

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">SPR-3(017) Supplement #35</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Cost Effective Measures for Roadside Design</p>		
<b>Name of Project Manager(s):</b> Rohde, Sicking, Reid, Faller, Lechtenberg	<b>Phone Number:</b> 402-472-9070	<b>E-Mail</b> kpolivka2@unl.edu
<b>Lead Agency Project ID:</b> 2611130069002	<b>Other Project ID (i.e., contract #):</b> RPPFP-06-01	<b>Project Start Date:</b> 7/1/2005
<b>Original Project End Date:</b> 6/30/06	<b>Current Project End Date:</b> 6/30/12	<b>Number of Extensions:</b> 5

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$103,514	\$81,775	97

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$4,934	

**Project Description:**

The relatively low levels of safety associated with low-volume roads have been well documented over the last 20 years. Many low volume roads have high posted speed limits and virtually no clear zone. Further, narrow pavements and sharp horizontal curves tend to increase the frequency of ran-off-road events. Even though there have been many papers written on this topic, there have been very few efforts to actually develop guidelines and recommendations for implementing roadside safety treatments on low volume roads. Instead, most of the studies have identified a shopping list of feasible safety improvements with no real guidance regarding when each item should be implemented. Guidelines for safety improvements can be developed with a combination of a benefit/cost analysis program like RSAP and a significant amount of engineering judgment.

The objectives of this study include to 1) identifying common hazardous roadside situations associated with low-volume roads, 2) determining if any cost effective safety treatments are available and 3) developing guidelines for when the safety treatments are recommended.

**Tasks**

1. Field study of roadside hazards on low-volume roads
2. Compilation of field study findings
3. Selection of common roadside hazards for analysis
4. RSAP analysis and evaluation of selected roadside hazards
5. Research report

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

Comments and edits received for the draft report are being addressed. Revised draft report resent to the members of the Pooled Fund State for re-review. Awaiting one state's review and comments as such a one-month extension will be requested.

**Anticipated work next quarter:**

Address the comments received and complete the final report. The final report will be published and the final copies of the report will be disseminated to the Pooled Fund member states. All work on this project is anticipated to be completed during the next quarter.

**Significant Results:**

Rural roadways (ADT < 500 and speed ≥ 55 mph) were surveyed and it was determined that common hazards along these types of roadways are culverts, trees, slopes, ditches, and bridges. Thus, these were the hazards evaluated with a benefit-to-cost analysis. Some sample results include: (1) culverts - remove headwall structures not shielded or transitioned to guardrail; (2) trees - remove trees 6" or greater in diameter located within 10' of roadside; (3) slopes and ditches - install barrier for most 1.5:1 & 2:1 slopes; and (4) bridges – leave existing rail for long bridges, install approved system for short bridges.

Tasks	% Complete
1. Field study of roadside hazards on low-volume roads	100%
2. Compilation of field study findings	100%
3. Selection of common roadside hazards for analysis	100%
4. RSAP analysis and evaluation of selected roadside hazards	100%
5. Research report	97%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

Due to a shifting of staff priorities, work of reviewing the internal draft report was greatly diminished. The project was extended through June 2012 in order to submit the draft report to the States for review and to complete the final report.

A one month extension will be requested to allow one state to complete their review of the revised draft report, to implement their comments, and publish the final report.

This remaining funds after the final report is completed will be moved to Contingency.

**Potential Implementation:**

This study will identify safety improvements that are applicable to a number of common hazards found along low volume roads. Guidelines will also be presented that provide objective criteria for determining when these safety improvements should be considered. The identified safety treatments and guidelines for their implementation will provide designers a set of tools for improving safety on low volume roads. This effort could potentially result in language that could be included in the Roadside Design Guide to provide guidance for roadside safety design on low-volumes, similar to the Geometric Guidelines for Very Low-Volume Local Roads published by AASHTO and intended to be incorporated into a future update of the Greenbook.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

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<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">SPR-3(017) Supplement #38</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Cost Effective Upgrading of Existing Guardrail Systems</p>		
<b>Name of Project Manager(s):</b> Reid, Rohde, Sicking, Faller, Lechtenberg	<b>Phone Number:</b> 402-472-9070	<b>E-Mail</b> kpolivka2@unl.edu
<b>Lead Agency Project ID:</b> 2611120090002	<b>Other Project ID (i.e., contract #):</b> RPPF-07-01	<b>Project Start Date:</b> 2/26/07
<b>Original Project End Date:</b> 12/31/10	<b>Current Project End Date:</b> 12/31/12	<b>Number of Extensions:</b> 1

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$92,084	\$68,581	85

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$7,770	

**Project Description:**

Existing guardrail installations are often substandard in some way, such as low height, inappropriate post spacing, or inadequate length. Although it is desirable to upgrade substandard barriers to meet current guidelines, available funding is often insufficient to achieve this goal. However, the safety performance of many existing guardrail systems can be greatly improved by eliminating only the most significant deficiencies. In general it is often desirable to implement low cost/high benefit improvements at sites where a complete upgrade cannot be justified. Unfortunately, highway agencies have the potential for creating a liability risk when guardrail is upgrading without bringing it up to current guidelines. Therefore, agencies cannot make any improvements to an existing guardrail or terminal unless it is upgraded to meet current recommendations. As a result, many guardrail systems remain in place for many years with identifiable deficiencies.

Objective: Develop guidelines for upgrading of existing guardrail installations that do not meet current criteria.

**Tasks:**

1. Field study of existing guardrail installations
2. Compilation of field study findings
3. Selection of installations to investigate
4. Sensitivity study to decrease the size of the analysis matrix
5. RSAP analysis
6. Research report

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

Review of the internal draft report continued.

**Anticipated work next quarter:**

Review of the internal draft report will be completed. The draft report will be submitted to the Pooled Fund member states for review and comment.

**Significant Results:**

A field survey of more than 60 barrier sites in Kansas revealed deviations from standard guardrail systems with guardrail height being the most prominent issue as well as different hazards that these systems were protecting. To account for the different guardrail height in the RSAP models containment index (CI) had to be changed. The CI was derived from past crash test results and LS-DYNA simulations of the MGS with 22" and 25" rail heights at speeds of 100, 70, and 60 km/h with the 2270P. The 22" and 25" rail heights contained the 2270P at impact speeds of 60 km/h and 70 km/h, respectively.

Task	% Complete
1. Field study of existing guardrail installations	100%
2. Compilation of field study findings	100%
3. Selection of installations to investigate	100%
4. Sensitivity study to decrease the size of the analysis matrix	100%
5. RSAP analysis	100%
6. Research report	60%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

The original analysis was completed with the longer runout lengths. Thus, additional analysis was completed with the shorter runout lengths that were published in the updated Roadside Design Guide.

**Potential Implementation:**

The guardrail removal and upgrading guidelines developed under this study will provide highway designers with a very important middle ground option between doing nothing and a complete upgrade of deficient guardrail. This middle ground option should provide most of the benefits of a complete upgrade at a much reduced cost. Further, the guidelines will eliminate the potential for increased liability currently associated with using a less-than-complete guardrail upgrade.



## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE Department of Roads

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<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> SPR-3(017) Suppl.#38		<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> Testing of Cable Terminal for High Tension Cable (1100C & 2270P)			
<b>Name of Project Manager(s):</b> Reid, Rohde, Sicking, Faller	<b>Phone Number:</b> 402-472-3084	<b>E-Mail:</b> jreid@unl.edu	
<b>Lead Agency Project ID:</b> RPPF-07-06	<b>Other Project ID (i.e., contract #):</b> 2611120090007	<b>Project Start Date:</b> February 26, 2007	
<b>Original Project End Date:</b>	<b>Current Project End Date:</b> December 31, 2012	<b>Number of Extensions:</b> 1	

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$100,563	\$36,789	37%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date

**Project Description:**

Objective: Redesign the cable release mechanism and foundation of the three cable end terminal to accommodate four high tension cables.

Tasks

1. Background and literature review - completed
2. Design and analysis, including bogie testing - in-progress
3. Full-scale testing
4. Report

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

Task 2. The draft report documenting the project to date was completed and sent to the states for review. Drawings for the redesigned cable anchor bracket and alternative terminal posts (detailed in the report) were modified to account for easier manufacturing, finalized and sent to the field for bogie testing.

**Anticipated work next quarter:**

Task 2. The draft report will be finalized, incorporating the states comments. Bogie testing of the redesigned cable anchor bracket and alternative terminal posts will be conducted.

**Significant Results:**

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

Final design details and full-scale testing for this project cannot be conducted until the High Tension Cable Barrier System is completed.

**Potential Implementation:**

The revised terminal will provide a non-proprietary end terminal for high tension barrier cable systems.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

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<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> <p style="text-align: center;">TPF-5(091) Suppl. #2</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Phase I - Guidelines for Post Socketed Foundations for 4-Cable, High-Tension, Barrier Systems</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Reid, Faller, Sicking, Rosenbaugh</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-9324</p>	<b>E-Mail</b> <p style="text-align: center;">rosenbaugh2@unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">2611211006001</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">RFPF-09-02</p>	<b>Project Start Date:</b> <p style="text-align: center;">8/15/2008</p>
<b>Original Project End Date:</b> <p style="text-align: center;">7/31/2011</p>	<b>Current Project End Date:</b> <p style="text-align: center;">7/31/2012</p>	<b>Number of Extensions:</b> <p style="text-align: center;">1</p>

Project schedule status:

- On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$73,549	\$52,100	95%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$6,042	

**Project Description:**

High-tension cable barriers often incorporate socketed post foundations to simplify repair of the system after an accident. Barrier posts are designed to slide in and out of a ground socket for easy replacement of damaged components. Unfortunately, there have been numerous examples of socketed post foundations that are damaged during a cable barrier crash. In most cases, socket damage requires repair crews to either replace the socket itself or drive a post directly into the soil adjacent to the damaged component. Either situation defeats the purpose of using sockets and greatly increases the time necessary to restore a damaged barrier. The increased repair time translates into higher maintenance costs and increased risk to repair crews working adjacent to high-speed facilities.

