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

FILE

INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS

Name of Dam Mathews Dam No. 35-0 County Riverside
Type of Dam Earth Type of Spillway Open channel with ogee crest side channel control
Water is 20.4 feet below spillway crest and 34.4 feet below dam crest.
W.S.E. at El. 1369.6
Weather Conditions Sunny and cool
Contacts Made Bei Su, Tom Hibner, and James Johns (Valve Operations) of MWD
Reason for Inspection Periodic Maintenance

Important Observations, Recommendations or Actions Taken

- Emergency Drawdown System valves [redacted] were successfully operated full cycle during this inspection according to the valve exercise schedule.
- The badly cracked construction joint in the concrete lining at Dike 1 has been repaired.
- MWD is still working on gaining property access rights to the Weir 1 location.
- MWD will soon be installing a weir box to measure and monitor the seepage flows from the broken hydraulic piezometers at Sta. 90+00 of Dike 1.
- The piezometers at this dam that are still operational, adequately monitored, and useful for dam safety have declined for various reasons to the point that this aspect of the dam instrumentation portfolio requires serious reconsideration. Our detailed recommendations are contained in the instrumentation section of this report.
- Recommend the holes developing along the Dike 1 old dam crest coping wall be regularly backfilled with gravel as needed to act as a filter, discourage rodent colonization, and control progressive erosion.
- Recommend an erosion gully at the left downstream groin of Dike 1 be backfilled with gravel of a prescribed size to sufficiently resist the erosive force of the runoff water. Similar measures should be taken for insipient erosion along the edges of the Dike 1 dam crest and erosion gullies deeper than 6 inches on Dike 2. The decomposed granite that is presently being used is easily eroded and requires annual repeat doses of erosion backfill.
- Recommend the tumbleweed obscuring visual inspection of portions of the Main Dam and Dike 2 be removed and the new growth controlled.

Conclusions

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

Observations and Comments

Dam [redacted] The crest and concrete parapet wall were level, well-aligned, and in satisfactory condition. We also walked the crest of the old dam because the reservoir water surface elevation was low enough to allow this. The water was lapping at the base of the old dam coping wall. We were able to see the entire concrete lined upstream slope of the raised portion of the dam (above the old dam crest). The visible portions of the upstream concrete panels were in generally satisfactory condition with no bulges, warps, or slumps. Some of the joints were spalled. We drove the dirt road along the downstream slope where it wasn't too steep to drive, and walked the other portions. The upstream and downstream slopes were uniform with no sign of instability. Excessive tumbleweed growth was noted on some portions of the downstream slope and should be removed and controlled. Rodent activity was also noted and control measures should be taken similar to those at Dike 1.

Photos taken? Yes X No
cc for Owner/Book

Inspected by Anna Kolakowski AK
Date of Inspection 12/27/2016 to 12/28/2016
Date of Report 01/26/2017

The main dam v-notch weir was clean and the passing flow was clear. The old spillway weir was clear and the passing water was clear. The new spillway weir was likewise clean and passing clear flow.

Dike 1 – The asphalt paved dam crest and the concrete parapet wall were level, well-aligned, and in good condition. There was normal cracking in the asphalt. The upstream and downstream slopes were uniform with no sign of instability. We walked the old dam crest, which gave us a good view of the entire concrete lined upstream slope of the dam raise. These visible portions of the upstream concrete panels were in generally satisfactory condition. Bei Su indicated an excellently repaired portion of a concrete panel that had suffered a cracked construction joint and was recommended by DSOD last year for repair.

We noted there were holes in the old dam crest roadway next to the edge of the old dam coping wall. Further investigation revealed these holes were each associated with a weephole at the base of the coping wall. We surmised that material was being eroded from the behind the coping wall through the weepholes by negative pressure induced by the wave action. The voids created by this material loss were undermining the paving above it. It was apparent a rodent had exacerbated the problem by very aggressively burrowing in one of these holes and this was further undermining the asphalt (see Photo 6). Recommend these holes be regularly backfilled with gravel to act as a filter, discourage rodent colonization, and control progressive erosion.

We also walked the entire toe area, which gave us a good view of the downstream slope. No concerning erosion or rodent activity was noted on the downstream riprap dam face or groin areas; however, an erosion gully at the left downstream groin should be backfilled with gravel of a prescribed size to sufficiently resist the erosive force of the runoff water. Similar measures should be taken for insipient erosion along the edges of the dam crest. The native grass on the toe apron is kept closely mowed. Rodent bait stations supplied with bait were placed every few hundred feet apart. This seemed to be a sufficient means to control the rodent activity.

