EVALUATION OF LOW PROFILE LIGHTS FOR PAVEMENT DELINEATION

Report TSD-TR-106-69

TRAFFIC and
SAFETY
DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

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By

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Conducted by

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January 1969

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CONCLUSIONS

This study shows the low profile lights were a definite benefit in the guidance of the motor vehicle and delineation of this traffic island.

After newly designed high-rise covers were installed, the low profile lights required little maintenance. The original low profile covers are apparently not suitable for roadway use when snow and ice removal devices are used.

The cost analysis of this 16-unit installation shows the purchase price of each complete unit to be approximately $65 per unit. The installation costs were $110 per unit. The maintenance costs of relamping and power consumption was $2.33 per unit for each month of service.

The reduction in frequency of flasher panel knockdowns has provided a savings of $100 per month. The total costs involved with this low profile light installation, plus required maintenance would equal the above savings after four years of operation. (See Figure V.) This is exclusive of safety and economic benefits to the public involved in striking the flasher panel.

On the basis of cost benefit considerations, it is recommended that this item be termed "operational" and continued in use at this location.

In view of the excellent experience at this installation, it is recommended that consideration be given to the use of low profile lights at other locations with extremely high accident experience and very high ambient and background light interference.

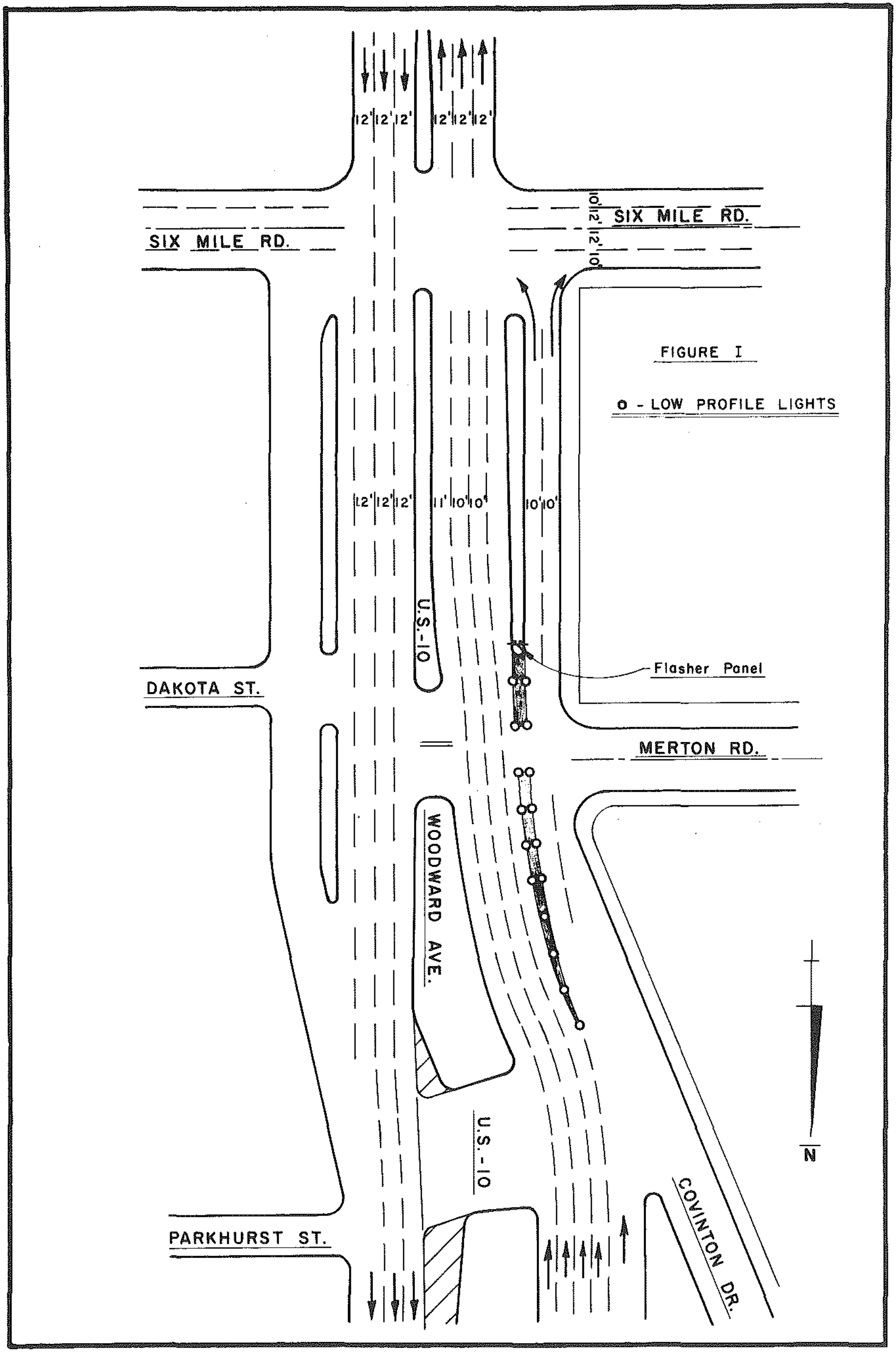
DISCUSSION

Delineation of the roadway path is a problem which faces every traffic engineer today. In rural areas, delineation of the roadway is accomplished with the use of reflective materials, due to the lack of interference from ambient and background lights. In urban areas, the delineation of the roadway does present a complex problem to the traffic engineer. This problem occurs when the amount of ambient and background light from street lights, stores and brilliantly illuminated advertising signs often cause the use of reflective materials for delineation to be almost totally ineffective. This is particularly true in urban areas where dirt, grime and salt deposits occur. In locations such as this, the use of flasher panels or illuminated "Keep Right" signs are usually sufficient delineation for traffic islands or other types of obstructions.

