

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 Soulajule Dam No. 33-9 County Marin
 Type of Dam ERTH Type of Spillway Concrete weir and chute
 Water is 0.5 feet below the spillway crest and 12.5 feet below the dam crest.
 Weather Conditions Clear and mild
 Contacts Made Alex Anaya and Carl Sanders during the inspection
 Reason for Inspection Periodic Evaluation

Important Observations, Recommendations or Actions Taken

Overall care and maintenance of the dam and appurtenances has improved significantly over the past three years. Mr. Anaya has addressed all safety and maintenance concerns expeditiously and comprehensively, and none other than normally scheduled maintenance is required at this time. The following are some of the issues resolved by Mr. Anaya since the previous inspection on February 24, 2015:

- Vegetation control along the downstream face has improved significantly, and is now approaching excellent. Tall and dense bushes and emerging trees along both groins have been cleared to open these important areas to improved monitoring for seepage and other defects.
- The local pockets and holes near the base of the concrete-slurry stabilized rock splash apron below the spillway stilling basin have been repaired as requested.
- The severely corroded outlet bypass pipe supports and hardware within the downstream control valve vault have been replaced as directed. The severely corroded connection hardware for the 36-inch butterfly valve within the outlet vault was replaced the previous year.

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> | <p>The visible portions of the upstream face, crest, downstream face, and abutments are in satisfactory condition, with no indication of surficial distress or instability. The upstream riprap armor remains in satisfactory condition and continues to provide reasonably adequate protection against wave action.</p> <p>Vegetation control along the downstream face has improved significantly, and is now approaching excellent. Tall and dense bushes and emerging trees along both groins have been cleared to open these important areas to improved monitoring for seepage and other defects. The majority of the embankment is covered in moderately dense ankle to knee tall grass and other moderately low ground cover that provide protection against erosion without preventing effective inspection and monitoring for seepage and other defects.</p> <p>Rodent control remains generally satisfactory though locally abundant indications of burrowing are evident along portions of the crest.</p> |
| <u>Spillway</u> | <p>The approach, control section, and exit channel were clear and unobstructed; a polyethylene log boom was in place several hundred feet upstream of the dam. The spillway concrete structure</p> |

Photos taken? Yes No
 cc for Owner/Book

Inspected by J. Lowe
 Date of Inspection 5 April 2016
 Date of Report 6 April 2016

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Date of Inspection 5 April 2016

Observations and Comments

remains in good condition with no obvious signs of distress or deterioration. The concrete-slurry stabilized rock splash apron below the stilling basin is also in good condition, and pockets and holes near the base of the apron have been repaired as requested. Large bushes along the lower left spillway wall should probably be trimmed back a bit to prevent possible root damage.

Total freeboard is 12 feet and the residual freeboard is 3.3 feet. Freeboard is satisfactory.

Outlet

Five 36-inch diameter butterfly valves mounted on the inclined inlet structure provides upstream control for the fully encased outlet. The five mechanically operated valves are located at elevations 323.0', 305.5', 228.0', 270.5', and 253.0'. Downstream control is provided by a pair of butterfly valves arrayed in series; a 36-inch butterfly valve within a concrete vault, followed by a recently installed 48-inch butterfly valve buried between the vault and outlet energy dissipater discharge. The outlet is normally pressurized.

The severely corroded outlet bypass pipe supports and hardware within the downstream control valve vault have been replaced as directed. The severely corroded connection hardware for the 36-inch butterfly valve within the outlet vault was replaced the previous year.

All of the outlet controls were partially cycled during this inspection, and all were found to be in good operating order. All outlet controls were fully cycled and found to be in satisfactory operating condition during the February 24, 2015 periodic inspection.

Seepage

No evidence of seepage was observed through the downstream face, groins, or abutments.

The seepage monitoring weir next to the right side of the outlet energy dissipating structure has been cleared of sediment and vegetative debris, as requested. Clear flow through the weir was approximately 10 gpm and is within historic limits.

Instr.

