NEBRASKA

Good Life. Great Journey.

DEPARTMENT OF TRANSPORTATION

Nebraska Research Work Program

Fiscal Year 2023

July 1, 2022
to
June 30, 2023

NEBRASKA
DEPARTMENT OF TRANSPORTATION
ORGANIZATION CHART

1-13-2022

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		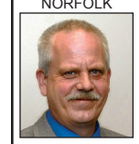	
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MATERIALS & RESEARCH DIVISION ORGANIZATIONAL CHART
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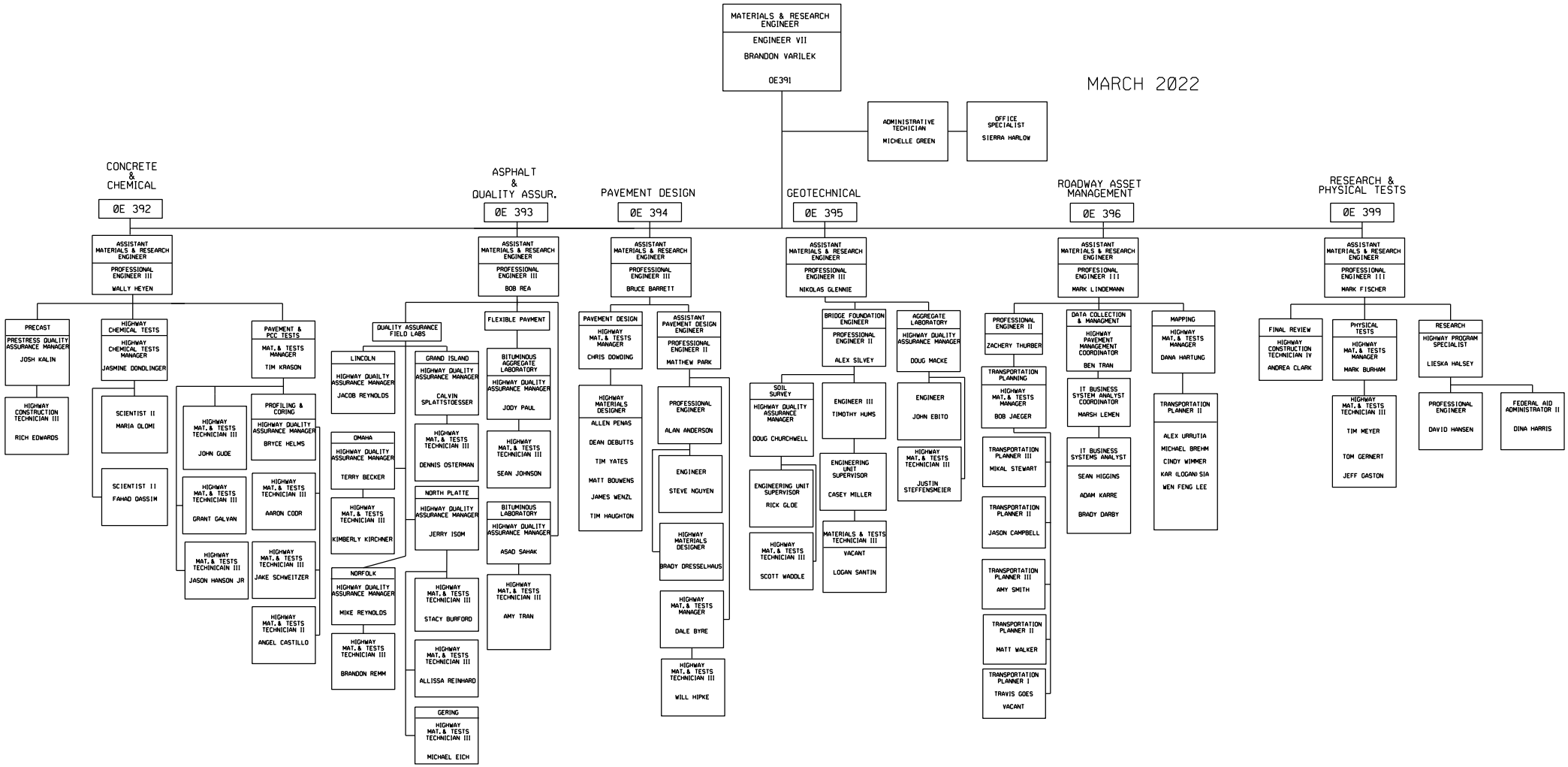
MARCH 2022



Research Section Mission

Mission/Objective

To coordinate the departments Research Program, with the following primary objectives:

- Reduce the costs of construction and maintenance.
- Improve the quality of service to the highway users.
- Increase the efficiency of highway planning, operations, and administration.
- Reduce crashes and crash severity.
- Encompass the interrelationship of socioeconomic, environmental, and technical factors into the transportation system; and implement favorable findings into departmental procedures and processes.

Typical NDOT Federally Funded Research Cycle

Accomplishments FY-2022 to date

- ✓ In July to September 2021, the solicitation for Statements of Need was made to the entire State of Nebraska for FY-2023 funding
- ✓ Forty-two (42) Statements of Needs were Submitted
- ✓ WebEx-virtual meeting were hosted by each focus group in early October; with over 125 attendees including Nebraska Department of Transportation personnel, industry leaders, city and county representatives and the Statement of Need presenters;
  - Materials, Pavements, Maintenance and Construction
  - Traffic, Safety, Planning and Technology
  - Structures and Geotechnical
  - Roadway, Hydraulics and Environmental

  - o The Nebraska Transportation Research Council (NTRC) prioritized the Statements of Need in each focus group. NDOT Research Staff requested research proposals for nineteen (19) Statements of Need.
  - o November 1st through December 3rd, 2021, NDOT's Research Section organized and held 19 framework review meetings placing technical experts with the researchers to develop a proposal to help accomplish the department's mission.
  - o On January 28, 2022, NDOT's Research Section conducted the RAC meeting and added thirteen (13) new SPR projects with a total budget of $1,730,499.
  - o NDOT expended approximately $1,240,536 in FY-2022 for all on-going research projects and provided financial support to TRB and NCHRP.

Accomplishments FY-2022 to date

- ✓ Throughout the year, the Research Staff has held numerous Technical Advisory Committee meeting on in progress and completed research. To date NDOT hosted 50 update meetings in this fiscal year.
- ✓ NDOT continues to be the lead state for the Midwest States Regional Pooled Fund Program - TPF-5(193) is in the process of closing and TPF-5(430) is in its third year for research.
- ✓ Complete and distribute the NDOT Research Hub Issue 2 via the research section website to all States, Federal Highway Administration, Nebraska Transportation Research Council Members, Research Advisory Committee Members and NDOT Divisions and Districts.
- ✓ Completed 8 Projects
- ✓ Updated Research Program Manual

Research Work Program Goals FY-2023

- ✓ Establish the FY-2024 research program.
- ✓ Monitor research projects and assist Technical Advisory Committees.
- ✓ Assist with implementation of research results and added the completed projects a SharePoint site for their follow up
- ✓ Work closely with our principal investigators on:
  - o Submission of quarterly reports and final reports
  - o Presentations to department personnel
- ✓ Administration of the Regional Pooled Fund Program activities, which are conducted at the University of Nebraska—Midwest Roadside Safety Facility.
- ✓ Compile an Annual Work Program Report to be distributed via the research section website to the public.
- ✓ Continue to collect implementation plans from the lead technical advisory committee member and ask for technology transfer from Principal Investigators. Distribute, collect, and publish evaluations on each completed project.
- ✓ Look to select a rapid response research project for the program.
- ✓ Investigate a research program management software tool.

TPF-5(193) CONTROL NO.: 00778				
SUPPLEMENT NUMBER	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
CURRENT PROJECTS				
#128	Dynamic Testing and Evaluation of a New York State DOT Transition between Boxed Guardrail Under AASHTO MASH 2016 TL-3 Guidelines	$236,626	$208,884	$27,742
#133	CALTRANS LS-DYNA Simulation Consulting Support	$31,391	$2,719	$28,672
#134	NYSDOT MASH 2016 Safety Hardware Evaluations - Phase 1	$955,951	$540,174	$415,777
#135	MASH 2016 Safety Hardware Evaluation	$1,033,463	$478,132	$555,331
#142	NDOT Generic End Terminal - Phase II	$325,393	$194,503	$130,890
#144	Midwest Pooled Fund MASH Hardware Clearinghouse	$51,206	$3,058	$48,148
#145	NDOT Q & A Improvements	$30,852	$14,933	$15,919
#146	Revision to Midwest Pooled Fund Q & A Website	$49,745	$18,803	$30,942
#151	Development of an Optimized MASH TL-4 Kansas Corral Rail	$401,400	$280,578	$120,822
#152	MASH 2016 Safety Hardware Evaluation - Phase 1	$1,239,301	$350,274	$638,429
#154	MASH Testing of Single Sign Support	$750,000	$228,240	$521,760
		$5,105,328	$2,320,297	$2,534,433

1. Budget Numbers as of 3/31/2022
2. Budget shows expenses that may not be entered into FMIS
3. Only active projects are shown. Supplements which have been completed are not shown

TPF-5(430) CONTROL NO.: 01010				
SUPPLEMENT NUMBER	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
CURRENT PROJECTS				
#1	RPFP-20-MGS-2: MGS with Reduced Embedment and Post Spacing over Low-Fill Culverts (Indiana)	$185,912	$45,484	$143,783
#2	PFP-20-AGT-1: Additional Retrofit Options for Post Conflicts within AGTs (New Jersey)	$251,429	$58,583	$243,307
#3	Guidelines for Flaring Thrie-Beam Approach Guardrail Transitions - Phase II	$302,783	$167,709	$258,162
#4	RPFP-2--TERM-1: Further Evaluation of the End Terminals Adjacent to Curb (New Jersey)	$257,208	$40,390	$241,947
#5	RPFP-20-SR-1: Development of a Short-Radius Guardrail for Intersecting Driveways or Roadways (New Jersey)	$251,032	$34,687	$249,162
#6	RPFP-20-CONSULT: Annual Consulting Services Support	$60,647	$35,206	$53,278
#7	RPFP-20-PFCHS: Pooled Fund Center for Highway Safety	$14,330	$14,330	$5,424
#8	RPFP-20-LS-DYNA: LS-DYNA Modeling Enhancement Support	$30,616	$30,616	$30,616
#9	Contingency FY20 (PF Yr 30) - Year 1	$11,043	$0	$11,043
#15	RPFP-21-CABLE-1: Redesign of the High-Tension Cable Median Barrier – Phase II	$253,893	$0	$253,893
#16	RPFP-21-CONC-2: Anchoring Temporary Barrier to Asphalt Pavement Phase II (Wisconsin)	$224,325	$3,945	$220,380
#17	RPFP-21-CONC-3: MASH TL-3 Portable Barrier System (Nebraska/Wyoming)	$148,296	$3,992	$144,304
#18	RPFP-21-AGT-1: Approach Guardrail Transition behind Curb and Elevated Sidewalk (Indiana)	$146,141	$4,695	$141,446
#19	RPFP-21-AGT-3: Guidelines for Flaring Thrie-Beam Approach Guardrail Transitions - Phase III (Continuation)	$121,307	$0	$121,307
#20	RPFP-21-SIGN-1: Breakaway Systems for Ground-Mounted, Large Steel Sign Support Structures (New Jersey)	$77,740	$0	$77,740
#21	RPFP-21-POLE-1: Breakaway Pole Research (Wisconsin)	$269,455	$2,011	$267,444
#22	RPFP-21-CONSULT: Annual Consulting Services Support	$61,446	$0	$61,446
#23	RPFP-21-MPFW: Midwest Pooled Fund Website	$18,573	$1,148	$17,425
#24	RPFP-21-LS-DYNA: LS-DYNA Modeling Enhancement Support	$43,823	$0	$43,823
#25	Contingency FY21 (PF Yr 31) - Year 2	$1	$0	$1
		$2,730,000	$442,797	$2,585,929

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TPF-5(430) CONTROL NO.: 01010				
SUPPLEMENT NUMBER	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
NEW PROJECTS				
#27	FY22-IND-1-PCB: MASH 2016 TL-3 Design and Evaluation of the Indiana F-Shape PCB in Free-Standing, Asphalt Anchored Configurations, and Transitions	$530,131	$0	$530,131
#28	RPFP-FY2022-MGS-4: Evaluation of Increased Blockout Depth with the Midwest Guardrail System	$262,851	$0	$262,851
#29	RPFP-FY2022-MGS-5: Surface Mounted Strong-Post MGS	$217,840	$0	$217,840
#30	RPFP-FY2022-AGT-3: Median Approach Guardrail Transition to Concrete Median Barrier	$233,888	$0	$233,888
#31	RPFP-FY2022-WZ-2: MASH TL-3 Portable Barrier System – Phase II	$331,619	$0	$331,619
#32	RPFP-FY2022-WZ-3: Midwest PCB – Anchored Median Installations	$155,262	$0	$155,262
#33	RPFP-FY2022-CONSULT: Annual Consulting Services Support	$65,000	$0	$65,000
#34	RPFP-FY2022-MPFW: Midwest Pooled Fund Website	$12,111	$0	$12,111
#35	RPFP-FY2022-LS-DYNA: LS-DYNA Modeling Enhancement Support	$40,000	$0	$40,000
#36	Contingency FY22 (PF Yr 32) - Year 3	$46,459	$0	$46,459
		$1,895,161	$0	$1,895,161

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Pooled Fund Participation Summary and Transfers (100% Federally Funded)			
Study Titles	Funding Type	Expenditures Last Year (FY22)	Budget Program Year (FY23)
TPF-5(317) Evaluation of Low Cost Safety Improvements	Z560	$5,000	$5,000
TPF-5(326) Develop and Support Transportation Performance Management Capacity Development Needs for State DOT's	Z560	$147,000	$0
TPF-5(347) Development of Maintenance Decision Support System	Z560	$30,000	$30,000
TPF-5(353) Clear Roads Phase II [Changed to TPF-5(479)]	Z560	$25,000	$0
TPF-5(372) Building Information Modeling (BIM) for Bridges and Structures	Z560	$20,000	$25,000
TPF-5(430) Midwest Roadside Safety Pooled Fund Program	Z560	$65,000	$65,000
TPF-5(432) Bridge Element Detrioration for Mid-west States	Z560	$20,000	$20,000
TPF-5(437) Technology Transfer Concrete Consortium	Z560	$12,000	$12,000
TPF-5(438) Smart Work Zone Deployment Initiative	Z560	$25,000	$25,000
TPF-5(447) Traffic Control Device Consortium	Z560	$15,000	$15,000
TPF-5(448) Improving Specifications to Resist Frost Damage in Modern Concrete Mixes	Z560	$20,000	$20,000
TPF-5(451) Road Usage Charge West	Z560	$25,000	$25,000
TPF-5(456) EconWorks - Improved Economic Insight	Z550	$4,000	$4,000
TPF-5(465) Consortium for Asphalt Pavement Research and Implementation (CAPRI)	Z560	$10,000	$10,000
TPF-5(467) Project Management Software for Research	Z560	$3,500	$46,000
TPF-5(479) Clear Roads Winter Highway Operations Phase III	Z560	$0	$25,000
TPF-5(480) Building Information Modeling (BIM) for Infrastructure	Z560	$60,000	$30,000
Solicitation 1536-Guidelines for Determining Traffic Signal Change and Clearance Intervals	Z560	$30,000	$30,000
Pooled Fund Total		$516,500	$382,000
Transportation Research Board (TRB) Annual Transfer	Z560	$92,657	$94,000
National Cooperative Highway Research Program (NCHRP) Annual Transfer	Z560	$341,839	$377,000
Total		$950,996	$853,000

IN-PROGRESS PROJECTS					
SPR-P1(20) CONTROL NO.: 00730L					
PROJECT NUMBER	FUNDING TYPE	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
CURRENT ACTIVE PROJECTS					
M087	Z560	Design Optimization and Monitoring of Joint-less Integral and Semi-integral abutment bridges in Nebraska	$167,687	$163,583	$4,104
M102	Z560	Phase Construction Bridges: Monitoring and Analysis for Traffic-Induced Vibration	$117,482	$94,111	$23,371
M103	Z560	Simple for Dead Continuous for Live (SDCL) Steel Girder Bridges with UHPC and GFRP	$132,358	$121,604	$10,754
M104	Z560	Data-Driven Prioritization and Empirical Predictions for Bridge Scour in Nebraska	$115,662	$71,650	$44,012
M107	Z560	Outdoor Laboratory and Testbed for Bridge health	$115,074	$72,574	$42,500
M115	Z560	Research on High-RAP Mixtures with Rejuvenators - Field Implementation	$99,950	$90,374	$9,576
M116	Z560	*Effect of Antioxidant Additives and Restorations on Performance of Asphalt Binders and Mixtures – Phase I	$428,662	$113,234	$315,428
BUDGET FOR IN PROGRESS SPR-P1(20) PROJECTS			$1,176,875	$727,129	$449,746
P100	Z560	Contingencies	$678,826	$40,406	$638,420
P088	Z560	Administration	$6,000		$6,000
P089	Z560	Research Implementation	$50,000		$50,000
TOTAL BUDGET FOR SPR-P1(20)			$1,911,701	$767,535	$1,144,166

ALL EXPENDITURES TO-DATE FOR SPR-P1(20)	Total	Federal	State
	$3,365,191	$2,692,152	$673,038

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IN-PROGRESS PROJECTS						
CONTROL NUMBER	PROJECT NUMBER	FUNDING TYPE	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
01021	FY21(001)	Z560	An Investigation of Water Obstructions and Related Weather Conditions for Nebraska Roadways	$164,700	$89,640	$75,060
01021A	FY21(002)	Z560	Development of Guideline for the Use of Geosynthetics in Different Roadway Layered System in Nebraska	$106,536	$84,922	$21,614
01021B	FY21(003)	Z560	Effect of Antioxidant Additives and Recycling Agents on Performance of Asphalt Binders and Mixtures – Phase II	$145,238	$33,070	$112,168
01021C	FY21(004)	Z560	Approach Guardrail Transition Retrofit to Existing Concrete Parapets and Bridges	$87,978	$29,153	$58,825
01021D	FY21(005)	Z560	UHPC Decked I-Beam for Accelerated Bridge Construction	$98,250	$61,248	$37,002
01021E	FY21(006)	Z560	Rapid Concrete Bridge Repair Survey and Patch Material Evaluation	$93,572	$20,696	$72,876
01021F	FY21(007)	Z560	Intelligent Work Zone Using Automatic Queue Detection (AQD) Systems	$159,466	$100,365	$59,101
01021G	FY21(008)	Z560	Estimating System and Traveler Costs Due to Lane Closures During Construction and Maintenance Operations	$179,500	$148,574	$30,926
01021H	FY21(009)	Z560	Energy Dissipation Optimization for Circular Culverts	$107,088	$97,763	$9,325
01021J	FY21(010)	Z560	Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support	$164,927	$35,089	$129,838
01021K	FY21(011)	Z560	Establishment of Wildflower Islands to Enhance Roadside Health, Ecological	$171,275	$116,996	$54,279
01034A	FY22(001)	Z560	Low-Cement Concrete Mixture for Bridge Decks and Rails	$112,394	$0	$112,394
01034B	FY22(002)	Z560	Nebraska Balanced Mix Design	$138,937	$437	$138,500
01034C	FY22(003)	Z560	WMA Short Term Aging	$140,616	$0	$140,616
01034D	FY22(004)	Z560	Erosion Resistant Rock Shoulder	$142,907	$37,994	$104,913
01034E	FY22(005)	Z560	Application of Remote Sensing and Hydrologic Modeling to Reduce Highway Flooding in the Nebraska Sandhills	$143,166	$24,732	$118,434
01034F	FY22(006)	Z560	Evaluation of NDOT's Sediment Barrier Practices Using Performance Data	$191,099	$0	$191,099
01034G	FY22(007)	Z560	Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support - Phase II	$219,556	$1,028	$218,528
01034H	FY22(008)	Z560	Production of Cast-in-Place UHPC for Bridge Applications	$83,996	$18,897	$65,099
01034J	FY22(009)	Z560	Accelerated Bridge Construction Decision Tool	$90,592	$0	$90,592
01034K	FY22(010)	Z560	Application of Steel Sheet Piles for the Abutment of Water-crossing Bridges in Nebraska	$155,304	$62,388	$92,916
01034L	FY22(011)	Z560	Truck Platooning Effects on Girder Bridges - Phase II	$120,843	$17,009	$103,834
01034M	FY22(012)	Z560	Inventory, Operations and Safety at Free Right-Turn Ramps	$182,563	$32,941	$149,622
BUDGET FOR IN PROGRESS PROJECTS				$3,200,503	$1,012,943	$2,187,560

