

EXPERIMENTAL PROJECTS CONSTRUCTION REPORT AND EVALUATION

Barrier Reflector Durability Study

Location: Cascade County/Great Falls District: I-15 Deck Structures
Emerson and Sun River

Project Name: Barrier Reflector Durability Study

Project Number: N/A

Experimental Project: MT-19-06

Type of Project: Reflector Prototype Test

Principal Investigator: Craig Abernathy: Experimental Project Manager (ExPM)

Technical Contact: Jayden Manuel, P.E.: Traffic Engineer/Great Falls

Construction Date: October 2019

Description

With the need for winter maintenance, and with the severity of the 2018-2019 winter season; conventional deck railing reflectors have been damaged due to successive plow passes with an underlying agent being the plow blades snow deflector.

The rate of occurrence of damaged reflectors has initiated the Great Falls District to design, construct, and test more durable reflector designs; in addition of using a different type of adhesive along with mechanical attachments. Each deck alternates the reflector units with a glue-only placement and a glue and screw placement respectively.

The project is located on Interstate 15 (C000015) Cascade County, within the township of Great Falls. Four structures are identified to test the prototype reflectors: the NB/SB Sun River and Emerson Junction bridge decks. These decks have substantial damaged or missing reflectors.

Experimental Design

The Districts Maintenance shop in conjunction with traffic engineering staff have developed three reflector prototypes to be tested on the subject structures.

The reflectors will be designated as T2, T3, & T4. Conventional reflectors will be added to the project as a control (T1). The construction report will detail the specific designs and test unit locations as applied in the field and subsequent site inspections.

Evaluation Procedures

The purpose of an experimental project report is to document the phases and events of any given project to gain the reader an understanding of the general activities required to install or incorporate the research element into an active construction or maintenance project as an in-service evaluation. This report also establishes a baseline for defining performance for any given feature under actual service conditions to determine its relative merits.

Pre-inspection: Document general condition of damaged reflectors prior to installation.

Construction Documentation: The Research Section will document the construction/installation methods, equipment used, material placement, weather, and specification conformance etc. (if applicable); and develop an initial location schematic for distress documentation.

***Post Documentation:** Will entail (at a minimum) monthly site visits/inspections of the sections for visual project documentation for inclusion into the final reports; in addition, an intent to include nighttime documentation of the reflector's efficacy; and to maintain the schematic map to track progress of the unit(s) condition and durability.

The District has discussed conducting retro-reflectivity readings on the prototypes; if that data is collected it will be included in the report.

If an occurrence involving the performance of the prototypes requires additional inspections by Research outside the monthly inspections, Research staff will accommodate.

*It was originally anticipated the duration of the analysis would only entail the 2019-20 winter season; but the current winter precipitation rate has been minimum resulting in minor plow passes, which most likely extend the project into the 2020-21 winter season.

Evaluation Schedule

Research will monitor and report on performance for the duration that the District deems it has enough data on the project to determine the best performing reflector. This is in accordance with the Department's "Experimental Project Procedures". Delivery of a construction/installation report, interim, monthly, annual or semi-annual reports is required as well as a final project report (responsibility of Research). A web page will be dedicated to display all reporting from the project.

2019: October: Installation/Construction Report

2019/20: October-March: Monthly Inspections

2020/21: April: **Tentative;** Final Evaluation/Final Report and Presentation

Analysis to Date

Since installation in October 2019 Research has conducted nine site inspections (mainly after snow events and while conducting site evaluations on other area projects).

As of March 16, there have been no instances of damaged or missing reflectors. Due to the relatively mild winter in the Great Falls area it is assumed that there has not been enough plow passes on the selected decks to facilitate that kind of damage as seen in the 2018-19 winter season.

However, District staff reported on **March 20** on the Sun River southbound structure (T4) that damaged units were observed in the travel lane. Research visited the site on March 23 and found eight units damaged (units 10-17), see page 18 for more detailed description.

Subsequent site inspections took place on **10/29 & 11/19 2020**. Numerous damaged reflectors were documented especially on the Sun river decks. That information has been updated on the deck layout diagrams (pages 15-17) and visual documentation of the type of damage found on pages 18-21. Note that the north bound Emerson Jct. T2 design has yet to receive any noticeable damage to report.

Currently, it is hard to determine if the recent damage is from snowplow activity or impact from oversize loads.

The project will carry on into the 2021 season to continue the data collection phase and possibly further until the District is satisfied it has enough information to determine the efficacy of the prototype designs.

The following information is representative of the prototype designs selected, pre-documentation of damaged units, and the installation phase.

Pages 14-17 are the test and control layouts; these will be used to document unit location of damage when it occurs on each deck. See pages 18-21 for a detailed description of unit damage as it occurs. The next formal inspection will inventory the efficacy between the glue only units and glue/screw units.

Research would like to thank the following Great Falls staff that was responsible in the planning and development and deployment of the research effort:

Mr. Jayden Manuel – Great Falls Traffic Engineer
Mr. TJ Buchanan – MDT Equipment
Mr. Kelly Holbrook – Shop Superintendent
Mr. Scott Western – Maintenance Superintendent
Mr. Kevin Peltier – Maintenance Superintendent
Mr. Quint Boe – Maintenance Staff
Mr. Steve Prinzing – Engineering Services Supervisor

Blade Snow Deflectors



↩ ↓ Typically made of a reinforced rubber material or poly. Installed on the top edge of the plow and is used to increase user's visibility while plowing by minimizing the snow that flies up over the top of the plow and onto the windshield, a needed safety measure for effective plowing.

The examples shown represent those styles of deflectors which obviously strike parts of the bridge barrier resulting in damage to the reflectors.