Instrumentation consists of the following:

- Twenty-one (21) survey monuments. Survey monuments were installed to measure post construction settlement and to monitor settlement and lateral displacement of the embankment crest and downstream face following significant seismic events. Surveys are performed approximately every five years.
- Nineteen (19) piezometers. Piezometers were installed to monitor post construction pore water pressure and to monitor the phreatic surface within the embankment. Piezometers are read monthly.
- One (1) 90-degree V-notch weir. The weir was installed to measure seepage from the toe drain and is monitored monthly.

The latest instrumentation data was received from the owner on December 16, 2015; survey data covers the reporting period between January 2006 and November 2015.

Settlement data shows that the dam continues to settle over time, though along a flattening settlement slope. The maximum differential settlement and the maximum total settlement since the start of the reviewed data period is 0.465 feet (5.6 inches) for monument M-16 on 8 October 2015. Settlement at all locations is significantly less than camber, and camber at monument M-16 is 25 inches.

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Alignment readings are presented and are quite steady up until 1991, after which they make a pronounced shift in the upstream direction beginning in 1992. The upstream shift continues through to the 2015 readings, with maximum total displacements of almost 2 inches between 1991 and 2015. A new survey instrument was introduced in December of 2005, and the change of instrument, reading and reporting errors, or a change in anchor monument locations are the only plausible explanations for the deviations. Several years of consistent data will be required before any meaningful trends can be ascertained, but based on data prior to 1991 the dam remains stable with regard to alignment.

Piezometers are distributed along the crest, along a bench near the mid elevation of the downstream embankment, on the upstream face, and along the downstream toe and groin. Design elevations for the piezometers are:

| Piezometer Number | Depth to Bottom of Piezometer | Design Tip Elevation | Comments |
|-------------------|-------------------------------|----------------------|--|
| P-1 | 141.33 | 204.66 | Left crest. |
| P-1A | 116.38 | 229.45 | Left crest. |
| P-1B | 46.17 | 299.83 | Left crest. |
| P-2 | 135.83 | 210.75 | Center crest. |
| P-2A | 156.33 | 190.10 | Center crest. |
| P-2B | 66.00 | 280.57 | Center crest. |
| P-3 | 90.46 | 255.36 | Right crest. |
| P-3A | 98.33 | 246.89 | Right crest. |
| P-3B | 45.08 | 300.38 | Right crest. |
| P-4 | 86.75 | 249.50 | Upper center downstream embankment. |
| P-5 | 78.29 | 231.55 | Left drainage bench. Critical elevation 250'. |
| P-6 | 88.74 | 224.49 | Center drainage bench. Critical elevation 250'. |
| P-6A | 116.76 | 196.39 | Center drainage bench. Critical elevation 250'. |
| P-7 | 75.79 | 237.41 | Right drainage bench. Critical elevation 250'. |
| P-8 | 59.85 | 252.71 | Far right drainage bench. Critical elevation 250'. |
| P-9 | 28.57 | 222.58 | Left downstream toe. Critical elevation 250'. |
| P-10 | 43.56 | 207.56 | Center downstream toe. Critical elevation 250'. |
| P-11 | 38.28 | 218.71 | Right downstream groin. Critical elevation 250'. |
| P-12 | 28.07 | 313.07 | Upper center upstream embankment. |

Measured piezometer water surface elevations remain relatively constant over the period reviewed, and all piezometers remain below the critical elevation indicated in the Embankment Dam Stability Analysis, Soulajule Dam, 33-9, dated 28 February 1978.

The seepage measurement weir is located on the right side of the outlet energy dissipater, and is designed to measure seepage from the toe drain. Data for the period January 2006 through July 2015 was reviewed prior to this inspection. Clear seepage measured at the monitoring weir correlates closely to rainfall; in the absence of rainfall seepage drops to essentially zero. Normal peak seepage of up to 70 or more gpm, quickly falls to near zero following the termination of winter storms. Seepage during this inspection was on the order of 2 to 3 gpm. Seepage reported was consistent with historic values and shows a trend to decreasing over time; probably the result of the past several years of drought.