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FY2023 RESEARCH PROGRAM						
CONTROL NUMBER	PROJECT NUMBER	FUNDING TYPE	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
NEW PROJECTS						
01046A	FY23(013)	Y560	High-Mast Tower Foundation – Phase II	$153,428	$0	$153,428
01046B	FY23(014)	Y560	Gravel Road Performance Enhancements	$166,064	$0	$166,064
01046C	FY23(015)	Y560	Application of Cementitious Materials and Fiber Reinforcement to Enhance Lime Stabilization for Nebraska Shale Soils	$142,129	$0	$142,129
01046D	FY23(016)	Y560	Nebraska Balanced Mix Design – Phase II	$141,914	$0	$141,914
01046E	FY23(017)	Y560	Development of the Nebraska Department of Transportation Winter Severity Index – Phase II	$183,603	$0	$183,603
01046F	FY23(018)	Y560	Updating rainfall zones and intensities in Nebraska for improved design of non-bridge sized drainage structures: Phase I	$120,000	$0	$120,000
01046G	FY23(019)	Y560	Minimizing take of threatened rattlesnakes and optimizing project review in SE Nebraska	$62,238	$0	$62,238
01046H	FY23(020)	Y560	A Statewide Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archeological Deposits in Nebraska: (PHASE III-The Sandhills Region)	$120,130	$0	$120,130
01046J	FY23(021)	Y560	Impacts of Stream Bed Adjustments on Local Stream Morphology at Bridge Crossings	$134,860	$0	$134,860
01046K	FY23(022)	Y560	Air-coupled GPR and HD Imaging for High-Speed Evaluation of Concrete Bridge Decks with Asphalt Overlays	$166,897	$0	$166,897
01046L	FY23(023)	Y560	Statewide StreamStats Web Toll for Estimating Streamflow Statistics	$74,600	$0	$74,600
01046M	FY23(024)	Y560	Repair/Preservation of Concrete Bridges Using Ultra-High-Performance Concrete (UHPC)	$80,007	$0	$80,007
01046N	FY23(025)	Y560	Modeling Pedestrian and Bicyclist Crash Exposure with Location-Based Service Data	$184,629	$0	$184,629
BUDGET FOR NEW PROJECTS				$1,730,499	$0	$1,730,499

OTHER PROGRAM ITEMS						
CONTROL NUMBER	PROJECT NUMBER	FUNDING TYPE	STUDY TITLES	TOTAL STUDY BUDGET	EXPENDITURES	REMAINING BUDGET
TBD	TBD	Y560	Rapid Response Research	$180,000	$0	$180,000
TBD	TBD	Y560	Travel/Training[2]	$3,000	$0	$3,000
TOTAL BUDGET				$1,913,499	$0	$1,913,499

1. Budget Numbers as of 3/31/2022
2. Travel or training necessary for performance/administration of the SPR funded work. This will be to attend national meetings/trainings for adminsitration of the SPR program.

IN PROGRESS PROJECTS

PROJECT NUMBER	M087
PROJECT TITLE	Design Optimization and Monitoring of Joint-less Integral and Semi-Integral Abutment Bridges in Nebraska
PRINCIPAL INVESTIGATOR	Chungwook Sim, Jongwon Eun, and Seunghee Kim – UNO, Chung Song – UNL
PROJECT START DATE	7/1/2018
PROJECT COMPLETION DATE	8/15/2021
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Mike Vigil, Steve Sabra, Lynden Vanderveen, and David Mraz-FHWA
PROJECT TOTAL COSTS	$167,687
PROJECT EXPENDITURES TO DATE	$163,583
NUMBER OF EXTENSIONS GRANTED	Two (2)
PERCENTAGE OF PROJECT COMPLETE	98%
STATUS	Behind Schedule- Working Draft Report
FY-2023 BUDGET	$4,104
FY-2023 TASKS TO BE COMPLETED	Task 2

Background: There are more than 9,000 integral abutment bridges and 4,000 semi-integral abutment bridges in the U.S., which increased dramatically in the past two decades (White 2nd, 2007). Nebraska is no exception – there are hundreds of integral and semi- integral abutment bridges in the state of Nebraska, and thus guidelines and specifications for these structures listed on the Bridge Office Policies and Procedures (BOPP, 2016). The obvious advantage of using integral abutment bridges is their reduced construction and maintenance costs by eliminating bearings and expansion joints that make the bridge “joint-less”. This also fits well with Nebraska's "well-timed" bridge preservation practice of eliminating problems before they occur. Despite the wide acceptance in usage (more than 40 States are using integral abutment bridges) and the advantage listed above, integral and semi-integral abutment bridges are often built with specific limitations under each State’s bridge design manuals; and the design primarily relies on limited empirical data. Noticeably, small numbers of problems were reported because these bridges were built within limitations of specific skew angles, pile types, span lengths, and construction practices to name a few.

Objective: The research objective of this project is to monitor the integral and semi-integral abutment bridges in Nebraska to: 1) obtain data for future design and construction practices for wider applications (longer spans, increased skew angles, improve design details in connections), 2) thoroughly understand the complex long-term behavior of soil-structure interactions (interaction between deck/abutment connection, soil/pile behavior both in integral and semi-integral bridges, backfill/abutment), and 3) better maintain existing structures (repair and strengthen if needed). Our multidisciplinary team of structural and geotechnical engineers will carefully investigate the loads produced in abutments over the Nebraska integral abutment bridges, measure the load displacement of piles with fiber optic sensing, examine ratcheting effects (passive pressure increase and inward residual displacement) and voids or settlement under approach span of these structures.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review/Field Investigation	$13,333	100%
Task 2: Field Instrumentation/Monitoring	$97,262	98%
Task 3: Numerical Simulation	$42,810	100%
Task 4: Design Recommendations	$14,282	100%

Deliverables: The end results of this research project will be the design and construction recommendations that can be integrated statewide or countywide for joint-less integral and semi integral abutment bridges. The recommendations will be incorporated into the NDOT BOPP manual as well as the NDOT Standard Specifications for Highway construction, which can be used for statewide and countywide implementation. The project staff intends to work with NDOT and Nebraska counties to ensure successful adoption and implementation. It is also anticipated that these recommendations will directly influence the maximum span lengths, skew angles, design considerations, and details outlined by the FHWA Technical Advisory.

Performance & Goals: Project has an approved extension request and is up to date on revised tasks and schedule.

PROJECT NUMBER	M102
PROJECT TITLE	Phased Construction Bridges Monitoring and Analysis for Traffic-Induced Vibration
PRINCIPAL INVESTIGATOR	Christine Wittich and Richard Wood – UNL, and George Morcous – UNO
PROJECT START DATE	7/1/2019
PROJECT COMPLETION DATE	5/31/2021
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber and David Mraz-FHWA
PROJECT TOTAL COSTS	$117,482
PROJECT EXPENDITURES TO DATE	$94,111
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	99%
STATUS	Behind Schedule-Draft Report Submitted
FY-2023 BUDGET	$23,371
FY-2023 TASKS TO BE COMPLETED	Tasks 4

Background: Due to the current state of deteriorating infrastructure in the region and country, the number of bridges in the state and in the country in need of replacement is expected to increase. However, the complete closure of a traffic route to allow for the construction of a new bridge is often not feasible -particularly in rural Nebraska, in which truck traffic is limited to few routes and is critical to the economic vitality of the state. To address this need and reduce detours, phased (staged) construction has become a very prevalent practice for bridge replacement, which allows the bridge to remain partially open to traffic throughout construction. While phased construction can be interpreted as a very broad term, herein it is defined as the situation where one segment of the bridge is constructed adjacent to an existing segment. Typically, the number of traffic lanes is reduced to allow for partial demolition of the bridge. Then, a new segment of the bridge is constructed -termed the first phase. Once traffic is re-routed to the new segment, the remaining bridge is demolished and replaced -the new construction termed he second phase. In most situations, rebar extends from the first phase deck and is spliced to the second phase deck reinforcement prior to pouring of the deck.

Objective: The primary objective of this research is to determine the amplitude, frequency, and duration of traffic-induced vibration that results in premature deterioration of concrete bridge decks in phased construction and identify methods for mitigating its effects.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review and Scope	$13,316	100%
Task 2: Field Monitoring of Bridges during Phased Construction	$29,649	100%
Task 3: Laboratory Evaluation of Traffic-Induced Vibration	$60,292	100%
Task 4: Recommendations and Reporting	$14,225	90%

Deliverables: As a result of this project, recommendations will be made to mitigate premature deterioration of concrete bridge decks poured during phased construction. If implemented, this will enhance the durability of Nebraska bridges reducing costs associated with deck maintenance, rehabilitation, and replacement. Furthermore, extensive cracking of phased construction bridge decks is a nationwide issue; and, recommendations developed in this project have the potential to impact construction practice around the United States and abroad.

Performance & Goals: Project has an approved extension request and is up to date on revised tasks and schedule.

PROJECT NUMBER	M103
PROJECT TITLE	Simple for Dead Continuous for Live (SDCL) Steel Girder Bridges with UHPC and GFRP
PRINCIPAL INVESTIGATOR	Joshua S. Steelman – UNL
PROJECT START DATE	7/1/2019
PROJECT COMPLETION DATE	12/31/2022
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Ross Barron, Steve Sabra, Lynden Vanderveen, Maher Tadros-e-Construct, Douglas Gremel-Owens Corning Infrastructure Solutions, and David Mraz-FHWA
PROJECT TOTAL COSTS	$132,358
PROJECT EXPENDITURES TO DATE	$121,604
NUMBER OF EXTENSIONS GRANTED	Two (2)
PERCENTAGE OF PROJECT COMPLETE	74%
STATUS	On Approved Revised Schedule
FY-2023 BUDGET	$10,754
FY-2023 TASKS TO BE COMPLETED	Tasks 4, 5, 6, 7 & 8

Background: This research will investigate optimized construction methods for the diaphragm to provide comparable or superior constructability and structural performance, compared to existing SDCL for steel girder bridge details, when using ultra-high performance concrete (UHPC) at the girder continuity locations. Glass Fiber Reinforced Polymer {GFRP) in UHPC GFRP has been studied as a viable alternative to steel reinforcing to reduce life cycle costs for bridge structures, especially decks. The material behavior is well documented for uses in conventional concrete but has not yet been thoroughly studied for uses in UHPC. The combination of UHPC and GFRP can offer an essentially maintenance-free structural system, with negligible cracking in the UHPC, and non-corrosive glass-reinforced polymer at crossing reinforcing bridging to conventional concrete in decks. The development length of steel reinforcing is known to be much shorter than in conventional concrete (Graybeal, 2014). Lap splices on the order of 5 to 6 inches have been implemented in practice for steel in UHPC. The required development and lap splice lengths for GFRP have received only limited attention at this time. Additionally, the susceptibility of steel crossing reinforcing to corrosion at the cold joint between conventional concrete and UHPC requires that concrete surfaces be roughened before placing UHPC. This additional labor cost can potentially be avoided by using GFRP. The availability of Owens Corning as a local resource in the state of Nebraska, and the willingness on the part of their company to collaborate and donate materials and expertise, present opportunities that will be leveraged in the proposed research for the benefit of NDOT.

Objective: The primary objectives of this research are to:

1. Develop details to optimize SDCL steel girder structural design and construction for material and construction efficiency with UHPC,
2. Identify available software tools for SDCL steel girder design and rating, and/or develop an action plan for modification to existing software, as applicable, and
3. Characterize development behavior and required embedment lengths for full development of GFRP bars in UHPC.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	$3,977	100%
Task 2: SDCL Field Surveys	$2,253	20%
Task 3: Parametric SDCL Scoping Study	$12,164	100%
Task 4: GFRP in UHPC Direct Tension Tests	$12,775	90%
Task 5: GFRP Lap Splices in UHPC Deck Joint Tests	$10,778	81%
Task 6: Experimental SDCL Validation	$56,522	58%
Task 7: Software Integration Study	$18,751	0%
Task 8: Documentation and Presentation	$15,138	52%

Deliverables: The primary benefits of this project will be reduced cost for multi-span steel girder bridges and reduced life-cycle maintenance cost (potentially maintenance free) with more resilient joint construction. Additionally, this project will further extend the benefits of UHPC by documenting GFRP development behavior. The research will support the design option to use GFRP crossing reinforcing at cold joint interfaces between conventional concrete in the deck and UHPC in longitudinal deck closure joints. GFRP will be more tolerant of any de-icing chemical penetration that may occur through road surface paving and membranes. Therefore, using GFRP crossing reinforcing could justify waiving the surface roughening currently required to enhance interlock at conventional/UHPC cold joints. Lastly, the investigations into SDCL with UHPC at continuity joints and GFRP development in UHPC can potentially improve the longevity of the structure at continuity locations.

Performance & Goals: Project has an approved extension request and is up to date on revised tasks and schedule.

PROJECT NUMBER	M104
PROJECT TITLE	Data-Driven Prioritization and Empirical Predictions for Scour of Rural Bridges in Nebraska
PRINCIPAL INVESTIGATOR	Richard L. Wood, Christine E. Wittich, Junke Guo and Chung R. Song – UNL
PROJECT START DATE	7/1/2019
PROJECT COMPLETION DATE	12/31/2021
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Ross Barron, Kirk Harvey, and Jason Dayton
PROJECT TOTAL COSTS	$115,662
PROJECT EXPENDITURES TO DATE	$71,650
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	70%
STATUS	Behind Schedule- Working on Draft Report
FY-2023 BUDGET	$44,012
FY-2023 TASKS TO BE COMPLETED	Tasks 2, 3, 4 & 5

Background: Bridge scour is a leading cause of bridge closures and failures in the country and Nebraska [1]. Over the last few years, high-profile bridge closures in Nebraska have been widely publicized in the media-citing scour as the primary issue. Within the FHWA specified process, two critical steps rely on site-specific details. This includes step 2 -to develop hydraulic parameters and step 5 -to evaluate the results for reasonableness. Different materials will scour at various rates. Loose granular soils can rapidly erode by flowing water, whereas cohesive soils, which are common to specific areas of Nebraska, are more scour-resistant (61. However, HEC-18, in section 3.1, conservatively assumes that the ultimate scour in cohesive soils can be as deep as the scour in loose granular soils (or sands). While this assumption is expected to be conservative because of the increased critical shear stress in cohesive soils [9], this can lead to highly improbable scour estimates and the potential for over-designed and costly bridge foundations. However, significant challenges arise in order to verify the magnitude of scour for these varying soils. This is primarily due to the cyclic nature of the scour process where scour is deepest during the peak of a flood but may be hardly visible as floodwaters recede and scour holes fill with sediment. Therefore, there is a critical need to develop improved hydraulic parameters and to provide guidance on reasonableness for scour estimates that reflect Nebraska soils.

Objective: The first objective of this project is to reduce the uncertainty in the scour prediction equations specific to Nebraska soils and hydraulic conditions using empirical field data collected in this project. Particular attention will be paid to the scour predictions of clayey and cohesive soils, which are currently presumed to be overly conservative in the existing FHWA HEC-18 approach. The second objective of this project is to evaluate and provide guidance on reasonable scour estimates for Nebraska soil and hydraulic conditions. This objective is done to address engineering judgment on whether the numerical scour predictions are "unconservative" or "over- conservative". Guidance will be provided using real field measurements to benchmark and clarify the ranges of acceptable scour in this area from the highly detailed, high-fidelity site assessments.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review and Scope	$2,985	100%
Task 2: Geometric Data Collection and Temporal Scour Rates	$61,448	88%
Task 3: Site Characterization	$15,226	80%
Task 4: Data-Driven Scour Validation	$17,676	5%
Task 5: Reporting	$18,327	0%

Deliverables: This project will provide guidance on hydraulic parameters and reasonable scour estimates specific to Nebraska conditions. This will enable NDOT engineers to assess bridge sites for scour more confidently. In addition to these direct outcomes, this project is expected to result in the following: reduced bridge closures, structural savings for new bridge design, validation and/or limitations of existing scour predictions, enhanced knowledge of scour and model for other states/agencies.

Performance & Goals: Project has an approved extension request and is up to date on revised tasks and schedule

PROJECT NUMBER	M107
PROJECT TITLE	Outdoor Laboratory and Testbed for Bridge Health
PRINCIPAL INVESTIGATOR	Richard Wood, Christine Wittich, Joshua Steelman, Jay Puckett, Dan Linzell and Jinying Zhu – UNL
PROJECT START DATE	7/1/2019
PROJECT COMPLETION DATE	3/31/2022
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Ross Barron, Babrak Niazi, Kent Miller, Kirk Harvey, Mike Vigil, and David Mraz-FHWA
PROJECT TOTAL COSTS	$115,074
PROJECT EXPENDITURES TO DATE	$72,574
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	75%
STATUS	Behind Schedule- Working on Draft Report
FY-2023 BUDGET	$42,500
FY-2023 TASKS TO BE COMPLETED	Task 3 & 4

Background: Bridge health assessment invokes inspection, nondestructive evaluation, and destructive testing. Inspection and nondestructive evaluation are commonly implemented in practice; however, these techniques may involve subjective decision making, human interactions, and lack of verified or calibrated approaches. Furthermore, destructive tests such as deck coring and overstressing structural elements beyond their elastic limit are not commonly performed in practice due to their detrimental impacts to in-service structures. Therefore, realistic out-of2 service bridge site(s) are critically needed to fully understand how bridges behave throughout their service life.

Objective: The proposed research project has one overarching objective to transform two bridge sites (a total of three bridges) into a national research and educational facility for bridge health and testing. This will permit access for nondestructive evaluation and destructive test verifications. Furthermore, this facility can be leveraged for future research projects and identify strategic directions for this first-of-its-kind facility on realistic aging infrastructure.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Preliminary Site Staging	$45,303	100%
Task 2: Site Characterization	$32,613	100%
Task 3: Facility Demonstration	$19,356	47%
Task 4: Reporting	$17,802	0%

Deliverables: The project aims to establish a research and educational facility for studies related to bridge health and the training of students/future engineers, bridge engineers, and bridge inspectors. Due to the closed-traffic conditions of these bridges, this laboratory facility will enable testing of new methods for analytical modeling (with calibration), remote sensing, and diagnostic and health monitoring procedures. This project will provide a detailed characterization of realistically aged bridges (two steel bridges at Yutan and one concrete bridge at Omaha). In the long term, this project aims to study key questions on bridge health to address statewide and national needs. This facility will also increase national visibility of NDOT and UNL Engineering.

The project will create a shared-use facility to understand bridge health. Within the deliverables of this project, a detailed characterization and model will be created of each bridge that can be used in future and other projects of need. The detailed data from each bridge will be disseminated for interested parties and publicly hosted on the web to support bridge health studies.

Performance & Goals: Project has an approved extension request and is up to date on revised tasks and schedule.

PROJECT NUMBER	M116
PROJECT TITLE	Effect of Antioxidant Additives and Restorators on Performance of Asphalt Binders and Mixtures – Phase I
PRINCIPAL INVESTIGATOR	Hamzeh Haghshenas – UNL and Robert Rea – NDOT Materials & Research
PROJECT START DATE	7/1/2019
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Brandon Varilek, Mike Reynold, John Gude, Jody Paul, Mathew Kumbier, Jasmine Dondlinger, David T. Hansen, Bruce Barrett and Robert Rea
PROJECT TOTAL COSTS	$428,662
PROJECT EXPENDITURES TO DATE	$82,359
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	85%
STATUS	On Approved Schedule
FY-2023 BUDGET	$315,429
FY-2023 TASKS TO BE COMPLETED	Tasks, 3, 4 & 5

Background:

The use of recycled materials, such as reclaimed asphalt pavement (RAP), recycled asphalt shingle (RAS), glass, and ground tire rubber, is a cost-effective and environmentally-friendly production method in the asphalt paving industry. The effects of recycled materials on asphalt mixtures have been investigated and reported by many researchers [1-4]. An extensive literature review reveals that the increase in stiffness, which is due to the aged asphalt binder present in RAP, is the main drawback caused by introducing RAP in asphalt mixtures [1, 5]. On the other hand, RAP in asphalt mixtures can result in an improvement in the rutting resistance of RAP blended mixtures [5-7]. The aging of an asphalt binder has a direct relationship with the stiffness and durability of asphalt mixtures [8-11].