Many existing socketed post foundation designs are constructed by drilling a hole in the soil, placing a steel sleeve in the hole, and backfilling with Portland cement concrete. Many of these designs do not have sufficient reinforcement to resist impact loads that are transmitted into the socket. Further, many of the sockets are too short to resist frost heave that can push the posts out of the ground. Thus, there is a need for general design guidelines that states can incorporate to assure that socketed post foundations perform as intended when used in the field.

**Objectives/Tasks:**

1. Conduct literature review on previous/current high-tension, cable systems.
2. Design new socket foundations for barrier posts.
3. Fabrication and dynamic testing of socketed foundations.
4. Analysis of test data and evaluation of socketed foundation designs.
5. Provide a written report documenting all work and conclusions.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

The Phase I research report was completed and is now in the hands of MATC to publish the paper copies (MATC provided matching funds for the research). The Phase report documents the first round of dynamic testing and evaluation and contains the recommendations for the second round designs of the socketed foundations. The report will be sent to the States as soon as the document is printed.

Due to the matching funds received from MATC, a significant amount of money remained in the project upon completion. Therefore, time and labor spent to design and conduct further testing of the socketed post foundations has been charged to this project. Through this quarter, an additional 7 component tests have been conducted, but funding still remains. For a summary of the Phase II work, please refer to the progress report for TPF-5(193) suppl #19 - RFP-10-CABLE-1.

**Anticipated work next quarter:**

The Phase I report will be printed and sent out to the Pooled Fund member States.

Dynamic component testing will continue on concrete foundation designs utilizing various embedment depths, diameters, and reinforcement configurations. This work (although being charged to the remaining funds of this project) will be documented on the Phase II project, please refer to the progress report for TPF-5(193) suppl #19 - RPFP-10-CABLE-1.

**Significant Results:**

PHASE I only:

Four socketed foundation designs were evaluated through dynamic bogie testing. All 4 of these first round designs experienced heavy damage in the form of concrete fracture and plastic deformation of the reinforcing steel. As a result, 4 new reinforcement designs were configured to provide additional strength to the socketed foundation. These recommended configurations will be evaluated in Phase II of this project.

Objectives/Tasks:	% Complete (Phase I only)
1. Conduct literature review on previous/current high-tension, cable systems.	100%
2. Design new socket foundations for barrier posts.	100%
3. Fabrication and dynamic testing of socketed foundations.	100%
4. Analysis of test data and evaluation of socketed foundation designs.	100%
5. Provide a written report documenting all work, conclusions, and recommendations.	99%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

Additional (matching) funds for this project were obtained through a Mid-America Transportation Center program. This matching funding was used during the first round of design, testing, and evaluation for the socketed foundations. Thus, much of the original funding for this project remained as it was not used until the MATC funding was depleted. As a result, the continuing work which would have been conducted under Phase II of the project is being charged to the Phase I project until the funds are gone.

This project is to close July 31, 2012. However, do to the MATC matching funds, much of the original funding remains and is being utilized to continue design and testing that would have ocured under Phase II of the project. As a result, the project will need to be extended solely to ensure the remaining funds will be accessible after the project end date.

**Potential Implementation:**

Upon successful completion of this project, State DOT's will have the option to use a socketed post foundation for cable barrier system posts. The socketed foundation will allow for quick, easy, and inexpensive repairs to damaged sections of the barrier.



## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

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<b>Project Title:</b> <p style="text-align: center;">Phase II - Guidelines for Post-Socketed Foundations for 4-Cable, High-Tension, Barrier System</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Reid, Sicking, Faller, Rosenbaugh</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-9324</p>	<b>E-Mail</b> <p style="text-align: center;">srosenbaugh2@unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">2611211026001</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">RPPF-10-CABLE-1</p>	<b>Project Start Date:</b> <p style="text-align: center;">7/1/2009</p>
<b>Original Project End Date:</b> <p style="text-align: center;">7/31/2012</p>	<b>Current Project End Date:</b>	<b>Number of Extensions:</b>

Project schedule status:

- On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$92,207	\$8,372	30%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$0	

**Project Description:**

This project is the second Phase of a project which was undertaken the year previous - split up due to available funds in previous year not being sufficient to cover entire project.

High-tension cable barriers often incorporate socketed post foundations to simplify repair of the system after an accident. Barrier posts are designed to slide in and out of a ground socket for easy replacement of damaged components. Unfortunately, there have been numerous examples of socketed post foundations that are damaged during a cable barrier crash. In most cases, socket damage requires repair crews to either replace the socket itself or drive a post directly into the soil adjacent to the damaged component. Either situation defeats the purpose of using sockets and greatly increases the time necessary to restore a damaged barrier. The increased repair time translates into higher maintenance costs and increased risk to repair crews working adjacent to high-speed facilities.

Many existing socketed post foundation designs are constructed by drilling a hole in the soil, placing a steel sleeve in the hole, and backfilling with Portland cement concrete. Many of these designs do not have sufficient reinforcement to resist impact loads that are transmitted into the socket. Further, many of the sockets are too short to resist frost heave that can push the posts out of the ground. Thus, there is a need for general design guidelines that states can incorporate to assure that socketed post foundations perform as intended when used in the field.

**Objectives/Tasks:**

1. Design new socket foundations for barrier posts.
2. Fabrication and dynamic testing of socketed foundations.
3. Analysis of test data and evaluation of socketed foundation designs.
4. Written report documenting all work and conclusions.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

The 3rd round of dynamic bogie testing has begun in which concrete foundations were evaluated in stiff soil (AASHTO grade B). The 12" diameter concrete foundations continue to see damage in the form of large pieces breaking free from the top - back side of the foundation during testing. Additionally, 30 inches of embedment was deemed too shallow for the foundations as excessive permanent set deflections were observed.

Additionally, work on the report documenting the second round of dynamic testing has begun. The report will include the 3rd round of testing as well.

**Anticipated work next quarter:**

The concrete foundations will be redesigned to prevent rotation and damage to the socketed foundation during impacts. Additional component testing is anticipated.

**Significant Results:**

Phase I of this project included the evaluation of 4 new socketed foundation designs. All 4 of these first round designs experienced heavy damage in the form of concrete fracture and plastic deformation of the reinforcing steel. As a result, 4 new reinforcement designs were configured to provide additional strength to the socketed foundation.

Round 2 of testing saw four foundations designs evaluated in sand. Although concrete shear failure occurred in all designs, the 60" embedment proved adequate to resist rotation in weak/saturated/sandy soils.

Round 3 of testing has begun testing concrete foundations in strong soil (AASHTO Grade B). 30 inches of embedment has proven too shallow to prevent rotation.

Objectives/Tasks:	% Completed (Phase II)
1. Design new socket foundations for barrier posts.	40%
2. Fabrication and dynamic testing of socketed foundations.	40%
3. Analysis of test data and evaluation of socketed foundation designs.	25%
4. Written report documenting all work and conclusions.	20%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

Additional (matching) funds for Phase-I of this project were obtained through a Mid-America Transportation Center program. This matching funding was used during the first round of design, testing, and evaluation for the socketed foundations. Thus, some of the original Phase-I funding remains as it was not used until the MATC funding was depleted. As a result, the continuing work which would have been conducted under Phase II of the project is being charged to the Phase I project until the funds are gone. No time has been charged to the Phase II project to date, but the test charges from Round 2 of testing have been placed on this project's budget.

This project was originally set to close on July 31, 2012. However, the additional funding obtained for Phase-I of the project has resulted in remaining funds in the Phase-I project and nearly all of the funds remaining for Phase-II. Therefore, an extension will be necessary to ensure the funds are available for use in future testing.

**Potential Implementation:**

Upon successful completion of this project, State DOT's will have the option to use a socketed post foundation for cable barrier system posts. The socketed foundation will allow for quick, easy, and inexpensive repairs to damaged sections of the barrier.

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Lead Agency (FHWA or State DOT): NE Department of Roads

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<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> <p style="text-align: center;">TPF-5(193) Suppl.#21</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> Additional Funding to Complete Development of a Crash-Worthy Terminal for Midwest Four-Cable, HT, Barrier System		
<b>Name of Project Manager(s):</b> Reid, Sicking, Faller	<b>Phone Number:</b> 402-472-3084	<b>E-Mail</b> jreid@unl.edu
<b>Lead Agency Project ID:</b> RPFP-10-CABLE-3	<b>Other Project ID (i.e., contract #):</b> 2611211028001	<b>Project Start Date:</b> July 1, 2009
<b>Original Project End Date:</b> July 31, 2012	<b>Current Project End Date:</b> July 31, 2012	<b>Number of Extensions:</b> 0

Project schedule status:

- On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$159,193	\$26,787	15%

**Quarterly** Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date

**Project Description:**

Objective: Redesign the cable release mechanism and foundation of the three cable end terminal to accommodate four high tension cables.

This is Phase II of the project. Phase I was funded in Year 17: SPR-3(017) Suppl.#38 - "Testing of Cable Terminal for High Tension Cable (1100C & 2270P)"

No reporting on this phase of the project will be done until Phase I is complete; see that project for status.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

**Anticipated work next quarter:**

**Significant Results:**

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

Final design details and full-scale testing for this project cannot be conducted until the High Tension Cable Barrier System is completed.

