

Research Project Quarterly Progress Report

Date: 4/30/2021 **Project Number:** TPF-5(430) Suppl. #1, RPFP-20-MGS-2
Project Title: MGS with Reduced Embedment and Post Spacing over Low-Fill Culverts
Principal Investigator: Faller, R.K., Bielenberg, R.W., Lechtenberg, K.A., Rosenbaugh, S.K., Mojdeh Pajouh
Principal Contact Information Email: mojdeh.pajouh@unl.edu **Phone:** 402-472-0920
Project Start Date: 1/21/2020 **Project Completion Date:** 12/31/2022

Report Period: **Due Date:**
 Quarter 1 (July 1 – September 30) October 31
 Quarter 2 (October 1 – December 31) January 31
 Quarter 3 (January 1 – March 31) April 30
 Quarter 4 (April 1 – June 30) July 31

Project Schedule Status:
 On Schedule
 On Approved Revised Schedule
 Ahead of Schedule
 Behind Schedule

Progress:

Task	Total Budget	% work Completed This Quarter	Expenses This Quarter	Total Expenses to Date	Total % of Task Completed	Remaining Budget
1. Project Planning & Management & CAD	\$16,853.00	0.0%	\$0.00	\$7,525.00	44.7%	\$9,328.00
2. Dynamic Bogie Testing	\$78,032.00	2.0%	\$1,530.00	\$35,587.00	45.6%	\$42,445.00
3. Dynamic Bogie Testing	\$61,310.00	0.0%	\$0.00	\$0.00	0.0%	\$61,310.00
4. Reporting and Project Deliverables	\$29,717.00	0.0%	\$0.00	\$0.00	0.0%	\$29,717.00
5.						
6.						
8. Total	\$185,912	-	\$1,530.00	\$43,112.00	23.2%	\$142,800.00

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

Previously, MwRSF had started the research effort by conducting six (6) bogie tests to evaluate post behavior through a range of reduced embedment depths. All tests were conducted with W6x8.5 posts. Two tests were performed at each reduced embedment increment of 4 in. from the standard 40 in. MGS post embedment, to a minimum of 28 in. (embedment depths of 28 in., 32 in., and 36 in.). The data from these tests was analyzed and compared with previous testing of guardrail posts at the standard embedment depth of 40 in. The data will also be used to develop post-soil resistance input for computer simulation.

Additional bogie testing was conducted. Analysis of the initial bogie tests found that the post soil interaction forces were limited by yielding of the W6x8.5 post used in the first six bogie tests. In order to isolate the soil response at lower embedments, a second set of three bogie tests was conducted with W6x16 posts at 40 in., 34 in. and 28 in. embedments. The data from these tests was further utilized to characterize the post response for shallow embedments.

MwRSF has continued development of models of the bogie tests in LS-DYNA to develop accurate post-soil models for further MGS system analysis with shallow embedments. Models of both the W6x8.5 and W6x16 dynamic component tests were developed. The W6x16 models are being calibrated to provide accurate soil response. The soil models used in the W6x16 post in soil models are then being applied to a model of W6x8.5 posts in soil with various embedment depths and compared with the previous component tests to ensure that the LS-DYNA models will produce the proper response when used to model the MGS with shallow embedment depths. Only limited progress was made this quarter due to other priorities and project deadlines.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

The COVID-19 pandemic and business responses may play a factor in future efforts. MwRSF has not been shut down and is still working, but much of the personnel has transitioned to working remotely, as has much of the country during this time of social distancing. This major shift in regular work operations may lead to delays and inefficiencies as well as other unforeseen hurdles. Additionally, changes to businesses outside of MwRSF may lead to possible delays in material acquisition. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

In the upcoming quarter, MwRSF will continue to develop validated models of the post-soil interaction with reduced embedments and begin simulation analysis of potential MGS design alternatives.