Objective: This research aims to investigate the effect of various Ras and one antioxidant additive on performance of asphalt binders and mixtures. Testing will be performed on various blends of Ras and antioxidants containing laboratory aged materials (up to 100%). The laboratory tests will be performed to evaluate chemical properties (e.g., SARA, FTIR, elemental analysis) of the additives and binders, rheological performance (e.g., PG, Glover-Rowe) of the binders, and mechanical properties (e.g., SCB and TSR) of the mixtures. In addition, the possible correlation between chemical characteristics of the additives and rheological/mechanical properties of the binders/mixtures will be examined.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	$19,545	100%
Task 2: Materials Selection	$16,002	100%
Task 3: Laboratory Tests	$54,154	88%
Task 4: Analysis of Test Results	$32,764	87%
Task 5: Documentation and Presentation	$17,324	60%

Deliverables: The findings of this research study will affect Nebraska asphalt binder mixtures specifications. Test results and findings will be used to provide useful implementation guidelines of Nebraska asphalt binders and mixtures containing laboratory aged materials. This research would also bring clear benefits in sustainability of pavements by expanding their service life sustainability by expanding the use of recycling materials into our pavement engineering.

Performance & Goals: Project has an approved extension request and is up to date on revised tasks and schedule.

PROJECT NUMBER	M118
PROJECT TITLE	Computation of Peak and Low Flow Statistics and StreamStats GIS Implementation in the Elkhorn River Basin in Nebraska
PRINCIPAL INVESTIGATOR	Kellan Strauch – USGS
PROJECT START DATE	9/7/2018
PROJECT COMPLETION DATE	12/31/2023
TECHNICAL ADVISORY COMMITTEE	Kirk Harvey
PROJECT TOTAL COSTS	$35,000
PROJECT EXPENDITURES TO DATE	$35,000
NUMBER OF EXTENSIONS GRANTED	Two (2)
PERCENTAGE OF PROJECT COMPLETE	55%
STATUS	On Approved Revised Schedule
FY-2023 BUDGET	$0
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3 & 4

Background: The project is to develop a model for the Elkhorn River Basin in Nebraska which has not been updated since the 1980's. The model is used by the department in developing flood modeling and allowing better flow and high water elevations for bridge designers.

Objective: This project will develop the Elkhorn River Basin model. Peak and low flow statistic computation will be computed using Bulletin 17C parameters for 20 streamflow gages in the Elkhorn basin. Once computed and analyzed, the information will be incorporated into the web-based StreamStats GIS based format. After testing, the data will be released for publication.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Peak flow statistic computation w/ Bulletin 17C for 20 streamflow gages in Elkhorn Basin Task 1a: Compilation of peak flow data Task 1b: Compute peak flow statistics to 2015 Task 1c: Comparison to USACE computations Task 1d: Compute peak flow statistics to 2018 Task 1e: Update peak flow statistic to 2019 (pending publication of streamflow record and updated regional skew)	$9,500	90% 100% 100% 100% 100% 75%
Task 2: Low flow statistic computation Task 2a: Compilation of streamgage daily flow data Task 2b: Low flow statistics computation using R statistical package DV stats Task 2c: Update low flow statistic (pending publication of streamflow record)	$7,500	90% 100% 100% 80%
Task 3: GIS implementation into StreamStats Task 3a: Acquire stream center lines for NeDNR Task 3b: LiDAR prep (burning stream center lines) Task 3c: Development of flow accumulation and flow direction grids Task 3d: Online StreamStats implementation	$12,000	75% 100% 80% 70% 0%
Task 4: Publication Task 4a: USG Scientific Investigations report Task 4b: GIS date release (data sets and metadata)	$6,000	50% 50% 50%

Deliverables: This project will result in the development and implementation of peak flow statistic computation, low flow statistic computation, GIS implementation into StreamStats and publication for use.

Performance & Goals: Project has an approved extension request and is up to date on revised tasks and schedule.

CONTROL NUMBER	01021
PROJECT NUMBER	FY21(001)
PROJECT TITLE	An Investigation of Water Obstructions and Related Weather Conditions for Nebraska Roadways
PRINCIPAL INVESTIGATOR	Mark R. Anderson – UNL
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Jesse Schulz, Julie Ramirez, Claire Inbody, and Janie Vrtiska
PROJECT TOTAL COSTS	$164,700
PROJECT EXPENDITURES TO DATE	$89,640
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	90%
STATUS	On Schedule
FY-2023 BUDGET	$75,060
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 5, 6 & 7

Background: The main goal of this proposal is to get a better understanding of where the water obstructions take place, as well as the cause of the obstruction in relationship to the weather conditions associated with the increased water levels causing the water obstruction. Recognizing the weather conditions responsible for the obstruction; from winter through spring with ice damming, runoff from heavy precipitation during thunderstorm activity, and water table increases in the Sandhills will be the focus of the research. In addition, the frequency of the water obstruction events will be calculated for the study period.

Objective: The main objective of this investigation is to generate spatial maps of water obstructions on Federal and State highways across Nebraska (NDOT's responsibilities). The spatial maps will provide NDOT with a climatology of where water obstructions have occurred in the past. Composite spatial maps will be generated annually, and a climatology will then be produced for the period of record. An example map is presented in Figure 1 representing the obstructions that occurred during the first half of the 2019 year. In addition to the locations of the water obstructions, meteorological information will be investigated for the cause of the obstruction. Each obstruction needs to be identified and then similar weather situations will be combined. Once the obstructions are identified, then NDOT can determine what form of action might be taken to reduce water obstructions in the future.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature review of water obstructions and weather conditions	$21,315	97%
Task 2: Collection of Nebraska CARS water obstruction data	$23,267	100%
Task 3: Collection of meteorological observations	$31,475	100%
Task 4: GIS analyses of the obstruction information	$26,818	100%
Task 5: Statistical analyses of the water obstruction information	$29,596	90%
Task 6: Examination of the water obstructions and meteorological information	$23,538	90%
Task 7: Final reports and presentations	$8,721	10%

Deliverables: The end result from this research project will be a better understanding of where water obstructions take place and the weather conditions associated with the water obstruction. The proposed project will help benefit all parties in better understanding what weather conditions precede water obstructions so that appropriate actions may be initiated to reduce water obstructions in the future. Actions may be in the form of news releases to the general public, messages displayed on variable message signs before, during or after a weather event. The proposed project may also have implications for maintenance operations for locations of the water obstructions within NDOT for Nebraska roadways.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01021A
PROJECT NUMBER	FY21 (002)
PROJECT TITLE	Development of Guideline for the Use of Geosynthetics in Different Pavement Layered System in Nebraska
PRINCIPAL INVESTIGATOR	Jongwan Eun & Seunghee Kim – UNL
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Brandon Varilek, Mark Lindemann, Bruce Barrett, Jesse De Los Santos and Ray Trujillo
PROJECT TOTAL COSTS	$106,536
PROJECT EXPENDITURES TO DATE	$84,922
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	60%
STATUS	On Approved Revised Schedule
FY-2023 BUDGET	$21,614
FY-2023 TASKS TO BE COMPLETED	Tasks 2, 3, 4 & 5

Background: Geosynthetics reinforcement such as geogrid, geotextile, etc. has been used as a viable alternative to stabilize the subgrade of roadway pavement construction in regions with soft and/or problematic subgrade (foundation) soils. Geosynthetics are typically marketed either as having the ability to lengthen the pavement design life through controlling the damage of the pavement or as a cost-saver to reduce the aggregate base thickness while maintaining the same level of design-equivalent single axle loads as with traditional pavement systems.

Objective: The proposed research will pursue the two primary goals:
(1) Evaluate the design properties of geosynthetic reinforced roadway pavement including base, subbase, subgrade in Nebraska; and
(2) Suggest a design guideline of geosynthetic reinforced roadway pavement.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Extensive Review of Geosynthetic-Reinforced Roadway Pavement	$17,810	100%
Task 2: Experimental Characterization of Geosynthetic Reinforced Pavement with Pullout and Direct Shear Tests Task 2.a Fundamental laboratory test, we will characterize and evaluate the fundamental properties of geosynthetics, and soils chosen for this study Task 2.b Pullout resistance will be evaluated in the different directions of the geosynthetics, such as the machine and cross-machine direction, by using a large pullout testing device (ASTM D6706). Task 2.c Large-size direct shear test (ASTM D5321) will be conducted to evaluate the shear resistance at the soil-geosynthetic interface	$32,400	85%
Task 3: Large-scale Track Wheel (LSTW) Tests to Evaluate Geosynthetic Reinforced Pavement	$25,986	55%
Task 4: Numerical Study of Geosynthetic-Reinforced Roadway System	$23,193	40%
Task 5: Suggestion of Design Recommendation	$7,147	10%
Task 6: Final Report	-	0%

Deliverables:
(1) It is anticipated that the in-depth review of current practices of geosynthetic reinforced payment in Nebraska and other states will identify an opportunity for improvements in the design and construction with less cost and still superb performance.
(2) The proposed project will provide precise input parameters of the soil-geosynthetic and aggregate-geosynthetic interactions, in accordance with the common design practice of Nebraska.
(3) Via the unprecedented large-scale experimental study and in-depth numerical simulations, the proposed project will lead to the improvement of design practices and the introduction of economically viable roadway pavement strategies. In doing so, it will contribute to effectively preventing the issue of deterioration with less cost tailored to the local soil properties in Nebraska.
(4) Subsequently, the proposed project will greatly help reduce the cost, time, and efforts for maintaining the existing roadways.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01021B
PROJECT NUMBER	FY21 (003)
PROJECT TITLE	Effect of Antioxidant Additives and Recycling Agents on Performance of Asphalt Binders and Mixtures – Phase II
PRINCIPAL INVESTIGATOR	Hamzeh Haghshenas & Jiong Hu – UNL and Robert Rea – NDOT Materials & Research
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Brandon Varilek, Bruce Barrett, Jasmine Dondlinger and David T. Hansen
PROJECT TOTAL COSTS	$145,238
PROJECT EXPENDITURES TO DATE	$33,070
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	57%
STATUS	On Approved Revised Schedule
FY-2023 BUDGET	$112,168
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 3, 4 & 5

Background: The use of recycling agents (RAs) (i.e., rejuvenators or softening agents) has gained significant attention from industry on a global scale. Its recent worldwide interest has grown as the world's population is placing a much larger focus on world climate, pollution, and ways to control the CO2 excess through reduce, reuse, and recycle. The recycling of waste materials and reducing the carbon footprint of manufactured products through the conservation of energy and reduction on the use of raw materials has become a primary focus. The use of properly engineered RA's and mix designs can effectively recover the properties of the aged asphalt binders and provide equivalent and in some cases better performing pavements. Current research has found that RAs can improve the cracking resistance, while being capable of maintaining the rutting resistance of the mixtures. However, there are some concerns about the effect of RAs on the moisture damage resistance [and the long term performance (aging) of these additives.

The idea of modifying the properties of aged binders using RAs and providing long-term age resistance through the addition of antioxidants seems to be a viable solution. Based on the test results that the PI obtained from the previous research (funded proposal number: SPR-P1(20) M116), the combination of these technologies was proved effective and can bring significant pavement life cycle cost savings, provide longer-lasting and more sustainable roadway pavements. However, the focus of this first phase of this research was to investigate if this chemistry combination would work, so it was tested on only one antioxidant, one unmodified asphalt binder and a selection of RAs.

Objective: The second phase of this research will study the effect of various RAs and antioxidant additives and their performance with modified asphalt binders and mixtures. Various tests will be performed on different combinations of RAs and antioxidants containing virgin and RAP materials to characterize physical characteristics and rheological performances of the binders as well as mechanical properties of the mixtures.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	$16,968	95%
Task 2: Materials Selection	$16,801	100%
Task 3: Laboratory Tests	$58,119	40%
Task 4: Analysis of Test Results	$33,555	20%
Task 5: Documentation and Presentation	$19,796	30%

Deliverables: Test results and findings will be used to provide implementation guidelines for common binder grades and mixes used in the central United States containing RAP materials. This research will also bring significant pavement life cycle cost savings, provide longer-lasting and more sustainable roadway pavements.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01021C
PROJECT NUMBER	FY21 (004)
PROJECT TITLE	Midwest Guardrail System (MGS) Thrie Beam Approach Guardrail Transition (AGT) Retrofit to Existing Concrete Parapets and Bridges
PRINCIPAL INVESTIGATOR	Scott Rosenbaugh – UNL
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Ross Barron, Mike Vigil, Phil TenHulzen, Austin White ,Abdul Sidiqi, David Mraz-FHWA, and Andrew Heuerman-FHWA
PROJECT TOTAL COSTS	$87,978
PROJECT EXPENDITURES TO DATE	$29,153
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	45%
STATUS	On Approved Revised Schedule
FY-2023 BUDGET	$58,825
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3 & 4

Background: When a roadway/bridge is resurfaced with an overlay, NDOT plans to replace the AGT adjacent to the bridge with a MASH TL-3 crashworthy design. To minimize repair costs, NDOT does not desire to replace or alter any bridge rails with adequate structural capacity and height. Bridge rails installed under NCHRP 230 or earlier standards are likely too short for current standards and need to be replaced, but bridge rails installed to NCHRP Report 350 standards should meet MASH TL-3 criteria and could remain in place. However, this creates a problem of attaching new, 31-in. tall AGTs to existing concrete bridge rails and parapets (after an overlay) that were not designed for such connections and the resulting system may not be crashworthy to current safety standards. Therefore, the development of cost effective retrofit options are desired for attaching new, 31-in. tall AGTs to existing NDOT bridge rail and parapet designs.

Objective: The objective of this project is to develop retrofit options for attachment of 31-in. tall thrie beam AGT systems to existing NDOT bridge rails and concrete parapets. The retrofits may involve the addition of connection plates to attach the thrie beam to the parapet, the addition of deflector plates to prevent vehicle snag, and/or overlapping the AGT on the parapet to prevent contact with the end of the parapet. However, the existing concrete structures are not to be modified except for the installation of anchorage hardware. The new retrofit designs will improve the overall safety of the barrier systems by ensuring its performance satisfies the Manual for Assessing Safety Hardware (MASH) Test Level 3 (TL-3) performance criteria, while preventing costly replacements of concrete structures.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Project Planning and Correspondence a. General project planning and documentation b. TAC meetings	$8,763	80%
Task 2: Design and Analysis a. Review of existing bridge rails, parapets, and end buttresses b. Concept development of retrofit options c. Selection of desired retrofit	$23,862	80%
Task 3: Analysis of Selected Retrofit a. LS-DYNA computer simulation b. Structural design of attachment hardware c. Selection of CIPs d. Development of CAD details	$33,515	25%
Task 4: Reporting and Project Deliverables a. Summary report to document research effort, including conceptual design, selection of desired retrofit, computer simulation, CAD details, and implementation guidance b. Report editing (internal and sponsor review) c. Technical Brief for NDOR d. PowerPoint presentation of research results following project completion e. Project closing (printing, dissemination, accounting)	$21,838	0%

Deliverables: Development of crashworthy retrofit options for the attachment of thrie beam AGT systems to existing NDOT bridge and concrete parapets will provide NDOT with a safe and cost-effective solution for upgrading guardrail and AGT systems without requiring difficult and costly modifications to the concrete parapets themselves or the addition of a new end buttress adjacent to the current end of the parapet. Further, the retrofit design will reduce installation times and limit the amount of lane closures and exposed workers as compared to reconstructing the concrete parapets. The availability of these retrofit attachments would also improve the long-term safety of the bridge and approach section by conforming to the safety performance criteria of MASH TL-3.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01021D
PROJECT NUMBER	FY21 (005)
PROJECT TITLE	UHPC Decked I-Beam for Accelerated Bridge Construction
PRINCIPAL INVESTIGATOR	George Morcous – UNL & Maher Tadros – e.Construct.US
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Ross Barron, Wally Heyen, Kent Miller, Mike Vigil, Mark Lafferty-Concrete Industries, Todd Culp-Core Slab and David Mraz–FHWA
PROJECT TOTAL COSTS	$98,250
PROJECT EXPENDITURES TO DATE	$61,248
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	75%
STATUS	On Approved Revised Schedule
FY-2023 BUDGET	$37,002
FY-2023 TASKS TO BE COMPLETED	Tasks 3, 4 & 5

Background: Ultra-High Performance Concrete (UHPC) is an excellent material for bridge construction due to its exceptional durability and superior mechanical properties. Several Departments of Transportations (DOTs), including NDOT, have limited the use of UHPC in bridge construction to joints and connections between bridge components due to the relatively high materials cost of commercially UHPC products. Recently, NDOT has sponsored a research project to develop a non-proprietary UHPC using local materials to reduce materials cost and ensure its availability to local contractors and precast producers. The project was completed successfully and an economical UHPC mix that satisfied all workability, durability, and strength requirements was developed and tested. The cost of the raw materials for this mix was about $700 per cubic yards which is about 30 percent of the cost of pre-bagged commercial UHPC materials. Therefore, it is economically feasible at this time to expand the use of UHPC to bridge components, such as deck slabs and girders, to have a service life of over 150 years. Some researchers (Voo and Foster 2010) estimate the theoretical service life to be about 340 years. Its use will clearly minimize bridge maintenance costs and traffic disruptions.

Objective: The objective of this project is to develop a UHPC superstructure system for bridges in Nebraska that is optimized with respect to structural efficiency, constructability, and economy. Few highway bridges have already been built using UHPC superstructure in France, Korea, Malaysia, USA, and Canada. These bridges had different superstructure systems including pi-girders, bulb-tee girders, tub girders, box girders, decked I-beams, and waffle slabs. These systems will be reviewed and evaluated to determine the system(s) that meet NDOT needs.

The research team will work with NDOT bridge engineers and local bridge producers and contractors in this project. This will include conducting necessary materials testing, structural testing, and formwork design; and addressing issues related to girder shipping and handling, longitudinal joints, differential camber and camber growth, railing connections, cross slope/skewed bridges, and multi span continuity.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Review Existing UHPC Superstructure Systems	$7,480	100%
Task 2: Evaluate System Alternatives	$9,967	100%
Task 3: Develop Final Design and Detailing	$19,954	90%
Task 4: Fabricate and Test Full-Scale Specimen(s)	$46,782	40%
Task 5: Prepare Project Documentation and Technology Transfer	$14,068	40%

Deliverables: The research team currently has a PCI funded research project on nation-wide implementation of UHPC precast/prestressed components in buildings and bridges. This project will supplement the team efforts to develop and implement UHPC superstructure system, which is a great benefit to the state of Nebraska, in particular, and bridge community at large. The use of precast UHPC superstructure system saves construction time of deck forming, reinforcing, casting, and curing, which leads to accelerated bridge construction. It also enhances construction safety, and minimizes traffic disruptions, which is highly needed on interstate highway projects. This project will be conducted by UNL researchers with unpaid consulting services by e.construct.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01021E
PROJECT NUMBER	FY21 (006)
PROJECT TITLE	Rapid Concrete Bridge Repair Survey and Patch Material Evaluation
PRINCIPAL INVESTIGATOR	Marc Maguire & Jiong Hu – UNL
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Wally Heyen, Ross Barron, Fouad Jaber, Mike Vigil, Logan Sia, David T. Hansen, Lieska Halsey and David Mraz-FHWA
PROJECT TOTAL COSTS	$93,572
PROJECT EXPENDITURES TO DATE	$20,696
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	60%
STATUS	Behind Schedule
FY-2023 BUDGET	$72,876
FY-2023 TASKS TO BE COMPLETED	Tasks, 3, 4 & 5

Background: Tracking the heat of hydration (HoH) of Portland cement concrete has become a widely used and viable technique to characterize cement mixtures hydration behavior for cement producers, practicing engineers, and contractors (ASTM C1679). The Nebraska Department of Transportation (NDOT) is interested in gaining background knowledge on the HoH generated from local cements at different ambient temperatures. This information will be primarily beneficial for troubleshooting field concrete setting issues thereby improving support for Portland cement concrete contractors and ultimately improving project quality. Isothermal calorimetry (IC) has become the method of choice for characterizing cement set and hydration behavior due to its reliability and relatively easy data collection.