**Potential Implementation:**

The revised terminal will provide a non-proprietary end terminal for high tension barrier cable systems.



## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> <p style="text-align: center;">TPF-5(193) Suppl.#22</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Maximum MGS Guardrail Height</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Reid, Sicking, Faller</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-3084</p>	<b>E-Mail</b> <p style="text-align: center;">jreid@unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">RPF-10-MGS</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">2611211029001</p>	<b>Project Start Date:</b> <p style="text-align: center;">July 1, 2009</p>
<b>Original Project End Date:</b> <p style="text-align: center;">July 31, 2012</p>	<b>Current Project End Date:</b> <p style="text-align: center;">July 31, 2012</p>	<b>Number of Extensions:</b> <p style="text-align: center;">0</p>

Project schedule status:

- On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$166,953	\$125,557	75%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date

**Project Description:**

Objective: Identify an upper bound on the acceptable height of the Midwest Guardrail System (MGS).

Tasks

1. Full-scale crash testing - completed
2. Report on full-scale crash testing - completed, Report TRP-03-255-12 published March 9, 2012
3. Analysis phase - in progress

Note: The analysis phase of this project is being supplemented by NDOR project SPR-1(12) M318, "Maximum Safe Guardrail Height." Thus, work on this project is delayed until that supplemental project is completed.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

Task 3. See Quarterly Report for NDOR project SPR-1(12) M318, "Maximum Safe Guardrail Height"

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

The supplemental project, NDOR project SPR-1(12) M318, is being worked on before completing this project. Results from that project will feed and direct this project. That project is on time and within budget, but its' project dates are 7/27/2011 thru 12/31/2012. Thus, it is highly likely that a 1-year extension will be requested for this project in the future.

**Potential Implementation:**

Clearly defined limits on the upper height for MGS guardrail will allow states to accurately determine when a guardrail is too high, either as a result of improper installation or frost heave. Further, a clearly defined upper height will be very helpful when determining acceptable MGS placement guidelines on moderate slopes or behind curbs.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> <p style="text-align: center;">TPF-5(193) Suppl.#24</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">LS-DYNA Modeling Year 4</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Reid, Sicking, Faller</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-3084</p>	<b>E-Mail</b> <p style="text-align: center;">jreid@unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">RPF-10-LSDYNA</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">2611211031001</p>	<b>Project Start Date:</b> <p style="text-align: center;">July 1, 2009</p>
<b>Original Project End Date:</b> <p style="text-align: center;">July 31, 2012</p>	<b>Current Project End Date:</b> <p style="text-align: center;">July 31, 2012</p>	<b>Number of Extensions:</b> <p style="text-align: center;">0</p>

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$37,634	\$16,310	43%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date

**Project Description:**

The objective of this research effort is to set up an annual modeling enhancement program funded by the Pooled Fund Program States to address specific modeling needs shared by many safety programs. Funding from this project would go towards advancement of LS-DYNA modeling capabilities at MwRSF. The exact nature of the issues to be studied would be determined by the most pressing simulation problems associated with current Pooled Fund projects.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

Version 2.g of the 1100c Toyota Yaris model was obtained from NCAC on March 29, 2012. This vehicle model requires extensive investigation and some modifications before it can be used in our actual projects. That investigation began during this quarter. Substantial progress was made, as follows.

1. Investigate original model "as-is" to understand basic make-up and functionality. This was done through a series of simulations such as settling due to gravity, rolling forward on level ground, steering in a circle, and frontal impact.
2. Split the original model into multiple files (called includes) so that various major features are self-contained. This has been the common practice at MwRSF for ease of usage amongst all our analysts.
3. Convert the units of the model to MwRSF standard simulation units (mm, ms, kg, kN). At this point the series of tests from step 1 need to be repeated in order to verify steps 2 & 3 did not substantially change the model results.
4. Rotate and position the Yaris into MwRSF standard impact location for ease of usage for various projects. Test this model for rolling and steering.

Next, step 4 model was impacted into the MGS model. During this phase many simulations were performed to properly define the contact behavior between the vehicle and the guardrail. This is not a trivial task. At this point it was identified that the tire & wheel response of the Yaris was not performing as desired. Thus, the tires & wheels were substantially modified following the MwRSF method of tire modeling. This method has been developed over many years, including Dustin Boesch's Master's Thesis. However, issues have arisen that have not been resolved.

**Anticipated work next quarter:**

Finish implementing the 1100c Toyota Yaris model into MwRSF standards and make available for other Pooled Fund projects.

2270p pickup truck model - based on the Chevy Silverado.

During the current quarter, MwRSF obtained two separate Silverado models from NCAC: (1) a new reduced model for quicker simulations and (2) an updated model of the detailed 2270p. The updated model contains a much needed improvement to the steering/suspension system. These vehicle models require extensive investigation and some modifications before they can be used in our actual projects. That will be the focus of this project for the next quarter, after the Yaris model has been implemented.

**Significant Results:**

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

No problems have been encountered to date.

**Potential Implementation:**

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(193) Supplement #30</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Deflection of Curved Runs of Cable Guide Under MASH TL-3 Impact</p>		
<b>Name of Project Manager(s):</b> Faller, Sicking, Reid, Lechtenberg, Bielenberg	<b>Phone Number:</b> 402-472-9070	<b>E-Mail</b> kpolivka2@unl.edu
<b>Lead Agency Project ID:</b> 2611211054001	<b>Other Project ID (i.e., contract #):</b>	<b>Project Start Date:</b> 8/1/10
<b>Original Project End Date:</b> 12/31/11	<b>Current Project End Date:</b> 12/31/12	<b>Number of Extensions:</b> 1

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$180,655	\$180,655	80

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$9,382	



**Project Description:**

Objective: To determine how much a curved cable system will deflect for a known impact condition and to determine the average energy absorbed when the test vehicle bends over the typical weak posts, rubs on the cable rail, and skids on the ground/pavement surface.

**Tasks:**

1. Prepare CAD details of 360-ft radius system
2. Construct 360-ft radius system
3. Full-scale test of 360-ft radius system (modified MASH 3-11)
4. Prepare CAD details of 440-ft radius system
5. Construct 440-ft radius system
6. Full-scale test of 440-ft radius system (modified MASH 3-11)
7. Analysis and documentation of test results
8. Draft and final research reports
9. Additional crash investigation and energy dissipation analysis
10. Draft and final report for additional analysis

**Tasks for additional work added to original project:**

11. Prepare CAD details of modified 440-ft radius system
12. Construct modified 440-ft radius system
13. Full-scale test of modified 440-ft radius system (modified MASH 3-11)

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

On April 26, 2012, MwRSF conducted one pickup crash test (test no. NYCC-3) into a 440-ft radius curved cable system with a 29-in. top cable height using a 2270-kg Dodge QuadCab according to the modified TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected. Data analysis of the third test was completed.

A draft report of the testing continued to be written.

Energy dissipation estimations continued utilizing the results from both tests. Additional items of potential energy dissipation were investigated. A draft report of the additional energy dissipation analysis continued to be written.

**Anticipated work next quarter:**

A draft research report of the testing will be completed. Internal review of the draft report will be initiated.

Energy dissipation estimations will be completed utilizing the three test results and prior component testing as well as developing reasonable estimates for the barrier-vehicle friction and vehicle damage. A draft research report of the energy analysis will continue to be written.

Note - funds for this project have been exhausted. All further work will be conducted under the additional funding project: TPF-5(193) Supplement #52, Lead Agency Project ID: 2611211074001

**Significant Results:**

On August 2, 2011, MwRSF conducted one pickup crash test (test no. NYCC-1) into a 360-ft radius curved cable system according to the modified TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected. On November 1, 2011, MwRSF conducted one pickup crash test (test no. NYCC-2) into a 440-ft radius curved cable system according to the modified TL-3 safety performance guidelines of MASH. The pickup was not contained nor redirected. Following the failed test of the 440-ft radius system, the NYSDOT decided to retest a modified system with a 2 in. higher top cable. On April 26, 2012, MwRSF conducted one pickup crash test (test no. NYCC-3) into a 440-ft radius curved cable system with a 29-in. top cable height according to the modified TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected.

Tasks:	% Completed
1. Prepare CAD details of 360-ft radius system	100%
2. Construct 360-ft radius system	100%
3. Full-scale test of 360-ft radius system (modified MASH 3-11)	100%
4. Prepare CAD details of 440-ft radius system	100%
5. Construct 440-ft radius system	100%
6. Full-scale test of 440-ft radius system (modified MASH 3-11)	100%
7. Analysis and documentation of test results	100%
8. Draft and final research reports	65%
9. Additional crash investigation and energy dissipation analysis	60%
10. Draft and final report for additional analysis	20%
11. Prepare CAD details of modified 440-ft radius system	100%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

The warmer temperatures during the 4th Quarter of 2010 and 1st Quarter of 2011 melted the snow and thawed the soil surface, thus resulting in a muddy work environment not conducive to post installation. In addition, the spring rains came early. Rains continued through the 2nd Quarter of 2011 and the wet conditions made construction quite difficult.

With the unsuccessful second test, NYSDOT requested a retest with raising the top cable height 2 inches. An addition to the original proposal was filed.

Funds for this project have been exhausted. All further work will be conducted under the additional funding project: TPF-5 (193) Supplement #52, Lead Agency Project ID: 2611211074001.

