



# 2023 DRISI Accomplishments





Highways interchange near Ventura at sunset.

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This brochure highlights the top accomplishments delivered by the Division of Research, Innovation and System Information (DRISI) that are tied directly to California Department of Transportation (Caltrans) Goals: Safety First, Enhance and Connect the Multimodal Transportation Network, Advance Equity & Livability in All Communities, Cultivate Excellence, Lead Climate Action, and Strengthen Stewardship.

# Safety First



The PII Redaction Project received the "Best Application Serving the Public" Award at the Best of California Awards 2023 Innovation Summit.

## PII Redaction Project

DRISI has implemented an automated system process that redacts Personally Identifiable Information (PII) on Traffic Crash Report (TCR) used by Transportation System Network, alleviating privacy risks. The redaction process supports Caltrans' Safety-First goal by eliminating risks of exposing PII to the public while allowing traffic safety engineers to see only applicable information required for safety investigation and roadway safety improvements. The PRP project received the "Best Application Serving the Public" award at the annual "Best of California Awards" 2023 Innovation Summit.

## Pilot testing Work Zone Intrusion Alarm (WZIA) systems

The main goal of this research was to evaluate the effectiveness and practicality of deploying and operating selected WZIA systems in Caltrans work zones. Five WZIA systems were selected for testing. The final report for this research provided recommendations and guidance to Caltrans on implementing these five WZIA systems in Caltrans operations. The final report also included a comparison of worker surveys before and after active work zone testing of these devices. The survey results captured the maintenance workers' feedback on device effectiveness, deployment, sound distinctiveness, and perceptions of effectiveness and practicality of the systems.

## Identification of Run-Off-Road (ROR), Cross-Over (CO), and Wrong-Way (WW) Collision Locations

This research improved existing transportation safety management – Crash Monitoring Programs to identify ROR, CO, and WW crash locations. Furthermore, this research effort also developed preliminary analysis for a new crash monitoring program (speeding-related) to identify locations and provide appropriate traffic calming measures that can reduce fatal and serious injury crashes related to speed. The outcome of this study can improve Caltrans' ability to effectively address ROR, CO, WW, and speeding-related crashes.

# Safety First



## Developing A Safe System Approach to Setting Speed Limits

The objective of this research was to develop a Safe Systems approach to setting speed limits in California. The desired outcome was a data-driven analysis that will lay the foundation for implementing a Safe System Approach in the state. Increasing number of injuries, fatalities and traffic crashes in California have become a growing challenge for the transportation professionals and policy makers. Nearly 3,600 people die yearly in traffic crashes, and more than 13,000 people are severely injured. Collectively, these traffic crashes cost California over \$53.5 billion, and speeding-related fatalities continue to represent a large portion of California's total traffic fatalities. The Safe System Approach will increase the safety of motorists, bicyclists, and pedestrians. Furthermore, this research project directly supports Goal 1 of the Caltrans Strategic Management Plan (2015-2020).



A car drives past a speed limit sign on the freeway.

## Roadside Safety Performance Measures for Specific Countermeasures to Protect Workers

DRISI researched and developed draft guidance outlining specific countermeasure to improve worker safety with the goal of incorporating them into appropriate Maintenance or Design manuals.

## Cost-Benefit Analysis for Concrete vs Metal Guardrails and Wood vs Metal Posts for Signs and Guardrails

DRISI performed cost-benefit analysis studies and developed a decision support tool for choosing between concrete vs metal beam guardrail barriers. Additionally, DRISI developed guidelines to support the decision for replacement of wooden posts with metal posts for signs and guardrails.

# Safety First



## Balsi Beam Implementation Research

DRISI researched and developed a set of guidelines for the safe and effective utilization of Balsi Beam. The Balsi Beam is a mobile work protection system developed by Caltrans to improve worker safety along highways. The guidelines are expected to improve worker safety by providing information on when and how to use the Balsi Beam system in work zones. DRISI conducted a Research Connection event regarding the Balsi Beam.



Maintenance workers using the Balsi Beam protection system on a bridge repair.



A variable speed advisory message.