Objective: The general objective of this research is to identify the HoH of locally available cements. The specific objectives are to identify HoH in (1) different ambient curing temperatures, (2) different water-to-cement ratios (w/c), (3) different manufacturers. The HoH and Thermal Power Curves developed will be able to identify critical conditions for set times across the NDOT construction situation.
Furthermore, this research will enable additional future research into the behavior of various mineral and chemical admixtures used by NDOT contractors to allow even more specific and continuous contractor support and enhance contractor and Portland cement concrete performance.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review and Survey Development	$14,040	100%
Task 2: Compiling Paper Data Identify Lab Testing	$12,390	100%
Task 3: Site Visits	$14,700	10%
Task 4: Lab Testing and Data Analysis of Collected Data	$28,737	10%
Task 5: Reporting	$23,705	50%

Deliverables: This project will allow NDOT to identify the HoH generation curve and the various metrics associated with different w/c and ambient temperatures. By better understanding the HoH of locally available cements, NDOT will be able to better anticipate early or late setting problems and provide guidance to concrete contractors in different conditions, using different mixtures. Ultimately, this will streamline the construction process, ideally providing better quality final concretes and reduce construction headaches for NDOT and its contractors. Future phases of this project will provide guidance on the combination of various admixtures under different conditions to provide additional information.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01021F
PROJECT NUMBER	FY21 (007)
PROJECT TITLE	Intelligent Work Zone Using Automatic Queue Detection Systems
PRINCIPAL INVESTIGATOR	Larry Rilett & Li Zhao – UNL
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Matt Neemann, Matt Baker, Dan Waddle, Jim Knott, Lorraine Legg, Curt Mueting, Eric Klein, Cameron Craig, Kevin Wray, Abe Anshasi-FHWA, and Andrew Heuerman-FHWA
PROJECT TOTAL COSTS	$159,466
PROJECT EXPENDITURES TO DATE	$100,365
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	80%
STATUS	On Schedule
FY-2023 BUDGET	$59,101
FY-202 TASKS TO BE COMPLETED	Task 2, 3 & 4

Background: The proposed research will evaluate the efficacy of the NDOT AQD system. The testbeds for this study will be located at various work zones on Interstate 80 in Nebraska. It is anticipated that four (4) sites will be studied. The effectiveness of the AQD systems will be verified quantitatively. A statistical analysis of crashes at work zones that are equipped and not equipped with the AQD system will be undertaken. In particular, the researchers will examine whether the AQD system had improved safety, e.g., a measured reduction in rear-end crashes. The research will also examine whether other types of crashes increased (or not). The study will also observe driver behavior as a function of the PDMS messages. In particular, the reduction in speed, if any, for the various sign messages will be quantified. Lastly, NDOT uses a cost-benefit analysis when deciding whether to deploy an AQD system at a work zone. This research will validate the assumptions underlying this benefit/cost methodology.

Objective:

The first objective of the study will be to determine whether the AQD system is performing adequately. For example, the researchers will ascertain whether the correct messages are being displayed on the PDMS for given traffic conditions at the AQD detectors. For instance, if the AQD system identifies a queue, the research will confirm that the correct message is displayed on the PDMS upstream of the queue. The hypothesis that will be tested is that the correct message is displayed X percent of the time.

The second objective of the study will be to ascertain how the drivers react to the messages displayed on the PDMS. It is expected that when the drivers are informed that a queue is present ahead of them, they will slow down. The amount of speed reduction will be quantified as a function of distance from the PDMS. The hypothesis that will be tested is that the drivers will, on average, drive slower in response to the queue-related PDMS messages. In other words, the average speed in the vicinity of the PDMS will be lower when a "stop/slow traffic ahead" message is displayed as compared to when a "roadwork ahead" message is displayed. Also, the location of the end-of-queue will be monitored to determine whether the response of drivers is linked to the message on the PDMS and not the tail-light of vehicles at the end-of-queue. The delay associated with the work zone will also be estimated from the empirical data using the Highway Capacity Manual 6th version (HCM6) methodology.

The third objective of the study will be to determine if crash rates are lower on the SWZ equipped with the AQD system and will compare them to crashes on work zones without the AQD system using statistical theory. Note that the static signage at both types of locations will be consistent with NDOT practice.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Literature Review	$13,949	100%
Task 2: Research on Operation of AQD System		
2a. Selection of Primary Test Sites	$14,308	100%
2b. Preliminary Study of Test Sites	$14,308	100%
2c. Data Collection and Processing	$55,598	90%
2d. Operational Analysis	$19,052	95%
Task 3: Safety Analysis		
3a. Historical Crash Data	$14,026	80%
3b. Surrogate Safety Measure	$14,069	65%
Task 4: Final Report and Presentation to NDOT	$14,155	55%

Deliverables: The insights gained from this research will improve the safety and efficiency of operations at freeway work zones within the State of Nebraska. There are four main benefits:

a. The functionality of the current AQD system will be validated using empirical data. In addition, any potential modifications and improvements will be identified;

b. The efficacy of the systems as measured by a reduction in average vehicle speed as a function of distance from the PDMS and the message displayed on the PDMS will be quantified;

c. The crash reduction rates associated with the AQD systems will be quantitatively identified; and

d. The NDOT benefit/cost procedure for the AQD system deployment will be validated. This will help NDOT refine the criteria used to justify the deployment of the AQD systems and determine when AQD systems should be used in work zones, etc.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01021G
PROJECT NUMBER	FY21 (008)
PROJECT TITLE	Estimating System and Traveler Costs Due to Lane Closures During Construction and Maintenance Operations
PRINCIPAL INVESTIGATOR	Larry Rilett – UNL
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Matt Neemann, Dan Waddle, Jim Knott, Lorraine Legg, Curt Mueting, Barbara Gerbino-Bevins, Kevin Wray, Abe Anshasi-FHWA and Justin Luther-FHWA
PROJECT TOTAL COSTS	$179,500
PROJECT EXPENDITURES TO DATE	$148,574
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	90%
STATUS	On Schedule
FY-2023 BUDGET	$30,926
FY-2023 TASKS TO BE COMPLETED	Tasks 5 & 6

Background: Lane closures are used to facilitate activities related to construction and maintenance/operations. However, there are economic costs associated with lane closures and these may accrue to both the traveling public as well as to traffic agencies. While it is sometimes necessary to prohibit lane closures during the day to alleviate traffic congestion, there are consequences of this decision related to project delivery timelines, construction costs, and safety within the work zone. The Nebraska Governor's office has identified maximizing the effectiveness of lane closures as a priority for Nebraska Department of Transportation (NDOT).

Objective: The specific objectives goals for this research topic identified by NDOT include:

1. Using the 2016 Highway Capacity Manual (e.g. HCM6) methodologies to provide estimates on capacity reduction, delay increases, and fuel usage increases related to various work zone/lane closure conditions. The HCM methodology is based on the VISSIM microsimulation model and this model will be calibrated to Nebraska conditions. Specifically, the following work zone/lane closure scenarios will be examined:
   i. 6 Lane Divided: 3 lanes, 1 lane closed
   ii. 6 Lane Divided: 3 lanes, 2 lanes closed
   iii. 4 Lane Divided: 2 lanes, 1 lane closed
   iv. 2 lane (undivided): 1 lane closed (flagging or traffic signal operation)

   An analysis of each of the scenarios with respect to length of work zone, percent trucks, speed limit, and time the work zone is active will be conducted; and
2. Conducting a detailed economic analysis of the costs of delay, increased vehicle operating costs, and accident costs for vehicles traveling through lane closures.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Literature Review	$19,663	100%
Task 2: Conduct HCM analysis, under Nebraska conditions for the 4 Lane Divided Highway: 2 lane, 1 lane closed scenario.	$24,655	100%
Task 3: Conduct HCM analysis, under Nebraska conditions for the 6 Lane Divided Highway: 3 lane a) 1 lane closed, and b) 2 lanes closed scenario.	$32,978	100%
Task 4: Conduct HCM analysis, under Nebraska conditions for the 2 lane, undivided highway: 1 lane closed, flagging or traffic signal operation scenario.	$33,090	100%
Task 5: Economic Analyses	$49,236	51%
Task 6: Final Report and Presentation to NDOT	$19,878	50%

Deliverables: This research will aid Nebraska DOT employees in improving safety, cost, and completion times of highway construction projects. This will be accomplished by estimating system and traveler costs associated with lane closures and using state of the art economic analyses to quantify these costs. Further, this project will directly address the recommendations made regarding peak hours versus night work detailed in NDOT's 2017 Work Zone Safety and Mobility Process Review Final Report.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01021H
PROJECT NUMBER	FY21 (009)
PROJECT TITLE	Energy Dissipation Optimization for Circular Culverts
PRINCIPAL INVESTIGATOR	David Admiraal – UNL
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Julie Ramirez, Phil TenHulzen, Dillon Dittmer, Jason Dayton, Kirk Harvey, John Linbo, Bob Carnazzo, and Ben Fischer
PROJECT TOTAL COSTS	$107,088
PROJECT EXPENDITURES TO DATE	$97,763
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	60%
STATUS	On Approved Revised Schedule
FY-2023 BUDGET	$9,325
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 3, 4, 6, 7, 8 & 9

Background: In 2004, NDOT research examined the use of weir energy dissipators for rectangular culverts. The method has proven valuable and effective for minimizing velocities and decreasing cost and has been included in FHWA's Hydraulic Engineering Circular No. 14: Hydraulic Design of Energy Dissipators for Culverts and Channels. NDOT has already installed similar dissipators (including weir and staggered weir wall dissipators) downstream of circular culverts, but there is no formal design procedure for this application. Although NDOT Roadway Hydraulics has developed methods of analysis for the new application, they do not have any guidance on the validity of the analysis method because no specific research has been conducted. The current method of analysis does not account for energy losses associated with the transition from a round pipe to a concrete box cross section. These additional losses may reduce the necessary size of the dissipation structure. As part of the proposed research, we would like to develop and validate a formal design procedure and simultaneously optimize design details of the resulting dissipator geometry.

Objective: The overarching objective of this research is: to develop and improve energy-dissipation designs for circular culverts in order to mitigate downstream erosion, lessen sedimentation and blockage by debris, minimize the footprint of the energy dissipation structure, and reduce installation cost.

Tasks & Percent to be completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review and Existing Structures	$11,230	95%
Task 1a: Literature Review		
Task 1b: Visit existing dissipation structures		
Task 1c: Document dissipation alternatives		
Task 2: TAC 1 - Select Alternatives	$0	100%
Task 3: Construct and Test Energy Dissipation Alternative 1	$42,455	95%
Task 3a: Build Alternative 1		
Task 3b: Test Alternative 1		
Task 4: Analyze data for Alternative 1	$14,358	10%
Task 5: TAC 2 - Report results of Alternative 1	$0	100%
Task 6: Build and Test Alternative 2	$23,858	0%
Task 6a: Build Alternative 2		
Task 6b: Test Alternative 2		
Task 7: TAC 3 – Design implementation meeting	$0	100%
Task 8: Analyze data for Alternative 2	$11,273	0%
Task 9: TAC 4 - Present Experimental Results to NDOT	$0	
Task 10: Complete Report and Technical Brief. TAC 5 - Final Presentation	$3,913	0%

Deliverables:

1. Documented design detail for all currently used dissipation structure types.
2. Possible extension of the design to include non-traditional applications such as sites with incomplete hydraulic jumps at the outlet.
3. Reduced cost of installation resulting from improved understanding of geometric limitations of the structures.
4. Decreased maintenance for new designs due to reduced sedimentation and clogging.
5. Smaller footprints for completed structures, leading to lessened right-of-way requirements, reduced environmental impacts, and expedited project delivery.
6. Improved effectiveness of the energy dissipation structures will lead to reduced downstream erosion impacts. Reduced erosion will lead to reduced sedimentation in downstream water bodies and wetlands.
7. Quantification of energy losses will include the transition from a circular pipe to a rectangular box structure, potentially resulting in size reductions of energy dissipation structure designs.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01021J
PROJECT NUMBER	FY21(010)
PROJECT TITLE	Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support
PRINCIPAL INVESTIGATOR	Robert Bielenberg, Scott Rosenbaugh, Ron Faller, and Cody Stolle – UNL
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Matt Neeman, Phil TenHulzen, Austin White, Nathan Sorben, and John Lutz
PROJECT TOTAL COSTS	$164,927
PROJECT EXPENDITURES TO DATE	$35,089
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	22%
STATUS	On Approved Revised Schedule
FY-2023 BUDGET	$129,838
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3 & 4

Background: NDOT desires that the mailbox support be updated to meet MASH 2016 TL-3 safety performance criteria. Very few mailbox supports have been evaluated according to MASH TL-3 specifications. The Texas A&M Transportation Institute (TTI) evaluated locking architectural mailboxes on thin-wall, steel-tube supports to MASH TL-3 (TTI Report No. 9-1002-12-9). A single-mailbox mount was tested and was successful. Two multiple-mailbox (combined standard and locking architectural mailboxes) mounts were tested and both configurations failed to meet MASH TL-3. The mailbox support for multiple mailboxes was subsequently redesigned and resulted in successful MASH TL-3 tests. Due to the limited number of tested mailbox supports, NDOT desired to design and evaluate a MASH TL-3 mailbox support.

Objective: The objective of this research project is to develop a non-proprietary mailbox support using PSST support posts that is MASH TL-3 crashworthy. The design should consider single and multiple mailbox configurations. The design may start with the previous NDOT mailbox support or could be developed independently depending on NDOT's preference. The Phase I objective will be to design and evaluate the mailbox support utilizing bogie testing.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Project Planning and Correspondence a. General project planning and documentation b. Literature search of previous crashworthy mailbox supports and PSST sign supports c. TAC meeting	$17,343	65.6%
Task 2: Design and Analysis a. Review of previous crashworthy mailbox supports and mailbox connections b. Establish design criteria based on NDOT's needs c. Development of PSST mailbox support concepts d. Preparation of 3D CAD details e. Sponsor comments on proposed concepts f. Recommendation of a proposed design	$43,383	43.7%
Task 3: Dynamic Component Testing a. Construction of test article – procure mailbox hardware and assembly of mailbox system at MwRSF's Outdoor Testing Facility b. Document material certifications, specifications, and certificates of compliance c. Conduct 6 dynamic component tests on proposed mailbox supports with MwRSF bogie representative of a small car d. Data analysis – Transducer and video analysis for each crash test e. System removal – Removal and disposal of system components	$82,280	6.6%
Task 4: Reporting and Project Deliverables a. Compile summary report to document research effort, including literature review, concept development, dynamic component tests, and recommendations for further testing b. Report editing (internal and sponsor review) c. Prepare Technical Brief for NDOR d. PowerPoint presentation of research results following project completion e. Project closing (printing, dissemination and accounting).	$21,921	0%

Deliverables: Development of a PSST mailbox support that meets MASH TL-3 requirements will provide NDOT with a crashworthy solution for mailboxes adjacent to state roadways. Additionally, the adoption of a design using PSST similar to current NDOT sign supports will reduce and simplify the state inventory.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01021K
PROJECT NUMBER	FY21 (011)
PROJECT TITLE	Establishment of Wildflower Islands to Enhance Roadside Health, Ecological Value, and Aesthetics - Phase II
PRINCIPAL INVESTIGATOR	John Guretzky, Tom Weissling and Judy Wu-Smart – UNL
PROJECT START DATE	7/1/2020
PROJECT COMPLETION DATE	5/31/2022
TECHNICAL ADVISORY COMMITTEE	Ron Poe, Jon Soper, and Melissa Maiefski-FHWA
PROJECT TOTAL COSTS	$171,275
PROJECT EXPENDITURES TO DATE	$116,996
NUMBER OF EXTENSIONS GRANTED	One (1)
PERCENTAGE OF PROJECT COMPLETE	76%
STATUS	On Approved Revised Schedule
FY-2023 BUDGET	$54,279
FY-2023 TASKS TO BE COMPLETED	Tasks 3 & 7

Background: A previous study completed by the University of Nebraska-Lincoln (UNL) in collaboration with NDOT has shown that wildflowers compose less than 10% of the botanical composition of highway roadsides 10 years following seeding. More recently in 2016, UNL/NDOT launched a new project to test the use of wildflower islands as a means of increasing the establishment and persistence of wildflowers on roadsides (phase I). These islands varied in size and consisted of segregated stands of diverse mixtures of wildflowers within grass-dominated roadsides. From this two-year study, we demonstrated that islands promoted higher bee abundance and richness than conventionally seeded plots following current NDOT practices.

Objective:

1. Continue to assess the plant community within wildflower islands from phase I to determine the role of island or patch size on longevity of wildflower plots,
2. On newly-seeded roadsides, we will repeat wildflower establishment in varying island sizes or strips (i.e., drill passes) but reduce the number of wildflower species in the seed mixture and introduce mowing regimes to better manage volunteer weeds and assess plant community responses to mowing, and
3. Assess attractiveness of wildflower mixtures on pollinators and other beneficial insects from Phase I and Phase II sites to evaluate the ecological impact of wildflower plots.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Implement project	$ 14,450	100%
Task 2: Line up contractors and collect data	$ 34,936.00	100%
Task 3: Literature search and insect identification	$24,851.00	76%
Task 4: Analyze data	$19,588.00	100%
Task 5: Compile 2020 results	$9,150.00	100%
Task 6: Data collection and treatment application	$22,237.00	100%
Task 7: Insect collection and identification	$9,559.00	50%
Task 8: Data analysis	$20,269.00	48%
Task 9: Task 9 and 10 – final report	$16,234.00	0%

Deliverables: Current methods of establishing wildflowers in roadside stands are expensive (wildflower seeds account for as much as 30% of seed mixture costs) and commonly unsuccessful. Based on phase I results, we believe there are cost-saving modifications that could be made to the seeding mixture to promote better establishment and longevity of wildflower islands. Deliverables of phase II include refinements to seeding methods, improved maintenance practices, and changes in seeding mixtures that would replace poor-performing species with native plant species that consistently grow well on roadsides and have other ecologically favorable traits (i.e. long bloom periods, positive responses to mowing, attractive to many insects). The proposed research for phase II surveys will include information about which plants are used by insects throughout the season to further demonstrate the ecological value of roadside habitats. Insect and vegetation surveys will be completed at phase I sites and newly-seeded phase II sites to provide more information about establishment and longevity of wildflower islands on roadsides. Additionally, wildflower islands will be evaluated to inform which wildflower mixtures and seeding methods are most favorable for beneficial insects. NDOT has recently become involved with the nationwide Candidate Conservation Agreement with Assurances (CCAA) efforts to promote monarch butterflies utilizing resources on energy and transportation lands illustrating the importance of pollinators to our state. Phase II of this project would align with these interests and priorities.Results generated from this project will improve our understanding of how to most efficiently and cost-effectively establish pollinator-friendly forage and wildlife habitat on roadsides and will inform other state and federal agencies interested in similar projects.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034A
PROJECT NUMBER	FY22(001)
PROJECT TITLE	Low-Cement Concrete Mixture for Bridge Decks and Rails
PRINCIPAL INVESTIGATOR	George Morcous and Jiong Hu - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Wally Heyen, Ross Barron, Noah Pitts, Wayne Patras, Scott Fischer, Brandon Varilek, Lieska Halsey, Mike Willman-GCP Applied Technologies, Kevin Piper-Simon, Mark Deetz-Lyman Richey Corporation, and David Mraz-FHWA
PROJECT TOTAL COSTS	$112,394
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	30%
STATUS	On Schedule
FY-2023 BUDGET	$112,394
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, & 5

Background: Early-age cracking of concrete bridge decks and rails accelerates the penetration of water and chemicals into the concrete, which leads to reinforcement corrosion, delamination, and eventually spalling. This common deterioration problem results in shorter service life, road closures, and costly repairs/replacements. The early-age cracking of concrete decks and rails is primarily attributed to the drying shrinkage of restrained concrete immediately after construction. Concrete mixture design and curing procedure are key factors in reducing drying shrinkage and, consequently, early-age cracking.