Total Percentage of Project Completion:

23.2%

Research Project Quarterly Progress Report

Date: 4/29/2021 **Project Number:** TPF-5(430) Suppl. #2
Project Title: Additional Retrofit Options for Post Conflicts within AGTs
Principal Investigator: Faller, Rosenbaugh, Rasmussen, Bielenberg, Lechtenberg, Reid, Stolle
Principal Contact Information Email: srosenabugh2@unl.edu **Phone:** (402) 472-9324
Project Start Date: 10/1/2018 **Project Completion Date:** 12/31/2021

Report Period:	Due Date:
<input type="checkbox"/> Quarter 1 (July 1 – September 30)	October 31
<input type="checkbox"/> Quarter 2 (October 1 – December 31)	January 31
<input checked="" type="checkbox"/> Quarter 3 (January 1 – March 31)	April 30
<input type="checkbox"/> Quarter 4 (April 1 – June 30)	July 31

Project Schedule Status:

On Schedule
 On Approved Revised Schedule
 Ahead of Schedule
 Behind Schedule

Progress:

Task	Total Budget	% work Completed This Quarter	Expenses This Quarter	Total Expenses to Date	Total % of Task Completed	Remaining Budget
1. Planning & Correspondence	\$27,155	50%	\$899	\$8,825	45%	\$18,330
2. Design and Analysis	\$106,064	50%	\$1,000	\$1,000	1%	\$105,064
3. Bogie Testing	\$99,897	0%	\$0	\$0	0%	\$99,897
4. Reporting and Deliverables	\$18,311	0%	\$0	\$0	0%	\$18,311
5.						
6.						
7.						
8.						
9. Total	\$251,429	-	\$1,899	\$9,825	9%	\$241,604

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

Previously in the 4th quarter of 2020, a survey of the AGT installation issues observed by the sponsoring states resulted in the focus of this project to be on the development of a top-mounted posts for AGTs. These posts would be 6x15 posts mounted to the top of a concrete slab. This concept would address all ground obstructions and possible even the issue of slopes.

In the 1st quarter of 2021, the literature review was expanded to include a review of top-mounted steel posts. Systems reviewed included both AGT posts and guardrail posts on culverts. Both bogie testing and full-scale crash testing documents were gathered on these top-mounted posts. Additionally, bogie testing of W6x15 AGT posts in soil was reviewed in order to establish the targeted design loads for the new post – an average force of 16-17 kips over 10 inches of deflection.

A W6x15 mounted to a rigid plate was found to be too strong as compared to a W6x15 in soil, and may result in excessive pocketing and vehicle snag. Thus, concept development has focused on methods to weaken the assembly. A few concepts being explored include 1) holes in the compression flange to instigate localized buckling, 2) cuts in the tension flange to instigate flange tearing, 3) tearing of the plate, and 4) bending of the plate while the post remains “rigid”. These concepts are being analyzed and modeled for initial evaluation. Further concepts are expected to grow as the analysis continues.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

The budget numbers presented herein do not include labor charges from March 2021 as those expenditures had not yet been charged to the project.

The COVID-19 pandemic and business responses may play a factor in future efforts. MwRSF has not been shut down and is still working, but much of the personnel has transitioned to working remotely, as has much of the country during this time of social distancing. This major shift in regular work operations may lead to delays and inefficiencies as well as other unforeseen hurdles. Additionally, changes to businesses outside of MwRSF may lead to possible delays in material acquisition. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

Conceptual design of possible retrofits will continue along with structural analysis of the concepts. Simple LS-DYNA models will be created of the concepts and will be used as a design tool to optimize the post assembly components prior to physical component testing.

Total Percentage of Project Completion:

9%

Research Project Quarterly Progress Report

Date: 4/28/2021 **Project Number:** TPF-5(430) Suppl. #3, RPFP-20-AGT-2
Project Title: Guidelines for Flaring Thrie-Beam Approach Guardrail Transitions - Phase II
Principal Investigator: Scott Rosenbaugh, Faller, Bielenberg, et al.
Principal Contact Information Email: srosenbaugh2@unl.edu **Phone:** (402) 472-9324
Project Start Date: 1/21/2020 **Project Completion Date:** 12/31/2022

Report Period: **Due Date:**
 Quarter 1 (July 1 – September 30) ----- October 31
 Quarter 2 (October 1 – December 31) ----- January 31
 Quarter 3 (January 1 – March 31)----- April 30
 Quarter 4 (April 1 – June 30) ----- July 31

Project Schedule Status:
 On Schedule
 On Approved Revised Schedule
 Ahead of Schedule
 Behind Schedule

Progress:

Task	Total Budget	% work Completed This Quarter	Expenses This Quarter	Total % of Task Completed	Remaining Budget
1. Project Planning & Correspondence	\$12,644.00	0%	\$0.00	32%	\$8,644.00
2. Full-Scale Crash Testing	\$278,516.00	100%	(\$612.00)	10%	\$238,507.00
3. Reporting	\$11,623.00	0%	\$0.00	0%	\$11,623.00
4.					
5.					
6.					
7.					
8.					
9. Total	\$302,783.00		\$-612	10%	\$258,774.00

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

The test article for full-scale crash test no. FLAGT-1 was completed. It consisted of a standardized concrete transition buttress, a three beam AGT, a distance of MGS, and an upstream guardrail anchor. The AGT and the MGS regions were back at a 15:1 rate (3.8 degrees from tangent) from the roadway. The guardrail was attached to the buttress using a wedge-shaped steel connection plate that filled the gap between the tangent buttress and the angled guardrail.

Test no. FLAGT-1 was conducted on 3-31-2021 in accordance with MASH test 3-21. The 2270P pickup truck impacted the AGT approximately 93 in. upstream from the buttress at a speed of 63.3 mph and an impact angle of $3.8 + 25.7 = 29.5$ degrees. The impact point was selected to maximize snag on the concrete buttress. The vehicle was contained and redirected, and the pickup remained upright and stable throughout the test. However, the impact forces and vehicle crush resulted in excessive deformations to the occupant compartment. Deformations of 12 in. were measured in the wheel/foot well and toe pan area, where MASH specifies a maximum allowable deformation of 9 inches. Additionally, the maximum longitudinal ORA was measured as 24.2 g's, which exceeded the MASH limit of 20.49 g's. Thus, test FLAGT-1 failed to satisfy MASH safety criteria due to excessive occupant compartment crush and excessive decelerations (longitudinal ORA).

System deflections were higher than anticipated. Video analysis is still being conducted to get accurate deflection measurements, but initial estimates are around 15 inches for maximum dynamic deflection and 10.5 in. for permanent set deflection. Test AGTB-2 on the original, tangent AGT system had a maximum dynamic deflection of 5.3 in. and a permanent set deflection of 2.8 in. It should be noted that flared guardrail and the impact speed and angle being slightly above targeted values resulted in a 35 percent increase in Impact Severity compared to the original test on a tangent system. Thus, increased deflections were expected. Simulations conducted during Phase I of the project only predicted a maximum deflection of 10.7 in. The increased system deflections resulted in large soil displacements, and a crack opened up in the soil along the front flanges of the AGT posts. This soil behavior was not observed in previous AGT or MGS testing. It is believed that the tight spacing of the posts (18.75 in. on center) and the increased loading and displacement to the posts lead to overlapping soil forces that opened up this soil crack.

Tire marks on the upstream face of the concrete buttress were observed, but were very similar to those observed in the original tangent test. Thus, excessive tire snag on the buttress was not likely in test FLAGT-1. However, the nested three beam rail was bent sharply near the upstream end of the concrete buttress and is likely a location of vehicle snag during the test. Additional analysis is being conducted to estimate the guardrail pocketing angles that occurred during the test.

MwRSF is still finishing the analysis of this test.

Efforts were also made to complete the Phase I report, which focused on the simulation of various flare rates and the selection of the 15:1 flare for further evaluation.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

The budget numbers presented herein do not include labor charges from March 2021 as those expenditures had not yet been charged to the project.

\$30,000 in project funds from the Year 28 Pooled Fund project titled "MASH Evaluation of Steel Post Bullnose" was reallocated to partially fund this project. However, the Year 28 project was set to close in March 2021. Thus, \$30,000 of charges that had previously been placed on this Year 30 project were reassigned to the newly allocated funds from Year 28. This Year 30 project was only charged \$29,388 in the first quarter of 2021, which resulted in an increase in funds remaining by \$612 from the 4th quarter 2020 QPR.

The COVID-19 pandemic and business responses may play a factor in future efforts. MwRSF has not been shut down and is still working, but much of the personnel has transitioned to working remotely, as has much of the country during this time of social distancing. This major shift in regular work operations may lead to delays and inefficiencies as well as other unforeseen hurdles. MwRSF will continue to make progress on this research

in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

Analysis of test FLAGT-1 will be completed. The results will be discussed with the project sponsors, and a system modification will be selected. Full-scale testing will resume with the modified system configuration.

