Research Project Quarterly Progress Report

Date: 4/30/2022 **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	$7,619.00	45.2%	$9,234.00
2. Dynamic Bogie Testing	$78,032.00	24.3%	$18,952.00	$54,539.00	69.9%	$23,493.00
3. Design and Analysis	$61,310.00	12.4%	$7,620.00	$12,171.00	19.9%	$49,139.00
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	-	$26,572.00	$74,329.00	40.0%	$111,583.00

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 were calibrated to provide accurate soil response. The soil models used in the W6x16 post in soil models were 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. Calibration of the W6x8.5 post models is completed as well. It is anticipated that LS-DYNA Support project funding may be applied to investigate advanced soil modeling techniques as part of this effort as well.

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 begin simulation analysis of potential MGS design alternatives with reduced post embedment.

Total Percentage of Project Completion:

40.0%

Research Project Quarterly Progress Report

Date: 4/30/2022 **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: 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. Planning & Correspondence	$27,155	0%	$0	$16,177	60%	$10,978
2. Design and Analysis	$106,064	100%	$1,752	$48,248	50%	$57,816
3. Bogie Testing	$99,897	0%	$0	$5,000	5%	$94,897
4. Reporting and Deliverables	$18,313	0%	$0	$0	0	$18,313
5.						
6.						
7.						
8.						
9. Total	$251,429	-	$1,752	$69,425	35%	$182,004

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 research team selected promising configurations of welded W6x15 and baseplate combinations for dynamic component testing. Test article drawings were compiled included in the bogie test plan. Six bogie test will be conducted with an iterative approach. 10-15 post and baseplate assemblies will be fabricated and each test article will be selected based on the results from the previous tests. The drawings are currently being reviewed.

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 budgets herein do not include March 2022 labor charges as those billing typically takes about a month to process.

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:

Dynamic test plans will be finalized and sent out to the test site for material acquisition, fabrication, and testing. The results will be analyzed and compared to the results of previous testing of Wx15 posts embedded in soil.

Project progress will be discussed with sponsors during MwRSF Pooled Fund meeting in late April.

Total Percentage of Project Completion:

35%

Research Project Quarterly Progress Report

Date: 4/30/2022 **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	50%	$2,000.00	50%	$3,644.00
2. Full-Scale Crash Testing	$278,516.00	50%	$3,526.00	65%	$110,392.00
3. Reporting	$11,623.00	0%	$0.00	0%	$11,623.00
4.					
5.					
6.					
7.					
8.					
9. Total	$302,783.00		$5,526.00	55%	$125,659.00

Progress and Accomplishments this Quarter:

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

Test FLAGT-2 was previously conducted and failed MASH test 3-11. The wheel was pushed backward and against the vehicle toe pan and floor board. Maximum toe pan deformations were measured to be 9.9", which exceeded the MASH limit of 9". Thus, the test FAILED per MASH safety criteria. Upon analysis of the test vehilce, system, and videos, it was determined that the increased impact angle caused by the 15:1 flare resulted in the wheel rim gouging into and snagging on the corrigations of the thrie beam. This resulted in the wheel being removed from the truck and shoved toward the toe pan. This phenomenon has been observed in other high-angle impacts into stiff corrigated guardrail.

Four system modification options were presented to the project sponsors: (1) use 10-ga thrie beam, (2) reduce flare rate from 15:1 to 20:1, (3) 10-ga thrie beam and a 20:1 flare, and (4) development of a different rail shape to increase strength and reduce snag potential. These options were emailed to the sponsors in March 2022. Votes will be tallied in April and the selected modification will be shown at the annual midwest Pooled Fund meeting in April 2022..

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.)

Both tests FLAGT-1 and FLAGT-2 failed to meet MASH performance criteria. As such, the project has had to be rescoped and system has had to be redesigned and the tests re-run. Additional project funds will be necessary to complete the full-scale testing on flared AGTs. A Phase III of this project has already been approved as part of the FY 2021 program, but Phase II was aimed at additional testing required on the upstream end of the AGT. A Phase IV of the project will be needed to fund retesting of the modified AGT on the downstream end near the buttress.

