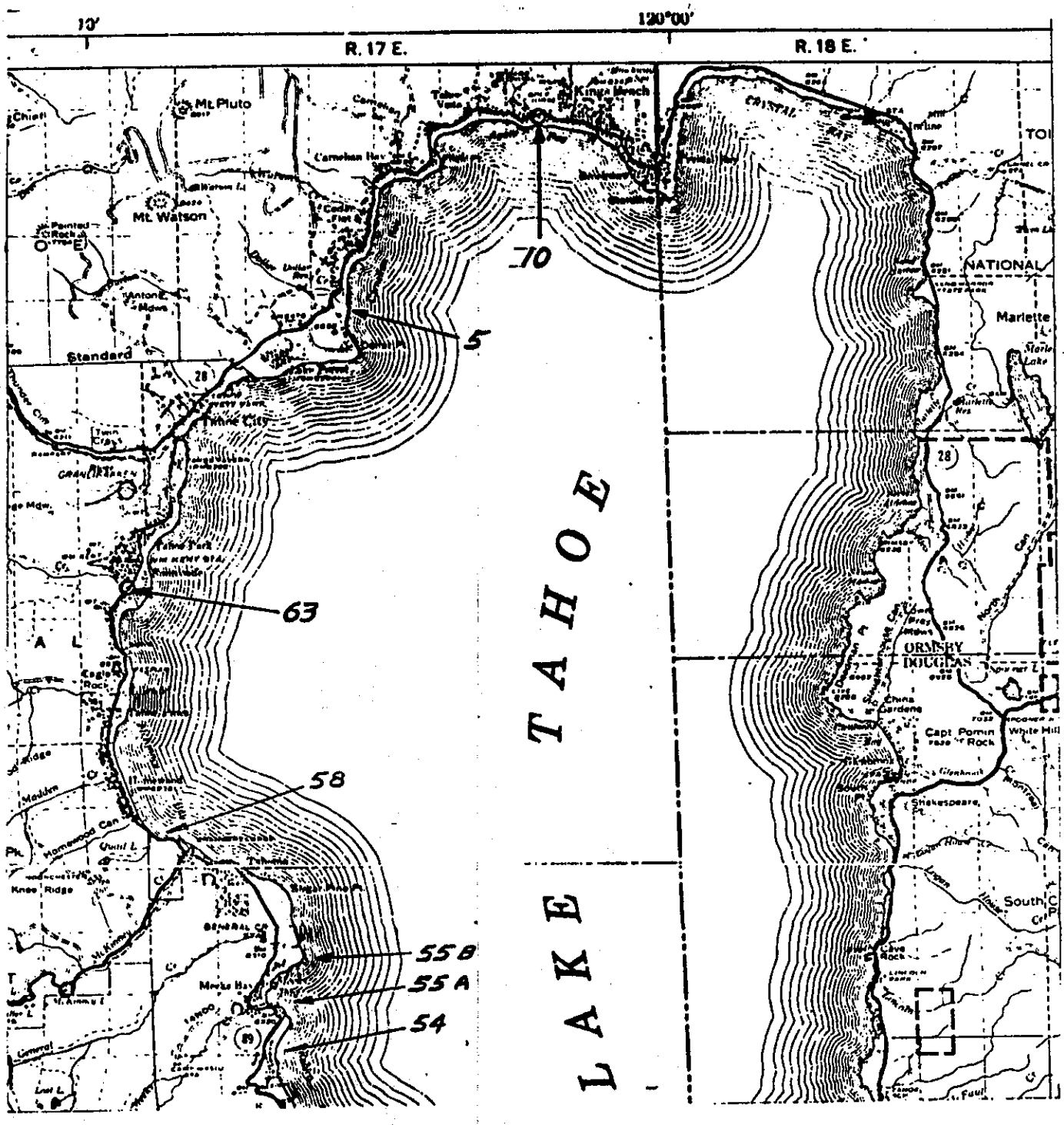
LOCATION MAP



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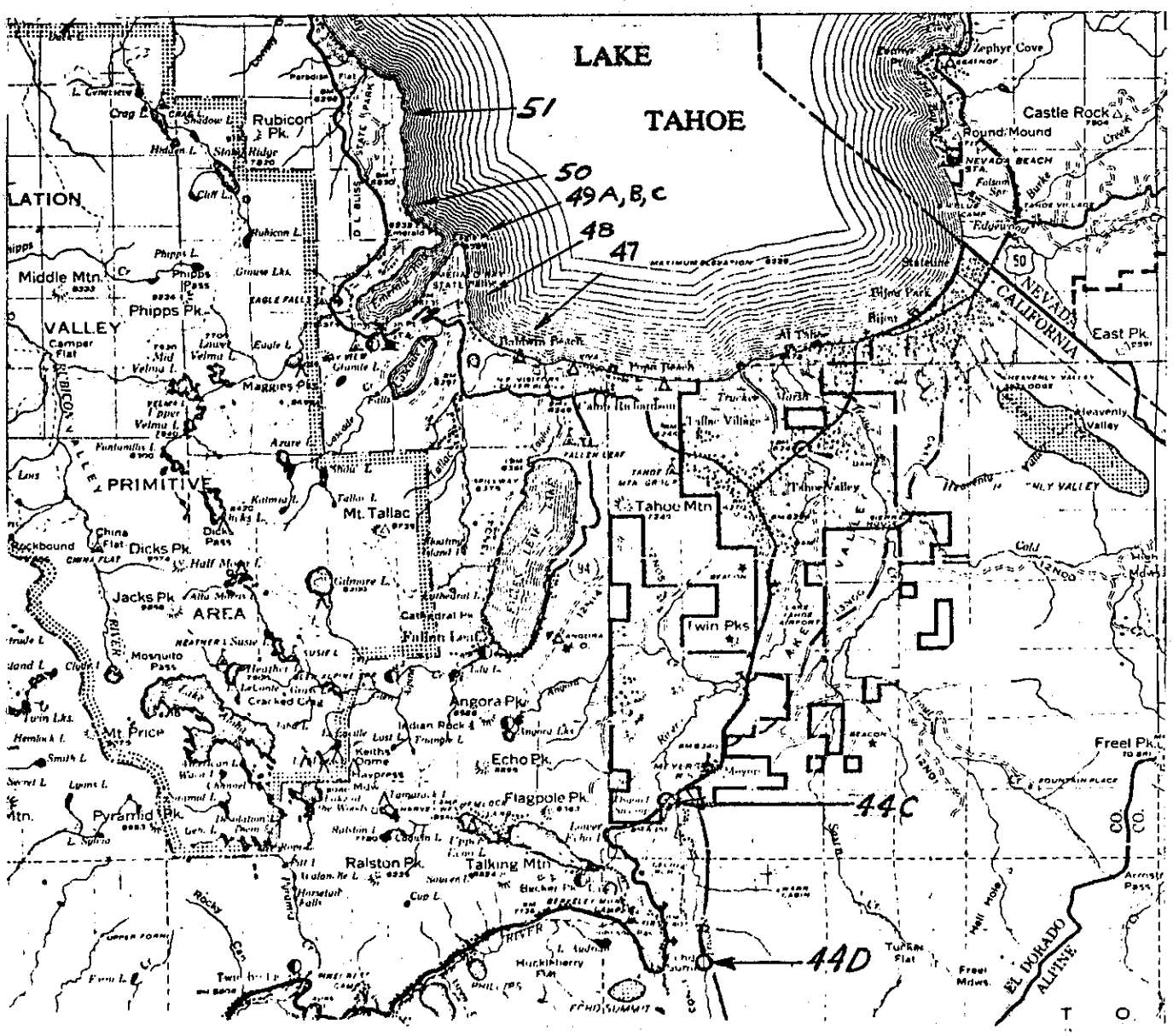

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ROAD EROSION TRANSECT SURVEY

BASIN _____ DATE _____

WATERSHED _____ PARTY _____

SUBUNIT _____ LOCATION: T ____ R ____ S ____ B & M _____

ROAD DESCRIPTION _____

START POST MILE _____ END POST MILE _____

ODOMETER READING		EQUIVALENT POST MILES		DISTANCE	CUT / FILL / RIGHT / LEFT	ASPECT / ANGLE	HEIGHT OF CUT FEET	AREA S.F.	DEPTH EROS-ION	VOLUME - C.Y.		REMARKS
START	END	START	END							YR. DISPL. / TO STR.	YR. DISPL. / TO STR.	

HMRT-703 (Orig. 11/71)

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Road Erosion Transect Survey

Basin - The Basin in which several watersheds drain, i.e., Sacramento River Basin, Lake Tahoe Basin, etc.

Watershed - The one specific drainage area generally identified by one major river or stream.

Subunit - A small drainage within a watershed.

Location - Identify by Township, Range, Section, and 1/4 Section if possible and with reference to appropriate Base and Meridian. This information is useful to others irregardless of their proximity to the project.

Road Description - Identify physical features of the road facility, i.e., no. of lanes, type pavement, shoulders, grade, etc.

Start and End Post Mile - The mileage marker delineating the Watershed Boundary on the roadway.

Odometer Reading - Record the reading at the beginning and end of a slope under investigation.

Equivalent Post Miles - Odometer reading referenced to the start and end Post Miles.

Distance - Mileage difference between start and end recorded along slope (convert to feet for expediency in calculating erosion volumes).

Cut or Fill - Use C for Cut and F for Fill.

