

## SURFACE GEOLOGY AND LIQUEFACTION SUSCEPTIBILITY IN THE INNER RIO GRANDE VALLEY NEAR ALBUQUERQUE, NEW MEXICO

Keith I. Kelson, Christopher S. Hitchcock, and Carolyn E. Randolph  
William Lettis & Associates, Inc.  
1777 Botelho Drive, Suite 262  
Walnut Creek, California 94596

### INTRODUCTION

Historic large earthquakes throughout the world demonstrate that liquefaction-related ground failure commonly causes extensive structural and lifeline damage in urbanized areas. Delineating areas that are susceptible to liquefaction hazards is critical for evaluating and reducing the risk from liquefaction through appropriate mitigation and emergency response. Because liquefaction generally occurs in areas underlain by low-density, saturated granular sediments, liquefaction susceptibility can be mapped using specific, well established geologic and geotechnical criteria. The inner Rio Grande valley near Albuquerque is within the seismically active Rio Grande rift, is underlain by saturated late Holocene floodplain deposits, and thus is particularly vulnerable to liquefaction hazards. The purpose of this study is to delineate areas of the inner Rio Grande valley near Albuquerque that are susceptible to liquefaction (Kelson et al., 1999). The map products developed in the study are useful for insurers, engineers, planners, and emergency-response personnel in order to properly assess and mitigate the risk from future liquefaction hazards in the Albuquerque area.

### Methods

Our approach in delineating liquefaction susceptibility in the Albuquerque area is to identify geologic units that are susceptible to liquefaction based on surficial geologic mapping, evaluation of shallow groundwater depths, and analysis of subsurface geotechnical data. These data sets are combined to produce a series of maps showing liquefaction susceptibility in the inner Rio Grande valley. This report presents several 1:24,000-scale maps of the inner valley that depict: (1) surficial geologic units, (2) depth to groundwater, and (3) liquefaction susceptibility. The map area covers the inner Rio Grande valley from the Jemez River on the north to the Isleta Pueblo on the south, and includes parts of the Bernalillo, Alameda, Los Griegos, Albuquerque West, and Isleta 7.5-minute quadrangles. The geologic maps of the inner valley are based primarily on interpretation of aerial

photography and geologic mapping, supplemented by geotechnical borehole data compiled from existing databases and logs on file with municipal, state, and federal agencies. The groundwater maps are based on analysis of water-level data from well catalogs, the geotechnical borehole database, shallow drive-point well data, and water-level elevations in drainage ditches.

### FLOODPLAIN MATERIALS AND WATER-TABLE DEPTHS

The inner Rio Grande valley is underlain primarily by saturated, unconsolidated sandy alluvium deposited by the Rio Grande and tributary arroyos (Fig. 1). This alluvium consists predominantly of sand and gravel with discontinuous interbeds of silt and clay. Borehole data from these deposits show that most have low Standard Penetration Test (SPT) blow counts. The valley also contains levees, embankments and other man-made features composed of engineered and non-engineered artificial fill. Groundwater in the inner valley is very shallow, with depths beneath most of the valley of less than 12 m (40 ft) (Fig. 2). In this analysis, we use the shallowest historic water level recorded, thus providing conservatively shallow water depths throughout the inner valley. Because of historic declines in groundwater levels near downtown Albuquerque, our analysis provides a conservative assessment of liquefaction susceptibility in areas that continue to experience water-level declines. Lesser amounts of historic groundwater decline in the areas north of Albuquerque (i.e., from Alameda to Bernalillo) and south of Albuquerque (i.e., from Armijo to Isleta Pueblo) suggest that liquefaction susceptibilities in these areas have not been affected by groundwater withdrawals.

### LIQUEFACTION SUSCEPTIBILITY

Based on our synthesis of the geologic, geotechnical, and groundwater data, large areas of the inner Rio Grande valley near Albuquerque are susceptible to liquefaction (Fig. 3). Areas underlain by deposits that may liquefy given a peak ground acceleration (PGA) of 0.1g or less, given the

occurrence of a magnitude 7.0 earthquake, are classified as having Very High susceptibility. In the inner valley, these areas include the saturated sandy alluvium associated with the present-day channel and active floodplain of the Rio Grande. Where groundwater is less than 9 m (30 ft), areas of artificial fill associated with levees and embankments are conservatively classified as having Very High susceptibility. Areas classified as having High susceptibility have groundwater depths of less than 9 m (30 ft) and are underlain by sandy alluvium that may liquefy with a PGA of 0.2g or less, given the occurrence of a magnitude 7.0 earthquake. Less extensive areas of the inner valley have deeper groundwater and / or are underlain by older, more consolidated deposits that are less susceptible to liquefaction, and are classified as having Moderate or Low susceptibility. Upland areas adjacent to the inner valley generally are classified as having a Low or Very Low susceptibility to liquefaction.

