2013 ANNUAL REPORT FOR THE MONTANA DEPARTMENT OF TRANSPORTATION RESEARCH PROGRAMS

FHWA/MT-14-001/8010

Annual Report

prepared for
THE STATE OF MONTANA
DEPARTMENT OF TRANSPORTATION

in cooperation with
THE U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

April 2014

prepared by

Susan C. Sillick
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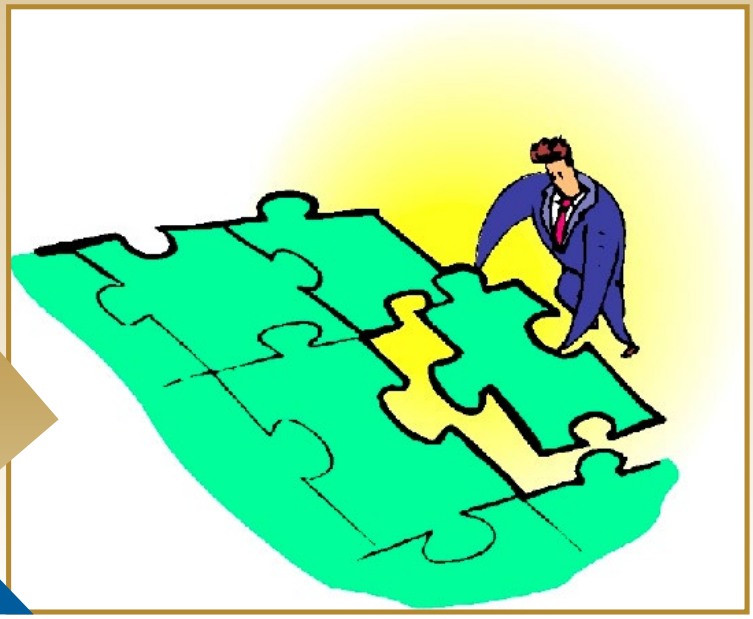
Montana Department of Transportation



RESEARCH PROGRAMS

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FFY 2013 ANNUAL REPORT FOR THE MONTANA DEPARTMENT OF TRANSPORTATION RESEARCH PROGRAMS

Prepared by
Susan C. Sillick
Craig Abernathy
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Montana Department of Transportation

January 2014

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16. Abstract

The Montana Department of Transportation (MDT) conducts research to discover, develop, or extend knowledge needed to operate, maintain, and improve the statewide multimodal transportation system. Specific goals include: evaluation and advancement of new technologies, materials, and methods; development of design and analysis techniques; and study of current transportation challenges. The purpose of this report is to give a comprehensive description of research, development, and technology transfer activities for federal fiscal year (FFY) 2013 within the Research Programs of the Montana Department of Transportation (MDT). Through these activities, the Research Programs enhance MDT's ability to deliver efficient and effective transportation services. MDT's mission is to serve the public by providing a transportation system and services that emphasize quality, safety, cost effectiveness, economic vitality, and sensitivity to the environment. MDT's Research Programs impact each and every part of MDT's mission. Research projects completed in FFY 2013 yielded results that when fully implemented will improve:

- ★ Efficiency and effectiveness of MDT operations and technology transfer, including improving training of and encouraging young individuals to enter the transportation construction work force, improving roadside revegetation, improving planning for growth, increasing recycling efforts, improving culvert and rest area design, evaluating MDT's weigh-in-motion (WIM)/automated traffic recorder (ATR) and occupant protection programs, evaluating bridge and pavement needs, improving bridge response to earthquakes, improving specifications, and improving traffic flow
- ★ Economic vitality
- ★ Sensitivity to the environment, including decreasing vehicle-wildlife collisions, improving habitat connectivity, improving air quality, decreasing erosion, increasing roadside revegetation, improving culvert and rest area design, increasing recycling efforts, and improving planning for growth
- ★ Safety, including reviewing speed limits and other traffic issues in terms of safety, reviewing safety programs, decreasing young driver risks, decreasing wildlife-vehicle collisions, improving roundabout communication efforts, improving bridge response to earthquakes, and improving incident response
- ★ Quality of what we do and how we do it, including improving air quality, improving bridge and culvert design, improving planning for induced growth, and evaluating bridge and pavement needs

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ALTERNATIVE FORMAT STATEMENT

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ACKNOWLEDGEMENTS

We would like to thank Carla Little of the Western Transportation Institute, Montana State University – Bozeman for her exceptional editing skills.

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1 INTRODUCTION

The purpose of this report is to give a comprehensive description of research, development, and technology transfer activities for federal fiscal year 2013 within the Research Programs of the Montana Department of Transportation (MDT). Through these activities the Research Programs enhance MDT's ability to deliver efficient and effective transportation services.

Responsibilities of the MDT Research Programs include:

- ★ Administer the Research portion of the State Planning and Research Program (SPR);
- ★ Lead and participate in cooperative research efforts with other states, universities, industry, and other partners through pooled-fund and other cooperative research, development, and technology transfer efforts;
- ★ Assist MDT staff in identifying and finding ways to meet research needs;
- ★ Provide leadership for research, development, technology, and technology transfer initiatives within MDT;
- ★ Conduct the Research and Experimental Projects Programs, and the Technology Transfer Program;
- ★ Assist with the implementation of research results; and
- ★ Conduct project and program evaluation.

In taking a look back at where we have been, we are given a clearer view of where we are heading, continuously improving as we move forward.

Janus, this Roman God symbolizes change and transition, such as the progression from past to future or from one vision to another.

2 ANNUAL PROGRAMS

2.1 ADMINISTRATIVE PROJECTS – Administration and Conduct of Research Programs

Project Number:	8010
Start Date:	10/1/12
Completion Date:	9/30/13
Total Cost:	$319,864
SPR Funds:	$319,864
FFY 2013 SPR Funds Expended:	$319,864
FFY 2013 MDT Indirect Costs:	$30,638
Unexpended Funds:	$0

Project Number:	8020
Start Date:	10/1/12
Completion Date:	9/30/13
Total Cost:	$35,353
SPR Funds:	$35,353
FFY 2013 SPR Funds Expended:	$35,353
FFY 2013 MDT Indirect Costs:	$3,264
Unexpended Funds:	$0

Project Number:	8021
Start Date:	10/1/12
Completion Date:	9/30/13
Total Cost:	$26,522
SPR Funds:	$26,522
FFY 2013 SPR Funds Expended:	$26,522
FFY 2013 MDT Indirect Costs:	$2,376
Unexpended Funds:	$0

Objective:

The purpose of these three ongoing projects is Fourfold. The first is to plan and administer the Research Programs and related research activities of MDT to find solutions to existing highway and transportation challenges in Montana. The second objective is to manage, coordinate, and conduct a program to test and properly evaluate new highway materials, products, designs, and/or methods for the ultimate purpose of improving highway performance; decreasing various highway costs; or attempting to solve existing highway construction, rehabilitation, or maintenance problems in Montana. The third objective is to provide funding for MDT staff when working on

MDT research or experimental projects, where other funds are not appropriate or available. This can include, for example, fieldwork, such as traffic control and coring; and meeting time and travel associated with research or experimental projects. The fourth and final objective is to plan and conduct a program of technology transfer and to develop and maintain a knowledge and understanding of the latest highway research projects and programs.

Accomplishments - Research Projects:

During FFY 2013, for the Research Projects Program, one solicitation cycle was completed, with 26 new research topics, resulting in five new research projects.

- MAP-21: primary National Freight Network and its Relationship to State Systems and Needs
- Safety Impact of Differential Speed limits on Rural 2-Lane Highways in Montana
- Special Event Traffic
- Speed Limits Set Lower than Engineering Recommendations
- Testing Woolen "Made in Montana" Roadside Reclamation Products

Two MPART projects were initiated in FFY 2013:

- Information/Education Synthesis on Roundabouts
- Montana Rest Area Use: Data Acquisition and Estimation Performance Measures

Eleven projects are contracted and remain active:

- Assessing the Effectiveness of Montana's Occupant Protection Program
- Evaluating Wildlife-Vehicle Collisions and Habitat Connectivity in the Madison Valley
- Evaluation of Wildlife Crossing Structures on US Highway 93 Evaro to Polson
- Feasibility of Reclaimed Asphalt Pavement as Aggregate in Portland Cement Concrete: Phase 1
- Feasibility of Reclaimed Asphalt Pavement as Aggregate in Portland Cement Concrete: Phase 2
- Flood Frequency Analyses for Montana Based on Data through Water Year 2009
- Impacts of Increased Canadian Economic Development on Northern Montana Highways Study: Phase II – Ports of Wild Horse and Morgan Highway Corridors
- Monitoring Wildlife Crossings on US 93 South
- Montana Weigh-in-Motion (WIM) and Automatic Traffic Recorder (ATR) Strategy
- Peer-to-Peer Traffic Safety Campaign Program
- Relative Operational Performance of Geosynthetics Used for Subgrade Stabilization: Phase 2

Ten active research projects were completed:

- Assessing the Extent and Determinates of Induced Growth
- Automatic Crash Notification: Assessing Montana's Motor Vehicle Crash and Related Injury Data Infrastructure
- Impacts to Montana State Highways Due to Bakken Oil Development
- Information/Education Synthesis on Roundabouts
- Local Technical Assistance Program – SFY 2013
- Montana Rest Area Use: Data Acquisition and Estimation – Development of Performance Measures
- Performance of Steel Pipe Pile-to-Concrete Cap Connections Subject to Seismic or High Transverse Loading: Phase III Confirmation of Connection Performance
- Re-Evaluation of Montana's Air Quality Program
- Summer Transportation Institute – FFY 2013
- Testing and Evaluation of Recovered Traction Sanding

A research project close-out questionnaire was sent to all technical panel members at the completion of each project. Results were compiled and disseminated with the ultimate goal of improving the conduct and management of research projects.

In addition, six projects are pending technical panel and RRC review and approval:

- Investigation of Prefabricated Steel Truss/Bridge Deck Systems
- MAP-21: primary National Freight Network and its Relationship to State Systems and Needs
- Safety Impact of Differential Speed limits on Rural 2-Lane Highways in Montana
- Special Event Traffic
- Speed Limits Set Lower than Engineering Recommendations
- Testing Woolen "Made in Montana" Roadside Reclamation Products

One project was placed on hold:

- Determination of Material Properties and Deflection Behaviors for Contemporary Prestressed Beam Design

Funds were contributed for 20 partnering projects:

- 2014 Asset Management Conference and Training on Implementation Strategies
- AASHTO Equipment Management Technical Services Program (EMTSP)
- AASHTO Materials Reference Library (AMRL)
- AASHTO Product Evaluation Listing (APEL)
- Clear Roads Winter Highway Operations Pooled Fund
- Evaluation of Lateral Pile Resistance Near MSE Walls at a Dedicated Wall Site
- Impact of Wide-Based Tires on Pavement Damage: A National Study
- Load and Resistance Factor Design (LRFD) Bridges and Structures Specification Maintenance (LRFDSM)
- National Cooperative Highway Research Program (NCHRP)

- National Transportation Product Evaluation Program (NTPEP)
- Next-Generation Transportation Construction Management
- North/West Passage Transportation Pooled Fund Program
- Passive Force-Displacement Relationships for Skewed Abutments
- SHRP 2 Implementation
- Simplified SPT Performance-Based Assessment of Liquefaction and Effects
- Technical Service Program to Develop AASHTO Materials Standards (DAMS)
- Technology Implementation Group (TIG)
- Transportation Learning Network
- Transportation System Preservation (TSP)
- Transportation Research Board Core Services Support

Accomplishments – Experimental Projects:

During FFY 2013, eighteen experimental projects were active.

- A2000 Polyvinyl Chloride (PVC) Irrigation Line
- Allied Modular Steel Beam Bridge
- Break-Out Square Post Breakaway System Phase I
- Chip Seal as Interlayer to Retard Reflective Cracking
- Crack Sealing Milled Asphalt Pavement Prior to Overlay
- Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS)
- MetaDome Truncated Dome Used in Existing and New Asphalt
- Plant Mix Seal on PCCP Dowel Retrofit
- Rest Area Wind Turbine for Supplemental Power
- Ribbed Aluminum Box Culvert (ABC)
- Seal Coat Asphalt Emulsion Over Existing Chip Seal
- Smart Cushion Innovations (SCI) 100 GM Crash Attenuator
- Streiter-Lite Animal Warning Reflector System
- Stay-Tuff Woven Fence
- TAPCO Sequential Dynamic Curve Warning System
- Urethane Epoxy Pavement Markings
- Warm Mix Asphalt
- Wet-Reflective Bead Technology Pavement Marking

During FFY 2013, three experimental projects were completed.

- Highways for LIFE Culvert Rehabilitation
- Hot-Laid Thermoplastic Pavement Markings
- Paving Fabrics to Mitigate Transverse Cracking

During FFY 2013, seven projects were pending. Pending experimental projects are assigned to a construction or maintenance project.

- Break-Out Square Post Breakaway System Phase I
- CHFRS-2p – High Float and Polymer Modified Emulsion Seal
- Kwik Bond Polyester Polymer Concrete (PPC) Overlay
- Poly-Carb High Friction Bridge Deck Treatment
- Polyvinyl Chloride (PVC) Lateral and Storm Drains
- Sacrificial Osterberg Cell (O-Cell) to Confirm Load Design
- Superior Traffic System (STS) Real-Time Traffic Management for Work Zone Application

During FFY 2013, four projects were proposed. Proposed projects are not yet assigned to a construction or maintenance project.

- Bridge Deck Anti-Icing System
- Intelligent Compaction
- Methyl Methacrylate (MMA) Pavement Markings
- ZBAR Deck Reinforcement

Accomplishments – Technology Transfer and Library Services:

Technology transfer and Library-related accomplishments achieved in FFY2013 include:

- A research and experimental project map was developed. Projects can be viewed by type (experimental and research), status (active, completed, and pending), and district. Click here to view map.
- Addition of 346 new titles to the library collection
- Creation of management-related library materials lists, organized by format, so that MDT employees can more easily find those materials
- Creation of a new library brochure to market library materials and services to MDT employees
- Creation of recorded online library catalog training for MDT employees
- Library and Research Customer Appreciation Day, held April 10, 2013 in anticipation of National Library Week
- Library needs assessment of the Engineering Division Bureau Chiefs and Section Supervisors
- Migration to Worldshare Interlibrary Loan platform and offering borrowing and lending options to patrons and other libraries through MDT Library. Borrowing was previously done through the Montana State Library, but by using Worldshare, patrons are provided requested materials more quickly.

- Original cataloging of library materials with the new RDA standard
- Purchase of ASTM Section 4.0 – Construction annual subscription for MDT employees
- Tracking
    - Circulation
    - New patrons registered and deleted
    - Brief reference (answering patron questions that require less in-depth answers – less than 5 minutes)
    - In-depth reference and literature searches (searching relevant databases and websites for information related to patron queries)
    - Interlibrary loans – borrowing materials for patrons and lending materials to other libraries.
    - Original and copy cataloging of new reports (both print and electronic formats)
- Mailing library materials to patrons in district offices and outlying areas
- Promotion of the library collection and services to employees through New Employee Orientation, articles in bi-weekly Interchange (employee newsletter), and Customer Appreciation Day
- Requesting free library materials offered through the Transportation Librarian Network
- Purchasing new materials in response to patrons' requests
- Attending Western Transportation Knowledge Network (WTKN) meetings, Transportation Librarian Roundtables, and the Special Library Association (SLA) annual conference to connect with other transportation and special librarians and to stay informed of trends in the librarian world.
- Attending Montana Shared Catalog meetings to represent MDT Library's interests.
- Hiring and training a library intern to work on cataloging projects

Library Services Analysis

Table 1 provides monthly summaries for Research and Library services provided during FFY2013.

Table 1: Library Services Analysis – FFY 2013:

	Oct. 12	Nov. 12	Dec. 12	Jan. 13	Feb. 13	Mar. 13	Apr. 13	May. 13	Jun. 13	Jul. 13	Aug. 13	Sep. 13	FY 2013 Totals
Items Circulated (CK IN/OUT)	29	33	30	56	49	50	88	52	43	21	27	38	516
Renewals	15	11	16	13	14	9	21	15	8	11	10	9	152
ILLs Borrowed (Includes Loans & Copies)	5		3	6	4	8	2	4	3	2	5	42	
ILLs Lent					2			1		2	2	3	10
Reference (Brief)	19	25	3	14	23	22	28	22	29	16	21	15	237
Lit Search (in depth Ref.)	9	10	14	23	10	15	22	17	17	18	8	9	172
Titles Cataloged - Copy	20	34	16	20	37	18	27	21	14	25	58	10	300
Titles Cataloged - Original	4		16	3	2		4	1		2	4	10	46

The library services analysis totals include:

- 516 Items Circulated. This count includes print and audiovisual materials that were both checked in and checked out of the library.
- 152 Renewals. This count refers to the renewal of library items that were already checked out.
- 42 ILLs Borrowed. This count refers to interlibrary loans that were requested for MDT Library patrons. It includes loans, which means physical items were mailed to the MDT Library for patrons, as well as copies, which means we received electronic copies of materials (usually journal articles) to pass on to MDT Library patrons.
- 10 ILLs Lent. This means that, through interlibrary loan, 10 items were lent from the MDT collection to other libraries from around the country.
- 237 Reference Questions (Brief). This means 237 questions were answered that were short in nature and, generally, took 5 or less minutes to answer (for example, how do I check out a book, how long can I keep materials, where are you located, etc.).
- 172 Lit Searches (in depth Ref.). This count includes literature searches, where literature was gathered on particular topics and presented to requestors in a report format; surveys to other state departments of transportation; and any in-depth reference, defined as answering customer questions that require more than 5 minutes to respond.
- 300 Titles Cataloged – Copy. This is the number of titles that were added to the collection this year for which there were already records created in the Online

Computer Library Center (OCLC). These records simply needed to be imported into our library system, Workflows, and then modified.

- ★ 46 Titles Cataloged – Original. These titles were also added to the collection this year; however, there were no records in OCLC, so records had to be created by the MDT librarian in order to add them to the collection.

Library Collection Analysis

Table 2 and Figure 1 summarize the library collection analysis for FFY2013.

Table 2: Library Collection Analysis by Item Type

ITEM TYPE	TOTAL COPIES
AUDIO-REC	6
BOOK	19,440
CD-CIRC	388
CIRC-MAG	2
DVD	170
E-BOOK	2,083
E-JOURNAL	6
KIT	93
MAP	5
MICROFORM	3
PAMPHLET	13
SUMMARY	2
VIDEO-REC	1,011
TOTAL	**23,222**

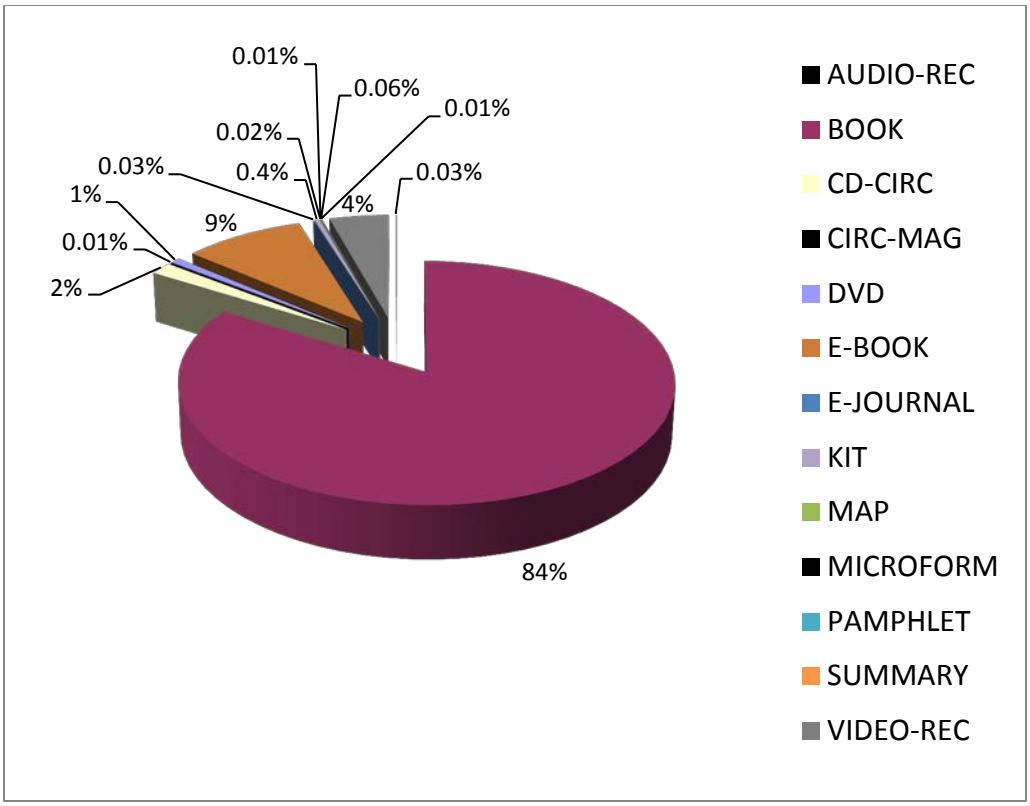


Figure 1: Library Collection Analysis by Item Type

The principal findings of the library collection analysis include:

- The MDT Library has a total of 23,222 copies held in the collection as shown in Table 2.
- The collection holds 18,296 titles. For some of these titles, there is more than one copy in the collection, which is why the total number of copies is greater than the number of titles.
- Of the 18,296 titles, 2,083 titles are held in electronic format only. These include electronic reports and web-only documents. This category is the second largest format type held in the library, after books.

Library Circulation Analysis

Table 3 and Figure 2 provide library circulation information.

Table 3: Library Circulation by Item type

Item Type	Total Circulation
BOOK	375
CD-CIRC	158
DVD	14
KIT	2
MICROFORM	7
VIDEO-REC	54
Totals	**610**

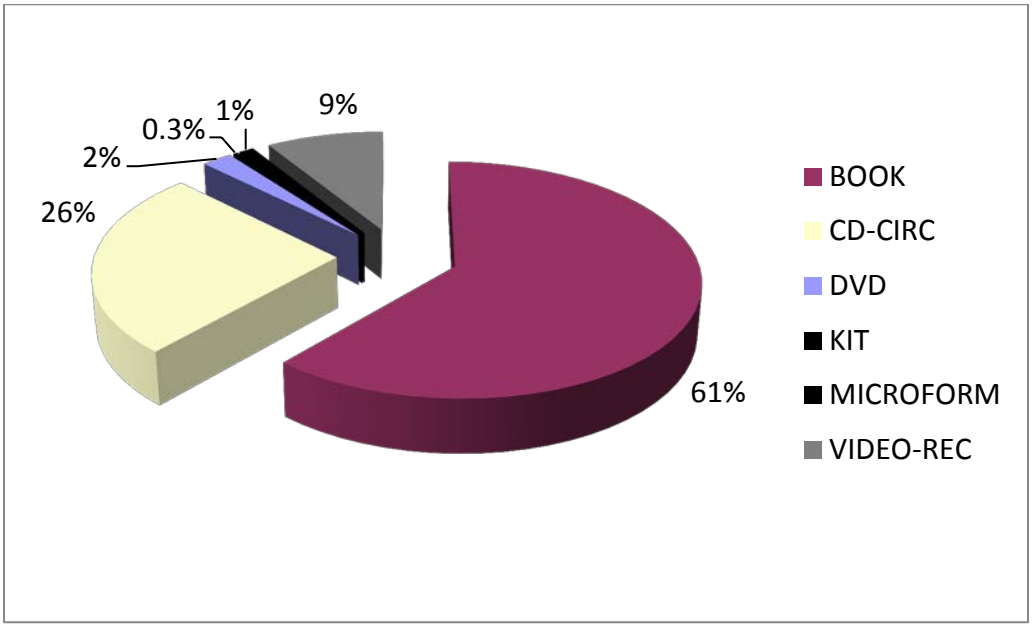


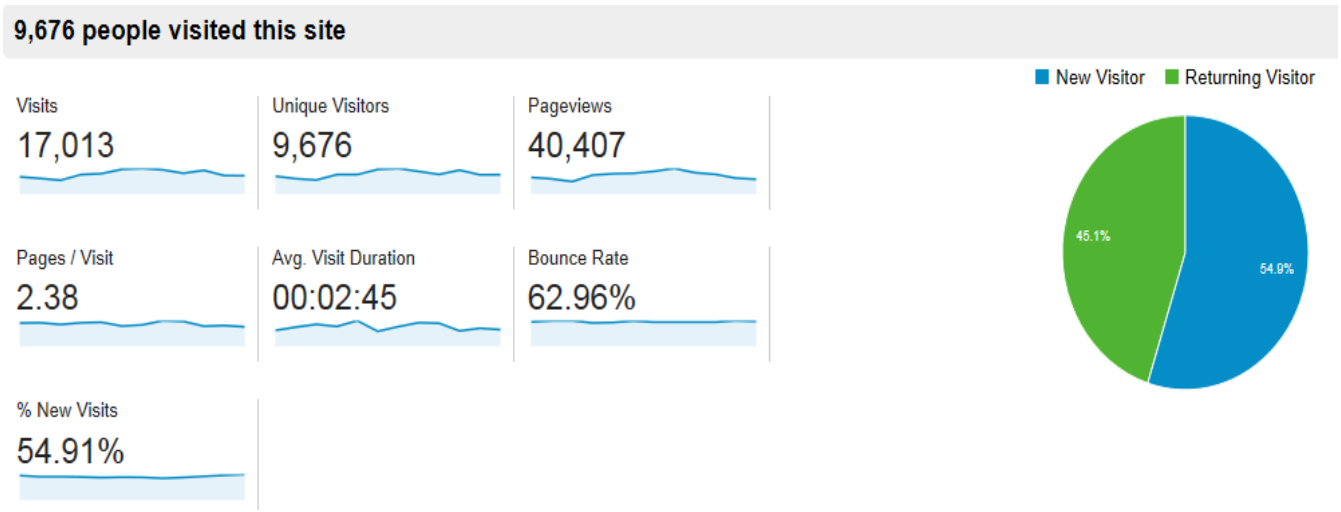
Figure 2: Library Circulation by Item type

The principal findings of the library circulation analysis include:

- During FFY2013, books were still the most heavily circulated items. Audiobooks on CD (CD-CIRC) were the next most circulated type, followed by VHS (Video-Rec) tapes.
- There's no circulation information on the e-book library collection, as these titles are not circulated, but rather are accessed by patrons through the library catalog.