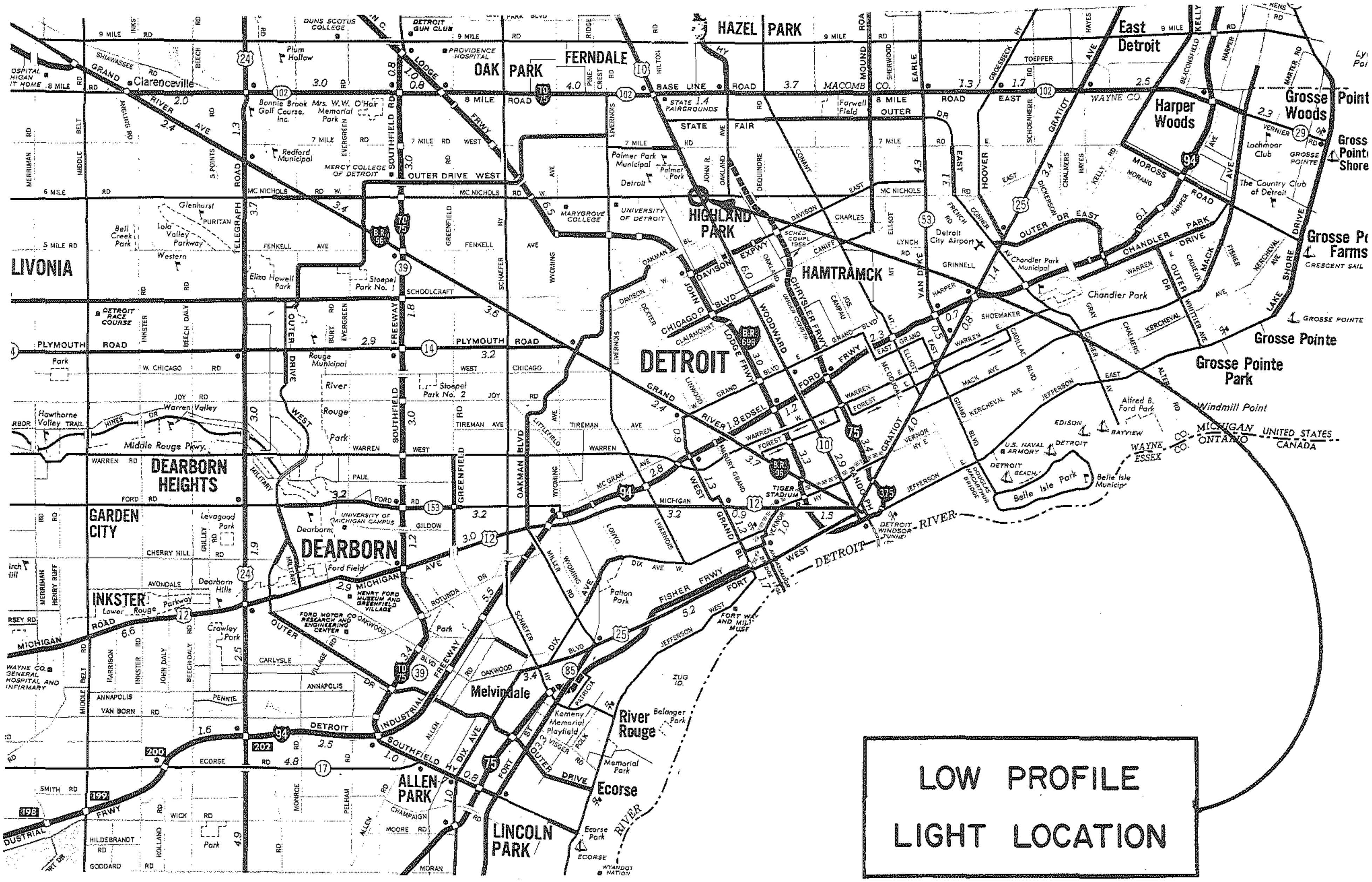
As in all traffic engineering work, there are locations where, when normal engineering practices are applied, the desired result is never achieved. At this type of location, it was decided to install and evaluate a low profile light method of delineation.

LOCATION

The location used for this experimental installation was southbound US-10 (Woodward Avenue) at Merton just north of Six Mile Road in the City of Detroit. Figure I is a schematic of the roadway showing the geometrics of the location. You will notice there are five lanes entering on a curve and becoming six lanes with an island separation. The two lanes to the right of the island are designated: One for "left turns only" and one for "right turns only" onto Six Mile Road. At Six Mile Road southbound, Woodward Avenue becomes only three lanes, which indicates a large amount of traffic using the turn lanes to the right of the traffic island.



12' 12' 12' 12' 12' 12'
SIX MILE RD.
SIX MILE RD.
10' 12' 12' 10'
FIGURE I
o - LOW PROFILE LIGHTS
12' 12' 12' 11' 10' 10' 10' 10'
U.S.-10
Flasher Panel
DAKOTA ST.
MERTON RD.
WOODWARD AVE.
U.S.-10
N
PARKHURST ST.
COVINTON DR.


