



March 9, 2017
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Friends of the Eel River,
c/o Kamman Hydrology & Engineering Inc.
7 Mt. Lassen Drive, Suite B-250
San Rafael, CA 94903

Attn: Mr. Greg Kamman and Mr. David Keller

Re: Preliminary Geologic and Geotechnical Evaluation
Scott Dam (Lake Pillsbury)
Lake County, California

Introduction

As requested, this letter summarizes our preliminary geologic and geotechnical evaluation of Scott Dam, an existing concrete dam which impounds Lake Pillsbury on the upper mainstem of the Eel River in northeastern Lake County, California. The purpose of our preliminary evaluation is to review provided documentation and files at the California Division of Safety of Dams (DSOD) in order to identify any geologic or geotechnical issues which may impact dam stability. We previously reviewed DSOD file materials as summarized in our memorandum issued on January 17, 2014. This letter updates the information contained in that memorandum on the basis of our review of more recent investigatory work by PG&E¹ regarding the landslide at the dam's left abutment.

Discussion and Professional Opinions

Based on our review of PG&E's recent Safety Review document, it is our opinion that the following geologic and geotechnical conditions may present some risk to dam stability and therefore warrant additional investigation:

- **Lateral deformations during seismic loading.** Lateral seismic deformation analyses of the dam have been previously performed due to DSOD concerns. Several studies were performed in the 1990's using a seismic acceleration of 0.60g and full water loads on the upstream side of the dam. More recent analyses have used higher levels of seismic loading (0.65g), based on an M6.0 earthquake rupturing the entirety of the 20-km "locked" segment of the Bartlett Springs Fault Zone. We did not see any analyses that included sediment loading on the upstream face of the dam, either in older documents or the more recent Safety Review. Based on the site bathymetry, a moderate amount of sediment has built up within the reservoir over time. The sediments deposited against the dam would result in a higher lateral active pressure on the dam compared to water pressure. The combination of higher seismic and sediment loadings could result in higher estimated lateral displacements.

¹ Pacific Gas and Electric Company (PG&E), "2016 Scott Dam FERC Part 12 Safety Review", August 2016.

In addition, recent work by USGS indicates that the Rodgers Creek Fault (discussed in the Safety Review as being part of the Rodgers Creek-Healdsburg-Maacama Fault System), may in fact be a norther extension of the Hayward Fault. By virtue of nearly doubling the fault length (and therefore, potential rupture length), this fault system may be capable of larger-magnitude earthquakes and larger ground accelerations than previously thought. Depending on actual expected ground motions from the maximum credible earthquake on this fault system, the analyses may need to be revised to consider a design basis earthquake on the Hayward-Rodgers Creek system in addition to the Bartlett Springs Fault. Updated seismic response and lateral deformation analyses may be warranted to check that the amount of movement would not damage the concrete dam.

- **Landslide complex at south (left) abutment.** A large landslide complex exists above the left abutment, and may include a large (approximately 6,000 to 7,000 cubic yard) boulder of greenstone rock which was incorporated into the dam's left abutment. Landslide movement has been detected at several different locations and several different depths. The deepest recorded movement is about 110 feet below ground surface. It should be noted that the geologic map (plate 5.1-1 of the March 2010 PG&E) only maps recent (post dam construction) landslide movement as landslide material. Topographic features indicate that older landslide materials extend farther to the west and are currently mapped as colluvium and bedrock areas. Evaluation of the large greenstone boulder incorporated into the left abutment is warranted to confirm it is not a "floaters" entrained in a larger landslide complex.
- The most recent Safety Review indicates that since 1969, measureable displacement in inclinometer 21 has occurred at depths up to 110-feet. More significant movement of shallower earthflows and landslides is occurring within the landslide complex. A monitoring program, including installation of several inclinometers, survey monitoring points, and other instrumentation within the landslide complex has been implemented by PG&E, but detailed data is not provided in the report and no conclusions regarding ongoing movements are provided. Also, there does not appear to be any inclinometers near the dam on the upstream side of the left abutment to monitor landslide movement. Additional inclinometers, along with pressure cells, appear warranted for future monitoring.
- The Safety Review further indicates that no analysis of seismic slope stability of the landslide complex has been performed. The stability of the landslide and expected movement under seismic and high groundwater conditions appears crucial in determine whether future landslide movement could damage the dam.
- A geotechnical concern is that the existing dam is acting as a strut across the canyon. The dam may be resisting landslide forces, directing landslide movement towards the east, and causing landslide material to "toe" out in the reservoir on the upslope side of the dam. Landslide forces on the dam are difficult to quantify, but can produce a combination of compression, uplift, and/or lateral loads on the dam. Additional analyses, as discussed above, are important to better understand the effect of the landslide on dam stability.

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We trust that this letter contains the information you require at this time. Please do not hesitate to contact me with any questions or concerns.

Very truly yours,
MILLER PACIFIC ENGINEERING GROUP



Scott Stephens
Geotechnical Engineer No. 2398
(Expires 6/30/17)