Objective: The main objective of this research project is to achieve a cement content reduction in NDOT bridge deck and rail concrete mixture through aggregate particle packing optimization and evaluate the overall performance of the new mixture. The Modified Toufar Model will be used in optimizing particle packing and the combined aggregate void content test will be used to experimentally justify optimized aggregate gradations. Locally available aggregates from both East and West Nebraska will be considered. The experimental program of this study consists of three Phases: Phase 1 focuses on obtaining optimized aggregate blends to reduce cement content by half or full sack, while meeting strength and workability requirements for bridge decks and rails. Phase 2 focuses on the evaluation of the overall performance of concrete with reduced cement content with respect to mechanical, viscoelastic, and durability properties. This will include, but not limited to, air content, setting time, modulus of rupture, modulus of elasticity, bond strength, surface and bulk resistivity, free shrinkage, restrained shrinkage, and freeze/thaw resistance. Phase 3 focuses on demonstrating the use of the developed mixture in the construction of a bridge deck slab and/or rail. This could be accomplished in an actual bridge project or full-scale laboratory specimen, where concrete pumpability, consolidation, and curing procedures are evaluated.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	$ 7,565	90%
Task 2: Mix Development	$ 21,0147	40%
Task 3: Performance Evaluation	$ 45,795	10%
Task 4: Demonstration	$ 22,716	0%
Task 5: Report and Presentation	$ 15,270	0%

Deliverables: This study will result in the following benefits: Alternative concrete mixture for bridge decks and rails that is less susceptible to early-age shrinkage cracking, which could increase the service life of bridge decks/rail and reduce road closures/detours associated with repair and replacement activities; and the use of less cement in bridge deck mixes will reduce the concrete cost and its carbon footprint, which are significant economic and environmental advantages.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034B
PROJECT NUMBER	FY22(002)
PROJECT TITLE	Nebraska Balanced Mix Design – Phase I
PRINCIPAL INVESTIGATOR	Hamzeh F. Haghshenas and Mahdieh Khademati - UNL & Robert Rea - NDOT
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Brandon Varilek, Bruce Barrett, Lieska Halsey, Mark Fischer, David Hansen, Asadullah Sahak, Jody Paul, and Gregg Leber-Constructors
PROJECT TOTAL COSTS	$138,937
PROJECT EXPENDITURES TO DATE	$437
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	32%
STATUS	On Schedule
FY-2023 BUDGET	$138,500
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4 & 5

Background: Typically, asphalt mixtures are designed under the Superpave system, in which the proportioning of the aggregates and asphalt binder is based on the aggregate quality characteristics and mixture volumetric properties such as air voids, voids in the mineral aggregate, and voids filled with asphalt. Mixtures designed with high amount of asphalt can be susceptible to rutting, while those with low asphalt content are prone to cracking, raveling, or other durability related pavement distresses. One of the largest shortcomings of current design procedures is the lack of long-term materials aging protocol. Therefore, performance tests should be included as part of the mixture design procedure to ensure the desirable field pavement performance. Many performance tests have been proposed for the evaluation of the rutting resistance (e.g., Hamburg Wheel Track Tester, Gyratory Stability, IDEAL Rutting Test, and High-Temp Indirect Tensile Test), cracking resistance (e.g., Semi-circular Bending Test and IDELA Cracking Test, and moisture susceptibility (e.g., Indirect Tensile Strength, Hamburg Wheel Track Tester) of the asphalt mixtures. In Balanced Mix Design (BMD), two or more mechanical tests are coupled to quantify the mixture resistance against different forms of distress.

Objective: The aim of this research is to establish benchmarks for the current and future mixture designs and criteria to address rutting, cracking, and moisture damage resistance in more detail, especially with a focus on high recycled mixtures and major binder modifications through the use of recycling agents and antioxidants. To this end, the BMD performance tests in high-, and mid-temperature used in different states will be considered and some of them will be carried out on various Nebraska mixtures collected from the field projects. In addition, moisture performance tests will be included in the Nebraska BMD. Long-term aging protocols will be applied to the mixtures to address cracking resistance more accurately. The field evaluation will be conducted on pavement sections and field data will be collected to establish pass/fail thresholds for future quality assurance and acceptance purposes. Then the mixtures containing recycled materials, recycling agents, and antioxidant will be designed and evaluated based on the established pass/fail thresholds.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	$ 17,570	90%
Task 2: Experimental Plan and Sample Collection	$ 11,687	65%
Task 3: Laboratory Tests	$ 43,290	0%
Task 4: Analysis of Test Results	$ 47,440	0%
Task 5: Documentation and Presentation	$ 18,950	5%

Deliverables: The results of this study will provide significant insights to the current and future mixture designs and criteria by addressing major pavement distresses like rutting, cracking, and moisture damage. A special focus will be given to high recycled mixtures modified by additives like recycling agents and antioxidants. The successful development and implementation of BMD in our state will provide safer, more efficient, trustworthy, and comfortable means for the transportation construction industry. It also can lead to significant cost reduction and provide longer lasting and more sustainable asphalt pavements.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034C
PROJECT NUMBER	FY22(003)
PROJECT TITLE	Asphalt Binder Laboratory Short-Term Aging – Phase II
PRINCIPAL INVESTIGATOR	Hamzeh Haghshenas and Mohammad Ghashami - UNL & Robert Rea - NDOT
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Brandon Varilek, Bruce Barrett, Lieska Halsey, Mark Fischer, David Hansen, Asadullah Sahak, and Nick Collins-Jebro
PROJECT TOTAL COSTS	$140,616
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	15%
STATUS	On Schedule
FY-2023 BUDGET	$140,616
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: While blending hot asphalt binder and aggregates in the plant, transporting, and laying the asphalt mixture, hardening of the binder can potentially occur due to the loss of volatiles and/or oxidation. This process is known as short-term aging. The PI and Co-PI proposed a research project entitled "Asphalt Binder Laboratory Short-Term Aging" to statistically investigate the effect of time, temperature, airflow rate, and asphalt binder weight on the chemical and rheological properties of different asphalt binders in the laboratory short-term aging (RTFO) process. In addition, it was attempted to find an improved RTFO aging protocol, which was applicable on both unmodified and highly modified binders. In continuation with the previous research project, finding short-term aging parameters (i.e., new/improved protocol) that can properly simulate the aging process that occurs during WMA production is vital since nearly all of the asphalt mixtures in our state are produced using WMA technology. Also, there is a need for better understanding of short-term aging of asphalt binders treated by RAs since NDOT is planning to use these chemical additives in the Nebraska asphalt mixtures in the near future.

Objective: The objective of this study is to propose a new/improved RTFO aging protocol, which is applicable on binders produced using WMA and RA technology. To meet the objective of this study, first a comprehensive chemical, rheological, and mechanical evaluation will be performed on binders extracted from plant produced WMA/RA mixtures (field short-term aging). From the same plant and project, we will collect binders and age them by varying the short-term aging parameters; time, temperature, airflow, and weight of binder poured in RTFO jar. Any discrepancies and similarities between field aged binders and lab aged binders will be identified. Then we will attempt to propose a new/improved short-term aging protocol in the lab, based on the tests results.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review	$ 10,686	50%
Task 2: Experimental Design and Sample Collection	$ 11,770	40%
Task 3: Laboratory Tests	$ 64,873	0%
Task 4: Analysis of Test Results	$ 28,956	0%
Task 5: Thermal Modeling and Analysis	$ 9,477	0%
Task 6: Documentation and Presentation	$ 14,854	0%

Deliverables: In this study, binders treated by WMA and RA technology will be extracted from plant produced mixtures and also the same binder that was used in the plant before mixing with aggregate will be conditioned in the laboratory by varying the aging parameters. Then the chemical, rheological, and mechanical properties of both extracted and laboratory aged binders will be compared to identify any possible discrepancies and similarities. The findings of this research will be used to improve the current AASHTO/ASTM short-term aging protocol [AASHTO T240/ASTM D2872] and address concerns which have been raised regarding the limitations of the short-term aging equipment (i.e., RTFO) and protocol in the simulation of the aging process that occurs during asphalt mixture production using WMA and RA technology. The modified protocol will ultimately improve the Nebraska quality control and assurance (QC/QA) procedure for short-term aging of asphalt binder.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034D
PROJECT NUMBER	FY22(004)
PROJECT TITLE	Erosion Resistant Rock Shoulder
PRINCIPAL INVESTIGATOR	Chung Song & Richard Wood - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Bruce Barrett, Nikolas Glennie, Lieska Halsey, Mark Fischer, and Terry Rogers-Martin Marietta
PROJECT TOTAL COSTS	$142,907
PROJECT EXPENDITURES TO DATE	$37,994
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	27%
STATUS	On Schedule
FY-2023 BUDGET	$104,913
FY-2023 TASKS TO BE COMPLETED	Tasks 2, 3, 4 & 5

Background: With the advent of climate change, weather patterns are becoming more unpredictable, and consequently, severe drought and flooding are unavoidable. For highway structures, this new weather pattern created new problems in the pavement system. Techniques to evaluate erosion resistance of these materials are not well developed so far. Consequently, the improved design of erosion resistant aggregate and combinations of soil and aggregate are needed. NDOT currently utilizes the gradation of crushed rock surface course and soils, however, materials with this gradation are not always readily available or perform as intended. This study combines dedicated testing methods and hydrodynamics analysis technique to test, evaluate and obtain the erosion resistant shouldering materials which outperform the current design recommendation.

Objective:

1) Obtain an experimental quantity called “erosion coefficient” for various conditions -three different gradations times five different binding agents. The binding agents include No agent (control), Lignon, Nebraska Soybean-based soap-stock, POSS, Loessy binding soils. These will be characterized using the University of Nebraska-Lincoln Erosion Test Bed (UNLETB) and a Jet Erosion Test (JET). The test will be conducted at the same density as the field crushed rock surface course.
   a. UNLETB is a large erosion testing bed. It will test combined specimen of crushed rock surface course and binding agents. JET is a small erosion testing apparatus, and it will test binding agents only.
   b. Expected products are numerical values of erosion coefficient for different samples.
2) Perform a numerical verification of the experimental results using a Hydro-dynamics analytical platform.
   a. For erosion coefficient obtained in objective 1, Flow3D, a computational fluid dynamics software, will be calibrated to predict the erosion performance of the above 15 different conditions. Ultimately, the calibrated parameters, Flow3D, and HEC-RAS(Hydrological Software) will be used to predict field erosion conditions such as field geometry of shoulder, flow depth, and flow velocity.
   b. Expected products are calibrated erosion parameters for field conditions (geometry, flow depth, and flow velocity).
3) Obtain a simplified field erosion equation for different gradations of crushed rock surface courses with multiple different binding agents.
   a. In addition to the Flow3D based calibrated erosion parameters, hand calculation enabled erosion parameters will be provided by statistical analysis.
   b. Expected products are mono grams.
4) Provide an optimized design chart so that NDOT may obtain a conservative gradation of crushed rock surface course (with and without binding agents) from multiple available choices.
   a. Combining output from objectives 1 to 3, a flow chart that can lead engineers to obtain proper crushed rock surface course will be obtained.
   b. Expected products are both in the form of graphical design chart and a computer-based design procedure.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Study	$ 6,829	100%
Task 2: Fabrication of UNL Erosion Testing Bed (UNLETB)	$ 18,694	95%
Task 3: Verification of Testing Technique by Analytical Method	$ 17,217	34.28%
Task 4: Testing and Recommendations for crushed rock surface course materials	$ 42,348	12.26%
Task 5: Reporting	$ 57,819	4%

Deliverables:

1) Allow flexibility in selecting crushed rock surface course – multiple available gradation and multiple available rock quarries will reduce supply chain issues.
2) Safer highway by reducing drop-offs and associated lane departure crashes.
3) Reduced maintenance work and cost saving by providing more resilient highway shoulder.
4) Reduced amount of dislodged rocks relieving stress to District Maintenance Operations.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034E
PROJECT NUMBER	FY22(005)
PROJECT TITLE	Application of Remote Sensing and Hydrologic Modeling to Reduce Highway Flooding in the Nebraska Sandhills
PRINCIPAL INVESTIGATOR	Aaron Mittelstet - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Julie Ramirez, Bob Carnazzo, John Linbo, Cara Roesler, Kirk Harvey, Jason Dayton, Mary Schroer, Nick Burnham, Jon Soper, Mark Kovar, and Jodi Kocher-Felsburg, Holt, & Ullevig, David Mraz-FHWA, and Zach Kresl-FHWA
PROJECT TOTAL COSTS	$143,166
PROJECT EXPENDITURES TO DATE	$24,732
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	16%
STATUS	On schedule
FY-2023 BUDGET	$118,434
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5, 6, 7 & 8

Background: Hydrologic calculations for the Nebraska Sandhills (NSH) generally assume high infiltration, no runoff, and ignore subsurface runoff (groundwater and interflow). While these assumptions allow for the solution to a complex problem, they are not accurate representations of the complex movement of water in the region. Highways in the Sandhills region are a scarce and vital link that facilitate the movement of people and goods throughout the region. Understanding the Sandhills hydrology and highway flooding is extremely difficult because stream gages and monitoring wells are sparse. The thousands of lakes in the NSH provides an opportunity to develop a detailed monitoring system of surface and ground water. Combined with available climate information (snow melt, precipitation) the higher density of groundwater and surface water elevation measurements (or estimates) from this project will lead to improved estimates of lag times between hydrologic events and water level changes. This research will help NDOT quantify the frequency, duration and depth of highway flooding in the NSH and assist NDOT in identifying the location to place culverts under the highway and where to place the highway elevation relative to the groundwater elevation.

Objective:

1) Identify the location, duration and frequency of highway flooding in the NSH.
2) Determine lag time and climatic conditions of highway flooding.
3) Identify frequency curves of highway flooding.
4) Prioritize highways based on frequency of flooding.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Determine Highways That Flood	$ 28,512	70%
Task 2: Duration and Depth of Flooding	$ 20,020	10%
Task 3: Conditions and Lag Time of Flooding	$ 31,328	3.5%
Task 4: Prioritize Highways Based on Frequency of Flooding	$ 31,328	0
Task 5: Identify Most Efficient and Informed Design to Prevent Future Flooding	$ 19,272	0%
Task 6: Write Final Report	$ 12,706	0%

Deliverables:

- A better understanding of how to prevent overtopping of state highways in the NSH will be gained by understanding the relationship of rainfall, surface storage, and groundwater depth. Understanding the elevation needs for the roadway profile and drainage structures will help keep roads open and minimize loss to the travelling public.
- Costs can be minimized by knowing the maximum elevation of surface water and minimizing the raise in roadway profile needed to prevent overtopping. By better understanding the hydrology, the number and size of culverts can be reduced, resulting in a reduction in costs.
- Reduction in road closures due to groundwater inundation.
- More efficient and informed hydrologic and hydraulic design processes can be applied to design in the NSH.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034F
PROJECT NUMBER	FY22(006)
PROJECT TITLE	Evaluation of NDOT's Sediment Barrier Practices Using Performance Data
PRINCIPAL INVESTIGATOR	Mike Perez and Wesley Donald - Auburn University & Blake Whitman - Middle Tennessee State University
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Ron Poe, Nick Soper and Brian Anderson
PROJECT TOTAL COSTS	$191,099
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	18%
STATUS	On Schedule
FY-2023 BUDGET	$191,099
FY-2023 TASKS TO BE COMPLETED	Tasks 2, 3, 4, 5, 6, & 7

Background: Construction activities involve heavy earthmoving activities that typically disturb several acres of land. Due to the nature of construction activity, sediment is the predominant pollutant of concern during the clearing and grading stages, which typically exposes large un-vegetated and un-stabilized land areas to erosive elements. Sediment runoff rates from construction sites can be 10 to 20 times higher than those of agricultural lands and 1,000 to 2,000 times greater than those of forested lands. Construction sites have measured erosion rates of approximately 20 to 200 tons per acre (45 to 450 metric tons per ha) per year. In addition to environmental implications, sedimentation can cause vast economic problems. The loss of aquatic habitat and diminished water quality is often difficult to quantify, however some impacts (i.e., cost of dredging and disposing of accumulated sediment) are easier to assess. Furthermore, the cost of eroded soil replacement comes at a high price. Stormwater management has become an increasingly important aspect of construction activities in the state of Nebraska. The National Pollutant Discharge Elimination System Permit for Storm Water Discharges from Construction Sites (NPDES Permit) requires the Nebraska Department of Transportation (NDOT) to develop a stormwater pollution prevention plan (SWPPP) for all construction activities that are covered by the permit. The SWPPP includes the design, installation, and maintenance of erosion and sediment control practices to minimize downstream impact from stormwater discharges. Currently, NDOT has specifications, standard drawings, and guidance for the design of erosion and sediment control practices. Opportunities exist to better understand the performance of standard NDOT erosion and sediment control practices, improve the design and performance of practices, and to develop additional design manual guidance for the proper selection and design of practices.

Objective:

1) Determine a methodology and modeling process to evaluate the performance of various buffer configuration (i.e., length, vegetation type, soil, etc.) typically encountered along NDOT highway construction sites.
2) Conduct large-scale laboratory experiments to determine the performance of sediment barrier practices used by NDOT using estimated soils losses and stormwater runoff volumes associated with NDOT highway construction projects that can be used to supplement buffers that are not able to meet the minimum 50 ft requirement.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Kickoff Meeting	$ 2,850	100%
Task 2: Literature Review	$ 16,150	55%
Task 3: Develop Methodology for Determining Buffer Efficiency	$ 30,400	55%
Task 4: Develop Large-Scale Testing Methodology	$ 7,600	35%
Task 5: Conduct Large-Scale Sediment Barrier Testing	$ 106,399	0%
Task 6: Data Analysis	$ 17,100	0%
Task 7: Final Report	$ 10,600	0%

Deliverables: The proposed project is expected to improve regulatory compliance and further demonstrate NDOTs commitment to environmentally friendly construction practices. Ultimately, the scientifically attained data generated through this research effort will provide designers, contractors, and NDOT inspectors with a comprehensive performance review of NDOTs sediment barrier practices and effective implementable strategies to improve their performance. In addition, recommendations for updates to current erosion and sediment control design tools that will allow NDOT designers to incorporate effective and innovative erosion and sediment control technologies into their stormwater management plans. Enhanced practices will protect water quality downstream of construction activities, reduce regulatory compliance issues, improve overall public perception, and save Nebraska taxpayer dollars. Erosion and sediment control research performed at the AU-ESCTF has led to immediate implementation through updated standard drawings and specification updates by the Alabama DOT.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034G
PROJECT NUMBER	FY22(007)
PROJECT TITLE	Crashworthy Perforated Square Steel Tube (PSST) Mailbox Support – Phase II
PRINCIPAL INVESTIGATOR	Bob Bielenberg - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Phil TenHulzen, Matt Neemann, Nathan Sorben, Austin White and John Lutz
PROJECT TOTAL COSTS	$219,556
PROJECT EXPENDITURES TO DATE	$1,028
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	Behind Schedule
FY-2023 BUDGET	$218,528
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3 & 4

Background: Federal requirements have made it mandatory that safe mailbox support systems be designed to yield or breakaway when impacted by a vehicle. NDOT has previously used a non-proprietary, u-channel post mailbox support that was evaluated at MwRSF in the 1980's to NCHRP 230. This design was implemented into NDOT's standard plans. However, this standard plan is now obsolete. Very few mailbox supports have been evaluated according to MASH TL-3 specifications. The Texas A&M Transportation Institute (TTI) evaluated locking architectural mailboxes on thin-wall, steel-tube supports to MASH TL-3 (TTI Report No. 9-1002-12-9). A single-mailbox mount was tested and was successful. Two multiple-mailbox (combined standard and locking architectural mailboxes) mounts were tested and both configurations failed to meet MASH TL-3. The mailbox support for multiple mailboxes was subsequently redesigned and resulted in successful MASH TL-3 tests. Due to the limited number of tested mailbox supports, NDOT desired to design and evaluate a MASH TL-3 mailbox support.