LOW PROFILE
LIGHT LOCATION
LIVONIA
DEARBORN HEIGHTS
GARDEN CITY
DEARBORN
INKSTER
OAK PARK
FERNDALE
HAZEL PARK
HIGHLAND PARK
HAMTRAMCK
DETROIT
East Detroit
Harper Woods
Grosse Point Woods
Grosse Pointe Shore
Grosse Pointe Farms
Grosse Pointe
Grosse Pointe Park
Melvindale
River Rouge
Ecorse
ALLEN PARK
LINCOLN PARK
Clarenceville
Belle Isle Park
DETROIT RIVER
UNITED STATES
CANADA
MICHIGAN
ONTARIO
WAYNE CO.
ESSEX CO.
MACOMB CO.
Windmill Point
TIGER STADIUM
DETROIT WINDSOR TUNNEL
Detroit City Airport
UNIVERSITY OF DETROIT
MARYGROVE COLLEGE
MERCY COLLEGE OF DETROIT
STATE FAIRGROUNDS
UNIVERSITY OF MICHIGAN CAMPUS
HENRY FORD MUSEUM AND GREENFIELD VILLAGE
FORD MOTOR CO. RESEARCH AND ENGINEERING CENTER
DETROIT RACE COURSE
Chandler Park
Rouge Park
Ford Field
9 MILE
8 MILE ROAD
7 MILE RD
6 MILE
5 MILE RD
PLYMOUTH ROAD
WARREN
FORD RD
MICHIGAN AVE
GRAND RIVER AVE
OUTER DRIVE
SOUTHFIELD
TELEGRAPH
WOODWARD
GRATIOT
JEFFERSON
FISHER FRWY
FORD FRWY
CHRYSLER FRWY
LODGE FRWY
DETROIT INDUSTRIAL FREEWAY

This photograph shows the geometric alignment involved. Note: In the daytime, the flasher and signal panel blends into the background.

This photograph is taken from the same position. Note: At night, the interference of very highly illuminated advertising signs along with the street lighting illumination causes the flasher panel at the end of the island to be almost indistinguishable.

METHOD OF DELINEATION

To determine the best method of delineation for the traffic island, observations were made both during daylight hours and darkness. It appeared that the area with the least amount of illumination interference is the road surface itself. This is apparent in the preceding photographs. The delineation device to be most effective should be installed in the pavement surface. The observations also showed that the device would require sufficient intensity, that it be easily seen and recognized by the driver of a motor vehicle even with the presence of ambient light interference.

In looking for a device to fulfill these needs, a suggestion was made to investigate the type of low profile lights that are in common use on airport runways. In investigation of this device, it was found that they could be installed in the pavement and apparently not be disturbed by winter maintenance. The device had a very high light intensity of 600 candlepower. It was decided that this device would be used at this location.

Figure II is a schematic showing the positioning and spacing of the low profile lights used for delineation of the traffic island.

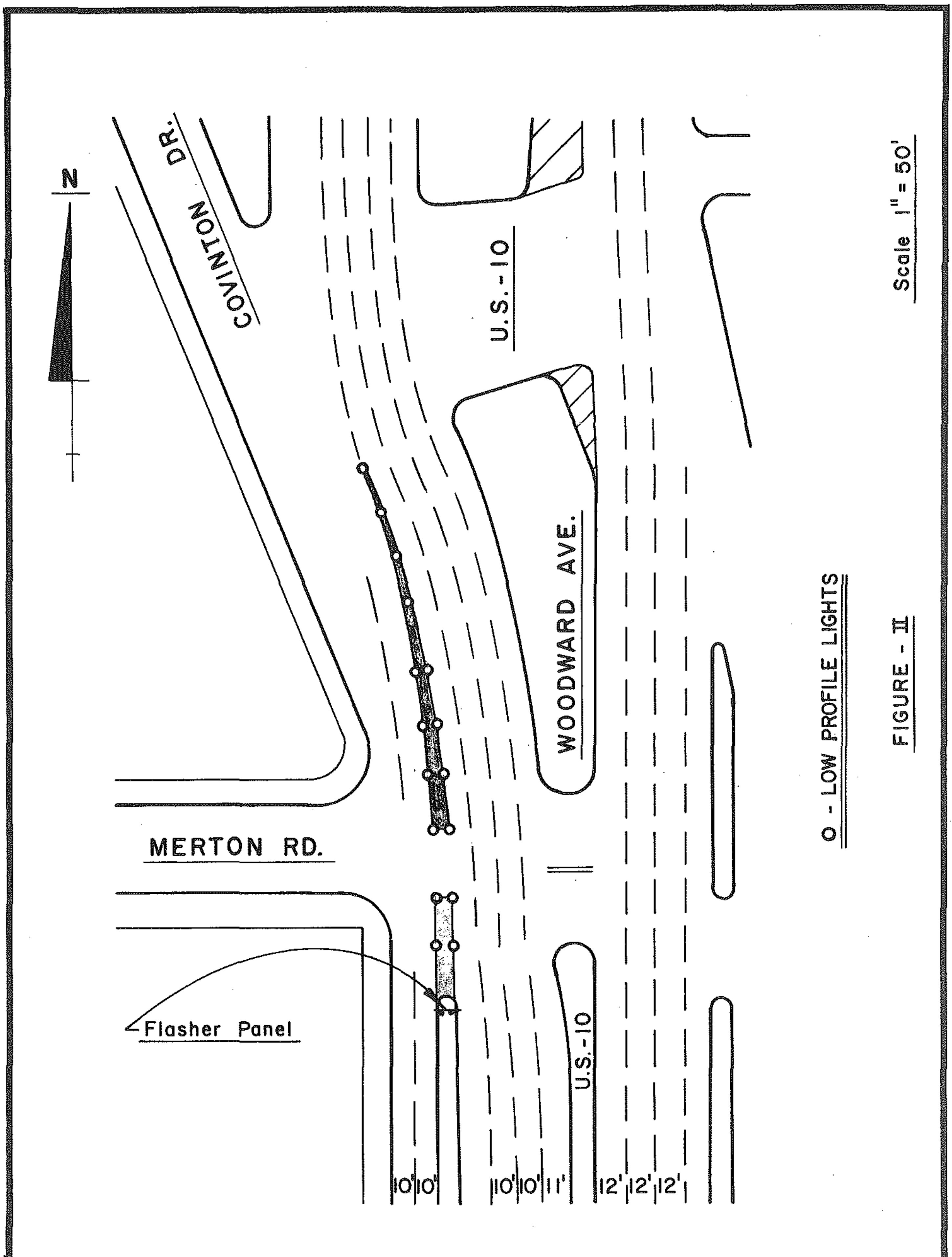

N
COVINTON DR.
U.S.-10
WOODWARD AVE.
MERTON RD.
Flasher Panel
U.S.-10
10' 10'
10' 10' 11'
12' 12' 12'
O - LOW PROFILE LIGHTS
Scale 1" = 50'