The budget numbers presented herein do not include labor charges from March 2022 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 unforseen hurdles. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

The desired system modification will be identified. New system details will be drawn and sent out to the test site for fabrication and testing.

Total Percentage of Project Completion:
55%

Research Project Quarterly Progress Report

Date: 4/30/2022 **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	0%	$0.00	65.3%	$6,679.00
2. Full-Scale Crash Testing	$176,505.00	3.2%	$5,713.00	21.1%	$139,233.00
3. Design & Analysis	$39,381.00	0%	$0.00	6.6%	$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		$5,713.00	20.4%	$204,750.00

Progress and Accomplishments this Quarter:

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

In this quarter, MwRSF began fabrication of the barrier system for full-scale crash testing. Testing is planned for May 2022.

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 unforseen hurdles. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Currently, the full-scale testing may be delayed due to its status in the MwRSF testing que. COVID-19 has reduced avaiable staff at the outdoor test facility, created increased employee leave, and created material procurement issues. These issues have created a backlog of testing ath the facility. MwRSF is trying our best to resolve the test backlog, but delays are currently expected for most projects. We will continue to update the status of the full-scale testing and its effect on the overall project timeline.

Anticipated Work Next Quarter:

in the next quarter, MwRSF will continue to prepare for the full-scale crash testing. Pre-test evaluations may be conducted to investigate vehicle stability when traversing non-level terrain, before installing the guardrail system. Testing is currently scheduled for late May.

Total Percentage of Project Completion:

20.4%

Research Project Quarterly Progress Report

Date: 4/30/2022 **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	38.3%	$19,096.00
2. Design and Analysis	$177,021.00	2.0%	$3,504.00	18.0%	$145,116.00
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 began preliminary simulations of an short-radius system that disspates energy through interial resistance. The simulation effort started with modification of the MGS system with interial posts to determine the feasiblity of using inertial posts for vehicle redirection. That effort is still underway.

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 unforseen 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 make additional progress on simulation of the interial post short-radius concept. Simulation results will be evaluated to determine the feasibility of the concept and reviewed with sopnsors.

Total Percentage of Project Completion:

17.4%

Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) Suppl. #6 RPFP-20-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	18.5%	$11,221.00	80.0%	$11,636.00
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 unforseen 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:
80.8%

Research Project Quarterly Progress Report

Date: 4/30/2022 **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: 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. LS-DYNA Modeling Enhancement	$30,616.00	0.0%	$0.00	100%	$0.00
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9. Total	$30,616.00		$9,796.00		$0.00

Progress and Accomplishments this Quarter:

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

None

Note that funding for this project has been depleted and subsequent LS-DYNA support activities will be done under the FY2021 funding.

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 unforseen hurdles. 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 use the LS-DYNA funds to support modeling needs in ongoing Midwest Pooled Fund Projects. This may include the following.

1. MwRSF has recently done an extensive amount of research in advance soil modeling techniques for use in modeling dynamic post in soil interactions. These models have been primarily developed on a component level. Research is needed to more fully developed these advanced soil modeling techniques and incorporate them into existing roadside hardware models to improve our model fidelity and allow improved investigation of soil parameters effects on roadside hardware such as post embedment, slopes, and other factors.
2. MwRSF has recently developed advanced steel fracture parameters for the GISSMO material failure command in LS-DYNA. This allows users to relate the stress state of the material to the failure strain in order to aid in predicting failure under multiple types of loading conditions. To date, the research in this area has focused mainly on the simulation of coupon samples used to develop the failure parameters. Research is needed to incorporate this steel failure methodology into existing guardrail and roadside hardware models.
3. MwRSF sees a need for advancement in concrete modeling methods. Currently several concrete material models exists and previous research at MwRSF has investigated the material models themselves. However, further research is needed to investigate the incorporation of reinforcing steel and in the concrete material and ensuring effective load transfer through the reinforcing steel. Additional investigation of bonding and development of the reinforcement is needed as well.
4. Vehicle model improvements are a constant need for Midwest Pooled Fund research efforts. Currently needed vehicle model improvements include more refined tire models, enhanced suspension models with suspension failure, and upgrades to existing TL-4 single unit truck and TL-5 tractor-trailer models.

