EVALUATION OF
FLEXIBLE PLASTIC GLARE SHIELD
IN OREGON

by

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Prepared for

FEDERAL HIGHWAY ADMINISTRATION

Washington, D.C. 20590

May 1981

NOTICE

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FIGURES

INTRODUCTION

This experimental features project was approved by the Department of Transportation, Federal Highway Administration, on July 11, 1973. A four-mile section of flexible plastic glare screen was installed on top of the existing concrete median barrier on the Baldock Freeway in September of 1974. This is a six-lane, high-volume section with lineal illumination and a designated speed of 55 mph. Amber reflectors were installed at the same time.

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PURPOSE: The purpose of this report is to summarize the data collected when flexible plastic glare screen was installed on the concrete median barrier on the I-5 Baldock Freeway in Portland, Oregon.

PROBLEM: There was little national experience, evaluation, or technical information on the use of flexible plastic headlight glare shields.

SCOPE: Included in this report are the following:

(1) Design data.

(2) Before and after studies of the number of accidents and the number of times a vehicle hit the GM barrier.

(3) Costs for both installation and maintenance.

(4) A review of the performance and recommendations for

improvement in the design of the attachment mechanism.

(5) Pictures, where possible.

DESIGN DATA

In general, 24-inch high blades were used. Some 14 and 18-inch blades were required to maintain horizontal sight distance for traffic on the outside of sharp curves. Spacing varied from 21 inches on the sharpest curve, to 48 inches on tangent sections. All were mounted at a 45 degree angle.

The installation detail is shown in Figure 1, Appendix A.

ACCIDENT STUDIES

Dennis Peterson, Region Traffic Engineer, Metropolitan Section, completed a report on the "Effect of Glare Screen on Freeway Accidents" in February, 1976. The full report is attached as Appendix A. In summary, before and after analyses show that fewer vehicles hit the barrier when the glare screen was in place; however, the data is not from identical months so it is difficult to draw positive conclusions. For the one month that was the same, August, there was a 50 percent reduction in the number of hits to the barrier. This percentage held for both the total hits and the hits at night. The amber reflectors, installed at 25 foot intervals along with the glare screen, may have been responsible for this reduction. The reflectors could have been installed without the glare shield.

The analysis of reported accidents showed an increase from 0.51 to 0.58 accidents per million vehicle miles after the installation of the shields. One-third of the accidents occurred at night in both periods of the study.

INSTALLATION AND MAINTENANCE

The initial installation cost was $89,100. The contractor was well organized and completed the project in 18 eight-hour shifts.

Most of the maintenance costs are incurred establishing traffic control in order to replace damaged blades, so replacement is not feasible on a one-by-one basis. Available maintenance costs are summarized as follows:

Date	Labor & Equipment	Number of Paddles	Cost	Average Cost Per Paddle	Length of Service Period
April 1975	---	44	$703.00*	$15.98	6 months
Jan 1976	$500.71	17	$156.25	$38.65	9 months

*includes labor and equipment

The average cost in 15 months was approximately $91 per month or about $22 per paddle replaced.

Repair generally involved drilling new holes close to the original ones, inserting new expansion bolts, and patching the damaged holes with grout.

The reflectors became quite dirty and less effective with time. They were washed once following a sweeping operation. This took a two-man crew seven hours. It was felt that closing a lane of the freeway to wash the reflectors could not be economically justified.

DESIGN REVISION

The mounting bracket used on the project used a single anchor bolt at the center of the base plate. Nine months after installation, the maintenance crew reported frequent loosening of the anchor bolts caused, presumably,

by the truck pressure wave. The loosening allowed the blades to rotate from their intended 45 degree angle to traffic, thus reducing their effectiveness. Over-torquing the single, center mounting bolt caused the base plates to warp which, in turn, reduced the contact area between the concrete barrier and the base plate. This warping aggravated the tendency of the blades to rotate. A further problem with the center mounting bolt was that the blade had to be disassembled in order to tighten the anchor bolt. The bracket was subsequently redesigned to use two anchor bolts at opposite corners of the base plate. An additional modification involved bending the bolts used to mount the blades to the base plates at a 30 degree angle. This eliminated the need for beveled washers required to fit the somewhat elliptical shape of the blades. The original design is shown in Figure 1 and the revision is shown in Figure 2. This revised mounting bracket is now being used exclusively.

PICTURES AND PUBLIC REACTION

No comment was solicited from the public and none was received. Staff comment noted a marked improvement in driver comfort.

