

SOLUTIONS

PROJECT HIGHLIGHTS

Development of a ¾-inch Minus Base Course Type A Specification for Montana

Gravel bases are a critical component of roads, providing drainage, structural support, and load distribution to reduce pressures on subgrade soils. For some construction projects in Montana, obtaining materials that meet the current specifications for crushed base course aggregates having a maximum nominal size of 2 in. (CBC-5A) and 1½ in. (CBC-6A) is becoming more difficult due to declining natural resources. There are also issues with the clean, larger size materials raveling once they have been placed and then exposed to traffic. This research project was initiated to examine multiple sources of crushed base course aggregates from around Montana to determine whether gradations having a smaller maximum particle size would perform at least as well as Montana CBC-6A and CBC-5A materials.



The first step in this investigation was to review other state and federal standard specifications to document standard ¾-inch minus base course specifications. Of the limited number of ¾-inch minus gradation specifications found, only the ones from Colorado and Nebraska were considered useful as base course materials for Montana, and it

was determined the Colorado specification would be used to generate ¾-inch minus mixes for laboratory testing. Next, a variety of crushed aggregates from several sources throughout the state of Montana, having a ¾-inch minus gradation, were tested to determine their performance characteristics. These performance characteristics were compared to existing data from laboratory tests conducted on Montana CBC-5A and CBC-6A materials¹. Further analysis was done to determine the effect that changes in the ¾-in. minus gradation had on their performance characteristics.

¹Mokwa, R., Trimble, N. and Cuelho, E. (2007) "Experimental Assessment of Aggregate Surfacing Materials," Final report for the Montana Department of Transportation, FHWA/MT-07-011/8117-30, pp. 74.



RESEARCH PROGRAMS Winter 2017

IN THIS ISSUE

PROJECT HIGHLIGHTS

[Development of a ¾-inch Minus Base Course Type A Specification for Montana](#)

[An Assessment of Traffic Safety Culture Related to Driving After Cannabis Use](#)

[Use of 3D Geocomposite for Added Synthetic Subsurface Drainage Layer \(SSDL\) in Asphalt Cement \(AC\) Pavement](#)

LIBRARY CORNER

[MT.Gov Connect](#)

DID YOU KNOW?

[Traffic Safety Culture Transportation Pooled Fund \(TSC-TPF\)](#)

CALENDAR OF EVENTS

NEW RESEARCH REPORTS

NEW EXPERIMENTAL REPORTS

CONTACT US



Samples of aggregate were collected from eight different gravel pits located throughout Montana’s five districts (Figure 1). Portions of these gravel samples were crushed to create ¾-inch minus mixes (Prepared mixes). These gradations were further modified to evaluate the effect that gradation had on their engineering properties (Modified mixes). The following lab tests were conducted to characterize the physical attributes and material properties of these gravel mixes:

- Particle size distribution
- Fractured face count
- Modified Proctor density
- Relative density (maximum and minimum index densities)
- Specific gravity
- R-value (tested by MDT)
- Direct shear
- Permeability

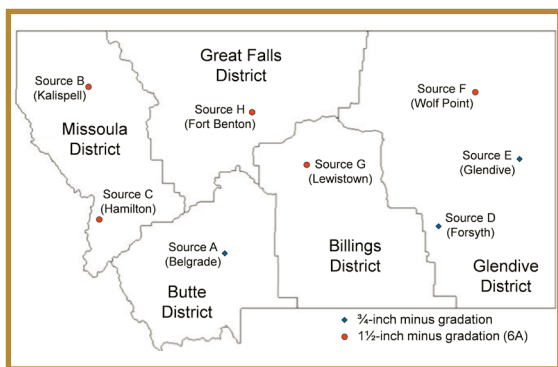


Figure 1: Map of Materials Sources in Montana

Statistical analyses of average values were conducted using a two-sided t-test (for samples having unequal variance) to determine if apparent trends in measured laboratory test results represent true differences between aggregate types. The two-sample t-test is a statistical test used to determine if the averages of the two data sets are statistically different from

one another based on a mathematical evaluation of the data scatter. In cases where the averages are statistically different, a direct comparison of the mean values indicates which value is greater. Otherwise, the means are considered statistically equal.