Example Images of Documented Reflector Damage



← ↓ Several examples of damaged or missing reflectors on the Emerson and Sun River structures



Prototype Designs and Control Reflectors



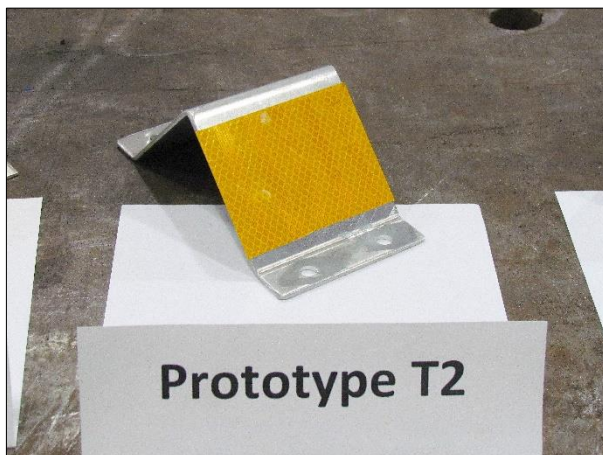
← Control **T1** is the conventional reflector that is currently used and proven to be unable to withstand accumulated reflector impacts.

T1 is installed on the **Emerson Jct. Southbound** structure.

Note: When this image was taken it was unclear which of the two conventional reflectors were to be used on the project; the unit on the right is the chosen unit.

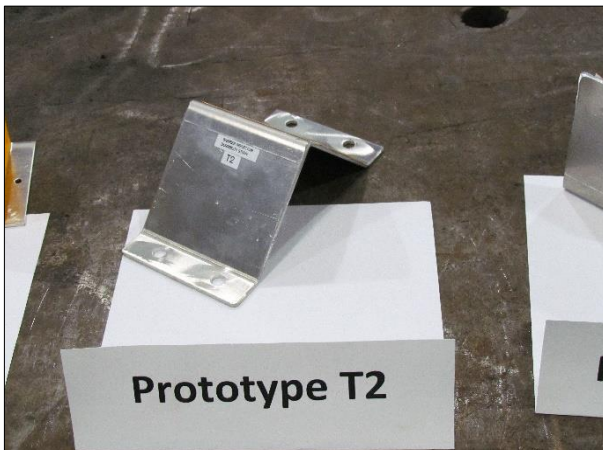


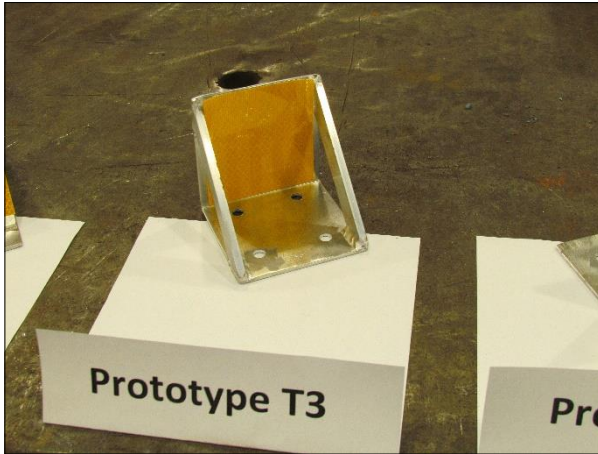
The top image shows the front side of the reflector, the lower image is the rear view.



← Prototype **T2** is installed on the **Emerson Jct. Northbound** structure.

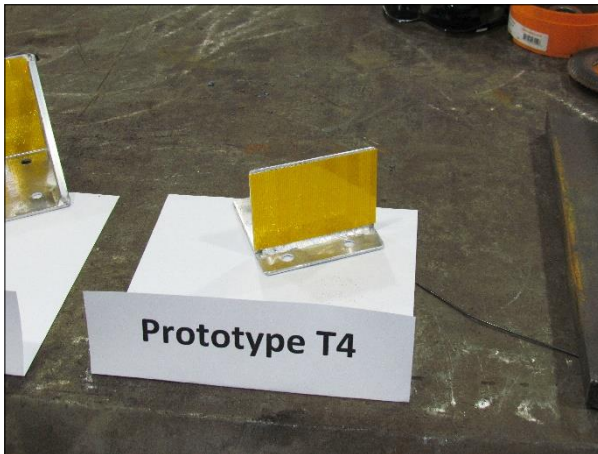
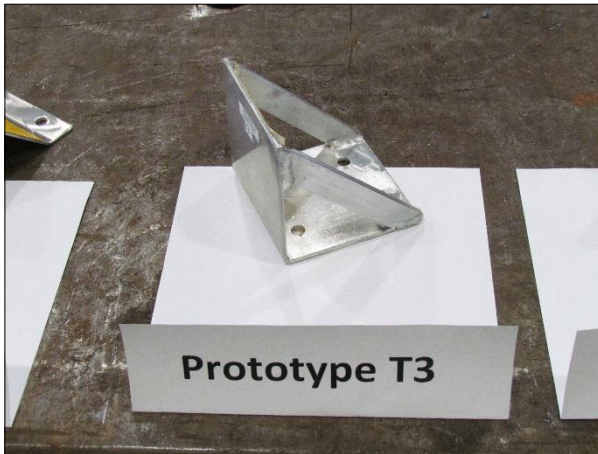
The top image shows the front side of the reflector, the lower image is the rear view.





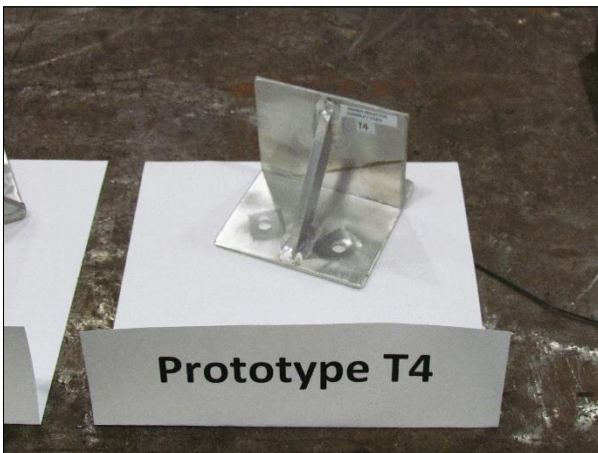
← Prototype **T3** is installed on the **Sun River Bridge Northbound** structure.

