

**Experimental Feature Evaluation
 December 2022**

Experimental Feature:	Sprayroq – SprayWall Polyurethane Applied Culvert Lining
Location:	Missoula District, Mineral County, Interstate 90, RP 59.0, Nemote Creek
MDT Project Name:	I-90 Nemote Creek Culvert
MDT Project Number:	IM 90-1(205)59
Experimental Project Number:	MT-13-14
Principle Investigator:	Chad DeAustin, Experimental Project Manager (ExPM)
Construction Date:	February 2017
Date of Inspections:	April 2017, April 2018, March 2020, September 2021, July 2022

Project Map



Feature Description & Outline

The experimental feature used on this project is Sprayroq – SprayWall Polyurethane Applied Culvert Lining used to rehabilitate an existing culvert. The feature is located at the crossing of Nemote Creek on Interstate 90, approximately two miles northwest of the Tarkio Loop Road interchange, and 1.3 miles southeast of the Quartz Flats westbound rest area. The eight (8) gauge steel plate pipe (SPP) culvert is 242 linear feet, with an interior radius of 12 ft.

Bulging and sagging of the steel plated panels located near the east end of the culvert were noted in 2006 and recommended for remedial action in May 2013. Maximum deflection within areas of deformation was roughly estimated to be six inches located in the upper plates of the pipe. The purpose of the rehabilitation effort is to improve the structural capacity of the pipe to reduce the chance of a culvert failure that would impact the I-90 roadway.

Due to site constraints and apparent minimal change in the areas of deformation over the past seven years, the Department selected a cure-in-place-pipe (CIPP) process to provide structural enhancement and corrosion resistance. The selected product is Sprayroq's catalyzed, two-component coatings *SprayWall*. *SprayWall* is a procedure using self-priming, spray-applied structural polyurethane coating as the lining medium. The manufacturer states the lining allows return to active service within an hour of application. Product information including technical performance, specifications and ASTM certification can be found at: [SprayWall Polyurethane Lining](#).

The extent of the treatment encompassed the culvert inlet to approximately 30 feet down flow into the culvert with a 360° *SprayWall* application. Areas of the apparent deformation received a thicker application of *SprayWall*. Standard applied thickness of the polyurethane is a range of $\frac{1}{2}$ "– $\frac{3}{4}$ ".

Evaluation Procedures & Schedule

The measure of effectiveness (MOE) prevalent with this feature are:

- Construction practices (constructability, construction time, cost effectiveness, etc.),
- Performance of the *SprayWall*.

The accordance with MDT's Experimental Features Procedures, the Experimental Project Manager will monitor and report on performance for a minimum of five years annually. This includes delivery of a work plan, construction report, annual reports, and final project report.

2017: Installation/Construction Report
2018-2021: Annual Inspections/Evaluation Reports
2022: Final Evaluation/Final Report

Conclusion

Due to the deteriorating condition, this culvert below I-90 needed to be addressed but replacement would have led to major traffic impacts to the interstate as the culvert is approximately 20' below the roadway. By using Sprayroq's SprayWall, MDT was able to rehabilitate the structural integrity of the culvert and to date, there is no noticeable difference in the deflection of the culvert when compared to the condition before and after the product installation.

This culvert is biannually inspected as a part of MDT's Bridge Management program. The Research section will work with the bridge inspection team to ensure any changes in condition are documented and included in an updated report.

A dedicated [webpage](#) provides all reporting for the experimental feature.

Preconstruction - 2014



↑ Upstream culvert inlet view, east end.



↑ Representative image of the observed sagging in the top panels of the steel plate arch culvert. Deflection estimated at six inches inspected in 2014 (red). Corrosion also apparent at the base of the culvert (yellow).



↑ Interior view of extent of steel plate deflection.

During project development, Sprayroq representatives inspected the culvert and provided SprayWall application recommendations based on repairing the deflection of the culvert. After discussions with the contractor, it was decided to not repair the deflection. Sprayroq engineers recalculated the application of the SprayWall for the new site parameters.

The original calculation, with the ovality of 9%, was an application rate of 412 mil thickness. With the change in parameters, a new ovality was used of 19.2% resulting in a new mil thickness of 555. For safety purposes, Sprayroq recommended 750 mils for the deflection and area within two feet then tapering to the original design thickness over the remaining area.

Construction – February 2017

The period of culvert preparation and polyurethane application was from January to March. Although there were obstacles encountered due to the time of year the construction took place, no issues were reported after completion that may affect the long-term performance of the SprayWall application.