Total Percentage of Project Completion:

20%

Research Project Quarterly Progress Report

Date: 1/29/2021 **Project Number:** TPF-5(430) Suppl. #4, RPFP-20-TERM-1
Project Title: Further Evaluation of the End Terminals Adjacent to Curb
Principal Investigator: Robert Bielenberg and Cody Stolle, Faller, et al
Principal Contact Information Email: rbielenberg2@unl.edu **Phone:** (402) 472-9064
Project Start Date: 1/21/2020 **Project Completion Date:** 12/31/2022

Report Period: **Due Date:**
 Quarter 1 (July 1 – September 30) ----- October 31
 Quarter 2 (October 1 – December 31) ----- January 31
 Quarter 3 (January 1 – March 31)----- April 30
 Quarter 4 (April 1 – June 30) ----- July 31

Project Schedule Status:
 On Schedule
 On Approved Revised Schedule
 Ahead of Schedule
 Behind Schedule

Progress:

Task	Total Budget	% work Completed This Quarter	Expenses This Quarter	Total % of Task Completed	Remaining Budget
1. Project Planning & Correspondence	\$19,248.00	15%	\$6,200.00	58	\$6,679.00
2. Full-Scale Crash Testing	\$176,505.00	3%	\$6,400.00	4%	\$169,485.70
3. Design & Analysis	\$39,381.00	1%	\$2,617.48	1%	\$36,763.52
4. Reporting & Deliverables	\$22,074.00	0%	\$0.00	0%	\$22,074.00
5.					
6.					
7.					
8.					
9. Total	\$257,208.00		\$0.00		\$235,002.22

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

Using results of the state DOT and manufacturer surveys, researchers contacted Safety by Design, Inc (SDI) to notify them that the Sequential Kinking Terminal (SKT) was the preferred terminal selected by state DOTs. SDI considered and accepted the opportunity to evaluate the SKT installed in combination with a 4-in. curb for MASH test designations 3-30 and 3-32.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

None.

The COVID-19 pandemic and business responses may play a factor in future efforts. MwRSF has not been shut down and is still working, but much of the personnel has transitioned to working remotely, as has much of the country during this time of social distancing. This major shift in regular work operations may lead to delays and inefficiencies as well as other unforeseen hurdles. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

Test plans will be started for investigating end terminal performance in conjunction with curbs. Terminal configurations to be used in combination with the sloped 4-in. curb will be confirmed with SDI and included in the test plan. Pre-test evaluations will be conducted to investigate vehicle stability when traversing non-level terrain, before installing the guardrail system. Once completed, survey results, test plans, and recommendations will be submitted to Midwest Pooled Fund state DOTs for review and approval before proceeding.

Total Percentage of Project Completion:

8%

Research Project Quarterly Progress Report

Date: 4/30/2021 **Project Number:** TPF-5(430)_Suppl5_RPFP-20-SR-1
Project Title: Development of a Short-Radius Guardrail for Intersecting Driveways or Roadways
Principal Investigator: J. Reid, R. Faller, R. Bielenberg, K. Lechtenberg, S. Rosenbaugh
Principal Contact Information Email: rbielenberg2@unl.edu **Phone:** (402) 472-9064
Project Start Date: 1/16/2020 **Project Completion Date:** 12/31/2022

- Report Period:** **Due Date:**
- Quarter 1 (July 1 – September 30) ----- October 31
 - Quarter 2 (October 1 – December 31) ----- January 31
 - Quarter 3 (January 1 – March 31)----- April 30
 - Quarter 4 (April 1 – June 30) ----- July 31

- Project Schedule Status:**
- On Schedule**
 - On Approved Revised Schedule**
 - Ahead of Schedule**
 - Behind Schedule**

Progress:

Task	Total Budget	% work Completed This Quarter	Expenses This Quarter	Total % of Task Completed	Remaining Budget
1. Project Planning and Correspondence	\$30,952.00	0.0%	\$0.00	5.9%	\$29,130.00
2. Design and Analysis	\$177,021.00	1.0%	\$1,850.00	1.0%	\$175,171.00
3. Reporting and Project Deliverables	\$43,059.00	0.0%	\$0.00	0.0%	\$43,059.00
4.					
5.					
6.					
7.					
8.					
9.					