Research and Library Website Analysis

Figure 3 provides access information for the external research website (this is the external webpage accessible to both MDT employees and non-MDT employees).



Source: Google Analytics

Figure 3: External Research Website Access

The principal findings of the external research and library website analysis include:

- From October 1, 2012 to September 30, 2013, 9, 676 unique visitors visited the external MDT Research webpage. 54.91% of these visitors were new to the site.
- The most commonly visited link on the MDT Research page was the Erosion and Sediment Control Best Management Practices landing page.
- Of the 17,013 total visits during FFY2013 (note: This is the number of visits, not visitors), 4,020 (24%) were referred to the MDT Research page through the State of Montana homepage.
- Of the 40,407 research page views, there were 2,194 (5%) library page views during FFY 2013. It is available as a link from the MDT homepage, under Publications, and is also accessible as a link from the Research homepage.

Table 4 shows the geographic locations where the visits originated.

Table 4: Visitor Geographic Origin

Country / Territory	Visits
	17,013 % of Total: 100.00% (17,013)
1. United States	13,868
2. India	503
3. Canada	372
4. Philippines	240
5. United Kingdom	195
6. (not set)	179
7. Australia	112
8. China	104
9. Malaysia	89
10. Iran	61

Source: Google Analytics

Table 5 and Figure 4 show the data related to internal access (this is an internal webpage, accessible only to MDT employees on a state network computer or through a Citrix log in).

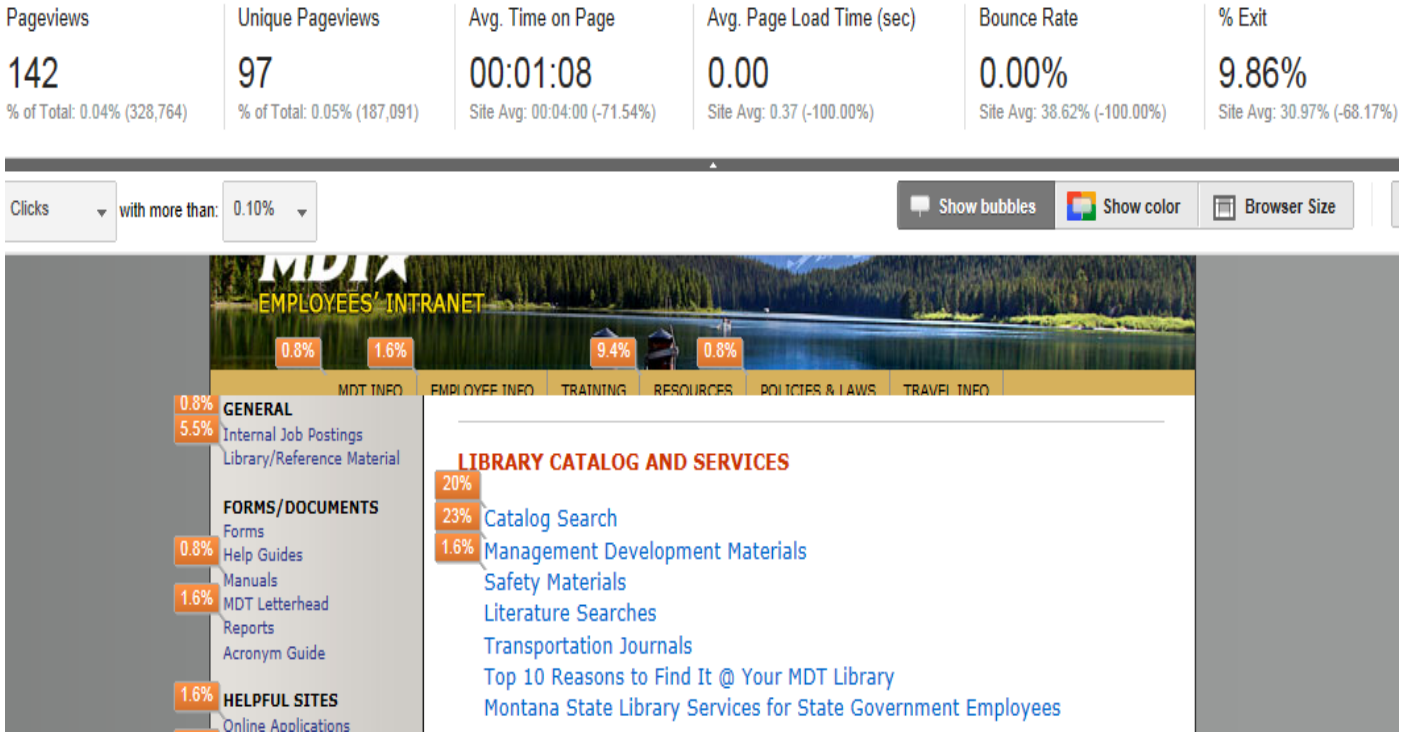
Table 5: Internal Research Website Access

Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit
	140 % of Total: 0.04% (328,764)	101 % of Total: 0.05% (187,091)	00:05:32 Site Avg: 00:04:00 (38.24%)	13 % of Total: 0.01% (101,834)	23.08% Site Avg: 38.62% (-40.24%)	33.57% Site Avg: 30.97% (8.38%)
1. /research/	140	101	00:05:32	13	23.08%	33.57%

Source: Google Analytics

The principal findings of the internal research website analysis include:

- The internal Research homepage received 140 page views.
- This page is a landing page with links to Research and Experimental project pages and reports, as well as links to the library homepage and Research newsletters, which yields a higher exit rate (33.57%).



Source: Google Analytics

Figure 4: Internal Library Website Access

The internal library website analysis includes the following results.

- 20% of visitors to the internal library page utilized the Catalog Search link.
- 23% used the Management Development Materials link. This link goes to catalog-generated lists of management-professional development materials, which are organized by material format (book, audiobook, DVD, VHS, and so on).
- 9.4% of visitors clicked on the link to the ASTM Section 4.0 Online Subscription (not pictured above). This link was added in August 2013. This link was the third most utilized on the internal library homepage.
- 5.6% of visitors clicked on the AASHTO Roadside Design Guide.

- ★ 3.8% clicked on the AASHTO Policy on the Geometric Design of Highways and Streets.

Reports/Training/Technology Transfer:

- ★ Research and experimental project progress and final reports were published on the Research Programs website (http://www.mdt.mt.gov/research/).
- ★ The Research Review Committee (RRC) met four times throughout the year to discuss research and pooled-fund projects.
- ★ The Research Programs Manager attended the January 2013 TRB Annual Meeting and the July 2013 AASHTO Research Advisory Committee Meeting.
- ★ The Research Programs Manager attended periodic on-line meetings for the following TRB committees:
  - ➢ Committee Research Coordinators' Council
  - ➢ Conduct of Research
  - ➢ Information Services
  - ➢ Library and Information Science for Transportation
  - ➢ Technology Transfer
- ★ Performance appraisals were conducted for all Research Programs staff and performance plans were developed for the upcoming year.
- ★ The Librarian attended the Montana Library Association's (MLA's) Academic and Special Librarian Division (ASLD) retreat in October 2012, as well as the Special Library Association's (SLA's) Annual Conference in June 2013.
- ★ The Librarian participated in periodic meetings for the following forums throughout the year:
  - ➢ Western Transportation Knowledge Network
  - ➢ Transportation Librarians' Roundtable
  - ➢ (Montana) State Librarians' Roundtable
  - ➢ Montana Shared Catalog Members Meetings

MDT Project Manager:

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2.2 MONTANA LOCAL TECHNICAL ASSISTANCE PROGRAM (LTAP)

Project Number:	2443
*Start Date:	7/1/12
Completion Date:	6/30/13
Total Cost:	$320,000
SPR Funds:	$80,000
Federal Funds:	$140,000
State Funds:	$100,000
FFY 2012 Funds Expended:	$320,000
FFY 2012 MDT Indirect Costs:	$0
Unexpended Funds:	$0
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/ltap/ltap.shtml

* Note: The LTAP program is run on a state fiscal year. Hence, it is run nine months behind the federal fiscal year. FFY 2013 LTAP is currently active, running from 7/1/13 to 6/30/14. Therefore, the FFY 2012 LTAP Program is presented here.

Objective:

The mission of the national Local Technical Assistance Program (LTAP) **i**s to foster a safe, efficient, and environmentally sound transportation system by improving skills and knowledge of local transportation providers through training, technical assistance, and technology transfer.

LTAP centers enable counties, parishes, townships, cities, and towns to improve their roads and bridges by supplying them with a variety of training programs, an information clearinghouse, new and existing technology updates, personalized technical assistance, and newsletters.

Through these core services, LTAP centers provide access to training and information that may not have otherwise been available. Centers are able to provide local road departments with work force development services; resources to enhance safety and security; solutions to environmental, congestion, capacity and other issues; technical publications; and training videos and materials.

Montana has more than 70,000 miles of roads in cities, counties, and highway districts. Montana LTAP has focused on assisting state and county road offices and city street departments in road and bridge maintenance and repair. By sharing technical

information and improving the distribution of this information, the program promotes efficient use of local transportation agencies' scarce resources. Specific LTAP tasks in FFY 2012 included: compile and maintain a mailing list, publish a quarterly newsletter, provide technology transfer materials, provide information and on-site technical assistance, conduct or arrange seminars/training sessions, and conduct program evaluation.

Progress:

Four quarterly newsletters were published and distributed as hard copies, as well as electronically to a large listserv via e-mail. Technical assists and information were distributed and responded to through phone calls, faxes, personal contact at workshops, conferences, and e-mail. LTAP worked with FHWA to promote the "Every Day Counts" initiatives, including coordination of the Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS) technology showcase in Dupuyer, Montana. Training sessions were presented throughout the state.

Reports:

Four quarterly progress reports were submitted, reviewed, and published on the project website at the above URL.

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2.3 MONTANA SUMMER TRANSPORTATION INSTITUTE

Project Number:	6439-220
Start Date:	5/16/13
Completion Date:	9/30/13
Total Cost:	$47,729
SPR Funds:	$0
Federal funds:	$40,029
State funds:	$500
Cost Share:	$7,200
FFY 2013 Funds Expended:	$47,729
FFY 2013 MDT Indirect Costs:	$0
Unexpended Funds:	$0
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/admin/summer.shtml

Objective:

The Summer Transportation Institute (STI) is intended to spark interest in transportation careers; aid in the development of the next generation of engineers, scientists, planners, and designers; and address the nation's need for a diverse pool of transportation professionals. The STI recruits rising tenth, eleventh, and twelfth grade students. The program is free to all selected participants with program expenses paid by a grant from the Federal Highway Administration (FHWA) and in kind contributions from MDT, WTI, and MSU. Students live on campus while learning about career opportunities in transportation. The two-week program provides a multidisciplinary

academic curriculum, which included guest speaker presentations, hands-on laboratories, and field trips.

Progress:

This annual program was held in June. All work is complete.

Reports:

The final report was submitted, reviewed, and published on the project website at the above URL.

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Contractor Project Manager:

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2.4 SHRP 2 IMPLEMENTATION

Project Number:	SHR-2(013)
Start Date:	10/1/12
Completion Date:	9/30/13
Total Cost:	$313,696
SPR Funds:	$313,696
FFY 2013 Funds Expended:	$313,696
FFY 2013 MDT Indirect Costs:	$0
Unexpended Funds:	$0
Status:	Two Year Annual Program (FFY 2013 and 2014) – FFY 2013 Complete

Description:

The second Strategic Highway Research Program (SHRP 2) has undertaken more than 100 research projects designed to address critical state and local challenges, such as aging infrastructure, congestion, and safety. The research results are now being made available in a series of effective solutions that will improve the way transportation professionals plan, operate, maintain, and ensure safety on America's roadways.

Authorized in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), SHRP 2 builds on the success of the first SHRP, which produced, among other innovations, Superpave – a process for creating more durable roads – and new technology for addressing snow and ice. The Moving Ahead for Progress in the 21st Century Act (MAP-21) has authorized additional funding to support implementation activities; with at least partial

funding from each state's SPR funding. The AASHTO Board of Directors approved 4% funding for each of the two years from SPR funding. In FFY 2013, MDT contributed this 4% SPR funding exclusively from its Research portion, which is 25% of the total SPR funding.

SHRP 2 will continue to launch proven innovations through 2015 as research and pilot projects are completed. By implementing SHRP 2 Solutions, the transportation community will more efficiently strengthen the Nation's highway system to serve us through the 21st century. For more information, view the SHRP2 outreach toolkit, FHWA SHRP 2 website, AASHTO SHRP 2 website, and the TRB SHRP 2 website.

SHRP 2 implementation funding is being provided to state DOTs and other agencies to implement the results of the research. There are three categories of SHRP 2 implementation funding: proof of concept, lead adopter, and user incentive. MDT did not apply for any SHRP 2 Implementation Assistance grants in FFTY 2013.

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2.5 TRANSPORTATION RESEARCH BOARD SUPPORT

Project Name:	TRB Core Services
Project Number:	TPF-5(261)
Start Date:	10/1/12
Completion Date:	9/30/13
Total Cost:	$94,186
SPR Funds:	$94,186
FFY 2013 Funds Expended:	$94,186
FFY 2013 MDT Indirect Costs:	$0
Unexpended Funds:	$0
URL:	http://www.trb.org/Main/Home.aspx

Project Name:	NCHRP
Project Number:	TPF-5(413)
Start Date:	10/1/12
Completion Date:	9/30/13
Total Cost:	$414,079
SPR Funds:	$414,079
FFY 2013 Funds Expended:	$414,079
FFY 2013 MDT Indirect Costs:	$0
Unexpended Funds:	$0
URL:	http://www.trb.org/NCHRP/NCHRP.aspx

TRB Core Services Support

The partnership of TRB and the state transportation research community has been in place since 1920, with states providing direct financial support beginning in the 1940s. This TRB/state partnership promotes the development and implementation of innovations that save countless lives, improve mobility and access, and vastly increase the cost-effectiveness of materials, designs, construction practices, and operations.

TRB provides an information infrastructure that is designed to serve the nation's highly decentralized transportation system in which no single organization dominates. Indeed, the cooperation that TRB encourages among transportation agencies at all levels is the envy of other sectors that are similarly decentralized but do not have a mechanism like TRB to facilitate interactions among practitioners and researchers in an independent setting.

MDT invests in TRB's Core Program, which provides a forum for state DOT employees to collaborate with transportation professionals from other organizations to share information on research and issues of interest.

MDT's investment leverages a considerable return. As part of the independent institution that includes the National Academy of Sciences and the National Academy of Engineering, TRB has earned a national and international reputation for objective, high-quality products. In calendar year 2012, TRB's Core Program was funded at a level of $16 million, in part by the $7.34 million in contributions from state DOTs. The average state contribution in 2012 was approximately $144,000. Because of TRB's cooperative makeup, on average every $1 that a state invests in TRB Core Program

activities leverages approximately $111 in research-related activity ($7.34 million ÷ 50 states and DC = $144,000; $16 million ÷ $144,000 = $111).

TRB has made a concerted effort to diversify its revenue streams over the last seven years.

- ★ State DOT dues for the TRB Core Program did not increase from 2006-2012, and they are scheduled to be reduced by 5% for the next two years.
- ★ The share of TRB Core Program income from state DOTs has dropped from 55% to 45% over the last seven years.
- ★ The share of TRB Core Program income from private sources has increased from 19% to 32% over same time period.

Core Program staffing has remained at essentially the same level for more than 15 years. Over that same period:

- ★ The number of Annual Meeting sessions and workshops has increased by 100%.
- ★ The number of presentations at the Annual Meeting increased by 114%.
- ★ The number of papers undergoing peer review has increased by 154%.

A portion of MDT's federal State Planning and Research funds is invested in and is the primary source of funding for TRB's National Cooperative Highway Research Program (NCHRP), which conducts and delivers research in acute problem areas that affect state DOT highway planning, design, construction, operation, and maintenance nationwide.

In addition to the financial contribution, Montana employees are involved in the following activities:

- ★ Selecting and providing oversight to projects in TRB's National Cooperative Highway Research Program and second Strategic Highway Research Program (SHRP 2).
- ★ Serving on panels for other TRB cooperative research programs in the areas of transit, airports, hazardous materials, and freight.
- ★ Providing input to TRB's Technical Activities Division, which functions as a research clearinghouse and facilitates collaboration among the states, transportation organizations, academia, and individual researchers and practitioners.
- ★ Serving on National Research Council-appointed committees that develop, refine, or offer direction on national transportation issues, often based on a request for advice from a public or private agency.

TRB's Core Program budget is approximately $16 million per year with approximately 45% funded by the state DOTs. The remainder comes from federal agencies, other

transportation organizations, and TRB self-generated revenue. MDT's current contribution is $94,186 each year, which means MDT leverages approximately $170 in research-related activity for every $1 invested in TRB's Core Programs.

This investment in TRB and the pooled funding it represents is mission-critical, enabling MDT to:

- ★ Have a voice in setting national research priorities and agendas;
- ★ Continue to have access to the user-oriented research;
- ★ Avoid duplication of research efforts;
- ★ Demonstrate a return on investment of taxpayers' dollars;
- ★ Support the uniform, practical, and common-sense application of transportation research results;
- ★ Continue to develop a more enlightened and informed workforce;
- ★ Improve our customers' experience by accelerating the development and implementation of solutions to problems that affect transportation planning, design, construction, operation, and maintenance; and
- ★ Retain employees by offering them stimulating and professionally rewarding opportunities to participate in efforts that will help improve the nation as a whole.

Tangible Benefits

MDT receives more than $71,216 worth of tangible benefits, which break down as follows:

- ★ Complimentary registration to the TRB Annual Meeting. MDT sent 3 employees to the TRB Annual Meeting last year, saving Montana $ 2,745.
- ★ The face-to-face meetings and interactions that take place at the Annual Meeting generate ideas, products, and partnerships from which MDT benefits. The Annual Meeting provides an unparalleled opportunity for MDT staff to share knowledge and perspectives with 12,000 colleagues and to learn about the latest in transportation research, policy, and practice. This sense of community also offers a significant morale boost during tough economic times.
- ★ To address budget restrictions within states, TRB offers activities that not only save states money, but push traditional conference type-information out to state employees who are not able to travel. Examples include the following:
  - ➢ In 2012, TRB provided complimentary access to the Compendium of Papers and Annual Meeting speaker visual aids through the TRB Annual Meeting Online portal, or AMOnline for short. Speaker visual aids are from lectern and poster sessions, workshops, and peer-reviewed papers at committee meetings. Non-TRB sponsors are charged $20 per paper/presentation.

Approximately 171 visitors from Montana accessed the site, equating to a value of approximately $ 3,420 for MDT.

- Complimentary, unlimited attendance in TRB Webinars. In 2012 TRB charged $99 for each site a non-sponsor organization registers to access any one of the approximately 40 webinars TRB produces per year. A subscription package, which allows employees of a subscribing organization access to each of TRB's webinars, is also available for $ 999. Last year, approximately 279 Montana employees "attended" a TRB webinar as part of the 93 complimentary site licenses MDT received last year. If MDT would have had to pay for these licenses on an individual basis it would have cost $ 5,115. The value of this benefit has increased because in 2011 TRB began issuing Professional Development Hours (PDHs) credits to MDT employees who attend live webinars. This provides us a flexible and extremely economical way to ensure that our engineers' licenses remain current.
- Complimentary copies of TRB publications. Last year MDT received approximately $52,836 worth of publications from TRB through our standing subscription requests. In addition, TRB fulfills all individual "over the counter" publication requests from state employees on a complimentary basis.
- Complimentary, electronic access to the TRR Journal Online, which includes more than 9,100 peer-reviewed papers that have been published as part of the Transportation Research Record: Journal of the Transportation Research Board (TRR Journal) series since 1996. Last year, MDT employees downloaded 92 papers. TRB charges non-sponsor-affiliated individuals $25 per paper per download. Based on the $25 download rate, the value from the TRR Journal Online that MDT received last year was $2,300.
- Free exhibit space at the TRB Annual Meeting. This benefit is valued at approximately $ 3,000. Traditionally almost all the states have passed this benefit on to AASHTO which collectively exhibits on behalf of the state DOTs.
- Reduced fees to TRB-sponsored specialty conferences. This discount is about 20% below the general registration fee for the more than 25 specialty conferences TRB conducts each year. Last year about 5 MDT employees attended a TRB specialty conference, which resulted in a savings for the department of about $406.
- Reimbursement for State Representative Meeting Travel. TRB reimburses the costs for lodging for TRB State Representatives to attend the State Representatives annual meeting, which is held in conjunction with the AASHTO Research Advisory Committee (RAC) meeting. The reimbursement and reduction in travel cost savings associated with the dual scheduling of these events amounts to a value of approximately $1,800 per year.

Intangible Benefits

- Access to research collaboration tools such as the Research Needs Statements (RNS), Research in Progress (RiP), and Practice Ready Papers (PRP) databases, which were built and are maintained by TRB in part by the department's contribution to TRB.
- Access to the Transport Research International Documentation (TRID) database. TRID is a newly integrated database that combines the records from TRB's Transportation Research Information Services (TRIS) Database and the Organisation for Economic Co-operation and Development's Joint Transport Research Centre's International Transport Research Documentation (ITRD) Database. TRID provides access to more than one million records of transportation research worldwide. TRID is maintained by TRB in part by the department's contribution to TRB.
- Weekly notices on TRB Activities via the TRB E-Newsletter. The weekly electronic service is designed to keep individuals up-to-date on TRB activities and to highlight selected transportation research-related activities taking place at the federal and state levels, and within the academic and international transportation communities. As of July 2013, some 62 state employees receive the newsletter directly, but many more receive it through Research staff.
- In-state, annual access to TRB staff. Not all of MDT's staff can participate in TRB, so TRB comes to us. TRB's annual field visit program is designed to keep TRB aware of and responsive to MDT's needs. TRB's last visit to Montana was in June 2013.

National Cooperative Highway Research Program (NCHRP)

- State contributions to NCHRP in 2012 totaled more than $39 million. MDT's contribution to that total was $414,079, which means MDT leverages approximately $95 in research-related activity for every $1 MDT invests in TRB's NCHRP activities.
- MDT staff participates in NCHRP by:
  - Submitting problem statements,
  - Rating problem statements, and
  - Participating on and chairing NCHRP panels. TRB reimburses state employees for travel and lodging expenses related to participation in panel meetings.
- MDT benefits by implementing research results developed through NCHRP. In 2012, NCHRP produced some 78 publications that described the results of research.
- In addition to conducting research on specific problems identified by practitioners and selected by the AASHTO Standing Committee on Research, NCHRP through its 20-24 project series addresses issues selected by state CEOs

in the areas of resource development, decision support, and financial management.