**Potential Implementation:**

This will provide justification for limits that have been placed on the amount of curvature that could be used for a given post spacing for a curved cable system since operating speeds on freeways have continued to increase and vehicle weights have continued to grow. In addition, it will allow the New York State Department of Transportation to provide information to help the New York State Police performing accident reconstructions, particularly as it relates to determining impact speeds, such as how much energy is absorbed in the process of deforming a standard weak post.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

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<b>Transportation Pooled Fund Program Project #</b> <i>(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(193) Supplement #31</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b>  <p style="text-align: center;">Wood Post for MGS</p>		
<b>Name of Project Manager(s):</b> Reid, Sicking, Faller, Lechtenberg, Bielenberg	<b>Phone Number:</b> 402-472-9070	<b>E-Mail</b> kpolivka2@unl.edu
<b>Lead Agency Project ID:</b> 2611211045001	<b>Other Project ID (i.e., contract #):</b> RFPF-11-MGS-1	<b>Project Start Date:</b> 7/1/10
<b>Original Project End Date:</b> 12/31/13	<b>Current Project End Date:</b> 12/31/13	<b>Number of Extensions:</b> 0

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$121,215	\$80,253	75

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$1,072	

**Project Description:**

Although the Federal Highway Administration has approved the use of the MGS with both W6x9 steel and 6x8-in. wood posts, no rectangular standard southern yellow pine post designs have been subjected to full-scale crash testing according to the MASH criteria. Eventually this testing needs to be conducted to verify the MGS performance with the most common wood post used in the United States.

Objective: Verify that 6x8-in. southern yellow pine wood post option for MGS has similar characteristics to the steel post MGS.

**Tasks:**

1. Full-scale crash testing (MASH 3-10 and 3-11)
2. Analysis and documentation of test results
3. Research report
4. Hardware guide drawings and FHWA acceptance

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

The reporting of the two crash tests was initiated.

**Anticipated work next quarter:**

An internal draft report will be completed. Review of the internal draft report will be initiated.

**Significant Results:**

On August 3, 2011, MwRSF conducted one pickup crash test (test no. MGSSYP-1) into a 31-in. tall Midwest Guardrail System (MGS) with standard southern yellow pine wood posts using a 2270-kg Dodge QuadCab according to the TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected.

On September 13, 2011, MwRSF conducted one small car test (test no. MGSSYP-2) into a 32-in. tall Midwest Guardrail System (MGS) using an 1100-kg Kia Rio according to the TL-3 MASH safety performance guidelines. Again, the small car was successfully contained and redirected.

Task	% Complete
1. Full-scale crash testing (MASH 3-10 and 3-11)	100%
2. Analysis and documentation of test results	100%
3. Research report	50%
4. Hardware guide drawings and FHWA acceptance	50%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

The same test pit was used for Project No.:RPF-11-MGS-3 – TPF-5(193) Supplement #33, Project Title: MGS without Blockouts. The wood post MGS system was constructed and tested following the completion of the aforementioned project. However, there are no additional problems or issues to report at this time.

**Potential Implementation:**

Full-scale crash testing and verification of the safety performance of the southern yellow pine post MGS system will provide designers with increased confidence when specifying a rectangular wood post option for the MGS. In addition, specifying wood posts can be a less costly alternative to steel posts in some areas, and wood posts may provide for a more aesthetic treatment.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(193) Suppl. #32</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">MGS Guardrail Attached to Culverts</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Reid, Sicking, Faller, Rosenbaugh</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-9324</p>	<b>E-Mail</b> <p style="text-align: center;">srosenba@unlserve.unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">2611211046001</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">RFPF-11-MGS-2</p>	<b>Project Start Date:</b> <p style="text-align: center;">7/1/2010</p>
<b>Original Project End Date:</b> <p style="text-align: center;">12/31/2013</p>	<b>Current Project End Date:</b>	<b>Number of Extensions:</b>

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$91,071	\$40,884	30%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$22,858	



**Project Description:**

Some cross-drainage culverts are wider than 24 ft and therefore cannot be treated with a long-span guardrail system. Although it is acceptable to utilize the deformable, top-mounted post attachment design developed for metric height guardrail under NCHRP Report No. 350, many existing culverts are too narrow to accommodate the loss of roadway width that comes with a top mounted system. Recently, the MGS Bridge Railing system was successfully developed and crash tested using the TL-3 MASH guidelines. The bridge railing system attaches to the exterior, vertical edge of reinforced concrete decks. It is believed that this bridge railing system could be adapted to mount to the backside face of an existing culvert headwall. The objective of this research effort is to develop an MGS guardrail system that attaches to the outside vertical face of the culvert headwall for box culverts greater than 24 ft wide.

**Objectives / Tasks**

1. Literature review of current culvert designs
2. Design of MGS attachment to face of headwall
3. Dynamic bogie testing
4. Data analysis and evaluation
5. Written report documenting all design work, testing, and conclusions

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

The 3-span simulated culvert was constructed for use in dynamic component evaluations. The simulated culvert was designed to represent a worst-case scenario culvert top slab and headwall commonly found throughout the Pooled Fund States.

Four design concepts have been developed for the attachment of the system posts to the culvert head wall. All attachment concepts are focused on retrofitting an existing culvert headwall so that no geometry alterations, additional steel reinforcement, or voids are necessary for the use of the new barrier system. Design drawings were completed for all four concepts and they are currently being fabricated.

**Anticipated work next quarter:**

Each of the four design concepts will be attached to the simulated culvert and evaluated through dynamic testing. The first round of testing shall be oriented perpendicular to the roadway/barrier, or creating strong axis bending in the posts. The best performing design concepts will also be evaluated with testing oriented parallel to the barrier and through the weak axis of the post.

**Significant Results:**

A complete review of culvert designs used by Pooled Fund member states revealed a critical culvert design for testing and evaluation. A simulated culvert matching this critical design has been constructed. Design drawings for 4 attachment concepts have been completed, and the concepts are currently being fabricated.

Objectives / Tasks	% Complete
1. Literature review of current culvert designs	100%
2. Design of MGS attachment to culvert headwall	80%
3. Dynamic bogie testing	15%
4. Data analysis and evaluation	0%
5. Written report documenting all design work, testing, and conclusions	0%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

none

**Potential Implementation:**

Development of a new attachment for the MGS system to low-fill culverts will allow designers to install the MGS system on culverts wider than 24 ft without reducing the width of the overall roadway. In addition, it is anticipated that the new attachment design on the outside of the headwall will reduce construction and maintenance costs.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(193) Supplement #33</p>		<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Wood Post for MGS</p>			
<b>Name of Project Manager(s):</b> Reid, Sicking, Faller, Lechtenberg, Holloway		<b>Phone Number:</b> 402-472-9070	<b>E-Mail</b> kpolivka2@unl.edu
<b>Lead Agency Project ID:</b> 2611211047001	<b>Other Project ID (i.e., contract #):</b> RPPF-11-MGS-3	<b>Project Start Date:</b> 7/1/10	
<b>Original Project End Date:</b> 12/31/13	<b>Current Project End Date:</b> 12/31/13	<b>Number of Extensions:</b> 0	

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$157,655	\$78,181	80

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$1,404	

**Project Description:**

The oversized blockout used with the MGS design is one reason that the guardrail has demonstrated a 100 percent increase in redirective capacity as compared to conventional guardrail systems. However, there are some locations where roadway width is insufficient to accommodate a 12-in. blockout. A number of proprietary adaptations of the MGS design have been developed that do not utilize a blockout, thereby providing more useable roadway in constricted sites. A non-blocked version of the MGS should be feasible for use in those locations with constricted roadway widths.

Objective: Develop a MASH version of the MGS without blockouts for standard steel posts using standard components. If modifications to the system such as post to rail attachment are deemed to be necessary, the new components should be able to replace the existing components for all new construction and repair applications. By changing the standard components in the supply chain, it should be possible to minimize the risk of utilizing the wrong components in a no blockout design.

**Tasks:**

1. Full-scale crash testing (MASH 3-10 and 3-11)
2. Analysis and documentation of test results
3. Research report
4. Hardware guide drawings and FHWA acceptance

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

Review of the internal draft report continued.

**Anticipated work next quarter:**

A draft report will be completed and submitted to the Pooled Fund member states for review and comment.

**Significant Results:**

On May 15, 2011, MwRSF conducted one pickup crash test (test no. MGSNB-1) into the Midwest Guardrail System (MGS) without blockouts using a 2270-kg Dodge QuadCab according to the TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected.

On June 15, 2011, MwRSF conducted one small car test (test no. MGSNB-2) into the Midwest Guardrail System (MGS) using an 1100-kg Kia Rio according to the TL-3 MASH safety performance guidelines. Again, the small car was successfully contained and redirected.

Task	% Complete
1. Full-scale crash testing (MASH 3-10 and 3-11)	100%
2. Analysis and documentation of test results	100%
3. Research report	85%
4. Hardware guide drawings and FHWA acceptance	50%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

There are no problems or issues to report at this time.

**Potential Implementation:**

Narrow roadways will benefit from a non-proprietary non-blocked out system by making more roadway width available while still providing acceptable guardrail performance. Additionally, a non-proprietary alternative to the existing non-blocked out guardrails would eliminate problems associated with identifying and properly repairing proprietary 31-in. tall guardrail systems.

It should be noted that, even if the MGS is made to function without a blockout, the 12-in. block would still be recommended where there was adequate space existing along the roadside. The blockout greatly improves the barrier's capacity to contain and redirect high-energy impacts with high c.g. vehicles.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(193) Suppl. #34</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Assess Standard Weld Detail</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Reid, Sicking, Faller, Rosenbaugh</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-9324</p>	<b>E-Mail</b> <p style="text-align: center;">srosenba@unlserve.unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">2611211048001</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">RPF-11-MGS-4</p>	<b>Project Start Date:</b> <p style="text-align: center;">7/1/2012</p>
<b>Original Project End Date:</b> <p style="text-align: center;">12/31/2013</p>	<b>Current Project End Date:</b>	<b>Number of Extensions:</b>

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$10,000	\$8,592	80%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$733	



**Project Description:**

In 2001, the Midwest Roadside Safety Facility (MwRSF) successfully developed a guardrail connection for low-fill culverts according to the Test Level 3 (TL-3) safety performance guidelines found in NCHRP Report No. 350. After evaluating several base plates, bolts, and weld combinations with undesirable results, a final configuration was chosen which consisted of a ½-in. plate attached with a 5/16-in. three-pass fillet weld on the critical flange and a 1/4-in. fillet weld on the web and back-side flange. The final post design was successfully tested and evaluated using both dynamic component bogie testing and full-scale vehicle crash testing.