↑↓ The contractor elected to perform the work during the coldest month of winter when the stream was fully frozen. With the intent to remove the ice, then to dry the culvert with high heat to allow the preparation work required prior to the SprayWall application. Shown are representative images of the progress of removing ice from the culvert. Jackhammers, shovels, and picks were used to break up nearly two feet thick ice.





↩️ More images of ice removal.



↩️ Ice removal complete and culvert is now ready for preparation phase. The red arrow highlights the placement of tarp with sandbags beyond the rehab area to block air flow and water from entering the clean and dry section of pipe.



← Surface prep is the key to successful polymer application. For maximum adhesion of the SprayWall liner, the interior surface of the culvert needs to be free of debris, rust, scale, moisture, etc. As seen here, areas of the pipe, mostly seam connections, needing grinding to remove deteriorated material were spray painted orange.



←↓ To prevent oxidation and moisture seepage, Flex Seal is applied to all plate seams and bolts. In areas where moisture still permeated the sealant, a product called Speed Dry was also used to minimize moisture infiltration.





↙ The base of the culvert where corrosion took place is sand blasted (Kleen Blast Abrasives) to bare metal and vacuumed clean.



↙ The culvert interior after sand blasting.



← Warm air is circulated within the prepared section of culvert. Ambient air and surface temperature must be above 60 degrees for adequate adhesion of the polyurethane coating.



←↓ Although the application of the rubber sealant did mitigate moisture intrusion, the internal heating of the culvert caused moisture, that was inherently frozen around the pipe, to begin to melt and seep through at various plate joint connections. To mitigate this, the contractor would drill near the seam and inject a two-part hydroscopic polyurethane (Dural Aqua-Dam 200F) which expands to create a waterproof seal.





← Once the Aqua-Dam is injected, pencils were used to plug the holes to prevent seepage and allow curing. Once it sets the pencils are cut flush to the surface and excess sealant is removed prior to SprayWall application. MDT inspectors stated the applied sealants were not 100% effective in mitigating the moisture intrusion.



← The start of SprayWall application. Wearing protective clothing a worker applies the SprayWall to the bottom third of the culvert and allowed the material to cure.



← As the spray coating proceeded up the walls of the culvert, boards were propped to be used as stands for the workers to complete the treatment.



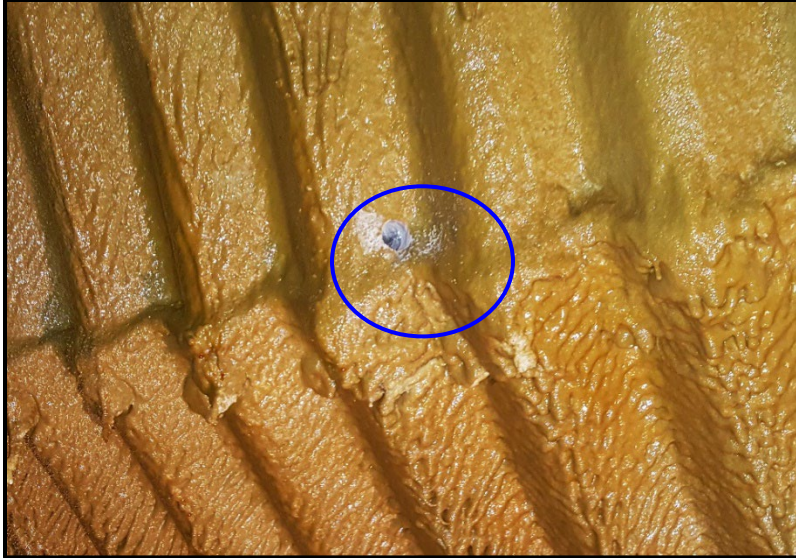
← SprayWall uses a conventional two-part polymeric elastomer to produce the structural, spray-applied polyurethane. Pictured is the Graco Reactor H-VR Variable Ratio Hydraulic Proportioner. This unit ensures the correct range of volumetric ratio to adjust the A and B pumps to dispense the exact amount of material specified and the correct blend based on product requirements.



← View of SprayWall coating near end of rehab section after full cure. As a rule, SprayWall begins to gel in about 8 seconds, with a tack-free condition after 2 minutes. Within 60 minutes, the initial cure is complete, and the structure can accept flow, while complete curing continues over the next 72 hours based on ambient temperature.