- ★ NCHRP's Impact on Practice series, available at http://www.trb.org/NCHRP/NCHRPImpactsonPractice.aspx, highlights how transportation agencies have put NCHRP research results to use.

Other TRB Research Programs

In addition to TRB's National Cooperative Highway Research Program (NCHRP), TRB also manages a variety of other programs that are not directly supported by the states, but from which MDT benefits. These programs are authorized by Congress and funded through various administrations within the U.S. Department of Transportation. The programs include the following:

- ★ The second Strategic Highway Research Program (SHRP 2) was established by Congress to investigate the underlying causes of highway crashes and congestion in a short-term program of focused research in the areas of safety, renewal, reliability, and capacity. The Program was authorized in 2005 and funded at a level of $223.4 million. Many state DOT employees currently serve or have recently served on SHRP 2 committees and expert task groups.
- ★ The Transit Cooperative Research Program (TCRP) was funded at about $7 million per year by the Federal Transit Administration in 2012. TCRP is an applied, contract research program that develops near-term, practical solutions to problems faced by transit agencies.
- ★ The Airport Cooperative Research Program (ACRP) was funded at about $15 million per year by the Federal Aviation Administration in 2012. ACRP is an industry-driven, applied research program that develops near-term, practical solutions to problems faced by airport operators.
- ★ The National Cooperative Freight Research Program (NCFRP) was funded at about $3 million per year by the Research and Innovative Technology Administration in 2012. NCFRP conducts research and disseminates timely findings that help inform investment and operations decisions affecting the performance of the freight transportation system.
- ★ The Hazardous Materials Cooperative Research Program (HMCRP) is funded at about $1 million per year by the Pipeline and Hazardous Materials Safety Administration in 2012. HMCRP conducts research intended to advance current knowledge and practice relating to hazardous materials transportation.
- ★ The National Cooperative Rail Research Program (NCRRP) was authorized in 2008 and was funded at about $ 5 year by the Federal Railroad Administration through 2012. NCRRP addresses concerns in the areas of intercity passenger rail (including high-speed rail) and freight rail services.

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3 RESEARCH PROJECTS

3.1 OVERVIEW

Once a year, the Research Programs Manager solicits research ideas from as wide a variety of individuals as possible. This open solicitation enhances the possibility of receiving a diverse spectrum of research suggestions.

Before a topic statement can be prioritized, it must have a champion and a sponsor. A champion is internal to MDT, and is willing to support the topic statement to the Research Review Committee (RRC) and serve as the technical panel chairperson should the topic statement move forward to this stage. In doing this, the champion asserts there is a research need and this need is important to MDT. A sponsor is at least at the level of a Division or District Administrator who agrees the research is important to MDT and is willing to ensure implementation occurs. Only topic statements with both a champion and sponsor move forward to the project prioritization stage.

The champions for each topic statement present their topic to the RRC and District Administrators (DA). At this same meeting, the RRC and District Administrators then select the high priority topics for that solicitation cycle. These topics are chosen because they address actual concerns of the Department.

Following the selection of these high priority topics, Research Programs staff forms a technical panel for each topic. Technical panels are formed to follow research projects from inception through implementation and documentation of performance measures, and are typically composed of three to ten people with knowledge or expertise and interest in the specific area of research. Panel members are drawn from MDT's Division and District offices, as well as from outside the Department. The technical panel's responsibility begins with a review of the literature to determine the need for research, if any, and continues with the development of a viable research plan. This plan should include:

- The tasks need to be accomplished;
- An identification of the barriers to implementation and how to reduce or eliminate these barriers;
- A determination of the required time and funding to complete the project;
- Selection of researcher(s) to perform the research;
- A determination of the research products required to facilitate implementation; and
- A determination of appropriate performance measures related to the research to be qualified or quantified through the research.

Final funding is approved by the RRC.

During and following the research, the Research Programs representative on each technical panel serves as MDT's project manager and liaison between the technical panel and the consultant. The technical panel monitors research progress by reviewing monthly, quarterly, annual, task, final, project summary, implementation, and performance measures reports, and any other reports and deliverables produced. Finally, the technical panel makes implementation recommendations to the appropriate MDT Administrator, through the RRC, which are then implemented by the appropriate operational unit(s).

The research projects process as detailed above is shown in Figure 5. In addition to the solicitation process (as described above), there are a number of other methods to initiate research projects: Montana Partnership for the Advancement of Research in Transportation (MPART Small Projects), partnership projects, and Administration High Priority topics (Figure 5).

MDT has contracts in place with Montana State University, The University of Montana, and Montana Tech for small projects (<$35,000 and 1 year) under our MPART Small Projects agreement. An example of a small project would be a synthesis project, which includes a review of the literature and a survey of the state of the practice, similar to National Cooperative Highway Research Program (NCHRP) synthesis projects. If there is a need for a small project, the steps below are followed:

- ★ Champion notifies Research Programs Manager of need.
- ★ Technical panel is formed.
- ★ Proposal is obtained.
- ★ Technical panel recommends proposal for funding to RRC.
- ★ RRC approves or denies funding request.

Partnership projects can be any projects where MDT decides to partner with others to conduct research. The process varies depending on whether these projects are pooled-fund studies or other partnering projects and whether MDT is the project lead or not.

Finally, if MDT Administration identifies a research need that requires immediate attention, the Research Programs manager is informed, a technical panel is formed, and a proposal(s) is obtained and approved either by the RRC or Administration.

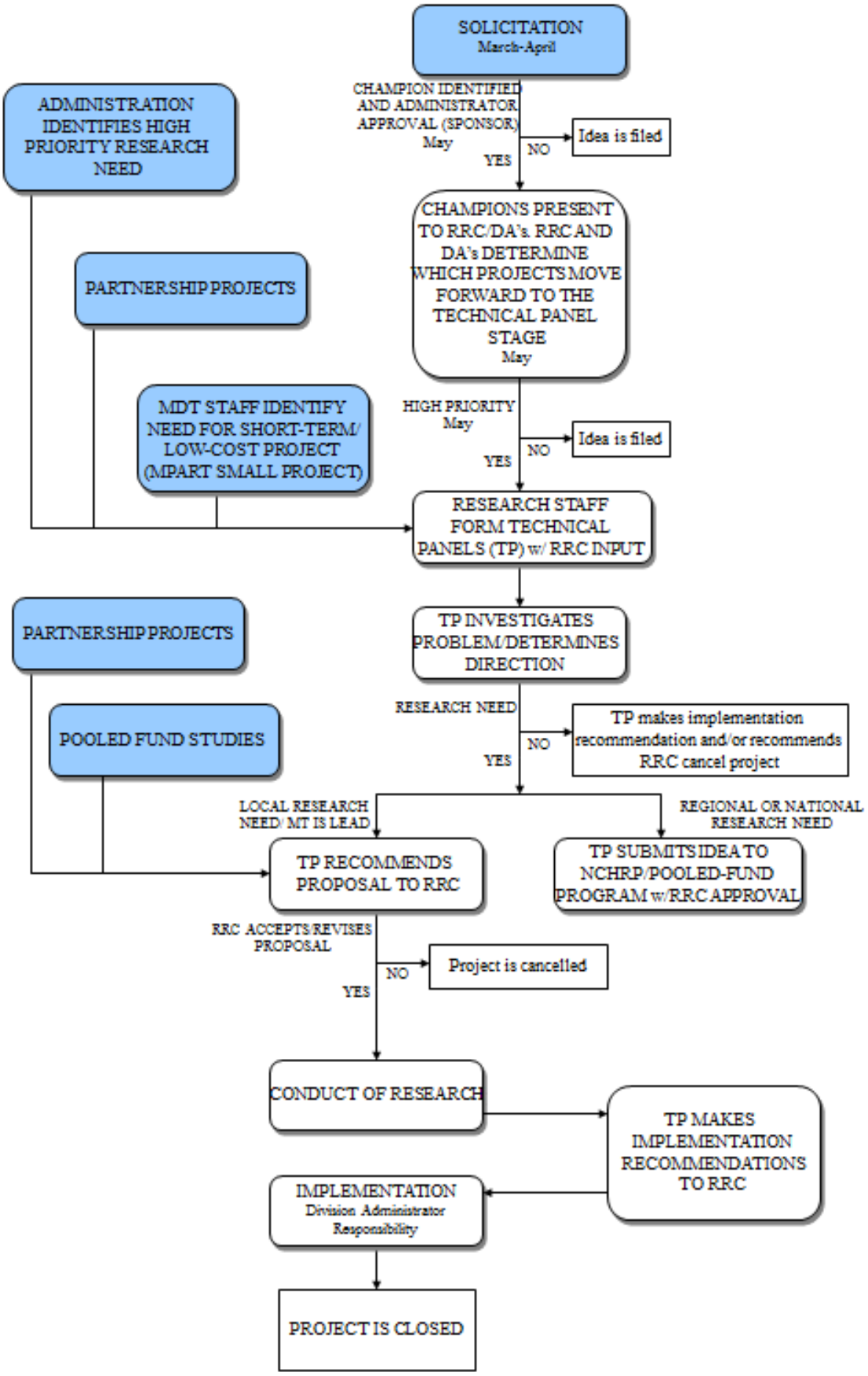

Figure 5: Research projects process.

3.2 BRIDGE AND HYDRAULICS RESEARCH PROJECTS

3.2.1 Active Projects

3.2.1.1 Flood Frequency Analyses for Montana Based on Data through Water Year 2011

Project Number:	8209
Start Date:	7/1/10
Completion Date:	3/31/14
Total Cost:	$263,050
SPR Funds:	$143,050
Federal:	$100,000
State:	$20,000
FFY 2013 SPR Funds Expended:	$23,134
FFY 2013 MDT Indirect Costs:	$2,308
Unexpended Funds:	$10,413
Contractor:	United States Geologic Survey
URL:	http://www.mdt.mt.gov/research/projects/hyd/flood.shtml

Objective:

The overall objective of this project is to improve pier-scour estimates at bridges in Montana. To this end, this project has two major components. The first component is an analysis of existing bridge-scour data in Montana and adjacent mountain states. The second component is a long-term pier-scour data collection program for bridges over coarse-bed streams throughout Montana. The goal is to obtain on-site pier-scour measurements at selected sites per year over a 5-year period. While initially proposed to include data through water year 2009, flooding in 2011 was substantial at a large number of USGS gaging stations, both active and discontinued. Through collaboration with the USGS and the MDT it was determined to extend the project to accommodate the 2011 events into the current scope and final report.

Progress:

Hydraulic data is being compiled and the final report is being drafted.

Reports:

Four progress reports have been submitted. Project information can be viewed at the above URL.

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3.2.2 Completed Projects

3.2.2.1 Performance of Steel Pipe Pile to Concrete Bent Cap Connections Subjected to Seismic Loading or High Transverse Loading: phase III Confirmation of Connection Performance

Project Number:	8203
Start Date:	8/1/09
Completion Date:	11/30/12
Total Cost:	$115,647
SPR Funds:	$101,320
Contractor Cost Share:	$14,327
FFY 2013 SPR Funds Expended:	$2,747
FFY 2013 MDT Indirect Costs:	$274
Unexpended Funds:	$54
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/structures/seismic.shtml

Objective:

MDT and Montana State University (MSU), through previous research, developed a new procedure to design concrete filled steel tube (CFT) pile to concrete pile cap connections. A series of CFT piles embedded in a concrete pile cap is a desirable system to support small to mid-span bridges. Traditional methods for designing the connection between the CFT piles and pile cap often lead to congested and complex reinforcing schemes; this complexity can limit the use of this support system. MDT and MSU developed a simple design method for this connection utilizing a new reinforcing scheme that greatly simplifies the design and construction of this connection. The new reinforcing scheme includes U-shaped reinforcing bars that encircle the embedded CFT piles within the cap that counteract the moment-related demands introduced by the embedded pile under lateral load events. The efficacy of this design method implementing the new reinforcing scheme was evaluated in this research.

The final report presents the details and results of tests on six half-size connections designed to exercise various design parameters in the MDT design guide. In these tests four primary limit states were observed:

1. Formation of a plastic hinge in the concrete-filled steel tube,
2. Crushing of the concrete surrounding the embedded pile,
3. Yielding of the longitudinal reinforcement, and
4. Splitting failure of the concrete cap.

The MDT design methodology addresses all of these limit states fairly accurately. Some possible improvements to MDT's methodology suggested by the test results are presented and discussed in the final report.

Progress:

With the project complete, a formal presentation was conducted by the contractor to MDT summarizing the results.

The design changes detailed in the final report have been accepted as standard practice by the MDT. The methodology is not yet included in the bridge design manual but will be incorporated once that documented is updated.

Reports:

The final report is accepted and published. It can be viewed at the above URL.

Implementation:

There are five implementation recommendations related to the limit states described above in the Objective Section. MDT's response to these recommendations is as follows:

1. AASHTO incorporated the American Institute of Steel Construction's methodology for calculating the plastic moment capacity of CFTs into the new seismic design specification. MDT plans to adopt the AASHTO specification.
2. MDT will reduce allowed concrete compressive strengths and include interior U-bars near the tip of the embedded pile, as appropriate, to delay the onset of crushing in the interior of the cap.
3. Recognizing the potential benefits of mechanics-based models relative to empirical relationships to describe physical behaviors, MDT and MSU either independently or collaboratively may further research and develop such models to better characterize longitudinal yield behavior of the U bars.
4. Similarly recognizing the advantages of developing a more robust analytical model to predict cap splitting, MDT and MSU either independently or collaboratively may further research and develop such a model.
5. To address possible unconservative branching of the design process based simply on level of moment demand on the connection as a fraction of CFT plastic moment capacity, MDT will remove this "branch".

Performance Measures:

It was estimated this design procedure will be used on structures two times per year and the cost savings per structure will be $50,000. This results in a cost savings of $100,000 per year. A benefit/cost ratio was estimated to be 8.53:1 and a return on investment was estimated at 7.53.

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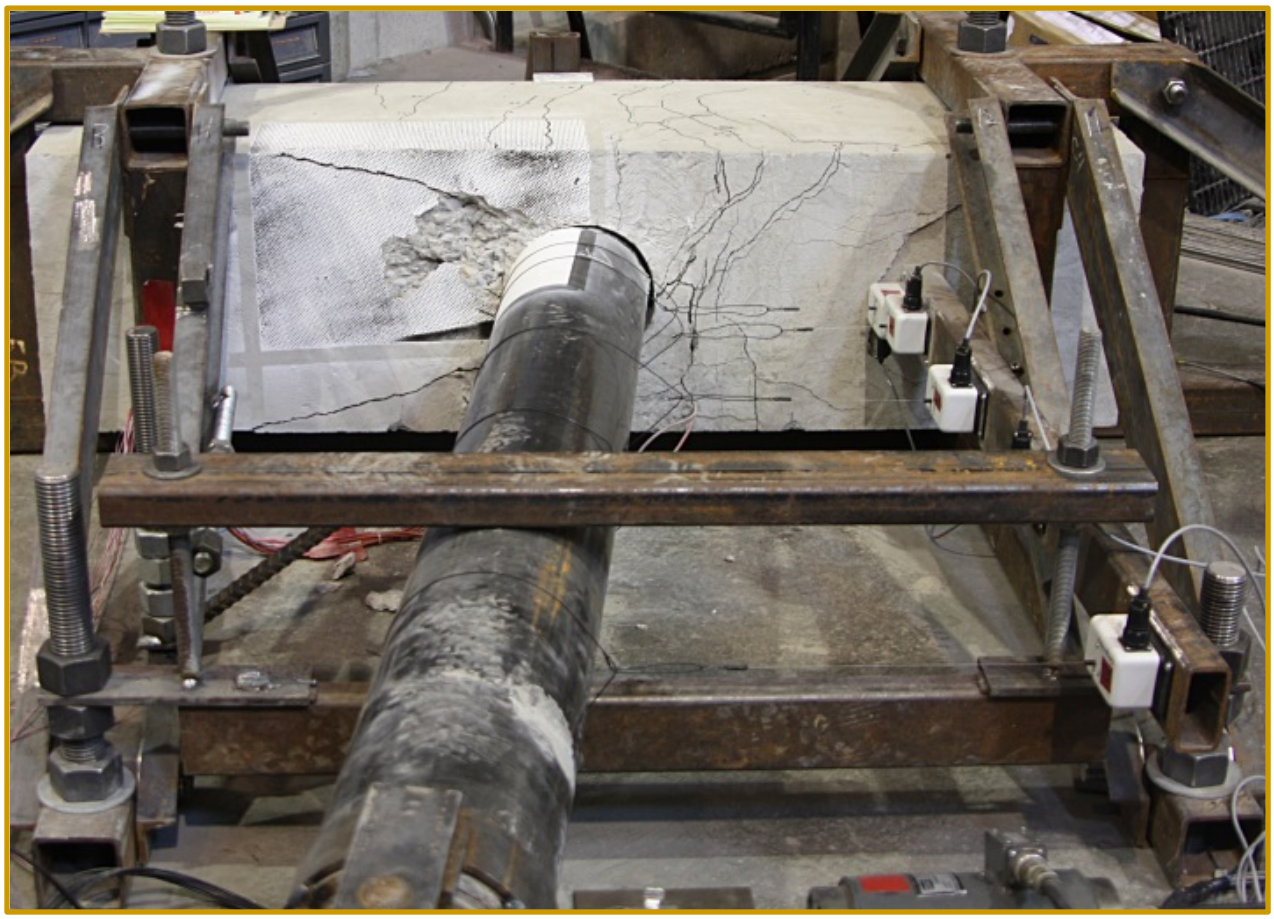

3.2.3 On-Hold Projects

3.2.3.1 Determination of Material Properties and Deflection Behaviors for Contemporary Prestressed Beam Design

Project Number:	8215
Start Date:	9/1/11
Completion Date:	3/31/14
Total Cost:	$129,492
SPR Funds:	$129,492
FFY 2013 SPR Funds Expended:	$533
FFY 2013 MDT Indirect Costs:	$53
Unexpended Funds:	$114,322
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/structures/prestress.shtml

Objective:

The primary goal of this project is to provide guidance specific to Montana design and construction practices that will result in more efficient prestress concrete bridge structures. In this regard, the project is focused on providing improved concrete material properties in conjunction with a better understanding of girder deflection behaviors. Specific objectives consist of the following:

1. Determine through tests and analyses appropriate values for the elastic and non-elastic properties of the typical concrete used in MDT prestress concrete bridge girders.

2. Measuring the deflections through time experienced by girders in an actual bridge structure, comparing these deflections to those estimated analytically, and suggesting appropriate modifications in the analysis process to produce better deflection predictions.

Progress:

During late September 2012, an issue arose with Cretex (the Helena prestress beam manufacturer) and the local concrete supplier regarding concern over mix design discrepancies. The project halted at this point until the subject parties resolved the issue. By late January 2013, the dispute was still in place and in February 2013 the project was formally postponed until the issue could be resolved.

Reports:

Due to the mix design issue, no progress reports were expected in FFY 2013.

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3.2.4 Pending Projects

3.2.4.1 Investigation of Prefabricated Steel Truss/Bridge Deck Systems

Contractor: Western Transportation Institute, Montana State University
Project URL: http://www.mdt.mt.gov/research/projects/structures/prefab.shtml

Topic Statement:

The objective of this proposed research is to investigate, and develop, as appropriate, a prefabricated steel truss/deck system as an alternative to other accelerated bridge construction (ABC) systems available to MDT. Over the past several years the benefits of decreased bridge construction times have increasingly been recognized, and include improved safety of the travelling public, reduced economic impacts associated with construction related detours and delays, and reduced impacts on the environment. The proposed system consists of a section of concrete deck, precast on supporting steel truss elements. Once the substructure is prepared, these sections would be transported and placed in parallel to form the bridge. It is anticipated the bridge could be completed within a few days after the sections are placed. Relative to precast concrete ABC systems currently available to MDT, these steel systems could offer more predictable deflection behaviors (important to rideability) and the ability to bridge longer spans, as well as a simply a cost competitive alternative to concrete. It is anticipated that local fabricators would be able to build this system. However, there is limited experience with such truss supported systems, and thus some research is required to move forward toward their field deployment. Such research would consist of reviewing the state of the practice with prefabricated steel bridge sections, analyzing proposed designs, confirming expected performance as necessary by test, and deployment and monitoring of a demonstration project.

Background Statement:

As with most technology based products, bridge designs continue to evolve to better take advantage of the latest in technological developments, as well as to better serve the changing needs of society. Specifically in the bridge arena, analysis and design methodologies continue to improve, as better computational tools become available to execute these analyses, and these tools are updated to reflect increased understanding of bridge performance obtained through ongoing research and accumulated in-service experience. Additionally, new and/or improved materials for bridge construction continue to be discovered, as well as more optimal systems for using these materials, which results in more efficient, longer lasting structures. Finally, renewed attention is being brought to bear in the bridge community on user concerns, notably during construction/maintenance, when the user may at the least be inconvenienced, but more importantly may experience economic losses, increased energy costs and increased risk

of accidents due to construction related delays and detours. Furthermore, lengthy construction times result in greater environmental impacts. All of these concerns can be mitigated by using bridge designs amenable to accelerated construction methods, and that require little maintenance once in-service. Over the past decade, accelerated bridge construction (ABC) has been become a national priority strongly supported by FHWA, with the simply stated guiding principle of: "Get in. Get out. Stay out." One ABC concept that has been put forth uses prefabricated bridge sections consisting of steel supporting elements (girder/truss) topped with a concrete slab. A typical prefabricated section, for example, could consist of a 10 foot strip of concrete deck on two supporting steel members that will longitudinally span between elements of the substructure. Once completed, a sufficient number of these prefabricated sections are placed in parallel on the substructure to form the bridge. Only a few inter-element joints subsequently need to be addressed in the field to complete the structure. It is estimated that such a bridge will be operational within a few days after the prefabricated sections are set. A steel fabricator in Lewistown, MT (Allied Steel) has approached MDT specifically about developing and using a steel truss supported prefabricated bridge system in ABC in Montana. From discussions with the Bridge Bureau, MDT has limited experience with this particular type of system, but recognizes that it could offer some advantages over a prefabricated concrete based ABC system that is already used in the state (typically a prestressed system in which the deck is an integral part of the girder). While the concrete system has offered good performance, its deflections can be difficult to predict (affecting rideability), and its span lengths could be limited (basically a material with a relatively low strength to weight ratio), compared to a steel alternative. From a consumer perspective, having a steel alternative available could result in more cost effective solutions across the board.

A summary of the perceived advantages and disadvantages of prefabricated steel bridge systems was prepared as part of a project sponsored by FHWA on identifying optimum systems for bridge construction, rehabilitation and replacement, and provides some guidance on what future systems should aim for based on the advantages and disadvantages of existing systems. It appears that the system proposed by Allied Steel has some promise and would meet all but a few of these proposed goals for new systems. The FHWA document goes on to recommend two new systems for potential use (both are girder-based systems; while space truss systems scored well, the fabricators they spoke with had reservations about them). They conclude that before systems are implemented in real-world applications, half-scale units should be tested under static loads to verify stiffness/strength properties, and they recommend that these systems also be tested under fatigue to ensure durability.

Research Proposed:

The objective of this project would be to research and fully develop a prefabricated steel truss based ABC system for use on Montana's highways. This objective would be

accomplished in three phases, with the work on each successive phase contingent upon the outcome of the previous phase. Specifically, these phases would be:

- **Phase 1.** Review of the state of the practice in prefabricated steel bridge systems, followed by proof-of-concept analysis/evaluation of the system proposed by Allied Steel.
- **Phase 2**. Further research and testing of the proposed system as necessary to finalize its design. Such testing could include both sub-component and full element testing to evaluate local (e.g. fatigue) and global (e.g. stiffness) performance.
- **Phase 3.** Construction and monitoring of a field demonstration project.

