EXPERIMENTAL USE
HEADLIGHT GLARE SCREEN
IN WATERBURY & BOLTON, VERMONT

FINAL REPORT 88 - 1

JANUARY 1988

REPORTING ON WORK PLAN 82-R-17

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

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ACKNOWLEDGMENT

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ABSTRACT

This project evaluates the performance of a Syro Glarefoil glare screen system installed on the top of a steel beam guardrail in the Towns of Waterbury and Bolton, Vermont. The study was designed primarily to evaluate the durability of the glare screen system in a severe winter environment.

Slight problems were encountered during installation of the glare screen, and it is believed that subsequent problems encountered over time were due, in part, to inconsistencies in the installation procedures.

Some of the individual blades received damage from winter maintenance operations. High winds common to that section of roadway contributed to increased stress on the connecting system which lacked adequate strength for such conditions.

Modifications in snow plowing procedures were required to reduce damage to the system. The cost of replacing damaged blades and maintaining the system was significant.

The Syro Glarefoil Glare Screen has been effective at eliminating headlight glare but modifications to the mounting system would be required before the product could be recommended for use at additional locations.

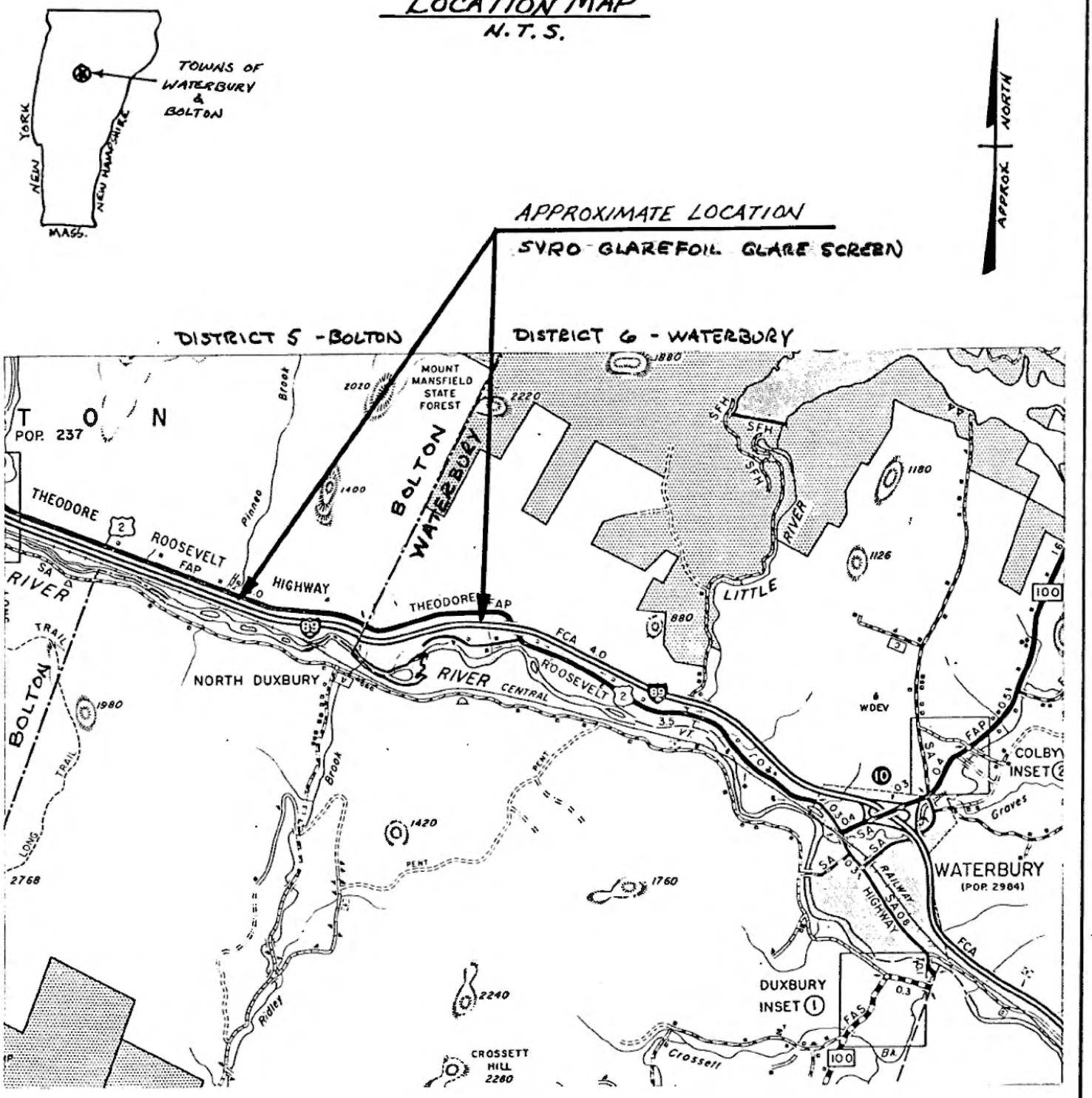
INTRODUCTION

In September and October of 1983, 4,665 two foot, three foot and four foot high glare screen blades were installed on mounting plates atop steel beam guardrail between Interstate 89 and U.S. Route 2 in the Towns of Waterbury and Bolton, Vermont. Interstate 89 is a four lane highway, divided by concrete median barrier, in the experimental project area. U.S. Route 2 is a two lane road which runs parallel to I 89 with a distance between the two roadways of approximately 19' (edge of pavement to edge of pavement). The system was placed in conjunction with the Berlin-Williston I 89-2 (24) C/2 safety project. The glare screen is located between I 89 MM 66.94 and MM 68.72 (see location map on Page 3).

The initial design called for the use of a "Forward" Glare Screen as supplied by Proven Products, Inc., 7660 S.W. La View Drive, Portland, Oregon 97219. During the construction phase of the project, a decision was made to allow the substitution of a Syro Glarefoil System manufactured by Syro Steel Co., 1170 N. State St., Girard, Ohio 44420.