During the implementation of the W-beam guardrail system for attachment to concrete box culverts, various State Departments of Transportation have raised questions concerning the use of the three-pass fillet weld on the critical flange. As such, there exists a need to re-examine the use of the three-pass weld and determine whether a simplified alternative weld detail could be used in combination with the rigid post attachment.

**Objectives / Tasks**

1. Literature review of current practices
2. Design of new weld detail
3. Dynamic testing and analysis
4. Written Report containing design work, testing, and conclusions

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

All four projected bogie tests (combined between this project and its related project TPF-5(193) Suppl. #47, RFP-12 MGS 4) have been conducted and analyzed. Similar to the original study, the 3-pass weld was the only weld to hold the impact force without fracturing or tearing the base plate.

Work has begun on the the report documenting all testing and conclusions. The report will cover the results for both projects.

**Anticipated work next quarter:**

Work will continue on the report documenting testing and conclusions for the two related projects.

**Significant Results:**

Two weld designs were selected via popular vote from the Pooled Fund members. Both weld designs were evaluated through a dynamic bogie impact test. During the tests the base plate tore adjacent to the weld on the front flange.

Objectives / Tasks	% Completed
1. Literature review of current practices	100%
2. Design of new weld detail	90%
3. Dynamic testing and analysis	100%
4. Written Report containing design work, testing, and conclusions	25%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

**Potential Implementation:**

The development of a simplified, standard weld detail will be compatible with the culvert-mounted, W-beam guardrail system and available for use on low-fill concrete box culverts.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> TPF-5(193) Suppl.#37	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> Annual LS-DYNA Modeling Enhancement Support		
<b>Name of Project Manager(s):</b> Reid, Sicking, Faller	<b>Phone Number:</b> 402-472-3084	<b>E-Mail</b> jreid@unl.edu
<b>Lead Agency Project ID:</b> RPPF-11-LSDYNA	<b>Other Project ID (i.e., contract #):</b> 2611211050001	<b>Project Start Date:</b> July 1, 2010
<b>Original Project End Date:</b> December 31, 2013	<b>Current Project End Date:</b> December 31, 2013	<b>Number of Extensions:</b> 0

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$35,901	0	0

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
0	0	0

**Project Description:**

This is a continuation of TPF-5(193) Suppl.#24, "LS-DYNA Modeling Year 4" and thus, no progress to report until funds are exhausted in that project.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

**Anticipated work next quarter:**

**Significant Results:**

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

**Potential Implementation:**

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(193) Supplement #44</p>		<b>Transportation Pooled Fund Program - Report Period:</b> <input checked="" type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase I			
<b>Name of Project Manager(s):</b> Reid, Sicking, Faller, Bielenberg, Lechtenberg		<b>Phone Number:</b> 402-472-9070	<b>E-Mail</b> kpolivka2@unl.edu
<b>Lead Agency Project ID:</b> 2611211064001		<b>Other Project ID (i.e., contract #):</b> RPF-12-CABLE1&2	<b>Project Start Date:</b> 7/1/11
<b>Original Project End Date:</b> 6/30/14		<b>Current Project End Date:</b> 6/30/14	<b>Number of Extensions:</b> 0

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$233,262	\$61,276 (+\$57,360 from Yr 21 Cont.)	60

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$14,434 (+\$489 from Yr 21 Cont.)	



**Project Description:**

This project is an extension to previous projects (RPFP-08-02: Four-Cable Median Barrier in 4:1 V-Ditch; RPFP-09-01: New Funding for High-Tension Cable Barrier on Level Terrain with New Cable Attachment; and RPFP-10-CABLE-2: Replacement Funding for High-Tension Cable Barrier on Level Terrain).

Original Objective: To complete the development, testing, and evaluation of the four-cable, high-tension, median barrier system for use in 4H:1V sloped medians.

Revised Objective: To complete the development, testing, and evaluation of the four-cable, high-tension, median barrier system placed 0 to 4 ft away from the slope break point of a 6H:1V sloped medians.

**Tasks:**

1. Full-scale crash testing (MASH 3-10)
2. Full-scale crash testing (MASH 3-11)
3. Full-scale crash testing (Additional MASH 1500A)
4. Analysis and documentation of test results
5. Research report (s)
6. Hardware guide drawings and FHWA acceptance

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

Review of the internal draft report of test no. 4CMBLT-1 continued.

The internal review of the draft research report of the vehicle trajectory analysis was completed. The draft report was submitted to Pooled Fund member states for review and comment.

Design modifications to the keyway bolt and keyway holes in the post were investigated. Sixteen dynamic component tests (test nos. HTCUB-48 through HTCUB-49 and HTCUB-52 through HTCUB-65) were performed with three different keyway bolts and modified keyway holes which were anchored to a rigid jig to determine the cable release capacity in the lateral and vertical directions. The keyway bolt with a 1/4-in. extension and a slightly modified keyhole appeared to be the most promising design. In this design, the button did not contact the inside of the flange as it was pulled vertically which reduced the maximum vertical load from 1.2 kips to 0.5 kips, while maximizing the lateral capacity. LS-DYNA simulations of the tested versions as well as other concepts continued.

Another design was also designed which is a one-piece, tabbed bracket. Two different thicknesses are in the process of being fabricated. The advantage of these brackets would be the ease of installation as they are only one piece and can be crimped into place. Their behavior is expected to be similar to that of the best keyway bolt designs.

Designs for the top cable attachment were also initiated. Couple of ideas to be investigated include: keeper rods made of stainless steel or brass and stainless steel cable ties.

**Anticipated work next quarter:**

Publish the final report for the vehicle trajectory analysis and disseminate to the member states.

Complete internal review of the draft research report of 4CMBLT-1. Submit the draft report to Pooled Fund member states for review and comment.

Design modifications of the new tabbed bracket design as well as the top cable attachment will continue to be investigated.

An update meeting with the Pooled Fund member states will be scheduled for the next quarter after the results of the component testing has been completed.

CAD drawings of the modified system will potentially be prepared with the potential of the redesigned system to be constructed.

**Significant Results:**

As the result of the guidance from the member States in August 2011, it was decided the four-cable barrier system would be developed for use on sloped medians as steep as 6H:1V instead of 4H:1V but still placed 0 to 4 ft away from the slope break point (Plan B from letter dated August 15, 2011).

Task	% Complete
1. Full-scale crash testing (MASH 3-10)	0%
2. Full-scale crash testing (MASH 3-11) - 4CMB-5	100%
3. Full-scale crash testing (Additional MASH 1500A) - 4CMBLT-1	100%
4. Analysis and documentation of test results - 4CMB-5	100%
5. Analysis and documentation of test results - 4CMBLT-1	100%
6. Analysis and documentation of test results (MASH 3-10)	0%
7. Research report - 4CMB-4 and 4CMB-5	100%
8. Research report - 4CMBLT-1	85%
9. Research report	0%
10. Research report - Vehicle Trajectory Analysis	95%
11. Hardware guide drawings and FHWA acceptance	0%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

This project is an extension to previous projects (RPFP-08-02: Four-Cable Median Barrier in 4:1 V-Ditch; RPFP-09-01: New Funding for High-Tension Cable Barrier on Level Terrain with New Cable Attachment; and RPFP-10-CABLE-2: Replacement Funding for High-Tension Cable Barrier on Level Terrain).

It should be noted that the test conducted with the 1500A on the system placed on level terrain (Test No. 4CMBLT-1 conducted on June 14, 2011) was charged to the Project No.:RPFP-11-CONT – TPF-5(193) Supplement #39, Project Title: Pooled Fund Year 21 Contingency even though it was one of the tests funded in Project No.:RPFP-12-CABLE1&2 – TPF-5(193) Supplement #44, Project Title: Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase I, V-Ditch. At the time this test was conducted, Year 22 funds were not available for use. The funds in the above mentioned contingency funds were available and were to be used to fund part of Phase II of this project.

As the result of the guidance from the member States in August 2011, it was decided the four-cable barrier system would be developed for use on sloped medians as steep as 6H:1V but still placed 0 to 4 ft away from the slope break point (Plan B from letter dated August 15, 2011). Depending on the simulation results and future modifications to the proposed MASH test matrices, up to seven full-scale crash tests may be required, including three level terrain tests.