Three recommendations were made based on the results of this study. First, it was recommended to incorporate a standard specification for ¾-in. minus crushed base course aggregates. This would require modifications to Section 701.02.4 of Montana’s standard specifications for road and bridge



construction to include Crushed Base Course Type 7A, having a maximum nominal size of ¾ in. The second recommendation was to limit the amount passing the #40 sieve to ensure good permeability. The range of particle sizes was selected based on information from federal and state sources, as well as a preliminary specification from the Glendive District. Limiting the amount passing the #40 sieve to 25 percent will help ensure acceptable drainage characteristics of the constructed aggregate layer. The practicality and constructability of producing mixes that fit within these modified bounds, however, should be evaluated prior to full implementation. The third recommendation was to maintain current levels of plasticity, wear and fractured face requirements until definitive research has been conducted to specifically study the effect that changing these requirements has on the performance characteristics and the cost-benefit of these mixes.

To learn more about this project, visit the [research project website](#). If you have questions, please contact Kris Christensen (krchristensen@mt.gov or 406.444.6125).



An Assessment of Traffic Safety Culture Related to Driving After Cannabis Use



Several states have legalized recreational cannabis use, and more are considering legalization. Increased use of cannabis among drivers may pose a barrier to achieving the National Toward Zero Deaths (TZD) initiative. The transformation of traffic safety culture is a primary element of the TZD strategy. A positive safety culture can significantly reduce crash fatalities and serious injuries. This research focused on specific aspects of traffic safety culture that relate to the decision to drive after consuming cannabis (DUIC). Research shows that cannabis is the most commonly used illicit drug in the United States and, due to recent legalization trends, use is increasing. Increased use of cannabis may lead to more incidents of driving after using cannabis. This research project was a formative study to better understand which specific aspects of traffic safety culture (the values and beliefs shared among groups of road users and stakeholders that influence their decisions to behave or act in ways that affect traffic safety) predict the decision to drive after using cannabis. The research sought to answer four critical research questions:

1. How does traffic safety culture compare between users and non-users of cannabis?
2. How does traffic safety culture correlate with the decision to drive under the influence of cannabis?
3. How does traffic safety culture compare between states with and without legalized recreational use laws?
4. How does traffic safety culture compare between states with and without legalized medical use laws?

A survey was implemented to investigate the traffic safety culture related to driving after cannabis use based on an augmented form of the integrated behavioral model based on the theory of reasoned action and the prototype willingness model (Fishbein & Ajzen, 2010¹ and Gerrard et al, 2008²). The questions were developed to measure each component of the model. The survey development process included interviews with regular users of cannabis to better understand behavioral, normative, and control beliefs associated with driving after using cannabis.

The survey results provided understanding into the traffic safety culture around DUIC. The relative frequency analysis provided an initial understanding into the range of values, beliefs, and attitudes about DUIC. In particular, about half of the individuals reporting use of cannabis in the past year indicated they had driven one or more times within four hours of using cannabis. In addition, about one in six respondents did not know if their state had a law about driving under the influence of cannabis.

Partial correlation coefficients showed that components of the model were strongly associated with DUIC behavior. A comparison of the means of these components among different groups (non-users of cannabis, users of cannabis who do not drive under the influence of cannabis, and people who do drive under the influence of cannabis) revealed important differences in shared values, beliefs, and attitudes.

Additional analyses answered four questions about the culture of DUIC:

How does traffic safety culture compare between users and non-users of cannabis?

All implementations of the survey showed significant differences in beliefs and attitudes about DUIC between users and non-users of cannabis. In particular, users of cannabis have a greater intention to DUIC, greater willingness to DUIC in a variety of circumstances, a more positive attitude about DUIC, hold normative beliefs (both injunctive and descriptive)



that are more supportive of DUI, and experience more situations where they are likely to DUI.

How does traffic safety culture correlate with the decision to drive under the influence of cannabis?