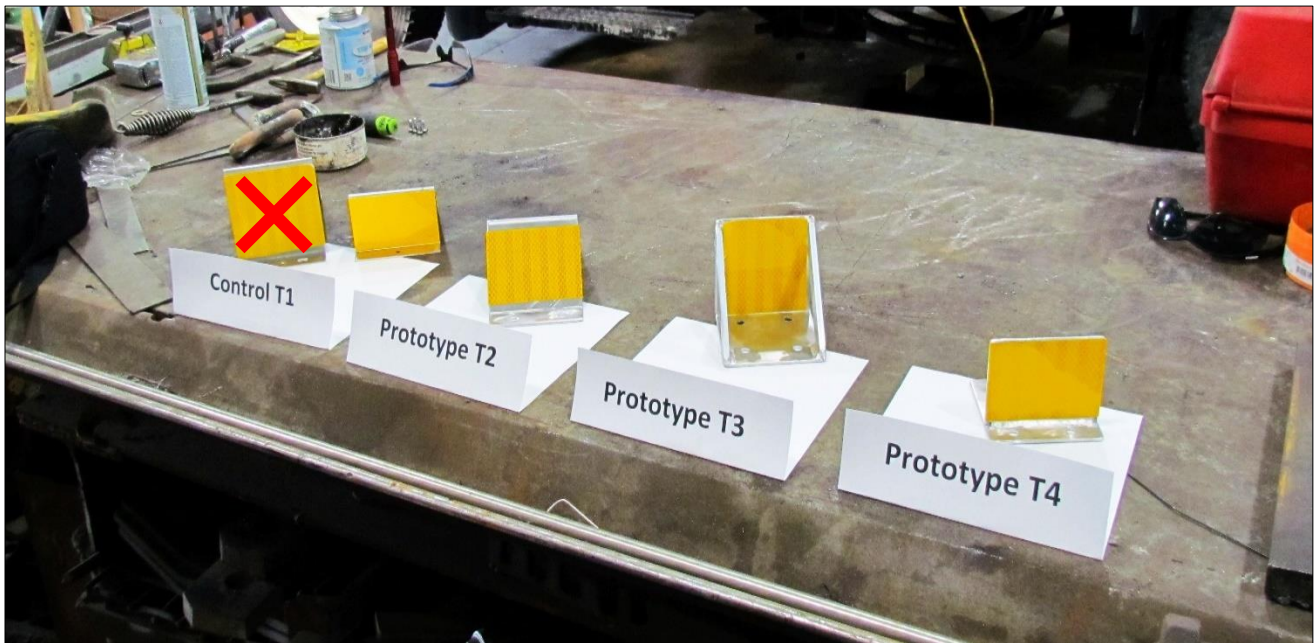
The top image shows the front side of the reflector, the lower image is the rear view.



← Prototype **T4** is installed on the **Sun River Bridge Southbound** structure.

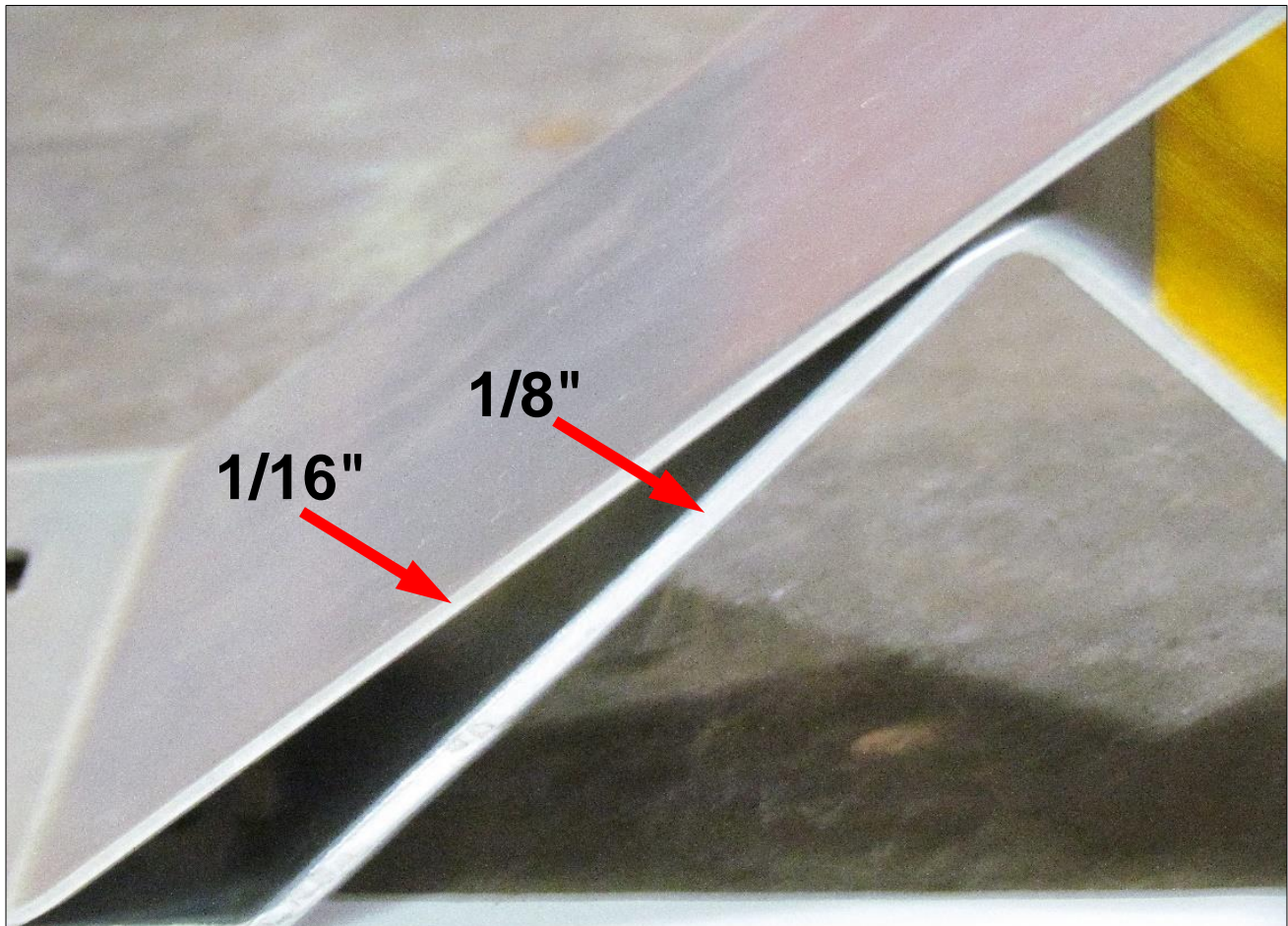
The top image shows the front side of the reflector, the lower image is the rear view.





