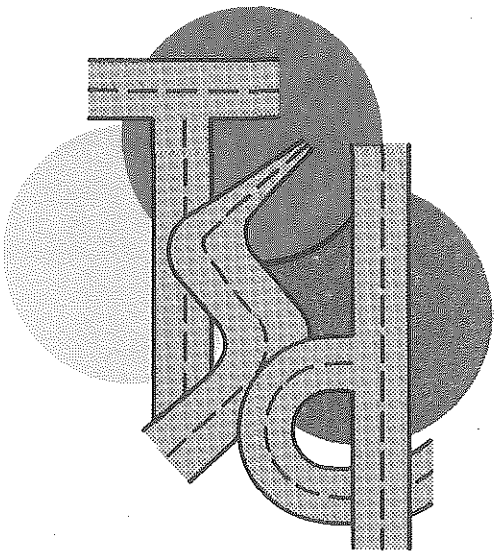
Report TSD-320-76

THE MICHIGAN PHOTOLOG SYSTEM



TRAFFIC and SAFETY DIVISION

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
AND TRANSPORTATION

MICHIGAN DEPARTMENT
OF
STATE HIGHWAYS AND TRANSPORTATION

Report TSD-320-76

THE MICHIGAN PHOTOLOG SYSTEM

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Operational Inventories Unit

November, 1976

PREPARED BY

Operational Inventories Unit
Traffic and Safety Division
Michigan Department of State Highways and Transportation

in cooperation with
The Michigan Office of Highway Safety Planning
and
The U.S. Department of Transportation
Federal Highway Administration

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INTRODUCTION

The advent of the National Highway Safety Act of 1966 stimulated considerable research and development in the field of highway safety throughout the nation. Strong emphasis was placed on the development of new systems to record data useful for facilitating the planning and management of a highway system.

The Federal Highway Administration conducted early research into employing the use of sequential photography to fulfill the need for highway data retrieval. Presentation of their findings to various highway agencies throughout the country provoked considerable interest in this type of visual data storage capability. The use of photography and introduction of a distance-governed sequence was called "photolog," and the process of obtaining this data log was called "photologging." It can be described as a sequential series of photographs recording roadway features and appurtenances.

BACKGROUND

In February, 1971, personnel from various divisions of the Michigan Department of State Highways and Transportation evaluated the technique of photologging through the loan of equipment from the Federal Highway Adminstration. As a result, a Photolog Advisory Committee, consisting of members from the Maintenance, Testing and Research, Bureau of Transportation Planning, Design, and Traffic and Safety Divisions, was established in August, 1971, to investigate the feasibility of photologging for department use. This resulted in a system proposal which included:

1. Benefits to be derived from a photolog inventory of highway features.

2. Equipment necessary to establish a photolog system.

3. Staff required to procure the equipment, establish procedures, and photolog the trunkline system.

4. Operating budget requirements for the first two years.

5. A recommendation to place the project supervision responsibility with the Traffic and Safety Division.

On October 26, 1971, Mr. John P. Woodford, Director of the Michigan Department of State Highways and Transportation, approved the photologging system proposal for implementation.

IMPLEMENTATION

Implementation of the Photolog System was initiated by the department through a federally funded grant from the Michigan Office of Highway Safety Planning. The initial project grant was approved on April 1, 1972, and subsequent grant reapplication approvals were obtained for 1973, 1974, and 1975. Under these grants, the federal government provided 50 percent of the funds required for equipment and staff salaries. Utilization of these funds allowed photologging 9,282 two-way

miles of trunkline, including interchange ramps and crossroads, rest areas, and scenic turnouts. The photologging involved taking a 35mm color photograph every one-hundredth of a mile (52.8 feet). Eastman Kodak Color Negative Film Type 5254 was selected because of its high resolution, quality reproduction capabilities, local processing availability, and negative editing capability prior to positive printing. Department personnel reviewed other existing systems before selecting the type of film; however, those systems with 16mm or smaller film sizes were found to be unsatisfactory. The Michigan Photolog Inventory complements the department's aerial photography effort and the Michigan Accident Location Index (MALI) Project currently being implemented. The Michigan Photolog is applicable in the following functional highway safety standard areas: Identification and Surveillance of Accident Locations and Highway Design, Construction, and Maintenance.

Goals

In accordance with Office of Highway Safety Planning grant requirements, the following project goals were identified:

1. Provide a background field data storage and retrieval capability for in-office study of high hazard locations, thereby saving time and money by reducing the number of field trips.

2. Provide an alternate method of inventorying traffic control devices.

3. Provide a less expensive and expeditious method of studying deterioration rates of roadways on the trunkline system in order to anticipate maintenance and reconstruction needs.

4. To effect a "driver's eye view" inventory of the complete state trunkline road network to be used for determining the adequacy of existing safety features and the need for operational or geometric changes.

5. To complete photologging of the highway system, editing of the films into a final format and placement of projection units in each district office and in Lansing with corresponding films.

Accomplishments

In the 1972 grant period, all field equipment and accessories were acquired, tested, and installed in the photolog vehicle (See Appendix A and Figures 1 and 2). Editing equipment and projectors were acquired and tested for film processing and viewing. Due to a lack of available office space in the Highways Building, the Photolog Subunit was housed in a project house trailer from July of 1972 through December of 1973. The trailer housed the editing and viewing equipment and a staff of four technicians and a supervisor. Funds expended in the 1972 grant totaled $15,991 including $7,842 in federal funds.

The project proposal for the 1973 grant period required that 50 percent of the trunkline mileage be photologged. Field procedures were tested and photologging in Districts 1, 2, 4, and 6 was completed for a total mileage of 4,250 miles or 47 percent of the trunkline system (see Figure 3). Editing the film into final format was completed for Districts