All three implementations of the survey showed significant differences in beliefs and attitudes among users of cannabis about DUI between those who engage in DUI and those who do not. In particular, those who DUI have a positive attitude about DUI, hold normative beliefs (both injunctive and descriptive) that are supportive of DUI, and experience more situations where they are likely to DUI. Six different behavioral beliefs about DUI were strongly correlated with attitude and provide more insights. Specifically, those who DUI were more likely to feel calmer, more alert, and more cautious if they drive after using cannabis compared to those who do not DUI. They were less likely to feel that they would be arrested, that their reaction time would be slower, or that they would be in an accident compared to those who do not DUI.

How does traffic safety culture compare between states with and without legalized recreational use laws?

Results from this survey did not reveal significant differences in values, beliefs, or attitudes between states with and without legalized recreational use of cannabis. This finding does not preclude such differences existing; however, among the items measured on this survey, no differences were found. More time may be required to see an impact in beliefs and attitudes.

How does traffic safety culture compare between states with and without legalized medical use laws?

Results from this survey did not reveal significant differences in values, beliefs, or attitudes between states with and without legalized medical use of cannabis. This finding does not preclude such differences existing; however, among the items measured on this survey, no differences were found.

Recommendations are as follows:

Recommendation #1: Interventions should be developed to address the beliefs of those who use

cannabis. An intervention is an intentional experience specifically designed to change beliefs. Interventions can include a wide variety of activities including classroom instruction (in a driver's education program, for example), experiential activities like driving simulators, education campaigns, one-on-one counseling, etc. Furthermore, as laws and policies about DUI are developed and enforced, these efforts can include education to change the beliefs revealed in this study. The specific beliefs to be addressed include:

- Knowledge of existing DUI laws: About one in six individuals did not know whether DUI was illegal in their state or not. Educating the general public about current laws is an important opportunity to also address the beliefs noted below.



- Attitudes about DUI: Individuals who drive after using cannabis have positive attitudes about DUI. Specifically, they feel it is safe, sensible, pleasant, and acceptable. These positive attitudes may promote DUI behavior. Based on this survey, these attitudes are informed by six behavioral beliefs. Research needs to be compiled (or, perhaps even conducted) to better understand to what degree cannabis use impacts driving. Specifically, individuals reported that they feel calmer, more alert, and more cautious when they drive under the influence of cannabis. Is this reflected in their performance or is this merely their perception? Furthermore, individuals reported that they are not likely to get arrested, that their reaction time will not be slower, and that they are not more likely to be in an accident when they drive under the influence of cannabis. Are these beliefs accurate?



- Educational materials and interventions need to be designed to address these beliefs. In some cases, research results may not be available and additional research may need to be conducted.
- Perceived norms: Individuals who drive after using cannabis have different perceptions about whether such behavior is acceptable to others (injunctive norms) and is common (descriptive norms). Accurate information about the acceptability and prevalence of DUI/DWI should be included in all conversations about cannabis, driving, and DUI/DWI interventions. Safety advocates can unintentionally increase inaccurate perceptions about norms by using such language as “there is an epidemic of DUI/DWI” or “everyone seems to think it is OK to drive under the influence of cannabis.” While such language can raise attention and concern, it can also foster beliefs that increase DUI/DWI behavior.

Recommendation #2: Interventions should be designed for a variety of settings. This survey revealed that those who DUI/DWI do so in a variety of situations. Specifically, they are more likely to be in situations where they need to drive to run errands or drive home after using cannabis when out or at a party (and for some, even driving to work or school). Therefore, efforts to address DUI/DWI cannot only address social settings, but must

address DUI/DWI in a variety of contexts. DUI/DWI policies should be developed by schools and workplaces. Education should not only address using cannabis in a social setting, but should address driving in any situation.

Recommendation #3: Interventions should seek to align with existing values. Those who use cannabis and drive under the influence are more likely to value enjoyment in life, stimulation, and self-direction and less likely to value security, tradition, and conformity. Therefore, interventions need to be designed that align with these values to increase the likelihood of acceptance.

This project was conducted as a part of the [Traffic Safety Culture Transportation Pooled Fund \(TSC-TPF\)](#). View the [project website](#). For more information on this project or the pooled fund, please contact Sue Sillick (ssillick@mt.gov or 406.444.7693).