Figure 3 shows the paddles on a curve. Figures 4 and 5 show a daytime view and a nighttime view, both taken from the same position near the end of a section.

CONCLUSIONS:

1. This glare screen installation has satisfactorily minimized headlight glare.
2. While there has not been a reduction in accidents with the shields in place, the number of hits to the barrier has been

CONCLUSIONS (cont'd)

significantly reduced. The reduction in hits may have been due to the amber reflectors which were installed at the same time.

3. There is a significant increase in driver comfort.
4. By replacing the paddles at a six to nine month interval, the maintenance cost is not excessive.
5. Closing a lane of the freeway to wash the reflectors is not justified.
6. The mounting bracket should contain two anchor bolts to prevent rotation of the blades and the bolt that holds the paddle to the bracket should be bent at a 30 degree angle.

APPENDIX

OREGON STATE HIGHWAY DIVISION

Metropolitan Section

Effect of Glare Screen on Freeway Accidents

February 1976

Introduction

Oregon's first paddle-type glare screen, mounted on top of concrete GM median barrier, was installed on a four-mile section of the Baldock Freeway (I-5) in September 1974. This is a six-lane, high-volume freeway with lineal illumination and a designated speed of 55 m.p.h.

The concrete GM barrier had been in place prior to the addition of the glare screen. This afforded an opportunity to test the effectiveness of the glare screening on drivers performance. The effectiveness of the glare screen has been evaluated with "before" and "after" studies of the reported accidents and of the number of times vehicles hit the GM barrier.

Design Data

Figure 1 shows the height and spacing of the flexible plastic paddles. In general, 24-inch high blades were used. This blade height was reduced on two curves in order to maintain adequate stopping sight distance. Spacing varied from 21 inches on the sharpest curve, to 48 inches on tnagent sections. All paddles were mounted at a 45 degree angle.

Daytime and nighttime views are illustrated in Figures 2, 3, and 4.

Construction Costs and Time

Installation was by contract. Final costs for all work was $89,100. As a result of thorough advance work planning and mobilization, the contractor was able to complete the project in 18 eight-hour shifts.

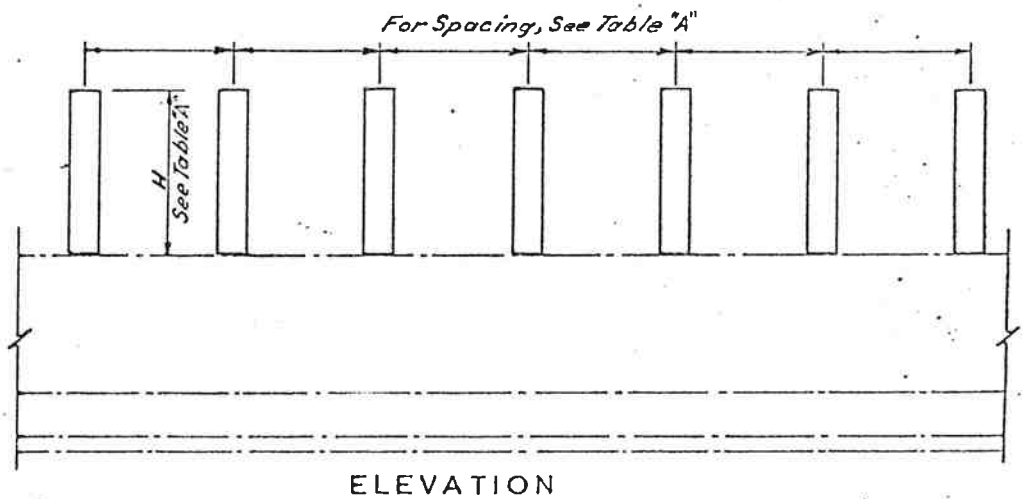
MARQUAM BR.-S.W. SPRING GARDEN ST. SEC. PACIFIC HIGHWAY MULTNOMAH COUNTY				SHEET No.
FED. ROAD Div. No.	STATE	PROJECT NUMBER	FISCAL YEAR	TOTAL SHEETS
10	OREGON	I-5-6(79)297		See Index

TABLE "A"