In Phase 1 researchers would conduct a full literature review of the state-of-the-practice relative to prefabricated steel bridge systems. Work would include a review of fatigue issues in steel truss elements. Working with MDT, researchers would then study/model the proposed system to verify the basic design and identify potential trouble areas. If the system was judged as promising at the conclusion of Phase 1, these trouble areas would be addressed in Phase 2 through further analysis and testing, culminating in a design for a demonstration project. In Phase 3, a demonstration project would be pursued; such a project could be eligible for funding through FHWA's Highways for LIFE program (http://www.fhwa.dot.gov/hfl/).

Urgency and expected Benefits:

As mentioned in the background section of this research topic statement, ABC methods result in:

- **Improved safety**. The time of exposure of the travelling public to work zone related driving risks is reduced. Similarly, the exposure time of construction workers to highway work zone hazards is reduced, and a greater proportion of the work is done in the relatively safer environment of a fabrication facility.
- **Reduced economic impacts**. Delays and detours associated with bridge construction has direct cost impacts on highway users through increased transportation costs associated with increased travel time/distances.
- R**educed environmental impacts**. The amount of additional energy consumed by the travelling public as a result of construction delays and detours, and any associated environmental impacts, are minimized. Further, the level of disturbance of the environment at the construction site is reduced, as a greater proportion of the work is done offsite.
- R**educed inconvenience to the travelling public.** Congestion is reduced through a shortened construction time.

While MDT already employs precast concrete-based ABC systems, this project will result in a steel-based alternative to these concrete systems. Such an alternative would allow for better optimization of system selection in any given situation, as each system has unique advantages and disadvantages. While it might seem that the system

manufacturer should fund this research, as a primary customer for the system, MDT would ultimately bear these costs. Additionally, MDT's participation in research sponsorship will result in project findings being available in the public domain.

Progress:

A research topic statement was submitted in FFY 2013 and can be viewed at the above project URL. A technical panel was formed and has met twice, including one meeting with the Contractor. The Contractor will draft a scope of work with research tasks for the technical panel's review.

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3.3 ENVIRONMENTAL RESEARCH PROJECTS

3.3.1 Active Projects

3.3.1.1 Evaluating Wildlife-Vehicle Collisions (WVC) and Wildlife Connectivity in the Madison Valley and Hebgen Lake Area

Project Number:	8217-001
Start Date:	4/30/12
Completion Date:	12/31/14
Total Cost:	$227,685
SPR Funds:	$227,685
FFY 2013 SPR Funds Expended:	$105,903
FFY 2013 MDT Indirect Costs:	$10,099
Unexpended Funds:	$74,679
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/env/madison_valley.shtml

Objective:

The overall objective of this project is to determine the effect of the major highways in the Madison Valley on wildlife mortality and movement patterns. Proactively investigating the effect of this highway corridor on wildlife will provide timely information that can be used by resource management agencies and local landowners to guide land use decisions (protecting habitat) as well as guide possible wildlife-vehicle

collision mitigation efforts. A major outcome of this project will be a GIS database of the study area that documents areas of known and successful highway crossings and areas of elevated road kill or wild animal-vehicle collisions. This database has the potential to increase efficiency and effectiveness for MDT and other agencies.

Progress:

Roadkill surveys and wildlife monitoring continued this year.

Reports:

Four quarterly progress reports and two task reports (Bibliography and Literature Review, and Data Inventory and Reconnaissance) were received. All progress reports, completed task reports, and other project information can be viewed on the project website at the above URL.

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3.3.1.2 Evaluation of Wildlife Crossing Structures on US Highway 93 Evaro to Polson

Project Number:	8208
Start Date:	1/15/10
Completion Date:	7/31/15
Total Cost:	$821,204
SPR Funds:	$621,795
Federal Funds:	$50,000
Contractor Cost Share:	$149,409
FFY 2013 SPR Funds Expended:	$98,504
FFY 2013 MDT Indirect Costs:	$9,301
Unexpended Funds:	$303,231
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/env/wildlife_crossing.shtml

Objective:

The US Highway 93 North (US 93 N) reconstruction project on the Flathead Indian Reservation in northwest Montana represents one of the most extensive wildlife-

sensitive highway design efforts in North America. The reconstruction of the 56 mile (90 km) long road section includes the installation of 42 fish and wildlife crossing structures and approximately 16.6 miles (26.7 km) of wildlife exclusion fencing. The mitigation measures are aimed at improving safety for the traveling public through reducing wildlife-vehicle collisions and allowing wildlife to continue to move across the landscape and the road. The magnitude of the US 93 N reconstruction project and associated mitigation measures provide an unprecedented opportunity to evaluate the extent to which these mitigation measures help improve safety through a reduction in wildlife-vehicle collisions, maintain habitat connectivity for wildlife, and to assess the monetary costs and benefits of the mitigation measures.

In 2002, prior to reconstruction, the Western Transportation Institute (WTI) was funded by the Federal Highway Administration (FHWA) and the MDT to initiate a before-after field study to assess the effectiveness of the wildlife mitigation measures. This project will provide post-construction monitoring and evaluation.

Progress:

The research team continued to conduct crossing structure, jump-out, and track bed monitoring; pellet group counts; and data collection and entry. Information signs for the mitigation measures were prepared. Follow-on projects and additional reports not funded by this project included:

- *Acceptance of wildlife crossing structures* (Master's thesis)
- *Effect of cover on small mammal presence and movement through wildlife underpasses* (Master's thesis)
- *The effectiveness of wildlife guards and the use of wildlife crossing structures by deer and black bear* *(Master's thesis).
- *Effectiveness of wildlife guards at access roads* (Peer-reviewed article published in the Wildlife Society Bulletin)
- *Effect of cover on small mammal movement through wildlife underpasses on Highway 93 North* (Conference presentation)
- *Effectiveness of wildlife guards at access roads* (Poster)
- *Outreach matters! Highway wildlife mitigation outreach activities on the Flathead Indian Reservation and surrounding areas, Montana* (Poster)
- *Acceptance of large mammal underpasses by white-tailed deer and mule deer* (Poster)

Finally, the Deputy Minister of Transportation of Mongolia, Deputy Minister of Environment of Mongolia, and 11 others (13 delegation members in total) visited the US93 N project on April 7-8, 2013. MDT, the Confederated Salish and Kootenai Tribes (CSKT), and WTI all contributed to the meetings and field trip. Article in Missoulian: http://missoulian.com/news/state-and-regional/mongolian-officials-look-to-western-montana-wildlife-crossings-as-model/article_a538d3a2-a09f-11e2-8e8d-001a4bcf887a.htm.

Reports:

Two annual reports and four quarterly progress reports were received, reviewed and published on the project website at the above URL. In addition, project photos were received and posted to the project website.

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3.3.1.3 Monitoring Wildlife Crossings on US 93 South

Project Number:	8194
Start Date:	8/31/08
Completion Date:	7/31/15
Total Cost:	$509,247
SPR Fund:	$509,247
FFY 2013 SPR Funds Expended:	$57,641
FFY 2013 MDT Indirect Costs:	$4,550
Unexpended Funds:	$166,850
Contractor:	Patricia Cramer
URL:	http://www.mdt.mt.gov/research/projects/env/us93_wildlife.shtml

Objective:

The purpose of this research is to determine the effectiveness of wildlife crossing structures by investigating:

1. White-tailed deer (Odocoileus virginianus) use of wildlife crossing structures and wildlife crossing sites,
2. White-tailed deer usage rates of wildlife crossing structures by type and across types (including height, width, length, and material),
3. Relationships between usage rates of wildlife crossing structures and landscape variables,
4. Changes in animal-vehicle collisions between pre-construction and post-construction of wildlife crossing structures within a twenty-five mile stretch of US Highway 93 South, mile post (MP) 74 to MP 49, and
5. Relationships between animal-vehicle collisions and wildlife crossing structures over time and space.

Progress:

A number of experimental and control cameras were installed and post-construction monitoring continues. White-tailed deer usage rates were determined by monitoring wildlife crossing structure sites and wildlife crossing structures with motion-triggered cameras. Over 300,000 images were analyzed and the following calculations were made for each crossing structure.

- Deer/day
- Success/day
- Success rate
- Rate of repellency
- Parallel rate

In addition, vegetation and fecal pellets near the crossing structures were analyzed.

Finally, two Generalized Additive Models were developed: 1) to demonstrate the preconstruction relationship between traffic volumes and animal-vehicle collision (AVC) counts and 2) to control for spatial and temporal effects of AVC and traffic volume data, and the estimated effect of traffic volumes on AVC counts. The Kernel Density Analysis that indicates AVC numbers over time and space was updated.

Reports:

Three quarterly progress reports and one annual report were received, reviewed, and published on the project website at the above URL, along with project photos and videos.

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3.3.2 Pending Projects

3.3.2.1 Testing Woolen "Made in Montana" Roadside Reclamation Products

Contractor: Western Transportation Institute, Montana State University
URL: http://www.mdt.mt.gov/research/projects/env/wool_test.shtml

Topic Statement:

Department of Transportation (MDT) lands require the creation of the proper environmental conditions conducive to the successful establishment and survival of reclamation plantings as well as the control of soil erosion, and the control of surface runoff and its sediment load into adjacent receiving waters (as regulated by the Clean Water Act). The development and testing of various wool matting, batting, and soil-seed-wool packets produced by Brookside Woolen Mill of Malta, MT will allow researchers to address each of these issues with locally made products that provide an alternative use for a Montana agriculture "waste product" (wool rejected by mills for clothing). WTI proposes to collaborate with Thayne Mackay, the proprietor of the Brookside Woolen Mill, to test the effectiveness of a variety of commercially viable woolen erosion control, soil retention and vegetation establishment blankets and related materials for roadside reclamation purposes. For example, standard practice often uses coconut fiber (coir)-straw erosion control fabric and other similar or related geotextile materials that are imported to Montana from the tropical regions of the world. This project has the potential to replace these products with superior materials manufactured in rural Montana.

Background Statement:

Erosion control fabrics must meet the requirements established by the Erosion Control Technology Council and the U.S. Department of Transportation, Federal Highway Administration's standard specifications for construction of roads and bridges on federal highway projects [FP-03 2003 Section 713.17, Type 3.B]. There are several types of erosion control blankets: temporary, extended and semi-permanent. One of the standard erosion control fabrics, for example, which is produced by the manufacturer North American Green, is comprised of straw and coconut fiber that meets federal specifications for an extended term erosion control blanket. According to the manufacturer's information sheet, this erosion control blanket is a 100% biodegradable blanket comprised of a 70% agricultural straw – 30% coconut fiber blend matrix with a functional longevity of up to 18 months.

Brookside Woolen Mill believes it can produce a cost competitive product from woolen fibers that is stronger and, more importantly, can store more moisture than the standard coconut-straw mats to give young seedlings a better chance at establishment, survival

and growth. Scoured wool can store up to 400%of its weight in water, which is much better than rock wool (synthetic product) or coco coir. Wool becomes saturated at 33 1/3% of its weight of moisture-free fibers. Thus, when scoured wool absorbs water greater than 33 1/3% of its weight, this moisture is more readily available for plant growth and adsorption. This could give a woolen erosion control blanket a decided advantage in harsher, drier climates if it meets FHWA standard specifications and is cost competitive. In addition, sheep wool contains up to 17% nitrogen and can act as a slow release fertilizer for plant establishment.

Other products that woolen fibers or felted woolen equivalents could potentially outperform are wattles (fiber rolls), weed mats, and re-vegetation pads that are standard reclamation products made of coconut-coir fibers.

Research Proposed:

The proposed research would primarily be a series of "side by side" tests of new woolen reclamation products produced by the Brookside Woolen Mill (Brookside) in Malta, MT with a comparable coconut or coir fiber product that is commercially available for the same purpose. These would be tested in the same environment, either at active highway reclamation projects selected by the MDT Reclamation Specialist or at WTI's Transcend research facility in Lewistown, MT, where a steep slope test site (3:1) has been constructed for experiments such as this.

The following variables would be controlled: site preparation, seed mix and application rates (when needed), moisture and other weather conditions. Controlling for these variables would then allow the dependent variables to be calculated for the woolen and coconut products as measures of product performance: amount of erosion and vegetative cover (when appropriate).

Erosion will be measured using the Bureau of Land Management's (BLM) standard methodology. This is a classification system using estimates of sheet erosion, rills and gullies.

Vegetation establishment and growth will be estimated using two parameters:

1. Stems per meter^2
2. Cover - vertical projection of the crown or shoot area of a species projected on the ground as a percent of the reference area

A current list of woolen reclamation products that are currently under consideration include:

- Water and soil erosion wattles (6, 9, and 12 inches in diameter and 10 feet long)
- Seed mats – high density material that does not allow plants to penetrate so that mowing or herbicide control for maintenance surrounding road signs and other poles in highway Right of Ways is not necessary.
- Erosion Control Blankets (of varying densities and thicknesses)
- Erosion Control Blankets embedded with seed (re-vegetation pads)

Many of these "woolen versus coconut-coir" product tests will be replicated 10 times, where practicable, so that they can be statistically evaluated. For erosion control blankets and weed mats, the ideal sample size will be ten 1 m^2 test plots randomly placed across a 10m X 10 m grid at the test site. This allows simple T-tests to be conducted to determine whether the difference in the mean of each set of data is significantly different. This method allows the researchers to determine if a woolen product performs better or worse than its equivalent commercially available coconut-coir product.

Urgency and Expected Benefits:

It is the purpose of this research to investigate the feasibility of incorporating a Montana Made product that utilizes agricultural waste materials in a way that is economical and environmentally sound. If the woolen products perform to satisfaction, the public would benefit by creating a market and value for a locally made commodity. Because of the uniqueness of the product, the research team intends to identify sites and applications where the product's use will provide better performance than with materials currently available in the commercial market.

Progress:

A research topic statement was submitted in FFY 2013 and can be viewed at the above project URL. A Technical Panel was formed to determine if this high priority topic should move forward to the research stage. The technical panel met to discuss this topic. The panel then developed a scope of work and requested a proposal from the Western Transportation Institute at Montana State University. The proposal was drafted in FFY 2013; it will be finalized and funding will be requested from the RRC in FFY 2014.

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3.4 HIGHWAYS RESEARCH PROJECTS

3.4.1 Active Projects

3.4.1.1 Feasibility of Utilizing Recycled Asphalt Pavement in Portland Cement Concrete Pavement Phases 1 and 2

Phase 1:

Project Number:	8207-000
Start Date:	1/15/10
Completion Date:	11/30/13
Total Cost:	$150,666
SPR Funds:	$116,873
Contractor Cost Share:	$33,793
FFY 2013 SPR Funds Expended:	$3,810
FFY 2013 MDT indirect Costs:	$422
Unexpended Funds:	$0
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/mat/cement.shtml

Phase 2:

Project Number:	8207-002
Start Date:	9/10/12
Completion Date:	12/31/14
Total Cost:	$69,456
SPR Funds:	$69,456
FFY 2013 SPR Funds Expended:	$54,414
FFY 2013 MDT indirect Costs:	$5,284
Unexpended Funds:	$15,041
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/mat/cement.shtml

Objective:

The primary goal of these projects is to develop and characterize a concrete suitable for transportation-related applications in which a portion of the conventional aggregate in Portland cement concrete pavement (PCCP) has been replaced with reclaimed asphalt pavement (RAP). Preliminary research has demonstrated the feasibility of creating concrete with RAP aggregate; however, these prior studies focused on short-term mechanical properties of the material, and do not address long-term durability characteristics of the concrete, as these two projects will. The results of these research projects may provide another option for using plant mix while conserving natural resources and energy.

Phase 1 research investigated the effects of RAP on several mechanical properties along with key durability characteristics and used both mineral and chemical admixtures to enhance concrete performance. Phase 2 of the study will focus on evaluating the field performance of the mixtures developed and tested in Phase 1. Phase 2 will evaluate the performance of these materials under various environmental conditions and traffic loads, and provide an opportunity to address any constructability issues associated with its deployment. In parallel with this work, two test slabs will be constructed at the Transcend research facility in Lewistown, MT. The test slabs will be instrumented to monitor shrinkage, curling, response to vehicle loads, and temperature. In addition to this continuous monitoring, the slabs will be inspected quarterly for cracking and other distresses.

Progress:

All work is complete for Phase 1; the final report was drafted and is pending final review and posting to the project website. Note: This was completed in early FFY 2014. Phase 2 research began in September 2012; to date, no progress reports have been received.

Reports:

The Phase 1 draft final report was received. All project information for both phases can be viewed at the above URL.

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3.4.1.2 Relative Operational Performance of Geosynthetics Used for Subgrade Stabilization: Phase 2

Project Number:	7712-251; TPF-5(251)*
Start Date:	10/1/11
Completion Date:	2/28/14
Total Cost:	$653,621
MDT SPR Funds:	$168,121
SPR Funds from Other States:	$485,500
FFY 2013 SPR Funds Expended:	$306,071
FFY 2013 MDT indirect Costs:	$23,755
Unexpended Funds:	$12,682
Contractor:	Western Transportation Institute, Montana State University

URLs: http://www.mdt.mt.gov/research/projects/geotech/subgrade.shtml and http://www.pooledfund.org/Details/Study/479

*Note: This project is a Montana-led pooled-fund study. Participating states include: Idaho, Montana, New York, Ohio, Oklahoma, Oregon, South Dakota, Texas, and Wyoming

Objective:

The main objective of this project is to determine material properties of geosynthetics that affect in-field performance of geosynthetics used for subgrade stabilization. This will allow DOT personnel to objectively and confidently specify appropriate geosynthetics based on material properties and cost for a specific situation, while also allowing competition among manufacturers.

Progress:

To accomplish the objective, test sections were constructed at a controlled test site to investigate the relative benefit to an unpaved road of various geosynthetics available on the market. An artificial subgrade was constructed to provide equivalent conditions for each test section; likewise the gravel surfacing along the entire test bed is uniform so that direct comparisons can be made among geosynthetic products. The sections were loaded with controlled traffic and frequent rut measurements. Forensic investigations are complete. The excavation of the base course, geosynthetic, and subgrade provided a good opportunity to evaluate the shape of the rut in the two wheel paths, distortion of the geosynthetic from trafficking and rut accumulation, pullout, and other qualitative assessments. The project now moves into the data analysis phase.

Reports:

Four task reports and three progress reports were submitted and accepted; they can be viewed at the above URL.

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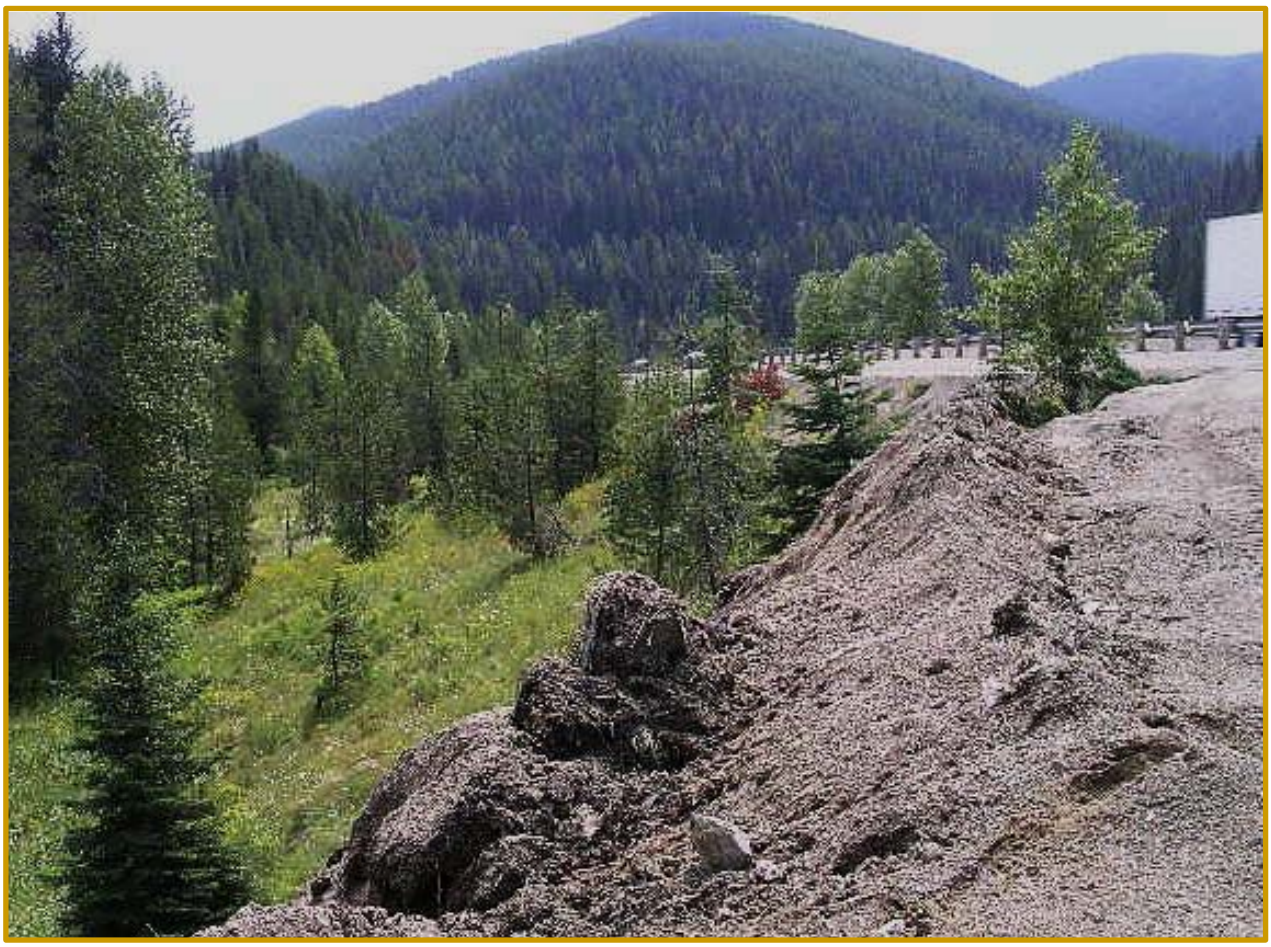
3.5 MAINTENANCE RESEARCH PROJECTS

3.5.1 Completed Projects

3.5.1.1 Recycling Recovered Sanding Material

Project Number:	8213
Start Date:	4/1/11
Completion Date:	5/31/13
Total Cost:	$55,531
SPR Funds:	$55,531
FFY 2013 SPR Funds Expended:	$7,819
FFY 2013 MDT indirect Costs:	$780
Unexpended Funds:	$0
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/env/recycling.shtml

Objective:



MDT collects winter sand from roadways following winter maintenance operations. While removing such materials helps to alleviate problems alongside highways, it can create storage/disposal problems unless cost-effective alternatives are identified and implemented. The recovery and reuse of this material is desirable to reduce the quantity of landfilled materials and to conserve natural resources. However, when used without any further treatment, recovered winter sand may create problems, including sedimentation in streams; clogging of culverts; and environmental contamination from chemicals, heavy metals, and volatile organic compounds.

The objective of this study was to evaluate the practical suitability and the cost effectiveness of a statewide program for recycling and reusing traction sand on Montana roadways. This study indicates that collected traction sand can be considered a viable product for reuse and recycling, rather than categorizing it as a waste product. By recycling and reusing traction sand, MDT will conserve natural resources and could potentially save money by eliminating landfill costs and reducing the amount of new abrasives and aggregates that are purchased every year.

Progress:

All research is complete.

Reports:

The final, project summary, and implementation reports were published on the project website and can be viewed at the above URL.

Implementation:

The most practical and economical recycling option involves the collection and reuse as traction sand material. However, traction sand reuse procedures will need to be specially catered to mesh with routine procedures and practices already in place, and currently used for spring cleaning and maintenance. Initially, the procedures should use to the maximum extent equipment that is currently available at the local district maintenance shops. It is anticipated that over time, procedures and equipment will be modified to improve the efficiency of the process and the consistency of the results.

Gradation data from samples collected in this study indicate the material cleaned from ditches contains random and sometimes excessive amounts of rock, oversized material, and debris which would incur substantially greater processing to develop a material that is suitable for reuse. To the extent possible and practical, the material collected from ditches will be kept separate from the material collected elsewhere.
However, for materials collected from other locations, gradation data yield particle size distributions on the finer border of the specified gradation range for traction sand. This

indicates that over time, as the sand is reused and recollected over multiple seasons, the gradation will continue to drift into the finer range and, consequently, the amount of necessary processing is expected to increase over time. This additional processing will involve either screening and removing undersize material or blending in additional course material. It is anticipated the most cost efficient option would involve the blending of salvaged sand with newly imported virgin traction sand. MDT will randomly sample collected material to conduct sieve analyses, the results of which will be compared to the virgin material. Material gradation will be adjusted as necessary.