FIGURE 1

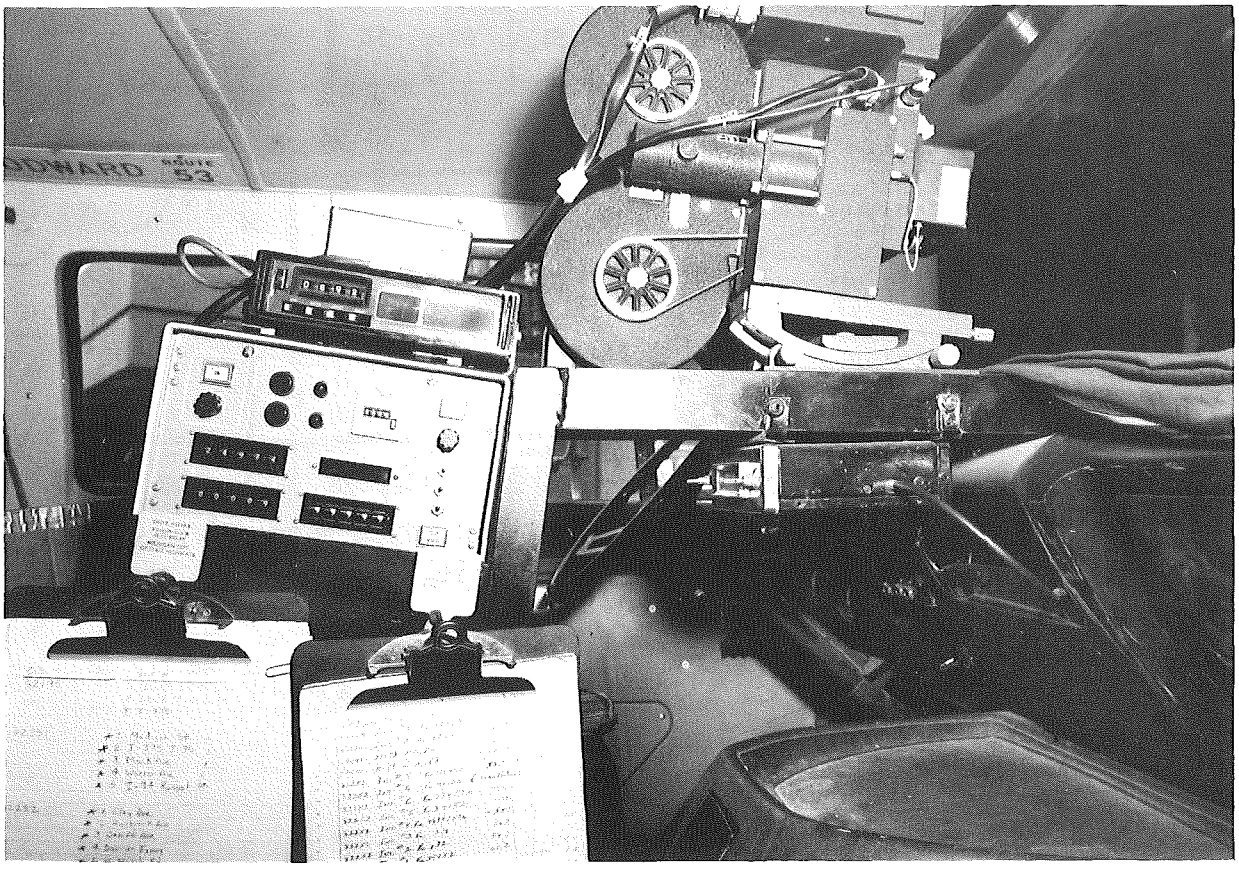
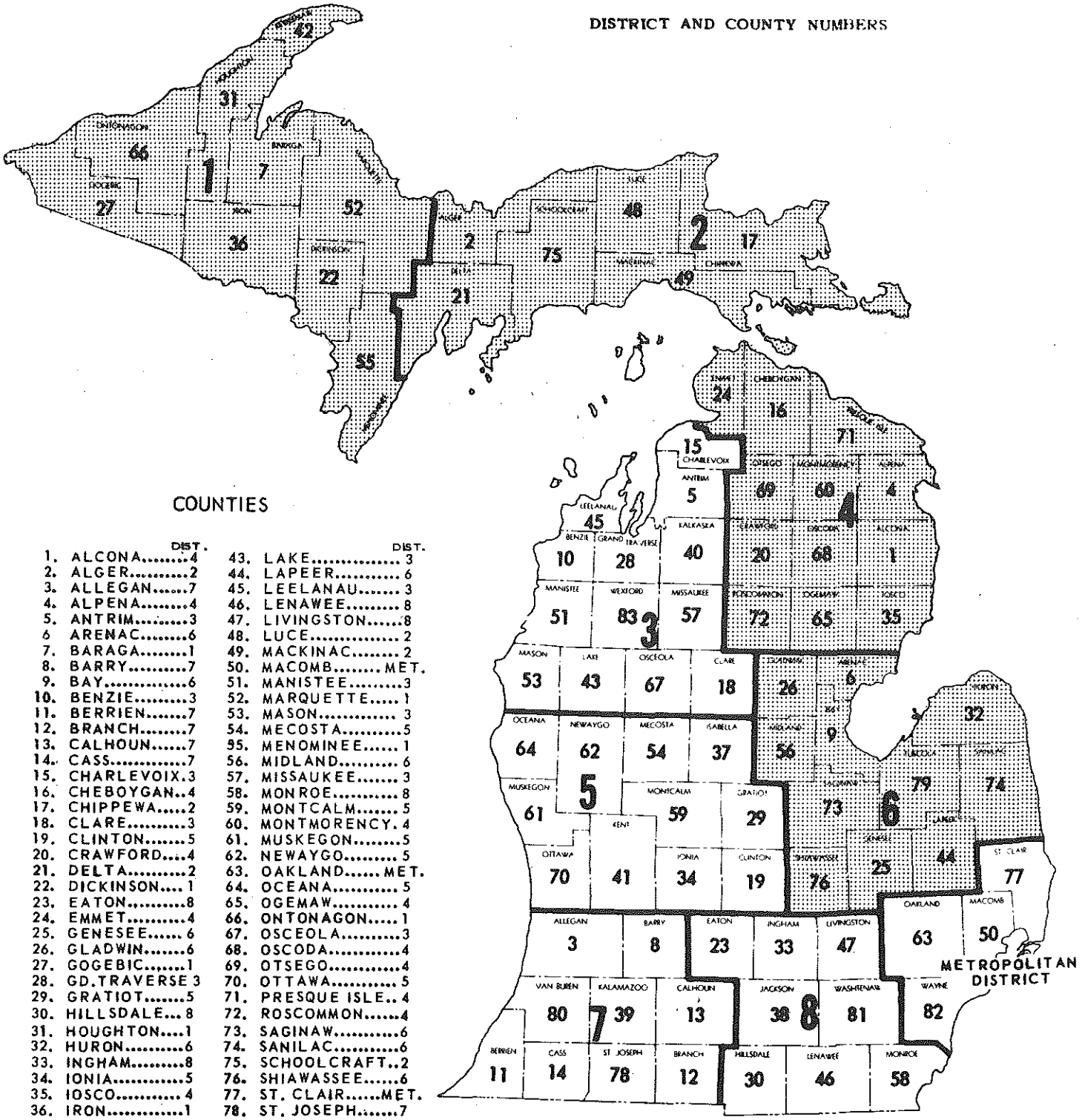