Dike 2 -- The entire upstream face of Dike 2 was exposed because of the low lake level. The riprap upstream slope was so choked with tumbleweed that an adequate visual inspection could not be performed. Recommend the tumbleweed be removed and the new growth controlled. The downstream slope could be inspected and it appeared uniform with no sign of instability or major erosion. The asphalt paved dam crest and the concrete parapet wall were level, well-aligned, and in good condition.

The dam and dikes appeared overall well-maintained and all of the abutments were stable.

Spillway

The spillway approach was completely in the dry. The approach, ogee control and side channel, and discharge channel were clear of obstruction and the weepholes were dry. The concrete elements of the approach apron, ogee control section, channel, and walls were in good condition with no open or misaligned joints or concerning cracks.

Outlet

Table 1 summarizes the 47 valves/gates on the Lake Mathews emergency drawdown system:

[redacted]

As discussed in the two previous inspection reports, a valve operation schedule has been agreed upon by which each of the valves in the emergency drawdown system are operated during a DSOD inspection once every three years. Table 2 shows the schedule.

[redacted]

The inspection this year fell on the Year 2 operation schedule and all [redacted] valves were operated according to the schedule. The I/O Tower 2 and access bridge appeared in excellent condition and the valves visible above the waterline appeared to be in good condition. The Tower 2 [redacted] valves at [redacted] and [redacted]) were all successfully operated full cycle. These valves were operated under hydraulic power with electrical assist to recharge pressure as needed.

[redacted] valves [redacted] were closed before operation of the associated [redacted] Valves [redacted] and then opened again thereafter. All were successfully and smoothly operated.

During this inspection flow was being discharged into the forebay through the tailrace of the hydroelectric plant (not a part of the emergency drawdown system).

Seepage

The reservoir level was relatively low and no seepage was noted on the dam or dikes, groins, or toe areas.

Instr.

Instrumentation at this dam consists of survey monuments, piezometers, and seepage weirs. The latest surveillance submittal dated June 2, 2016, covers the monitoring period January 1, 2015 through December 31, 2015. The instrumentation submittal for this dam is presented in a format

that includes an engineering evaluation, plans showing the location of instrumentation, and plots that provide for clear evaluation of the data.

Survey Monuments
The survey data (lateral and vertical movement) was evaluated and no concerning settlement or lateral movement was identified in the reporting period or on the 10-year plots.

Piezometers
The piezometers at this dam that are still operational, adequately monitored, and useful for dam safety have declined for various reasons to the point that this aspect of the dam instrumentation portfolio requires serious reconsideration. Because of the aging system, quite a number of original piezometers are no longer in service because they are broken, abandoned, or malfunctioning. Also, a number of piezometers are no longer monitored due to reported unsafe access.

Piezometers D-1 through D-13 that once monitored saturation levels in the downstream shell of the Main dam have been abandoned due to access and safety concerns. As a result, the maximum dam section is now absent of all downstream shell monitoring. The owner's engineering evaluation provides the opinion that the limited information provided by the abandoned piezometers (reportedly dry or flat) is better provided by the seepage instrumentation (90 degree v-notch weir) at the toe of the dam, which also would provide early warning of any significant changes in seepage level caused by adverse changes in the embankment or foundation, or malfunction of the filter and drain zones. Pros and cons can be argued for this approach. Seepage volume is indicative of the amount of water moving through the dam, but it does not locate where the phreatic level is within the dam. Also, malfunction of the filter and drain zones may lead to less seepage rather than more seepage and this trend, absent piezometric data, could be misinterpreted.

One upstream open well piezometer (C-1) continues to be monitored in the Main dam. MWD explains that C-2, at the same location as C-1, has remained inoperable since early 2013. Piezometer C-1 is located on the upstream side of the dam crest, and chimney drain, and typically indicates the saturation level in the dam at 65 to 69 feet below the dam crest. There are three piezometers (S-1, S-2, and S-3) that are still reported in the old spillway section. These are also located on the upstream side of the dam crest. They indicate a more fluctuating saturation level at up to 34 feet below the dam crest for S-1, and 44 feet for S-2. Piezometer S-3 indicates the saturation level lower than 39 feet below the dam crest.