FIGURE - II

THE LOW PROFILE LIGHT

The low profile light used employs a unique design to simplify and reduce cost of installation. Each light unit contains its own isolating transformer; the lamp element is hermetically sealed as an integral unit with the secondary of its isolating transformer. There are no exposed connections subject to corrosion or current leakage. When relamping, there are no electrical connections to make or break, the only linkage broken is a magnetic circuit. Relamping can be accomplished with the circuit energized. This simplifies replacement of burned-out lamps. Failure of one lamp will not cause the rest of the lamps to become inoperative.

The low profile light base and cover casting as a unit can support a static load in excess of 40,000 pounds.

Figure III shows the dimensions of the base and cover casting for the original units and also the dimensions of the cover redesign.

LOW PROFILE LIGHTS

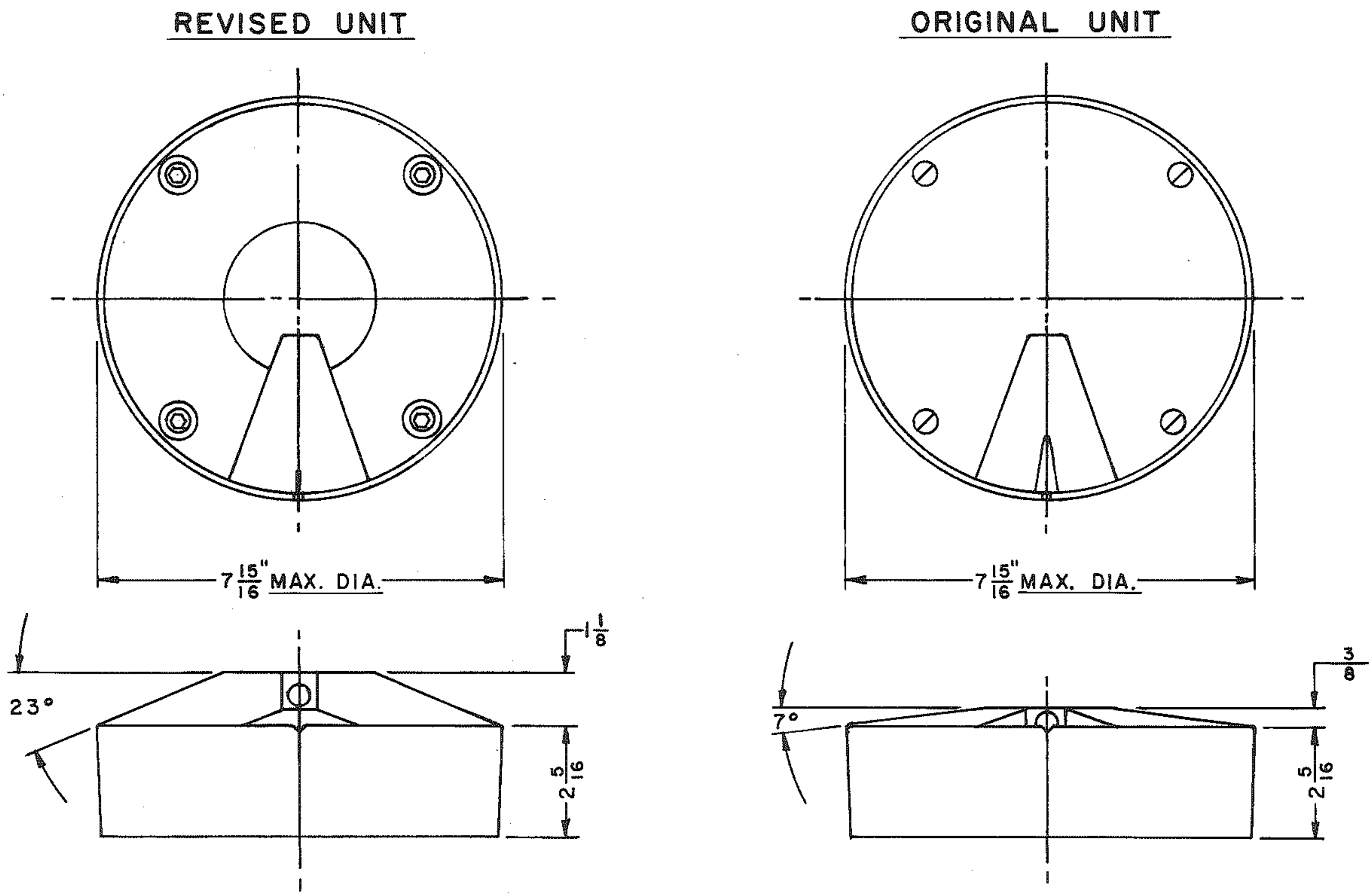


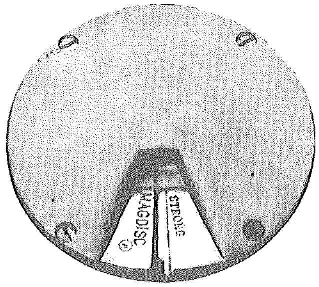
FIGURE III

FORM 1595-B (REV. 6-56)

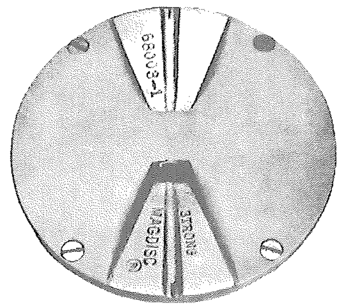
The low profile light operates from a 60-cycle 20 ampere series regulated system. The voltage across the terminals of the transformer primary of each unit is 3.5 volts. The lamp element is a 45 watt quartz iodide lamp which produces 600 candlepower along the main axis. This lamp has an average life of 1000 hours when operated at rated current.