It is anticipated that summary reports on the soil modeling and AGT modeling will be completed. Additonal work may also occur on the new tire models.

Total Percentage of Project Completion:
100%

Pooled Fund
Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) Suppl. #15, RPFP-21-CABLE-1

Project Title: Redesign of the High-Tension Cable Phase II

Principal Investigator: Faller, Asadollahipajouh, Bielenberg, Holloway, Lechtenberg, Rosenbaugh, Steelman, Stolle

Principal Contact Information Email: kpolivka2@unl.edu **Phone:** (402) 472-9070

Project Start Date: 7/1/2021 **Project Completion Date:** 7/31/2024

Identify Quarter:	Identify Period of Performance:	Identify Quarterly Report Submittal Deadline:
Quarter 3	1/1/22 - 3/31/22	4/30/22

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 Plan/Corresp, CAD, Material Certs	$16,861.00	8%	$1,489.00	8%	$15,375.00
2. Full-Scale Crash Testing	$217,148.00	0%	$0.00	0%	$217,148.00
3. Reporting & Project Deliverables	$19,887.00	0%	$0.00	0%	$19,887.00
4.					
5.					
6.					
7.					
8.					
9. Total	$253,893.00	1%	$1489.00	1%	$252,404.00

Progress and Accomplishments this Quarter:

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

Began preparing test plan for tests

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

Anticipated Work Next Quarter:

Complete test plan for first test. Begin mateial acquisition.

Total Percentage of Project Completion:

0%

Pooled Fund
Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) Supp#16 - RPFP-21-CONC-2

Project Title: Anchoring of Temporary Barrier to Asphalt - Phase II

Principal Investigator: Faller, Bielenberg, et al.

Principal Contact Information Email: rbielenberg2@unl.edu **Phone:** (402) 472-9064

Project Start Date: 7/1/2021 **Project Completion Date:** 7/31/2024

Identify Quarter:	Identify Period of Performance:	Identify Quarterly Report Submittal Deadline:
Quarter 3	1/1/22 - 3/31/22	4/30/22

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	$13,939.00	0	$1,213.00	9.1	$12,180.00
2. Design and Analysis	$59,224.00	4.5	$2,688.00	10.1	$53,239.00
3. Full-Scale Crash / Bogie Testing	$122,413.00	0	$0.00	0	$122,413.00
4. Reporting and Project Deliverables	$29,295.00	0	$0.00	0	$29,295.00
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, the researchers developed a series of potential retrofit concepts to improve the system performance. These concepts were reviewed in terms of their pros and cons, including crash performance, cost, and installation ease. MwRSF presented the concepts to the sponsors and surveyed the sponsors regarding their preferred concepts for further development. Feedback from the survey identified the preferred concept as a saddle cap attached to the PCB connection pin that spans the barrier joint.

In this quarter, MwRSF has continued development of the simulation models for analyis and development of the preferred concept. Simulation models of the anchored PCB were developed and preliminary models of the retrofit system were developed.

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:

In the next quarter, MwRSF will continue efforts on a simulation model of the retrofit anchored PCB system and evaulated its initial performance and potential design changes.

Total Percentage of Project Completion:

3.2%

Pooled Fund
Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) Suppl#17 - RPFP-21-CONC-3

Project Title: MASH TL-3 Portable Barrier System

Principal Investigator: Faller, Bielenberg, et al.