← Close-up of SprayWall texture after full cure.



← Several quality controls tests were performed; as seen here, a coring was performed to measure product thickness. The image below shows a core sample taken near the pipe deflection seam at approximately 3/4". Other inspections such as pull testing and spark testing were performed with satisfactory results.



← Example of core sample.



← Completed Sprayroq SprayWall installation under final inspection.



↑↓ Before culvert section rehabilitation (2016) and completed project, respectively.



2019 – January



↩️⬇️ During the January 2019 site inspection, it was noticed that approximately the lower quarter section of the culvert had developed a grainy, sandpaper like texture (top and center image). In contrast as compared to the lower image which represents the texture further up the culvert lining.

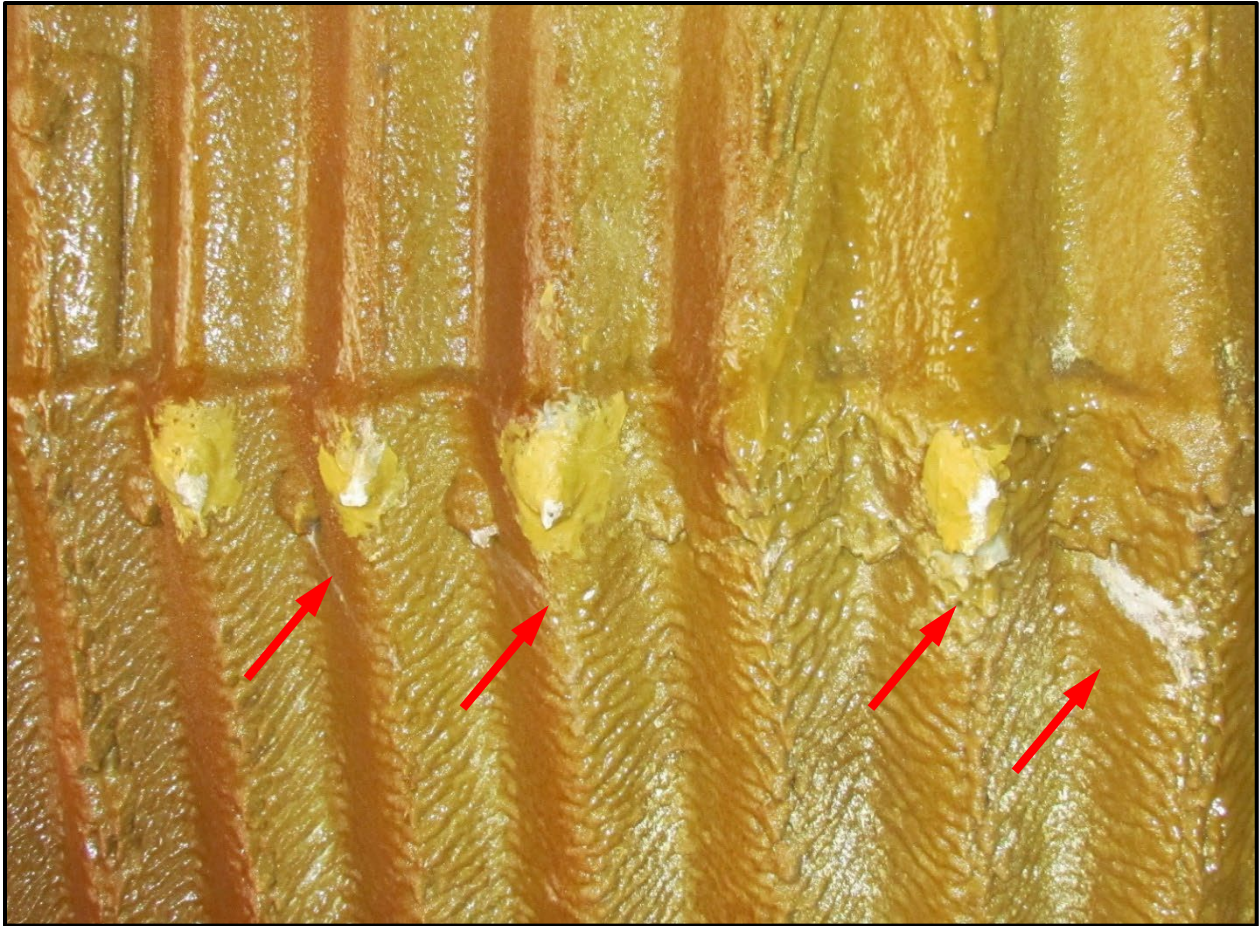
These images were sent to Mr. Rocky Capehart who was the vendor representative for the project. He in turn sent the images to the Sprayroq chemical lab for review and opinion.



