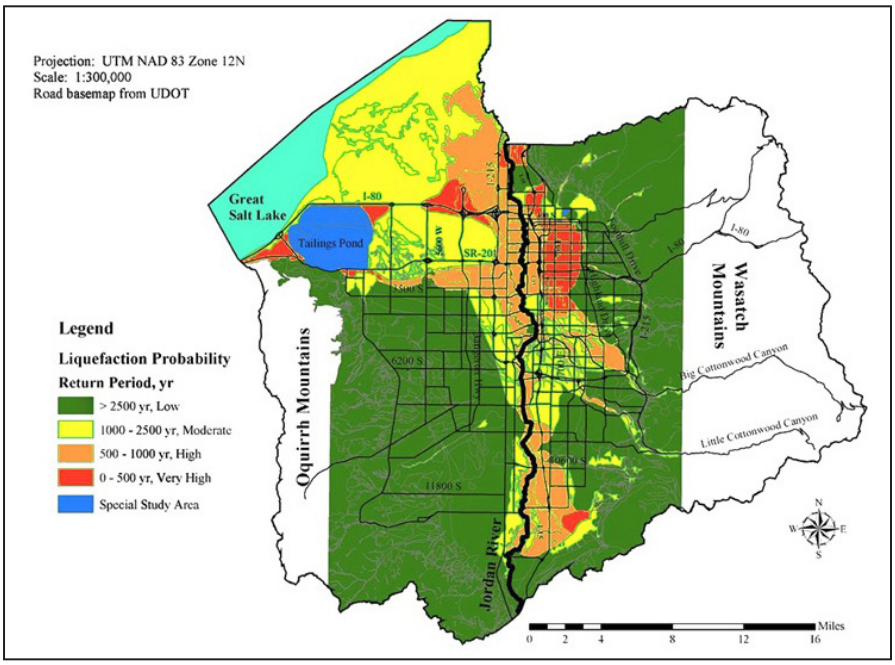
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 22-477 (project 524) | August 2022

Development of Next Generation Liquefaction (NGL) Database for Liquefaction-induced Lateral Spread



the **ISSUE**

Liquefaction-induced lateral spread is a type of permanent ground deformation from the horizontal movement of surface soil resulting from soil liquefaction and resulting loss of shear strength during earthquakes. It is generally the most pervasive and damaging type of liquefaction-induced ground failure occurring during major earthquakes, and it has caused hundreds of millions of dollars of damage to transportation infrastructure such as bridges, embankments, culverts, and pavements. There is a need to improve the analytical and numerical methods to estimate the amount of permanent ground displacement associated with liquefaction-induced lateral spread. These methods will be used to make transportation more resilient to such damages and to proactively identify, quantify, visualize, prioritize, and mitigate risk from earthquakes.

The research topic addresses the need to improve empirical, semi-empirical, analytical, and numerical methods to estimate the amount of permanent ground displacement associated with liquefaction-induced lateral spread resulting from major earthquakes.

the **RESEARCH**

This research was conducted in conjunction with the Pacific Earthquake Engineering Research (PEER) Center and various state departments of transportation via a pool-fund study managed by the Utah Department of Transportation (UDOT). The project was executed in two phases: (1) database development and collection, and (2) predictive model development.

This project addresses the work associated with Phase 1. The scope and work plan for Phase 2 will be addressed in a subsequent project. The researchers developed peer-reviewed and consistent methods for data documentation and archiving of liquefaction lateral spread. We populated the database with well-documented case histories of liquefaction-induced lateral spread from earthquakes worldwide.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

Colorado State University
North Dakota State University
South Dakota State University
University of Colorado Denver
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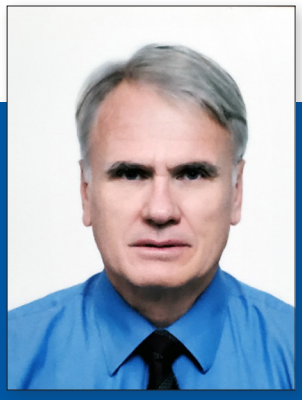
University of Utah
Utah State University
University of Wyoming



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Project Title

Development of Next Generation Liquefaction (NGL) Database for Liquefaction-induced Lateral Spread

Sponsors | Partners

Utah DOT

Transportation Pooled Fund Study TPF-5(350)

Pacific Earthquake Engineering Research Center

Southwest Research Institute

Dominion Energy

USDOT, Research and Innovative Technology Administration

the **FINDINGS**

This report presents several advancements in the empirical modeling of liquefaction-induced lateral spread. It starts with a newly collected dataset of 5,560 historical lateral spread displacement vectors, a sample size over 10 times larger than the existing databases, and subsurface data comprising over 633 standard penetration test boreholes. This work presents a comprehensive comparison of the state-of-the-art empirical models for lateral spreads through Monte Carlo simulations and sensitivity analyses and proposes new evaluation metrics to measure performance. It also quantifies the uncertainty of model weights of the multiple linear regression (MLR) model using Bayesian statistics. A new functional form is proposed for the MLR model using the least absolute shrinkage and selection operator method. Importantly, the conventional probabilistic framework for predicting lateral spread is expanded to account for the probability of lateral spread triggering.

the **IMPACT**

The Next Generation Liquefaction (NGL) Project is advancing the state of the art in liquefaction research and working toward providing end users with a consensus approach to assess liquefaction potential within a probabilistic and risk-informed framework. Specifically, NGL's goal is to first collect and organize liquefaction information in a common and comprehensive database to provide all researchers with a substantially larger, more consistent, and more reliable source of liquefaction data than existed previously.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1131

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.