## Testing of Combined Variable Speed Advisory (VSA) and Coordinated Ramp Metering (CRM) for Freeway Traffic Control

This project aimed to test and validate the combination of Variable Speed Advisory (VSA) and Coordinated Ramp Metering (CRM) for Freeway Traffic Control and traffic flow improvement along SR NB 99. The major takeaway from this study was that the VSA signs on the shoulder lane may go unnoticed by some drivers, which could significantly affect the drivers' compliance. Overhead gantries are a better and more effective option. In addition, the study results showed that VSA signs located about 300-600 feet downstream of the onramp were not the best and optimal solution. It was also determined that VSA signs are more beneficial if placed downstream from the onramp where drivers can pay better attention to the lane merge into mainline traffic.

## Crash Coding

DRISI uses Location Coding and Sequence of Event Coding processes to identify crash prone areas for safety investigation. DRISI completed location and sequence of event coding for 153,340 crashes on the State Highway System that occurred during 2023. The ongoing crash coding supports Caltrans' Safety-First goal by providing up to date and more accurate crash information allowing Caltrans the ability to use data for publications, mapping, safety analysis, safety investigations, and safety projects.

# Safety First



A passenger car crash test on the new Type 86H Concrete Barrier Rail.

## Caltrans Field Trials of the Intelligent Truck-Mounted Attenuator (ITMA)

In the “Caltrans Field Trials of the Intelligent Truck-Mounted Attenuator (ITMA)” research project, the Division of Research, Innovation and System Information (DRISI) has been successfully conducting monitored field trials of ITMA system on California public roads, performing different maintenance operations including sweeping, paint striping, and raised pavement marker operations.

The ITMA system is composed of a leader vehicle (LV) and a follower vehicle (FV) in which the FV follows the path of the LV while maintaining a user-defined, safe distance. The ITMA system uses Radar and LiDAR for object detection, which causes the FV to stop if an object is 100 feet or closer in the lane.

The goal of this project is to remove the Truck-Mounted Attenuator TMA operator from this vehicle, which can result in significant reductions in operator injuries for Caltrans due to public vehicles' impacts with the TMA vehicles in highway work zones.

## Type 86H State Historic Bridge Rail Webinar

This webinar discussed current baluster rails in our State Highway System that do not meet federal safety standards. It described Caltrans' detailed process from the construction to crash testing stage to determine if the new Type 86H Concrete Barrier Rail meets the current Manual for Assessing Safety Hardware (MASH) 2016 crashworthiness guidelines. The webinar further discusses that the Type 86H was determined to be crashworthy and suitable to replace existing concrete baluster bridge rails for new bridge construction projects, rehabilitation, and bridge rail replacement projects.

# Cultivate Excellence



## Transportation Research Board (TRB) and National Cooperative Highway Research Program (NCHRP)

DRISI's participation in TRB and NCHRP help influence the direction of national research policy, programs, and projects. This Fiscal Year TRB Core Program annual budget is approximately \$17 million. California's contribution to the Core Program is \$620,599, which means we leverage approximately \$24 for every \$1 we invest. The TRB Annual Meeting is the most important yearly transportation forum where state and federal representatives can meet to address issues of common interest and form partnerships to leverage limited state funds. Historically, Caltrans send about 15 to 20 representatives to the annual meeting. This year, we were able to send 31 delegates. The 2023 TRB Annual Meeting Key Takeaways & Lessons Learned report memorialized the success with Caltrans' involvement.

On the NCHRP front, state contributions to the program in 2022 totaled \$41.6 million. The state's contribution to that total was \$5,006,961 which means we leverage approximately \$9 in research-related activity for every \$1 we invest in TRB's NCHRP activities.

## Preliminary Investigation for Multimodal Common Operating Picture (COP) for Emergency Services.

The Preliminary Investigation (PI) objective was to support Caltrans in making an informed procurement decision or develop a well thought out request for qualifications solicitation, based in part on best practices from other State Department of Transportations (DOTs). The primary PI deliverable was a survey of other state DOTs to determine what (if any) Multimodal Common Operating Picture (COP) software they are using, their best practices, and any information DOTs feel would help Caltrans make an informed procurement. The PI recommended that Caltrans procure commercial COP packages or services that would greatly facilitate Caltrans' internal emergency response capabilities, along with its ability to effectively communicate with external agencies including the California Office of Emergency Services, counties, and cities.