↑ Overview of control and prototype designs.

↓ The conventional reflectors had a thickness of $1/16$ "; whereas the prototypes design thickness was increased to $1/8$ " respectively. The alloy used was 6061 aluminum. Bracket supports used on T3 & T4 were $1/4$ " in thickness



Installation – October 2019: Example of Prototype Application-T2 Unit



← The chosen adhesive for the project was the pro-grade clear solvent base perchloroethylene E6800.



← The Tapper No. 11 Concrete Anchor (1/4" X 1 3/4") was the mechanical attachment for the reflector.



← Type IV HIP reflective sheeting was applied on-site.



← Prior to the placement of the reflector the deck barrier surface was ground for a clean application.



← The underside of the reflector also received a thorough buffing.



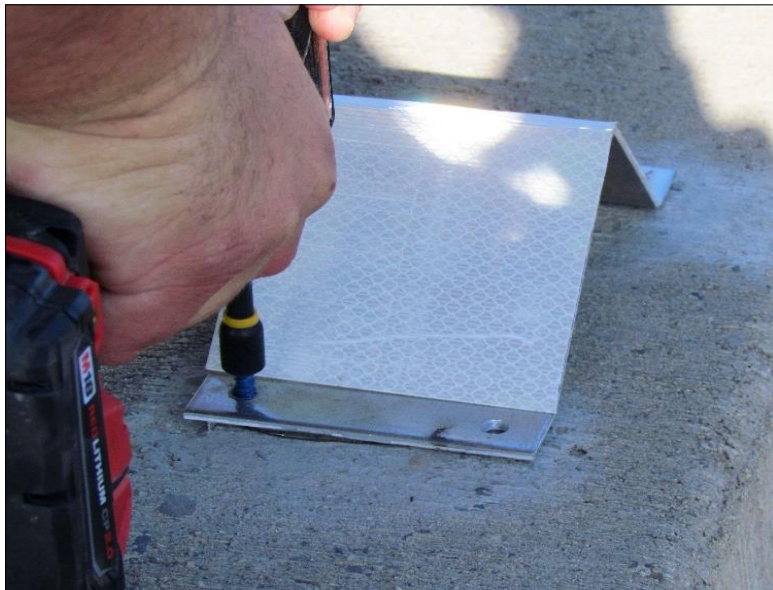
← The reflector units received a liberal application of E6800 adhesive.



← Completed placement of a 'glue only' attachment.

Note: The red arrow shows the adhesive extruding through the unit's screw holes.

This excess *may* allow for a more efficient bond of the unit to the barrier with the glue-only units.



← Tapper anchor being inserted into the deck barrier.

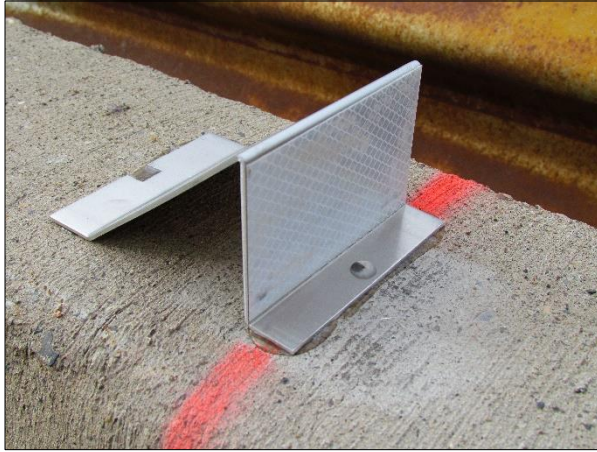


← Completed T2 unit using both screw and adhesive attachment.

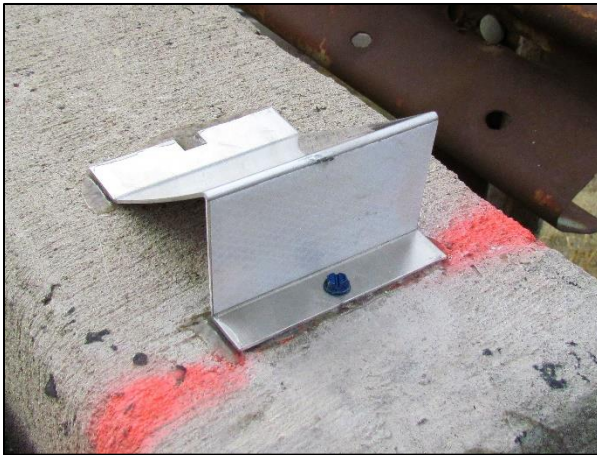
Note: The previous application process for the T2 units apply to all control/prototype installations on the project; with half of the units using only glue and the other half using glue and mechanical attachment to the deck barrier.

Only two anchor attachments were used.

Representative Images of Completed installations of T1, T3 & T4

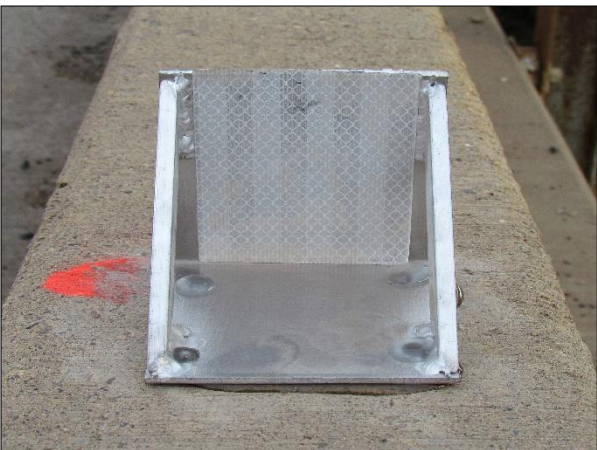


← Control Unit T1; glue only attachment.



