2015 ULAG MEETING SUMMARY

Utah Liquefaction Advisory Group
Monday, February 9, 2015
Utah Department of Natural Resources Building, Room 2000

Steve Bartlett, University of Utah, Chair
Jessica Castleton, Utah Geological Survey, Coordinator

Members present:

Steve Bartlett, University of Utah
Kevin Franke, Brigham Young University
Jim Higbee, Utah Department Of Transportation
Bill Turner, GHS Geotech Consultants
Les Youd, Brigham Young University
Grant Gummow, Utah Department Of Transportation

Invited guests:

Russell Green, Virginia Tech
Levi Ekstrom, Brigham Young University
Jasmin Harper, Brigham Young University
Brian Peterson, Brigham Young University
Charles Ewert, Weber County
Dana Shuler, Weber County
Corbett Hansen, Terracon
Jeff Gilbert, Terracon
Max Johnson, Salt Lake County
Alan Taylor, Taylor Geotechnical
Greg Baptist, Salt Lake County
Kristin Ulmer, Brigham Young University

INTRODUCTION

Overview of Utah Liquefaction Advisory Group (ULAG) Objectives, Summary of Recently Completed Work, and Work in Progress

The meeting commenced at 8:30 a.m. with 23 attendees. After brief introductory remarks Steve Bartlett led a discussion by the ULAG members regarding current mapping, future mapping possibilities, and plans for future research.

PLANNING AND PRIORITIES FOR FY2016

General

The working group identified five priorities for FY2016: (1) Development of probabilistic liquefaction hazard maps for Davis County, incorporating the use of Unmanned Aerial Vehicle (UAV) acquired data, as needed, (2) Development of a lateral spread database, (3) Downtown Salt Lake fault/deformation investigations incorporating geophysical research, (4) Data archiving for the establishment of a subsurface geotechnical database for professional and public use, and (5) Formation of a data standardization committee to formalize data standards and formats for geotechnical datasets.

(1) Development of probabilistic liquefaction hazard maps for Davis County, incorporating the use of Unmanned Aerial Vehicle (UAV) acquired data, as needed, —The working group agreed that Davis County is the highest priority area in Utah for new liquefaction hazard mapping. The group identified Kevin Franke and Steven Bartlett to work in collaboration writing a proposal for Davis County mapping. Mapping in Davis County will include defining the Farmington siding lateral spread based on recently acquired LiDAR and supplemented by UAV acquired data.

(2) Development of a lateral spread database —Expand liquefaction database to include lateral spread. Kevin Franke mentioned that states that have expressed an interest in this type of project include California, Alaska, Utah, South Carolina, and Idaho. The group supports the development of a scope of work document to be presented to possible funding sources.

(3) Downtown Salt Lake fault/deformation investigations incorporating geophysical research —Combine available geophysical research to create a database allowing for detailed mapping of marker beds and deformation in the downtown area.

(4) Data archiving for the establishment of a subsurface geotechnical database for professional and public use. Leverage statewide resources (UGS, UDOT, U of U , etc.) to combine and build on existing geotechnical databases.

(5) Formation of a data standardization committee to formalize data standards and formats for geotechnical datasets. Form a multiagency committee to discuss collaboration and funding options for determining geotechnical database format and attribute standardization.

Note that past ULAG meeting agendas, meeting summaries, and presentation files may be found on the UGS ULAG web page (http://geology.utah.gov/ghp/workgroups/ulag.htm), and products resulting from ULAG-related research may be found on the University of Utah ULAG web page (http://www.civil.utah.edu/~bartlett/ULAG/).

TECHNICAL PRESENTATIONS

Linking liquefaction triggering to damage potential

Keynote presentation by Russell Green, Virginia Tech

Russell presented an overview research resulting from liquefaction during the 2010-2011 Canterbury earthquake sequence and an evaluation of Cone Penetration Tests (CPT)-based liquefaction evaluation procedures. Damage analysis related to liquefaction effects was examined to determine grain size distribution of liquefied soils in the Christchurch region. Re-liquefaction of soils occurred and was documented after multiple earthquake events. CPT-based liquefaction evaluation procedures were studied to determine the predictability of each method. It was concluded that all CPT-based procedures do a reasonable job predicting field based observations; however, Idriss and Boulanger (2008) performed better than the other procedures. Future work would include the development of a new liquefaction severity index that accounts

for both the fine-grained crust and fine-grained layers interbedded with liquefiable layers, has depth weighting factors for liquefaction damage potential to shallow and deep foundations and embankments, is compatible with the liquefaction triggering curve, and gives a full quantification of uncertainty.