This report describes the observations made during installation and initial performance through the first four years of service.

LOCATION MAP
N.T.S.



PROJECT LOCATION: I-89 NB & U.S. RTE. 2
IN THE TOWNS OF WATERBURY & BOLTON

PROJECT: BERLIN-WILLISTON IR 89-2(24) C/2

R&D 1986

PRODUCT INFORMATION

The Syro Glarefoil glare screen is made of individual flexible plastic glarefoil blades constructed of high molecular weight polyethylene. The wall has a minimum thickness of 0.100 inches, except at corners, which are 0.060 inches, minimum. The blades are forest green in color for a pleasing appearance and ability to blend well in the environment. The tensile strength has a 3,000 psi minimum as determined by ASTM D638. Each blade shall withstand a sharp bend test (180° bend without mandrel) at 0°F, without cracking.

The manufacturer states that the blades:

- Eliminate oncoming headlight glare
- Reduce distraction
- Permit view in lateral direction
- Permit crossover access in case of emergency
- Are weather and impact resistant
- Have rounded edges and top for safety
- Stay clean due to their smooth ribless surface
- Easy maintenance with minimum traffic disruption
- Are rigid yet flexible upon impact
- Can be mounted securely on barrier wall or guardrails
- Measure 8 inches wide by 2, 3, or 4 feet high
- Have a competitive initial cost and reduced service-life cost

INSTALLATION OBSERVATIONS

In September, 1983 workers began the installation of the Syro Glarefoil glare screen. A crew of four men started on the northern end of the guardrail section at MM 68.72± and proceeded south to MM 66.94±. All trucks and equipment were located along the shoulder of U.S. Route 2 eastbound. Traffic disturbance was minimal and traffic on I 89 was not affected.

The mounting plates (C-channel) were installed first with connecting brackets at each guardrail post. Workers commented that it was difficult to work with the hand tools in the limited space between the two steel beam guardrails. As a result, more time was needed than originally anticipated.

The next step involved the installation of the base plate brackets which serve to hold the glare screen blades to the mounting plate. A wooden template with a 45° angle was made for the purpose of consistent alignment of each bracket, and to help expedite the procedure. Workers commented on the difficulty of wrench placement on the underside of the mounting plate while installing the base plate bracket. The photographs on the following page were taken during installation of the base plate brackets.