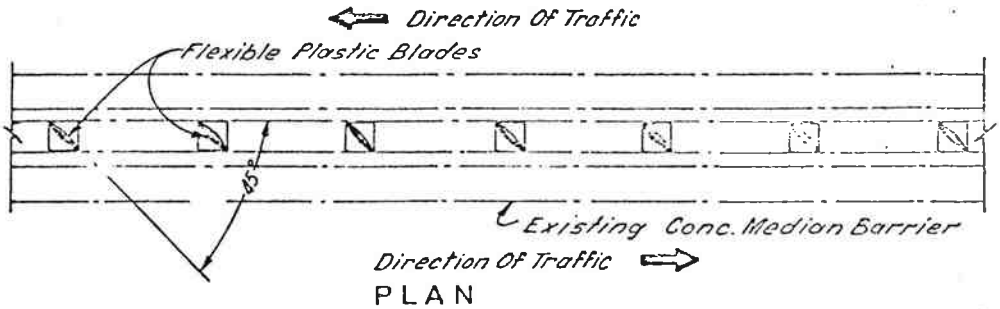
STATION To STATION	FLEXIBLE PLASTIC BLADES						
	Number Req'd. H			Spacing Center To Center			
	14"	18"	24"	1'-9"	2'-0"	2'-6"	4'-0"
71+30 - 88+02			419				✓
88+02 - 99+12			444			✓	
99+12 - 117+00			447				✓
117+00 - 145+00			1120			✓	
145+00 - 153+50		425			✓		
153+50 - 168+50			600			✓	
168+50 - 182+50			350				✓
182+50 - 192+50			400			✓	
192+50 - 199+50			175				✓
199+50 - 200+50			40			✓	
200+50 - 202+50		100			✓		
202+50 - 217+20	840			✓			
217+20 - 219+20		100			✓		
219+20 - 279+77.5			2423			✓	

TABLE "B"

H (See Table "A")	BLADES	
	Length Req'd. (Millimeters)	Total No. Req'd.
14"	355	840
18"	455	625
24"	605	6418



ELEVATION



PLAN

GLARE SHIELD INSTALLATION DETAIL

FIGURE 1

Study Procedure

Four months prior to the glare screen installation, the GM rail was painted to obliterate all tire marks. Two men, traveling in a pickup, were assigned the duty of monitoring the rail each morning and evening. They kept a record of new tire marks by time of day (morning and evening) and by location, for a period of 92 consecutive days, or three calendar months. These months; August, September, and October 1973, constituted the "before" period.

This same procedure was used after the installation of the glare screen to gather data for comparative purposes. Extenuating circumstances precluded using the same three calendar months. The "after" period is represented by the months of June, July, and August 1975.

Weather records were maintained and are included in Appendix A.

GM Rail Hit Data

Table 1 shows the total daytime and nighttime hits by month and direction.

Table 1

GM RAIL HITS

Month	Before (1973) Northbound	Before (1973) Southbound	After (1975) Northbound	After (1975) Southbound
June	-	-	8	13
July	-	-	1	7
August	5	7	5	1
September	16	5	-	-
October	7	6	-	-
Totals	28	18	14	21
Both directions	46		35	

It appears there were fewer cases of vehicles hitting the GM rail after the installation of glare screen; however, because the "before" and "after" data were not obtained during the same three calendar months, no valid conclusions should be drawn from these data.

The same rationale should be followed when examining the difference in total hits occurring during the hours of darkness as shown in Table 2.

Table 2

GM RAIL HITS (DARK HOURS)

	Before (1973)		After (1975)	
Month	Northbound	Southbound	Northbound	Southbound
June	-	-	4	6
July	-	-	0	3
August	3	3	2	1
September	5	2	-	-
October	7	6	-	-
Totals	15	11	6	10

Both directions 26 16

The locations of the hits shown in Table 1 and 2 are portrayed on hit spot maps in Appendix B.

Accident and Volume Data

Accident records as reported to the Motor Vehicles Division were prepared for an 11-month period before and after the glare screen installation. They are summarized in Tables 3 and 4. Monthly average daily traffic statistics were obtained from a permanent recorder in the test section and are tabulated in Table 5.

There were 60 reported accidents in the "after" period as compared to 49 in the "before" period. Traffic volumes were up 7 per cent in the "after" period, resulting in an accident rate increase from 0.51 accidents per million-vehicle miles in the "before" period, to 0.58 in the "after" period. Accidents occurring during the hours of darkness accounted for one third of the total in both periods of study. On the basis of these data, there is no evidence that glare screening enhanced the safety on this section.