**Potential Implementation:**

The successful completion of the development, testing, and evaluation of the Midwest four-cable, high-tension, median barrier in sloped medians will allow the member states to implement a non-proprietary, high-tension, cable system along our nation's highways and roadways. The successful completion of this project along with the non-proprietary four-cable, high-tension, median barrier on level terrain and cable guardrail end terminal would help to assure acceptance by FHWA and improve its chances for widespread implementation.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

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<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(193) Supplement #45</p>		<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase II			
<b>Name of Project Manager(s):</b> Reid, Sicking, Faller, Bielenberg, Lechtenberg		<b>Phone Number:</b> 402-472-9070	<b>E-Mail</b> kpolivka2@unl.edu
<b>Lead Agency Project ID:</b> 2611211065001	<b>Other Project ID (i.e., contract #):</b> RFPF-12-CABLE1&2	<b>Project Start Date:</b> 7/1/11	
<b>Original Project End Date:</b> 6/30/14	<b>Current Project End Date:</b> 6/30/14	<b>Number of Extensions:</b> 0	

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$91,800 (+\$91,089 from Yr 21 contingency)	\$0	0

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$0	

**Project Description:**

The Midwest Roadside Safety Facility (MwRSF) has been conducting research for the Midwest States Regional Pooled Fund Program to develop a non-proprietary, high-tension, four-cable, median barrier that is capable of being used anywhere in a V-ditch with 4H:1V side slopes. Three tests still remain to complete the test matrix of the cable barrier system in a V-ditch. In addition, the four-cable, high-tension, median barrier has never been tested on level terrain. There is a concern that FHWA may not approve this design without testing on flat ground, especially when considering the wide cable spacing and increased cable heights. Further, the barrier deflections observed in crash tests performed in a 4H:1V V-ditch are likely higher than would be observed on flat ground. Crash testing of the barrier installed on level terrain would identify barrier deflections and working widths that can be expected when the barrier is used in narrow medians with gentle slopes and would allow for better performance comparisons between the Midwest four-cable barrier and other proprietary systems.

Objective: To complete the development, testing, and evaluation of the four-cable, high-tension, median barrier system for use on level terrain.

**Tasks:**

1. Full-scale crash testing (MASH 3-10 and 3-11)
2. Analysis and documentation of test results
3. BARRIER VII calibration and analysis for alternate configurations
4. Research report
5. Hardware guide drawings and FHWA acceptance

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

None

Priorities set by the Pooled Fund member States are for the continued development of a high-tension, cable barrier system for relatively-flat and sloped median applications was to focus on the four-cable barrier system for use on sloped medians as steep as 6:1 but still placed 0 to 4 ft away from the slope break point.

**Anticipated work next quarter:**

None.

Priorities set by the Pooled Fund member States are for the continued development of a high-tension, cable barrier system for relatively-flat and sloped median applications was to focus on the four-cable barrier system for use on sloped medians as steep as 6:1 but still placed 0 to 4 ft away from the slope break point.

**Significant Results:**

Task	% Complete
1. Full-scale crash testing (MASH 3-10 and 3-11)	0%
2. Analysis and documentation of test results	0%
3. BARRIER VII calibration and analysis for alternate configurations	0%
4. Research report	0%
5. Hardware guide drawings and FHWA acceptance	0%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

A portion of this project (\$91,089 is not included in the project budget shown on page 1) will be funded with Project No.: RFPF-11-CONT – TPF-5(193) Supplement #39, Project Title: Pooled Fund Year 21 Contingency.

It should be noted that the test conducted with the 1500A on the system placed on level terrain (Test No. 4CMBLT-1 conducted on June 14, 2011) was charged to the above mentioned contingency funds even though it was one of the tests funded in Project No.:RFPF-12-CABLE1&2 – TPF-5(193) Supplement #44, Project Title: Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase I, V-Ditch. At the time this test was conducted, Year 22 funds were not available for use. The funds in the above mentioned contingency funds were available and were to be used to fund part of this project (Phase II ).

As the result of the guidance from the member States in August 2011, it was decided the four-cable barrier system would be developed for use on sloped medians as steep as 6:1 but still placed 0 to 4 ft away from the slope break point (Plan B from letter dated August 15, 2011). Depending on the simulation results and future modifications to the proposed MASH test matrices, up to seven full-scale crash tests may be required, including three level terrain tests.

**Potential Implementation:**

The successful completion of the development, testing, and evaluation of the Midwest four-cable, high-tension, median barrier on level terrain will allow the member states to implement a non-proprietary, high-tension, cable system along our nation's highways and roadways. In addition, the crash testing of the four-cable, high-tension, median barrier on level terrain would also provide a more complete understanding of barrier performance (i.e., dynamic deflections, working width, etc.) when used in relatively flat, narrow medians. The crash results from the level terrain testing will be used in combination with computer simulation to evaluate the effects of reduced post spacing. The successful completion of this project along with the non-proprietary four-cable, high-tension, median barrier in V-ditch and cable guardrail end terminal would help to assure acceptance by FHWA and improve its chances for widespread implementation.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> <p style="text-align: center;">TPF-5(193) Suppl. #46</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Midwest Four-Cable, High-Tension, Median Barrier - Phase III, End Terminal</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Reid, Sicking, Faller, Bielenberg</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-3084</p>	<b>E-Mail:</b> <p style="text-align: center;">jreid@unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">RPF-12-CABLE</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">2611211066001</p>	<b>Project Start Date:</b> <p style="text-align: center;">July 1, 2011</p>
<b>Original Project End Date:</b> <p style="text-align: center;">June 30, 2014</p>	<b>Current Project End Date:</b> <p style="text-align: center;">June 30, 2014</p>	<b>Number of Extensions:</b> <p style="text-align: center;">0</p>

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$199,626	0	0

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date



**Project Description:**

Objective: Redesign the cable release mechanism and foundation of the three cable end terminal to accommodate four high tension cables.

In a previous Pooled Fund Project, a cable end terminal consisting of three cables was designed and successfully crash tested according to NCHRP Report 350 criteria. That end terminal was designed for a low tension system. Further, MwRSF has also been working to develop a non-proprietary, high-tension, cable barrier system. Thus, there is a need to adapt this terminal for use in high-tension cable systems while also being satisfying the safety performance standards of MASH.

This is Phase III of the project.

Phase I was funded in Year 17: SPR-3(017) Suppl.#38 - "Testing of Cable Terminal for High Tension Cable (1100C & 2270P)"

Phase II was funded in Year 20: TPF-5(193) Suppl.#21 - "Additional Funding to Complete Development of a Crash-Worthy Terminal for Midwest Four-Cable, HT, Barrier System"

No reporting on this phase of the project will be done until Phases I and II are completed; see those projects for status.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

**Anticipated work next quarter:**

**Significant Results:**

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

Final design details and full-scale testing for this project cannot be conducted until the High Tension Cable Barrier System is completed.

**Potential Implementation:**

The revised terminal will provide a non-proprietary end terminal for high tension barrier cable systems.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(193) Suppl. #47</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">MGS Culvert Attachment with Epoxied Rods</p>		
<b>Name of Project Manager(s):</b> Reid, Sicking, Faller, Bielenberg, Rosenbaugh	<b>Phone Number:</b> 402-472-9324	<b>E-Mail</b> srosenba@unlserve.unl.edu
<b>Lead Agency Project ID:</b> 2611211067001	<b>Other Project ID (i.e., contract #):</b> RPPF-11-MGS-4	<b>Project Start Date:</b> 7/1/2011
<b>Original Project End Date:</b> 6/30/2014	<b>Current Project End Date:</b>	<b>Number of Extensions:</b>

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$19,935	\$7,509	45%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$7,509	

**Project Description:**

MwRSF has previously developed a TL-3 guardrail system for use on low-fill culverts and according to the NCHRP Report No. 350 safety performance criteria. In this application, the steel guardrail posts were anchored to the top of the culvert slab using through bolts in combination with a base plate that is welded to the bottom of the posts. However, problems can arise when the guardrail post coincides with the location of a vertical support wall found inside the culvert. For this scenario, through bolts cannot be utilized to anchor the guardrail posts to the culvert slab since there is unavailable space to place the lower bearing plate or access the lower end of the through bolt. Instead, it is necessary to use an alternative anchorage option, such as a threaded rod anchored into the culvert slab and upper region of the vertical wall. Unfortunately, no design recommendations exist for using epoxied anchor rods to attach the steel posts to the top of the culvert slab. A small research study is needed to evaluate suitable epoxied anchor rods for use with the W-beam guardrail over culvert system.

In 2010, the Midwest Pooled Fund States funded a small project to determine an alternative, standard weld detail which simplifies the post-plate attachment for the guardrail system mentioned above and to evaluate the new weld detail through both analysis and bogie testing. The proposed project herein is to act as a supplement to the current project, RFPF-11-MGS-4.

**Objectives / Tasks**

1. Literature review
2. Design of epoxied anchors
3. Dynamic testing and analysis of design
4. Written report containing all design, analysis and conclusions

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

The bogie testing portion of this project (2 tests) were completed. 6 inches of embedment caused the threaded rods to pull out of the concrete. 8 inches of embedment provided adequate strength throughout the impact.

Additionally, work began on the report documenting all testing, analysis, and conclusions for this project. Project TPF-5 (193) suppl. #34 will be included in the testing report as they both deal with attachment of the top mounted culvert post to existing culvert slabs.

**Anticipated work next quarter:**

Work shall continue on the documentation report.

**Significant Results:**

The first dynamic bogie impact test conducted on a post assembly anchored by rods embedded 6" into the tarmac resulted in the anchors pulling out of the concrete. The second test was conducted on a post utilizing an 8" embedment depth. During the second test, both the anchors and the post-to-plate weld held and the post was plastically deformed. Thus, 8 inches of embedment will be required for proper attachment of the top-mounted culvert post in locations where epoxy anchors are desired over the original bolt-through design.