¹Fishbein, M., & Ajzen, I. (2010). Predicting and Changing Behavior: The Reasoned Action Approach (1st edition). New York: Psychology Press.

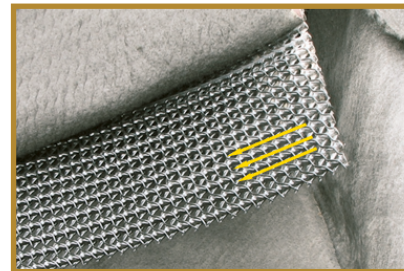
²Gerrard, M., Gibbons, F. X., Houlihan, A. E., Stock, M. L., & Pomery, E. A. (2008). A dual-process approach to health risk decision making: The Prototype Willingness Model. *Developmental Review*, 28(1), 29–61. <http://doi.org/10.1016/j.dr.2007.10.001>.

Use of 3D Geocomposite for Added Synthetic Subsurface Drainage Layer (SSDL) in Asphalt Cement (AC) Pavement

In the fall of 2016, the Department chose to install the Tensar RoaDrain 5 (TD-5) as an experimental feature on US 287 (P-87) in Gallatin County. The SSDL is a multilayered geotextile tri-planer geonet core with a non-woven geotextile (or fabric) that is laminated (heat welded) to the top and bottom of the core. RoaDrain is used when subsurface moisture is in sufficient quantities to affect the performance of the roadway structure.

Although difficult to see in the image to the right, the construction of the geonet core creates a channel

conduit which runs perpendicular to the placement in the roadway offering a path of least resistance to upward moisture migration (yellow arrows).



Fabric peeled back to expose the core construction



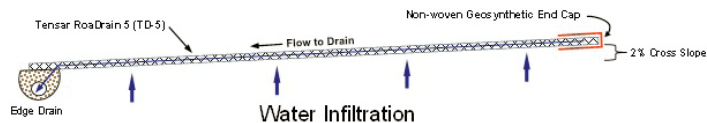
The section of highway in question, as of four years ago, had deteriorated to the point an excavation was performed and treated using usual methods of rehabilitation (geotextile, special borrow, base course, and asphalt pavement resurfacing). The section has failed again since then, and the Department chose to install the Tensor SSDL at the subgrade under the assumption that water retention within the pavement layers deteriorated the structural base course, which contributed to the premature failure of the pavement.

The project involved the installation of the SSDL geocomposite on an approximate 700 ft. (0.13 mile) section of the affected roadway. The graded slope has an 8" perforated HDPE pipe installed edge drain to aid in the SSDL system.

As subsurface water migrates through the filter fabric and into the geonet composite core, it channels the moisture to the edge drain, following the path of least resistance and funneling the water down-slope to the drain outlet.

The following illustration describes how the SSDL performs:

Cross Section of RoaDrain Design Properties



The edge of the SSDL away from the drain is covered (or capped) by a section of geosynthetic fabric (as seen in the diagram as a red box) to prevent any intrusion of sediment which may clog the internal channels of the core.

SSDL installed on the northbound lane



SSDL traversing both lanes and ready for base course application

To learn more about this project, visit the [research project website](#). If you have questions, please contact Craig Abernathy (cabernathy@mt.gov or 406.444.6269).

LIBRARY CORNER

MT.Gov Connect

Montana state agencies increasingly provide information in electronic formats, which makes resources more easily accessible to the public and saves printing costs. Before this technology was available, agencies were required to send at least one printed copy of reports to the Montana State Library for preservation. In light of the changes in process and technology, an important question to ask is: how is this information now being preserved in an ever-changing digital environment? The State Library has, thankfully,

found a solution to capture agencies' websites, thus ensuring continued future access.

[Mt.Gov Connect](#) is the State Library's portal to finding this preserved information. They have worked with Internet Archive's web archiving service,





called Archive-It, to crawl agencies' sites and capture them. It's similar to taking a screenshot of each site on a regular basis; except in this case, the links work, and the information is still accessible. They have had these web crawlers in place since 1996, and as a result, they have a robust collection, which shows the changes in these agencies over time.