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

In this quarter, MwRSF completed the literature review of existing short-radius guardrail research and began work on that section of the research report. MwRSF also developed 15 potential design concepts and determined advantages and disadvantages of each concept. Four preferred concepts were presented to the sponsors at the Midwest Pooled Fund Annual Meeting. MwRSF plans to further develop these initial concepts and present them to the sponsors at a separate meeting.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

None

The COVID-19 pandemic and business responses may play a factor in future efforts. MwRSF has not been shut down and is still working, but much of the personnel has transitioned to working remotely, as has much of the country during this time of social distancing. This major shift in regular work operations may lead to delays and inefficiencies as well as other unforeseen hurdles. Additionally, changes to businesses outside of MwRSF may lead to possible delays in material acquisition. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

MwRSF will further develop the previous concepts and hold a meeting with the sponsors to discuss the concepts, receive feedback, and potentially determine a preferred concept for further development and analysis.

Total Percentage of Project Completion:

1.5%

Research Project Quarterly Progress Report

Date: 4/30/2021 **Project Number:** TPF-5(193) Suppl. #147 RPFP-19-CONSULT
Project Title: Annual Consulting Services Support
Principal Investigator: J. Reid, R. Faller, R. Bielenberg, K. Lechtenberg, S. Rosenbaugh
Principal Contact Information Email: rbielenberg2@unl.edu **Phone:** (402) 472-9064
Project Start Date: 1/21/2020 **Project Completion Date:** 12/31/2022

Report Period: **Due Date:**
 Quarter 1 (July 1 – September 30) ----- October 31
 Quarter 2 (October 1 – December 31) ----- January 31
 Quarter 3 (January 1 – March 31) ----- April 30
 Quarter 4 (April 1 – June 30) ----- July 31

Project Schedule Status:
 On Schedule
 On Approved Revised Schedule
 Ahead of Schedule
 Behind Schedule

Progress:

Task	Total Budget	% work Completed This Quarter	Expenses This Quarter	Total % of Task Completed	Remaining Budget
1. Project Planning and Correspondence	\$60,647.00	11.1%	\$781.00	12.4%	\$53,107.00
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

This project allows MwRSF to be a valuable resource for answering questions with regard to roadside safety issues. MwRSF researchers and engineers are able to respond to issues and questions posed by the sponsors during the year. Major issues discussed with the States have been documented in our Quarterly Progress Reports and all questions and support are accessible on a MwRSF Pooled Fund Consulting web site.

In the past quarter MwRSF has responded to a series of state inquiries. The Quarterly Progress Report summarizing these responses has been attached to this document. The summary will also be available for download at the recently completed MwRSF Pooled Fund Consulting web site - <http://mwrsf-qa.unl.edu/>

We are continuing to work with and improve the MwRSF Pooled Fund Consulting web site as our experience with it grows. We would ask that all Pooled Fund member states use the new site from this point forward for their inquiries and to contact us with any issues they experience with the web site.

The summary of the consulting effort for this quarter is attached with the progress update.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

The COVID-19 pandemic and business responses may play a factor in future efforts. MwRSF has not been shut down and is still working, but much of the personnel has transitioned to working remotely, as has much of the country during this time of social distancing. This major shift in regular work operations may lead to delays and inefficiencies as well as other unforeseen hurdles. Additionally, changes to businesses outside of MwRSF may lead to possible delays in material acquisition. MwRSF will continue to make progress on this research in the most effective manner possible moving forward

Anticipated Work Next Quarter:

MwRSF will continue to answer questions and provide support to the sponsors during the upcoming quarter.

We would ask that all questions be submitted through the web site so that they can be answered and archived therein.

<http://mwrsf-qa.unl.edu/>

Total Percentage of Project Completion:

11.1%

Research Project Quarterly Progress Report

Date: 4/28/2021 **Project Number:** TPF-5(430) Suppl. #7, RPFP-20-PFCHS
Project Title: Pooled Fund Center for Highway Safety
Principal Investigator: Reid, Bielenberg, Faller, Holloway, Lechtenberg, Rosenbaugh, Rasmussen,
Principal Contact Information Email: kpolivka2@unl.edu **Phone:** (402) 472-9070
Project Start Date: 1/21/2020 **Project Completion Date:** 12/31/2022

Report Period: **Due Date:**
 Quarter 1 (July 1 – September 30) ----- October 31
 Quarter 2 (October 1 – December 31) ----- January 31
 Quarter 3 (January 1 – March 31) ----- April 30
 Quarter 4 (April 1 – June 30) ----- July 31

Project Schedule Status:
 On Schedule
 On Approved Revised Schedule
 Ahead of Schedule
 Behind Schedule

Progress:

Task	Total Budget	% work Completed This Quarter	Expenses This Quarter	Total % of Task Completed	Remaining Budget
1. Website Develop, Populate, and Host	\$14,330.00	13%	\$1,917.00	70%	\$4,245.00
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

Troubleshooting and fixing any issues that have occurred during the transition.