Installation costs of this light are reduced because from 25 to 100 units can be installed in series on one distribution transformer.

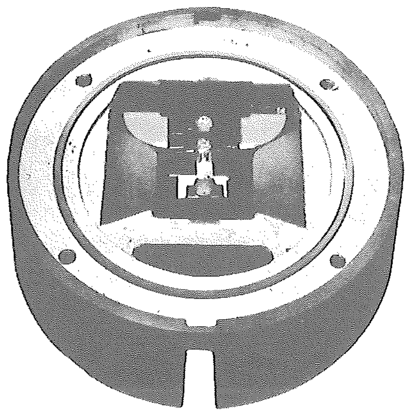
In Figure IV, we show the low profile light cover casting, base and relamping assembly.



COVER CASTING
UNI-DIRECTIONAL

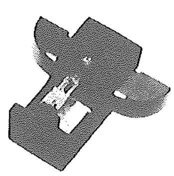


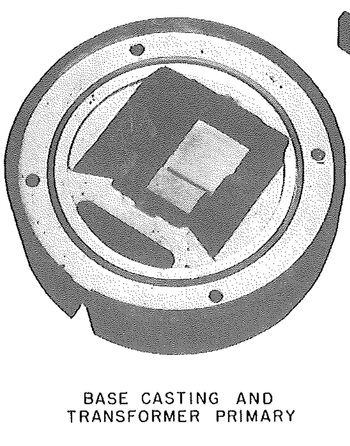
COVER CASTING
BI-DIRECTIONAL



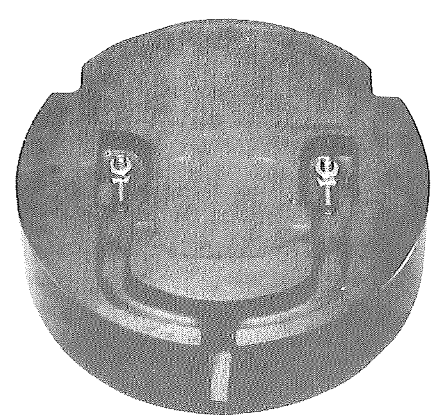
BASE AND
RELAMPING ASSEMBLY

RELAMPING ELEMENT WITH
INTEGRAL TRANSFORMER SECONDARY





BASE CASTING AND
TRANSFORMER PRIMARY



BASE CASTING
PRIMARY LEAD STUDS

FIGURE IV

STUDY

The study of the low profile light installation was divided into two parts. The cost effectiveness of the installation was studied by using the accident data, relating this to the cost of repairing the flasher panel each time it was knocked down. The following is the accident data on the low profile light installation:

One Year Before Installation

October 20, 1963 through October 19, 1964

Period of 12 Months

The flasher panel at the end of the island was knocked down eight times. The average cost to repair and replace the flasher panel is $400 for each occurrence.

Total estimated repair and replacement cost per month = $266

After Low Profile Light Installation

October 20, 1964 through August 5, 1965

Period of 7 1/2 Months

During this period, the low profile lights were on a 24-hour operation.

The flasher panel at the end of the island was knocked down three times. The average cost to repair and replace the flasher panel is $400 for each occurrence.

Total estimated repair and replacement cost per month = $160

August 6, 1965 through January 6, 1967

Period of 17 Months

During this period, the low profile lights were on photo cell operation (nighttime only).

The flasher panel at the end of the island was knocked down seven times. The average cost to repair and replace the flasher panel is $400 for each occurrence.

Total estimated repair and replacement cost per month = $164

From the accident data presented above, there is a 38 percent reduction in the number of times the flasher panel was struck. It was evident there is no appreciable difference in photo cell operations (nighttime only) and 24-hour operation.

This accident data does not include all accidents in the low profile light area due to the availability of reports. Only the number of times the flasher panel at the end of the island was struck and had to be repaired were tabulated. This data was taken from the City of Detroit Public Lighting Commission maintenance records.

The time required to observe a certain number of accidents, in place of the number of accidents observed in a fixed time is a useful method of analyzing accident reports.

A statistical analysis based on the time elapse before N accidents occur is straight forward. Accidents are assumed to occur in a Poisson distribution. The rate of occurrence is assumed not to have changed. Under this assumption, the ratio of elapse time in the after period to the elapse time in the before period is F - distributed with 2N degrees of freedom.

First restricting accidents to dark hours only

7 accidents occurred in 358 days before the installation

7 accidents occurred in 1246 days after the installation

$$\text{Thus,} \quad F\ 14,\ 14 = \frac{1246}{358} = 3.48$$

This is significant at the .5 percent level. Therefore, for dark hours the conclusion is reached that the Poisson rate was reduced.