Objective: The objective of this research project is to develop a non-proprietary mailbox support using PSST support posts and evaluate the mailbox to MASH TL-3 safety criteria through full-scale crash testing. The design should consider single and multiple mailbox configurations. The design may start with the previous NDOT mailbox support or could be developed independently depending on NDOT's preference. The Phase I research to design and evaluate the mailbox support utilizing bogie testing is current ongoing. The research proposed herein will evaluate the PSST mailbox support design to MASH TL-3 through full-scale crash testing.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Project Planning and Correspondence	$ 18,236	6.3%
1a: General Project planning and documentation		
1b: Develop of CAD details for fabrication and testing		
1c: Sponsor correspondence and TAC meetings		
Task 2: Design and Analysis	$ 8,242	0%
2a: Selection of critical MASH full-scale crash tests and PSST mailbox support configuration for evaluation through full-scale crash testing		
2b: Determination of CIAs for each test		
Task 3: Full-Scale Crash Testing	$ 174,929	0%
3a: Construction of Test Article		
3b: Full-scale Crash Test, MASH 60, 61, 62		
3c: Data and Video Analysis		
3d: System Removal and Disposal		
Task 4: Reporting and Project Deliverables	$ 18,149	0%
4a: Research Report - First Draft		
4b: Report Editing (internal and sponsor)		
4c: TF13 Hardware Guide Drawings		
4d: FHWA Eligibility Submittal		
4e: NDOT Technical Brief		
4f: NDOT PowerPoint presentation of research results		
4g: Project Closing (printing, dissemination, accounting)		

Deliverables: Development of a PSST mailbox support that meets MASH TL-3 requirements will provide NDOT with a crashworthy solution for mailboxes adjacent to state roadways. Additionally, the adoption of a design using PSST similar to current NDOT sign supports will reduce and simplify the state inventory.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034H
PROJECT NUMBER	FY22(008)
PROJECT TITLE	Production of Cast-in-Place UHPC for Bridge Applications
PRINCIPAL INVESTIGATOR	Jiong Hu & George Morcous - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Ross Barron, Wally Heyen, Wayne Patras, Kyle Zilig, Jordan Wipf, Lieska Halsey, Lynden Vanderveen, Dale Burkhead-Simon, and David Mraz-FHWA
PROJECT TOTAL COSTS	$83,996
PROJECT EXPENDITURES TO DATE	$18,897
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	40%
STATUS	On Schedule
FY-2023 BUDGET	$65,099
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2,3, 4 & 5

Background: Ultra-high performance concrete (UHPC) is a new class of concrete that has mechanical and durability properties that far exceed those of conventional concrete. The use of UHPC will result in significant improvements in the structural capacity and durability of bridge components. Due to its superior characteristics, UHPC has drawn substantial interest in the bridge community at both federal and state levels. Besides the bridge deck connections applications in multiple states, Federal Highway Administration (FHWA) Every Day Counts (EDC-6) program "UHPC for Bridge Preservation and Repair" emphasizes the use of UHPC for bridge applications due to its excellent mechanical and durability properties. The research team has already developed a non-proprietary mix using local materials through a recent completed NDOT project (SPR-P1(18) M072) entitled "Feasibility Study of Development of Ultra-High Performance Concrete (UHPC) for Highway Bridge Applications in Nebraska" with a unit cost at approximately $740/CY. While the development of non-proprietary UHPC mixes could greatly encourage the usage of UHPC, the lack of training and experience in batching and handling the material hinders its widespread use. FHWA and multiple state agencies have recently developed guidelines for the use of UHPC. However, most of these documents are focused on either the design of UHPC components or precast UHPC production. There is a lack of detailed guidelines on cast-in-place (CIP) UHPC production and handling, especially when non-proprietary mixes are used. Due to the large amount of fine powders and the very low water-to-cement ratio in UHPC, the proportioning and batching of UHPC is very different from conventional concrete. Also, while it is generally known that UHPC is very flowable, it is often challenging to achieve the desired workability while maintaining stability and too high flowability could lead to fiber segregation. On the other hand, the viscous nature of UHPC could lead to a lack of flow and consolidation. Another peculiarity of UHPC is the rapid workability loss due to the high content of high-range water-reducing (HRWR) admixture. The self-consolidation properties of UHPC cannot easily stand for an extended period of time, resulting in issues of concrete transportation and placement. A preliminary study from the investigators shows that guidelines need to be developed to better control the workability and stability of UHPC in both static and dynamic conditions.

Objective:

1) Provide technical training for producers, contractors, and NDOT engineers required for batching, mixing, transporting, placing, and testing cast-in-place UHPC with both non-proprietary and proprietary mixes (pre-bagged),
2) Develop guidelines for UHPC production and controlling, and maintaining the workability of UHPC production in on-site conditions, and
3) Develop special provisions for cast-in-place UHPC production and quality control.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: State-of-the-Practice of CIP UHPC Production	$ 16,730	95%
Task 2: UHPC Production and Testing Guidelines Development	$ 20,164	80%
Task 3: Training Material Development and Contractors Training	$ 22,665	70%
Task 4: UHPC Field Production Demonstration	$ 11,724	10%
Task 5: Special Provision, Report and Presentation	$ 12,714	0%

Deliverables:

1. Address the challenges associated with UHPC production and on-site construction. The lack of experience and best practice guidelines often causes concerns for producers and contractors.
2. Provide the necessary knowledge and technical support for UHPC production and construction. The success of this project will greatly encourage producers and contractors to adopt this innovative material in cast-in-place bridge applications.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034J
PROJECT NUMBER	FY22(009)
PROJECT TITLE	Accelerated Bridge Construction (ABC) Decision Tool
PRINCIPAL INVESTIGATOR	Phil Barutha & Marc Maguire - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Wayne Patras, Kyle Zilig, Mike Vigil, Kent Miller, Lynden Vanderveen, and David Mraz-FHWA
PROJECT TOTAL COSTS	$90,592
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	15%
STATUS	On schedule
FY-2023 BUDGET	$90,592
FY-2023 TASKS TO BE COMPLETED	Tasks 2, 3, 4 & 5

Background: A challenge transportation asset managers face is the need to cost effectively prioritize the repair and replacement of the large inventory of deteriorating bridges while considering the increasing budgetary constraints. Accelerated bridge construction (ABC) is defined by the FHWA as bridge construction that uses innovative planning, design, materials, and construction methods in a safe and cost-effective manner to reduce the onsite construction time that occurs when building new bridges or replacing and rehabilitating existing bridges. ABC techniques have a great potential to minimize the traffic disruptions during bridge replacements and construction, promote traffic and worker safety, and improve the overall quality of the built bridges. Despite the major advances in design and construction of ABC techniques, some agencies are hesitant about using ABC techniques due to risks during construction and perceived higher initial costs. In addition, oftentimes the current decision process used to determine and prioritize the candidate bridges for this type of construction can be based solely on average annual daily traffic (AADT), where this may be prudent to evaluate based on several factors. A decision making framework incorporating important factors in determining the suitability of ABC in Nebraska will allow NDOT to find the best fit candidate bridges to maximize the benefits of Accelerated Bridge Construction.

Objective: The main objective of the study is to develop a decision making framework to help inform NDOT on the applicability of ABC methods on the various bridges within the transportation network in Nebraska. The study will obtain data specific to Nebraska and develop a decision model to compare the use of ABC as compared to traditional methods using factors weighted on importance to achieving agency objectives. Weighted factors may include direct costs, user impacts, average daily traffic, site conditions, safety, and other pertinent factors impacting construction methodology. The specific factors and weighting will be determined in coordination with NDOT during the research study.

The project will result in development of an ABC Decision Tool that will serve as a framework to allow NDOT to rigorously determine and prioritize the use of ABC on candidate bridges in need of replacement or new construction which will provide the agency with the most value. The decision tool is intended to be used early in the preliminary project development phase to evaluate design and construction methodology alternatives.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review of Current ABC Decision Processes	$ 11,013	100%
Task 2: Investigate NDOT Internal Processes to Determine ABC	$ 31,460	10%
Task 3: Obtain Feedback from Nebraska Contractors	$ 8,186	0%
Task 4: Development of Decision Process and Tool	$ 24,304	0%
Task 5: NDOT Review and Validation of Decision Tool	$ 15,629	0%

Deliverables: The results of this study can be used to help NDOT determine the best candidate bridges to utilize ABC early in the design and construction methodology decision making process. The decision tool can serve as a preliminary screening process to identify bridges with attributes that benefit most from the use of ABC. Early identification of good candidate bridges allows the NDOT to better implement ABC methods to maximize the benefits and minimize the costs of ABC in a budget constrained environment.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034K
PROJECT NUMBER	FY22(010)
PROJECT TITLE	Application of Steel Sheet-Piles for the Abutment of Water-Crossing Bridges in Nebraska
PRINCIPAL INVESTIGATOR	Seunghee Kim, Jongwan Eun, Chung Song, and Chungwook Sim - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Ross Barron, Wayne Patras, Noah Pitts, Jake Blessen, Matt Eames, Jason Dayton, Brandon Varilek, Nikolas Glennie, Alex Silvey, Mark Mainelli-Mainelli Wagner and Associates, Jesse Sire-JEO, and David Mraz-FHWA
PROJECT TOTAL COSTS	$155,304
PROJECT EXPENDITURES TO DATE	$62,388
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	On Schedule
FY-2023 BUDGET	$92,916
FY-2023 TASKS TO BE COMPLETED	Tasks 2 3, 4, & 5

Background: Sheet piles are recommended to be installed for most water-crossing bridges, along with load-bearing piles, to avoid the scouring problem and protect backfill soils in Nebraska. A specific design procedure related to the axially loaded sheet piling does not exist in most parts of the US. Accordingly, the research team perceived a lack of data and experience in the design and analysis of vertical and lateral load resistance of the axially loaded sheet piling. For example, there is insufficient confidence in the estimate of bending and lateral stresses induced by the axial loading and lateral soil pressure, respectively. There is also uncertainty on how lateral load could be transferred from the superstructure to the sheet pile during a seasonal temperature variation. In terms of the side frictional resistance, it is unknown how the skin frictional resistance of the sheet pile could be mobilized in the different passive and active zones. Moreover, the side frictional resistance could be noticeably different between the dry and submerged soil conditions. For the end bearing resistance, the soil plugging effect may improve the end bearing capacity. Those uncertainties may result in a too conservative design, and thus, an unnecessary increase in the construction cost.

In addition to those general challenges, there are additional research needs perceived by engineers in Nebraska. First, the load transfer from the superstructure to the substructure could be substantially different depending on the connection design that is a unique design of Nebraska DOT compared to other states. The main difference with other states is that Nebraska is no longer using back walls behind the deck for semi-integral abutment bridges. If there is a back wall element, there will be a joint created at the end of the deck before the approach span starts. Nebraska moved from this design and has details which combines the deck, girder, and approach span and creates the joint far away from the end of the deck at the approach span. Due to the difference in details at the end of the deck, the total horizontal force created by temperature loading from the superstructure, which should interact with the lateral soil loads that will create a moment, will differ from other cases. Second, the tie-rod anchor may be avoided depending on the soil condition and bridge design. With that, the reduction or elimination of the anchor will bring the cost and time saving for the construction. Lastly, there is a research need that investigates the feasible length of the superstructure that is compatible with the concept of the axially loaded sheet pile abutment system of a short-span bridge for general geologic conditions and construction practices in Nebraska.

Objective: The overall goal of this study is to investigate the anticipated performance of steel sheet-pile bridge abutment to encourage its wider applications to not only new construction but also repair/replacement of existing water-crossing bridges in Nebraska. To achieve this goal, we set several objectives as follows:

- Suggest an improved analysis method that incorporates the combined effect of axial and lateral loads that are imposed on the sheet pile walls and considers the following aspects:
    - Skin frictional resistance in active/passive zones for either dry or submerged soil conditions, Soil plugging effects, Different cross-sections of the sheet piles,Design configurations (cantilever vs. anchored walls), Effect of seasonal temperature variations.
- Elucidate the moment generated by the forces between the horizontal movement of the superstructure of semi-integrals in Nebraska vs. loads caused by the soil behind (e.g., active/passive pressures, the friction of backfill on superstructure end or the shearing resistance of backfill, which could play a role if the bridge has skew and lateral bearings are not provided).
- Assess the feasibility of avoiding the tie-rod anchoring for various design parameters.
- Suggest a range of superstructure length and skew angle that can be supported by the axially loaded sheet pile abutment system.
- Provide the research summary and design recommendations that can be used by engineers and contractors for the water-crossing bridges in Nebraska.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Review on the Sheet Pile Bridge Abutment Systems	$ 14,460	100%
Task 2: Experimental Studies to Obtain Design Parameters	$ 81,354	40%
Task 3: Numerical Studies to Investigate the Performance of Sheet Pile Bridge Abutment Systems	$ 44,677	0%
Task 4: Summary and Design Recommendations	$ 7,846	0%
Task 5: Final Report	$ 6,967	0%

Deliverables: Experimental and numerical modeling data and improved analysis for the axially loaded sheet pile abutment systems, including the anchored design, will be provided; A better understanding of the earth pressure development, the mobilization of skin friction resistance, end-bearing capacity, and load transfer will be provided; Design recommendations to improve the performance of sheet pile abutment systems will be provided; and Based on those outcomes, the research findings can help reduce the construction time and cost for both new and repair/replacement of water-crossing bridges in Nebraska.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034L
PROJECT NUMBER	FY22(011)
PROJECT TITLE	Truck Platooning Effects on Girder Bridges, Phase II
PRINCIPAL INVESTIGATOR	Joshua Steelman, Jay Puckett, and Daniel Linzell - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Ross Barron, Kent Miller, Kyle Zilig, Kpandji Lakmon, Emilie Hudon-Olsson and David Mraz-FHWA
PROJECT TOTAL COSTS	$120,843
PROJECT EXPENDITURES TO DATE	$17,009
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	18%
STATUS	On Schedule
FY-2023 BUDGET	$103,834
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: Connected and Automated Driving System (C/ADS)-equipped vehicles are expected to become increasingly common in the United States and elsewhere globally. Truck platooning with CV technologies places trucks much closer than current design codes anticipate. Truck platooning is expected to be deployed imminently, according to the anticipated timeline provided in Trimble. The density of truck traffic and the implications for structural safety and serviceability should be considered as part of a platooning policy to avoid compromising bridge service lives. Platoons of heavy trucks will be economically advantageous for freight operators in the near future, but information currently available is insufficient for bridge owners to establish platoon operation limitations and guidelines ensuring safe and serviceable loading demands in girder bridge structures in terms of vehicle weights, live load uncertainties, and headways.

Objective:

1. Calibrate appropriate live load factors for use with platoons to address the Service III limit state for concrete girder bridges.
2. Calibrate appropriate live load factors for use with platoons to address the Service II limit state for steel girder bridges.
3. Propose a framework for characterization of uncertainty from individual contributions within live load effects.
4. Facilitate adoption of platoon permitting with illustrative examples.
5. Approximately assess the significance of platoon-induced fatigue with respect to service life.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Service III Evaluation for Prestressed Concrete Girders	$ 26,703	65%
Task 2: Service II Evaluation for Composite Steel Girders	$ 27,362	0%
Task 3: Operationalize Uncertainty Calibration	$ 8,711	0%
Task 4: Illustrative Examples	$ 18,983	0%
Task 5: Fatigue Platoon vs Design Comparison	$ 6,894	0%
Task 6: Correspondence and Documentation	$ 32,190	0%

Deliverables: This research will enable NDOT to strategically and responsibly incentivize platoon operations along the I-80 corridor by optimizing freight transport efficiency. Additional truck traffic will provide economic benefits from direct sale of vehicle fuel, as well as secondary economic benefits to mechanics and technicians who provide vehicle maintenance and smart vehicle control services. Providing a smart corridor for platoons also positions Nebraska for future benefits if a transportation tax is imposed on a vehicle-miles-traveled basis rather than a direct fuel tax. The results of this research will enable platooning operations to increase vehicle weights without compromising service lives of bridges from overloads and repeated cycles of inelastic behavior. This research will build upon a framework developed in the first phase of the research and thereby capitalize on investments previously allocated by NDOT.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01034M
PROJECT NUMBER	FY22(012)
PROJECT TITLE	Inventory, Operations, and Safety at Free Right-Turn Ramps
PRINCIPAL INVESTIGATOR	Aemal Khattak - UNL
PROJECT START DATE	7/1/2021
PROJECT COMPLETION DATE	5/31/2023
TECHNICAL ADVISORY COMMITTEE	Alan Swanson, Scott Milliken, Kris Fornoff, Kyle Christensen, and Abe Anshasi-FHWA
PROJECT TOTAL COSTS	$182,563
PROJECT EXPENDITURES TO DATE	$32,941
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	
STATUS	On Schedule
FY-2023 BUDGET	$149,622
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: Research on right turns at rural intersections on the state highway system was initiated by the Nebraska Department of Transportation (NDOT) during the 1990's (McCoy et al., 1995) and again during the 2016-2018 period (Khattak and Kang, 2018). In the former study, the authors developed guidelines for the establishment of FRT ramps on rural two-lane highways in Nebraska based on a benefit-cost analysis. They recommended that design-year right-turn AADTs ranging from 440 to 825 vehicles per day (depending on truck percentage) warranted a FRT ramp at unsignalized intersections on rural two-lane highways. Acceleration lanes improved vehicle merge operations and while right-turning traffic moved efficiently, there were no discernable safety improvements from FRT ramps.

In the latter study, the authors looked at safety and economic benefits of rural intersections with offset right-turn lanes (ORTL) compared to rural intersections with no right-turn lanes and those with traditional right-turn lanes. They also investigated drivers' stopping behavior on the minor approaches at ORTLs. Results showed ORTLs had the lowest crash rates; however, the difference was statistically not significant. The cost-benefit analysis indicated that compared to intersections with no right-turn lanes, ORTL intersections had an annual reduction of 0.202 crashes per million entering vehicles, which translated to $22,662 savings in crash costs per year. When compared with intersections having no right-turn lanes, a traditional right-turn lane reduced 0.0758 crashes per million entering vehicles annually or $8,504 savings in crash costs per year. Driver stopping behavior assessment showed that number of through lanes, width of right-turn lane and width of the ORTL offset were statistically associated with driver's stopping position on the minor approach and overall drivers were taking advantage of the ORTLs improved sight distance. In this study, free right-turn (FRT) ramps were excluded due to their uniqueness (compared to traditional right-turn lanes and ORTLs) for a later study.

NDOT has several FRT ramps across the state highway system. The intersection minor approaches stop-controlled and varying driver warning devices may be in place at these locations. There are concerns about the safety and operations of FRT ramps and therefore, there is a need to review the operations and safety of these locations.

Objective:

- Create a statewide inventory of rural free right turn ramp intersections and provide to NDOT in an appropriate format.
- Using NDOT 10-year crash data, conduct statistical safety analyses of rural FRT intersections extending ¼-mile in each direction from the intersection.
- Study vehicular operations at rural intersections with and without FRT ramps. This will include a comparison of recorded vehicular speeds and conflict analysis.
- Develop guidelines for operations and safety tradeoffs to assist with NDOT projects on maintaining similar locations, removing or reconstructing ramps and traffic warning/control signage.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	$ 27,493	80%
Task 2: Inventory of Rural FRT Ramp Intersections	$ 21,456	60%
Task 3: Safety Analysis of Rural FRT Ramp Intersections	$ 32,654	0%
Task 4: Study of Vehicle Interactions and Comparison	$ 42,421	0%
Task 5: Operations and Safety Tradeoffs Analysis	$ 19,090	0%
Task 6: Final Report and TAC Presentation	$ 39,450	0%

Deliverables: The research will assist NDOT Traffic Engineering, District staff, and Roadway Design Divisions with making more informed decisions when dealing with rural intersections with free right turn ramps. The research will also lead to improved public safety on Nebraska highways.