Continued maintenance, repair, and upkeep of the website

Updated research hub with new completed projects.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

This is continuation funding until the funds from Project No.: RFP-19-PFCHS – TPF-5(193) Supplement #148, Project Title: Pooled Fund for Highway Safety have been exhausted.

The COVID-19 pandemic and business responses may play a factor in future efforts. MwRSF has not been shut down and is still working, but much of the personnel has transitioned to working remotely, as has much of the country during this time of social distancing. This major shift in regular work operations may lead to delays and inefficiencies as well as other unforeseen hurdles. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

Troubleshoot and fix any issues that have occurred during the transition.

Continued maintenance, repair, and upkeep of the website

Updated research hub with new completed projects.

Total Percentage of Project Completion:

70%

Research Project Quarterly Progress Report

Date: 4/30/2021 **Project Number:** TPF-5(430) Suppl. #8, RPFP-20-LS-DYNA

Project Title: LS-DYNA Modeling Enhancement Support

Principal Investigator: Reid, Faller, et al.

Principal Contact Information Email: jennifer.rasmussen@unl.edu **Phone:** (402) 472-0870

Project Start Date: 1/21/2020 **Project Completion Date:** 12/31/2022

- Report Period:** **Due Date:**
- Quarter 1 (July 1 – September 30) ----- October 31
 - Quarter 2 (October 1 – December 31) ----- January 31
 - Quarter 3 (January 1 – March 31)----- April 30
 - Quarter 4 (April 1 – June 30) ----- July 31

- Project Schedule Status:**
- On Schedule**
 - On Approved Revised Schedule**
 - Ahead of Schedule**
 - Behind Schedule**

Progress:

Task	Total Budget	% work Completed This Quarter	Expenses This Quarter	Total % of Task Completed	Remaining Budget
1. LS-DYNA Modeling Enhancement	\$30,616.00	0.0%	\$0.00	0.4%	\$30,506.00
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9. Total	\$30,616.00		\$0.00		\$30,616.00

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

The Year 30 LS-DYNA modeling enhancement support was initiated part way through the first quarter of 2020. Due to remaining funds in the Year 29 LS-DYNA modeling enhancement support, no funds will be utilized from this project until Year 29 modeling funds are depleted.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

None.

The COVID-19 pandemic and business responses may play a factor in future efforts. MwRSF has not been shut down and is still working, but much of the personnel has transitioned to working remotely, as has much of the country during this time of social distancing. This major shift in regular work operations may lead to delays and inefficiencies as well as other unforeseen hurdles. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

None - due to remaining funds in the Year 29 LS-DYNA modeling enhancement support, no funds will be utilized from this project until Year 29 modeling funds are depleted.

Total Percentage of Project Completion:

0.4%

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

In this quarter, MwSRF completed most of the system installation exevept for finsihing the slope. The system is currently behind several other systems in the testing que and will be tested as soon as possible. Final slope preparations and anchorage posts will be installed shortly before testing.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

Note that the original start date for the project was listed as October of 2019 with an end date in the 3Q of 2021 (Sept. 30, 2021). Authorization of for the project was not received until January 2020, so the end date has been pushed back accordingly to end of December 2021.

The COVID-19 pandemic and business responses may play a factor in future efforts. MwRSF has not been shut down and is still working, but much of the personnel has transitioned to working remotely, as has much of the country during this time of social distancing. This major shift in regular work operations may lead to delays and inefficiencies as well as other unforeseen hurdles. Additionally, changes to businesses outside of MwRSF may lead to possible delays in material acquisition. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

In the next quarter, MwRSF anticipates conducting the full-scale crash testing of the MGS with 1/2 post spacing adjacent to slope.

