

## **Potential for Liquefaction in the Las Vegas Valley**

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### **Project overview/scope:**

A preliminary study by Jim Werle and others (Werle et al. 2000) found that liquefaction might be a hazard in low-lying parts of the Las Vegas valley where soils are sandy and the water table is high. Historic water table levels have fluctuated significantly due to human activity. In the central Las Vegas area, an extensive perched water table has developed. As a result, liquefaction hazards may now exist in places where they never did before. The key part of the liquefaction hazard analysis that remained to be investigated in the subject study is the survey of potentially liquefiable soils. This study provided opportunity for a UNLV student to work with faculty and practitioners to develop a more comprehensive understanding of the liquefaction potential in Las Vegas valley.

### **Work Plan summary:**

Mr. John Criscione, P.G., graduate student in UNLV Geoscience, was hired to work with the Principal Investigators and Dr. D. Burton Slemmons to expand the database of sites that have been evaluated for liquefaction potential, based on information that is gathered in standard geotechnical site investigations. Records at Converse Consultants were made available for this study. The results of the survey were to be factored in with the local seismicity studies already conducted to assess liquefaction potential according to the guidelines presented in the State of California Special Publication 117, as recommended in guidelines adopted for the State of Nevada. Distribution of population and development was also to be considered in assessing the hazard.

### **Justification/Benefit:**

The liquefaction hazard in the Las Vegas valley is not well understood and may be more significant than assumed, due to human intervention resulting in the increased presence of shallow groundwater. The seismic opportunity is clearly present, but the extent and distribution of ground conditions conducive to liquefaction require further study. The study was intended to shed light on the extent to which the potential for liquefaction exists in the Las Vegas valley, and whether the areas where liquefaction potential exists are currently developed or are in planning stages for development. It was anticipated that results of the study would show whether more detailed investigations are warranted.

### **Outcomes**

The outcome of this research project was summed up in a 2002 paper by Criscione and others that was published in the Proceedings of the 37<sup>th</sup> Annual Symposium on Engineering Geology and Geotechnical Engineering, a regional meeting that rotates between Idaho, Montana, Utah, and Nevada.