Performance & Goals: Project is up to date with the current tasks and progress.

NEW PROJECTS FY 2023

CONTROL NUMBER	01046A
PROJECT NUMBER	FY23(013)
PROJECT TITLE	High-Mast Tower Foundation – Phase II
PRINCIPAL INVESTIGATOR	Marc Maguire-UNL
PROJECT START DATE	07/01/2022
PROJECT COMPLETION DATE	05/31/2024
TECHNICAL ADVISORY COMMITTEE	Brandon Varilek, Mick Syslo, Mark Fischer, Mark Burham, Nikolas Glennie and David Mraz-FHWA
PROJECT TOTAL COSTS	$153,428
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$ 101,799
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, & 4

Background: Phase I addressed a review of the research literature, design specifications, state of practice in electrical- and communication-tower embedment, and corrosion. A mastic layer is typically provided for corrosion protection.
Next, the required resistance for a typical NDOT tower was computed with the developed tools. The foundation analysis and designs were conducted for sandy and clay soils typical of Nebraska with the resistance established. A finite element tool was developed for rigorous analysis, and this was combined with analysis from L-Pile, an industry standard. Finally, and significantly, site conditions and construction practices were documented. An appendix was developed that outlines project qualifications, execution methods, and construction documentation. Phase I work did not include testing. To our knowledge, no transportation structures have been directly embedded.
The next step is to construct and test embedded poles in a controlled and safe location. NDOT property is suggested, but other sites may be possible. This project will:
1. Construct embedded poles
2. Statically test up to the design limit
3. Test the poles dynamically and monitor performance (low to high excitations applied with an eccentric mass oscillator (or shaker) – we will control the amplitude and loading frequency. We will monitor deformations, strains, and accelerations with our standard data acquisition and sensors. The number of cycles will approximate the years of service life.
The proposed Phase II work will employ Phase I work with a construction demonstration followed by static and dynamic testing. Tools and methods developed in Phase I are directly applicable to Phase II. Similarly, the literature review from Phase I will be considered sufficient, however, we will check for recent studies.

Objective:

1. Develop a pole design and procedures for the construction of foundations for high-mast poles.
2. Demonstrate these procedures with the installation of high-mast poles.
3. Confirm the performance with static tests to approximate the design winds.
4. Obtain damping ratios for these poles.
5. Dynamically test the pole to model long-term performance under dynamic loads.
6. Based on these findings, provide design and construction provisions to be integrated into NDOT specifications for design and construction.
7. Document the work product in a final report.
8. Share results nationally via COBS T-12 that maintains the AASHTO specifications for these structures (this is beyond the scope and is longer term)

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature and Specification Review	$ 14,543	0%
Task 2: Construct Poles (this task is largely provided by NDOT)	$ 19,453	0%
Task 3: Test Poles	$ 82,870	0%
Task 4: Report Findings	$ 36,561	0%

Deliverables: Research is expected to provide a design guide for structural strength I and fatigue loads. Validate the present methods for drilled shafts used by NDOT. Note that no failure or service problems have been noted in the current foundations.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046B
PROJECT NUMBER	FY23(014)
PROJECT TITLE	Gravel Road Performance Enhancements
PRINCIPAL INVESTIGATOR	Bora Cetin-Michigan State University
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Bruce Barret, Nicholas Glennie, Brandon Varilek, Terry Rogers- Martin Marietta; Mitch Doht- LTAP;
PROJECT TOTAL COSTS	$166,064
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$73,098.20
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: Approximately 72,134 miles of gravel roads (39 miles state highway) exist in the 194,938-mile road network in the State of Nebraska. Two of the most common distresses for gravel roads are rutting and wash boarding. Rutting often occurs when the moisture content of gravel roads is high. These distresses are recurring across the state. The sustainability of granular roadways is very important to the rural economy since these roads provide access to rural land and enable the transportation of agricultural products. Many counties spend significant portions of their budgets on maintenance and rehabilitation of gravel roads. Opportunities exist to improve the performance of the gravel roads which would reduce the maintenance frequency and would yield significant cost savings. The proposed research project will examine several stabilization and construction methods that pose strong potential to minimize damages of gravel roads. A range of potential stabilization technologies to address these issues will be studied, including crushed rock embedment, gradation optimization, and the possible addition of angular material, and waste fines. The proposed study will conduct a comprehensive laboratory study to evaluate the efficiency of different treatment methods on improving the performance of granular road. Gravel road materials (along with the subgrades) will be collected from different locations in Nebraska that experienced significant road distresses. Data (e.g., resilient modulus, California bearing ratio (CBR), abrasion, freeze-thaw durability) will be measured and evaluated to quantify the treatment effectiveness. A primary outcome for this research is to optimize the NDOT gradation for gravel surfacing with materials that are locally sourced. In addition, this research will also develop a data-driven model to estimate the type and amount of materials to be added that would improve the performance of gravel roads via use of simple index properties

Objective:

The overall goal of this project is to develop, through rigorous laboratory tests, new guidelines for a wide range of Nebraska-specific gravel road materials and to develop a modeling tool to determine the optimized gradation to achieve a target gradation and plasticity and binding capacity, respectively, which will maximize the performance and durability of gravel roads. To accomplish this goal, the research team has established the following objectives:

1. Identify and review the current state of the practice for other state DOTs and industry (Midwest states in particular) via reports and an online survey/interview on the topic of gradation and stabilization guidelines used for gravel roads.
2. Conduct a thorough laboratory study to quantify the effects of variations in gradation and plasticity on the geomechanical characteristics of gravel road geomaterials.
3. Identify the optimum gradation and plasticity ranges that will lead to increased strength and reduced damage from freezing-thawing cycles.
4. Develop an optimized gradation modeling tool that uses laboratory index properties of aggregates to determine relative proportions of fresh aggregate, fines, and stabilizer materials to be added to achieve an optimized target gradation and plasticity.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Kickoff Meeting	$ 0	0%
Task 2: Literature Review & Survey	$16,540.24	0%
Task 3: Sample Collection	$11,026.82	0%
Task 4: Laboratory Testing	$83,362.84	0%
Task 5: Data Analysis and Development of Tool and Guideline Update	$33,080.46	0%
Task 6: Final Report	$22,053.64	0%

Deliverables: The maintenance of gravel roads can consume significant portions of county budgets. Improving the longevity of granular roads by optimizing the performance of surfacing materials will reduce the consumption of virgin aggregate required for surfacing, as well as the frequency of required maintenance. As a result, counties will consume fewer aggregates which are finite natural resources, thus leaving more funds to devote to other pressing social, economic, and environmental needs. The project will generate more broadly applicable stabilization techniques, which county engineers can use to achieve such improved longevity of gravel roads.

CONTROL NUMBER	01046C
PROJECT NUMBER	FY23(015)
PROJECT TITLE	Application of Cementitious Materials and Fiber Reinforcement to Enhance Lime Stabilization for Nebraska Shale Soils
PRINCIPAL INVESTIGATOR	Jongwan Eun- UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Bruce Barret, Nicholas Glennie, Brandon Varilek, Alex Silvey
PROJECT TOTAL COSTS	$142,129
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$65,930
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Performance & Goals: Project is up to date with the current tasks and progress.

Background: As the previous discussion, lime and cement can be mutually complementary. Lime alone has been ineffective in stabilizing several specific soils in Nebraska. In particular, lime has not been effective at stabilizing shale soils in northeast Nebraska. However, previous studies have found that by combining lime with fly ash, cement, or fiber reinforcement they can control shrinkage and swelling as well as increase strength and stiffness. This method of combining an additive with lime enhances the performance of the stabilization. However, NDOT has not tried varying proportions of additives with lime that provisions can be written, and construction practices developed for use in the field. Thus, a systematic study is warranted to help NDOT facilitate its usage for subgrade stabilization. It is needed to identify the effectiveness of mixing cementitious materials and fiber reinforcement to enhance lime stabilization and to prepare the design practice in Nebraska.

Objective:

The objectives of this research are to 1) Identify the effectiveness of mixing cementitious materials and fiber reinforcement to enhance lime stabilization and 2) evaluate the design properties of cementitious materials and fiber reinforcement to enhance lime stabilization for weak subgrade in Nebraska. Based on the expertise of the team, the scope of work includes:

1) Performing extensive literature review from other DOT's cases and practices that applied to mix cementitious materials and fiber reinforcement to subgrade stabilization,

2) Evaluating geotechnical properties of weak subgrade soils (e.g., Pierre Shale) treated and non-treated with cementitious materials and fiber reinforcement,

3) Assessing environmental resistance of treated soils with freezing-thawing cycles,

4) Analyzing the performance of treated and non-treated subgrades through Large-Scale Track Wheel (LSTW) test [evaluating k value, CBR, resilient (Mr) modulus],

5) Suggesting a design practice of lime, cementitious materials, and fiber mixture. The site-specific applicability and cost-effectiveness of treated and non-treated subgrade will be identified.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	$12,795	0%
Task 2: Geotechnical characterization	$22,157	0%
Task 3: Freezing-thawing cycle test	$64,043	0%
Task 4: Large scale tracking wheel test	$29,483	0%
Task 5: Design recommendation	$12,651	0%
Task 6: Final Report and TAC Presentation	$1,000	0%

Deliverables: The proposed research will provide mixing guidelines of lime and cementitious materials or lime and fiber reinforcement stabilization with weak soils for the roadway layers. Based on the results, the site-specific applicability of lime-cement or fiber-treated subgrades will be identified. The end results of this research project will contain a performance chart of lime, cement, or fiber stabilization with the selected sets of soil conditions, aggregate types, and the types and mixing ratio of the lime and cement or fiber stabilization.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046D
PROJECT NUMBER	FY23(016)
PROJECT TITLE	Nebraska Balanced Mix Design – Phase II
PRINCIPAL INVESTIGATOR	Hamzeh F. Haghshenas - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Bruce Barrett; Robert Rea, Mike Reynolds; Asadullah Sahak; Jody Paul
PROJECT TOTAL COSTS	$141,914
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$65,612
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4 $ 5

Background: The research team currently is performing a research project entitled "Nebraska Balanced Mix Design - Phase I" funded by Nebraska DOT to develop BMD method for Nebraska pavements. Phase I of this research project will ultimately define the Nebraska BMD method which considers 3 main distresses: rutting, fatigue cracking, moisture damage. To be able to fully implement the outcomes of this research, the field evaluation must be conducted, and field data must be collected to establish pass/fail thresholds for future quality assurance (QA) and acceptance (QC) purposes.

Objective:

The aim of this research is to establish pass/fail thresholds for future QA/QC for the BMD mix design. To this end, several projects across the state will be selected, the condition of pavements before paving will be evaluated, and after paving will be monitored. In addition, mixes from each selected project will be collected and the BMD performance tests selected from the phase I of the BMD project will be carried out. The results of laboratory tests will be compared with field performance data to establish pass/fail thresholds.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	$ 17,494	0%
Task 2: Experimental Plan and Sample Collection	$ 10,417	0%
Task 3: Laboratory Tests	$ 41,593	0%
Task 4: Analysis of Test Results	$ 50,548	0%
Task 5: Documentation and Presentation	$ 21,863	0%

Deliverables: This study will improve the current mixture design method (i.e., Superpave) in Nebraska, where currently only volumetric characteristics are considered and the effects of additives such as recycling agents, antioxidants, polymers, and fibers cannot fully be addressed. More than that, the BMD method can be employed to design asphalt mixtures containing high RAP materials based on the fundamental properties of mixtures that can better address the main modes of distress: rutting, cracking, and moisture damage.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046E
PROJECT NUMBER	FY22(017)
PROJECT TITLE	Development of the Nebraska Department of Transportation Winter Severity Index – Phase II
PRINCIPAL INVESTIGATOR	Mark R. Anderson - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Tom Sands, Mike Mattison, Tom Renninger, Jesse Schulz, Kurt Vosburg, James Laughlin and Todd Cecrle
PROJECT TOTAL COSTS	$183,603
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$106,134
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: The Nebraska Winter Severity Index (NEWINS) was previously developed (Phase I, NDOT Report No. SPR-P1-(17)M054; Walker et al. 2018) to provide an independent, historic meteorological baseline of individual winter storm severity and overall, statewide winter seasonal severity. The NEWINS framework identified six winter storm categories based on their expected impacts to NDOT winter maintenance operations and mobility. Subsequent work assessed the NEWINS in the context of the Maintenance Decision Support System (MDSS; Anderson et al. 2020a) and with respect to weather-related vehicular crash severity (Anderson et al. 2020b). The proposed work seeks to facilitate the next phase in the expansion of NEWINS by leveraging its framework and algorithms in support of forecasting and predicting the anticipated severity of winter storms. The prediction relevant input data will be obtained from the National Centers for Environmental Information (NCEI) National Digital Forecast Database (NDFD) which is populated from National Weather Service forecasts. The NEWINS algorithms will be run on the digital forecast database in order to produce an expected, or forecasted, winter storm classification at various time increments in advance of the storm. An additional advantage of the NDFD is that NEWINS predictions are no longer restricted to NDOT district-level resolution. NEWINS can now be computed for smaller regions including although not limited to superintendent maintenance areas, specific roadway corridors (e.g., Interstate 80), and for individual counties throughout the state. Further, the NDFD could facilitate inclusion of a freezing rain parameter within the previously developed NEWINS.

Objective:

The study objectives are to expand and evaluate the NEWINS tool. This expansion intends to refine the spatial and temporal resolution of the enhanced NEWINS at the supervisor and superintendent level of a NDOT district (Figure 1). Additionally, the enhanced index will be evaluated to include freezing rain and icing events. Further, consideration of post-event weather conditions such as blowing and drifting snow and sub-freezing temperatures could also be included into NEWINS. Last, NEWINS will incorporate computer model forecast data instead of climatological data, which has been done in the past. This allows NEWINS data to be evaluated up to 72 hours before, or during an event (Figure 2). The forecasted NEWINS weather information will allow for maintenance planning and scheduling based on forecasted impacts.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	$ 10,369	0%
Task 2: Data Collection, Modeling, and Observational Products	$ 21,233	0%
Task 3: NEWINS Capability Expansion	$ 61,900	0%
Task 4: Case Study Analysis	$ 37,574	0%
Task 5: Assessment Analysis	$ 31,400	0%
Task 6: Quarterly report, final report, presentations and Write-Ups	$ 21,127	0%

Deliverables: The project team will develop recommendations for an NDOT implementation plan. The project team anticipates that NDOT staff will need to further associate forecast NEWINS output with their own internal maintenance, personnel, and operational data in order to fully implement the potential benefits of having a forecasted winter storm severity index metric.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046F
PROJECT NUMBER	FY23(018)
PROJECT TITLE	Updating rainfall zones and intensities in Nebraska for improved design of non-bridge sized drainage structures: Phase I -
PRINCIPAL INVESTIGATOR	Rezaul Mahmood - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Julie Ramirez, Bob Carnazzo, Kirk Harvey, Jason Dayton, and Jodi Kocher-Felsburg, Holt, & Ullevig
PROJECT TOTAL COSTS	$120,000
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$70,852
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background:

NDOT utilizes the Rational Method to calculate peak design discharge flows for small drainage areas (less than 640 acres) when sizing culverts and storm sewers. This method requires information about land use, watershed travel time, and precipitation data for the location of interest. NDOT's current implementation of the Rational Method simplifies the precipitation data into three rainfall zones with intensity-duration-frequency (IDF) curves determined from UNL research completed in 1988. That research developed the three rainfall zones based on the National Weather System's Technical Paper 40 (1961) by using spatial analysis of the general pattern of rainfall isohyets shown in TP-40. Climate scientists typically define a climate normal in terms of 30-year averages, meaning that the 60 years old precipitation data being utilized by NDOT to date is likely not representative of the current climatic conditions in Nebraska.

Objective: Based on the findings, the necessary updates in the current approaches will be suggested. The specific objectives of the proposed research are listed below:

1. Compare the intensities in the rainfall data from 1961 against the intensities in the current data.
2. Review and update the current rainfall zones.
3. Review and update the IDF curves.
4. Provide updated calculation method for peak flow based on updated rainfall intensities applicable to Nebraska.
5. Provide recommendations for the practitioners.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Data Collection and processing	$ 11,519	0%
Task 2: Preparation of the updated IDF curves for the existing zones	$ 15,674	0%
Task 3: Comparison of the updated IDF curves and the existing curves	$ 15,612	0%
Task 4: Spatial Analysis of the collected data to create new rainfall zones	$ 20,239	0%
Task 5: Preparation of the new IDF curves for the new zones	$ 16,130	0%
Task 6: Dissemination and deliverables	$ 40,825	0%

Deliverables: The project will result in updated rainfall zones and the associated IDF curves for the state of Nebraska for their use in the Rational Method to calculate peak flow. The results will clearly show the benefits of using updated rainfall information, which is expected to result in a more realistic estimation of flood peaks. A detailed guide will be provided, which will include all the specifics of the analysis and the outcomes. The copies of codes, data, and results prepared as a part of the work will be transferred to NDOT for archiving and further use. The new zones will be made available as shapefiles, and the corresponding IDF curves will be stored in an Excel file for easy interpretability and use. A demo computer program (not complete software) will be developed for demonstration purposes.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046G
PROJECT NUMBER	FY23(019)
PROJECT TITLE	Minimizing take of threatened rattlesnakes and optimizing project review in SE Nebraska
PRINCIPAL INVESTIGATOR	Shawn Dunn
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Ronald Poe; Jeff Hartman; Nicholas Soper, Jon Soper and Zach Kresl- FHWA
PROJECT TOTAL COSTS	$62,238
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$42,486
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: The western massasauga (Sistrurus tergeminus) and the timber rattlesnake (Crotalus horridus) are listed threatened snake species occurring in the southeast portion of Nebraska and protected under Neb. Stat. 37-801-811. A thorough review of the massasauga's life history can be found in Patten 2006 and Patten et al. 2016.

Recent studies (e.g., Fogell 2011) have shown these species are using green spaces in the right-of-way along several roads in Jefferson, Gage, Pawnee, and Richardson Counties which necessitates the need for added Environmental Review from Nebraska Department of Transportation (NDOT) staff and onsite surveys prior and during maintenance and construction to roadways.

Objective:

a) Identify precise locations of western massasauga brumation sites;
b) Map travel corridors from brumation site to active (summer) sites and explore how they relate to NDOT ROW;
c) Develop standardized survey/search protocols.
d) Document materials used by snakes as basking and/or refuge locations;
e) Provide recommendations to avoid or minimize impacts to protected snakes for future NDOT maintenance and construction practices.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Data Collection & Supply Purchasing: initial ground surveys, mileage, LifeTags, CTT Locators, etc.	$ 27,000	0%
Task 2: Snake surveys & Life Tag Attachment: ground surveys, snake capture and processing, mileage, etc	$ 10,886	0%
Task 3: Geolocate snakes: continue surveying for snakes but also establish routes to track tagged snakes.	$ 8,600	0%
Task 4: Data analysis: office work with collected data including movement, material use, standard morphometric data, mapping, etc.	$ 3,100	0%
Task 5: Second field season: largely repeat Tasks 2 and 3 using data from first season.	$ 11,652	0%
Task 6: Final data analysis: analyze snake movements to accomplish grant Objectives and present final products to NDOT.	$ 1,000	0%

Deliverables: This research will result in the immediate benefits of increased knowledge of protected snake locations; thus, those data will immediately benefit project reviews, minimize the need for conservation conditions in some areas, and reduce the chances of take. Standardized protocols, recommended materials and construction practices will all be provided by Quarter 8 (see Schedule below) and can be quickly be implemented into NDOT review process.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046H
PROJECT NUMBER	FY23(020)
PROJECT TITLE	A Statewide Geographic Information System (GIS) as a Predictive Tool for Locating Deeply Buried Archeological Deposits in Nebraska: (PHASE III-The Sandhills Region)
PRINCIPAL INVESTIGATOR	Courtney Ziska-History Nebraska
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Stacy Stupka, John Swigart, Kresl Zach and Jeff Hartman
PROJECT TOTAL COSTS	$120,130
PROJECT EXPENDITURES TO DATE	$0
NUMBR OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$59,515
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5, 6, 7 & 8

Background: The Sandhills cover a vast portion of central and western Nebraska and are drained by the Cedar, Calamus, North Loup, Middle Loup, Dismal, Snake, and Niobrara rivers and their tributaries. The proposed project will examine multiple localities along some of these streams to fill in the major data gap in our existing Phase I and Phase II buried sites prediction tool. While new data will always be added and the model improved, the current proposal seeks to complete acquisition of baseline data for all drainages in the entire state. Upon completion, if awarded, the project will allow to prediction tool to be operational for all of Nebraska.