Objectives / Tasks	% Completed
1. Literature review	100%
2. Design of epoxied anchors	100%
3. Dynamic testing and analysis of design	90%
4. Written report containing all design, analysis and conclusions	25%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

**Potential Implementation:**

The development of an epoxied anchor rod alternative to the original through bolt anchorage of the culvert guardrail posts will allow the system to be installed anywhere across the top slab of the concrete culvert, regardless of the location of interior, culvert walls.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> <p style="text-align: center;">TPF-5(193) Suppl. #48</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Pooled Fund Center for Highway Safety</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Ron Faller, John Reid, Bob Bielenberg</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-9064</p>	<b>E-Mail</b> <p style="text-align: center;">rbielenberg2@unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">2611211068001</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">RPF-12-PFCHS-1</p>	<b>Project Start Date:</b> <p style="text-align: center;">7/1/2011</p>
<b>Original Project End Date:</b> <p style="text-align: center;">6/30/14</p>	<b>Current Project End Date:</b> <p style="text-align: center;">6/30/14</p>	<b>Number of Extensions:</b> <p style="text-align: center;">0</p>

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$24,859.00	\$395.00	5%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$395.00	



**Project Description:**

Many of MwRSF's inquiries from members of the Midwest States Pooled Fund program can be answered based upon prior pooled fund or other research. Further, even though answers to pooled fund inquiries are normally routed to all pooled fund states in the quarterly progress report, there are numerous repeat questions every year. The quarterly summaries are helpful to member states, but they are temporary and not well organized by the type of question or specific topic. Many pooled fund inquiries could be answered through the development of a Center of Highway Safety web site. This web site would provide an organized and searchable summary for all State inquiries and MwRSF reports as well as CAD details pertaining to Pooled Fund crash tested systems. This safety center would also be helpful to non-member states with problems or inquiries similar to those identified by the member states.

A dedicated and well-maintained Pooled Fund Center for Highway Safety web site would provide for all of these needs. It would provide for a searchable database of previous MwRSF inquiries and solutions, a searchable online listing of downloadable research reports, and a searchable archive of CAD details for crash tested and/or approved systems and features. Through MwRSF's relationship with the Nebraska Transportation Center (NTC), experienced personnel can be hired to perform website design, programming, as well as provide reliable website hosting facilities. However, the development, maintenance, operation, and hosting of the web site will require funding. It is anticipated that the costs to develop, operate, maintain, and host a Pooled Fund Center for Highway Safety web site would be \$24,859.00 in funding for FY 22.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

The MwRSF Pooled Fund Consulting web site is fully functional and MwRSF has begun work on the Pooled Fund Center for Highway Safety web site. MwRSF has met with web site developers at UNL and have begun plans for a web site that will house all of the MwRSF research reports and CAD details in a searchable format for downloading. It is anticipated that the web site will tie in with both the existing MwRSF web site and the recently finished MwRSF Pooled Fund Consulting web site. The web site is in its early development phase. This includes a plan for the site design and organization, the search functionality, and determination of materials to archive on the site.

MwRSF has met with the web site development team at UNL and has developed a rough prototype of the web site. Currently, MwRSF is helping the developers determine the list of potential materials that may be added to the web site in the future so that the framework of the site can be programmed to more readily accept these updates at a later time as states request them.

Progress has been limited this quarter on due to work by the web site development team on the MwRSF Consulting Services web site. There were minor issues with the search and attachment functions on the consulting web site and resources were prioritized to address those issues before working on the Pooled Fund Center for Highway Safety web site.

**Anticipated work next quarter:**

In the coming quarter, MwRSF will continue the process of developing the Pooled Fund Center for Highway Safety web site. We will begin to archive materials once the site framework is set up and running. Again, at this time, the existing funds for the project should allow for archiving of MwRSF research reports and CAD details.

**Significant Results:**

None.

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

None.

**Potential Implementation:**

The Pooled Fund Center for Highway Safety web site would provide immediate access to a wide library of roadside safety materials for designers and engineers, including reports, CAD details, etc. It would also provide a searchable database of previous solutions and responses to prior Pooled Fund inquiries and problems. The web site would also be available through controlled access to state DOT's around the country which would promote improved roadside safety.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(193) Supplement #49</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Annual Fee to Finish TF-13 and FHWA Standard Plans</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Reid, Sicking, Faller, Lechtenberg</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-9070</p>	<b>E-Mail</b> <p style="text-align: center;">kpolivka2@unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">2611211069001</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">RPF-12-TF13</p>	<b>Project Start Date:</b> <p style="text-align: center;">7/1/11</p>
<b>Original Project End Date:</b> <p style="text-align: center;">6/30/14</p>	<b>Current Project End Date:</b> <p style="text-align: center;">6/30/14</p>	<b>Number of Extensions:</b> <p style="text-align: center;">0</p>

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$3,993	\$3,360	75

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$333	

**Project Description:**

Each year, the Midwest States Pooled Fund program sponsors several roadside safety studies at the Midwest Roadside Safety Facility (MwRSF) of the University of Nebraska-Lincoln. Some of these research efforts result in the development of new roadside safety features. As part of this effort and on behalf of the member states, MwRSF seeks FHWA acceptance for those devices or systems meeting current impact safety standards. In the future, FHWA will require standard Task Force (TF) 13-format CAD details along the typical system details when requests for hardware acceptance are made.

MwRSF prepares 2-D and/or 3-D CAD details for newly developed roadside safety features that are subjected to full-scale vehicle crash testing. The CAD details used to describe the as-tested systems or components are not always prepared and presented in the same format as now required by AASHTO TF 13 and FHWA. As such, additional CAD details and background information must be prepared when FHWA acceptance is sought under MASH or when the new system or associated components are submitted for inclusion in the electronic version of the barrier hardware guide.

Objective: For all new barrier hardware, the member states request that MwRSF seek formal FHWA acceptance and placement of standardized TF-13 CAD details in the electronic version of the highway barrier guide. This funding shall be used to supplement the preparation of the TF-13 format CAD details.

**Tasks:**

1. Prepare CAD details for Hardware Guide

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

Updated drawings based on comments received at the AASHTO TF-13 Spring meeting held in April 2012.

**Anticipated work next quarter:**

Continue to update drawings based on comments received at the AASHTO TF-13 Spring meeting held in April 2012.

**Significant Results:**

This project is used to supplement the preparation of the TF-13 format CAD details. Previously, it was determined that there are 14 systems and 11 components that need to be prepared in the TF-13 format. During discussions with the AASHTO TF-13 subcommittee in July 2011, new components had to be generated from the existing system drawings. Thus, the original 11 components became 32. Two of the systems and one component had limited work that need to be completed on the drawings as they were to be included in the Bridge Rail Guide and Luminaire Guide, respectively.

In evaluating the separation of the components, it was determined that some could be combined into one drawing based on the same type of component, but just one varying parameter.

Summary of Barrier Guide individual drawings to date:

- 31 systems - 25 approved, 6 to be reviewed
- 41 components - 15 approved, 26 to be reviewed
- 2 systems submitted to Bridge Rail Guide
- 1 component submitted to Luminaire Guide

Task	% Complete
1. Prepare CAD details for Hardware Guide	100%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

Funding from Project No.: RPPF-11-TF-13 – TPF-5(193) Supplement #38, Project Title: Annual Fee to Finish TF-13 and FHWA Standard Plans used prior to starting this project.

At the present time, standard TF13-format CAD details are now required and subjected to review and comment by TF 13 members. This review is taking place during the TF-13 meetings which occur twice a year. After the initial review, the drawings are edited and then reviewed again at a later meeting. Once the CAD details are deemed acceptable and meet TF 13 guidelines, they are integrated into the electronic, web-based, version of the existing barrier hardware guide. Consequently, it requires a minimum of 6 months to get a drawing accepted for inclusion in the hardware guide; that is if there are only minimal edits to be made to the drawing. Sometimes, TF-13 requires a second review and more edits, thus adding another 6 months on to the time for its acceptance. For example, five (5) of the 13 systems were submitted for review during the September 2010 meeting. However, the allotted time only allowed the review of three (3) of the systems. The other two (2) were reviewed during the May 2011 meeting. Thus, some drawings may be in the review state at TF-13 for over a year before they are even looked at for the first time.

TF-13 is in the process of developing an online review system which will expedite the review process and allow more systems to be reviewed prior to their semi-annual meetings. Then at the TF-13 meetings it will be a final review and vote on if the drawings are ready to be implemented into the online guide.

**Potential Implementation:**

Newly-developed highway safety hardware will be contained in the electronic, web-based guide, thus promoting the standardization of barrier hardware across the U.S. and abroad.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Midwest Roadside Safety Facility, UNL

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> <p style="text-align: center;">SPR-3(017) Supplement #49</p>		<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input checked="" type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">MGS Implementation (Year 18)</p>			
<b>Name of Project Manager(s):</b> Reid, J.D., Sicking, D.L., & Faller, R.K.		<b>Phone Number:</b> 402-472-6864 (Faller)	<b>E-Mail</b> rfaller1@unl.edu
<b>Lead Agency Project ID:</b> RPF-08-07 (2611120095008)	<b>Other Project ID (i.e., contract #):</b> SPR-3(017) Supplement #49	<b>Project Start Date:</b> September 1, 2007	
<b>Original Project End Date:</b> December 31, 2009	<b>Current Project End Date:</b> December 31, 2011	<b>Number of Extensions:</b> 3	

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$15,928 (original)	\$10,966	75%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$584 (3.7%)	\$584	75%



**Project Description:**

This project consists of MGS implementation assistance and guidance for the Pooled Fund member states. Four general categories were initiated for the MGS. They are as follows:

Task	% Completed
Standard, Half, and Quarter Post Spacing	100
MGS with Curbs and MGS with 2:1 Slopes	100
MGS with Culvert Applications	100
MGS Stiffness Transition	5

In 2007, Pooled Fund consulting funds were used to assist states with the MGS implementation effort. MwRSF began the effort with a review of CAD details from the Illinois and Washington DOTs. Project correspondence occurred via email with a pre-determined Technical Working group. To date, three subject areas were covered and are as follows: (1) Standard, Half, and Quarter Post Spacing; (2) MGS with Curbs and MGS on 2:1 Slopes; and (3) MGS with Culvert Applications. A fourth category, MGS Stiffness Transition, was delayed in order to await the completion of a simplified, steel-post and wood-post approach guardrail transition.