OREGON STATE HIGHWAY DIVISION
TRAFFIC ENGINEERING SECTION
ACCIDENT ANALYSIS
COLLISION DIAGRAM

City of Portland Before Period County Multnomah
Intersection of Baldock Frwy. and M.P. 296.00
Highway Number 1 (I5) to M.P. 299.54
Period Covered 10-1-73 8-31-74
Compiled by [illegible] Drawn by _____ Date 12-8-75

LEGEND

- Person Killed
- Pedestrian Killed
- Person Injured
- Pedestrian Injured
- Property Damage Only
- Collision – Rear-end
- Collision – Head-on
- Collision – Sideswipe

BEFORE

- Path of Pedestrian
- Path of Vehicle
- Path of Animal
- Vehicle Moving
- Vehicle Stopped
- Vehicle Backing
- Properly Parked
- Improperly Parked
- Vehicle Overturned
- Vehicle Skidded

Day - 33
Nite - 16
Before Study Total - 49

Collision Type	10-1-73 – 12-31-73 Fatal	Non-fatal	Prop. Damage	Total	1-1-74 – 8-31-74 Fatal	Non-fatal	Prop. Damage	Total									Total Fatal	Non-fatal	Prop. Damage	Total
Angle							1	1											1	1
Head-on																				
Rear-end		4	7	11		6	10	16										10	17	27
Sideswipe		3		3		5	4	9										8	4	12
Turning Movement																				
Parking																				
Non-collision																				
Fixed Object		3	1	4		2	2	4										5	3	8
Pedestrian						1		1										1		1
Backing																				
Misc.																				
TOTAL		10	8	18		14	17	31										24	25	49

Form E-261-6-70

TABLE 3

OREGON STATE HIGHWAY DIVISION
TRAFFIC ENGINEERING SECTION
ACCIDENT ANALYSIS
COLLISION DIAGRAM

City of Portland County Multnomah
Intersection of Baldock Frwy. (After Period) and MP. 296.00
Highway Number 1 (I 5) To MP. 299.54
Period Covered 10-1-74 8-31-75
Compiled by [illegible] Drawn by _____ Date 12-9-75

LEGEND

- Person Killed
- Pedestrian Killed
- Person Injured
- Pedestrian Injured
- Property Damage Only
- Collision – Rear-end
- Collision – Head-on
- Collision – Sideswipe

AFTER

- Path of Pedestrian
- Path of Vehicle
- Path of Animal
- Vehicle Moving
- Vehicle Stopped
- Vehicle Backing
- Properly Parked
- Improperly Parked
- Vehicle Overturned
- Vehicle Skidded

Fatal: MP. 299.55 7:10 P.M.
Cldy 4-17-75
Dry
Day
Nbd Truck 4/c
Struck Br. column

Day - 39
Nite - 21
Total - 60

After Study

Collision Type	10-1-74 - 12-31-74				1-1-75 - 8-31-75															
	Fatal	Non-fatal	Prop. Damage	Total	Fatal	Non-fatal	Prop. Damage	Total	Fatal	Non-fatal	Prop. Damage	Total	Fatal	Non-fatal	Prop. Damage	Total	Fatal	Non-fatal	Prop. Damage	Total
Angle																				
Head-on																				
Rear-end		7	5	12		10	8	18										17	13	30
Sideswipe		1	5	6		4	5	9										5	10	15
Turning Movement																				
Parking																				
Non-collision		1		1														1		1
Fixed Object		2	2	4	1	5	4	10									1	7	6	14
Pedestrian																				
Backing																				
Misc.												-								
TOTAL		11	12	23	1	19	17	37									1	30	29	60

Form E-261-6-70

TABLE 4

TABLE 5

AVERAGE DAILY TRAFFIC

BALDOCK FREEWAY (I-5)

Before		After	
Month	ADT	Month	ADT
October '73	76254	October '74	75694
November	73312	November	75150
December	67478	December	72400
January '74	60468	January '75	71679
February	62404	February	72890
March	68603	March	78409
April	71835	April	79422
May	74477	May	78229
June	78754	June	82314
July	77276	July	78792
August	81137	August	83387
Average	72000	Average	77100

Repair Costs

During the first six months, a total of 44 paddles were damaged by vehicles. In a one-and-a-half-day operation, repairs were made at a cost of $700. This cost reflects material (31 new paddles and brackets), equipment rental, and labor charges.

Damage repair primarily involved drilling new holes within an inch or two from the original, inserting a new expansion bolt, and patching the damaged hole with grout. The actual repair operation ran very smoothly. Most of the operation time was spent setting up traffic control for the work area.

The only other paddle maintenance has been cleaning the reflectors. When the paddles were initially installed, reflectors were bright and effective. During the winter months they became quite dirty and ineffective. The reflectors were washed by a two-man crew following a sweeping operation. This took seven hours to accomplish. One comment was received that the paddles were dirty. Unless a quick, simple way to wash them can be found, washing is not justified.