FIGURE 2

MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

DISTRICT AND COUNTY NUMBERS



COUNTIES

	DIST.		DIST.
1. ALCONA	4	43. LAKE	3
2. ALGER	2	44. LAPEER	6
3. ALLEGAN	7	45. LEELANAU	3
4. ALPENA	4	46. LENAWEE	8
5. ANTRIM	3	47. LIVINGSTON	8
6 ARENAC	6	48. LUCE	2
7. BARAGA	1	49. MACKINAC	2
8. BARRY	7	50. MACOMB	MET.
9. BAY	6	51. MANISTEE	3
10. BENZIE	3	52. MARQUETTE	1
11. BERRIEN	7	53. MASON	3
12. BRANCH	7	54. MECOSTA	5
13. CALHOUN	7	55. MENOMINEE	1
14. CASS	7	56. MIDLAND	6
15. CHARLEVOIX	3	57. MISSAUKEE	3
16. CHEBOYGAN	4	58. MONROE	8
17. CHIPPEWA	2	59. MONTCALM	5
18. CLARE	3	60. MONTMORENCY	4
19. CLINTON	5	61. MUSKEGON	5
20. CRAWFORD	4	62. NEWAYGO	5
21. DELTA	2	63. OAKLAND	MET.
22. DICKINSON	1	64. OCEANA	5
23. EATON	8	65. OGEMAW	4
24. EMMET	4	66. ONTONAGON	1
25. GENESEE	6	67. OSCEOLA	3
26. GLADWIN	6	68. OSCODA	4
27. GOGEBIC	1	69. OTSEGO	4
28. GD. TRAVERSE	3	70. OTTAWA	5
29. GRATIOT	5	71. PRESQUE ISLE	4
30. HILLSDALE	8	72. ROSCOMMON	4
31. HOUGHTON	1	73. SAGINAW	6
32. HURON	6	74. SANILAC	6
33. INGHAM	8	75. SCHOOLCRAFT	2
34. IONIA	5	76. SHIAWASSEE	6
35. IOSCO	4	77. ST. CLAIR	MET.
36. IRON	1	78. ST. JOSEPH	7
37. ISABELLA	5	79. TUSCOLA	6
38. JACKSON	8	80. VAN BUREN	7
39. KALAMAZOO	7	81. WASHTENAW	8
40. KALKASKA	3	82. WAYNE	MET.
41. KENT	5	83. WEXFORD	3
42. KEWEENAW	1		

FIGURE 3

1 and 6, with editing started in District 2. The funds expended in the 1973 grant period totaled $85,667 including $42,711 in federal funds.

During the 1974 grant period, field photography was completed except for the Metropolitan District. A camera malfunction prevented completion of filming during this grant period, which left approximately 8 percent of the trunkline mileage and approximately 25 percent of the editing to be completed in 1975. The viewing equipment, storage cabinet and films were delivered to Districts 1 and 6. Projector usage for both districts and the Lansing office was tabulated indicating significant savings for the department (see Appendix D). In January of 1974, the photolog subunit was moved to the Highways Building, at which time the staff was enlarged to five technicians and a supervisor. The move made the photolog viewer more accessible to potential users. The expenditures in the 1974 grant period totaled $114,080 including $69,240 in federal funds.

The 1975 grant funded the project for only six months and had four objectives: completion of the photologging and editing, implementation of the project in all district offices, a thorough evaluation of the project, and preparation and publishing of a report. Accomplishments for this period included completion of the field photography and film editing, and delivery of photolog viewers to Districts 3, 4, 5, 7, and 8. A second viewer was installed in Lansing to accommodate increased user demand. In order to complete the statewide photolog system, the department purchased three viewers at 100 percent department cost for subsequent installations at the Escanaba Design office, District 2, and the Metropolitan District office. An organizational change within the Traffic and Safety Division in June, 1975, placed responsibility for the Photolog Subunit (including a staff of three technicians and a supervisor) with the Operational Inventories Unit. The project cost for the first 6 months of 1975 was $80,164, including $28,079 in federal funds.

In summary, all project goals were fulfilled. The total trunkline system has been photologged and the film edited into final form, establishing a visual field data storage and retrieval system for the department.

Photolog Uses

The department's viewing equipment consists of a Vanguard Model M-35CS 35mm motion analyzer projector and control box with Model S13 rear projection stands (See Figures 4 and 5).

The state trunkline photolog provides viewers with a sequential pictorial record of roadway features and appurtenances for visual analysis. It provides an easy and inexpensive method of obtaining technical and detailed information, as well as providing a permanent record of the roadway on a given date. Some specific examples of use are:

1. Traffic and Safety Division:

    a. Accurately locate vehicular accidents when location information on the accident report is deficient.