With a few exceptions, chemical lab tests conducted in the study showed samples of sanding materials collected from the roadside have chemical and metal concentrations generally characteristic of naturally occurring background soil levels at the sites. However, MDT will randomly collect samples to conduct chemical contaminant testing for comparison to the virgin material.

MDT recognizes the potential benefit of this proposed work; when enough material is collected, MDT will hire a contractor to screen and blend material. It is expected MDT will hire a contractor to conduct this process on materials from the Lookout Pass area every three years and the Bozeman Pass area every year.

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3.6 PLANNING AND SAFETY RESEARCH PROJECTS

3.6.1 Active Projects

3.6.1.1 Assessing the Effectiveness of Montana's Occupant Protection Program

Project Number:	8221-001
Start Date:	2/1/13
Completion Date:	5/31/14
Total Cost:	$92,685
SPR Funds:	$92,685
FFY 2013 SPR Funds Expended:	$15,237
FFY 2013 MDT Indirect Costs:	$153
Unexpended Funds:	$77,295
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/safety/occupant.shtml

Objective:

The overall goal of any seatbelt campaign is to reduce the number of injuries and fatalities by finding strategies that successfully encourage drivers to buckle up. In Montana and other states, increasing seatbelt use requires a collaborative effort that includes dissemination of public information, education and enforcement of seatbelt laws. In order to help MDT reach its occupant protection goals, this project will evaluate MDT's occupant protection programs by identifying program strengths, problem areas and recommended improvements.

Progress:

This project was contracted in FFY 2013. The project kick-off meeting was held. The literature review is complete. The statistical team is in the final stages of building the data matrix for analyses of the efficacy of the specified occupant protection programs. The data includes all county-level information (population size, median income, etc.), as well as MDT programs, including OPI data and STEP information. The team also completed preliminary model building, which in the early stages looks promising. The team has begun work on a PowerPoint training module for participants in MDT's occupant protection program. Text for the best practices document is in development.

Reports:

Task report 1 was drafted, reviewed, and published on the project website at the above URL, along with other project information. Quarterly progress reports also were received.

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3.6.1.2 Impacts of Increased Canadian Economic Development - Phase 2: Ports of Wild Horse and Morgan Highway Corridors

Project Number:	8197-002
Start Date:	12/1/12
Completion Date:	4/30/14
Total Cost:	$116,211
SPR Funds:	$116,211
FFY 2013 SPR Funds Expended:	$60,367
FFY 2013 MDT Indirect Costs:	$5,868
Unexpended Funds:	$55,844
Contractor:	HDR Decision Economics

URL: http://www.mdt.mt.gov/research/projects/mcs/canada_impact_nhwy.shtml

Objective:

The objective of this study is to determine whether Montana's current infrastructure is capable of supporting additional 16-hour 7-days-a-week commercial ports, namely the ports of entry and their connecting roads at Wild Horse and Morgan. The study will also produce traffic forecasts along these two corridors.

Additionally, the study will examine the traffic impacts of Canadian economic growth as a result of significant energy investments in Alberta and the restructuring of the Canadian wheat industry on trade through the Montana border. Finally, the study will examine the effects of harmonization of truck size and weight at port sites.

Progress:

This project was contracted in FFY 2013. A project kick-off meeting was held. No reports were received in FFY 2013. However, Task 1 involving data and projection updates from Phase 1, based on a desktop review and interviews, was nearly complete and was submitted in early FFY 2014. In addition, Task 2 involving a quantification of impacts and development of traffic projections based on desktop research, interviews with industry representatives and regional stakeholders, and the use of a spreadsheet-based traffic forecasting tool developed during the Phase 1 project was nearly complete and was submitted in early FFY 2014.

Reports:

Task 1 and 2 reports are complete. Project information is published at the URL above.

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3.6.1.3 Montana Weigh-in-Motion (WIM) and Automatic Traffic Recorder (ATR) Strategy

Project Number:	8222-001
Start Date:	5/1/13
Completion Date:	1/31/15
Total Cost:	$207,501
SPR Funds:	$207,501
FFY 2013 SPR Funds Expended:	$31,252
FFY 2013 MDT Indirect Costs:	$2,612
Unexpended Funds:	$176,139
Contractor:	Western Transportation Institute, Montana State University

URL: http://www.mdt.mt.gov/research/projects/planning/wim.shtml

Objective:

This project will provide MDT with a comprehensive review and evaluation of the existing WIM program and a basic review of the ATR program. MDT spends approximately $172,350 annually on its WIM program, alone; thus a formal and systematic program review is warranted to assess, as possible, the costs and benefits of the program. Program costs are generated by the activities required to collect, analyze, distribute, and present traffic data. Program benefits are experienced by data users working across the spectrum of MDT activities, in the form of improved pavement designs, infrastructure planning, weight enforcement, and operations monitoring.

Traffic data collection provides the underpinning for almost all transportation-engineering activities. This review of MDT's data collection program will provide recommendations on program modifications to ensure essential traffic data is being collected, analyzed, distributed and used in a cost effective manner consistent with MDT's needs and requirements. The results of this review will also provide guidance on the direction of future program development.

Progress:

This project was initiated in FFY 2013 and a project kick-off meeting was held. A comprehensive literature review on traffic data collection programs and the results of a companion survey of such programs in a few selected states around the country have been completed. The project now moves into the inclusive description and inventory phase of the traffic data collection program.

Reports:

One task and two progress reports were submitted and accepted; they can be viewed at the above URL.

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3.6.1.4 A Peer-to-Peer Traffic Safety Campaign Program

Project Number:	8218-001
Start Date:	5/1/12
Completion Date:	3/31/14
Total Cost:	$146,536
SPR Funds:	$146,536
FFY 2013 SPR Funds Expended:	$84,424
FFY 2013 MDT Indirect Costs:	$7,742
Unexpended Funds:	$20,249
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/safety/peer_to_peer.shtml

Objective:

The objective for this research project is to develop a process for a sustainable, statewide peer-to-peer traffic program specific to Montana and teen driver safety. The project will identify and develop useful peer-to-peer program tools for a Montana program.

Progress:

An implementation plan was developed. This involved survey design and implementation, interviews with principals and teachers at the target schools, and identification of student team leaders and group members. A draft program guidebook was developed. Methods for delivering the message were evaluated; both the effective and ineffective methods of message dispersion were identified, including recommendations for future programs. Finally, post-program assessments were developed and included distribution and collection of post-program surveys, facilitation of focus groups, and staff reflection of program effectiveness.

Reports:

Task reports and other project information are published at the URL above.

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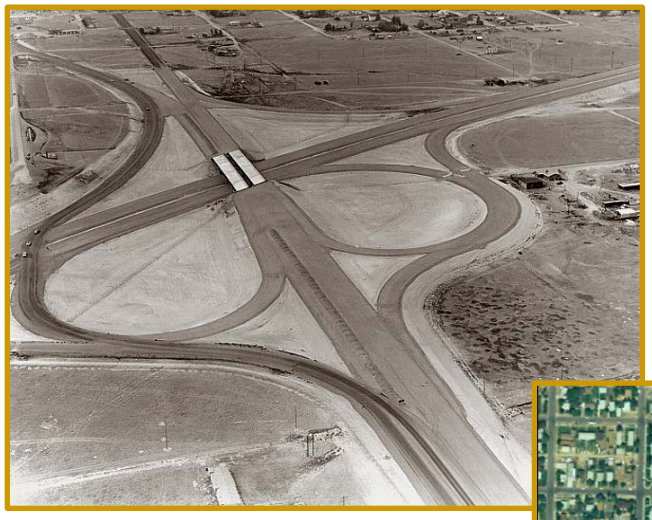
3.6.2 Completed Projects

3.6.2.1 *Assessing the Extent and Determinates of Induced Growth*

Project Number:	8216
Start Date:	11/22/11
Completion Date:	6/30/13
Total Cost:	$115,017
SPR Funds:	$115,017
FFY 2013 SPR Funds Expended:	$43,033
FFY 2013 MDT Indirect Costs:	$4,026
Unexpended Funds:	$20,467
Contractor:	The Louis Berger Group, Inc.
URL:	http://www.mdt.mt.gov/research/projects/planning/growth.shtml



1961

Capital Interchange
Helena, Montana

2005

Objective:

The objective of this research was to identify and develop a Montana-specific, consistent, legally defensible, and efficient process for assessing the indirect land use and environmental effects of transportation projects for MDT.

Progress:

All research is complete.

Reports:

The final report and other project information were published on the project website and can be viewed at the above URL.

Implementation:

An *Indirect Effects Desk Reference* was provided as a component of this project. This product provides a step-by-step screening process to determine if further analysis is warranted, and, when necessary, it also includes a detailed analysis framework process. The detailed analysis framework process includes recommendations on the analysis methodologies most applicable to the data available in different portions of Montana. This desk reference will be incorporated into the *MDT Environmental Manual*. Finally, an adaptive management process was developed to aid MDT staff in updating the *Indirect Effects Desk Reference* as conditions change. MDT staff will monitor implementation, including mechanisms for soliciting and tracking feedback from practitioners. A technical review committee will be established to evaluate feedback, review need for updates, and make decisions on changes to the *Indirect Effects Desk Reference*.

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3.6.2.2 Automated Crash Notification: Assessing Montana's Motor Vehicle Crash and Related Injury Data Infrastructure

Project Number:	6608-959
Start Date:	2/1/09
Completion Date:	8/30/13
Total Cost:	$976,923
SPR Funds:	$0
Federal Funds:	$976,923
Unexpended Funds:	$13,077
Contractor:	University of Montana- Missoula
URL:	http://www.mdt.mt.gov/research/projects/admin/crash_notification.shtml

Objective:

The long-term goals of this research were to reduce the time to deliver emergency care to motor vehicle crash victims; to make improved (better informed) triage, transport and treatment decisions where choices exist; and to improve long-term rehabilitation outcomes for motor vehicle crash survivors. The researchers reviewed and documented Montana's current data infrastructure and developed recommendations for incorporating new information technologies to enhance the trauma response system. These recommendations were used to construct the procedures for introducing Advanced Automatic Collision Notification (AACN) data and used in a simulated live demonstration of the procedures.

Progress:

All research has been completed.

Reports:

The final report was completed, reviewed, and published on the project website at the above URL.

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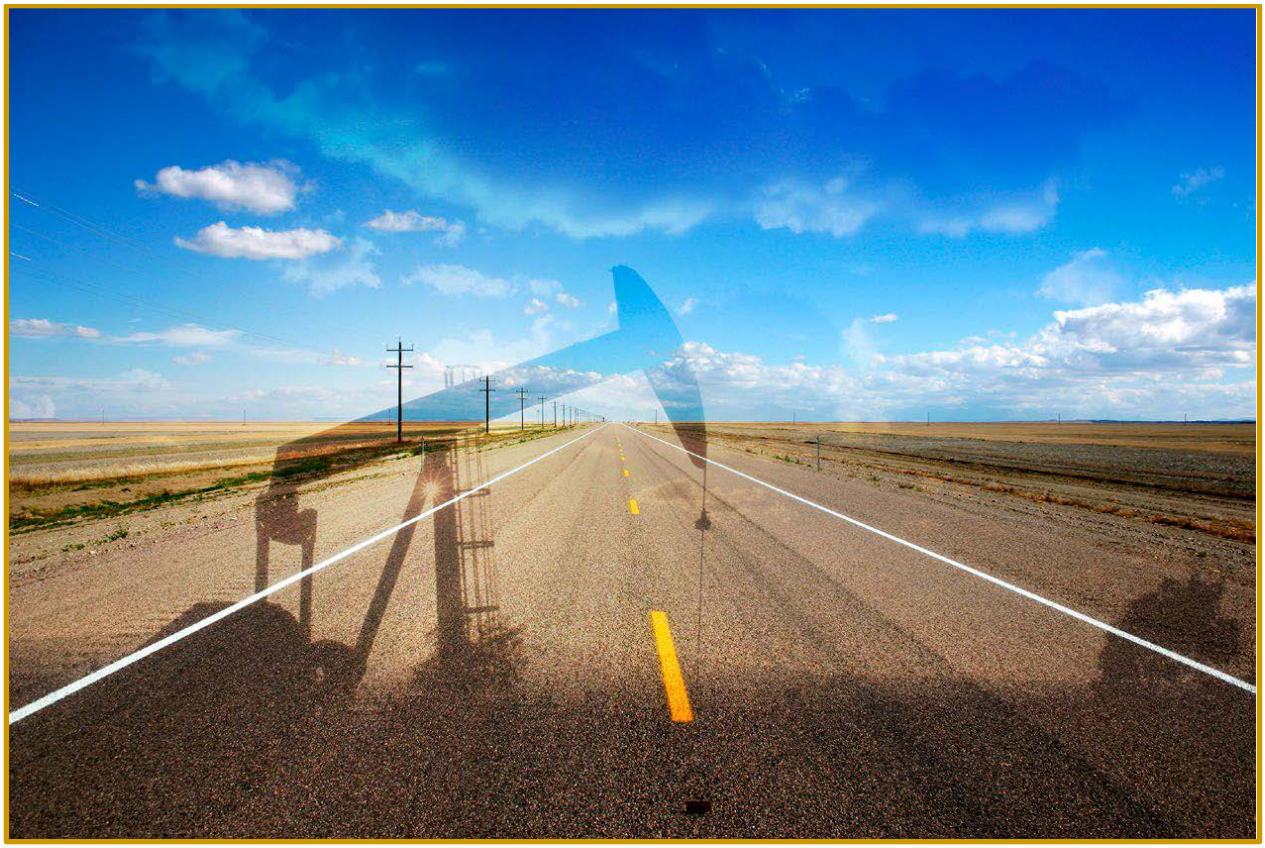
3.6.2.3 Impacts to Montana State Highways Due to Bakken Oil Development

Project Number:	8219-001
Start Date:	4/1/12
Completion Date:	5/31/13
Total Cost:	$117,047
SPR Funds:	$117,047
FFY 2013 SPR Funds Expended:	$75,480
FFY 2013 MDT Indirect Costs:	$7,529
Unexpended Funds:	$7,246
Contractor:	Upper Great Plains Transportation Institute, North Dakota State University

URL:http://www.mdt.mt.gov/other/research/external/docs/research_proj/oil_boom/final_report.pdf



Objective:

Recent oil development in western North Dakota and eastern Montana has resulted in large-scale highway needs, which suggest the possibility that substantial investment will be required in the near future. The objective of this project was to develop a

regional traffic model to predict and assess traffic increases in northeastern Montana as a result of oil development.

Progress:

All research is complete.

The analysis included a significant data collection effort to identify: existing and potential locations of inputs to the drilling and horizontal fracturing processes, existing and potential saltwater disposal and oil collection facilities, forecasts of future production and exploration, and detailed geographic information system (GIS) network development. A mathematical optimization model was estimated to predict impacted highway segments, and traffic volumes were calibrated using observed traffic counts. Four rig count scenarios were analyzed: 20, 40, 80 and 160 rigs. Results of the analysis show significant traffic increases in the Richland, Roosevelt, and Sheridan county area with additional traffic increases in the surrounding areas. The study developed traffic forecasts for all state-maintained roadways within the study area for the next 20 years. These results are presented visually as well as in supplementary GIS shapefiles.

Reports:

The final report was completed, reviewed, and published on the project website at the above URL, along with reports on corridor studies, pavement impacts, impacts to Montana's transportation and economy, and a summary of MDT efforts in the oil region. A presentation is also posted to the project website and a presentation.

Implementation:

The results of this project will be used to determine transportation enhancements in the region.

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3.6.2.4 Montana Rest Area Use: Data Acquisition and Estimation – Development of Performance Measures

Project Number:	8117-043
Start Date:	3/1/13
Completion Date:	3/31/13
Total Cost:	$1,259
SPR Funds:	$1,259
FFY 2013 SPR Funds Expended:	$1,259
FFY 2013 MDT Indirect Costs:	$126
Unexpended Funds:	$7
Contractor:	Western Transportation Institute, Montana State University
URL:	http://www.mdt.mt.gov/research/projects/planning/rest_area.shtml

Objective:

The purpose of this project was to develop performance measures for a previous project on estimating rest area usage, which was completed in FFY 2011. The performance measures were entered into the Research Performance Measures database (https://www.rpmweb.org/rpm/).

Progress/Performance Measures:

The performance measures report was completed; benefit-cost (~31:1) and return on investment (~30) performance measures were developed and entered into the Research Performance Measures database, along with additional project information.

Reports:

A performance measures report was drafted, reviewed, and published on the project website at the above URL.

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3.6.2.5 Re-Evaluation of Montana's Air Quality Program

Project Number:	8220-001
Start Date:	4/1/12
Completion Date:	9/30/13
Total Cost:	$151,744
SPR Funds:	$151,744
FFY 2013 SPR Funds Expended:	$90,141
FFY 2013 MDT Indirect Costs:	$8,737
Unexpended Funds:	$8
Contractor:	TranSystems Corporation

URL:
http://www.mdt.mt.gov/research/projects/planning/cmaq.shtml

Objective:

States have significant flexibility in the use of federal Congestion Mitigation and Air Quality (CMAQ) Program funds. MDT uses a portion of these funds to proactively address transportation related air quality and congestion problems throughout the state through the Montana Air & Congestion Initiative (MACI) Program. The MACI Program applies to the areas of Montana that are designated non-attainment or identified as "high risk" for becoming non-attainment of an air quality standard by the Montana Department of Environmental Quality (DEQ) and the Environmental Protection Agency (EPA). This research project developed practical refinements to MDT's current methods to identify high value investment projects for this program.

Progress:

All research is complete.

Reports:

The final, implementation, and project summary reports were drafted, reviewed, and published to the project website at the above URL.

Implementation:

Tasks performed in this project produced a prioritization of CMAQ measures that might be most worthwhile for Montana areas to consider. Based on this prioritization, a set of emission quantification spreadsheet tools was developed to estimate the emission reductions associated with these various CMAQ projects. An additional spreadsheet tool was developed to estimate the cost effectiveness of these projects based on the

emission reductions quantified in the emission tools. MDT will implement the use of these tools.

As recommended through this research, MDT will take the following actions.

- ★ MDT will use MACI-discretionary monies to provide funding for the high-risk area investments. The identification of high risk areas are to be based on MTDEQ recommendations from recent ambient air quality monitoring results.
- ★ MDT plans to continue to purchase air quality equipment in high risk areas.
- ★ When transportation project opportunities arise, MDT will pursue investment in congestion management options that achieve significant improvements in average speed (> 10 mph).
- ★ MDT typically considers a range of variables in selecting projects and plans to continue this practice.
- ★ MDT plans to use the provided tools to estimate benefits of CMAQ-eligible projects and will update the tools when needed.
- ★ MDT will continue to take advantage of opportunities to use CMAQ funds in conjunction with other transportation spending programs.
- ★ MDT's Rail, Transit, and Planning Division will be the main users of the tool developed through this project; however, it can be shared with anyone that expresses an interest in using the tool.
- ★ MAP-21 guidance that has been released by FHWA to date has not provided any information on $PM_{2.5}$ nonattainment areas beyond what is in the legislation. When that guidance is released, MDT will re-visit this issue.

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3.6.3 Pending Projects

3.6.3.1 MAP 21: Primary National Freight Network and Its Relationship to State Systems and Needs

Project URL:
http://www.mdt.mt.gov/research/projects/planning/rural_freight.shtml.

Topic Statement:

The U.S. DOT, under MAP-21, is working to designate a Primary Freight Network. State Departments of Transportation are to provide input and designate the Rural Freight Corridors to the Primary Freight Network (PFN) and the rest of the Interstate System. Implementation of this requirement is unclear at this time, with varying state and Federal goals, and performance measures to be developed as this requirement is fulfilled. Information on relevant data, such as allowable freight generators like ports, border crossings, and intermodal connectors is necessary for the full development of the relevant state corridors.

Background Statement:

MAP-21 may be considered a precursor to the next transportation authorization legislation in two years. It possesses a new strong freight emphasis, especially in Sections 1115 to 1118, in which states, MPOs, RTPOs, and stakeholders will all have a role. States that are organized, with data and analyses, will benefit in the next authorization. The role of states and DOTs in helping to designate the full Primary Freight Network is critical, if local and state needs and issues are to be addressed. The Primary Network, consisting of up to 30,000 miles, was scheduled to be identified by October 2013 with the full National Freight network to be fully identified by December of 2013.

The development of such a network is an important step in the structure of a relevant freight strategy. In such development, the role rural entities, state agencies/planners, and stakeholders play is critical. The movement of freight and goods throughout the state of Montana, whether transit freight or locally produced and marketed, requires an efficient and effective supply chain, as international ports and regional markets are accessed. Such a chain should reflect the volume, but also the value of products being moved. Perhaps opportunistically, the developing necessity to meet the intentions of MAP-21 and prepare for future authorizations is compounded by the new energy activity in Montana requiring new and consistent transportation and logistics support if full growth is to be achieved and the nation's energy goals are to be met. The current criteria may not effectively identify these critical corridors in rural areas.

States have had the opportunity to respond to the process USDOT plans to use to designate the Freight Network, as published in the February 6th, 2013 Federal Register. The Freight Analysis Framework (FAF) is a reasonable data source of commodity flows, but does little for intrastate and short haul movements related to local manufacturing and production activities, and connectivity of the nation's and state's major intermodal facilities. Significant data gaps exist, especially related to the rural freight movements connecting to the Interstate System. In the state of Montana, attention needs to be paid to military transportation systems, ports of entry and border crossings, existence of recent road projects currently underway in the state, and trends in commodity growth, including energy extraction and processing. Such databases will require surveys, new and continued system flows information for delineation of the rural segment, as well as completing a full justification for the primary freight network and the additional miles of Interstate. The metrics of such delineation of all three segments of the Primary Freight Network are unclear and require translation and application to rural roads, including bridges. State freight plans, with prioritized projects and investments, may well hold the key to the freight network relevant to the state and local levels.

Proposed Research:

The research plan for this effort will be finalized in conjunction with the Multimodal Planning Bureau and the administration team at the very start of the work. Tentative tasks of the work plan and resulting deliverables might include the following:

1. Collaborate with MDT and finalize the Scope of Work, expectations/deliverables, activities, as well as time frame for the research project.
2. Conduct a qualitative survey of states' responses to rural freight corridors relative to PFN. Number and coverage to be decided with MDT. Items for consideration include definitional approaches adopted by states to the delineation of rural freight corridors, data sources and models, tools used in delineation, and related information.
3. Interim report detailing survey results as to data, plans, tools, submissions, and related information. Discussions with MDT personnel of report findings.
4. Collect information on trip generating firms and industries of relevance in the state of Montana, traffic flows, origin and destinations by commodity and region; in essence, the development of an in-state economic activity index, existing and projected, including gray data from institutions and interviews/surveying, subject to budget.
5. Provide and discuss structure of Montana's freight systems, including feasible performance measures and metrics, thus providing support to state planning efforts to meet the requirements of MAP-21.
6. Review and develop tools and metrics to identify relevant state routes, offering the positive and negative attributes and implications of any application.
7. Final Report(s) as determined most beneficial to the MDT

Urgency and Expected Benefits:

Development of an efficient rural freight system to be effectively joined with the National Freight Network will enhance Montana's planning and competitiveness in world and regional markets and allow advantage to be taken of new and growing energy and agricultural opportunities. The prioritization of projects, relative to the Federal System will increase the "bang for the buck" in tight budget times. It will allow Montana to be organized and ready to participate in the new financial authorization after MAP-21, by identifying the synergistic outcomes for both state and national freight movement needs. It will also identify and make available to MDT the best practices from other states, to then be applied to the efforts of MDT.

Progress:

This project is on hold, pending hiring of the Multimodal Planning Bureau Chief position in the Rail, Transit, and Planning Division.

