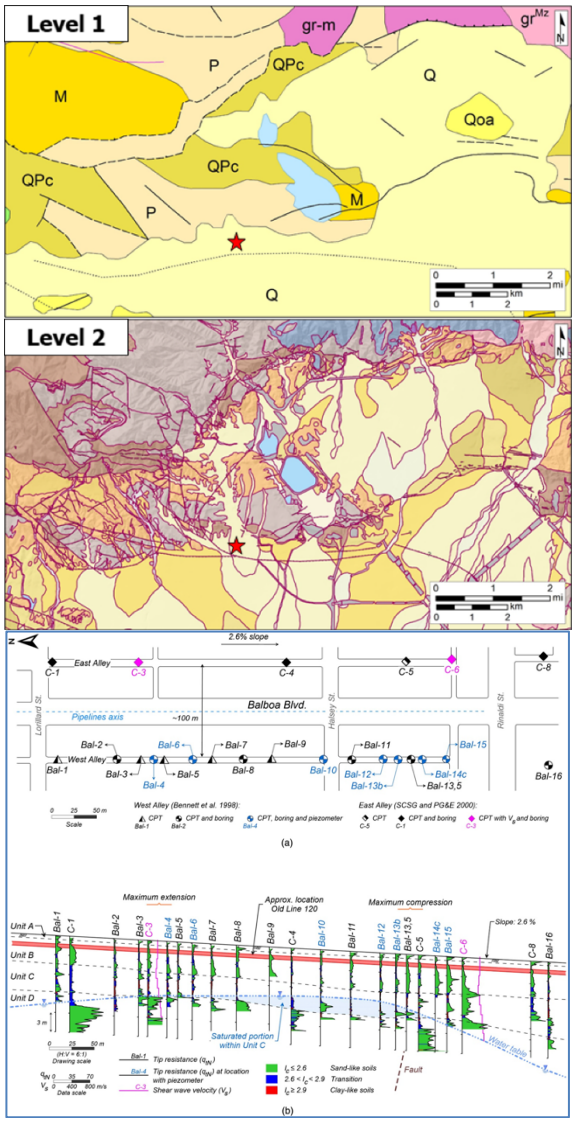
OpenSRA – Validation Report

OpenSRA is a new open-source seismic risk assessment software tool for gas utility regulators and owners that will enable them to strategically address challenges posed by the risk from earthquakes. The analytical procedures used in *OpenSRA* were evaluated with selected validation cases at several representative existing gas pipeline and storage facilities. The software was validated by comparing the estimated performance with that observed during historic earthquakes, and it is shown to provide reliable estimates of the seismic performance of the natural gas systems examined on the demonstration sites.



Levels 1, 2, and 3 geologic, geotechnical, and groundwater data with increasing resolution. (Sources: Level 1: CGS 2010; Level 2: Bedrossian et al. 2012; Level 3: Pretell et al. 2021)

Results

- Validation sites have documented case histories of pipeline response to ground deformations or seismic shaking.
- Range of analyses conducted from data with increasing resolution for geologic, geotechnical, and groundwater information.
  - Level 1 data – geospatially continuous at a uniform resolution over California
  - Level 2 data – regional
  - Level 3 data – site specific including groundwater
- Infrastructure data (e.g., pipeline properties) resolution increases from Level 1 to Level 3.
- Appropriate levels of uncertainty assumed for Level 1 analyses; uncertainty is reduced for Level 3 analyses.
- Increasing quality and resolution of data yields results with more certainty.

Benefits & advantages

- Results compiled into *OpenSRA* to aid in studying earthquake scenarios, prioritizing mitigation efforts, and planning post-earthquake assessments of a buried pipeline system.
- Ability to assess earthquake-induced ground movements at different scales, with appropriate levels of reliability.
- System-wide fragilities and prioritization of mitigation will provide *greater reliability* of the overall system. A methodical and rational approach to implementing mitigation *increases safety.*

Bain, Chris; Thomas O'Rourke; Jonathan Bray; Barry Zheng; Daniel Hutabarat; Scott Lindvall; Preston Jordan; Tsubasa Sasaki; Keurfon Luu; Yingqi Zhang; William Foxall; Jonny Rutqvist; David McCallen; Sherif Elfass; Tara Hutchinson; Elide Pantoli. 2023. Performance-Based Earthquake Engineering Assessment Tool for Natural Gas Storage and Pipeline Systems, Validation Report. California Energy Commission. Publication Number: CEC-500-202X-XXX. January 2023. *[PEER research report in progress.]*