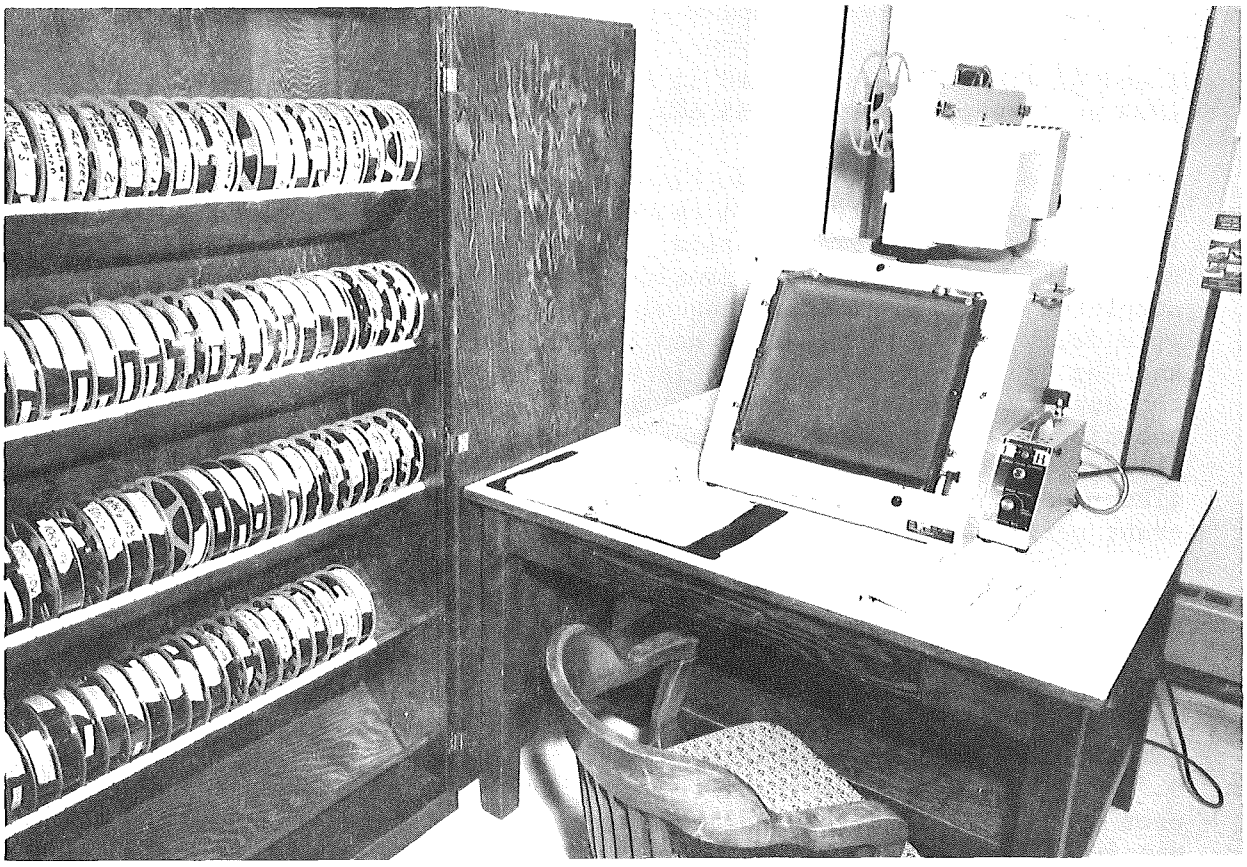


FIGURE 4

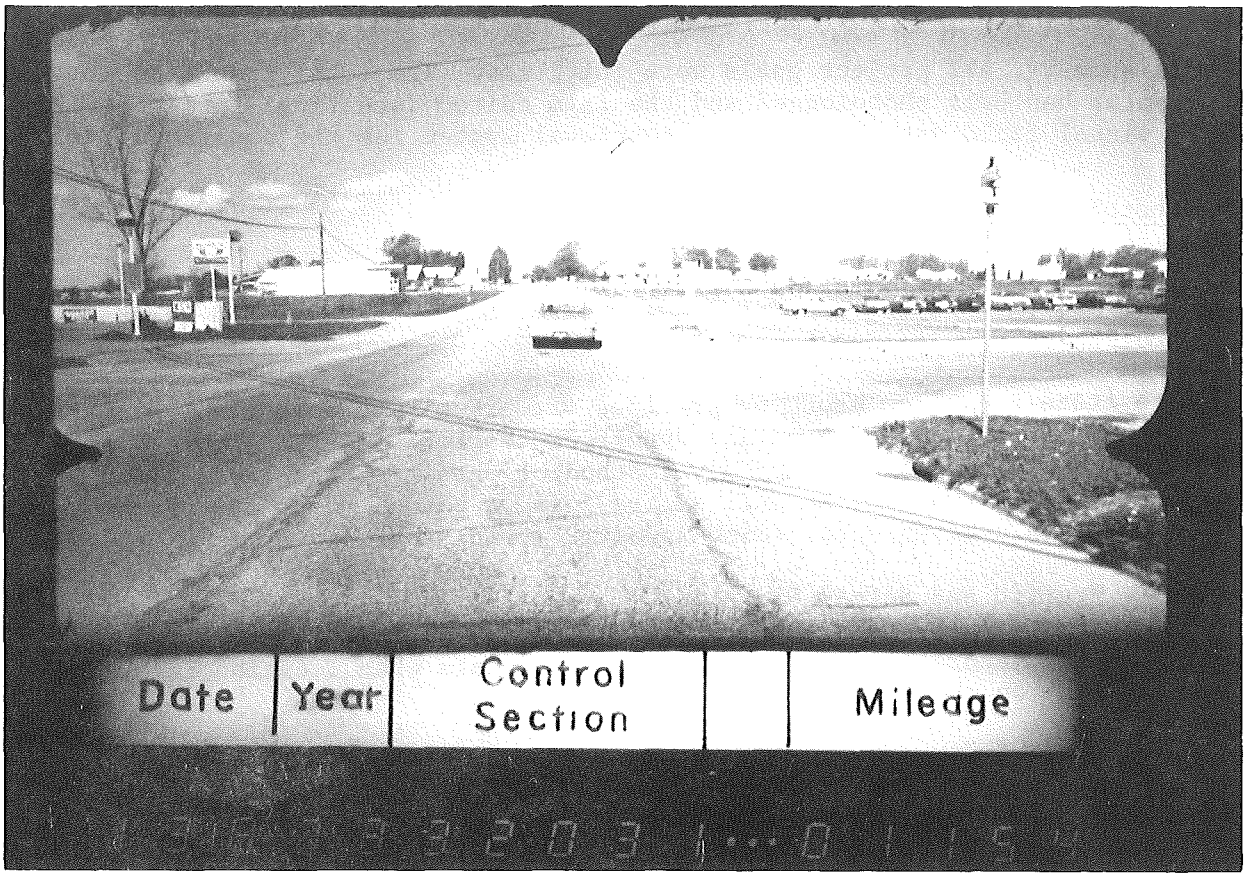


FIGURE 5

b. Confirm road and street locations and provide accurate segment measurements along the roadway in conjunction with development of the Michigan Accident Location Index (MALI).

c. Prepare functional geometric designs.

d. Inventory existing traffic control devices for location and description and provide a means for placement inspection of new devices.

e. Review geometrics and traffic control devices at high accident locations.

2. Environmental Liaison Section:

a. Review of design grade inspection plans when questions and controversy arise.

b. Gather information for the Modal Subcommittee to classify projects as major or nonmajor actions.

c. Aid in the planning process by providing information relative to:

(1) Condition and characteristics of the roadway
(2) Land use
(3) Vegetation (within and outside right-of-way)
    (a) Identification
    (b) Diagnostic survey as to necessity for actual field observation
    (c) Indicator of tree species, plant communities, disturbed, and undisturbed areas
(4) Drainage; structures and location
(5) Historical sites, parks, recreation areas
(6) Terrain/topography
(7) Right-of-way (existing and proposed)
(8) Distances and setbacks to homes, etc.

3. Regional Planning Divisions:

a. Check land use adjacent to existing facilities.

b. Check existing cross-sections for use in the inventory portions of transportation studies.

4. Maintenance Division:

a. Check for illegal placement or encroachment of advertising signs.

b. Driveway permit compliance.

c. Need for shoulder maintenance.

d. Resurfacing reviews.

e. Checking roadway lighting.

f. Condition of bridge decks, headwalls, and handrails.

5. Design Division:

a. Design squad reconstruction review.

b. Locating resurfacing stations.

c. Roadway measurements.

d. Culvert design and location.

e. Design information for bike paths.

f. Review of railroad crossing protection devices.

6. Attorney General Division:

a. Determine the physical characteristics of a highway, relative to allegations contained in complaints alleging highway defects.

b. Serve as a bench mark of road conditions existing on the date filmed from which the defense may be developed.

7. Construction Division:

a. Check design features of a highway before construction.

b. Record the before-and-after condition of roadway detours.

8. The photolog provides detailed information useful in replying to public inquiries regarding roadway conditions, signing, and other features.

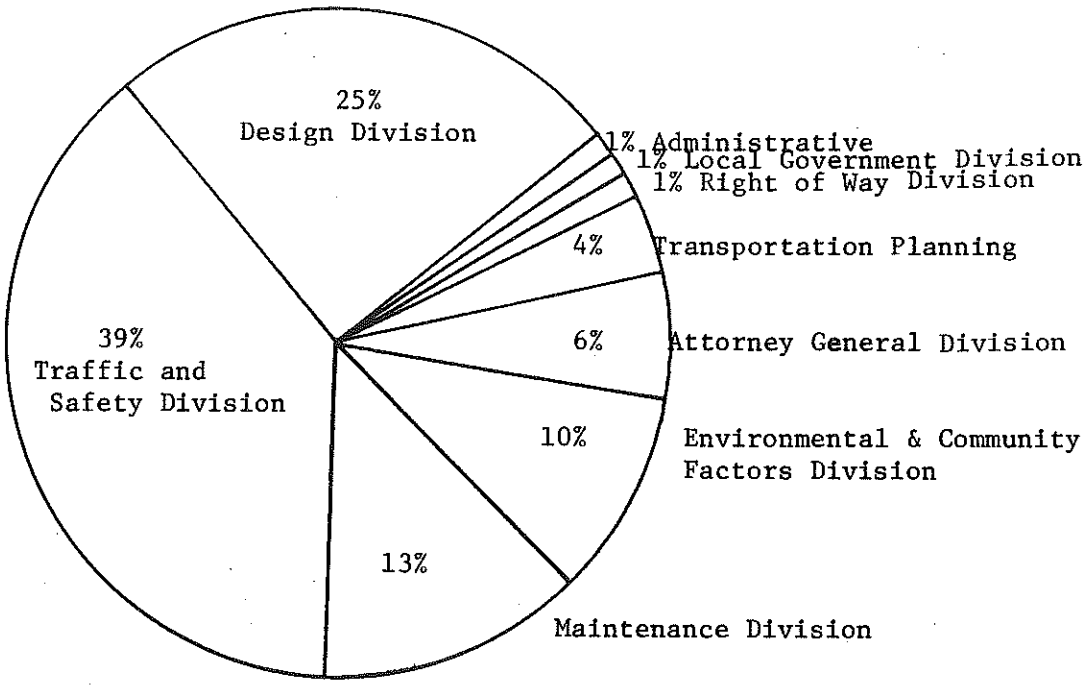
9. Department administrators utilize the photolog to familiarize themselves with sections of roadway or specific locations which have been brought to their attention by inquiries from citizens and legislators or special reports.