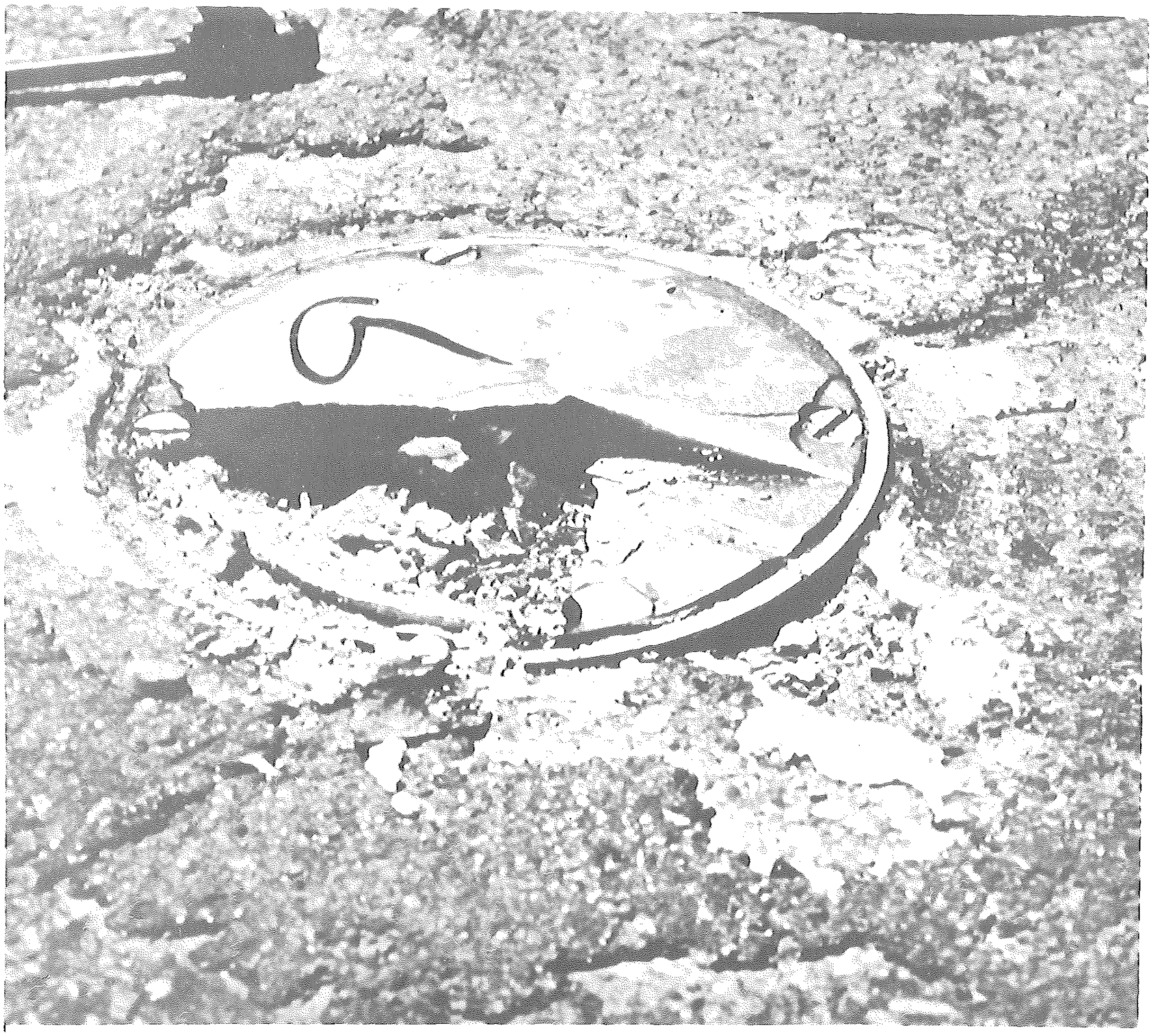
No analysis was conducted on the daylight accidents.

The second portion of the study involves the performance and maintenance data on the low profile light installation. The installation of the low profile lights was completed in October 1964, using the standard manufactured unit at that time.

The first close inspection of the installation was made in February 1965. At that time, there was a very heavy salt and dirt accumulation in the lens areas of the covers, enough to affect the light output of the units. The lens in the covers had been knocked out of four of the 16 units. The cause of lens knockout apparently was pressure of snowplowing on the salt and dirt buildup in the lens areas and the manner in which the lens was secured in the cover casting of the unit. One unit had a small hole due to being hit by the edge of a snowplow blade.

