

STATE OF CALIFORNIA  
CALIFORNIA NATURAL RESOURCES AGENCY  
DEPARTMENT OF WATER RESOURCES  
DIVISION OF SAFETY OF DAMS

**INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS**

Name of Dam Alpine Dam No. 33 County Marin  
 Type of Dam GRAV Type of Spillway Eight siphons  
 Water is 5 feet below the spillway crest and 13 feet below the dam crest.  
 Weather Conditions Clear and mild  
 Contacts Made Lucy Croy and Conner Pollard during the inspection  
 Reason for Inspection Periodic evaluation

**Important Observations, Recommendations or Actions Taken**

None of the upstream controls were cycled during this inspection because the outlet control stems were damaged by improper operation prior to this inspection. The owner is planning on replacing the damaged control stems within the next month or so.

The dam galleries were not entered during this inspection, and were last inspected in June of 2013. The owner will make arrangements to allow for inspection of the galleries during the next periodic inspection.

The plunge pool below the outlet conduit "Tee" outfall is susceptible to erosion, and the owner is planning to either relocate the outlet conduit to more suitable ground, or to armor the susceptible area with concrete stabilized large-boulder riprap.

**Conclusions**

From the known information and visual inspection, the dam, reservoir, and the appurtenances are judged safe for continued use.

**Observations and Comments**

<u>Dam</u>	The visible portions of the upstream face, crest, downstream face, and abutments are in satisfactory condition, with no indication of surficial distress or instability. Minor cracks and offsets appear unchanged from that reported in previous inspection reports.  Vegetation control is mostly satisfactory, but it's time once again to schedule clearing of emerging trees, bushes, and other tall and dense vegetation from alongside both downstream groins before they become an impediment to inspection and monitoring for seepage and other defects.
<u>Galleries</u>	The galleries are considered a confined space requiring qualified and trained personnel for access and inspection, and were not entered during this inspection; the galleries were last inspected on June 26, 2013. The galleries should be inspected during the next periodic inspection.
<u>Spillway</u>	The spillway approach was open and clear. A polyethylene log boom was in place several dozen yards upstream of the dam.  The current design storm, prepared in 1982, is for a 170,000-year return period producing 9475 cfs (~929 cfs / sq mi) from the 10.2 square mile drainage area. The spillway capacity is ~9770 cfs which is slightly greater than the peak inflow. Total freeboard is 8 feet and the residual freeboard for the design storm is 2.3 feet. Freeboard is satisfactory.
<u>Outlet</u>	The 125-foot tall dry outlet tower has inlets at five different elevations. The upper most inlet at elevation 626' is controlled with a 24-inch slide gate mounted outside of the tower; the remaining four inlets at elevations 595', 567.5', 540', and 530.75' are controlled with externally mounted 18-inch slide gates. Each of the five slide gate valves outside of the tower has an equivalent sized gate

Inspected by J. Lowe  
 Date of Inspection 15 February 2018  
 Date of Report 16 February 2018

Photos taken? Yes X No \_\_\_\_\_  
 cc for Owner/Book

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## Observations and Comments

valve within the dry portion of the tower.

The upper four outlet tower inlets manifold into a single 30-inch concrete-encased steel pipe within the tower, from whence the outlet pipe passes beneath the dam for conveyance to facilities downstream; the outlet is normally pressurized. The lowest 18-inch tower inlet feeds a separate "scour pipe" which discharges at the downstream spillway apron of the dam.

Significant additional drawdown capacity is provided by a recently installed 24" Tee within the primary outlet conduit, just beyond the downstream toe of the dam. Flow through the outlet conduit outfall is controlled by three 24" butterfly valves. A detailed description of this supplementary outlet system is provided in the 26 February 2015 inspection report.

None of the upstream controls were cycled during this inspection because the outlet control stems were damaged by improper operation prior to this inspection. The owner is planning on replacing the damaged control stems within the next month or so. The three downstream control 24" butterfly controls at the outlet conduit Tee were fully cycled and found to be in good operating condition. Those upstream and downstream outlet controls accessible from outside of the outlet tower (exterior valves) were partially cycled during the 12 April 2016 inspection. All upstream and downstream controls that remain operable, including those within the outlet tower, were fully cycled during either the February 26, 2015, or April 30, 2015 inspections.

The plunge pool below the outlet conduit "Tee" outfall is susceptible to erosion, and the owner is planning to either relocate the outlet conduit to more suitable ground, or to armor the susceptible area with concrete stabilized large-boulder riprap.