The percentage distribution of usage in both the Lansing office and district offices is shown in Figures 6 and 7, respectively.

Department personnel have developed a very useful method for extracting measurements from photolog film. A fiducial plate located in the camera film gate is marked to denote the exact center of optics, both horizontally and vertically, in each photograph. These center optic marks enabled the development of a grid system for determining approximate dimensions (See Figure 8 and Appendix B).

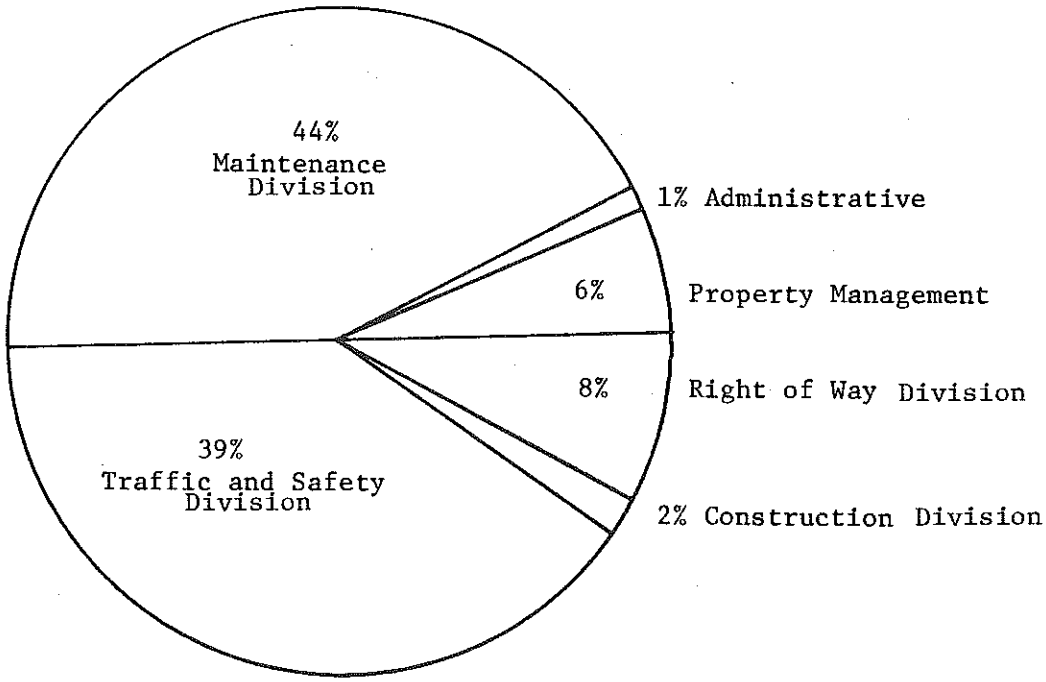
The viewing equipment and grid system provides the department with capability to utilize the photolog as a building block toward developing a mass computerized data file, such as a computerized trunkline signing inventory.

Figure 6
Lansing Office

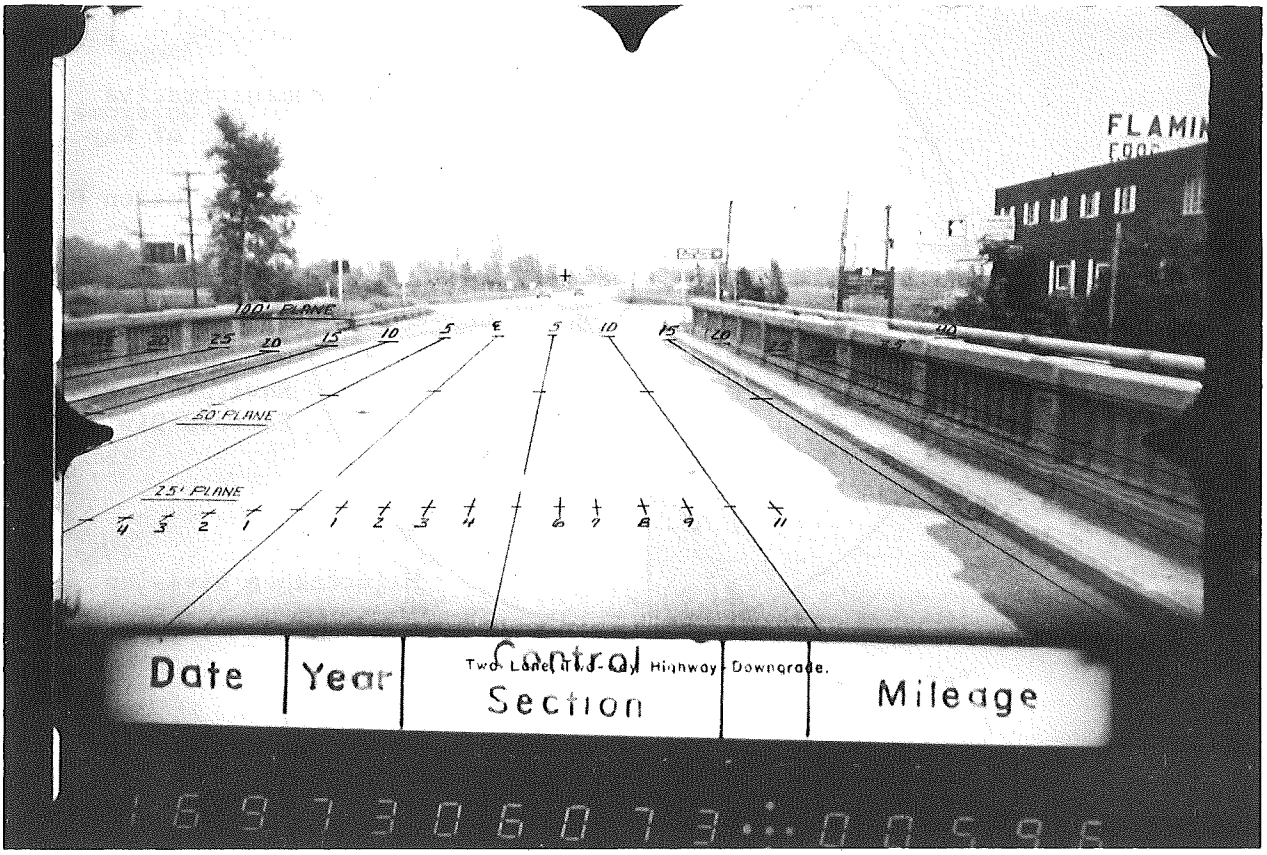


Percentage Distribution of Photolog Viewers

Figure 7
District Offices



Percentage Distribution of Photolog Viewers



Two Lane, Two-way Highway-Level.