← Control Unit T1; glue and screw anchor attachment.

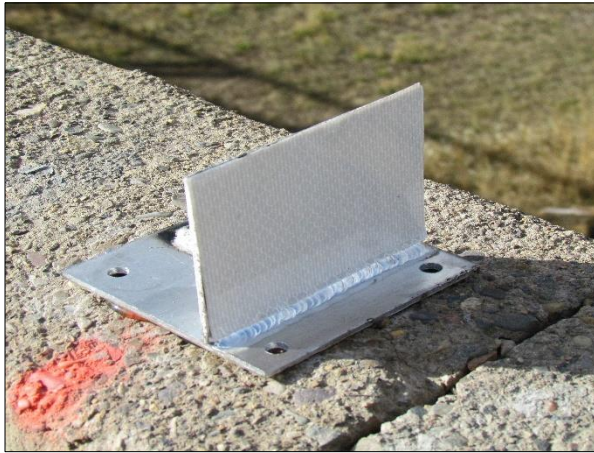
Note: Unit T1 had only one anchor applied (front of reflector).



← Test Prototype Unit T3; glue only attachment.



← Test Prototype Unit T3; glue and screw anchor attachment.

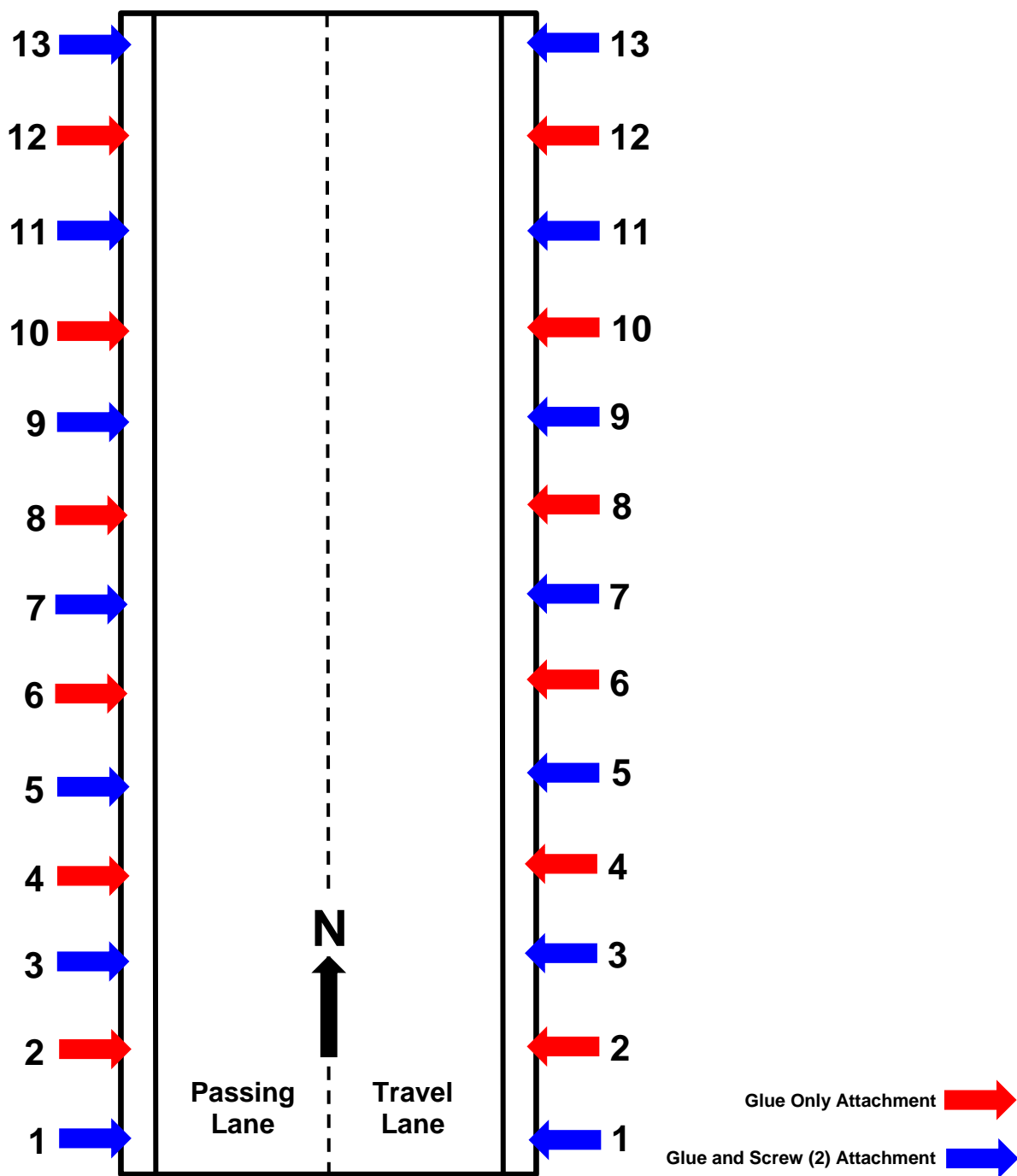


← Test Prototype Unit T4; glue only attachment.