Installing Glarefoil Brackets

Installing Glarefoils

The last step was the installation of the glare screen blades. The first blades installed were four feet in length. Each blade has four connector bolts at the base which are fastened to the base plate bracket. The photograph below shows a worker using a large industrial size drill to tighten the bolts. As a result, many bolts were over tightened causing deformation and weakening of the plastic blade material. In some cases the bolts were believed to have been stripped and this condition became more apparent over time.

The workers commented that "it was difficult to tell when the bolt was sufficiently tightened". The condition was most likely due to the oversize drill used for the job.

It was noted that the predrilled holes in the blades and base plate bracket did not align perfectly. Therefore workers found it necessary to use extra force by either pulling or pushing the blade itself or using a hammer to bend the base plate bracket. This condition was apparently due to poor quality control during manufacturing. Such factors resulted in imperfections in vertical alignment which decreased the quality of the glare screens appearence in general.

The view from Route 2 looking north westerly.

POST CONSTRUCTION OBSERVATIONS

The experimental glare screen was surveyed for effectiveness in eliminating glare from oncoming vehicle headlights during night-time traffic. This was done by driving through the project in both directions on I 89 and U. S. Route 2. It was quickly apparent that the glare screen was effective in eliminating glare from vehicles on the adjacent roadway.

The glare screen was periodically inspected during the daytime for problems relating to durability. The first inspection was done prior to any snow fall and the condition was generally the same as at the time of installation.

The next daytime inspection was in January of 1984 after two months of service. Several snow falls had occurred in the area causing plowing operations to begin. It was discovered that the normal plow speeds of 35 to 40 miles per hour caused damage to the glare screen by hurling the snow against the blades. This condition was prevalent along U. S. Route 2 where the blades are only seven ± feet from the edge of the traveled lane. Once plow operators slowed down to 15 to 20 miles per hour this problem was minimized.

The other problems encountered during the second survey were all related to the various points where the glare foil fastened to the guard rail. Many of these connections were loose which contributed to loss of blade alignment.

Of particular concern were the mounting plate connector brackets and bolts which serve as the structural connection of the glare screen system to the guard rail. Apparently bolts were not originally torqued tight enough causing the mounting plate to lift up and lean away from plowing operations on U. S. Route 2.

The following photographs were taken on the U. S. Route 2 side.

Tilted mounting plate bracket.

Tilted mounting plate bracket.

This condition was present on approximately 30 -40% of the mounting plate sections suggesting that snow loading from plowing operations pushed on the blades and caused an upward force on the bracket, which enabled the bolts and/or mounting plate brackets to slip. Once this condition occurred all of the blades on the plate would lean off their vertical axis causing increased stress on the mounting brackets used to fasten each individual blade. In some cases this stress bent the mounting bracket and the blade leaned even farther from the vertical axis.

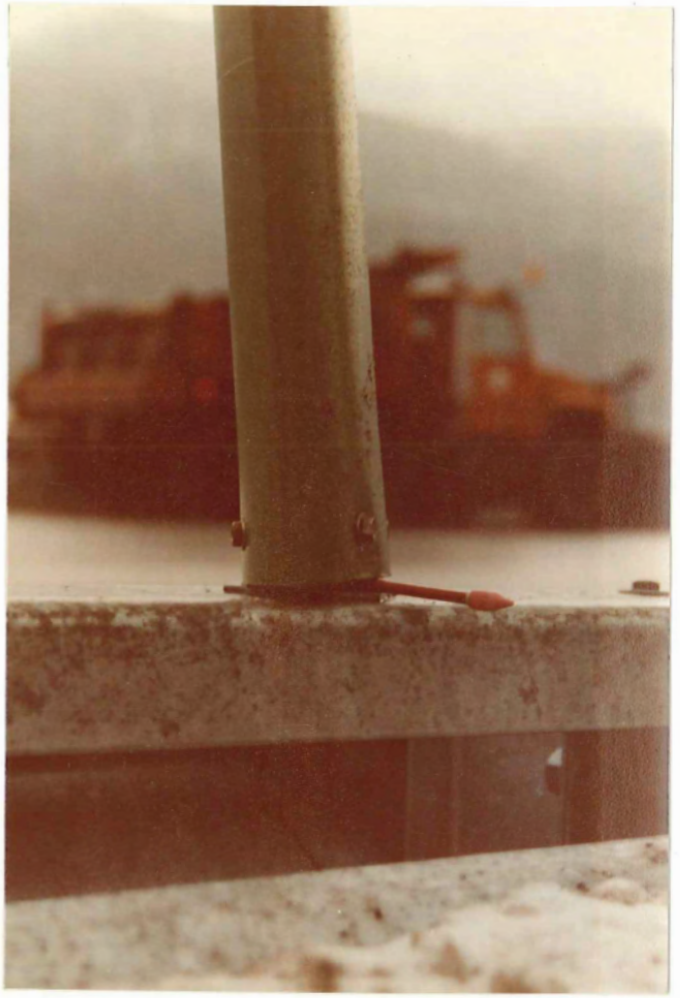
The loose condition of the mounting plate brackets was confirmed by applying force to the upper portion of the blade counter to the lean.