FIGURE 8

A feasibility study of establishing a computerized sign (traffic control devices) inventory system to aid in the installation, control, maintenance, and modernization of traffic control devices has been completed, but design of the system and its implementation are awaiting completion of the current operational and systems analysis within the entire Traffic and Safety Division.

Cost Evaluation

Filming of the trunkline system was completed in June, 1975. The film was then edited into final format, except for the Metro District, and viewing equipment was purchased for seven of the nine district offices and the Lansing office. During 1972, 1973, and 1974, limited benefit accrued to the department since filming was incomplete and only two district offices were equipped with viewing equipment prior to 1975. A comparison of the Lansing office photolog viewers record (See Appendix C) for 1974 and 1975 indicates a 320 percent increase in use for that period (See Appendix D for cost saving estimates). The cost of refilming the trunkline system on a 2-year cycle, including labor and materials, will be approximately $118,000 per year (See Appendix E). The cost of photologging the state trunklines has been reduced from $16.75 to $12.60 per one-way mile.

Department savings during the 1975 calendar year for the Lansing and district offices was estimated to be $158,800. The total capital investment for the Photolog System was approximately $50,000 and the wages including travel and subsistence was approximately $91,000. Therefore the benefit-cost ratio is $1.60 (See Appendix G). That is, the department will realize a return of $1.60 for each $1 spent on the Michigan Photolog System. The estimated growing rate for savings during the next five years is approximately 20 percent annually; therefore the benefit-cost ratio should keep up concurrently.

Summary and Conclusions

As with all inventories, the original photolog film inventory will gradually become outdated due to new construction and maintenance activities. The usefulness of the system will diminish unless the photolog is kept current. The present 2-year refilming schedule is being continued by the department. The usage requirements in both the Lansing and district offices must be identified fully before a change in the refilming schedule is implemented. An irrational change may substantially reduce the viewer demand and overall effectiveness of the system.

A great deal of information about the trunkline system roadways is necessary to effectively manage a highway system. Roadway information should be readily accessible in a form suitable for the various needs of the department.

The photolog duplicates to some extent information found on as-constructed road plans, but it also provides information not available from those plans and, more importantly, it displays this information in a convenient and easily comprehensible manner.

In conclusion, the Michigan Photolog System has proven to be a valuable tool in overall management of the highway system. As experience with the photolog continues, new diversified uses not initially contemplated are expected to increase. With the convenience of available roadway information, the photolog permits personnel to become more familiar with the physical roadways system and encourages more efficient control of all facets of the roadway system.

APPENDIX

FIELD EQUIPMENT AND ACCESSORIES

APPENDIX A

The photolog vehicle (shown in Figure 1) is an 8-cylinder van type cab-over-engine truck that was selected to prevent the hood protrusion from blocking the view of the roadway immediately ahead of the vehicle. The storage area in the van accommodates a 4-cubic-foot AC/DC refrigerator unit, a Department-manufactured camera mount, bench seat, film changing bag, and extra safety lighting. The safety lighting on the roof of the vehicle consists of two 2-million-candlepower strobe lights mounted near the rear of the truck and a 1-million-candlepower strobe light mounted near the front. The safety lighting is important because the photolog vehicle is consistently being driven at lower than average speeds and must stop periodically to allow the crew to change film and program new data into the control box.

DISTANCE MEASURING INSTRUMENT

The Distance Measuring Instrument (DMI) is manufactured and distributed by Nu-Metrics, P.O. Box 489, R.D. 1, Vanderbilt, Pennsylvania 15486. The Nu-Metrics Model P-107 was selected for the photologging operation because the measurement units are in hundredths of a mile. The DMI measures from inside the vehicle while traversing the distance at virtually any speed. The numerical display's readout range is from .01 to 999.99 miles. The unit operates on power from the vehicle battery and is constructed with all solid-state integrated circuits.

The lighted readouts on the DMI are signals from a Di Prox proximity switch which is a noncontact integral sensor control that is mounted on the left rear wheel of the vehicle. The sensor is mounted approximately one-fourth inch away from the wheel which has ten tabs attached to the brake hub. Electrical pulses are created each time one of the tabs passes the sensor. The pulses are conveyed through electrical cables to the DMI, which converts the number of wheel rotations into the increments of measurement previously selected, and to the control box which triggers the camera shutter.

Camera:	Automax 35mm Cine/Pulse camera with data box and optics installed - Model G-2H fiducial marks at center of optics (horizontal and vertical).
Lens:	Auto Nikkon Lens, 24mm focal length F/2.8.
Control Box:	Photologging Control Unit - Model LA-1225 including 10 digit, 1 alpha L.E.D. information display and 5 digit L.E.D. mileage display.
Actuator:	Distance measuring unit - Model P-1072 displays in miles and 1/1000 of a mile and provides external output pulse every 1/1000 of a mile.
Mount:	Huber Camera Mount - Model 195-D
Film Type & Reel Length(s):	400 feet rolls of 35mm eastman color negative #5254 (approximately 64 miles of roadway).
Viewer/ Projector:	Vanguard Model M-35CS projection head with 750 watt lamp complete with one projection lens and control box. Vanguard Model S13 rear projection stand Vanguard Model S1 wall projection stand.
Splicer:	Maier Hancock 16-35mm film hot splicer.
Printer:	Let to contract.
Other:	Editing equipment needed:

a) Neumade Model 352 35mm two Hub film synchronizer

b) Neumade Model DR-2 35mm two reel capacity rewinds

c) Neumade 1000' aluminum 35mm split film reels

We also recommend a 3 cubic foot electric refrigerator which operates on 12 volts DC battery and 110 volts AC to store film in the vehicle.

METHODOLOGY OF PHOTOLOG GRID MEASUREMENT

APPENDIX B

The Photolog Grid was accomplished by choosing a typical roadway cross section, laying out a grid, and photographing it with a photolog vehicle. The grid was then projected on a Vanguard S1 rear projection screen and was developed by tracing the projected image. Accuracy checks were conducted by comparing measurements made from various films with field measurements at the actual sites, and it was found that from the center of the right lane of a 2-lane, 2-way roadway the horizontal measurements taken from the films were found to be within one foot up to 35 feet to the right of centerline and 25 feet to the left. The longitudinal and lateral measurements were found to be within one foot up to 50 feet in front of the camera location and two feet up to 100 feet in front of the camera location. Using the attached grid (Figure 8) to obtain vertical dimensions from a projected photograph, note that the bottom of the photograph is 14.5 feet in front of the camera location. In ascending order in the photograph, the next set of marks on the grid are 25 feet, 50 feet, and 100 feet in front of the camera location. For horizontal dimensions, each line in the grid represents 5 feet, except the small crosses at the 25-foot area which are one foot apart, thus enabling lane widths to be determined. Due to variations experienced where significant upgrade or downgrade conditions existed, the development of separate grids was required.