Because of higher winter maintenance priorities, repairs were not accomplished during the winter months. This resulted in a relatively low maintenance cost per paddle. Evaluation of cost and appearance of the damage will be used in the future to determine the frequency of repairs. It would require about two crew-hours to repair one damaged paddle.

Initial reaction, upon installation of the paddles, was that they would put us back into the median repair business again. Our experience has now shown us that traffic exposure time in this pursuit is minimal. Overall, the installation is serviceable. There are few minor problems with the hardware used, but these could be revised on future contracts.

Conclusions

Based upon the results of this study, comments from highway users and other observations, the following conclusions are offered:

1. This glare screen installation has satisfactorily minimized head light glare;

2. The cost of maintaining this glare screen atop the GM barrier is minimal;

3. The glare screen affords driving comfort during both daylight and darkness;

4. The motoring public favorably accepted the glare screen; and

5. The glare screen does not reduce the accident experience on freeways with illumination.

APPENDIX A

WEATHER RECORDS

DRY AND WET DAYS

Baldock Freeway (I-5)

1973

	August	September	October
1	D	D	D
2	D	D	D
3	D	D	D
4	D	D	D
5	D	D	D
6	D	W	W
7	D	W	W
8	D	D	D
9	D	D	D
10	D	D	D
11	D	D	W
12	D	D	D
13	D	D	W
14	D	D	D
15	D	D	D
16	D	D	D
17	D	W	D
18	D	D	D
19	D	W	D
20	D	W	W
21	D	W	W
22	D	W	D
23	D	W	W
24	D	W	W
25	D	D	W
26	D	D	D
27	D	D	D
28	D	D	W
29	D	D	D
30	D	D	D
31	D	-	W

DRY AND WET DAYS

Baldock Freeway (I-5)

1975

	June	July	August
1	D	W	D
2	D	D	D
3	D	D	D
4	D	D	D
5	D	D	D
6	D	D	D
7	D	D	D
8	D	D	W
9	D	D	D
10	D	D	D
11	D	D	D
12	D	D	D
13	D	D	D
14	D	D	D
15	D	D	D
16	D	D	D
17	W	D	W
18	D	D	W
19	W	D	D
20	D	D	D
21	D	D	D
22	D	D	W
23	W	D	D
24	W	D	D
25	D	D	D
26	W	D	D
27	D	D	D
28	D	D	W
29	D	D	W
30	W	D	W
31	-	D	D