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3.7 TRAFFIC RESEARCH PROJECTS

3.7.1 Completed Projects

3.7.1.1 Informational/Educational Campaign for Roundabouts

Project Number:	8117-042
Start Date:	1/1/13
Completion Date:	9/30/13
Total Cost:	$20,663
SPR Funds:	$20,663
FFY 2013 SPR Funds Expended:	$20,663
FFY 2013 MDT Indirect Costs:	$1,924
Unexpended Funds:	$47
Contractor:	Western Transportation Institute, Montana State University

URL: http://www.mdt.mt.gov/research/projects/traffic/roundabouts.shtml

Objective:

Roundabouts are a form of traffic control for at-grade intersections and are part of the Federal Highway Administration's (FHWA) current list of nine proven safety countermeasures. In the past year, the public has strongly opposed some roundabout projects proposed by MDT. Providing facts and figures about roundabouts has not been an effective method of gaining public support for these projects. MDT needs an effective and efficient Montana-specific strategy to use in public meetings or other public venues to promote roundabouts when they are the preferred intersection control and to educate the public on the proven safety benefits roundabouts offer.

The goal of this project was to use proven and effective educational tools and outreach strategies from other states while adding a Montana flavor, making the message more receptive to a local audience.

Progress:

All research has been completed.

Reports:

Final, implementation, and project summary reports were drafted, reviewed, and published on the project website at the above URL.

Implementation:

Useable elements from this work include various approaches for MDT to consider for roundabout education and outreach to stakeholders and the public. The approaches have been summarized in a manner such that MDT can readily identify applicable strategies for consideration and use based on the needs of a particular roundabout project. Eleven implementation recommendations resulted from this research.

1. MDT will make an investment in education and promotion of roundabouts at the statewide level. The intent is to educate the public on roundabouts in such a way that, when they attend public meetings for projects that may incorporate a roundabout, members of the public can better articulate why they may or may not be in favor of a roundabout.

2. On a project-by-project basis, when roundabouts are new to an area, MDT will air Public Service Announcements (PSA) that discusses how to use them. The focus of PSAs should be on education and the benefits of roundabouts rather than promoting them in a manner that comes across as a sales pitch. This implementation item ties in with the first recommendation above, although it would be implemented after a roundabout project has proceeded to construction.

3. MDT will develop a longer video(s) that can be placed on the internet, with more detail on different aspects of roundabouts (a series of videos could also be produced to discuss individual topics in more detail) to allow viewers to learn about the subject at their convenience. Whenever possible, local scenes from roundabouts throughout the state should be employed in the video footage, along with testimonials from local residents and officials. This, also, is a direct offshoot of the first implementation item above.

4. Supplemental approaches to roundabout education and outreach will be considered for use when appropriate. For example, if a roundabout is being proposed or constructed in a local community, posters, direct mailings and/or restaurant advertising (place mats and coasters) might be considered. Other efforts, such as local kiosk displays at shopping malls or booths at public events

such as county fairs are other ideas that might be employed on a case-by-case basis. This implementation item is also related to the first item above, although it can also incorporate different mediums.

5. For each project where a roundabout is recommended, MDT ensures and will continue to ensure the roundabout is the most appropriate solution.

6. As many agencies have found that meeting with local officials and establishing their support before public meetings helps to increase public support for the project, MDT holds and will continue to hold meetings with local government officials when considering roundabouts for specific projects.

7. At public meetings, MDT will tailor materials and discussion points for the audience (e.g., local residents, businesses, etc.), keeping information basic and non-technical. When engaging the public (e.g. taking questions), a dialogue or two-way conversation will be pursued, as opposed to trying to explain a question away with facts. This creates an atmosphere where the public feels that their thoughts and opinions are being heard, rather than the perception that their thoughts and views have been dismissed.

   The challenge is the absence of a toolbox for the public on what MDT has been doing with roundabouts, such as videos, brochures, and so forth. This will be partly addressed through the implementation of the above items.

8. On a project-by-project basis, MDT will use visual aids for meetings and other roundabout materials, as they are essential in helping to explain how the alternative will operate and why it is preferred. Such visual aids can include conceptual images, scale models of roundabouts, and simulation videos. When a large parking lot is available, it might also be advantageous to conduct a full-size roundabout demonstration in conjunction with a project to allow the public to understand the dimensions and layout for the proposed design, as well as how to drive through a roundabout. In line with visual aids, printed materials, specifically pamphlets and handbills will also be employed. These materials should incorporate imagery from roundabouts that have been constructed and are successfully operating in the state.

9. MDT's dedicated roundabout web pages will be expanded. A web presence allows anyone who is interested in roundabouts to review information at their convenience. The roundabout website also offers a good opportunity to highlight successful projects and provide longer duration video footage. Many websites have provided maps and images of the different roundabout sites that have been constructed throughout the state; this should be considered.

10. MDT will reach out to local television, radio and newspaper media outlets during all phases of a proposed project incorporating roundabouts. It will be used as an opportunity to explain why a roundabout has been considered, the benefits of a roundabout in that particular situation, and other background information, with the intent to explain why it is a preferable option and how it can be a positive feature if/when constructed.

11. MDT will publicize the benefits of roundabouts, including before and after safety results, as an important part of outreach and education activities.

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3.7.2 Pending Projects

3.7.2.1 Safety Impact of Differential Speed Limits on Rural Two Lane Highways in Montana

Project URL:
http://www.mdt.mt.gov/research/projects/traffic/differential_speed.shtml

Topic Statement:

On May 28, 1999 Montana law was established to enact a differential speed limit between commercial and passenger vehicles. Nationwide, research has been completed analyzing the safety impacts of differential speed limits between commercial and passenger vehicles; however, the research has focused on interstate or controlled access facilities. No research has been located discussing the safety impacts of differential speed limits on 2-lane facilities, especially 2-lane facilities with limited passing opportunities.

Background Statement:

In 2012, over 33% of all deaths on Montana's highways listed "speed" as a contributing factor to the crash. Additionally, several highway safety studies completed by MDT have noted the speed differential between commercial and passenger vehicles as a perceived safety concern. This concern was identified through observations of platoons of cars queued behind commercial vehicles with little opportunity for a passing maneuver because of opposing traffic volumes and/or roadway geometry, resulting in a perceived increase in aggressive or risky driving. Research is needed to evaluate the safety impacts of a statutory speed differential on higher volume rural 2-lane roadways.

Research Proposed:

The proposed research would include a review of other studies evaluating statutory speed differential completed by other states or at the national level. A review of historical, Montana specific crash and speed data on select corridors would also be completed to determine the safety effects of the statutory, differential speed limit.

Urgency and Expected Benefits:

Expected benefits include documentation of the safety effects of the statutory speed differential. Depending on the results, the research may provide guidance or thresholds when regulatory speed differential may not be in the travelling public's best interest. The results of the research will be utilized by the MDT Traffic and Safety Bureau during the completion of future speed limit studies as well as corridor wide safety reviews.

Progress:

A research topic statement was submitted in FFY 2013 and can be viewed at the above project URL. A Technical Panel was formed to determine if this high priority topic should move forward to the research stage. The technical panel met to discuss this topic. Proposals have been requested from two different university transportation centers (UTC) to be reviewed and selected by the technical panel.

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3.7.2.2 Special Event Traffic

Project URL: http://www.mdt.mt.gov/research/projects/traffic/event_traffic.shtml

Topic Statement:

Planned special events, such as sporting events and concerts produce nonrecurring congestion as attendees attempt to simultaneously exit the event, overloading the local transportation network. To a lesser extent, the arrival for special events can also overload parts of the local transportation network. These types of events can have a significant impact on traffic operations, particularly in small urban and rural environments, where limited infrastructure is available to access and egress the event venue.

Background Statement:

MDT has implemented a few traffic management strategies throughout the state for special events. However, MDT has not developed or documented best management practices. The special events for the most part are on a smaller scale throughout the state and they have been handled on a case-by-case basis. However, three venues that operate on a larger scale and warrant a closer look are the MetraPark in Billings, Montana State University (MSU) in Bozeman, and the University of Montana (U of M) in Missoula. MDT has implemented special event signal timings in Billings and Missoula on state maintained routes. MSU in conjunction with the city and WTI have implemented traffic management strategies on local streets in the Bozeman area around the campus. This did not include the state maintained routes at that time.

A coordinated effort is essential between the venues, the cities/counties, and the department in order to achieve the maximum benefit. Currently, Yellowstone County is looking at the traffic management strategies for the MetraPark. This research could take this into account while developing the best management practices for traffic management strategies.

Research Proposed:

The research would start with a literature search to identify previous research and best management practices developed for special event traffic management strategies. The research would develop the best management practices for MDT for special event traffic management strategies.

Three venues (MetraPark in Billings, Montana State University in Bozeman, and the University of Montana in Missoula) will be studied to evaluate what has been done in

the past and what further could be done. Based on the best management practices, researchers will develop a traffic management strategy for each venue.

Urgency and Expected Benefits:

This research would provide the department and local governments with guidelines for implementing traffic management strategies for special events. It would look at three specific venues in the state and develop a site specific traffic management strategy for each venue. Once a traffic management strategy is developed, an implementation plan could be developed.

Progress:

A research topic statement was submitted in FFY 2013 and can be viewed at the above project URL. A Technical Panel was formed to determine if this high priority topic should move forward to the research stage. The technical panel met twice to discuss this topic and developed a draft scope of work. The draft scope of work is in review.

MDT Project Manager:

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3.7.2.3 Speed Limits on Rural Two Lane Highways in Montana

Project URL:
http://www.mdt.mt.gov/research/projects/traffic/speed_limits_lower.shtml

Topic Statement:

There are times when speed limits are set lower than engineering recommendations. It is MDT's supposition that drivers do not voluntarily comply with a speed limit set lower than the engineering recommendation. MDT would like to document compliance with limited enforcement present and the level of enforcement needed for compliance with the set speed limit.

Background Statement:

There are various locations throughout the state with speed limits set lower than the engineering recommendation. Before and after studies have indicated that there is not voluntary compliance with these speed limits. When enforcement is present on a regular basis, compliance is improved. However, the level of enforcement necessary to ensure compliance is unknown.

Research Proposed:

The research will begin with a literature search to see what studies may have already been completed by other agencies to take a look at various speed limits set lower than the engineering recommendation across the state. Locations will include areas where there is limited enforcement and areas where there is heavy enforcement. The research will document the speeds and whether there is voluntary compliance with the set speed limit. The research will also document what level of enforcement is needed to obtain compliance when voluntary compliance does not take place. Finally, the effect of lower speed limits on crash history both in the number of accidents and the severity of accidents will be documented.

Urgency and Expected Benefits:

Expected benefits include documentation of the safety effects of speed limits set lower than the engineering recommendation. The research may provide information on how much enforcement is necessary to obtain compliance with these speed limits. The research will provide documentation on the before and after speeds. The results of the research will be utilized to educate the traveling public, local governments, and the Transportation Commission on special speed limits; the benefits of a traffic and engineering investigation; and the challenges of setting a speed limit lower than the engineering recommendation.

Progress:

A research topic statement was submitted in FFY 2013 and can be viewed at the above project URL. A Technical Panel was formed to determine if this high priority topic should move forward to research. The technical panel met to discuss this topic. Proposals have been requested from two different university transportation centers (UTC) to be reviewed and selected by the technical panel.

MDT Project Manager:

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4 EXPERIMENTAL PROJECTS

4.1 OVERVIEW

The incorporation of experimental features into construction and maintenance projects allows for a vital field evaluation of new materials and methods. This evaluation, if performed well and scientifically-based, allows MDT to determine the implementation value of these new materials and methods.

4.1.1 Work Plan

Prior to construction of an experimental feature, the Experimental Projects Manager (EPM) writes and submits a formal work plan to FHWA for their approval. This work plan includes the following information:

- ★ Location of project
- ★ Construction project number
- ★ Title (type) of project
- ★ Principal investigator
- ★ Statement of objectives
- ★ Experimental design
- ★ Estimated quantities and costs
- ★ Evaluation schedule
- ★ Reporting requirements

This work plan is important as it formalizes the project with FHWA, which yields three additional benefits:

1. FHWA will participate in the original construction and repair, if the project should fail prematurely, at 100%.
2. Proprietary features may be specified.
3. One-hundred percent federal funding can be used for the experimental feature(s).

4.1.2 Construction Report

Following the construction of an experimental feature, the EPM is required to submit a construction report for statewide distribution through the Research Programs. This report is prepared within thirty days of completed construction of the project and includes:

- ★ Location of project
- ★ Construction project number

- ★ Title (type) of project
- ★ Principal investigator
- ★ Statement of objectives
- ★ Date construction of experimental feature was completed
- ★ Summary of materials and methods
- ★ Quantity and cost of experimental feature
- ★ Construction details
- ★ Construction problems and a statement of how these problems might have been alleviated

4.1.3 Progress and Final Reports

Progress and final reports are required by FHWA throughout the formal evaluation period as stated in the work plan and are completed within 30 days of the performance evaluation. Reports consist of a performance summary of the experimental feature to date. The final performance summary contains information on the experimental feature as specified in the work plan, including implementation recommendations. Annually, progress and final project results are presented to FHWA and MDT staff from Maintenance; Design; Construction; Materials; and District Offices, including the Field Research Coordinators and the District Construction Services Supervisors. This helps to ensure all parties are kept-in-the-loop with performance of the experimental features and creates a feedback loop from design to construction to maintenance and then back to design.

Additionally, experimental projects are conducted in association with the Department's Product Acceptance Program. Two related AASHTO Technical Services Programs include:

1. AASHTO Product Evaluation listing (APEL)
2. National Transportation Product Evaluation Program (NTPEP)

4.2 ACTIVE PROJECTS

4.2.1 A2000 Polyvinyl Chloride (PVC) Irrigation Line

Project Name:	Checkerboard - Martinsdale
Project Number:	STPP 14-2(20)63
FHWA Number:	MT 11-02
Construction Date:	July 2012
Completion Date:	Summer 2017
Contractor:	Schellinger Const. Co., Inc.
URL:	http://www.mdt.mt.gov/research/projects/a2000.shtml

Objective:

The objective of this project is to determine the effectiveness and long-term durability of the Contech A-2000 PVC pipe in an irrigation application. This type of pipe may prove to be a viable alternative to reinforced concrete pipe (RCP).

Progress:

A site inspection of the 18" (46 cm) A-2000 was conducted on April 2, 2013 by research staff. A walk through of the approximately 2084 ft. length section showed no evidence of visual disturbance on the surface or surrounding area of the irrigation line or the manhole connections.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
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4.2.2 Allied Modular Steel Beam Bridge

Project Name:	Maxwell Coulee – 22 M E Jordan
Project Number:	UPN 7962000
FHWA Number:	MT 12-05
Construction Date:	October 2012
Completion Date:	Summer 2017
Contractor:	Allied Steel Inc.
URL:	http://www.mdt.mt.gov/research/projects/maxwell.shtml

Objective:

The use of this prefabricated system will reduce the single-lane detour usage timeframe and is in line with several of the aspects of FHWA's Every Day Counts initiative. The Modular Steel Beam System constructed is a technology new to MDT that is being developed by a local fabricator. Proprietary purchase for this first use will allow MDT to define design details in conjunction with the fabricator that are both economical and structurally sound.

Progress:

The project was installed in October 2012 with minor issues involving the beam seat approach slabs. To date the structure is performing well.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
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4.2.3 Break-Out Square Post Breakaway System

Project Name:	Break-Out Square Post
Project Number:	N/A
FHWA Number:	MT 12-08
Construction Date:	August 2012
Completion Date:	Variable
Contractor:	MDT Maintenance
URL:	http://www.mdt.mt.gov/research/projects/break_out.shtml

Objective:

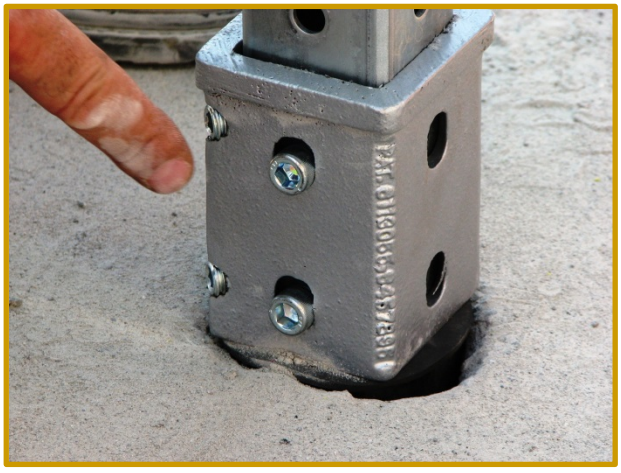
The objective of this project is to determine the effectiveness of the Break-Out Square Post coupler as a possible alternative to other breakaway devices. This product is designed to (upon impact) break flush with grade with no damage apparent to base or anchor and offer a quick turnaround to get the sign back in service.

Progress:

The project was installed in August of 2012. An April 2013 site inspection found the sign leaning about 15 degrees and recessing in the base of the pavement. The District was informed of the situation.

Reports:

Reports can be viewed at the above URL.



MDT Project Manager:

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4.2.4 Chip Seal as Interlayer to Retard Reflective Cracking

Project Name:	St. Xavier N & S
Project Number:	SFCS 313-1(18)22
FHWA Number:	N/A
Construction Date:	June 2008
Completion Date:	Pending
Contractor:	Riverside Contracting
URL:	http://www.mdt.mt.gov/research/projects/chipseal.shtml

Objective:

This project involved placing a conventional chip seal prior to an overlay (or as an interlayer) in an attempt to minimize reflective cracking. The purpose of the chip seal is to act as a stress-absorbing layer, similar to a stress-absorbing membrane interlayer (SAMI) application without the rubberized additive.

Progress:

The project to date has exhibited no visual distress on either the control or test sections. Research will continue to monitor the project until measurable data may be presented.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
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4.2.5 Crack Sealing Milled Asphalt Pavement Prior to Overlay

Project Name:	Dutton N & S
Project Number:	IM 15-6(35)309
FHWA Number:	N/A
Construction Date:	August 2005
Completion Date:	Summer 2015
Contractor:	Schellinger Const. Co., Inc.
URL:	http://www.mdt.mt.gov/research/projects/crack_sealing.shtml

Objective:

The objective of this project is to determine if crack sealing milled pavement prior to overlay will deter the migration of transverse cracking, or have an effect on pavement performance, when compared to an adjacent milled pavement that receives no crack sealing treatment.

Progress:

Since construction in 2005, visual distresses have begun to appear only recently on the control and test sections. Research has elected to continue the analysis for several more seasons to establish a statistical trend.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

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4.2.6 Geosynthetic Reinforced Soil - Integrated Bridge System (GRS-IBS)

Project Name:	S.E. of Dupuyer – S.E.
Project Number:	STPP NHTSA 3-3(23)65
FHWA Number:	MT 12-04
Construction Date:	August 2013
Completion Date:	Summer 2018
Contractor:	Scarsella Bros.
URL:	http://www.mdt.mt.gov/research/projects/grs_ibs.shtml

Objective:

The structure built at the South Fork Dry Fork Marias River crossing was selected for a new technology that has been tested in other states and has been proven to work. The new bridge is built with Geosynthetic Reinforced Soil (GRS) - Integrated Bridge System (IBS) technology. GRS-IBS is a system that uses a series of alternating layers of granular fill material and fabric sheets of geotextile to create a composite reinforcement that provides a support for the bridge slab.

Progress:

The GRS abutment and pre-slab deck is complete with exception of the paved approach to the beam seat. The paving will be complete in the spring of 2014 and the construction report will be updated at that time.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
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4.2.7 MetaDome Truncated Dome Used in Existing and New Asphalt

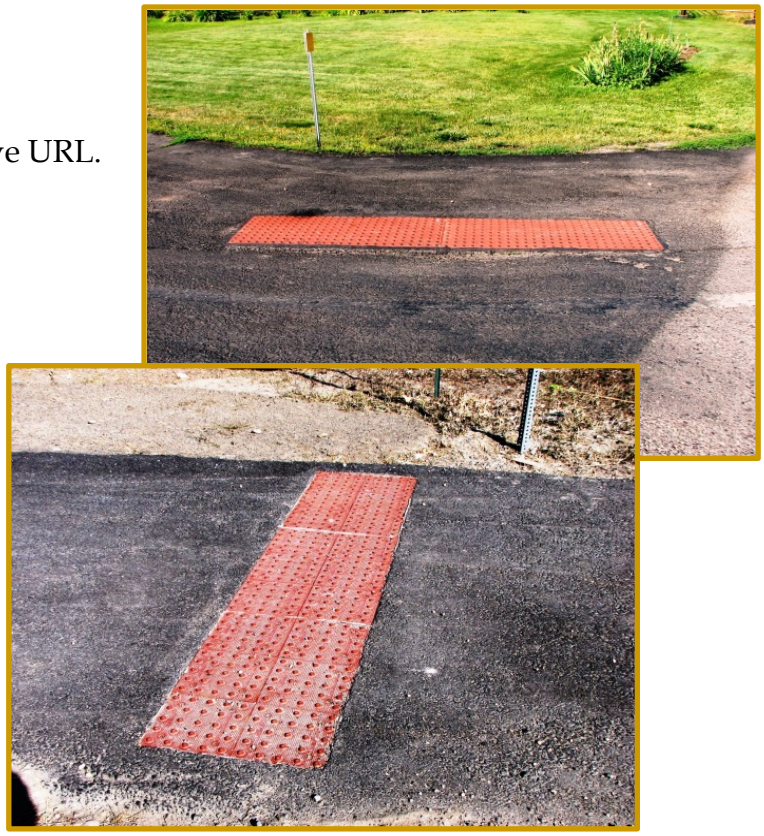
Project Name:	ADA Asphalt DWD
Project Number:	STPP-STPE 13-5(8)96
FHWA Number:	MT 12-06
Construction Date:	September 2012
Completion Date:	Summer 2017
Contractor:	MetaDome/MDT District Personnel
URL:	http://www.mdt.mt.gov/research/projects/dwd.shtml

Objective:

The objective of this project is to determine the effectiveness of the MetaDome detectable warning devices (DWD) in existing and new asphalt installations.

Progress:

Installations of both asphalt cement (AC) applications went well. During the first winter season after installation, the DWDs (existing AC in Missoula) were damaged by plow activity and several were replaced. The panels (Three Forks) applied in new AC are performing well.



Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

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4.2.8 Plant Mix Seal on PCCP Dowel Retrofit

Project Name:	Glendive East & West (EB/WB)
Project Number:	IM 94-6(51)210
FHWA Number:	MT 10-01
Construction Date:	September 2010/July 2011
Completion Date:	Summer 2016
Contractor:	Diamond Grind Inc.
URL:	http://www.mdt.mt.gov/research/projects/plantmix.shtml

Objective:

The objective of this project is to determine the effectiveness and durability of bond in applying a 16mm (0.625") plant mix seal (PMS) to rehabilitated PCCP with a diamond grind. In addition the PMS has the potential to reduce the winter maintenance costs (labor and material) by approximately 80%, as compared to PCCP.

Progress:

The project was installed in September 2010 (eastbound lanes) and in July 2012 (westbound lanes). To date (based on visual distress), the PMS application is performing well.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

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4.2.9 Rest Area Wind Turbine for Supplemental Power

Project Name:	Anaconda Interchange Rest Area
Project Number:	IM 90-4(48)208
FHWA Number:	MT 00-15
Construction Date:	October 2008
Completion Date:	Summer 2014
Contractor:	Creative Energies
URL:	http://www.mdt.mt.gov/research/projects/wind_turbine.shtml

Objective:

The purpose of this project is to determine the performance and cost-effectiveness in the reduction of grid-line power service through the installation of a tower-mounted utility grid interconnected to a wind turbine.

Progress:

Per submitted reports, the unit supplements the annual power consumption of the rest area by 20% on average when operating properly. Due to mechanical problems the unit was out of service during most of 2011.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

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4.2.10 Ribbed Aluminum Box Culvert (ABC)

Project Name:	Jct. US 2 – North Belknap Crossing
Project Number:	STPS 325-1(3)0
FHWA Number:	MT 12-01
Construction Date:	February/March 2012
Completion Date:	Summer 2017
Contractor:	Riverside Contracting
URL:	http://www.mdt.mt.gov/research/projects/aluminum.shtml

Objective:

The objective of this project is to document all phases of the installation practice of the Aluminum Box Culvert (ABC) unit, and monitor and report on long-term performance. Issues such as special backfill required, installation of reinforcing ribs, equipment required, and construction loading will supplement the report.