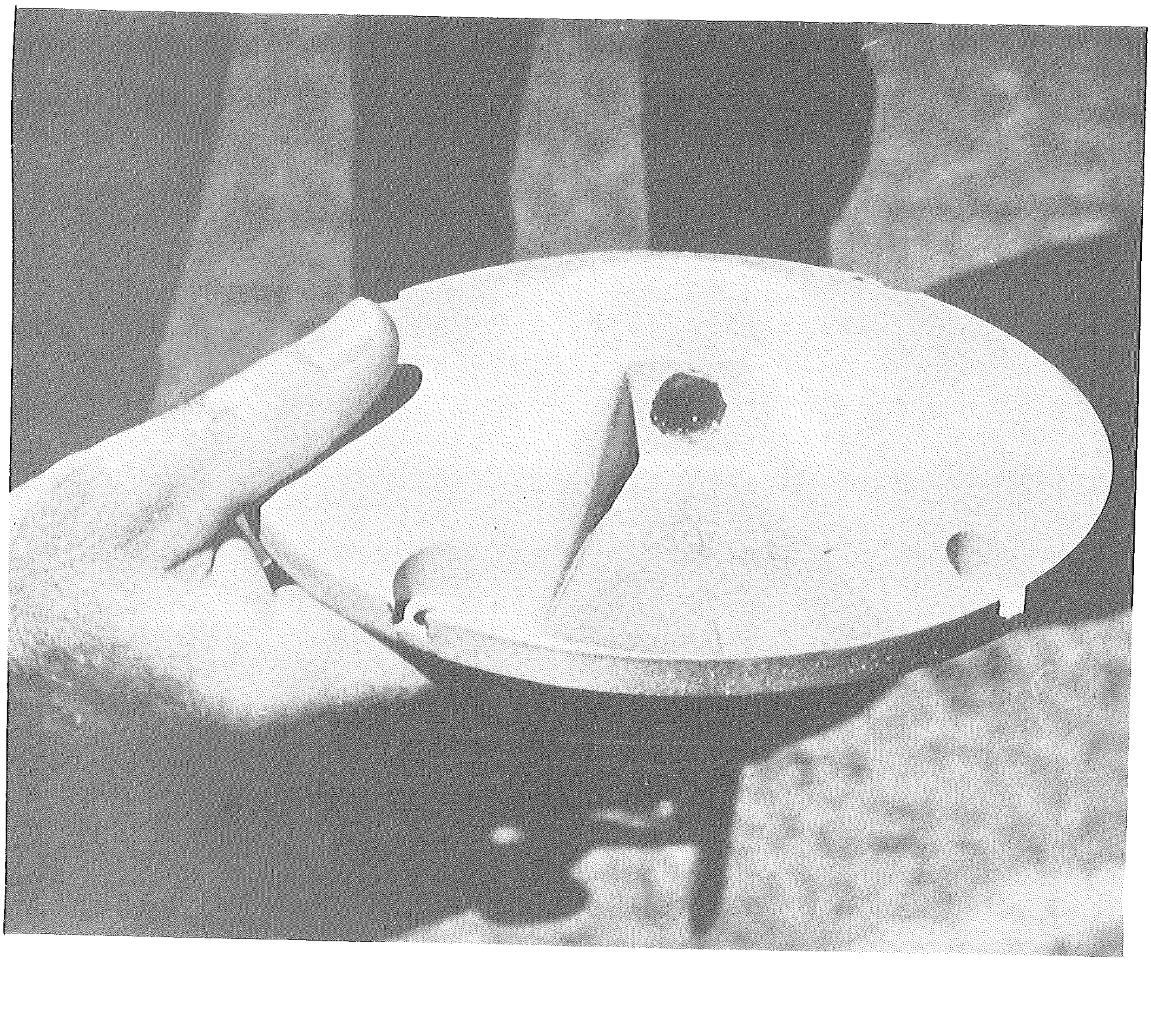
In June 1965, the installation was again inspected. At this time, the majority of the units were inoperative. Most of the unit covers had cracks, and the lenses had been knocked out. All units, except one, had deposits of salt and water in them, which apparently entered through the cracks in the unit cover or after the lenses were knocked out. It was very surprising that some of the units were still operative, considering the amount of salt and water found in the units.

The following photograph shows the condition of a typical unit:

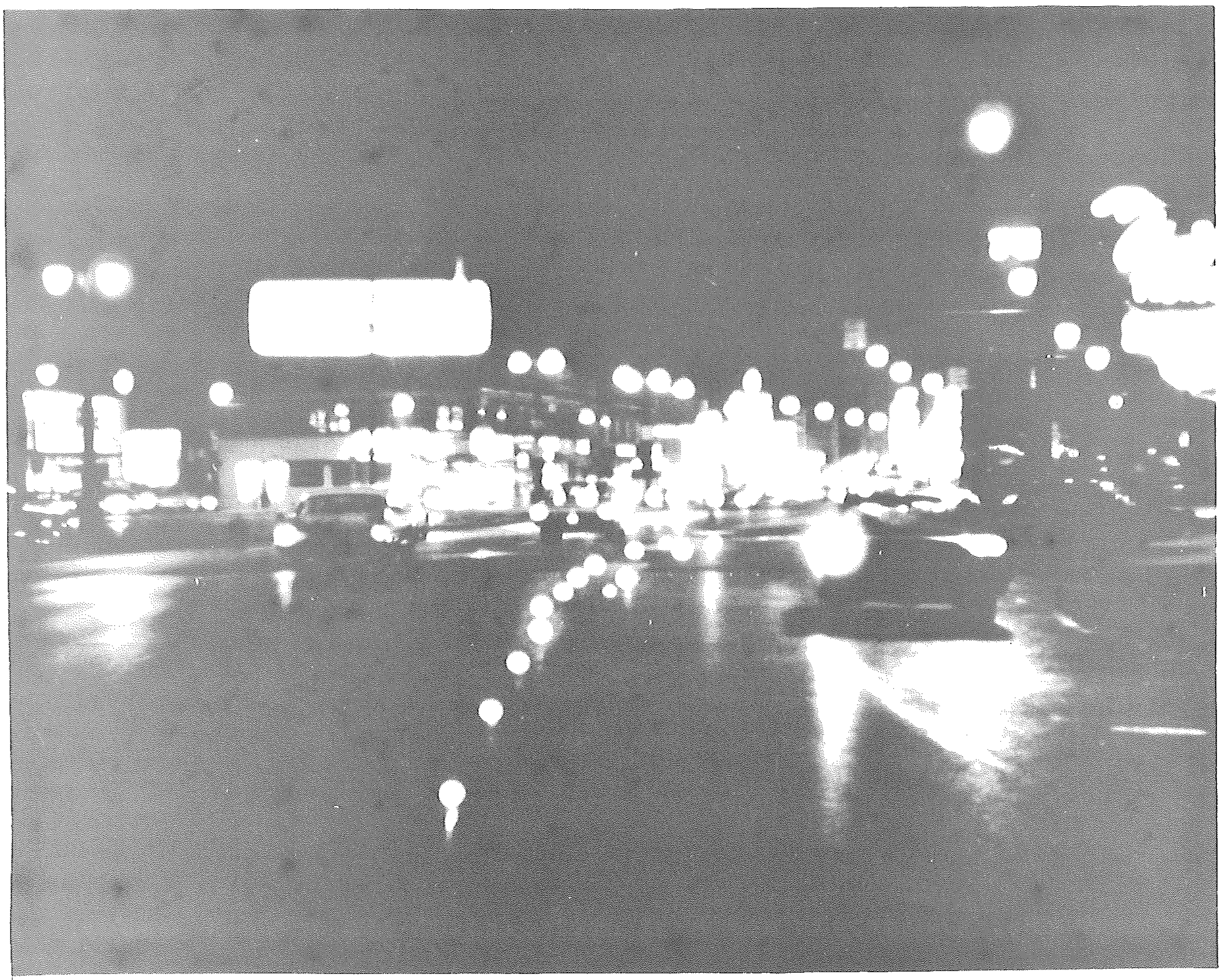


At this time, the installation was completely refurbished.