APPENDIX B

VEHICLE HITS AGAINST THE GM BARRIER

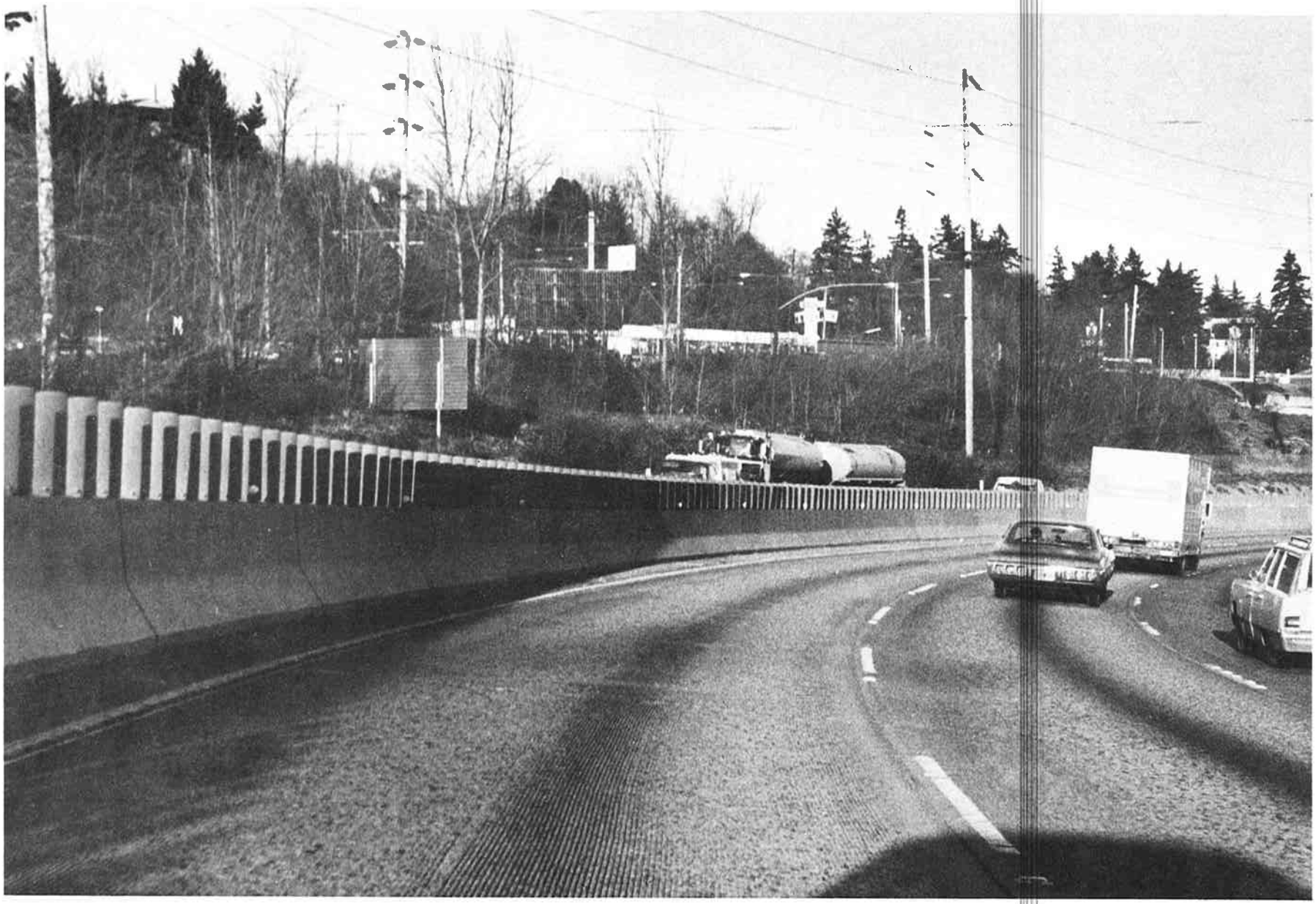


Figure 3

Northbound on a curve. Note reflectors at base of 24-inch paddles. Spacing 30 inches.

Figure 4

Southbound near end of section. 24-inch paddles, 30-inch spacing.

Figure 5

Southbound night view at same locations shown in Figure 4. Note contrast in headlight glare on section with and without screening.