The final reporting of the simplified, steel-post, approach guardrail transition system attached to the MGS was completed in the Fourth Quarter of 2010. The final reporting of wood post R&D effort was completed in November 2011, including dynamic bogie post testing and Barrier VII analysis. The MGS implementation activities commenced in the 1st Quarter of 2012 with the updating of the discussion group members and request for MGS standards for each State DOT.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

The MGS implementation activities commenced in the 1st Quarter of 2012 with the updating of the discussion group members and request for MGS standards for each State DOT.

**Anticipated work next quarter:**

The MGS implementation continued in the First Quarter of 2012 after the simplified, wood-post transition report was finalized on November 28, 2011. The project will be extended into the Fall of 2012 in order to complete this discussion.

**Significant Results:**

To date, MwRSF has provided review and comment regarding the MGS standard plans for Washington, Illinois, Kansas, and Nebraska and for 3 out of 4 categories. Since this effort began several years ago, the first three categories will be re-reviewed as many more states are actively preparing and updating MGS details.

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

A 3-month project extension is requested to complete the discussion on MGS implementation. The requested extension would cover through September 30, 2012.

**Potential Implementation:**

MwRSF's review and comment has assisted several State DOTs with the advance implementation of the MGS.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> <p style="text-align: center;">TPF-5(193) Suppl. #50</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Annual Consulting Services Support</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Ron Faller, John Reid, Bob Bielenberg</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-9064</p>	<b>E-Mail</b> <p style="text-align: center;">rbielenberg2@unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">2611211070001</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">RPF-12-CONSULT</p>	<b>Project Start Date:</b> <p style="text-align: center;">7/1/2011</p>
<b>Original Project End Date:</b> <p style="text-align: center;">6/30/14</p>	<b>Current Project End Date:</b> <p style="text-align: center;">6/30/14</p>	<b>Number of Extensions:</b> <p style="text-align: center;">0</p>

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$39,992.00	\$28,258.00	75%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$12,047.00	

**Project Description:**

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 will now be accessible on a MwRSF Pooled Fund Consulting web site.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

In the past quarter MwRSF has responded to a series of state inquiries. The Quarterly Progress Report summarizing these responses has NOT been attached to this document. It will be submitted at a later date once security issues with the web server noted below are addressed. At that time, it will also be available for download at the recently completed MwRSF Pooled Fund Consulting web site - <http://mwrsf-qa.unl.edu/>

MwRSF completed development of a web site for the consulting effort . This web site allows the states to submit problems directly to the web site. MwRSF responds to the consulting problems through the web site, and the problems and responses are archived in a searchable database. The site has a complete archive of consulting responses.

We would ask that all Pooled Fund member states use the new site from this point forward for their inquiries.

It should be noted that some issues with the web site involving the search function and attachment of files were identified in this quarter. These issues were sent to the web site developers and have been addressed. In addition to these issues, the server housing the MwRSF Pooled Fund Consulting web site was hacked in mid June and the web site was taken offline to fix the security breach. The web site will be put back online once the server security issues are alleviated. Due to the security issues the quarterly summary is not available at this time and will be submitted at a later date.

**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/>

**Significant Results:**

A quarterly summary of the consulting effort will be provided at a later date.

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

None.

**Potential Implementation:**

None.

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> <p style="text-align: center;">TPF-5(193) Suppl. #51</p>	<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Annual LS-DYNA Modeling Enhancement Support</p>		
<b>Name of Project Manager(s):</b> <p style="text-align: center;">Reid, Sicking, Faller, Bielenberg</p>	<b>Phone Number:</b> <p style="text-align: center;">402-472-3084</p>	<b>E-Mail</b> <p style="text-align: center;">jreid@unl.edu</p>
<b>Lead Agency Project ID:</b> <p style="text-align: center;">RPF-12-LSDYNA</p>	<b>Other Project ID (i.e., contract #):</b> <p style="text-align: center;">2611211071001</p>	<b>Project Start Date:</b> <p style="text-align: center;">July 1, 2011</p>
<b>Original Project End Date:</b> <p style="text-align: center;">June 30, 2014</p>	<b>Current Project End Date:</b> <p style="text-align: center;">June 30, 2014</p>	<b>Number of Extensions:</b> <p style="text-align: center;">0</p>

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$36,543	0	0

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
0	0	0



**Project Description:**

This is a continuation of TPF-5(193) Suppl.#37, "Annual LS-DYNA Modeling Enhancement Support" and thus, no progress to report until funds are exhausted in that project.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

**Anticipated work next quarter:**

**Significant Results:**

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

**Potential Implementation:**

## TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <p style="text-align: center;">TPF-5(193) Supplement #52</p>		<b>Transportation Pooled Fund Program - Report Period:</b> <input type="checkbox"/> Quarter 1 (January 1 – March 31) <input checked="" type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 4 – December 31)	
<b>Project Title:</b> <p style="text-align: center;">Deflection of Curved Runs of Cable Guide Under MASH TL-3 Impact - Retest</p>			
<b>Name of Project Manager(s):</b> Faller, Sicking, Reid, Lechtenberg, Bielenberg		<b>Phone Number:</b> 402-472-9070	<b>E-Mail</b> kpolivka2@unl.edu
<b>Lead Agency Project ID:</b> 2611211074001		<b>Other Project ID (i.e., contract #):</b>	<b>Project Start Date:</b> 12/15/11
<b>Original Project End Date:</b> 12/31/12		<b>Current Project End Date:</b> 12/31/12	<b>Number of Extensions:</b>

Project schedule status:

On schedule     
  On revised schedule     
  Ahead of schedule     
  Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$58,350	\$22,014	80

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	\$22,014	

**Project Description:**

This project was additional funding to retest the 440-ft radius system with the modified top cable height. The original project was TPF-5(193) Supplement #30, Lead Agency Project ID: 2611211054001.

Tasks of original project:

1. Prepare CAD details of 360-ft radius system
2. Construct 360-ft radius system
3. Full-scale test of 360-ft radius system (modified MASH 3-11)
4. Prepare CAD details of 440-ft radius system
5. Construct 440-ft radius system
6. Full-scale test of 440-ft radius system (modified MASH 3-11)
7. Analysis and documentation of test results
8. Draft and final research reports
9. Additional crash investigation and energy dissipation analysis
10. Draft and final report for additional analysis

Tasks for additional work added to original project:

11. Prepare CAD details of modified 440-ft radius system
12. Construct modified 440-ft radius system
13. Full-scale test of modified 440-ft radius system (modified MASH 3-11)

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

On April 26, 2012, MwRSF conducted one pickup crash test (test no. NYCC-3) into a 440-ft radius curved cable system with a 29-in. top cable height using a 2270-kg Dodge QuadCab according to the modified TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected. Data analysis of the third test was completed.

A draft report of the testing continued to be written.

Energy dissipation estimations continued utilizing the results from both tests. Additional items of potential energy dissipation were investigated. A draft report of the additional energy dissipation analysis continued to be written.

**Anticipated work next quarter:**

A draft research report of the testing will be completed. Internal review of the draft report will be initiated.

Energy dissipation estimations will be completed utilizing the three test results and prior component testing as well as developing reasonable estimates for the barrier-vehicle friction and vehicle damage. A draft research report of the energy analysis will continue to be written.

**Significant Results:**

On August 2, 2011, MwRSF conducted one pickup crash test (test no. NYCC-1) into a 360-ft radius curved cable system according to the modified TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected. On November 1, 2011, MwRSF conducted one pickup crash test (test no. NYCC-2) into a 440-ft radius curved cable system according to the modified TL-3 safety performance guidelines of MASH. The pickup was not contained nor redirected. Following the failed test of the 440-ft radius system, the NYSDOT decided to retest a modified system with a 2 in. higher top cable. On April 26, 2012, MwRSF conducted one pickup crash test (test no. NYCC-3) into a 440-ft radius curved cable system with a 29-in. top cable height according to the modified TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected.

Tasks:	% Completed
1. Prepare CAD details of 360-ft radius system	100%
2. Construct 360-ft radius system	100%
3. Full-scale test of 360-ft radius system (modified MASH 3-11)	100%
4. Prepare CAD details of 440-ft radius system	100%
5. Construct 440-ft radius system	100%
6. Full-scale test of 440-ft radius system (modified MASH 3-11)	100%
7. Analysis and documentation of test results	100%
8. Draft and final research reports	65%
9. Additional crash investigation and energy dissipation analysis	60%
10. Draft and final report for additional analysis	20%
11. Prepare CAD details of modified 440-ft radius system	100%

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

The warmer temperatures during the 4th Quarter of 2010 and 1st Quarter of 2011 melted the snow and thawed the soil surface, thus resulting in a muddy work environment not conducive to post installation. In addition, the spring rains came early. Rains continued through the 2nd Quarter of 2011 and the wet conditions made construction quite difficult.

With the unsuccessful second test, NYSDOT requested a retest with raising the top cable height 2 inches. An addition to the original proposal was filed.

Funds for the original project, TPF-5(193) Supplement #30, Lead Agency Project ID: 2611211054001, have been exhausted. All further work will be conducted under this additional funding project.

**Potential Implementation:**

This will provide justification for limits that have been placed on the amount of curvature that could be used for a given post spacing for a curved cable system since operating speeds on freeways have continued to increase and vehicle weights have continued to grow. In addition, it will allow the New York State Department of Transportation to provide information to help the New York State Police performing accident reconstructions, particularly as it relates to determining impact speeds, such as how much energy is absorbed in the process of deforming a standard weak post.