Caltrans delegates at the 2024 Transportation Research Board (TRB) Annual Meeting, held January 7-11, 2024 in Washington, D.C.

# Cultivate Excellence



## Research implementation Webpage and Workshops

DRISI has successfully launched its new research implementation webpage, offering a clear roadmap for applying for implementation seed money. With clear and comprehensive content, employees can easily grasp the implementation process and apply for implementation support. Additionally, in 2023 DRISI hosted two research implementation workshops, alongside several informational sessions highlighting the new implementation process. These sessions provided valuable opportunities for discussion on potential implementation projects, fostering collaboration and driving momentum towards translating research into tangible outcomes.

## District Innovation Fairs

In 2023, Caltrans held innovation fairs in Fresno, San Bernardino, and Orange County showcasing innovative projects across all disciplines. These fairs provided an opportunity for staff to showcase their important work and demonstrate to their colleagues how they're able to develop new ideas and take informed risks to better perform their job functions. As a result, staff can exchange ideas and identify ways to innovate in their own disciplines.



Attendees review projects at a 2023 Caltrans Innovation Fair.

## Game Changing Innovation Implementation

Throughout the year, DRISI held multiple Innovation Leadership Council (ILC) meetings. As part of Caltrans' Executive Board, the ILC meets to identify and discuss large-scale innovative projects happening across all Districts and Programs. At its November meeting, the ILC identified three game-changing projects that will transform the way Caltrans does business and delivers for its customers: GIS, Building Information Modeling for Infrastructure (BIM4I), and the Enterprise Data Warehouse. The Council planned ways to effectively implement these game changers, including timeline and budget.



# Multimodal Network



## Integrating Micromobility with Public Transportation

This research covered environmental audits at 18 BART stations to count arrivals, departures, and parked personal and shared micromobility vehicles (small, low speed, human or powered devices such as a bicycles, scooters, electric scooters/bikes, or other small lightweight wheeled vehicles), an online survey of BART and micromobility users, and interviews with government, industry, and community stakeholders. This research showed that in the California Bay Area, the prevalence of personal micromobility currently dwarfs rates of shared micromobility use, and that includes a burgeoning segment of transit users connecting with their own e-bikes and e-scooters. Successes and challenges were highlighted, and recommendations were made for station design, including greater availability of shared micromobility vehicles, more affordable secure parking for personal micromobility vehicles, better signage, and wayfinding. Beyond the station proper, there is a need for protected bike lanes and consistent design standards for bike facilities throughout the region.

## Pilot testing for feasibility of technologies for inventorying Complete Streets assets and Condition Evaluation Rating System

Complete Streets facilitates various transportation modes, emphasizing accessibility for pedestrians and cyclists. A comprehensive approach to Complete Streets asset management results in the identification of the needs and best practices nationwide. A roadmap has been proposed, outlining strategies for asset management development and enhanced data collection, ensuring sustainable transportation infrastructure for all users.



A streetcar, Muni bus, and cyclist ride on Market Street in downtown San Francisco. Editorial Credit: Michael Vi / Shutterstock

# Multimodal Network



## Evaluating Benefits from Transportation Investments Aligned with the Climate Action Plan for Transportation Infrastructure (CAPTI)

Building upon two executive orders targeting the mitigation of greenhouse gas (GHG) emissions in California, the Climate Action Plan for Transportation Infrastructure (CAPTI) offers a comprehensive plan to work toward a more unified vision for transportation that prioritizes climate, health, and social equity. Caltrans and the Mineta Transportation Institute worked in close collaboration with the California State Transportation Agency (CalSTA) to help evaluate the benefits from transportation investments across the State of California. The holistic evaluation framework involved an analysis of vehicle miles traveled (VMT) and emissions impacts, an economic impact analysis, and an equity analysis of transportation investments in California. Findings indicate that CAPTI has generally had a positive impact on California communities by helping align transportation investments with the state's climate and equity goals while continuing to generate significant economic activity through investments in transportation infrastructure, which was reported in the CAPTI annual report prepared for the Legislature by CalSTA.