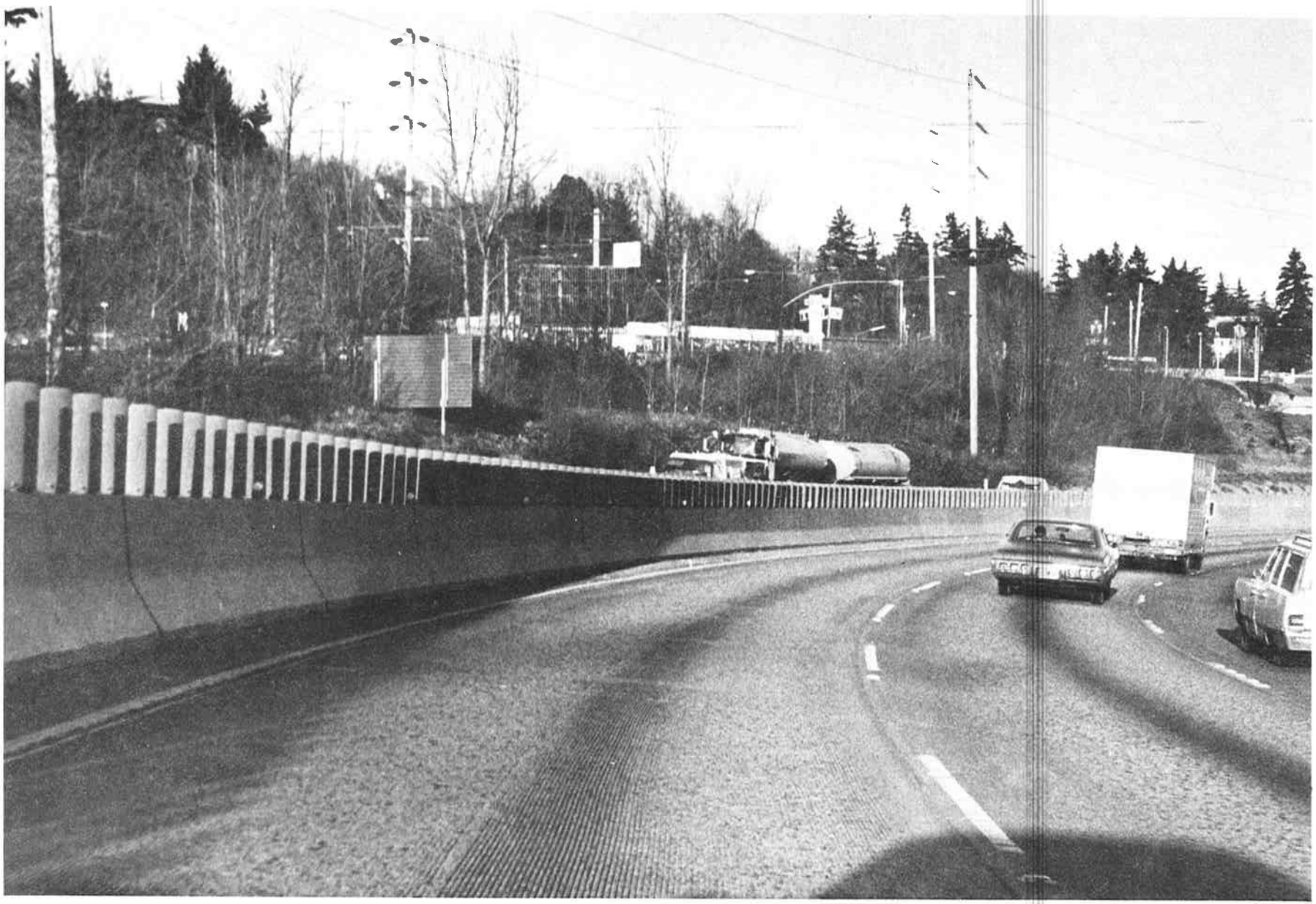


Figure 2

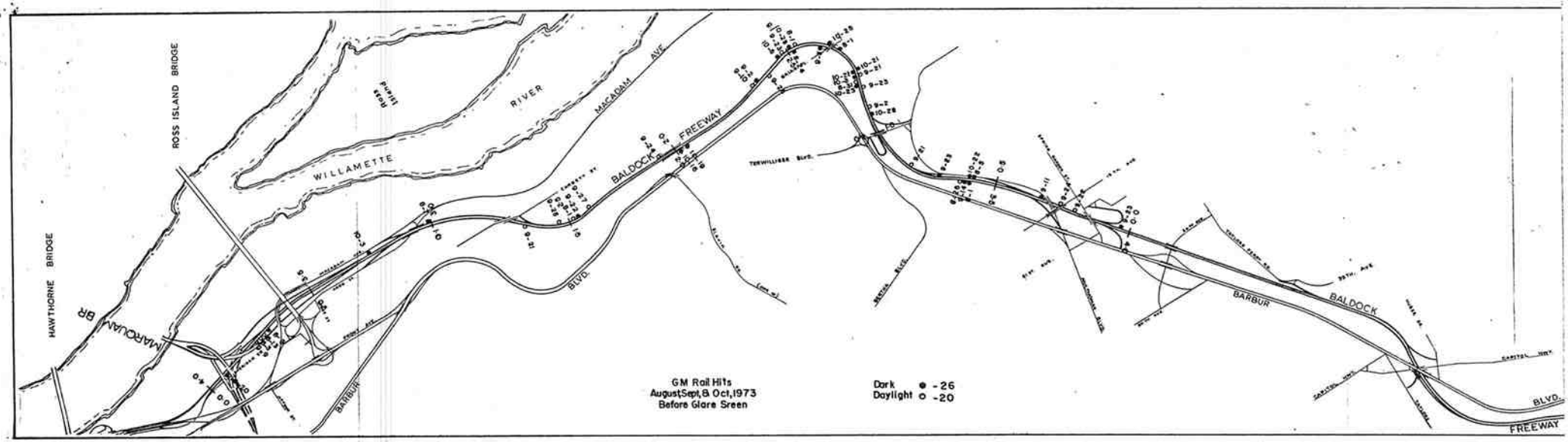
Northbound on a curve. Note reflectors at base of 24-inch paddles. Spacing 30 inches.