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In their December 16, 2015 instrumentation data submittal letter the owner reports, "*The Soulajule Dam piezometer readings are consistent with historic readings. The weir readings vary due to clogging and flooding. The weirs are now cleaned every six months as a part of a preventive maintenance program. Soulajule Dam is trending toward stabilization: settlement of -0.47 ft (maximum) and alignment of +0.18 ft (upstream direction; maximum).*"

Based on the data submitted the dam appears to be performing satisfactorily, and no additional instrumentation is believed necessary at this time.



The crest and upstream face as viewed from the right spillway wall. The small bushes in the foreground have re-emerged after having been cut earlier in the year.

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Vegetation control along the downstream face has improved significantly (above and below), and is now approaching excellent. The right downstream groin and left spillway wall could use a bit more work (outlined below and on the next page), but beyond that all is near perfect.



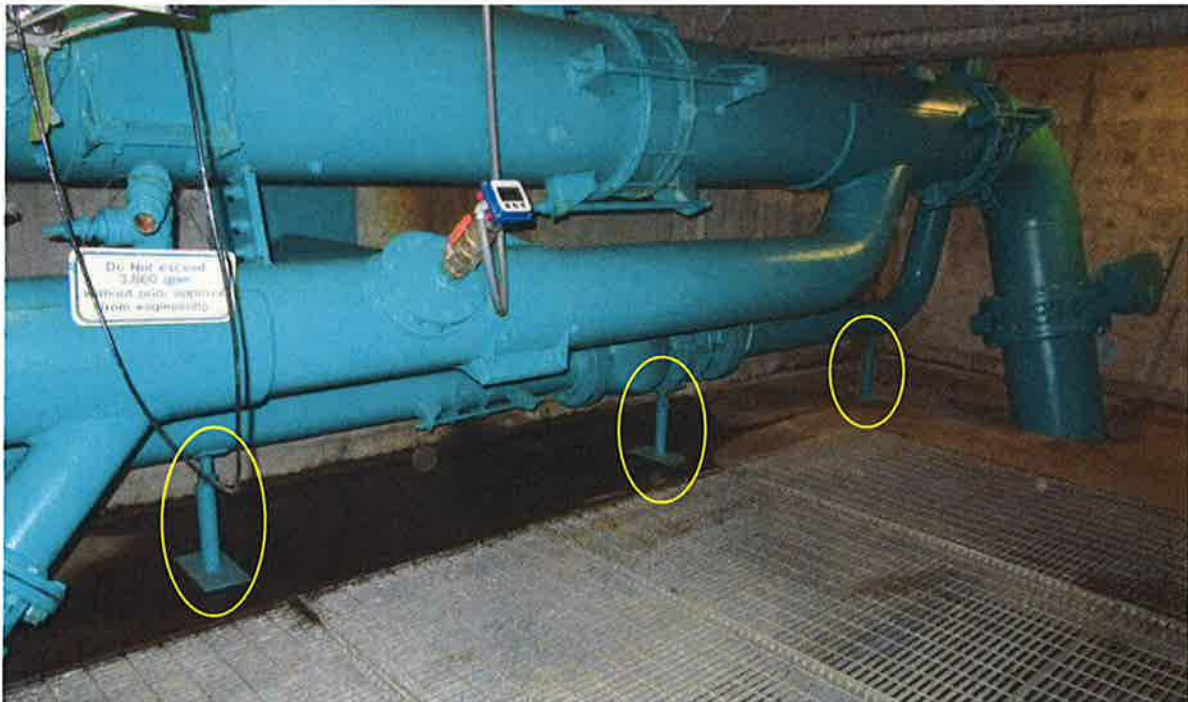
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The spillway and flip bucket looking in the upstream direction. Large bushes along the lower left spillway wall should probably be trimmed back a bit to prevent possible root damage.



The severely corroded outlet bypass pipe supports and hardware (circled) within the downstream control valve vault have been replaced as directed.