



## DEPARTMENT OF CONSERVATION

**CALIFORNIA GEOLOGICAL SURVEY**

SCHOOL REVIEW UNIT • 801 K STREET, MS 12-31 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 324-7324 • FAX 916 / 445-3334 • TDD 916 / 324-2555 • WEB SITE [conservation.ca.gov/cgs](http://conservation.ca.gov/cgs)

Mr. Chris Thomas  
Chief Business Official  
San Rafael City Schools  
310 Nova Albion Way  
San Rafael, CA 94903

July 20, 2016

**Subject: Second Engineering Geology and Seismology Review for  
San Rafael High School – Stadium Improvements  
148 Third Street, San Rafael, CA  
CGS Application No. 01-CGS2278**

Dear Mr. Thomas:

In accordance with your request and transmittal of additional documents, the California Geological Survey (CGS) performed a second review of the engineering geology and seismology aspects of the consulting report prepared for San Rafael High School in San Rafael. This review was performed in accordance with Title 24, California Code of Regulations, 2013 California Building Code (CBC) and followed CGS Note 48 guidelines. We reviewed the following report, which we received electronically on July 14, 2016:

- 2. Response to CGS Comments, San Rafael High School – Stadium Improvements, San Rafael, California:** Miller Pacific Engineering Group, 504 Redwood Boulevard, Suite 220, Novato, CA 94947; company Report No.779.231, report dated June 24, 2016, five pages, 32 figures attached.

Previously, we reviewed the following report:

- 1. Geotechnical Investigation, San Rafael High School – Stadium Improvements, San Rafael, California:** Miller Pacific Engineering Group, 504 Redwood Boulevard, Suite 220, Novato, CA 94947; company Report No.779.231, report dated September 14, 2015, 21 pages, two appendices, and eight figures attached.

CGS previously reviewed and submitted our findings regarding this project in our review letter dated June 7, 2016. Based on our first review, the consultants were requested to provide data to support the selected Site Class, then revise the ground motion analysis accordingly. Also, the consultants were to revise the liquefaction settlement analysis with the appropriate seismic input

parameters, provide a revised quantitative seismic settlement calculations, and address the issue of cyclic softening in the Bay Mud deposits.

### **Subsurface Characterization and Site Class**

Previously, the consultants characterized the subsurface soil profile as Site Class E based on the presence of greater than 10 feet of soft clay. CGS reviewed the subsurface data presented in the boring and CPT logs and noted the Bay Mud sediments beneath the site might be more appropriately classified as Site Class F based on the criterion of "greater than 10 feet of peat and/or highly organic clay" defined in Section 20.3.1 of ASCE 7-10. To address this issue the consultants provide a log and the associated laboratory testing from a boring (SR-89-1) previously drilled on the south side of the San Rafael Canal for an Army Corps of Engineers study. They state the Atterberg Limits testing of the Bay Mud samples from this boring "indicate the Bay Mud is classified as a 'fat clay' (CH) not an organic soil (OH)". Additionally, they state the CPT logs may indicate the presence of organic soils below the site, but they did not encounter any highly organic or peaty soils in their Boring 6. Therefore, they conclude The Bay Mud at this site does not meet this criterion for Site Class F. However, CGS notes the plastic limit is not the appropriate parameter to determine whether or not a soil is classified as "organic". **According to ASTM D-2487 "organic silts and clays" are defined as soils where the ratio between the liquid limit of an oven-dried portion of the sample and the liquid limit of an air-dried portion of the sample is less than 0.75.** Therefore, the consultants should perform Atterberg Limits tests on various Bay Mud samples according to the ASTM D-2487 requirements in order to determine whether or not the particular Bay Mud deposits at this site qualify as organic soil, and therefore should be classified as Site Class F per ASCE 7-10, Chapter 20. According to the logs for the CPT-3/Boring 6 pair, the Bay Mud in that portion of the stadium complex is between 9 and 10 feet thick; however, based on the logs for CPT-1 and CPT-2, and the Bay Mud thickness contour map provided in Report 2, the Bay Mud unit thickens to approximately 18 to 20 feet. If the laboratory testing indicates some of the Bay Mud soils should be classified as organic soil, but the overall profile from Boring 6 does not meet the 10-foot thickness requirement, the consultants should consider drilling an additional boring near CPT-1 or CPT-2 to collect deeper samples of the Bay Mud for further laboratory testing in order to more fully characterize this critical geologic unit.