APPENDIX C

PHOTOLOG VIEWERS RECORD

YEAR 76

☑ LANSING OFFICE ☐ DISTRICT_____

1507 (10/75) PLEASE PRINT

Date	Name of Viewer	Number of Viewers	Division	Amount of Time Viewed (min.)	Control Section	Route Number	Zone (See Map)	Information Required	Was Required Information Provided? Yes	No	Was Field Trip Saved? Yes	No	Manhours Saved	Comments
8-24	D. Abbott	1	Design	10	82062	US 12	2-3	Underclearance Posting	X		X		4	Handy 1-300
8/24	G. Efelamaki	1	Traffic	10 Min	63053	I-96-10	2	Roadside Develop.	X		X		6	1-150
8/24	D. Abbott	1	Design	15 min	21022	US-2	13	Median Barrier Limits	X		X		4	3-450
8/24	M. Thomo	1	Traffic	30 min	82121	I96BS	2		X		X			1-150
8/24	D. Engelmann	1	T	5	39041	BL94	2	Signs survey	X			X		
8/24	Efelamaki	2	Traffic	20 min	58041	BL94	2	"	X		X			1-150
8/25	Weiss	1	Traffic	20	81103	M-14	2	"	X		X		6	1-150
	Galbraith	2	Maint	10	82221				X		X	X	2	
8/25	J. Meszaros	1	Traffic	1 hr	82193 83171	M-39	2	Yellow book project	X		X		8	1-150
8/25	S. Rathburn	1	T&S	10 min	09012	M-247	2	Roadside @ Inter.	X			X		
8/25	Barnes & Painter	2	T&S	1 hr	52041	M-28 US-41	14	Guardrail	X		X			3-750
8/25	J. MESZAROS	1	Traffic	1 hr	82192	M-39	2	Yellow book project	X		X		8	1-150
8/25	J. Jackson	1	Traffic	15 min	58011	M-95	15	Intersection	X		X		-	2-800
8/25	D. Wiertella	1	T&S	10 min	28051 83013	M-37	5	mile points	X			X	1/2	
8-26	L. Pearson	1	"	20	77023 49023 83031	M-21 US-2 US-131	3 4 9	Guardrail Install.	X		X			3-450
8-26	J. Reincke	1	Environ	15 min	02041	M-28	13	ROW - shore observ.	X			X	-	
8-26	H. Wong	2	Design	10 min	77132	M-25	4	Widening Project	X			X		It was helpful
8-27	Wessel	1	T&S	10 Min	47061	I-96BL	1	Geometrics	X		X			1-150
8-27	McMullan	1	A.B.	10 min	77022	M-21	3	General Rd condit	X		X		8	helpful 1-250
8-27	T. Bergquist	1	Design	20 min	63022	I-96BL	2	geometrics	X		X		8	1-150
8-27	D. Barnes	1	T&S	50 min	75021 75011	US-2	10	Guardrail	X		X			3-450
8-30	Wessel	1	T&S	10 min	46041	M-34	2	Geometrics	X		X			1-150
8/30	HoLoway	1	T&S	10 min	17042	US-2	10	Power Co. Support Structure	X		X		12	3-450
8/30	HoLoway	1	T&S	5 Min	58071	M-125	3	Cable Clearance		X		X		
8/30	Efelamaki	1	"	10 Min	39081	M-43	2	Drive Location	X		X		4	1-150
		29		8.44							7			17-30 5700

PHOTOLOG VIEWERS RECORD SUMMARY

YEAR 1975

☒ LANSING OFFICE

☐ DISTRICT _____

1507-A (N 10/75)

PLEASE PRINT

APPENDIX D

MONTH	A NUMBER OF VIEWERS MONTH/TOTAL	B NUMBERS OF HOURS VIEWED MONTH/TOTAL	C NUMBER FIELD TRIPS SAVED MONTH/TOTAL	D FIELD DAYS SAVED MONTH/TOTAL	E TRAVEL EXPENSES SAVED* (C × 2) $2.75 = MONTH/TOTAL	F OVER NIGHT TRAVEL EXPENSES SAVED* (D−C)×2×$27.50 MONTH/TOTAL	G VEHICLE MILES SAVED MONTH/TOTAL	H VEHICLE COST SAVED (6 × 0.09) = MONTH/TOTAL	I FIELD MANHOURS SAVED* (D × 16 hr.) = MONTH/TOTAL	J EST. OFFICE MANHOURS SAVED (LOG SHEETS) MONTH/TOTAL	K NET MANHOURS SAVED J − B + I MONTH/TOTAL	L TOTAL COST OF MANHOURS SAVED K × $8.00 MONTH/TOTAL	M TOTAL COST SAVED E+F+H+L MONTH/TOTAL
JAN.	50/ 50	54/ 54	23/ 23	34/ 34	127/ 127	605/ 605	6,168/ 6,168	555/ 555	544/ 544	132/ 132	622/ 622	4,976/ 4,976	6,263/ 6,623
FEB.	52/ 102	58/ 112	19/ 42	35/ 69	105/ 231	880/ 1,485	8,689/ 14,857	782/ 1,337	560/ 1,104	138/ 270	640/ 1,262	5,120/ 10,096	6,887/ 13,150
MAR.	82/ 184	78/ 190	29/ 71	40/ 109	160/ 391	605/ 2,080	9,277/ 24,134	835/ 2,172	640/ 1,744	268/ 538	830/ 2,092	6,640/ 16,736	8,240/ 21,390
APRIL	61/ 245	29/ 219	25/ 96	38/ 147	138/ 529	715, 2,795	9,737/ 33,871	876/ 3,048	608/ 2,352	234/ 772	813/ 2,905	6,504/ 23,240	8,233/ 29,623
MAY	92/ 237	47/ 266	36/ 132	52/ 199	198/ 727	880/ 3,675	13,824/ 47,695	1,244/ 4,292	832/ 3,184	341/ 1,113	1,126/ 4,031	9,008/ 32,248	11,330/ 40,953
JUNE	84/ 321	53/ 319	20/ 152	30/ 229	110/ 837	550/ 4,225	8,268/ 55,963	744/ 5,036	480/ 3,664	202/ 1,315	629/ 4,660	5,032/ 37,280	6,436/ 47,389
JULY	45/ 366	24/ 343	9/ 161	15/ 244	50/ 887	330/ 4,555	3,506/ 59,469	316/ 5,352	240/ 3,904	248/ 1,563	464/ 5,124	3,712/ 40,992	4,408/ 51,797
AUG.	109/ 475	42/ 385	29/ 190	52/ 296	160/ 1,047	1,265/ 5,820	14,100/ 73,569	1,269/ 6,621	832/ 4,736	423/ 1,986	1,213/ 6,337	9,704/ 50,696	12,398/ 64,195
SEPT.	108/ 583	31/ 416	35/ 225	53/ 349	193/ 1,240	990/ 6,810	12,800/ 86,369	1,152/ 7,773	848/ 5,584	325/ 2,311	1,142/ 7,479	9,136/ 59,832	11,471/ 75,666
OCT.	122/ 705	52/ 468	58/ 283	63/ 412	319/ 1,559	275/ 7,085	10,950/ 97,319	986/ 8,759	1,008/ 6,592	366/ 2,677	1,322/ 8,801	10,576/ 70,408	12,156/ 87,822
NOV.	92/ 797	27/ 495	46/ 329	55/ 467	253/ 1,812	495/ 7,580	9,200/ 106,519	828/ 9,587	880/ 7,472	120/ 2,797	973/ 9,774	7,784/ 78,192	9,360/ 97,182
DEC.	108/ 905	29/ 524	47/ 376	66/ 533	259/ 2,071	1,045/ 8,625	13,300/ 119,819	1,197/ 10,784	1,056/ 8,528	112/ 2,909	1,139/ 10,913	9,112/ 87,304	11,613/ 108,795