Principal Contact Information Email: rbielenberg2@unl.edu **Phone:** (402) 472-9064

Project Start Date: 7/1/2021 **Project Completion Date:** 7/31/2024

Identify Quarter:	Identify Period of Performance:	Identify Quarterly Report Submittal Deadline:
Quarter 3	Jan 2021 - March 2021	4/30/22

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	$33,717.00	0	$0.00	8.2	$30,962.00
2. Design and Analysis	$81,642.00	0.6	$511.00	2.6	$79,012.00
3. Reporting and Project Deliverables	$32,937.00	0	$0.00	0	$32,937.00
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 began design and simulation of the staggered, interlocking PCB concept preferred by the sponsors. This work included evaulation of potential curvature, review of lifting mechansims, determination of preliminary barrier geometry, incorporation of drainage, and initial structural reinforcing design.

An initial simulation model of the concept was performed and structural issues were noted. Potential design modfications were noted and will be evaluated in the next 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.)

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:

In the next quarter, MwRSF will continue analysis of the staggered, interlocking PCB concept. This will include simulation of revised designs to improve the structural integrity and additonal analysis of segment length and tolerance variations if time allows.

Total Percentage of Project Completion:

3.6%

Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) Suppl. #18, RPFP-21-AGT-1

Project Title: Approach Guardrail Transition Behind Elevated Sidewalk

Principal Investigator: Faller, Pajouh, Bielenberg, Lechtenberg, Rosenbaugh, Steelman, and Stolle

Principal Contact Information Email: srosenabugh2@unl.edu **Phone:** (402) 472-9324

Project Start Date: 7/1/2021 **Project Completion Date:** 7/31/2024

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. Planning and CAD	$27,125	100%	$101	$2,796	1%	$24,329
2. Design and Analysis	$87,468	0%	$0	$2,000	0%	$85,468
3. Reporting and Project Deliverables	$31,548	0%	$0	$0	0%	$31,548
4.						
5.						
6.						
7.						
8. Total	$146,141	-	$101	$4,796	3%	$141,345

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 is on hold waiting for the vehicle and tire models get updated as part of NCHRP 22-39.

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 of 2022 as those expenditures had not yet been charged to the project.

This project was proposed and budgeted with the understanding that the vehicle and tire models had to be updated as part of a different project prior to conducting simulated crash tests as part of this project. As such, the project was put on hold in 2021 and early 2022.

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:

The literature review will be completed and the state survey will be sent out. Work to create and validate the models for the simulation effort may be started.

Total Percentage of Project Completion:

3%

Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) Suppl. #19, RPFP-21-AGT-3

Project Title: Guidelines for Flaring AGTs, Phase III

Principal Investigator: Faller, Pajouh, Bielenberg, Lechtenberg, Rosenbaugh, Steelman, and Stolle

Principal Contact Information Email: srosenabugh2@unl.edu **Phone:** (402) 472-9324

Project Start Date: 7/1/2021 **Project Completion Date:** 7/31/2024

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. Planning and CAD	$4,705	0%	$0	$0	0%	$4,705
2. Design and Analysis	$109,854	0%	$0	$0	0%	$109,854
3. Reporting and Project Deliverables	$6,748	0%	$0	$0	0%	$6,748
4.						
5.						
6.						
7.						
8. Total	$121,307	-	$0	$0	0%	$121,307

Progress and Accomplishments this Quarter:

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

Work on this project, Phase III, has yet to begin as the research efforts are still being conducted on the previous phase of this project – see project TPF-5(430)_Supplement 3 for details on Phase II efforts.

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 of 2022 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:

Work on this project will begin once Phase II of this project has been completed.