Performance-based Assessment of Liquefaction Triggering and Lateral Spread: A Simplified Approach

Levi Ekstrom and Kristin Ulmer, Brigham Young University

Levi and Kritsin summarized performance-based methods, how they differ from conventional methods, and compared the advantages and disadvantages. Advantages presented include:

- Consideration of multiple scenarios and their respective likelihood.
- Consistent estimate of hazard.
- Return-period based on approach for decision makers.

Disadvantages to the method include:

- Special training and expertise is required.
- Complex analysis requires time.
- Difficult to incorporate into routine projects.
- May overpredict liquefaction hazard in some areas of high seismicity.

The performance-based methodology provided could provide engineers with the ability to quickly calculate liquefaction hazards.

Probabilistic Liquefaction and Lateral Spread Hazard Mapping for Utah County

Jasmyn Harper, Brigham Young University

Jasmyn summarized probabilistic liquefaction and lateral spread hazard mapping for Utah County being completed at Brigham Young University. The creation of the maps incorporated the construction of a subsurface database and subsequent analysis and map creation. Geotechnical data included 795 Standard Penetration Tests (SPT) and 39 CPT. The data was used to create liquefaction triggering maps and lateral spread displacement maps with thresholds at 1 cm, 3 cm, and 10 cm. The subsurface database was completed in December of 2014, and the maps are projected to be complete by July 2015.

Next Generation Liquefaction Field Reconnaissance: Unmanned Aerial Vehicles

Kevin Franke, Brigham Young University

Kevin presented on the use of UAVs in landslide and earthquake reconnaissance. Brigham Young University has deployed UAVs to create high resolution models of the 2013 US-89 Arizona landslide, and the 2014 North Salt Lake landslide. UAVs can be continuously deployed

for landslide monitoring in situations where it is unsafe to monitor on the ground. Following the 2014 8.0M earthquake in Chile, the team used UAVs for damage reconnaissance. The coverage resulting from UAV models compared to photographs created from handheld photographs provided more coverage and detail. In conclusion, it is determined that UAVs could improve the ability to gather data from post-liquefaction damage sites.

Liquefaction Hazards – From Mapping to Implementation

Steven Bartlett, University of Utah

Steve summarized important topics related to liquefaction damage and liquefaction maps and the implementation of this data into performance-based hazard ordinances. Types of liquefaction damage and susceptibility, and liquefaction maps were discussed. Types of liquefaction maps include: liquefaction potential and ground displacement, seismic strong motion inputs for liquefaction potential, lateral spread, ground settlement, and fully aggregated liquefaction. Performance-based ordinances must be created with a risk-based approach based on performance goals.

2015 Utah Liquefaction Advisory Group (ULAG) Meeting: Current Issues and Problems in Addressing Liquefaction Related to Geologic Hazard Ordinances

David Simon, Simon Associates LLC and Alan Taylor, Taylor Geotechnical

David discussed current issues and problems in addressing liquefaction related to geologic hazard ordinances, the development of local geologic hazard ordinances, and the necessity of data collaboration. Of many challenges in the drafting of geologic hazard ordinances, the willingness of the municipalities is key. Municipalities with prescriptive geologic hazard ordinances in Utah include: Salt Lake County, Draper City, Morgan County, and Iron County. The ordinances in place in these municipalities work well when properly implemented and supported and can provide a guide for other municipalities.

DISCUSSION

Liquefaction Related to Geologic Hazard Ordinances

The afternoon session focused on a group discussion with all parties involved in the process of creating geologic hazard ordinances available to ask and answer questions as a platform for overcoming challenges and encouraging ordinance development. Some of the challenges discussed include:

- Difficulty in creating boundaries for large areas and areas of development separated by areas of no development.
- Consultant reports not following requirements.
- Legal issues when it comes to “non-buildable” lots.

- Scope issues related to site specific investigation requirements.

Possible solutions and suggestions offered include:

- Implementing a risk-based approach to determine when a recommendation is valid while keeping the end user in mind.

- Multiple steps in the internal review process to determine report compliance.

- End-user education is key when communicating risk associated with high risk lots.

It was agreed that input from city and county government officials, geotechnical engineers, mappers, researchers, and geologists is critical to beginning the discussion on how to best go about data collaboration and encourage the development of geologic hazard ordinances in more Utah communities.