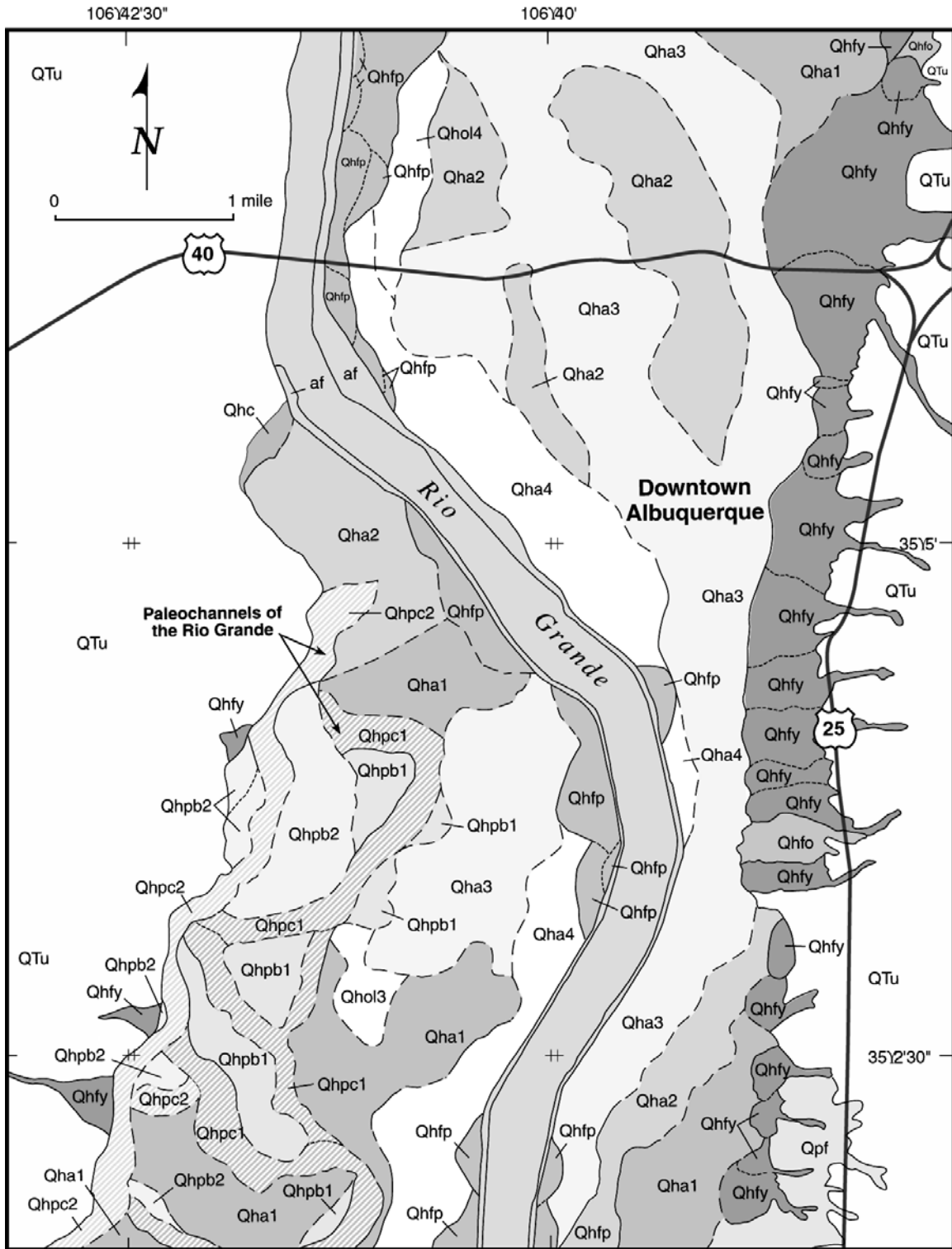
Overall, the areas classified as having a Very High or High liquefaction susceptibility include most of the inner Rio Grande valley. This area involves roughly 240 square kilometers (90 square miles) within the valley north and south of Albuquerque. Downtown Albuquerque is classified as having areas of High susceptibility (roughly southwest of the intersection of Silver Avenue and Sixth Street) and Moderate susceptibility (roughly southwest of the intersection of Marquette Avenue and First Street). The zones identified herein as Very High or High susceptibility encompass the areas most likely to experience liquefaction-related damage from a moderate to large earthquake in central New Mexico. Overall, it is reasonable to assume that large areas of the inner valley will be affected by liquefaction-related damage. Site-specific geotechnical investigations should be performed in areas of Very High or High susceptibility to assess risk to existing facilities and to evaluate and mitigate liquefaction hazards prior to future development.