Total Percentage of Project Completion:

0%

Pooled Fund
Research Project Quarterly Progress Report

Date: 5/12/2022 **Project Number:** TPF-5(430) Suppl. #20, RPFP-21-SIGN-1

Project Title: Breakaway Systems for Ground Mounted, Large Steel Sign Support Structures

Principal Investigator: Faller, Asadollahipajouh, Bielenberg, Holloway, Lechtenberg, Rosenbaugh, Steelman, Stolle

Principal Contact Information Email: joshua.steelman@@unl.edu **Phone:** (402) 472-1972

Project Start Date: 7/1/2021 **Project Completion Date:** 7/31/2024

Identify Quarter:	Identify Period of Performance:	Identify Quarterly Report Submittal Deadline:
Quarter 3	1/1/22 - 3/31/22	4/30/22

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 Plan/Corresp, Lit search, survey	$21,681.00	0%	$0.00	0%	$21,681.00
2. Sign Configuration Analysis & Selection	$28,702.00	0%	$0.00	0%	$28,702.00
3. Research Report & Deliverables	$27,357.00	0%	$0.00	0%	$27,357.00
4.					
5.					
6.					
7.					
8.					
9. Total	$77,740.00	0%	$0.00	0%	$77,740.00

Progress and Accomplishments this Quarter:

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

None

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 unforseen hurdles. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

Initiate literature review

Total Percentage of Project Completion:

0%

Pooled Fund
Research Project Quarterly Progress Report

Date: 5/3/2022 **Project Number:** TPF-5(430)-Suppl #21

Project Title: NDOT Breakaway Pole Research (Wisconsin)

Principal Investigator: Faller, Bielenberg, Pajouh, Holloway, Lechtenberg, Rosenbaugh, Steelman, Stolle

Principal Contact Information Email: mojdeh.pajouh@unl.edu **Phone:** (402) 472-0920

Project Start Date: 7/1/2021 **Project Completion Date:** 7/31/2024

Identify Quarter:	Identify Period of Performance:	Identify Quarterly Report Submittal Deadline:
Quarter 3	January 1 - March 31	April 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	$66,665.00	4.5%	$3,000.00	13.2%	$57,877.00
2. Design and Analysis	$162,291.00	0	$0.00	0	$162,291.00
3. Reporting and Project Deliverables	$40,509.00	0	$0.00	0	$40,509.00
4.					
5.					
6.					
7.					
8.					
9. Total	$269,455.00	1.1%	3000.00	3.3%	$260,677.00

Progress and Accomplishments this Quarter:

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

In the past quarter, the comprehensive literature review of slip base poles was complete. This review included state DOTs standard plans and past crash tests to collect data on slip base features, pole dimensions/materials, and critical design elements affecting safety performance. Efforts were initiated to design a survey on slip base poles to be sent to the Midwest Pooled Fund program members.

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 project costs presented herein only include labor charges through February 28, 2022.

Anticipated Work Next Quarter:

In the next quarter, the research team will send a survey to the Midwest Pooled Fund program members and complete the analysis of the literature search results. Based on the findings and the survey responses, critical pole and base configurations will be identified. Next, CAD drawings for potential critical configurations will be initiated.

Total Percentage of Project Completion:

3.3%

Pooled Fund
Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) Suppl#22 / RPFP-21-CONSULT

Project Title: Annual Consulting Services Support

Principal Investigator: Faller, Bielenberg, et al.

Principal Contact Information Email: rbielenberg2@unl.edu **Phone:** (402) 472-9064

Project Start Date: 7/1/2021 **Project Completion Date:** 7/31/2024

Identify Quarter:	Identify Period of Performance:	Identify Quarterly Report Submittal Deadline:
Quarter 3	Jan 2022 - March 2022	4/30/22

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	$61,446.00	0	$0.00	0	$61,446.00
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.)

None. Funding from the previous Pooled Fund Consulting effort will be depleted prior to utlizing the funding for this project.