Progress:

During the March 2013 inspection, no visual abnormalities of the interior or exterior of the culvert were observed. In addition, the road bed displayed no visual distress.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
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4.2.11 Seal Coat Asphalt Emulsion Over Existing Chip Seal

Project Name:	Beavertail Road Chip Seal
Project Number:	PO 09115006
FHWA Number:	MT 10-05
Construction Date:	September 2011
Completion Date:	Summer 2016
Contractor:	Missoula Maintenance
URL:	http://www.mdt.mt.gov/research/projects/seal_coat.shtml

Objective:

The objective of this project is to determine the effectiveness and durability of applying a fog seal (SS1 asphalt emulsion) post chip seal with two varying rates of SS1 application in an effort to minimize chip loss.

Progress:

Since the seal and cover application in Fall 2011, all three sections are performing well. It may take several seasons before a visual trend of performance can be identified. Test section 1 (TS1) does have the appearance of a tighter mat and good chip embedment as compared to TS2 and the control.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

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4.2.12 Smart Cushion Innovations (SCI) 100 GM Crash Attenuator

Project Name:	Taft-West
Project Number:	M-90-1(84)0
FHWA Number:	MT 11-04
Construction Date:	August 2012
Completion Date:	Summer 2017
Contractor:	MDT District Personnel
URL:	http://www.mdt.mt.gov/research/projects/sci.shtml

Objective:

The purpose of this project is to test the SCI100GM, a fully redirective, speed-dependent, non-gating, bi-directional crash attenuator with a design to eliminate side panel stress during a collapse. The hydraulic porting of the attenuator ensures the proper resistance is used to stop the vehicle before it reaches the end of the cushion's usable length; this device, based on a frontal impact, may be reset and back in service in under an hour.

Progress:

All five SCI installations appear in good shape since installation. No impacts to the units have occurred. Some road sanding material has accumulated in and around the SCI components. Product information states this will not reduce the efficiency of the function of the SCI; however, excessive material build-up around the sheave and hydraulic components may reduce the effectiveness of the unit, so regular maintenance is suggested.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

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4.2.13 Strieter-Lite Animal Warning Reflector System

Project Name:	Fencing-East of Whitehall
Project Number:	HSIP 69-1(22)2
FHWA Number:	MT 09-02
Construction Date:	May thru October 2010
Completion Date:	Summer 2015
Contractor:	MDT – Butte District
URL:	http://www.mdt.mt.gov/research/projects/streiter_lite.shtml

Objective:

The purpose of this project is to perform an analysis of the effectiveness of Strieter Lite deer reflectors to mitigate animal-vehicle collisions.

Progress:

Installation of the reflector system was completed in October 2010. Maintenance of the reflector system includes cleaning and replacing broken reflectors each spring and straightening of slanted posts. Maintenance in 2013 included the ordering and replacement of eight reflector units. Crash and carcass data is not robust enough to determine any trends in the effectiveness of the system.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

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4.2.14 Stay-Tuff Woven Fence

Project Name:	I-15 Augusta Interchange to Craig
Project Number:	IM 15-4(129)229
FHWA Number:	MT 11-01
Construction Date:	November 2011
Completion Date:	Summer 2016
Contractor:	Williamson Fencing
URL:	http://www.mdt.mt.gov/research/projects/tuff.shtml

Objective:

The objective of this project is to determine the effectiveness and durability of the Stay-Tuff woven fence. This product uses a hinge-joint knot resulting in solid vertical (stay) wires. It is reported to have improved flexibility and strength. Additionally, the product uses heavier gauge top and bottom horizontal (line) wires to reduce the potential of sagging. Finally, this fence requires fewer posts than required for conventional fencing.

Progress:

To date, the project is performing well. In March of 2012 a large cottonwood tree fell across a section of the Stay-Tuff fence. Normally this type of damage would require the removal of the damaged section and replacement with a new section of fence. However, maintenance staff was able to pull up and reattach the Stay Tuff fencing to the post and put it back into service.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
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4.2.15 TAPCO Sequential Dynamic Curve Warning System

Project Name:	Curve Near Beaverhead Rock
Project Number:	HSIP 49-2(10)14
FHWA Number:	MT 12-09
Construction Date:	August 2013
Completion Date:	Summer 2018
Contractor:	Stillwater Electric Co.
URL:	http://www.mdt.mt.gov/research/projects/tapco.shtml

Objective:

A TAPCO BlinkerBeam & BlinkSync dynamic LED curve warning system was installed providing additional signage and delineation to better warn motorists of the upcoming curve and provide visual orientation to help guide motorists through the curve. The TAPCO product is a solar-charged, nickel-metal hydride (NiMH) battery powered, triggered wireless device, which is actuated by Doppler radar when a vehicle approaches.

Progress:

Since installation, the TAPCO system has had numerous technical problems involving under-capacity solar panels, defective batteries, and poor connections. The District hopes these issues will be resolved to a point that this system may function reliably.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

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4.2.16 Urethane Epoxy Pavement Markings

Project Name:	Elk Park
Project Number:	HWY-310386-RP
FHWA Number:	MT 12-02
Construction Date:	June 2012
Completion Date:	Summer 2017
Contractor:	HighMark Traffic Services
URL:	http://www.mdt.mt.gov/research/projects/urethane.shtml

Objective:

The objective of this project is to determine the effectiveness and long-term durability of two urethane epoxy pavement marking products (Swarco MFUA-10 and Ennis HPS-4), as compared to MDT's currently approved epoxies (Poly-Carb).

Progress:

All sections applied (control and test) are performing equally in regard to durability issues (snow plow damage) and retroreflectivity readings.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
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4.2.17 Warm-Mix Asphalt

Project Name:	Monida-Lima (SB)
Project Number:	IM 15-1(109)0
FHWA Number:	MT 10-02
Construction Date:	September 2011
Completion Date:	September 2016
Contractor:	Jim Gilman Excavating, Inc.
URL:	http://www.mdt.mt.gov/research/projects/warm_mix.shtml

Objective:

The purpose of this project is to determine the effectiveness of Warm Mix Asphalt (WMA) using three WMA additives and technologies as compared to MDT's standard Hot Mix Asphalt (HMA) surfacing.

Progress:

The project was paved in September 2011 with the chip seal applied in July 2012. No visible difference between WMA technologies or HMA pavements was noted. Reflective cracking and cover material loss was noted throughout the project.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Kris Christensen
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4.2.18 Wet-Reflective Bead Technology Pavement Marking

Project Name: Rockvale - Laurel
Project Number: HSIP 4-1(63)43
FHWA Number: MT 12-12
Construction Date: September 2013
Completion Date: Summer 2018
Contractor: Arrow Striping
URL: http://www.mdt.mt.gov/research/projects/bead_technology.shtml

Objective:

The objective of this project is to evaluate the effectiveness of 3M Ceramic Elements and Visimax Plus Elements when blended with conventional MDT Type 2 glass beads. These elements are claimed to provide increased retroreflectivity during wet conditions. The increased retroreflectivity during wet conditions is also being evaluated to determine their effectiveness as a safety treatment. Finally, the 20 mil thick striping is recessed in a 60 mil deep grind resulting in an increased durability during plowing seasons.

Progress:

The project has exhibited acceptable dry/wet retroreflective readings on both the control and test sections, and is in good condition since placement. Research staff will continue to monitor the project until measurable data may be presented.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
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4.3 COMPLETED PROJECTS

4.3.1 Highways for LIFE Culvert Rehabilitation

Project Name: MacDonald Pass
Project Number: NH-HFL 8-1(30)23
FHWA Number: MT 00-17
Construction Date: September 2008
Completion Date: April 2013
Contractor: PEC Contracting
URL: http://www.mdt.mt.gov/research/projects/macpass_culvert.shtml

Objective:

This project was nominated by the MDT through the Federal Highway Administration (FHWA) Highways for LIFE (HfL) pilot program to promote the adoption of innovations and new technologies, thereby improving safety and highway quality, while reducing congestion caused by construction. Cure-in-Place (CIP) and High-density Polyethylene (HDPE) pipe liners were chosen to line the existing corrugated steel pipe, allowing the road to remain open during construction. This in turn eliminated congestion, traffic delay, and potential safety issues which would normally occur during a conventional culvert replacement project.

Progress:

To date all liner applications are performing well. Based on the performance to date, MDT has nominated several culvert rehabilitation projects in the state using CIP techniques.

Reports:

Reports can be viewed at the above URL.

Implementation:

This treatment has been implementation as a culvert rehabilitation method.

MDT Project Manager:

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4.3.2 Hot-Laid Thermoplastic Pavement Markings

Project Name:	Various: Avon – Elliston – Deer Lodge
Project Number:	N/A
FHWA Number:	N/A
Construction Date:	2008-2009
Completion Date:	March 2013
Contractor:	MDT Maintenance
URL:	http://www.mdt.mt.gov/research/projects/thermo_various.shtml

Objective:

In the past, MDT staff understood thermoplastic pavement markings required treatment prior to chip sealing due to the potential debonding of the chip seal from the pavement marking material. Two treatment methods were used.

1. When markings were found to be in acceptable condition and location, the markings were left in place, masked, and covered by a seal coat. The masking and seal coat were then peeled away from the thermoplastic pavement markings.
2. If the markings were not in an acceptable condition or location, they were removed via full depth grinding. The resultant trenches were patched with plant mix materials prior to seal coat application. Then pavement markings were applied over the chip seal.

Both options were labor intensive and expensive.

The intent of this project was to identify a less costly method of preparing plant mix surfaces with thermoplastic pavement markings prior to chip sealing. Two methods were compared.

1. A chip seal was placed directly over thermoplastic pavement markings.
2. Thermoplastic pavement markings were scarified prior to placement of a chip seal.

Progress:

Results showed both treatments yielded satisfactory results.

Implementation

This project showed that no surface preparation is required prior to placement of a chip seal over thermoplastic pavement markings. Therefore, the Department will no longer require thermoplastics to be prepared prior to a seal and cover.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

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4.3.3 Paving Fabrics to Mitigate Transverse Cracking

Project Name:	Flesher Pass - East
Project Number:	STPS 279-1(15)22
FHWA Number:	MT 00-18
Construction Date:	September 2008
Completion Date:	April 2013
Contractor:	Riverside Contracting
URL:	http://www.mdt.mt.gov/research/projects/paving_fabrics.shtml

Objective:

The objective of this project is to assess a variety of pavement reinforcement systems (geotextile fabrics) in terms of reducing of reflective cracking.

Progress:

All geotextile fabrics have failed in preventing reflective cracking. All test and control sections exhibit an even progression of reflective cracking. Other potential geosynthetics for reducing reflective cracking are being considered for experimental evaluation.

Reports:

Reports can be viewed at the above URL.

Implementation:

Since all products failed, they will not be implemented as a possible treatment to reduce reflective cracking.

MDT Project Manager:

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4.4 PENDING PROJECTS

4.4.1 Break-out Square Post Breakaway (SPB) System Phase II

Project Name:	Montana Ave-Billings/Laurel Road-Billings
Project Number:	UPP 1020(18/20)
FHWA Number:	MT 13-03
Construction Date:	Estimated Spring 2014
Completion Date:	Summer 2019
Contractor:	N/A
URL:	http://www.mdt.mt.gov/research/projects/break_out.shtml

Objective:

The objective of this project is to determine the effectiveness of the Break-Out Square Post coupler as a possible alternative to the conventional single perforated square tube heavy duty stub the District currently employs. This SPB system is designed to (upon impact) break flush with grade with no damage apparent to base or anchor and offer a quick turnaround to get the sign back in service.

Progress:

Currently, the Districts intend to install twelve (12) SPB units on the project. Specific sign locations have yet to be determined.

Reports:

Reports can be viewed at the above URL. Phase II information is pending.

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4.4.2 CHFRS-2p – High Float and Polymer Modified Emulsion Seal

Project Name:	Wyoming Line – North
Project Number:	IM 90-9(112)544
FHWA Number:	MT-13-06
Construction Date:	Estimated Spring 2014
Completion Date:	Summer 2019
Contractor:	Western Emulsion
URL:	http://www.mdt.mt.gov/research/projects/chfrs-2.shtml

Objective:

Newly paved Grade S plant mix often exhibits an open surface, which may require varying application rates of chip oil to achieve desired chip embedment and retention. The proposed research is in an attempt to standardize application rates for chip seals on new Grade S mixes and to introduce an alternate chip seal product, based on the gel characteristics of CHRFS-2p along with a combination of CSS-1H (diluted 50%) fog seal treatments. Western Emulsion representatives have stated that the CHRFS-2p meets MDT's CRS-2p specification. The treatments proposed by the Contractor may potentially minimize absorption or drain down of chip oil into a newly paved Grade S surface.

Progress:

Current status is pending; the project is delayed and expected to be constructed in the spring of 2014.

Reports:

Pending.

MDT Project Manager:

Craig Abernathy
406.444.6269
cabernathy@mt.gov

4.4.3 Kwik Bond Polyester Polymer Concrete (PPC) Overlay

Project Name:	Bridge Deck Rehab/Repair 11
Project Number:	BH STWD (043)
FHWA Number:	MT-13-05
Construction Date:	Estimated Spring 2014
Completion Date:	Summer 2019
Contractor:	N/A
URL:	http://www.mdt.mt.gov/research/projects/kwikbond.shtml

Objective:

The purpose of this project is to evaluate a bridge deck rehabilitation system using an engineered composite polyester polymer concrete overlay system. This system can rehabilitate ride defects; seal out moisture, oxygen, and chloride ions, preventing them from permeating into the deck; and return the bridge to service in two hours (based on thickness of overlay) at temperatures down to 40°F.

Progress:

Current status is pending; the project is delayed and expected to be constructed in the spring of 2014.

Reports:

Pending.

MDT Project Manager:

Craig Abernathy
406.444.6269
cabernathy@mt.gov

4.4.4 Poly-Carb High Friction Bridge Deck Treatment

Project Name:	East of Kalispell- South of Roundup
Project Number:	HSIP 52-2(38)49/HSIP 16-2(14)47
FHWA Number:	MT 12-10/MT 13-01
Construction Date:	Estimated Spring 2014
Completion Date:	Summer 2019
Contractor:	N/A
URL:	http://www.mdt.mt.gov/research/projects/polycarb.shtml

Objective:

The Department has nominated this project as a preservation and performance enhancement demonstration. First a solvent-less, low-viscosity polymer seal will be applied to repair (or chemically weld) cracks in horizontal concrete decks. A second application overlay, using a hybridized copolymer epoxy and urethane layer with a broadcast of glacial gravel (basalt quartzite granite), will be applied as the friction course.

The treatment system will consist of application of Poly-Carb MARK – 135 SAFE-T-SEAL gravity fed crack repair system followed by application of the Poly-Carb MARK-163 FLEXOGRID Overlay System.

Progress:

Construction is currently scheduled for the spring of 2014. Two decks have been selected in Kalispell and Roundup.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
406.444.6269
cabernathy@mt.gov

4.4.5 Polyvinyl Chloride (PVC) Lateral and Storm Drains

Project Name:	Tatro Street-Miles City
Project Number:	STPU 8014(1),
FHWA Number:	MT 12-11
Construction Date:	Estimated Spring 2014
Completion Date:	Summer 2019
Contractor:	N/A
URL:	http://www.mdt.mt.gov/research/projects/pvc.shtml

Objective:

This project involves the installation of profile wall polyvinyl chloride (PVC) plastic pipe for use in urban projects with new trunkline and lateral connections. Profile wall PVC will also be used for connection into the existing storm drain laterals east of the Tongue River Slough. Evaluation emphasis is placed on the trenching and special bedding procedures, which is integral to the performance of the PVC placement.

Progress:

Construction is currently scheduled for the spring of 2014.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
406.444.6269
cabernathy@mt.gov

4.4.6 Sacrificial Osterberg Cell (O-Cell) to Confirm Load Design

Project Name:	Thompson River East
Project Number:	STPP 6-1(87)56
FHWA Number:	MT-13-02
Construction Date:	Estimated Spring 2014
Completion Date:	Summer 2019
Contractor:	N/A
URL:	http://www.mdt.mt.gov/research/projects/osterberg.shtml

Objective:

MDT plans to replace the existing structure over the Thompson River east of Thompson Falls, MT. A new 40 ft. wide bridge north of the existing structure on an offset alignment will be constructed.

A load test is proposed for a sacrificial eight foot diameter drilled shaft near pier 2 of the new bridge. This location will provide easy access to conduct the load test and still allow for production shafts to be drilled and other work to continue. Osterberg Load Cells (O-Cell) from Load Test Inc. will be used for this load test. The O-Cell is installed in the test shaft at a predetermined location to maximize skin friction or base resistance for verification of design parameters.

Progress:

Construction is currently scheduled for the spring of 2014.

Reports:

Reports can be viewed at the above URL.

MDT Project Manager:

Craig Abernathy
406.444.6269
cabernathy@mt.gov

4.4.7 Superior Traffic System (STS) Real-Time Traffic Management for Work Zone Application

Project Name:	Main St. – 19th/Grand
Project Number:	STPP 50-2(68)88
FHWA Number:	MT-13-04
Construction Date:	Pending
Completion Date:	Summer 2019
Contractor:	N/A
URL:	Pending

Objective:

The goal of this project is to use work zone data to improve safety and mobility, minimize delays, and maximize efficiencies with the use of available technologies. Additional goals are to improve incident management and decrease delays to emergency vehicles traveling through projects, and to manage and decrease vehicle queue lengths. The deployment of the STS system technologies may minimize traffic delays by using real-time information and may indicate appropriate strategies for improving worker safety in congested work zones on future projects.

Progress:

Current status is pending; with construction of the selected project delayed. Due to a reduction in resources, the STS deployment is currently being reconsidered and implementation of the system may be indefinitely delayed.

Reports:

Pending.

MDT Project Manager:

Craig Abernathy
406.444.6269
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4.5 PROPOSED PROJECTS

4.5.1 Bridge Deck Anti-Icing System

The Great Falls District is considering using a type of anti-icing technology on a new bridge construction in Helena. Currently research is being conducted on which type of anti-icing system will be applied.

4.5.2 Intelligent Compaction

The Department has expressed interest in selecting a project to display the potential of intelligent compaction (IC) in the paving of Hot Mix Asphalt (HMA). IC is the compaction of road materials such as soils, RAP bases, or asphalt paving materials using modern vibratory rollers equipped with an integrated measurement system, an on board computer reporting unit, GPS, and feedback control.

4.5.3 Methyl Methacrylate (MMA) Pavement Markings

The Glendive District is planning to incorporate MMA pavement markings on Portland cement concrete pavement (PCCP) in an effort to ascertain if this material will be more durable than currently approved pavement marking materials. The project may be selected by 2015.

4.5.4 ZBAR Deck Reinforcement

The MDT Bridge Bureau has proposed to incorporate a conventional reinforcing steel bar with a thermal-bonded zinc inner layer and a thermal bonded polymer outer layer (known as ZBAR) in a bridge deck project. To date a project has not yet been selected.

5 PARTNERING PROJECTS AND POOLED-FUND STUDIES

MDT contributed funds to the following partnering and pooled-fund studies in FFY 2013. Click on the project links to view project information.

Table 6: Partnering and pooled-fund contributions for FFY 2013

NUMBER	NAME	FUNDING LEVEL
TPF-5(275)	2014 Asset Management Conference and Training on Implementation Strategies	$10,000
N/A	AASHTO Equipment Management Technical Services Program (EMTSP)	$3,000
N/A	AASHTO Materials Reference Library (AMRL)	$20,000
N/A	AASHTO Product Evaluation Listing (APEL)	$1,200
TPF-5(218)	Clear Roads Winter Highway Operations Pooled Fund	$25,000
TPF-5(272)	Evaluation of Lateral Pile Resistance Near MSE Walls at a Dedicated Wall Site	$10,000
TPF-5(197)	Impact of Wide-Based Tires on Pavement Damage: A National Study	$25,000
N/A	Load and Resistance Factor Design (LRFD) Bridges and Structures Specification Maintenance (LRFDSM)	$10,000
TPF-5(413)	National Cooperative Highway Research Program (NCHRP)	$414,079
N/A	National Transportation Product Evaluation Program	$12,000
TPF-5(260)	Next-Generation Transportation Construction Management	$10,000
TPF-5(190)	North/West Passage	$25,000
TPF-5(264)	Passive Force-Displacement Relationships for skewed Abutments	$15,000
SHR-2(013)	SHRP 2 Implementation (http://shrp2.transportation.org/Pages/default.aspx, http://www.fhwa.dot.gov/goshrp2/, and http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/Blank2.aspx	$313,696
N/A	Technical Service Program to Develop AASHTO Materials Standards (DAMS)	$5,000
N/A	Technology Implementation Group (TIG)	$6,000
SPR-3(099)	Transportation Learning Network (TLN)	$117,000
N/A	Transportation System Preservation (TSP_2)	$20,000
TPF-5(261)	Transportation Research Board Cores Services Support	$94,186
	TOTAL	**$1,136,161**

6 SUMMARY

6.1 GENERAL

MDT's mission is to serve the public by providing a transportation system and services that emphasize quality, safety, cost effectiveness, economic vitality, and sensitivity to the environment. MDT's Research Programs impact each and every part of MDT's mission.

Research projects completed in FFY 2013 yielded results that when fully implemented will improve:

- ★ Efficiency and effectiveness of MDT operations and technology transfer, including:
  - Improving training of and encouraging young individuals to enter the transportation construction work force
  - Improving roadside revegetation
  - Improved planning for growth
  - Increasing recycling efforts
  - Improving culvert and rest area design
  - Evaluating MDT's weigh-in-motion (WIM)/automated traffic recorder (ATR and occupant protection programs
  - Evaluating bridge and pavement needs
  - Improving bridge response to earthquakes
  - Improving specifications
  - Improving traffic flow
- ★ Economic vitality
- ★ Sensitivity to the environment, including:
  - Decreasing vehicle-wildlife collisions
  - Improving habitat connectivity
  - Improving air quality
  - Decreasing erosion
  - Increasing roadside revegetation
  - Improving culvert and rest area design
  - Increasing recycling efforts
  - Improving planning for growth
- ★ Safety, including:
  - Reviewing speed limits and other traffic issues in terms of safety
  - Reviewing safety programs
  - Decreasing young driver risks
  - Decreasing wildlife-vehicle collisions
  - Improving roundabout communication efforts
  - Improving bridge response to earthquakes
  - Improving incident response

★ Quality of what we do and how we do it, including:
- Improving air quality
- Improving bridge and culvert design
- Improving planning for induced growth
- Evaluating bridge and pavement needs

6.2 FISCAL

Research Programs expenditures occurred through research projects, pooled-fund studies, NCHRP and TRB Core Services support, and support of SHRP 2 implementation (Figure 6). Figures 7 and 8 show these expenditures categorized by subject. MDT, as of July 2007, is required to charge indirect costs. The indirect costs rates are revised each state fiscal year. From July 2012 to June 2013, the indirect cost rate charged to each expenditure was 9.64% and from July 2013 to June 2014, the indirect cost rate charged to each expenditure is 9.12%. Figure 9 shows these indirect costs, as well as overhead costs, as compared to total project expenditures, including projects such as pooled-fund studies that are not charged indirect costs by MDT. Figure 10 shows total funding for all active research projects by funding source. Figures 11 and 12 show funding for in-state and out-of-state researchers. Figures 13 and 14 show funding by public and private consultants. Finally, for research projects completed in FFY 2013, $33,660 was unexpended.