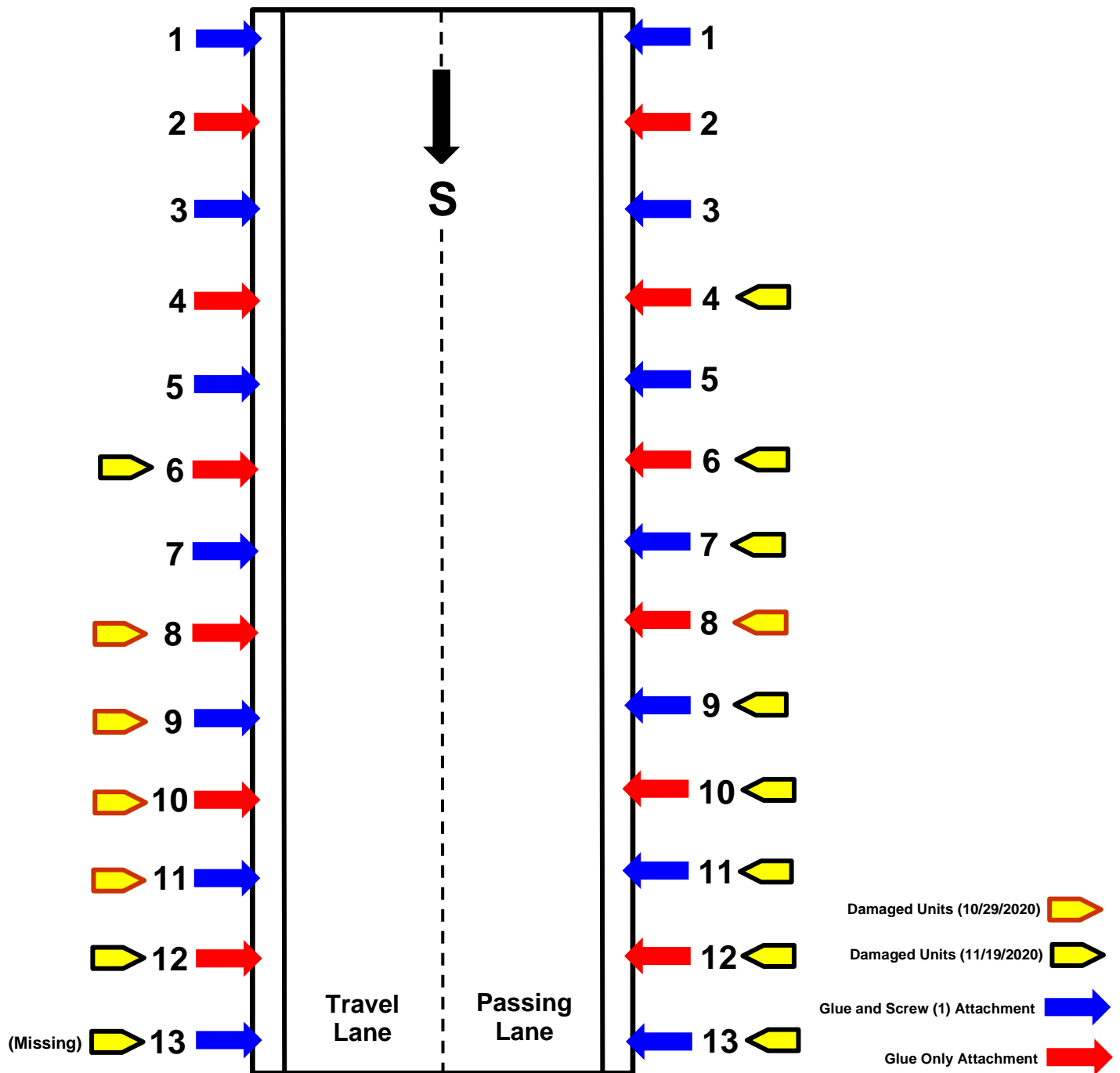


← Test Prototype Unit T4; glue and anchor attachment.

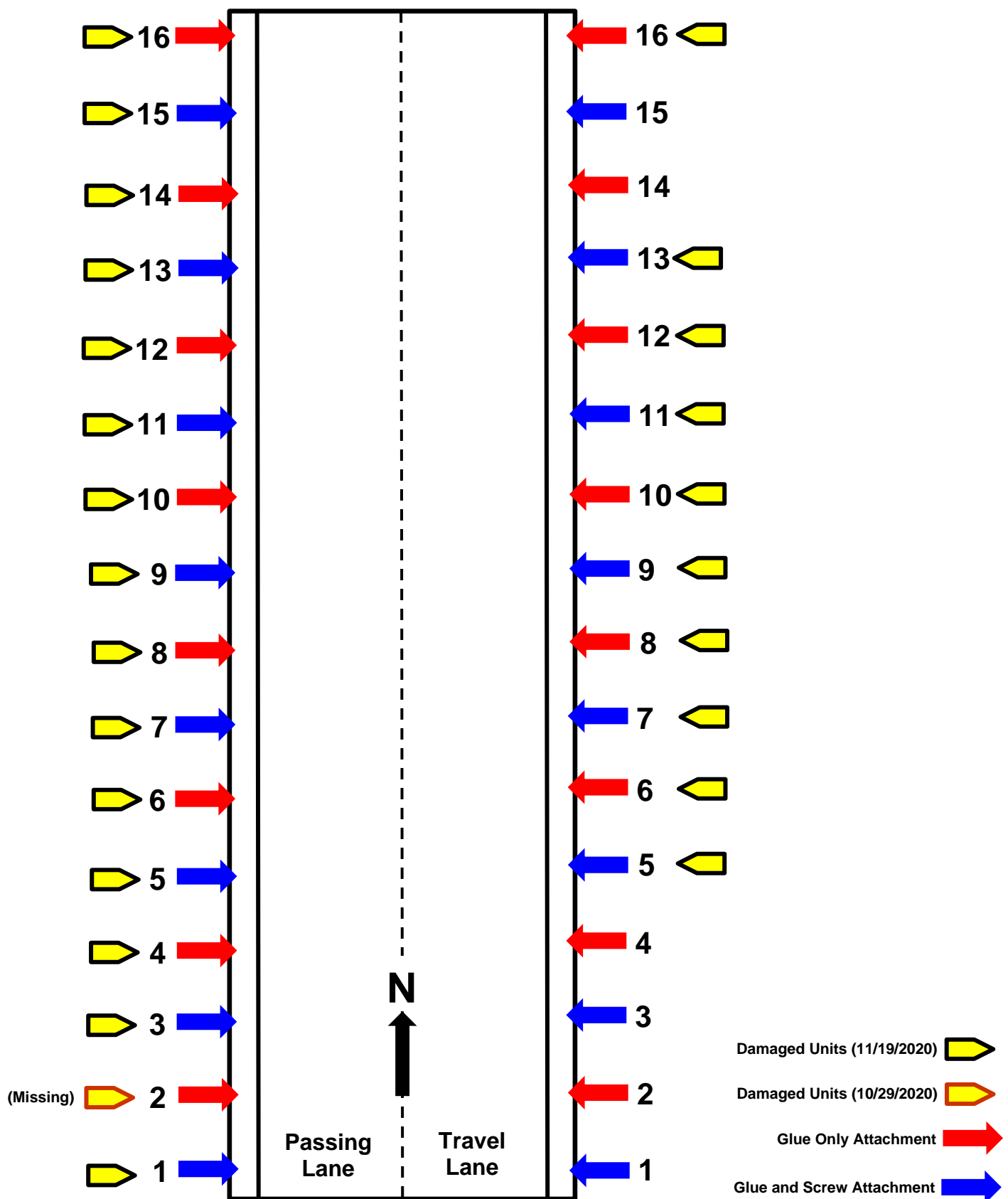
Test Section Delineator Design T2: Emerson Jct. Bridge – North Bound



