Evaluating the Repeatability of Lateral Spreading

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Abstract

We were unable to conduct the proposed research during the time of our contract. The landowners at our preferred and alternate sites did not grant us permission to access their property and conduct subsurface exploration. Alternative sites were explored, but none were deemed suitable for the proposed work. We spent less than 5% of our award in pursuing landowner permission and seeking alternative sites. The remainder of our award was never billed. The remainder of this Final Technical Report is a modification of a research summary submitted in 2005 for a USGS-sponsored conference on the NEHRP program in Northern California.

Investigations Undertaken

This research explores the repeatability and, therefore, predictability of lateral spreading associated with liquefaction during strong ground shaking. Current geotechnical research is investigating the geotechnical parameters that control the location, size, and orientation of lateral spreading during liquefaction. These studies are focused on identifying specific locations of lateral spreads within areas of high susceptibility to liquefaction. The underlying premise or assumption to these studies is that the location and magnitude of lateral spreading is a predictable phenomenon subject to epistemic uncertainty and does not occur randomly within an area of liquefaction. Our research is a first step towards testing this premise by evaluating geologic evidence for repeated lateral spreading. The consequence of this study will be whether or not we can treat lateral spreads similar to fault ruptures such that specific locations, magnitudes, and orientations can be predicted for evaluation of impact to the built environment (i.e., lifelines, buildings).

The scope of this research is to continue our trench investigations at sites of historical lateral spreads, building on a first-year study funded by NEHRP (Thompson et al., 2004). Our initial study included a trench site in Watsonville, CA on the Pajaro River floodplain that recorded three to five lateral spreading and paleoliquefaction events that recurred in a

narrow (~1-m-wide) zone. This site motivated our formulation of a hypothesis that the depositional environment and local geologic and geomorphic site history create conditions that can localize lateral spreading over a range of earthquake magnitudes. The purpose of our second effort is to extend the research to investigate different geomorphic and depositional environments where lateral spreading has occurred historically.

To date, we have been unable to conduct our exploratory trenching program. Landowners at two of our previously identified sites have not permitted us to conduct field investigations. Their decisions are due to circumstances outside of our control that have changed since initial, more favorable discussions were conducted in preparation for the proposal. We are currently (1) searching elsewhere for new sites with suitable geological conditions and favorable landowners and (2) continuing to negotiate with the landowners of the previously identified sites for permission to conduct our field program in the near future.

Results

There have been no results to date, as we have been unable to conduct field investigations at our previously identified sites, and have yet to identify alternate sites that have favorable geologic conditions and willing landowners.

Non-Technical Summary

This research evaluates the repeatability and, therefore, predictability of lateral spreading associated with liquefaction during strong ground shaking. Several recent earthquakes have produced lateral spreads that damaged port facilities, airports, lifelines, bridges and buildings. Similar to surface fault rupture, the precise and accurate location of where lateral spreads may occur is essential for properly mitigating this hazard. Our previous study provided direct geologic observations to assess historic and prehistoric lateral spreading at two sites in northern California. At one site, along the Pajaro River near Watsonville, we found evidence for repeated lateral spreading in a narrow zone that coincides with a boundary between older and younger floodplain deposits. This site shows that lateral spreading recurred in the same place during the 1989 Loma Prieta, 1906 San Francisco, and other large earthquakes near the Monterey Bay area. The field program of our current study has not been initiated due to our inability to gain permission to conduct field investigations at previously identified sites.

Reports Published

Thompson, S.C., Witter, R.C., Givler, R.W., Hitchcock, C.S., and Lettis, W.R., 2004, Evaluating the Repeatability of Lateral Spreading: NEHRP Final Technical Report, 54 p.

Thompson, S.C., Witter, R.C., Givler, R.W., and Lettis, W.R., 2004, Evidence for Repeated Liquefaction-Induced Lateral Spreading, Pajaro River, Watsonville, California: *Eos Transactions, American Geophysical Union*, v. 85, Abstract S31A-1020.