For example, they have captured MDT's website, 1996 through present. If you look at the [1996 website](#), you can see the dramatic differences from [today's site](#). Another example can be seen in MDT's Research webpage. [This](#) is what it looked like in 1996, compared to the [2017 page](#). They have links available to [all the archived versions of MDT's page](#), up to January 2017. There is a period from 2000-2006 when the domain was

not mt.gov, but rather state.mt.us. MDT's page captures during this time period are available [here](#).

The [MT.Gov portal](#) can be used to search the captured sites from all of the agencies, or users can browse the archived pages of a specific agency on [this page](#). The State Library also has a [Frequently Asked Questions page](#), which provides additional details about the web crawlers used.

This portal and the web crawling service helps to ensure that valuable Montana government information is saved, and that it is easily retrievable when needed.

For more information, please contact Katy Callon (kcallon@mt.gov or 406.444.0871).

DID YOU KNOW?

Traffic Safety Culture Transportation Pooled Fund (TSC-TPF)

The [Traffic Safety Culture Pooled Fund Research Program](#) is actively leading innovative research projects and is seeking new states and others to partner with us by joining this ongoing collaboration. Current participating states include Connecticut, Iowa, Idaho, Indiana, Louisiana, Montana, New Hampshire, Texas, Utah, and Washington.

Three years ago, the Montana Department of Transportation partnered with the Center for Health and Safety Culture (CHSC) within the Western Transportation Institute (WTI) at Montana State University to create a pooled fund dedicated to traffic safety culture. The fund supports an integrated, multiyear program of research to support the transformation of state and national traffic safety culture.

Transforming traffic safety culture is a primary component of the National Strategy on Highway Safety developed by the Towards Zero Deaths (TZD) Steering Committee. Only through the growth of a positive safety culture can further significant and sustainable reductions in crash fatalities and serious injuries be achieved. Such

transformation would not only support traffic safety goals by reducing risky behaviors and increasing protective behaviors, it would also increase public acceptance of other forms of effective traffic safety programs.



Recent projects of the pooled fund include developing a better understanding of shared beliefs and attitudes about [driving under the influence of cannabis](#) and exploring the concept of traffic safety citizenship – growing pro-social behaviors (like asking someone else to wear a



seat belt) that improve traffic safety. An article featuring this project will be included in the Spring 2017 Research Newsletter. A new research project to better understand the attitudes of law enforcement about traffic safety is just getting underway.

In addition, the Pooled Fund supports and helps to advance complementary research initiatives by other entities. Pooled Fund members and research staff work closely with NCHRP, NHTSA, and the National Center for Rural Road Safety on traffic safety culture research. Most recently, for the last two summers, the Pooled Fund, CHSC, and WTI have hosted visiting researchers from the European Union TraSaCu (traffic safety culture) project to encourage sharing of traffic safety culture research findings at the international level.

The benefits of participating in this pooled fund include leveraging a smaller investment of research dollars to complete larger research projects on the cutting-edge topic of traffic

safety culture. Participating members can guide the direction of research and vote on project selection. For example, some of the projects under consideration for future years include developing a better understanding of the values and beliefs of first-time DUI offenders or poly-drug users, and implementing demonstration projects to test and evaluate traffic safety culture interventions. Additionally, there is the benefit or sharing of traffic safety culture information and research results nationally and internationally.

MDT is now inviting new partners and State DOTs to join this pooled fund program. The minimum commitment amount is a total of \$40,000 per state through federal fiscal year (FFY) 2019, over three federal fiscal years (FFY 2017, 2018, & 2019). This amount allows for the additional benefit of paid travel to pooled fund meetings.

Please contact Sue Sillick (ssillick@mt.gov or 406.444.7693) for more information.