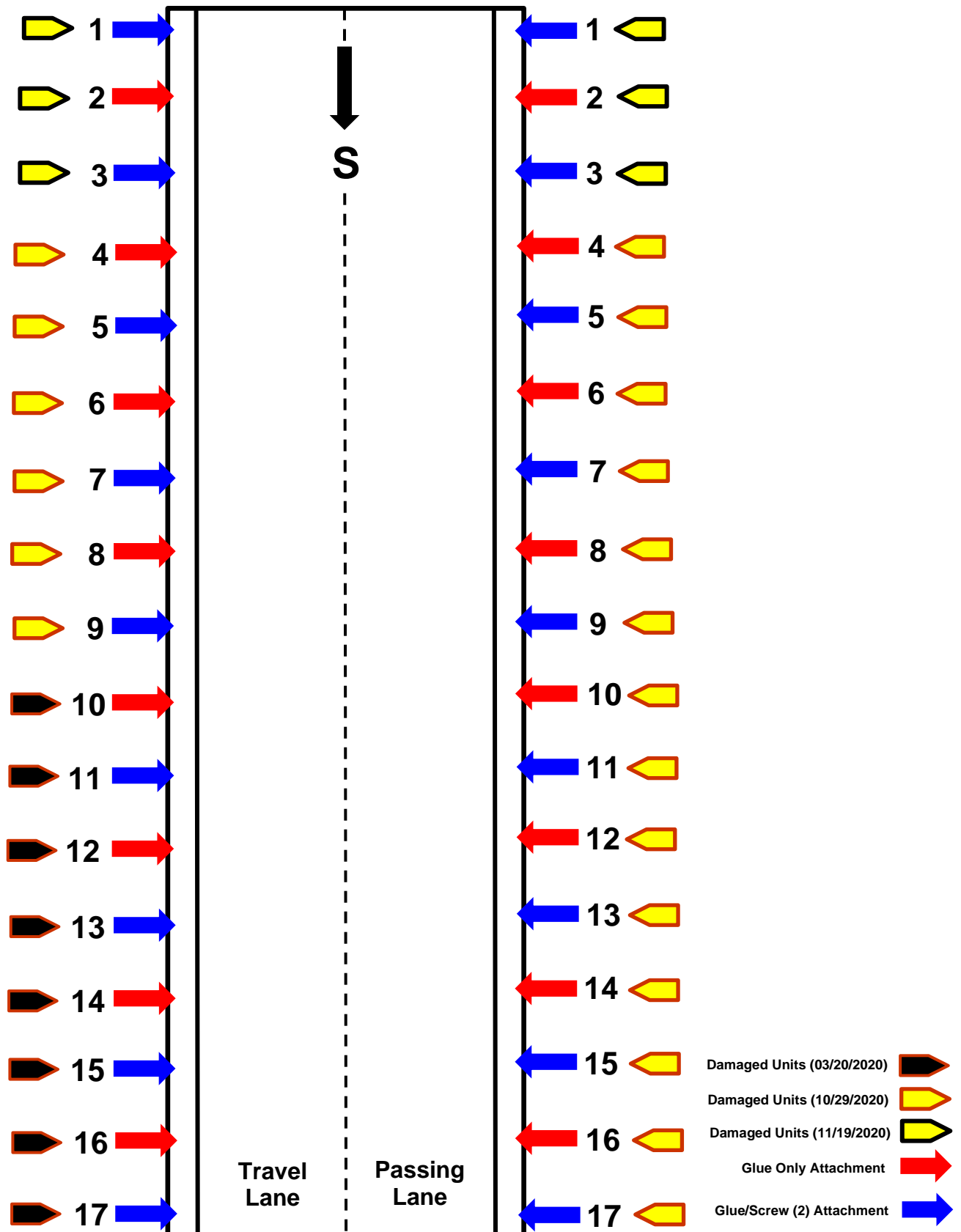
Control Section Delineator Design T1: Emerson Jct. Bridge – South Bound



Test Section Delineator Design **T3**: Sun River Bridge – North Bound



*Test Section Delineator Design T4: Sun River Bridge – South Bound



*If damage noted refer to 'Damage Description & Timeline' section in this report.

Damage Description and Timeline: March 20, 2020



↩ ↓ As previously stated on page 3, and as denoted on page 17; District staff reported **T4** damaged reflector units on the south end of Southbound Sun River bridge on March 20.

Research had conducted a site inspection on March 16 and at that time the units were intact.

The units affected were **T4** 10 through 17; 4 glue-only units and 4 glue and screw units.

All documented units had consistently the same type of damage as seen in these images; a dog-eared bend in the upper-left top portion of the reflector.



District Maintenance staff has reported that no plowing activity occurred during the week of March 16, currently it is the consensus that this damage may have been caused by a wide load clipping the units.

Upon inspection, visually; the reflector base either glue-only or glue and mechanical attachment held tight after impact.



Damage Description and Timeline: November 19, 2020: Sun River Bridge NB



↩↓ Representative images of some of the damaged or missing **T3 units** on the NB Sun River Bridge.