## ACKNOWLEDGMENTS

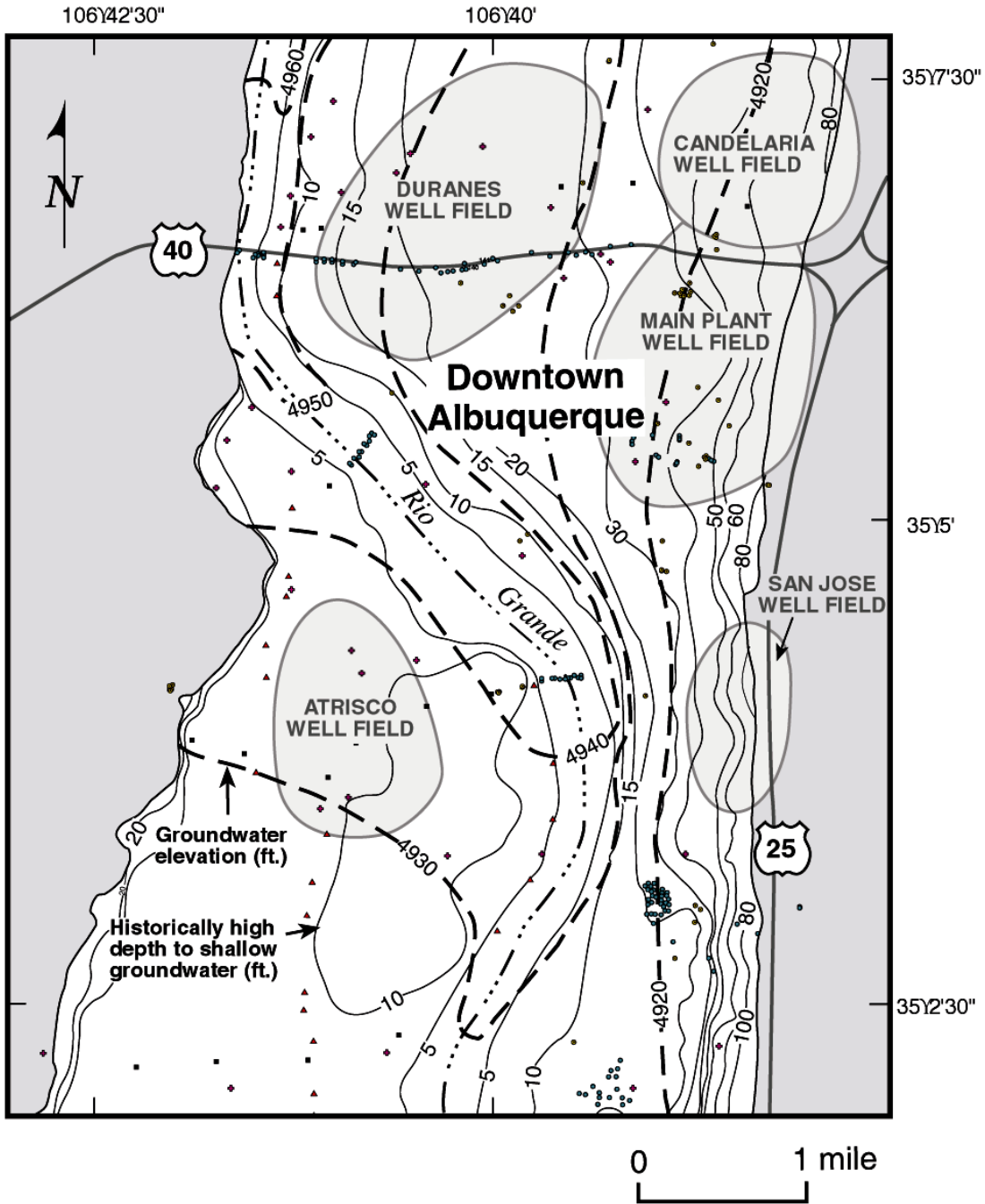
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## REFERENCES