In most cases the mounting plate would then return to a more level position flush with the top of the guardrail post.
It is believed that the problem was further compounded by the high winds which frequent this area of the Winooski River Valley. When high winds were blowing, vibration and bending were noticeable and contributed to loosening the bolts.

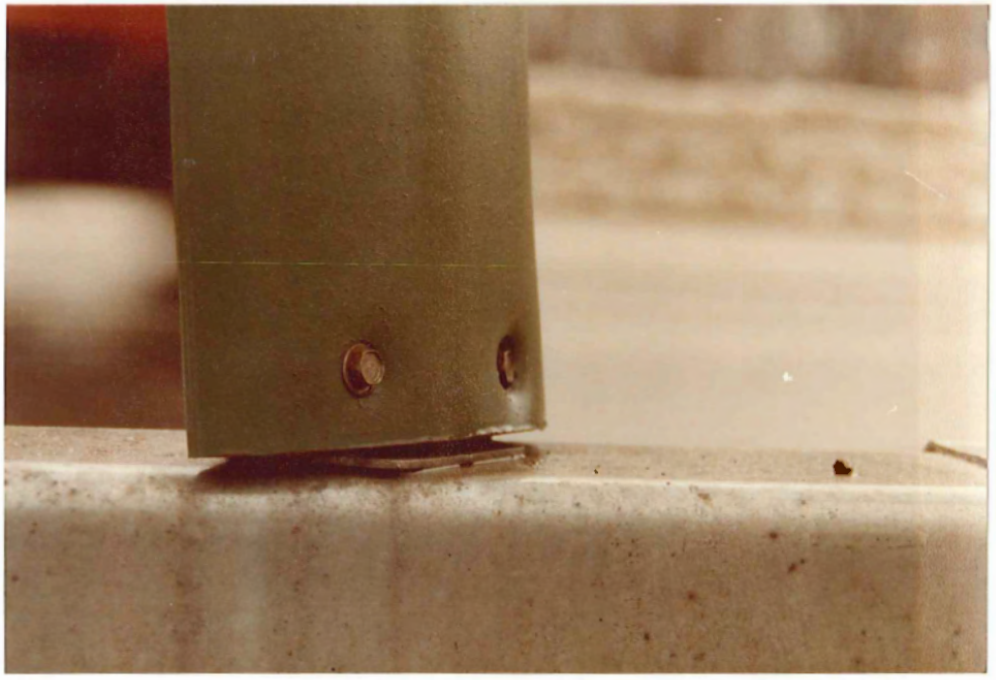
The photograph below shows the variation in the vertical alignment of the four foot blades.

With the new location of guardrail closer to U. S. Route 2, plow drivers commented on the increased difficulty of snow removal. The combination of a narrow four foot shoulder and the glare screen acting as a wall left little room for dispersion of the plowed snow. As mentioned earlier in this report, plowing speeds were slowed by as much as 20 miles per hour further emphasizing the problem. As snow accumulations increased there was less space available for stockpiling as can be seen in the photograph below.