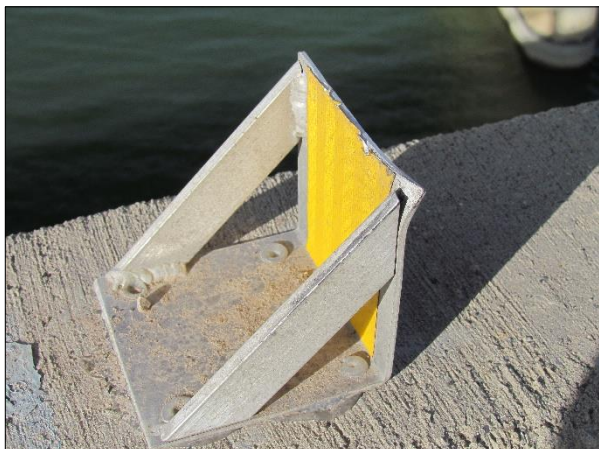
The top image is a glue-only reflector (left passing lane) that was completely removed by impact.



↩ Here is an impact (glue only attachment) that has broken the welded bracket.



↩↓ These two units show minor impact which has either clipped the top of the reflector or pulled up at the base.



Damage Description and Timeline: November 19, 2020: Sun River Bridge SB



↙↓ Representative images of the type of damaged **T4 units** on the NB Sun River Bridge.

The top image is a glue-only reflector (left passing lane) bent on both sides.

As seen with the rest of the images, most of reflectors are impacted in the upper corner at the oncoming traffic side.



Damage Description and Timeline: November 19, 2020: Emerson Jct. Bridge SB



↙↓ Representative images of the type of damaged **T1 units** on the SB Emerson Jct. Bridge.



Supplemental: T3 Unit

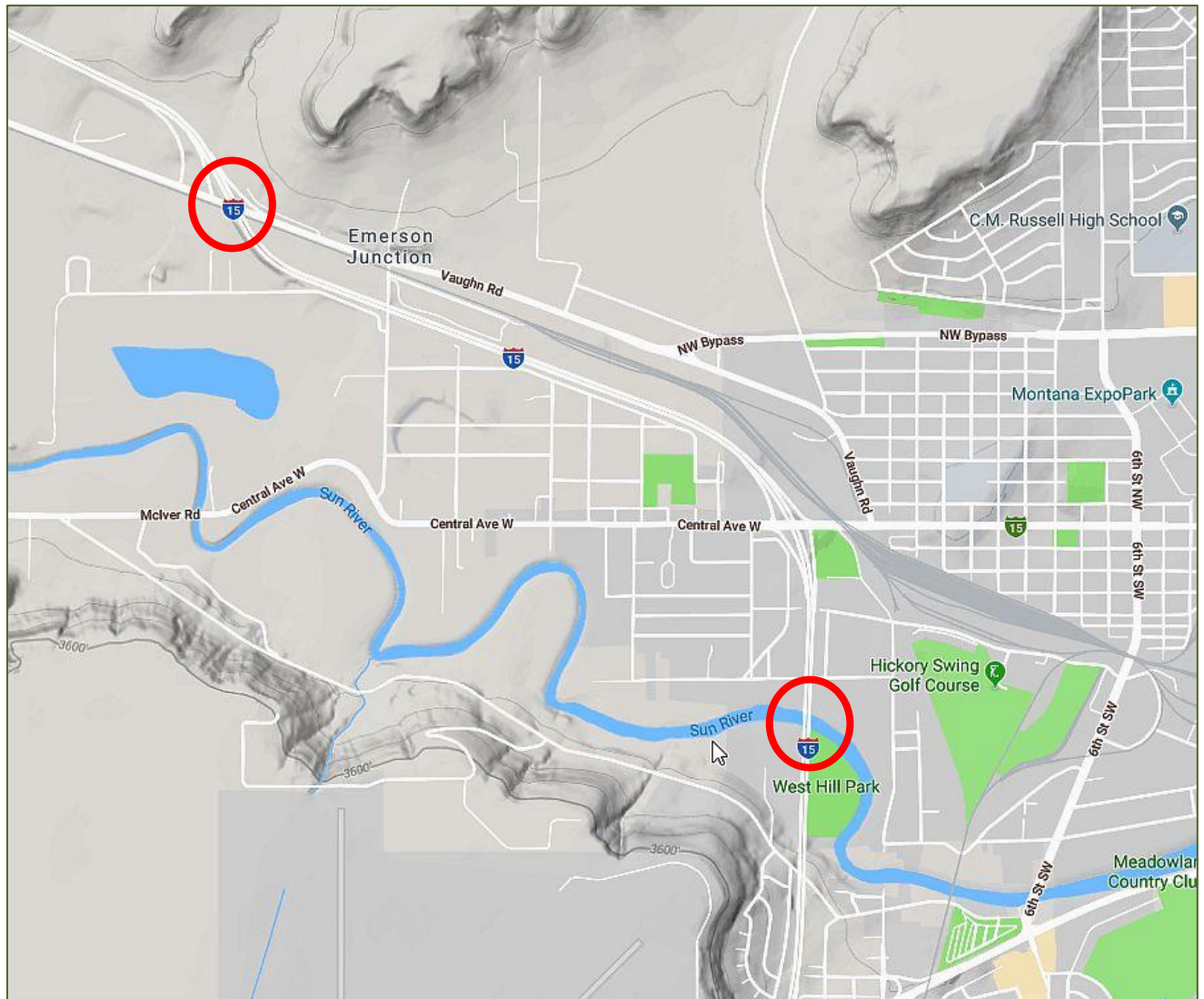


↑↓ To date it has been observed that units T1, T2, and T4 shed accumulated snow and ice at *relatively* the same rate, apart from unit **T3** (Sun River Bridge-Northbound). Although structurally the most durable prototype being tested, its somewhat box design does create the environment to capture and hold snow and ice longer than the other units.



***Project Location**

Cascade County/Great Falls District-Great Falls: Interstate 15 Structures at the Sun River and Emerson Junction; red circles are approximate structure locations.



*All values approximate; not to scale.