There is one remaining monitored piezometer (S-6) on the downstream side of the dam crest at the old spillway section. It indicates a saturation level in the dam in the past year lower than 44 feet below the dam crest.

At Dike 1, MWD reports that a number of piezometers are not reading accurately and are possibly inoperable. They are planning to investigate and determine if these instruments can be rehabilitated or may need to be abandoned. A program for maintaining the hydraulic piezometers, if feasible, is currently being planned.

Piezometer Instrumentation Recommendation #1:
Though the data for the upstream shell saturation level was once useful for monitoring the embankment response to the stresses of new construction and first filling, it is no longer considered of value now that the dam has stored water for decades. Though upstream shell piezometers might show the slope is saturated, this information is of limited value because slope stability analyses typically and conservatively model the upstream shell of a dam as saturated and the downstream shell as at least partially dry. *Therefore, it is recommended that the upstream piezometer monitoring be terminated and effort and resources be refocused on rehabilitating the downstream piezometric monitoring.*

Piezometer Instrumentation Recommendation #2:
The piezometric data can best be evaluated for dam safety if the saturation level is shown on a cross-sectional view of the dam and compared to the saturation level modeled in the slope stability analysis for the dam. *We recommend this representation should be added to future reports for meaningful and efficient interpretation of the data.*

Seepage Weirs
The weir data was evaluated and all seepage flow within this reporting period is consistent with past behavior corresponding to reservoir stage and precipitation. Anomalous peaks quickly return to normal and are typically associated with rain events. The operating weirs are instrumented with alarms, and seepage patterns will continue to be monitored. The weirs and their normal and reporting period range of seepage measures are as follows:

Table 3. Reporting Period Weir Seepage Flows as compared to Long Term Flows

Weir #	Weir Type	Location	Long Term (normal) Flow Range (gpm)	Reporting Period Flow Range (gpm)
PB-C	Palmer Bowlus	Dike 1	0 to 60	0 to 32
PB-D	Palmer Bowlus	Dike 1	0 to 250	0 to 100
PB-E	Palmer Bowlus	Dike 1	0 to 140	20 to 75
PB-M	Palmer Bowlus	Dike 1	0 to 500	0 to 170
Tunnel	Orifice	Tunnel	0 to 2	0.25 to 0.50
Old Spillway	30° v-notch	Old Spillway	0 to 60	0 to 0.25
New Spillway	30° v-notch	New Spillway	0 to 40	0 to 0.1
Main Dam	90° v-notch	Main Dam toe	0 to 60	5 to 10
F-2	Unknown	Dike 2	0 to 160	0 to 0

MWD will soon be installing a weir box, which has been delivered to the site, to measure and monitor the seepage flows from the [redacted] hydraulic piezometers (C-5, C-6, C-7) at Sta. 90+00 of Dike 1. The old abandoned (since 1979) terminus gauge box for these piezometers has collapsed, very likely due to corrosion, and two of the piezometer tubes were found to be flowing with water leaking directly onto the ground. The new weir box will capture and measure this flow.

The instrumentation program and monitoring frequency at this dam is judged to be satisfactory with the exception of the recommended piezometer rehabilitation and reporting improvements.

Name of Dam Mathews Dam No. 35-0

Date of Inspection 12/27/2016 to 12/28/2016

Photo 1. The downstream face of the Main Dam.

Photo 2. The upstream face of the Main Dam.

Photo 3. The old spillway channel with the Old Spillway Seepage Weir housing in the foreground and the old spillway bridge and embankment raise in the background.