A Sprayroq representative states this may be an issue of overspray during initial application.

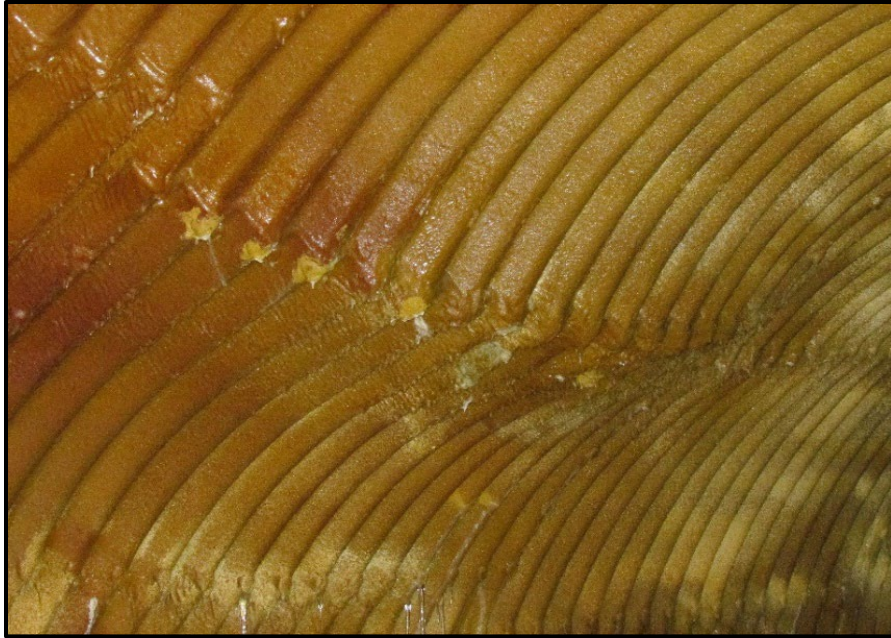


↩️ SprayWall texture noticed in much of the treated area.



↑ The above image is the apex of the deflected steel plate panel. It appears that precipitates, possibly from mineralized water, may be forming through small holes or cracks near the bolt plate connections.

2020 – March



↑ Area of culvert deflection. Although difficult to see in this image, there was some ice coating the culvert seams.



↑ This is the steel plate seam just below the area of deflection. Noticeable icicles are extruding from the plate bolt connections.

The moisture issues noticed during the 2019 and 2020 inspections at some seams and near the deflection were corrected with patch work that was done in February of 2021. This mitigated the mineral and water seepage.

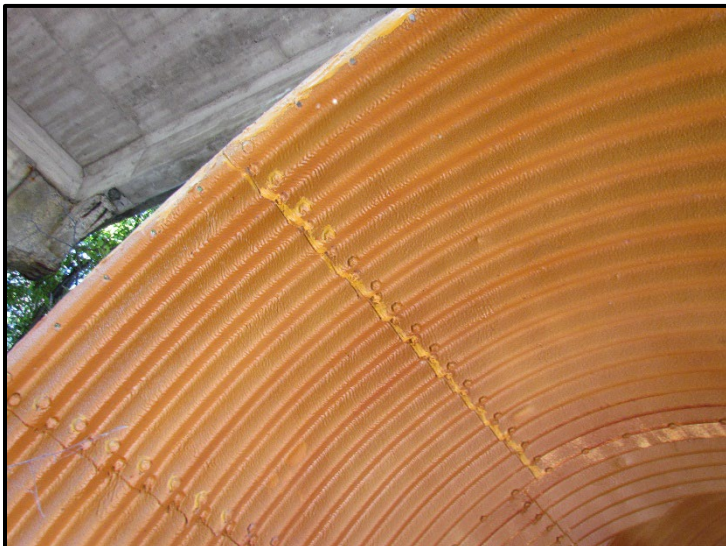
2022 – July



← Overview of inlet of the culvert.



← View highlighting the original deflected section of the culvert. There's no sign of failed adhesion or SprayWall liner separation from the culvert.



← View of some of the hand patch work done during the 2021 repair work. It shows no sign of degradation or water seepage.



↑↓ For comparison, above is the condition in 2018 and below is a photo from 2022.



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