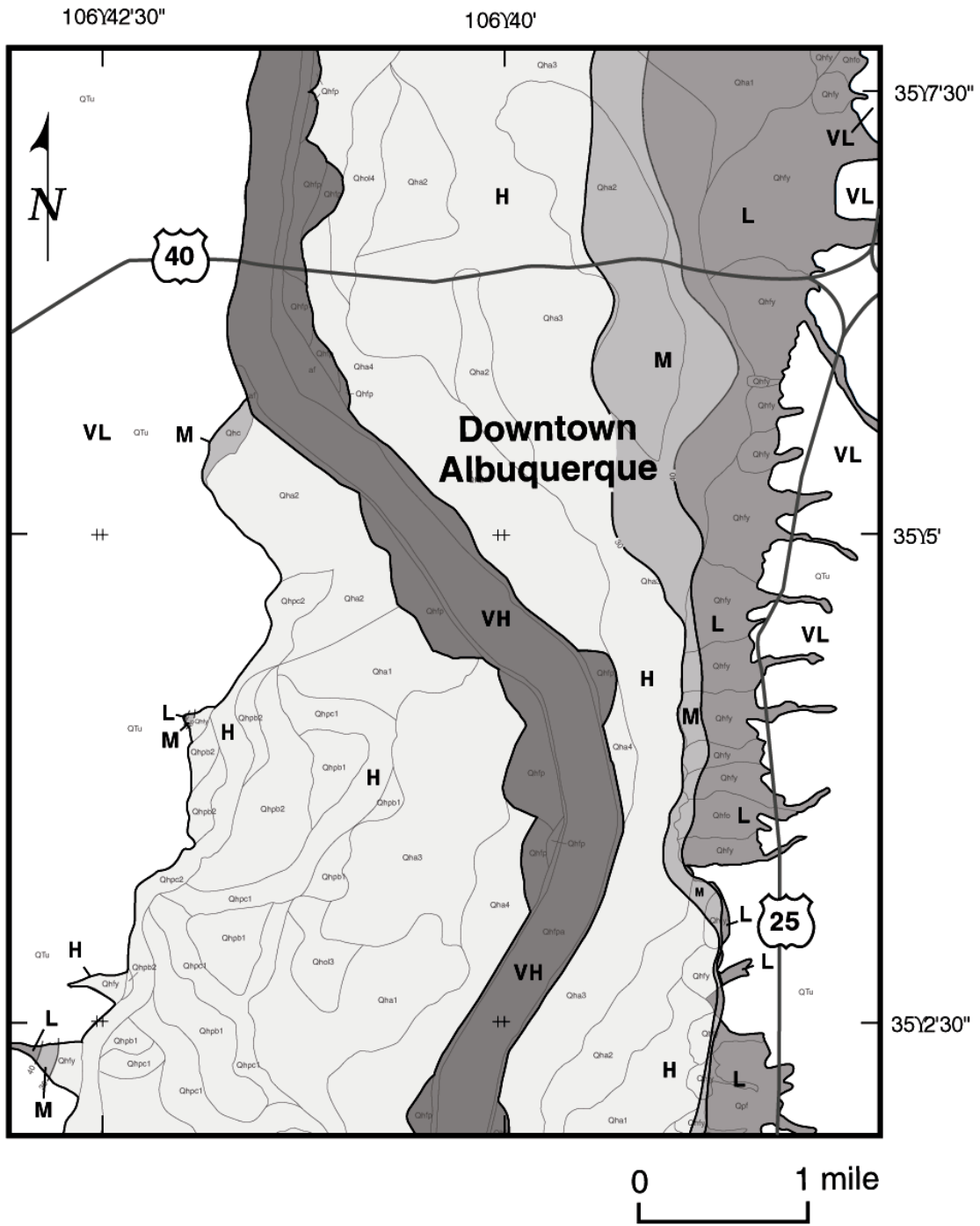
- Kelson, K.I., Hitchcock, C.S., and Randolph, C.E, 1999, Liquefaction Susceptibility in the Inner Rio Grande Valley Near Albuquerque, New Mexico: unpublished final technical report, U.S. Geological Survey National Earthquake Hazards Reduction Program, Award Number 98-HQ-GR-1009, 40 p., 9 plates, scale 1:24,000.



**Figure 1.** Surficial geologic map of part of the Albuquerque West quadrangle. Units designated by following notation; Q: Quaternary, Pleistocene, fp: floodplain, a: alluvium, ps: paleochannel, ol: overbank levee; pb: point bar; e: eolian, fy: young alluvial fan, fo: old alluvial fan, c: colluvium, af: artificial fill. Numerals indicate relative age of units, with 1=oldest and 4=youngest.



**Figure 2.** Groundwater elevation map (dashed lines) and depth-to-groundwater contour map (solid lines) of part of Albuquerque West quadrangle. Data point from shallow boreholes, drainage ditches, and drive-point wells (Kelson et al., 1999).



**Figure 3.** Liquefaction susceptibility of part of the Albuquerque West quadrangle (VH: Very high, H: High, M: Moderate, L: Low, VL: Very Low).