## Multi-Modal Intelligent Transportation Signal System

This research involved enhancements to multi-modal traffic systems, including Vehicle-to-everything (V2X) communication and High Intensity Activated CrossWalk (HAWK) signal systems for pedestrian detection, which was completed and proven operational. The Multi-Modal Intelligent Traffic Signal System (MMITSS) is the next generation of traffic signal systems that seeks to provide a comprehensive traffic information framework to service all modes of transportation, including general vehicles, transit, emergency vehicles, freight fleets, and pedestrians and bicyclists in a connected vehicle environment.



A young girl uses an inhaler.

# Stewardship & Efficiency



## Standardizing Environmental DNA Methodologies for Coho Salmon

DRISI developed an innovative approach known as environmental DNA (eDNA) which is less expensive, less invasive, and offers higher detection probabilities than traditional monitoring approaches used to detect coho salmon, which is a federally and state listed species. This new approach has shown to reduce the amount of resources required to obtain construction permits.



Diver in the Smith River, California, conducting snorkel observations of threatened coho salmon. Snorkel observations were compared to eDNA methods to evaluate efficacy of eDNA for non-invasive detection of coho salmon. Photo Credit: Jason Shaffer.

## Improve Bridge Debris Removal Process

DRISI worked with District 11 Maintenance to purchase a Vermeer trailer vacuum through research to assist in bridge maintenance and cleaning. Continued field usage of the trailer unit and feedback from district staff has shown improved drain inlet and bridge joint cleaning practices. Positive field testing resulted in District 11 moving forward to bring the Vermeer into the Caltrans fleet.

## Performance Engineered Concrete Paving Mixtures

The Performance Engineered Mixtures (PEM) pooled fund project aimed to improve concrete pavement durability by refining specifications based on engineering properties that relate to good pavement performance in the field. Additionally, the project focused on the continued development of methods to relate early age concrete properties to long-term performance.

## Monitoring Performance of Concrete Overlay Projects

The objective of this research was to develop guidance for Concrete on Asphalt (COA) in California by continued monitoring of the YOL-113 COA pilot project and evaluating the condition of other concrete overlay projects in California, to give Caltrans an additional pavement rehabilitation alternative on the state highway system.

# Stewardship & Efficiency



## Mobile Terrestrial Laser Scanning (MTLS) Data Collection Workflow

This research was a DRIS collaboration with the Caltrans Office of Land Surveys (OLS) and district surveyors within the current, active MTLS research project to develop MTLS Data Collection Workflow Manuals for the Caltrans' owned MX9 and MX50 MTLS vehicle systems. The workflow manuals support district MTLS users with efficient and consistent methodology for collecting MTLS data and furthers support deployment of the MTLS systems in the northern and central California regions.



A Caltrans employee inspects a dynamic message sign displaying current travel time messages to motorists.

## Reimagining Sensor Deployment

This research aimed to improve how Caltrans deploys its vast network of detection stations using third-party speed data to augment and achieve comprehensive geographic coverage. The project reimagined sensor deployment, where third-party data was procured to obtain travel times and speed data across the state where detection station data was not the most efficient or resourceful. This resulted in the changing role of dedicated roadside detection stations. It is no longer necessary to target the deployment of detection stations at every half-mile, which is Caltrans' current standard. The research results were a new paradigm to guide the decisions on where detection stations should be placed to provide the most informational value. This will result in money saving for Caltrans, with a focus on installation at the most critical spots, reducing unnecessary maintenance costs.

# Climate Action



## UC Davis Sustainable Transportation Energy Pathways (STEPS Plus) Support

The Sustainable Transportation Energy Pathways (STEPS) Program at the UC Davis Institute of Transportation Studies (ITS-Davis) is a four-year multidisciplinary research consortium that brings together the world's leading auto and truck OEMs, energy firms, new mobility companies, foundations, and government agencies to understand sustainable vehicle and energy solutions. Caltrans has continued support of this consortium, participated in in-depth conversations on innovative freight technology and vehicle sharing and automation, and coordinated informally with researchers to provide insight on topics within their expertise. This has provided Caltrans with a valuable venue for networking and coordination, new information on new technologies, and direct assistance on emerging topics such as zero emission vehicle fueling, vehicle automation, and freight fleet transitions.