CALENDAR OF EVENTS

February

NCHRP Synthesis Topic Statements
Due - 2/17/17
MDT RRC Meeting - 2/22/17

March

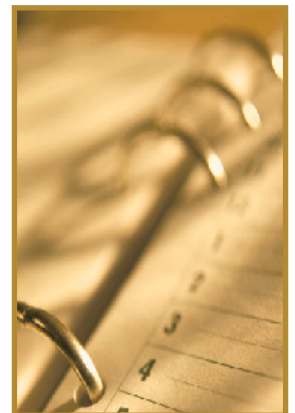
NCHRP IDEA Proposals Due - 3/1/17
TCRP Synthesis Topic Statements
Due - 3/15/17
MDT RRC Meeting - 3/22/17
MDT Research Ideas Due* - 3/31/17
NCHRP (FY2018) Projects Chosen

April

National Library Week - 4/9-15/17
MDT RRC Meeting - 4/27/17
MDT Research Topic Statements Due*
- 4/30/17

May

Transit IDEA Proposals Due - 5/1/17
AASHTO Spring Meeting - 5/22-25/17
MDT RRC Meeting - 5/31/17
MDT Topic Statement Champion
Presentations* - 5/31/17



For additional information, please see: <http://rppm.transportation.org/Lists/Calendar/calendar.aspx>.

* Changes are being made to the MDT Research projects process. For updates, please see the [MDT Research Solicitation webpage](#), sign up for the [Research Project Solicitation email distribution list](#), or subscribe to the [MDT Research What's New RSS feed](#).



NEW RESEARCH REPORTS

[Development of a 3/4-inch Minus Base Course Type A Specification for Montana](#)

[Driving After Cannabis Use](#)

[Evaluating Wildlife Mortality Hotspots, Habitat Connectivity and Potential Accommodation along US 287 and MT 87 in the Madison Valley, Montana](#)

[Evaluation of Wildlife Crossing Structures on US Highway 93 North - Phase 2, Post Construction](#)

[Exploring Traffic Safety Citizenship](#)

A listing of all past and current projects can be found at
http://www.mdt.mt.gov/research/projects/sub_listing.shtml.

NEW EXPERIMENTAL REPORTS

[A2000 Polyvinyl Chloride \(PVC\) Irrigation Line](#)

[Break-Out Square Post Breakaway System](#)

[Chip Seal as Interlayer to Retard Reflective Cracking](#)

[Crack Sealing Milled Asphalt Pavement Prior to Overlay](#)

[Crash Attenuator - Smart Cushions Innovations \(SCI\) 100GM Crash Attenuator](#)

[Detectable Warning Devices \(DWD\) - Asphalt Pavement Application](#)

[Fog Seal over Chip Seal \(FSCS\) Applications](#)

[Geosynthetic Reinforced Soil \(GRS\) IBS Technology](#)

[High Friction Surface Treatments \(HFSTs\)](#)

[Kwik Bond PPC 1121 Polyester Polymer Concrete \(PPC\) Overlay](#)

[Ribbed Aluminum Box Culvert \(ABC\)](#)

[RoaDrain Geocomposite for Added Subsurface Drainage](#)

[Stay-Tuff Woven Fence](#)

[Wet-reflective Bead Technology Pavement Marking](#)

A listing of all past and current projects can be found at
http://www.mdt.mt.gov/research/projects/exp_sub_listing.shtml.



REMINDER

Information on research services and products, such as research and experimental project processes and reports and technology transfer services, can be found on the Research web site at www.mdt.mt.gov/research.

MDT's library collection can be searched through the [library catalog](#). The catalog and other information resources are available through the [MDT Library web site](#).

CONTACT US

Sue Sillick – Research Programs Manager
406.444.7693
ssillick@mt.gov

Kris Christensen – Research Projects Manager
406.444.6125
krchristensen@mt.gov

Craig Abernathy – Experimental Projects Manager
406.444.6269
cabernathy@mt.gov

Katy Callon – Librarian
406.444.0871
kcallon@mt.gov

Alternative accessible formats of this document will be provided upon request. Persons who need an alternative format should contact the Civil Rights Bureau, Department of Transportation, 2701 Prospect Avenue, PO Box 201001, Helena, MT, 59620. Telephone (406) 444-9229. Those using a TTY may call 1(800) 335-7592 or through the Montana Relay Service at 711.

0 copies of this public document were published at an estimated cost of \$0.00 per copy, for a total cost of \$0.00, which includes \$0.00 for printing and \$0.00 for distribution