### **Site-Specific Ground Motion Analysis**

It is not yet clearly demonstrated the site should not be classified Site Class F. If the soils at the site are properly classified Site Class F based on the results from the requested laboratory testing data, a site response analysis is required per Section 11.4.7 of ASCE 7-10. The full site response analysis should be presented for CGS review and should follow the requirements of Section 21.1 of ASCE 7-10.

### **Seismic Settlement Calculations**

Based on our review of the data included in Report 1 the consultants were requested to provide the design groundwater depth they are using and revise their seismic settlement analysis to address the potential for settlement from both liquefaction of the sandy surficial soils and potential cyclic softening of the Bay Mud deposits. In Report 2 the consultants analyzed the cohesive Bay Mud deposits for potential settlements related to cyclic softening using the methodology described in Robertson (2009), which addresses the potential for seismically induced settlement from both

liquefaction of the sandy alluvium and cyclic softening of the Bay Mud deposits. **Based on their calculations, they determine there is a potential for up to 1.75 inch of seismically induced settlement at the stadium complex.** This methodology appears appropriate for the specific site conditions and the calculated result appears reasonable based on the data provided. If the site is ultimately classified Site Class F, the consultants should review the seismic input parameters derived from the site response analysis, and determine whether or not the seismic settlement analysis should be revised.

### **Lateral Spreading Potential**

The consultants did not comment on lateral spreading potential in Report 1 and were asked to do so given the proximity to the San Rafael Canal and the possibility of potentially liquefiable soils in the shallow subsurface. In Report 2 they state their calculations demonstrate there are no near-surface liquefiable layers that are continuous below the site, and therefore lateral spreading is not a potential hazard for this site. This conclusion appears to be reasonably supported by the data provided in Report 1.

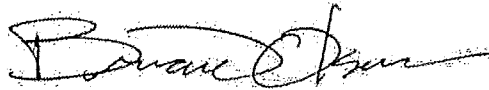
### **Bearing Capacity Failure**

In our first review, CGS requested the consultants evaluate and discuss the potential for liquefaction of shallow layers to impact the proposed building footings. The consultants note their liquefaction analysis indicates occasional thin (less than 1-foot-thick) liquefiable layers are present in the shallow subsurface, but that these layers are a part of the permeable landscape fill below the existing grass field, and will be removed as part of this project. CGS notes the three CPTs that show these shallow liquefiable layers are not located within the athletic field, but are to the south and west (CPT-1, CPT-2, and CPT-4), and therefore, did not encounter the granular landscape fill. **The consultants should address the potential for these shallow liquefiable layers to impact the shallow spread footings for the proposed home bleachers and restroom/concession building.**

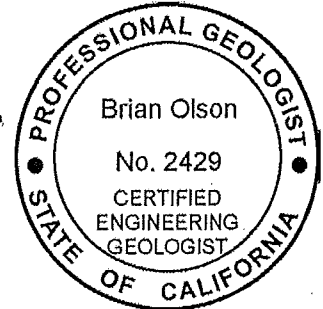
July, 2016

In conclusion, *the engineering geology and seismology issues at this site are not adequately assessed in the referenced report.* Additional information should be provided as requested. The consultants are reminded one copy of all supplemental documents should be submitted directly to CGS, and should include the CGS application number. If you have any further questions about this review letter, please contact the reviewer at (213) 239-0876.

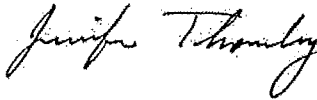
Respectfully submitted,



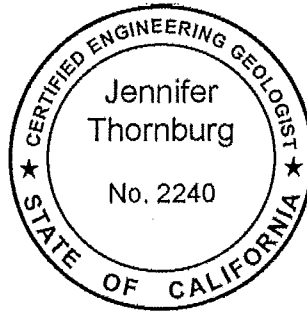
Brian Olson  
Engineering Geologist  
PG 7923, CEG 2429  
brian.olson@conservation.ca.gov



Concur:



Jennifer Thornburg  
Senior Engineering Geologist  
PG 5476, CEG 2240



**Copies to:**

Karen Van Dorn, *Senior Architect*  
Division of State Architect, 1515 Clay Street, Suite 1201, Oakland, CA 94612

Michael Jewett, *Certified Engineering Geologist* and Benjamin Pappas, *Registered Geotechnical Engineer*  
Miller Pacific Engineering Group, 504 Redwood Boulevard, Suite 220, Novato, CA 94947

Kam Lee, *Architect in General Responsible Charge*  
Marshall Lee Architects, 2340 Irving Street, Suite 106, San Francisco, CA 94122-1639