Right or Left - Use R for slope location on Right and L for slope location on Left. Right and Left is determined by facing in direction of increasing Post Miles.

Aspect - Indicate N (North), S (South), E (East), W (West), facing slope.

Angle - Estimate of the slope angle, i.e., 1-1/2:1, 4:1, etc. or use measured angle.

Area - Estimate the surface area in square feet of slope undergoing erosion.

Depth Erosion - Estimate of average depth of erosion on slope for period under investigation.

Volume (CY) -

(1) Determine an annual rate for latest year of the cubic yards of eroded slope material and enter the volume under "DISPL" (Displaced) and record the year. Estimate the percentage that reaches a tributary stream or is likely to be available for sediment transport. Record in cubic yards under "To Str" (To Stream).

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(2) Determine the volume of cubic yards of eroded material over a longer period of time than in (1) if sufficient evidence is available. Record the beginning year which volume is to be estimated from. Record cubic yards in "Displ". Again, estimate the quantity reaching tributary drainages and available for transport. Keep in mind potential changes that could have occurred over the period being estimated.

Remarks - Note any significant factors such as gully erosion, boulders on slope, cross drain near toe of cut, erosion in road ditch, vegetation established on 3/4 of slope, etc.

Remedial Measures - Make an estimate of possible remedial action that might be taken to reduce the erosion on this slope. For example, a stable top-of-cut ditch might reduce gully erosion, or establish vegetation on remainder of 1/2 slope, etc. These notes will assist future planning in the office.

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