A problem was experienced in removing the unit cover screws. This was apparently the fault of improper lubrication at the time of original installation. All units were cleaned of all foreign matter and new lamp units installed. A newly designed cover was put on each unit. (Shown in photograph below.)



This brought the installation to a new condition. (Shown in photograph below.)



On August 5, 1965, a photo cell was installed, and the operation was changed to nighttime only or approximately 12-hour operation.

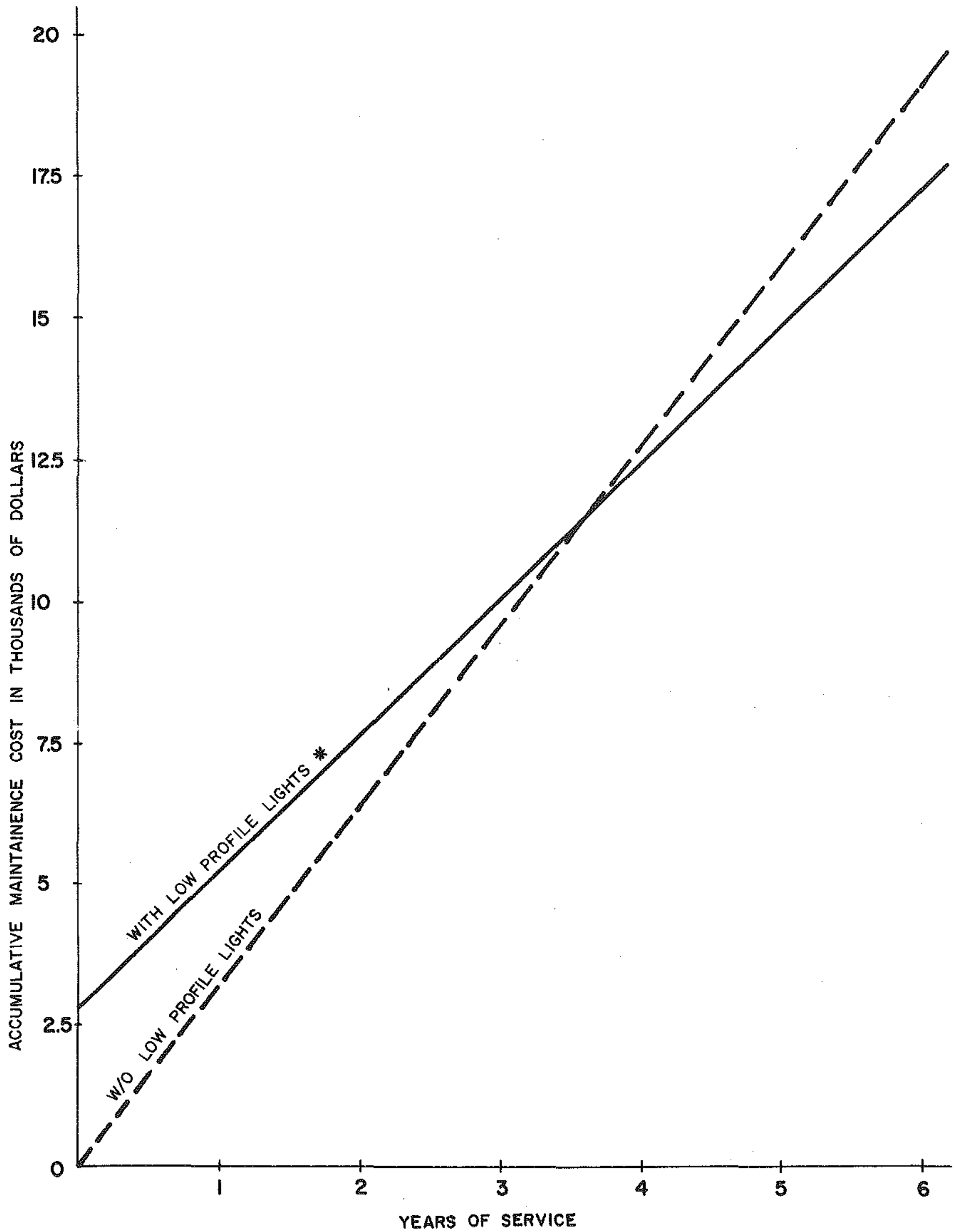
On August 19, 1965, the gore area between the low profile light units was painted with a yellow reflective paint.

During August 1965, a maintenance program was begun on a bi-weekly basis. This program consisted of a visual check of operation and the cleaning of the lens area of all units.

After the change to photo cell operation and the bi-weekly maintenance program began, records were kept to determine the maintenance and operation costs of the installation. During the period from June 1965 to January 1967, the records show the electrical power costs for 16 units on photo cell operation to be approximately $6.88 per month, or $.43 per month per unit.

During the period from August 1965 to January 1967, the maintenance required on the installation was very small: one relamping of each unit at an approximate cost of $22.50 per unit. The lamp life under photo cell operation is about one year. The replacement of one unit cover was required during this period because the lens was knocked out. This unit cover was returned to the manufacturer to have the lens replaced at a very nominal cost. In the fall of 1966, all covers were removed and seals and screws were lubricated with a silicone grease for the winter season.

MAINTAINENCE COST COMPARISON WITH AND WITHOUT LOW PROFILE LIGHTS



* including installation costs

FIGURE V