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 unforseen 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:

0

Pooled Fund
Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) Suppl. #15, RPFP-21-MPFW

Project Title: Midwest Pooled Fund Website

Principal Investigator: Faller, Asadollahipajouh, Bielenberg, Holloway, Lechtenberg, Rosenbaugh, Stolle

Principal Contact Information Email: kpolivka2@unl.edu **Phone:** (402) 472-9070

Project Start Date: 7/1/2021 **Project Completion Date:** 7/31/2024

Identify Quarter:	Identify Period of Performance:	Identify Quarterly Report Submittal Deadline:
Quarter 3	1/1/22 - 3/31/22	4/30/22

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	$18,573.00	6%	$1,148.00	6%	$17,425.00
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9. Total	$18,573.00	6%	$1,148.00	6%	$17,425.00

Progress and Accomplishments this Quarter:

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

None

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 untill the funds from Project No.: RPFP-20-PFCHS – TPF-5(430) Supplement #7, Project Title: Pooled Fund Center for Highway Safety have been exhaused.

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 unforseen hurdles. MwRSF will continue to make progress on this research in the most effective manner possible moving forward.

Anticipated Work Next Quarter:

Troubleshooting and fixing any issues that have occurred during the transition. Continue maintenance, repair, and upkeep of the website. Update research hub with new completed projects.

Total Percentage of Project Completion:

6%

Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) – Suppl. #10 – FY20-WISC-1-MGS SLOPE HALF POST 1Q 2020

Project Title: MASH 2016 TL-3 Evaluation of the MGS with Half Post Spacing and 7-ft Posts Adjacent to Sl

Principal Investigator: R. Bielenberg and R. Faller,

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	$10,490.00	0.0%	$0.00	81.2%	$1,968.00
2. Full-Scale Crash Testing	$193,277.00	11.6%	$22,417.00	72.7%	$52,767.00
3. Reporting and Project Deliverables	$16,441.00	0.0%	$0.00	0.0%	$16,441.00
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 worked on analysis and documentaion of the full-scale testing conducted previously, and made progress on the final report. Results from the full-scale testing were presented at the Midwest Pooled Fund Program Annual 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.)

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.

Currently, the full-scale testing has been delayed due to its status in the MwRSF testing que. COVID-19 has reduced avaiable staff at the outdoor test facility, created increased employee leave, and created material procurement issues. These issues have created a backlog of testing ath the facility. MwRSF is trying our best to resolve the test backlog, but delays are currently expected for most projects. We will continue to update the status of the full-scale testing and its effect on the overall project timeline.

Due to the delays noted above, MwRSF has requested and received an NCE to extend the project end date to 12/31/2022

Anticipated Work Next Quarter:

In the next quarter, MwRSF anticipates working towards the completion of the summary report for the project. MwRSF will also review the results of the full-scale crash test and develop recommendations for any needed transtions to the stiffened MGS installation adjacent to slopes.

Total Percentage of Project Completion:
67.7%

Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) Suppl. 12 – FY20-WY-1-GATE: MASH 2016 Th 3

Project Title: Evaluation of Drop-Arm Road Closure Gate

Principal Investigator: R. Bielenberg and R. Faller,

Principal Contact Information Email: rbielenberg2@unl.edu **Phone:** (402) 472-9064

Project Start Date: 2/26/2020 **Project Completion Date:** 9/30/2022

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	$17,507.00	0.0%	$2,115.50	38.3%	$10,796.50
2. Design and Analysis	$10,862.00	0.0%	$0.00	75.1%	$2,708.34
3. Full-Scale Crash Testing	$185,441.00	1.7%	$3,086.00	43.6%	$104,527.00
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.)

Following the failure of the ffirst full-scale crash test of the system, WYDOT was presented with several options for moving forward.

1. WYDOT can choose continue moving forward with the higher speed tests. If those tests pass, they could choose to self-certify the road closure gate based on limited concerns for occupant risk in the low-speed test. This may not be the optimal path to take, but it has been chosen by some states. As such, I wanted to list it as an option.
2. MwRSF can suggest modifying the system to alleviate the windshield penetration and rerun test no. 3-60. Several options exist, including modifying the metal plate extension used for the gate arm guide U-bolt attachment to be shorter, have rounded edges, or to flare back the corners. These changes could reduce the potential for windshield penetration significantly. One could also consider redesign of the gate arm guide attachment to a c-clamp or other design that does not create the same windshield hazard. Design and retesting of the modified system would likely require additional funding at some point to complete the test matrix.
3. WYDOT could terminate the effort – although this may leave one without a crashworthy gate system.