** TWO EMPLOYEES PER FIELD TRIP*

1557-A (N 10/75)

PHOTOLOG VIEWERS RECORD SUMMARY

YEAR 1974

☒ LANSING OFFICE

☐ DISTRICT _____

PLEASE PRINT

MONTH	A NUMBER OF VIEWERS MONTH/TOTAL	B NUMBERS OF HOURS VIEWED MONTH/TOTAL	C NUMBER FIELD TRIPS SAVED MONTH/TOTAL	D FIELD DAYS SAVED MONTH/TOTAL	E TRAVEL EXPENSES SAVED* (C × 2) $2.75 = MONTH/TOTAL	F OVER NIGHT TRAVEL EXPENSES SAVED* (D−C)×2×$27.50 MONTH/TOTAL	G VEHICLE MILES SAVED MONTH/TOTAL	H VEHICLE COST SAVED (6 × 0.09) = MONTH/TOTAL	I FIELD MANHOURS SAVED* (D × 16 hr.) = MONTH/TOTAL	J EST. OFFICE MANHOURS SAVED (LOG SHEETS) MONTH/TOTAL	K NET MANHOURS SAVED J − B + I MONTH/TOTAL	L TOTAL COST OF MANHOURS SAVED K × $8.00 MONTH/TOTAL	M TOTAL COST SAVED E+F+H+L MONTH/TOTAL
JAN.	5/ 5	5/ 5	1/ 1	1/ 1	6/ 6	0/ 0	250/ 250	23/ 23	0/ 0	48/ 48	43/ 43	344/ 344	373/ 373
FEB.	0/ 5	0/ 5	0/ 1	0/ 1	0/ 6	0/ 0	0/ 250	0/ 23	0/ 0	0/ 48	0/ 43	0/ 344	0/ 373
MAR.	1/ 6	1/ 6	0/ 1	0/ 1	0/ 6	0/ 0	0/ 250	0/ 23	0/ 0	6/ 54	5/ 48	40/ 384	40/ 413
APRIL	2/ 8	1/ 7	1/ 2	3/ 4	6/ 12	110/ 110	1,000/ 1,250	90/ 113	48/ 48	8/ 62	55/ 103	440/ 824	646/ 1,059
MAY	6/ 14	2/ 9	1/ 3	3/ 7	3/ 15	110/ 220	1,000/ 2,250	90/ 203	48/ 96	20/ 82	66/ 169	528/ 1,052	731/ 1,790
JUNE	11/ 25	6/ 15	3/ 6	5/ 12	17/ 32	110/ 330	1,550/ 3,800	140/ 343	80/ 176	56/ 138	130/ 299	1,040/ 2,092	1,307/ 3,097
JULY	76/ 101	40/ 55	24/ 30	39/ 51	132/ 164	825/ 1,155	11,000/ 14,800	990/ 1,333	624/ 800	274/ 412	858/ 1,157	6,864/ 8,956	8,811/ 11,908
AUG.	24/ 125	22/ 77	9/ 39	12/ 63	50/ 214	167/ 1,322	2,275/ 17,075	205/ 1,538	192/ 992	77/ 489	247/ 1,404	1,976/ 10,932	2,398/ 14,306
SEPT.	34/ 159	26/ 103	20/ 59	26/ 89	110/ 324	330/ 1,652	6,175/ 23,250	556/ 2,094	416/ 1,408	45/ 534	435/ 1,839	3,480/ 14,412	4,476/ 18,782
OCT.	46/ 205	33/ 136	23/ 82	36/ 125	127/ 451	715/ 2,367	9,125/ 32,375	821/ 2,915	576/ 1,984	102/ 636	645/ 2,484	5,160/ 19,572	6,823/ 25,605
NOV.	50/ 255	35/ 171	20/ 102	41/ 166	110/ 561	1,155/ 3,522	12,675/ 45,050	1,141/ 4,056	656/ 2,630	190/ 826	811/ 3,295	6,488/ 26,060	8,994/ 34,599
DEC.	35/ 285	30/ 201	16/ 118	24/ 190	88/ 649	440/ 3,962	6,025/ 51,075	542/ 4,598	384/ 3,014	104/ 930	458/ 3,753	3,664/ 29,724	4,734/ 39,333

FILMING COST ANALYSIS

APPENDIX E

The cost to film each 1-way mile of roadway is tabulated below:

Initial Costs

(Includes Labor, Equipment and Materials)

Project Cost / Total Miles	$313,000 / 18,681	=	$16.75/1-way mile

Refilming on a 2-year cycle

(Maintenance, Labor and Materials)

Estimated Cost / Total Miles	$236,000 / 18,681	=	$12.60/one-way mile

The cost breakdown for refilming is:

Maintenance	$ 1,000	
Negatives	30,000	(includes processing)
Prints	23,000	(two positive prints)
Staff	182,000	(includes travel and subsistence)
	$236,000	(2 years)

The cost of processing a 400-foot reel of negative film and a positive film print is $98. Maintenance costs on the photolog equipment during the grant periods were minimal due to equipment warranties and newness of equipment.

COST BENEFIT ANALYSIS

APPENDIX F

1. Equipment Cost

Total capital investment for Photolog System was $50,000. The capital recovery factor for photo equipment is based upon an eight-year service life at 6 percent annual interest rate. The annual capital recovery value factor is 0.1610.

Therefore, the annual equipment cost is:

$$\$50,000 \times 0.1610 = \$8,050$$

2. Total wages and travel expenditures for the Photolog Subunit during 1975 was $91,000.

3. Benefit for 1975:

Department savings accummulated in Lansing office	$108,795
Estimated savings for district offices	50,000
Total Savings	$158,795

Therefore the Benefit-Cost Ratio is:

$$(3)/(1)+(2) = \frac{158,795}{8050+91000} = 1.603$$

The estimated growing rate for savings during the next five years is approximately 20 percent annually; therefore, the benefit-cost ratio will keep up concurrently.