## Seepage

There was no seepage observed within the downstream face or groins. Consistent with previous inspections, there was minor seepage from the right abutment, and from several of the internal gallery drains. The owner has reported that seepage rates decrease significantly when the reservoir level drops more than 22.5 feet below spillway elevation.

There is no designated collection point or weir for estimating and apportioning seepage from the left galleries and left abutment. In the past, the total seepage from the left side of the dam has been visually estimated as it flows over and around the left downstream toe. With the reservoir high flows from the left side of the dam have been in the 5 gpm range, as they were during this inspection.

Seepage from the right galleries and right abutment is collected and measured at two locations designated the "Upper" and "Lower" leaks, respectively. The total cumulative seepage from the right side of the dam was on the order of 20 gpm or so cumulative flow, with the majority of that coming from gallery No. 5.

Seepage from both sides of the dam was clear and remains within historical levels.

## Instr.

Instrumentation consists of four (4) piezometers, and two (2) seepage measurement locations.

The latest instrumentation data was received from the owner on 21 June 2017.

Piezometer data for the reporting period from January 2007 through May 2017 was reviewed. All four piezometers were constructed in 1985 from holes drilled for geophysical testing, and are designed to measure uplift pressures at the dam foundation. The design uplift pressure assumed in the December 1982 Safety Review Report (SRR) equals 100% of the reservoir head at the upstream

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edge, reducing (linearly) to zero at the downstream toe.

Piezometers P1 and P4 are located along the downstream half of the dam crest, near the right and left abutments, respectively. Piezometer P2 is located several feet to the right of the right spillway wall just above the mid elevation of the dam; piezometer P3 is located near the left abutment just below the mid elevation of the dam. Piezometer P3 has recently been retrofitted with a vibrating wire piezometer.

The average elevation of piezometers P1, P3, and P4 remain relatively steady within the reporting period, neither raising nor lowering significantly over the ten-year period.

Piezometer P2 showed a gradual rise in average elevation from about 555' to about 570' between January 2001 and January 2009, after which the elevation spiked relatively quickly, reaching 605' by October 2009. The elevation stayed around 605' until April 2010, when it dropped rapidly to just under 540' in May of 2010, after the piezometer borehole was flushed with high pressure water. The average elevation has remained around the 540' elevation since the flushing.

Pore pressures measured within piezometers P2 and P3 remain below the design pressures assumed in the 1982 SSR. Pore pressures measured within Piezometers P1 and P4, however, are close to, and have at times been above, the design uplift values, though not within the data period reviewed for this report. Periodic cleaning of the piezometers is a sound practice and it will be interesting to see if future reports show a more stable trend in readings.

Seepage data for the reporting period from January 2007 through May 2017 was reviewed. Seepage data is reported for the "upper" and "lower" leaks, both of which are on the right side of the dam through the dam concrete. Seepage from the upper leak generally averages about 3 or 4 gallons per minute (gpm), with an occasional spike up to 6 or 7 gpm, and one spike up to 12 gpm in December 2010. Seepage from the lower leak averages about 15 gpm, with highs of up to 40 gpm coincident with full reservoir water elevations. All monitored seepage is clear, and average seepage rates for both leak locations haven't changed within the data period reviewed.

Settlement and alignment data for the reporting period from September 1, 2014 through July 6, 2016 was reviewed. Maximum reported settlement and alignment deviation are 0.17" and -0.70", respectively, which are probably within the range of instrumentation error as subsequent measurements show decreased settlement and alignment deviation at those same locations.

The owner's conclusions from their June 2017 submittal were that, "The Alpine Dam piezometer readings are consistent with historic readings. Piezometer #3 is now a vibrating piezometer. Monuments were installed on the dam in 2013 and the settlement and alignment readings are provided. No significant movement was measured". Based on the data submitted I agree with the owner's conclusions. The dam appears to be performing satisfactorily, and no additional instrumentation is believed necessary at this time.

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The upstream face as viewed from the upstream right abutment. Note the log boom upstream of the dam.



None of the upstream controls were cycled during this inspection because the control stems were damaged by improper operation prior to this inspection. The owner is planning on replacing the damaged control stems within the next month or so.

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The right downstream face and groin, above, and the left downstream face and groin, below. Vegetation control is mostly satisfactory, but it's time once again to schedule clearing of emerging trees, bushes, and other tall and dense vegetation from alongside both downstream groins.