Eventually the plowed snow was piled high enough that the only place for the snow to go was over the top of the pile and/or through the glare screen. District forces had to revise their plowing techniques to accomodate this problem. The District 5 maintenance crew used a grader and front-end loader to remove the excess snow and place it on the opposite side of U. S. 2. District 6 workers plowed snow from the eastbound lane while plowing the westbound lane. This procedure was done with caution due to the possibility of encounter with eastbound vehicles. This procedure was therefore limited to periods of low traffic during the day and at night. In some cases large frozen chunks of ice and snow would be pushed up against the blades, again putting severe stress on the base plate bracket, occasionally shearing it. This condition and its effects can be seen in the following photographs.



Vertical portion of bracket broken off



Note how bolt was overtightened on Glarefoil

Follow up surveys after the second winter of exposure (1985-1986) have shown that these conditions have continued to be a problem but only in the District 5 area in the Town of Bolton. The plowing operators of District 5 are running the plows closer to the guard rail than in District 6. A total of 18 blades were found to be missing or knocked down in the District 5 section. The following photographs show the difference in the plowing operations. This difference is clearly shown by location of plowed snow and its distance from the shoulder line.


DIST.
5
U.S. 2
3/86


DIST.
6
U.S. 2
3/12/86

The occurance of problems in District 6 has stabilized. The most recent survey, in the spring of 1987, revealed only minimal damage and there were no blades missing or broken as found in District 5.

COST INFORMATION

The total installed cost of the 4,665 glare screen blades and associated hardware for this project was $107,460. This represents an average cost of $23.04 per blade. Vermont does not have any glare screen system in place which could be compared with the Syro Glarefoil System. Studies conducted by other states have shown the glarefoil type systems to be more economical, particularly in terms of maintenance, than the typical glare screen "fence".[1]

[1]Pennsylvania D.O.T., Paddle-Type Glare Screen, Final Evaluation Report May 1984.

Louisiana D.O.T., Evaluation of Glare Reduction Devices, Memo Dated February 7, 1983.

DISCUSSION

Installation of the Syro Glarefoil Screen was "time consuming and tedious" as stated by the workers. There are numerous bolts involved in the connection of the system to the guardrail. It is possible that oversight on the part of the installation crew contributed to some of the bolts not being adequately tightened, thus detracting from the mounting system performance.

High winds, which tend to frequent this area of the Winooski Valley, further compounded the problems with performance of the mounting system. The winds caused vibration and occasionally bent individual blades. This bending would sometimes cause a crease to form near the base of the blade and thus weaken the plastic. Subsequent plowing would destroy the blade by breaking it off near the area of the crease. This problem was very limited in relation to the overall number of blades on the project. The vibration from wind may have contributed to the loosening of the various bolts used on the system.

Durability with regard to impact from snow plow damage has been reasonable once plowing operations were adjusted as mentioned previously. Surveys revealed that the two and three foot blades performed better than the four foot blades.

No significant problems in terms of vandalism or theft have been observed although individual blades can be broken off manually.

In terms of maintenance, the glare screen has been time consuming for District 5. The total cost for maintenance of their portion of the system from October 1983 installation through the spring of 1986 was $10,533.00. In 1985, approximately 75 blades needed replacement at a cost of $6,278.00. In 1986 District forces elected to shorten all of the four foot blades by 12 inches in order to decrease the damage from plowing. Each blade was removed, cut down and new holes drilled for the mounting bolts. The total cost for cutting blades down was $2,130.00.

Due to frequent snow falls in the 1985-86 winter, District 5 forces found it necessary to remove the snow built up along the guardrail and glare screen. A grader and bucket loader were used to pull the snow off the guardrail and push it accross the road. Cost of this operation totaled $1,325.00. General maintenance of the glare barrier totaled approximately $400.00 each summer for the years 1986 and 1987.

Both Districts commented that wet, heavy snow was difficult to deal with. The heavier weight put too much stress on the blades and plowing speeds needed to be decreased significantly under those conditions. Dry, light snow was much less a problem to remove and could be plowed and pushed through the blades without causing damage. It was also stated that if the guardrail and glare screen had been located closer to the center of the median the problems would have been minimized.

District 6 personnel commented that, although the glare screen was inconvenient relative to plowing operations, maintenance requirements were minimal. Maintenance costs over the four years of service has been approximately $1,600.00.