## New RHMA Materials with RAP/RAS for Interlayers and Base for Rigid Pavements

The objective of this research was to develop guidance on the use of rubberized hot mix asphalt (RHMA) mixes containing reclaimed asphalt pavement (RAP) in pavement structures, with special focus on base for new Portland cement concrete (PCC) pavements, through using higher quantities of RAP/RAS in asphalt mix designs and less expensive virgin materials.

## Rubberized Hot Mix Asphalt Layer Thickness Limits

The objective of this research was to support a study that determined the expected performance, cost, and environmental impacts of pavements with rubberized asphalt layers thicker than the current 0.2 ft (60 mm) limit. Thicker or multiple layers of RHMA-G will increase the use of recycled tires, and thus reduce maintenance costs and decrease environmental impacts.

## New Rubberized Hot Mix Asphalt (RHMA) Materials with RAP/RAS, Part A: for Structural Layers in Flexible Pavements

The objective of this research was to investigate the use of reclaimed asphalt pavement RAP in RHMA without reducing the amount of recycled tire rubber used by Caltrans to decrease environmental impacts.



Road paving using rubberized asphalt, a new recycled tires technology.

# Equity & Livability

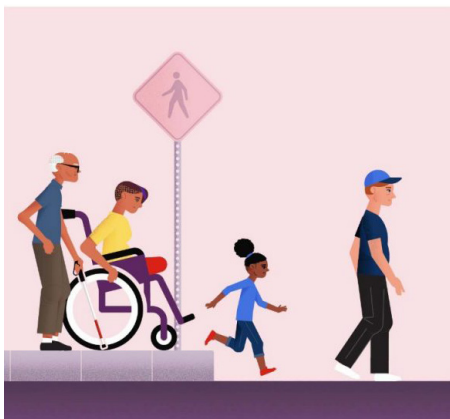


## Understanding and Responding to Homelessness in State Transportation Settings

In this white paper, researchers from the University of California, Los Angeles (UCLA) synthesized existing literature and findings from interviews with staff from state DOTs, service providers, and organizations responding to homelessness. In collaboration with homeless encampment coordinators in Caltrans headquarters and District 7, the report took a snapshot of current practices involving homeless encampments. Much has changed in this fast-evolving field since the release of the paper, but it has been nominated for a TRB lectern series in 2024. In this venue, Caltrans leadership will provide the latest news on initiatives and practices to a national audience, in addition to the holistic characterization of the problem presented in the UCLA white paper.

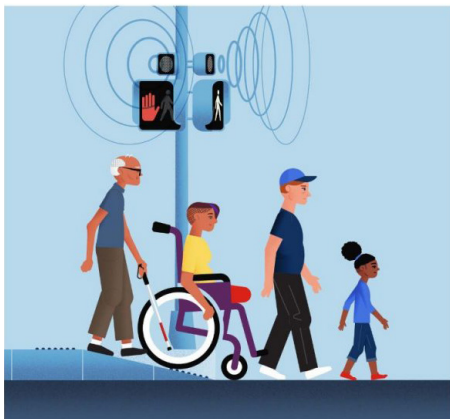
**EQUALITY:**

Everyone gets the same – regardless if it's needed or right for them.



**EQUITY:**

Everyone gets what they need – understanding the barriers, circumstances, and conditions.



Comparing equality and equity. Photo Credit: © 2022 Robert Wood Johnson Foundation

## The Implications of Freeway Siting in California: Four Case Studies on the Effects of Freeways on Neighborhoods of Color

Caltrans funded a quantitative and qualitative look at the history of freeway building in four case study areas: Neighborhoods in Sacramento, San Jose, Pasadena, and Pacoima. This information is critical for a broader understanding of the social and political factors that affected the selection of routes and the manner of acquisition of property and will assist Caltrans in building programs that use existing and new funding sources to address racial inequity perpetuated by state facilities. In-depth presentations and discussions in 2024 will bring this topic to relevant districts and their partners in continued attempts to provide a more equitable transportation system.



Homeless encampments along the roadside in Los Angeles, California. Editorial Credit: Philip Pilosian / Shutterstock.com



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