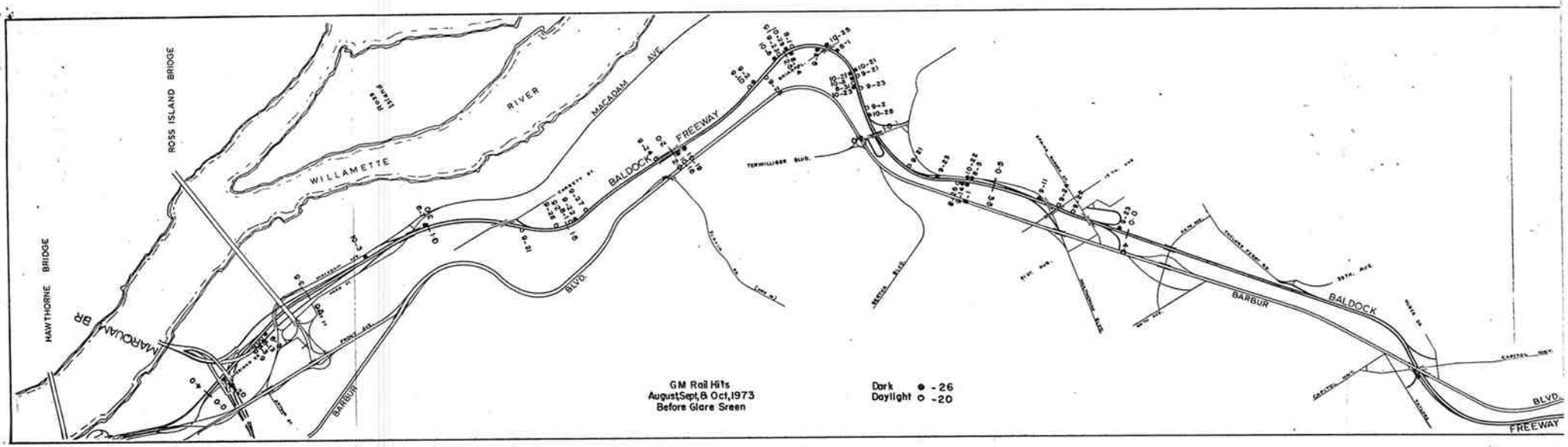
Figure 3

Southbound near end of section. 24-inch paddles, 30-inch spacing.

Figure 4

Southbound night view at same locations shown in Figure 3. Note contrast in headlight glare on section with and without screening.


ROSS ISLAND BRIDGE
HAWTHORNE BRIDGE
WILLAMETTE
RIVER
MACADAM AVE.
BALDOCK
FREEWAY
BLVD.
BARBUR
MARQUAM BR
GM Rail Hits
August, Sept, & Oct, 1973
Before Glare Screen
Dark ● -26
Daylight ○ -20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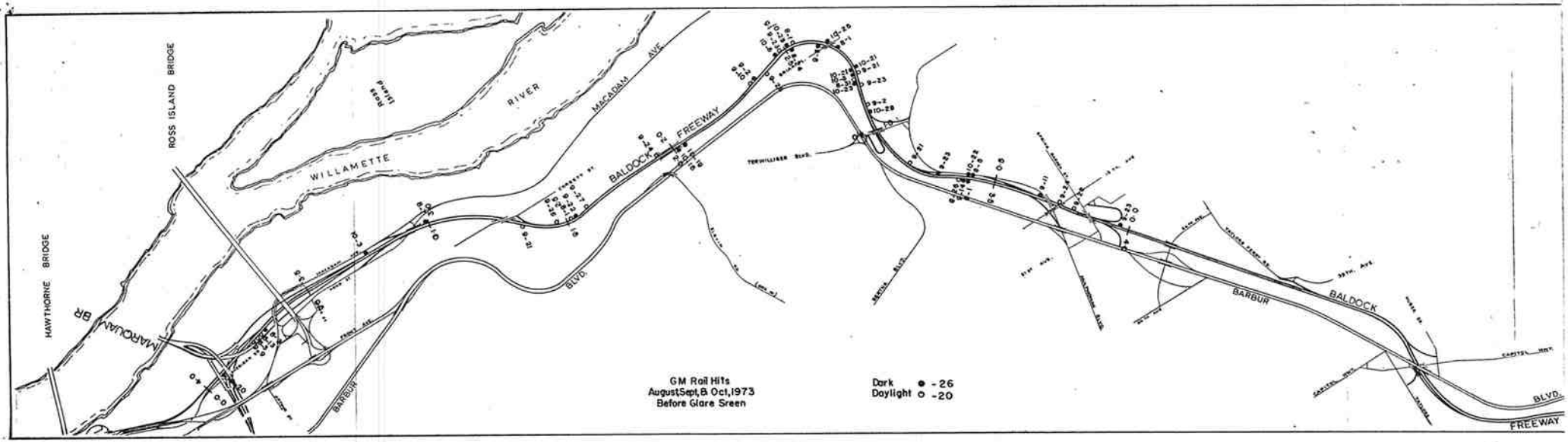
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