Objective: The proposed project will be developed by HN as a collaborative effort with the KGS.In addition to senior project staff at HN and KGS, a graduate research assistant will be employed. The proposed project will add to the existing Phase I and Phase II GIS-based data repository of all Nebraska geoarchaeological information including: published and unpublished reports or portions of reports, bibliographies, stratigraphic profiles, radiocarbon ages, maps, notes, and photographs. These data will be linked to specific LSAs in specific stream valleys and drainage basins and in some lakeshore setting in the Sandhills. The GIS will allow us to visualize the Sandhills data in the form of maps and diagrams and reveal temporal and spatial patterns of landscape evolution in drainage basins.

The GIS will be housed at and maintained by the HN State Archeology Office. However, it will be available to transportation planners at NDOT and FHWA and also to consultants either through remote site updates or on-line. After the conclusion of the proposed project, the GIS and associated data repository will be continually updated as new information becomes available. Therefore, as time passes and data gaps are filled, the predictive capability and planning utility of the program will increase. Because the high, medium, and low site potential assignments noted above are based on correlations between known archeological site locations and a number of environmental variables, the utility of the project will improve as new archeological and environmental data become available.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Project organization and planning	$ 3,750	0%
Task 2: Collect and digitize existing reports for Phase III geographic areas.	$ 3,000	0%
Task 3: Field investigations at various Sandhills locations.	$ 57,630	0%
Task 4: Refine GIS layer to add Phase III data which will also update digital repository.	$ 26,750	0%
Task 5: Meet with TAC to provide project progress and updates.	$ 1,000	0%
Task 6: Update Final Report and the GIS Users Guide and submit to TAC for review.	$ 25,000	0%
Task 7: Revise and finalize Final Report and GIS Users Guide following comments by TAC.	$ 2,000	0%
Task 8: Meet with TAC for final presentation and submission of final report	$ 1,000	0%

Deliverables: The project will take place over the course of two years and include a significant amount of fieldwork. Phases I and II of the project resulted in the development of usable GIS Revised. 2021 layers and user's guide along with a report. Upon completion of Phase III, the GIS will have been updated and available for immediate use. The user's guide and report will also be fully updated by project completion. There are no post-project implementation efforts anticipated.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046J
PROJECT NUMBER	FY23(021)
PROJECT TITLE	Impacts of Stream Bed Adjustments on Local Bridge Morphology
PRINCIPAL INVESTIGATOR	David Admiraal
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Kirk Harvey; Jason Dayton; Fouad Jaber, Mark Kovar, Jason Lehn; Julie Ramirez, Ross Barron, Jodi Kocher and David Mraz-FHWA
PROJECT TOTAL COSTS	$ 134,860
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$ 79,590
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4 & 5

Background: The goal of this project is to synthesize a hydrodynamic model with improved methods of representing sediment transport to better predict short-term and long-term channel migration for aggraded sand-bed rivers. Our team can rapidly and reliably collect detailed flow and topographic data and incorporating that data into the model will provide results that are more accurate and more quickly implemented than previous efforts. In addition, the model will be developed at a bridge crossing (Highway 281 over the Niobrara River) with a strongly aggraded streambed, a crossing that is of particular interest to NDOT because of the potential for abutment undermining, scour issues, and ice damage. The result of the project will be a documented strategy for rapidly collecting relevant field data associated with channel bed migration predictions, a detailed plan for incorporating that data into a hydraulic model with new modules for accurately simulating sediment transport and bedforms, and demonstrated short-term accuracy of the model at a field site that is of actual interest to NDOT. In addition, recommendations will be provided for collecting future data sets to validate the longer-term performance of the modeling approach. Along the way, channel migration concerns identified by the research team at the study site will be relayed to NDOT for possible mitigation efforts.

Objective:

The objectives of the present work include:

1. To establish a measurement method for rapidly collecting detailed topographic, bathymetric, and flow data at bridge crossings.
2. To utilize the new method to collect multiple complete data sets at a bridge crossing with dynamic streambed conditions (The Highway 281 bridges downstream of the Spencer Dam site).
3. To develop a hydraulic modeling approach for predicting short- and long-term morphologic changes at the bridge crossing and to compare predicted results with observed data.
4. To refine the modeling and data collection methods for application at any bridge crossing with a dynamic streambed.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Research Hydraulic Models and Data Collection	$ 12,848	0%
Task 2: Collect and Process Initial Data Sets	$ 26,883	0%
Task 3: Calibrate Hydraulic Model	$ 12,921	0%
Task 4: Collect and Process Secondary Data Sets	$ 22,921	0%
Task 5: Evaluate and Adjust Hydraulic Model	$ 12,929	0%
Task 6: Collect and Process Final Data Sets	$ 19,393	0%
Task 7: Complete Final Model Assessment	$ 13,079	0%
Task 6: Completion of Final Report and Deliverables	$ 14,179	0%

Deliverables: The primary outputs of this project will be two-fold: A detailed approach for collecting relevant channel and flow data at sand bed river sites with rapidly changing stream morphology and a hydraulic model that is capable of simulating stream morphology over short and long time scales. In order to relay the information that we organize and the models that we develop over the course of the project, we will provide two detailed summary guides at the end of the project: (1) a guide on the methods used to collect aerial and flow data at sand bed river sites with rapidly changing bed morphology, and (2) a guide on applying an appropriate hydraulic model to predict changes at such sites.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046K
PROJECT NUMBER	FY23(022)
PROJECT TITLE	Air-coupled GPR and HD Imaging for High-speed Bridge Deck Evaluation
PRINCIPAL INVESTIGATOR	
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Kent Miller; Babrak Niazi, Seth Brashears, Mike Vigil, Barbara Bevins, Ross Barron , Mark Lindemann and David Mraz-FHWA
PROJECT TOTAL COSTS	$ 166,897
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$ 98,787
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4 & 5

Background: Asphalt overlay is increasingly applied on most Nebraska bridges. GPR is the only proven NDE technique for evaluation of bridge decks with asphalt overlays. The team has successfully developed data analysis software for ground-coupled GPR in previous projects, and determined the threshold values through correlation with VEI and HCP data. However, the need of traffic control limits wide application of the ground-coupled GPR.

Air-coupled GPR and vehicle mounted HD imaging system may provide a solution for high-speed NDE of bridge decks. Because the current GPR analysis software has many limitations (proprietary, inconsistent threshold values, low spatial resolution etc.), we need to develop air-coupled GPR data analysis algorithms for evaluation of bridge decks with asphalt overlay. Data fusion analysis will be used to determine the threshold values for air-coupled GPR amplitude on bridge decks with and without asphalt overlays.

Objective:

The goal of this research project is to develop high-speed NDE technologies to evaluate bridge decks with asphalt overlays, using air coupled GPR and vehicle mounted HD imaging. Specific objectives include:

1. Develop data analysis algorithm for high-speed air-coupled GPR and establish reliable threshold values for asphalt overlaid bridge decks.
2. Fuse GPR data with high-definition surface images to improve spatial resolution.
3. Build correlation between surface defects (with HDI) and interior deterioration (with GPR), and evaluate performance of visual inspection based on HD images, which could be used as a screening tool for rapid bridge evaluation when detailed NDE may not be applied to all bridges.
4. Implement the proposed technology to Nebraska bridges and provide NDOT additional information for decision making.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: TAC Meeting and Review of Literature	$ 10,483	0%
Task 2: Data Collection on NOBL Bridges	$ 28,615	0%
Task 3: Air-coupled GPR and HD Data Analysis	$ 38,538	0%
Task 4: Data Fusion Analysis	$ 28,201	0%
Task 5: Field Demonstration	$ 34,837	0%
Task 6: Final Report and TAC Presentation	$ 26,222	0%

Deliverables: Air-coupled GPR data and HD images will be collected from multiple bridges scheduled for rehabilitation during the project period. Data will be collected at all construction stages: before repair (with old overlay), during the repair (after removal of asphalt overlay), and after repair (after applying new membrane and overlay). Results and findings will be communicated to NDOT as quickly as possible through technical meetings and briefs. By the end of the project, the team will submit a final technical report and the developed data analysis software package.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046L
PROJECT NUMBER	FY23(023)
PROJECT TITLE	Statewide StreamStats Web Tool for Estimating Stream flow Statistics
PRINCIPAL INVESTIGATOR	Kellan R. Strauch, USGS
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Kirk Harvey, Jason Dayton; Fouad Jaber, Julie Ramirez, Jamie DNR-Reinke and Ross Barron
PROJECT TOTAL COSTS	$ 74,600
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$ 74,600
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, & 3

Background: This project will implement StreamStats for Nebraska. StreamStats is an online mapping interface that is designed to provide a user-friendly tool that researchers, managers, and others can use to rapidly and easily compute basin characteristics, and flow statistics. These statistics describe the frequency of extreme conditions in streams and rivers and are valuable data that are routinely used by regulators, designers, builders, natural resource managers, biologists and others. Estimates of peakflow statistics are often needed to fulfill design or regulatory requirements, however, without StreamStats, flow data are generally only available for locations where there is a long-tenn stream gage. Statistical regression analyses of peak flows at stream gage locations can be used to estimate flows at locations without stream gages by relating extreme flow to basin characteristics. A wide variety of professionals, including engineers, scientists, regulators, and natural-resources managers regularly compute and use streamflow statistics, such as the I-percent annual exceedance probability flood statistic. These professionals must dedicate resources to detennine drainage area, watershed boundaries and basin characteristics upstream from a site of interest for each project they work on, because there are no publicly available web tools such as StreamStats in Nebraska. Often the methods used to estimate the flows related to these events at ungaged locations are time-consuming, resource-intensive and may generate non-reproducible results. These methods are seldom available to the public and non-hydrologists because they require considerable expe1iise and computer resources. This project would allow the public to gain access to a consistent, fast and widely accepted method of estimating a variety of useful flow statistics. Statewide regression equations for peak-flow frequencies in Nebraska have been published previously, but since the last repmi was published many years of streamflow data have been collected, analysis techniques have changed, and geospatial datasets have improved. In addition, the Nebraska Department Natural Resources (NeDNR) is cm Tenthly in the process of updating the geospatial datasets, peak streamflow statistics and regression equations for Nebraska. This project will integrate and process the Nebraska Department of Natural Resources updated geospatial datasets, peak streamflow statistics and regression equations into a free and readily available web-based application that would allow professional users and the general public to quickly and easily access streamflow statistics at gaged and ungagged locations.

Objective:

A process has been designed by the USGS national team for implementing the StreamStats tool, as has already been done in 43 other States. A national team at the U.S. Geological Survey (USGS) has developed the StreamStats user interface (Figure 1), but the web tool must be implemented on a state-by-state basis. This project will adapt StreamStats to Nebraska datasets, using the national implementation model to provide a web tool that will greatly reduce the amount of effmi, time, and cost required for a user to estimate peak-flow statistics at user-selected points. In order to develop the StreamStats web tool, several tasks ai·e required: 1.) Integrating NeDNR derived geospatial datasets into the StreamStats web interface. 2.) Review and approval of NeDNR peak streamflow statistics and regression equations. NeDNR peak streamflow statistics and regression equations will be analyzed for quality assurance to ensure that approp1iate methods and procedures were used to develop accurate streamflow regression equations. Results ofregression equations will also be compared to results calculated using StreamStats to ensure reproducibility of the solutions and identify and reconcile any possible discrepancies. 3.) Implementation and coding of regression equations into the StreamStats web tool. 4.) All data sets will be published in a pennanent publicly available repository (e.g. Sciencebase https://www.sciencebase.gov/catalog/) with associated complete metadata.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: StreamStats GIS development and implementation	$ 34,800	0%
Task 2: Peak flow regression equations review and approval	$ 29,800	0%
Task 3: Peakflow regression equation implementation into StreamStats	$ 36,600	0%
Task 4: Analysis and publication of datasets and metadata	$ 48,000	0%

Deliverables: Direct measurable environmental benefits such as improved water quality are expected to result from the implementation of this tool arising from the ability of managers and decision-makers to better plan for extreme flow conditions. Frequencies of peak flows are important to understanding floodplain connectivity, wetlands dynamics, geomorphology, instream habitat and the impacts of human infrastructure on the environment during flooding.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046M
PROJECT NUMBER	FY23(024)
PROJECT TITLE	Repair and Strengthening of Bridge Girders Using Ultra-High-Performance Concrete (UHPC)
PRINCIPAL INVESTIGATOR	George Morcous
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Fouad Jaber, Wally Heyen, Wayne Patras, Kyle Zillig, Mike Vigil, Kellie Troxel, Ross Barron, Lieska Halsey and David Mraz-FHWA
PROJECT TOTAL COSTS	$ 80,007
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$ 43,298
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2 & 3

Background: The preliminary literature review has indicated a very limited but promising use of UHPC in the repair/preservation of concrete bridge components, such as piers, pier caps, and girder ends. Although UHPC has excellent mechanical and durability properties, there is lack of guidelines on the design approach and construction procedures for using UHPC as a repair material to encase deteriorated/damaged concrete components in particular.

Objective:
The objective of this project is to develop procedures for using UHPC in the repair/preservation of concrete bridge components including the design and construction guidelines for immediate implementation. Two demonstration projects that include the repair of deteriorated concrete bridge pier and girder end will be conducted to help bridge engineers and contractors gain the design and construction experience of using UHPC in the repair/preservation. This will also include addressing issues like surface preparation, formwork design, placing and curing methods of UHPC, and installing interface anchors between UHPC and CC. The lessons learned from these two projects will be disseminated via presentations and publications for technology transfer

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Literature Review of UHPC in Repair/Preservation	$ 6,287	0%
Task 2: Design and Construction Guidelines	$ 18,196	0%
Task 3: Demonstration Projects	$ 37,630	0%
Task 4: Report, Presentation, and Technology Transfer	$ 17,894	0%

Deliverables: Two demonstration repair/preservation projects are expected to be implemented by NDOT during the project duration. Several candidate projects were studied, and two projects were tentatively selected for demonstration and technology transfer. Figure 5 shows an example of deteriorated concrete bridge pier to be repaired using UHPC jacketing, while Figure 6 shows another example of a deteriorated concrete bridge girder end to be encased in UHPC. Constructability issues, such as traffic control, repair duration, and cost will be also evaluated in these demonstrations.

Performance & Goals: Project is up to date with the current tasks and progress.

CONTROL NUMBER	01046N
PROJECT NUMBER	FY23(025)
PROJECT TITLE	Modeling Pedestrian and Bicyclist Crash Exposure with Location-Based Service Data
PRINCIPAL INVESTIGATOR	Yunwoo Nam - UNL
PROJECT START DATE	7/1/2022
PROJECT COMPLETION DATE	5/31/2024
TECHNICAL ADVISORY COMMITTEE	Don Butler, Dan Waddle, Curtis Nosal and Abe Anshasi- FHWA
PROJECT TOTAL COSTS	$184,629
PROJECT EXPENDITURES TO DATE	$0
NUMBER OF EXTENSIONS GRANTED	None
PERCENTAGE OF PROJECT COMPLETE	0%
STATUS	New Project
FY-2023 BUDGET	$125,941
FY-2023 TASKS TO BE COMPLETED	Tasks 1, 2, 3, 4, 5 & 6

Background: Biking and walking flows are essential components in safety analysis. Most local governments rely heavily on crash statistics to identify locations prone to pedestrian and bicyclist crashes.

However, to effectively diagnose pedestrian and bicycle safety, planners and engineers need to know the relative exposure of the pedestrians and bicyclists to risk. Not having appropriate information about the activity patterns and volume of pedestrians and bicycles at locations, it is challenging to accurately identify and predict risk levels at those locations. A variety of pedestrian and bicycle exposure measures have been suggested and tested in the literature (Alattar, Cottrill, and Beecroft, 2021; Goodspeed et al, 2021; Ryus et al, 2017; Turner et al, 2017), but these measures are inconsistent and limited, and there is no widely accepted single approach. Area-based exposure measures are usually estimated at a macro level. This approach does not adequately capture activities at facility-specific geographic scales (i.e., street segments), since data are aggregated to areawide geographic scales.

Another group of measures is based on field observation and extrapolation methods. Actual counts observed at selected locations in short periods of time are extrapolated to generate annual average daily pedestrian and bicyclist traffic estimates. This approach will not adequately display the difference in travel time (e.g., morning, afternoon, or evening), seasonal effects, days of the week, and will not cover the entire street network in a region.

One of the main challenges in developing exposure measures is the lack of walking and biking activity data available at a finer spatial resolution, such as street segments, covering the entire road network of a city. The main source of information about area-based exposure measures is survey data (such as ACS or NHTS). The units used in area-based exposure measures vary widely and the geographic scale of available travel data is limiting (only 59 records for Lincoln MSA in the 2017 NHTS). This type of data does not have facility-specific trip information. Some local entities are directly collecting pedestrian and bicyclist count data, but these counts are collected at a very limited number of locations. Therefore, there is a critical need to develop a reliable methodology to analyze pedestrian and bicyclist exposure to risk with emerging data sources.

Objective:

The motivation of the research is to enhance pedestrian and bicyclist safety with emerging active travel data. The main objective of the project is to develop a reliable methodology for measuring pedestrian and bicyclist exposure and analyzing associated risks.

Tasks & Percent Completed:

Tasks	Budget by Task	Percent Completed
Task 1: Meetings with TAC and quarterly report	$ 6,235	0%
Task 2: Review and document existing approaches	$ 10,550	0%
Task 3: Collecting data and creating geodatabase	$ 78,842	0%
Task 4: Data processing	$ 17,363	0%
Task 5: Street Light data calibration	$ 15,099	0%
Task 6: Final Report and TAC Presentation	$ 43,900	0%
Task 7: Completion of project, final report submission and presentation	$ 9,233	0%
Task 8: Dissemination of research outcomes	$ 3,407	0%

Deliverables: The research will provide immediate results for the study area and a foundational platform to expand to the rest of Nebraska. The research results will include a geodatabase pedestrian crash exposure model and a geodatabase bicyclist crash exposure model. Each model will function independently from the other model. Both models will be geographically constrained to Lincoln, NE. Lincoln was chosen as a testbed for several reasons. It is a midsize city, with an extensive network of multi-use pathways, as well as on-street bicycle facilities.

Performance & Goals: Project is up to date with the current tasks and progress.

COMPLETED PROJECTS

Project Number	Federally Funded Projects Completed and Published	Focus Area	Completed
M096	Report Link: Evaluating ASCT operations for Dodge Street Corridor NDOT Recommendations Based on completed Research – In Progress	Traffic	2021
M100	Report Link: A Statewide Geographics Information System as a Predictive Tool for Locating Deeply Buried Archeological Deposits (Phase II) NDOT Recommendations Based on completed Research – In Progress	Environmental	2021
M105	Report Link: Low-Cost Modal Identification Sensors of Bridge Field Testing NDOT Recommendations Based on completed Research	Structures	2021
M106	Report Link: Feasibility Study Alternatives to Prevent Settlements and Bumps at Bridge Approaches in Nebraska NDOT Recommendations Based on completed Research	Structures	2021
M108	Report Link: Design and Detailing of Cast-in-Place and Precast Concrete Approach Slabs NDOT Recommendations Based on completed Research – In Progress	Structures	2021
M115	Report Link: Research on High-RAP Mixtures with Rejuvenators - Field Implementation NDOT Recommendations Based on completed Research	Materials	2021
M117	Report Link: Research and Education for Optimizing the Development and Implementation of an Unmanned Aircraft Program at the Nebraska Department of Transportation NDOT Recommendations Based on completed Research	Technology	2021
FY21 (012)	Report Link: Field Demonstration of GPR and UAV Technologies for Evaluation of Two US75 Bridges NDOT Recommendations Based on completed Research – In Progress	Technology	2021