In 1985 District 6 replaced four blades at a cost of $70.00. The replacement blades used were left over from the original installation. In 1986 no blades were replaced. However, due to frequent snow falls, two additional snow plowing operations were needed. A grader and a truck with a plow were used each time for a total cost of $650.00. During the winter of 1986-1987 snow removal was required twice at a total cost of $800.00. Maintenance that spring included the replacement of five brackets with reinstallation of the same blades at a labor cost of $80.00.

Future installations should be designed to allow for wider shoulders and medians to accommodate snow plowing operations. The base plates used to connect the blade to the mounting plate should also be modified as follows:

1) Increase the height of the bracket

2) Add more bolts to fasten the bracket down

3) Strengthen materials used

4) Use larger washers on the bolts which connect the blade to the bracket

Additional areas of concern are the brackets which serve as the connection of the mounting plate to the guardrail post.

Perhaps torque requirements, or use of lock washers should be specified to avoid problems as discussed earlier in this report. Careful monitoring of bolt installation is highly recommended for future installations.

The glare screen has been effective in eliminating glare from oncoming vehicles. Informal surveys with individuals who use the roads have revealed positive responses. However, some commented that they did not care for the appearance of the glare screen during the daytime.

SUMMARY

- The Syro Glarefoil Glare Screen has been effective at eliminating headlight glare.

- Inconsistent installation procedures were believed to have contributed to performance problems with the mounting plate system.

- Two and three foot blades performed significantly better than the four foot blades in terms of durability and lower maintenance requirements.

- Modifications in snow plowing procedures were required to reduce damage to the system.

- Maintenance personnel consider the system a moderately high maintenance item.

- Reports by other State Agencies suggest that glarefoil type glare screens are less costly to maintain than the typical extruded mesh glare screens.

RECOMMENDATIONS

Modifications to the mounting system would be required before the Syro Glarefoil System could be recommended for use at additional locations.

Blade lengths should be limited to three feet where impact from plowed snow is anticipated.

Installation specifications should be developed to insure an acceptable end product.

STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH DIVISION

WORK PLAN FOR CATEGORY II EXPERIMENTAL PROJECT

HEADLIGHT GLARE SCREEN

WORK PLAN 82-R-17

OBJECTIVE OF EXPERIMENT

To evaluate the performance and durability of a "FORWARD" headlight glare screen system.

PROJECT

Berlin-Williston IR 89-2(24)C/2

PROJECT LOCATION

Beginning at a point approximately 0.285 miles northwesterly of the Montpelier-Berlin Town Line and extending 31.153 miles to the Williston-interchange.

EXPERIMENTAL WORK LOCATION

Between the eastbound shoulder of US Rte. 2 and the westbound lane of Interstate 89 at project station 955+00 - 1048+25 (Mile marker location 66.94 through 68.70).

MATERIALS TO BE USED

A "FORWARD" Glare Screen consisting of flexible plastic glare shield blades as supplied by Proven Products, Inc., 7560 S.W. Laview Drive, Portland, Oregon 97219.

APPLICATION PROCEDURE

The installation shall be made as recommended by the manufacturer.

CONTROL SECTION AND TREATMENT

The performance of the "FORWARD" Glare Screen will be compared with that of a "SCREEN-SAFE" Glare Screen to be installed on the M5000(1) Burlington Southern Connector project.

COST

Approximately 4665 glare shield blades will be installed at an estimated cost of $89,700. ($9.62 per Lf of barrier).

DATE OF INSTALLATION

Prior to November 1, 1983

DURATION OF STUDY

The project will be evaluated for the length of time required to obtain valid conclusions on the performance of the experimental product.

SURVEILLANCE

The experimental product will be monitored during installation and at least once yearly for the duration of the study. The surveillance will include the following:

1) Ease of installation and visual appearance.
2) Performance in eliminating headlight glare from oncoming vehicles.
3) Durability with regard to impact or snow plow damage, weathering and ultra violet light.
4) Susceptibility to vandalism or theft.
5) Maintenance requirements.

REPORTS

An initial report covering the installation and initial observations and a final report drawing conclusions on the effectiveness of the experimental product shall be submitted to the Federal Highway Administration.

Reviewed By:

R. F. Nicholson

R. F. Nicholson, P.E., Materials & Research Eng.

Date: 1-26-'83

Materials & Research Division
Agency of Transportation
January 25, 1983