WYDOT has indicated that they prefer option 2. MwRSF submitted an updated project budget and scope to WYDOT in 4Q 2021 and is currently awaiting approval to proceed.

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.)

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.

Currently, the full-scale testing has been delayed due to its status in the MwRSF testing que. COVID-19 has reduced avaiable staff at the outdoor test facility, created increased employee leave, and created material procurement issues. These issues have created a backlog of testing ath the facility. MwRSF is trying our best to resolve the test backlog, but delays are currently expected for most projects. We will continue to update the status of the full-scale testing and its effect on the overall project timeline.

Due to these delays, MwRSF has requested and received an NCE until 9/30/2022.

As noted previously, the failure of test no. WRCG-1 required revision of the scope and budget for the project. MwRSF revised these items and provided them to WYDOT for approval.

Anticipated Work Next Quarter:

In the next quarter, MwRSF will await approval to proceed based on the revised project scope. Once approval is obtained. MwRSF will work on development of design modifications and re-testing of the gate system.

Total Percentage of Project Completion:
41.7%

Pooled Fund
Research Project Quarterly Progress Report

Date: 4/30/2022 **Project Number:** TPF-5(430) Suppl. #24, RPFP-21-LS-DYNA

Project Title: LS-DYNA Modeling Enhancement Support

Principal Investigator: Faller, Bielenberg, et al.

Principal Contact Information Email: rbielenberg2@unl.edu **Phone:** (402) 472-9064

Project Start Date: 7/1/2021 **Project Completion Date:** 7/31/2024

Identify Quarter:	Identify Period of Performance:	Identify Quarterly Report Submittal Deadline:
Quarter 3	Jan 22 - March 22	4/30/22

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	$43,823.00	1	$403.00	1	$43,420.00
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.)

No work was done on this effort in the quarter due to other project priorities and needs.

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

Anticipated Work Next Quarter:

MwRSF will continue to use the LS-DYNA funds to support modeling needs in ongoing Midwest Pooled Fund Projects. This may include the following.

1. MwRSF has recently done an extensive amount of research in advance soil modeling techniques for use in modeling dynamic post in soil interactions. These models have been primarily developed on a component level. Research is needed to more fully developed these advanced soil modeling techniques and incorporate them into existing roadside hardware models to improve our model fidelity and allow improved investigation of soil parameters effects on roadside hardware such as post embedment, slopes, and other factors.
2. MwRSF has recently developed advanced steel fracture parameters for the GISSMO material failure command in LS-DYNA. This allows users to relate the stress state of the material to the failure strain in order to aid in predicting failure under multiple types of loading conditions. To date, the research in this area has focused mainly on the simulation of coupon samples used to develop the failure parameters. Research is needed to incorporate this steel failure methodology into existing guardrail and roadside hardware models.
3. MwRSF sees a need for advancement in concrete modeling methods. Currently several concrete material models exists and previous research at MwRSF has investigated the material models themselves. However, further research is needed to investigate the incorporation of reinforcing steel and in the concrete material and ensuring effective load transfer through the reinforcing steel. Additional investigation of bonding and development of the reinforcement is needed as well.
4. Vehicle model improvements are a constant need for Midwest Pooled Fund research efforts. Currently needed vehicle model improvements include more refined tire models, enhanced suspension models with suspension failure, and upgrades to existing TL-4 single unit truck and TL-5 tractor-trailer models.

It is anticipated that summary reports on the soil modeling and AGT modeling will be completed. Additonal work may also occur on the new tire models.

Total Percentage of Project Completion:
1%