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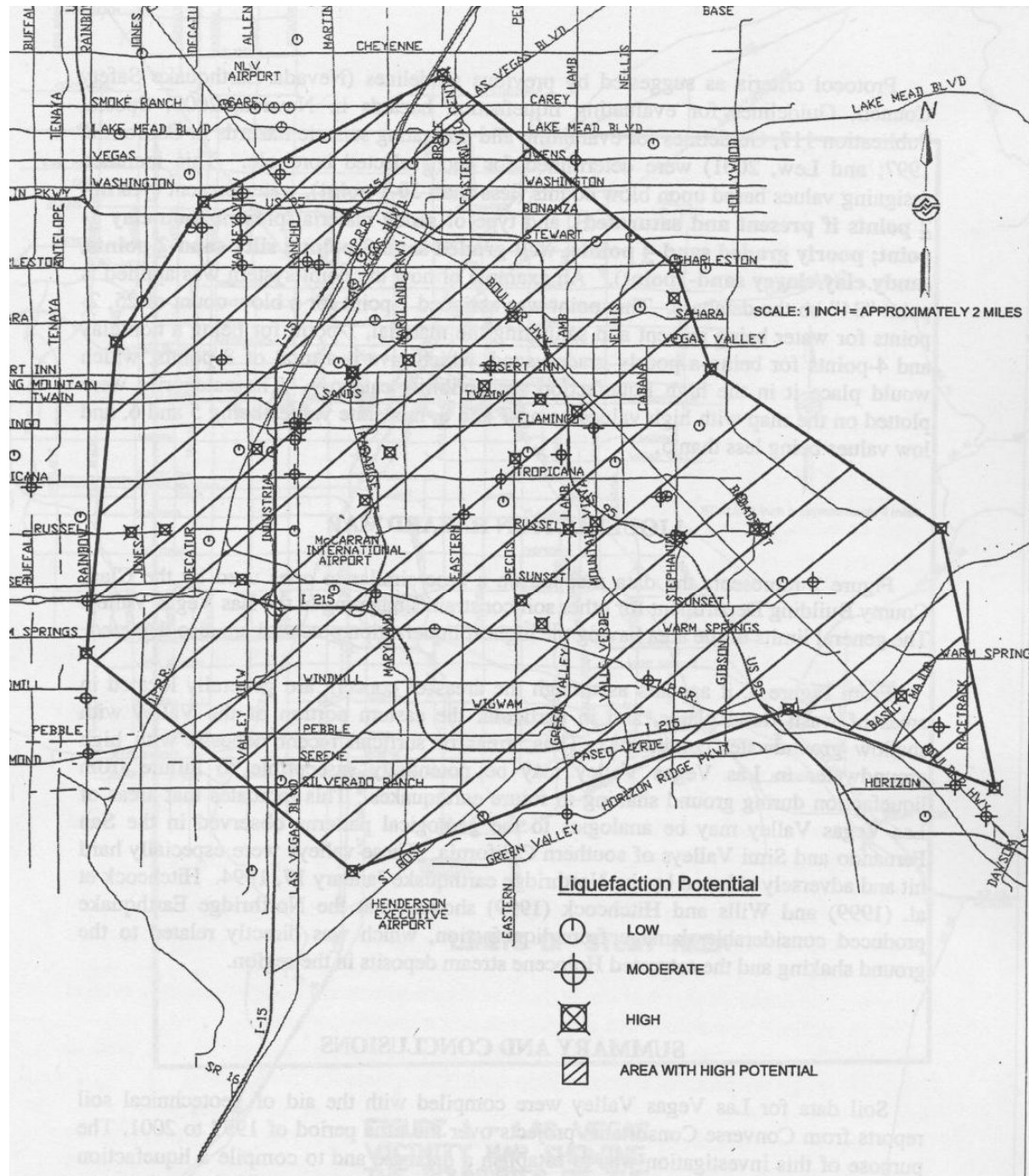
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A total of 149 borehole logs were selected for examination. Sites known to lack shallow groundwater or loose, coarse-grained sediments were excluded from selection *a priori*. Commonly-used, simplified criteria to assess liquefaction susceptibility were considered: groundwater conditions, overburden pressure, standard penetration resistance, and cyclic stress ratio (earthquake-induced shear stress normalized by effective overburden stress, assigned empirically as a function of depth and anticipated peak ground acceleration). A point system was developed and applied to rate liquefaction susceptibility. The final product of the study was a hazard map, also published in the paper referenced above. Our scoping study revealed an extensive region incorporating the topographically lowest part of the valley where the possibility of liquefaction could not be ruled out. This region includes heavily developed parts of Las Vegas, Henderson, and unincorporated Clark County.

We anticipate that further analyses of more, detailed datasets could drastically reduce the area in which liquefaction is truly a hazard. Until that time, our recommendation is that future development projects in areas suspected to have opportunity for liquefaction include a site-specific study to address this matter. If indeed the site-specific study results in an expectation that liquefaction is possible in the event of a credible earthquake, the project should incorporate remedial measures such as avoidance, densification, groundwater withdrawal, or a soil modification technique such as grouting.

## References

- Criscione, J. J., J. L. Werle, D. B. Slemmons, and B. Luke, 2002, "A liquefaction hazard map of the Las Vegas valley, Nevada," Proceedings, 37<sup>th</sup> Annual Engineering Geology and Geotechnical Engineering Symposium, ed. S. Sharma and J. H. Hardcastle. Idaho State University, Pocatello.
- Werle, J. L., M. K. Klein, L. Linnert Dunford, and B. Luke, 2000, "Screening investigations for liquefaction potential in the Las Vegas valley, Nevada," Proceedings, 35<sup>th</sup> Annual Engineering Geology and Geotechnical Engineering Symposium. Idaho State University, Pocatello.



Liquefaction hazard map showing the portion of the Las Vegas valley where the liquefaction hazard can not be ruled out *a priori*