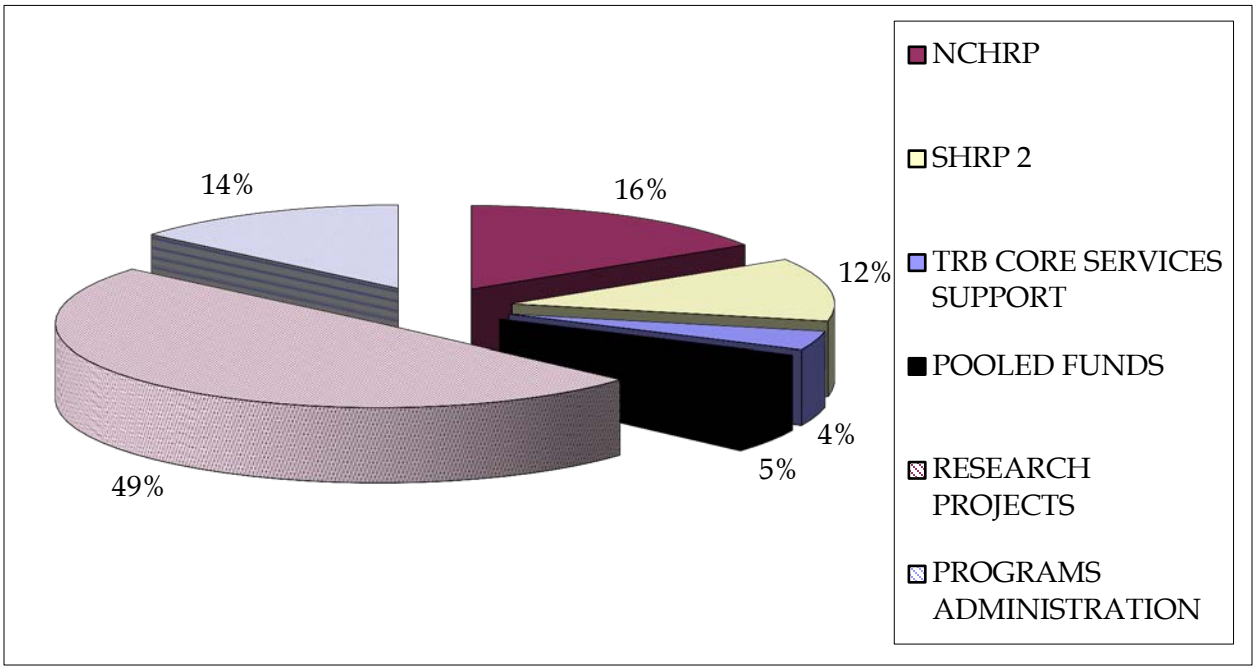

Figure 6: Percent of Research Programs expenditures for FFY 2013 by project type.

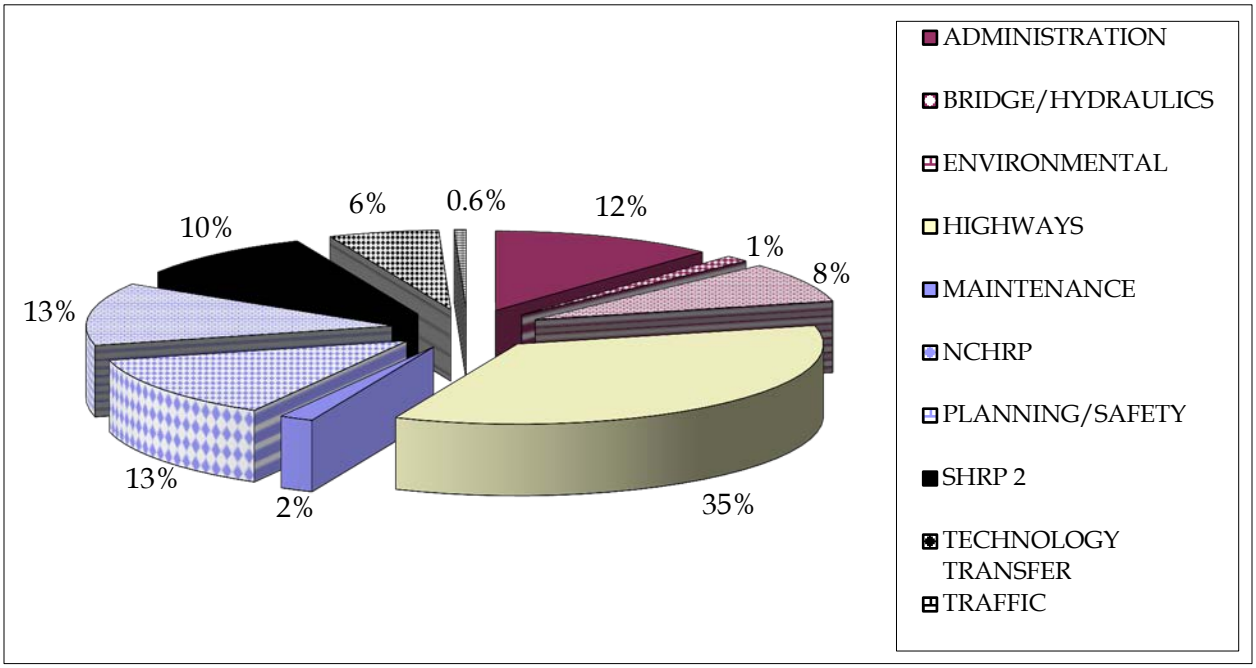

Figure 7: Percent of Research Programs expenditures for FFY 2013 by subject.

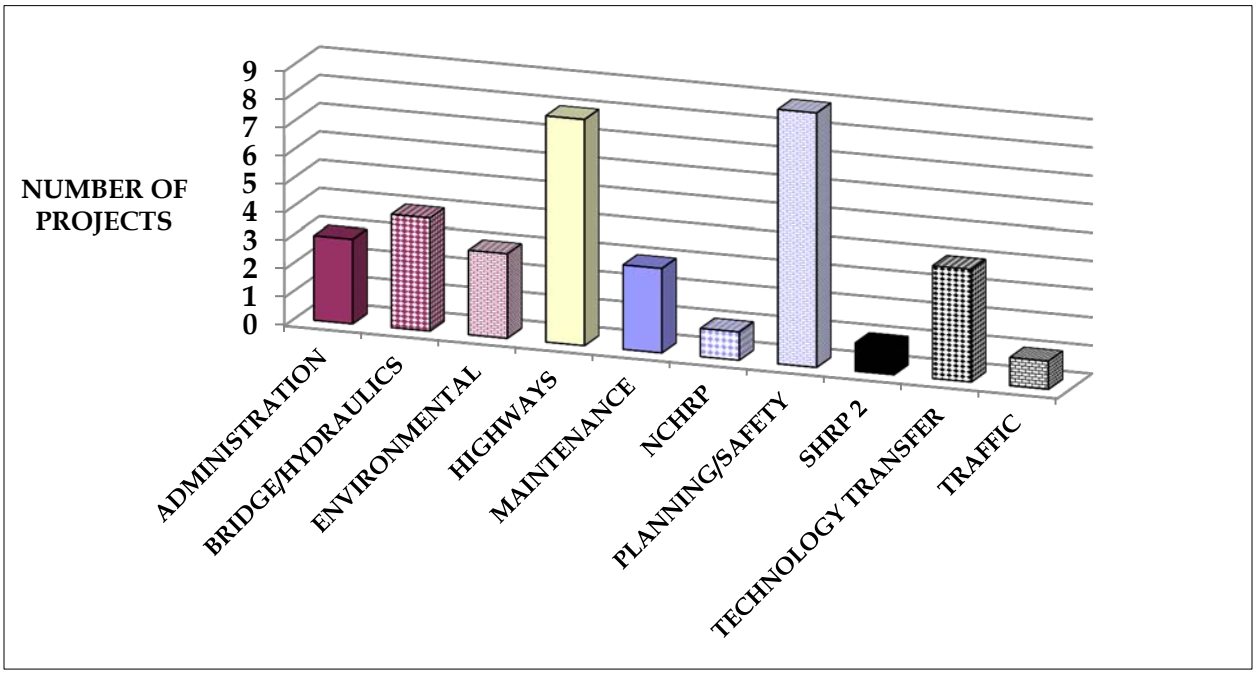

Figure 8: Number of Research Programs expenditures for FFY 2013 by subject.

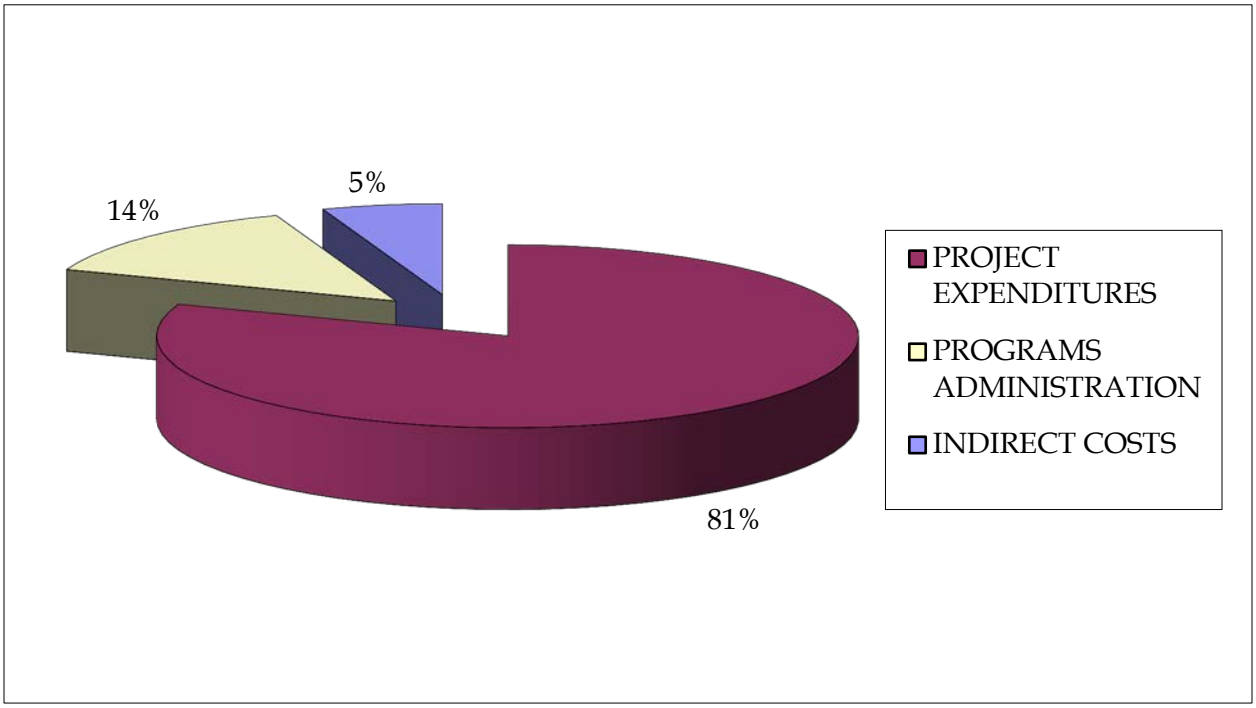

Figure 9: Overhead and indirect cost expenditures for FFY 2013 as compared project expenditures.

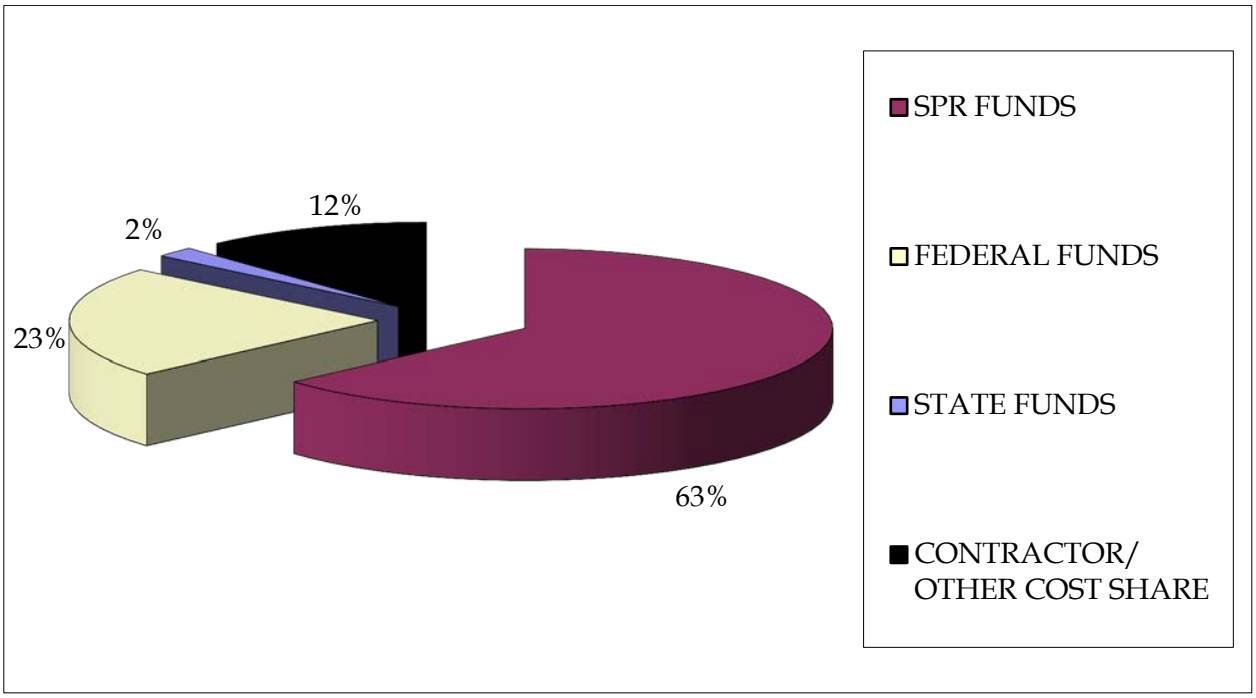

Figure 10: Percent of funding for all projects active in FFY 2013 by funding source.

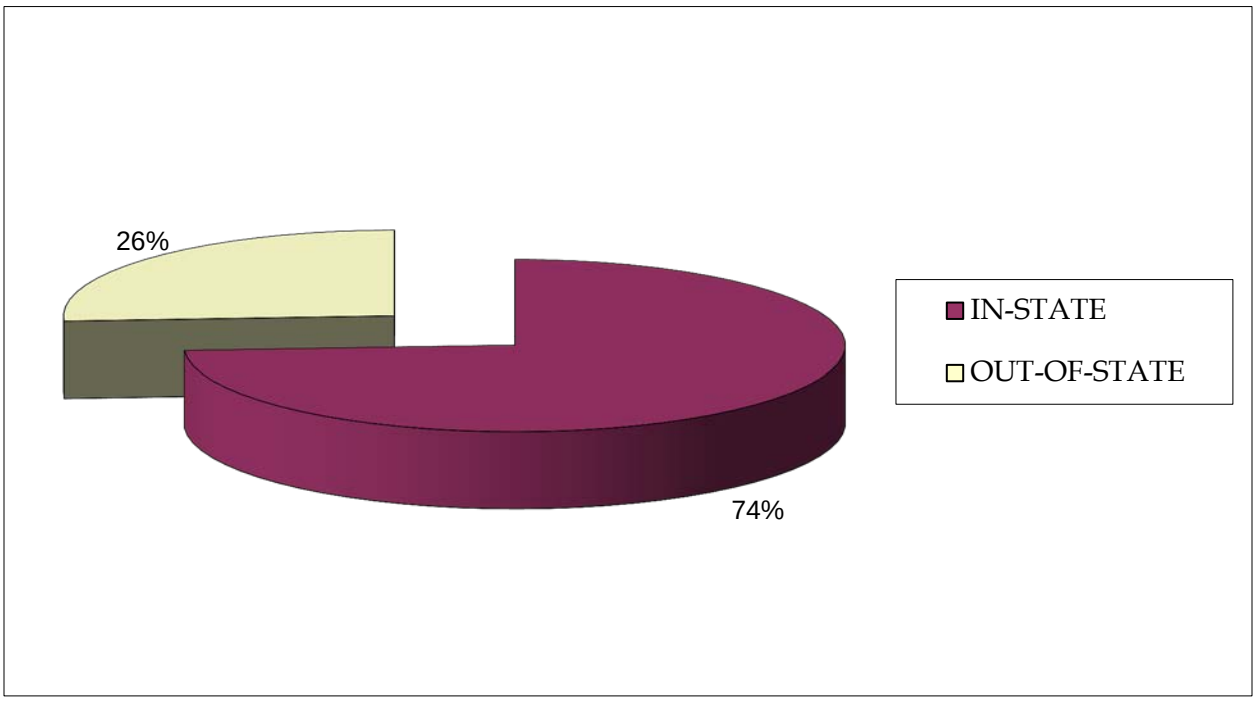

Figure 11: Percent of funding for all projects active in FFY 2013 by researcher location.

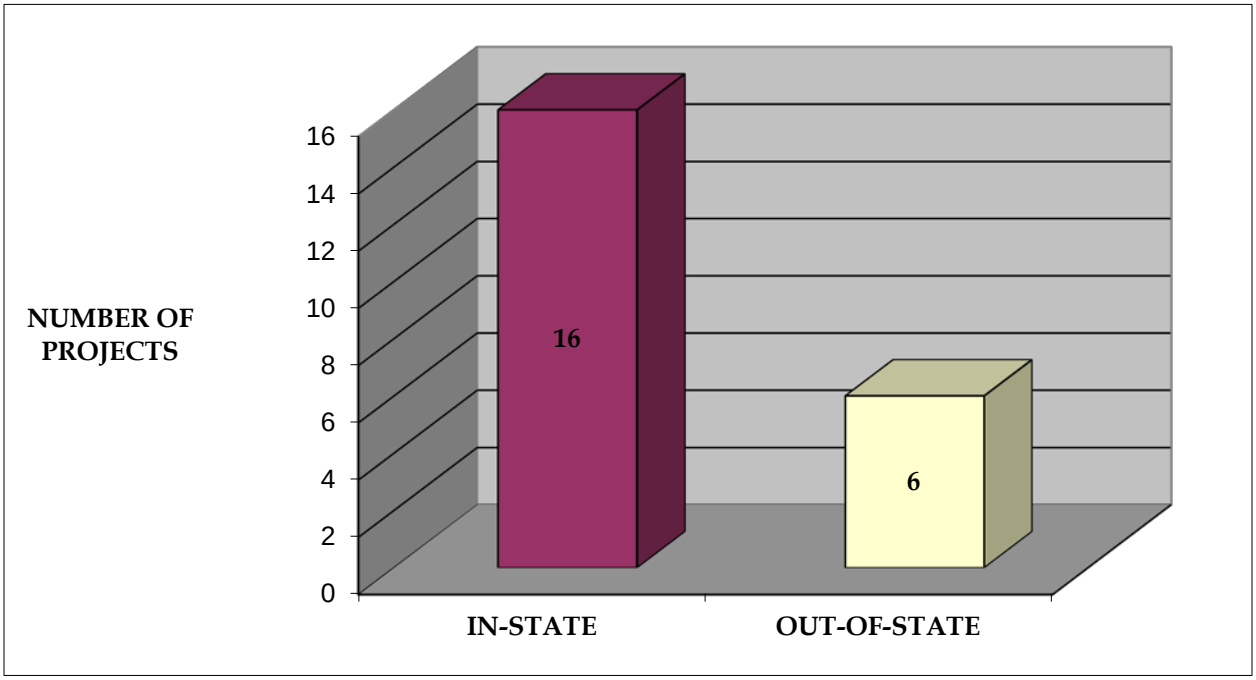

Figure 12: Number of projects active in FFY 2013 by researcher location.

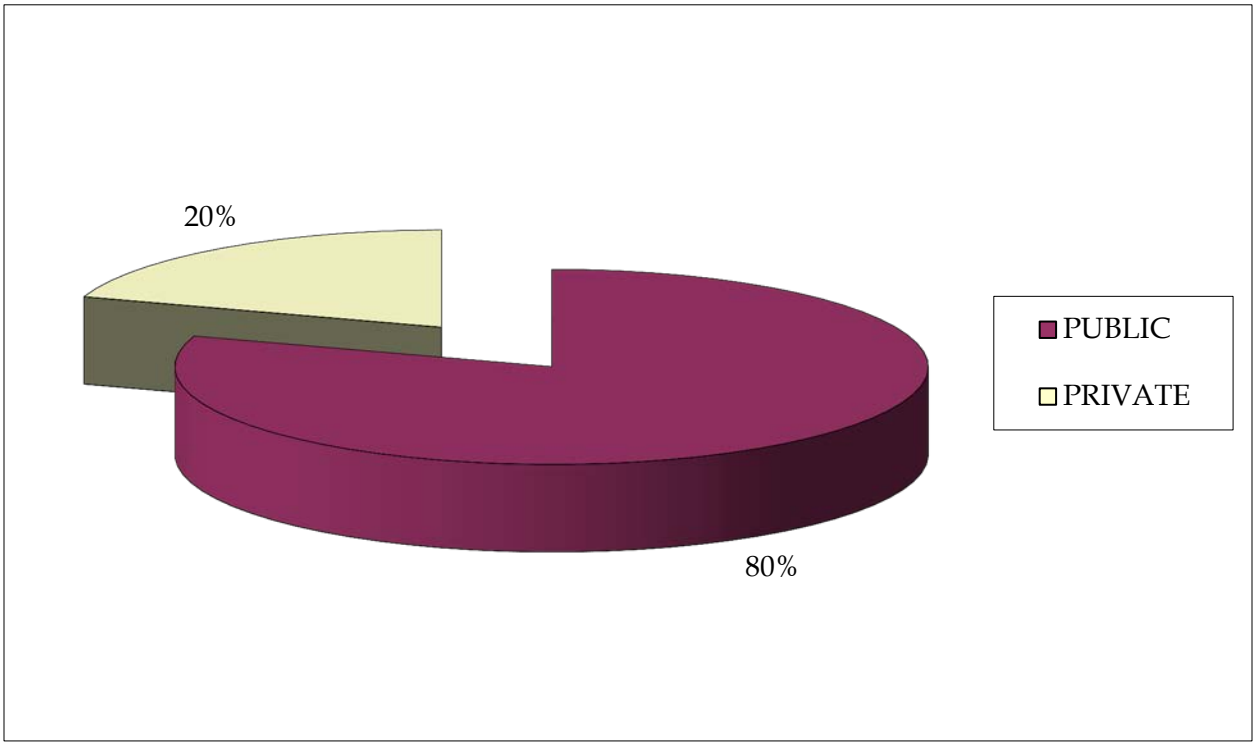

Figure 13: Percent of projects active in FFY 2013 by researcher type.

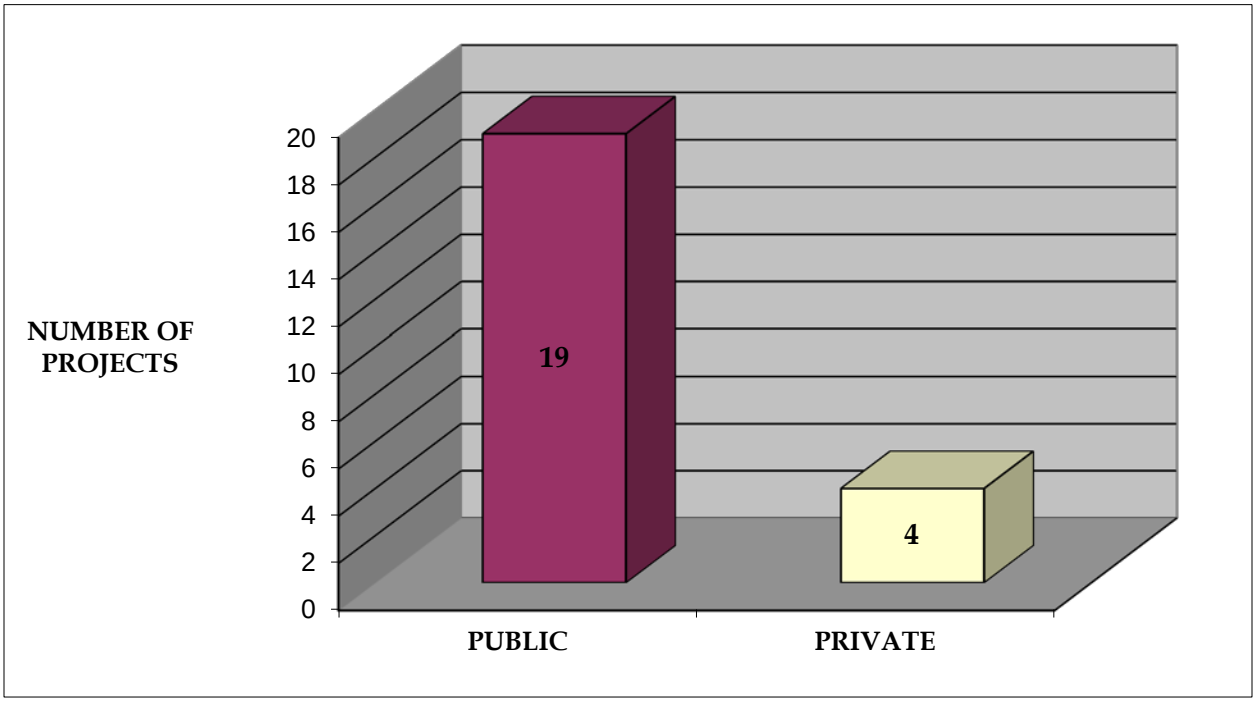

Figure 14: Number of projects active in FFY 2013 by researcher type.