Total Percentage of Project Completion:

18.8%

Research Project Quarterly Progress Report

Date: 4/30/2021 **Project Number:** TPF-5(430) Suppl. 12 – FY20-WY-1-GATE: MASU 2016 TL 2
Project Title: Evaluation of Drop-Arm Road Closure Gate
Principal Investigator: R. Bielenberg and R. Faller,
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Project Start Date: 2/26/2020 **Project Completion Date:** 9/30/2021

Report Period: **Due Date:**
 Quarter 1 (July 1 – September 30) ----- October 31
 Quarter 2 (October 1 – December 31) ----- January 31
 Quarter 3 (January 1 – March 31) ----- April 30
 Quarter 4 (April 1 – June 30) ----- July 31

Project Schedule Status:
 On Schedule
 On Approved Revised Schedule
 Ahead of Schedule
 Behind Schedule

Progress:

Task	Total Budget	% work Completed This Quarter	Expenses This Quarter	Total % of Task Completed	Remaining Budget
1. Project Planning and Correspondence	\$17,507.00	0.0%	\$2,115.50	38.3%	\$10,796.50
2. Design and Analysis	\$10,862.00	32.6%	\$3,542.23	75.1%	\$2,708.34
3. Full-Scale Crash Testing	\$185,441.00	3.1%	\$5,720.25	13.9%	\$159,629.16
4. Reporting and Project Deliverables	\$16,147.00	0.0%	\$0.00	0.0%	\$16,147.00
5.					
6.					
7.					
8.					
9.					

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

Previously, MwRSF received both the gate are and luminaire pole hardware for all three crash tests. The materials are currently in the full-scale test que at the MwRSF Outdoor Test Facility for conducting the three full-scale crash tests in the project. MwRSF will conduct these tests as soon as possible within the other existing tests scheduled at the site.

Note that ongoing simulation modeling conducted at MwRSF with respect to breakaway luminaire poles may suggest which vehicle orientation is more critical for impacting the pole. If that research indicates a different orientation than currently planned, MwRSF would consult with WYDOT prior to moving forward.

During this quarter CAD details for the pole were revised. the pole received from Valmont used a mirrored orientation from the original CAD and what was ordered. As three poles were currently on site, MwRSF altered the CAD and test setup to accommodate the actual poles. Full-scale crash testing is anticipated in the upcoming quarter.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

The COVID-19 pandemic and business responses may play a factor in future efforts. MwRSF has not been shut down and is still working, but much of the personnel has transitioned to working remotely, as has much of the country during this time of social distancing. This major shift in regular work operations may lead to delays and inefficiencies as well as other unforeseen hurdles. Additionally, changes to businesses outside of MwRSF may lead to possible delays in material acquisition. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Currently, material shipping delays and delays to the overall MwRSF test que have put the project behind schedule. MwRSF will attempt to continue to meet the proposed schedule to the degree possible.

Anticipated Work Next Quarter:

In the next quarter, MwRSF anticipates conducting the full-scale crash tests of the road closure gate system.

Total Percentage of Project Completion:

17.7%

Progress and Accomplishments this Quarter:

(Provide an informative summary of tasks/activities that occurred this quarter includes meetings, work plan status, significant progress, etc.)

All median departure crash data was analyzed and median departure crashes per hundred million vehicle-mile traveled (HMVMT), per mile, and per median width were analyzed. No strong trends were identified which related median width to likelihood of a cross-median event (CME) or cross-median crash (CMC). Research was compared with the 2009 results and a benefit-to-cost analysis study was performed. In addition, a black spot analysis was conducted on several roads with higher numbers of cross-median events and cross-median crashes than were predicted based on scalar ratios of median departures. Median departure data analysis was completed and a technical report was prepared. A no-cost extension was approved by KDOT and the research scope was expanded to include right-side deparutre crash analysis.

Circumstances Affecting Project, Scope, or Budget:

(Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints, along with recommended solution to those problems.)

Although the COVID pandemic greatly disrupted early project progress, the research team was able to overcome the delays and complete the Phase II research in early March. KDOT expressed an interest in reviewing additional data for right-side departures and provided a no-cost extension through the end of April, 2021. Research continued during March and into April 2021.

Anticipated Work Next Quarter:

Completion of all project tasks including the expanded research effort noted for the no-cost extension is expected in April 2021. A final report will be submitted to KDOT for reivew and approval.

Total Percentage of Project Completion:

85%