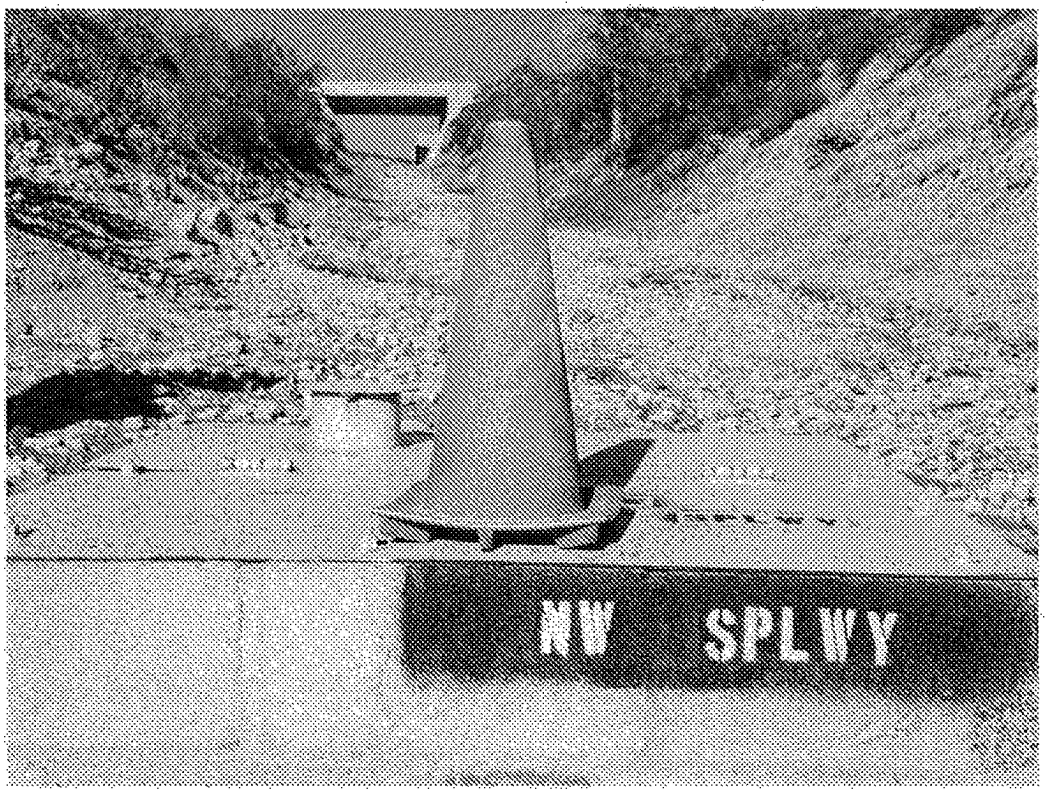

Photo 4. The new spillway channel with the New Spillway Seepage Weir in the foreground and the new spillway bridge in the background.

Photo 5. Walking the Dike 1 old dam crest gave a good view of the concrete lined upstream face of the dam raise.

Photo 6. The most severe example of the holes associated with the coping wall weepholes in the old dam crest of Dike 1.

Photo 7. Partial view of the downstream face of Dike 1.

Photo 8. The Dike 2 dam crest.

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DIVISION OF SAFETY OF DAMS

FILE

INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS

Name of Dam Mathews Dam No. 35-0 County Riverside
Type of Dam Earth Type of Spillway Concrete weir
Water is 17.8 feet below spillway crest and 31.8 feet below dam crest.

Weather Conditions Moderate
Contacts Made Dennis Godfirnon, Dennis LaChaine, Tom Hibner, and Bei Su with MWD
Reason for Inspection Periodic Maintenance Inspection

Important Observations, Recommendations or Actions Taken

- The erosion at the downstream left groin of Dike 1 is up to two feet deep and should be repaired.
- The concrete damage including buckling and cracking at the construction joint (due to expansion) to the upstream panels at the northeast side of Dike 1 should be repaired.
- [redacted] valves, [redacted] valves, and [redacted] valves were fully cycled during this inspection.
- A couple of the old hydraulic piezometer tubes have ruptured and water is squirting out of the tubes. MWD should develop a plan to remedy the leaking piezometer tubes.
- Weir 1 was requested to be cleared and the Main Dam toe weir plate should be repaired.
- The next instrumentation submittal should address the seepage and piezometer anomalies noted in the last inspection report.

Conclusions

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

Observations and Comments

Dam

Main Dam: The asphalt crest, fence, and parapet wall appeared level and well aligned. The visible portion of the concrete panels on the upstream slope appeared to be uniform and stable. The rip-rap covered downstream slope was also in good condition with no signs of any instability. The toe appeared normal and dry. Vegetation and rodent control were satisfactory. The abutments and groins were stable and in good condition. The erosion damage to the downstream right groin at the Main Dam has been repaired as requested during the last inspection.

Dike 1: The asphalt crest and parapet wall were well aligned, level, and in good condition. The visible portion of the concrete panels on the upstream slope appeared to be in satisfactory condition. There was concrete damage including buckling and cracking at the construction joint (due to expansion) to the upstream panels at the Northeast side of Dike 1. There have been other areas that had this damage and have been repaired. Even though the damaged panels are above the freeboard section of the dam, it would be beneficial to repair the concrete damage to mitigate potential erosion under the concrete panels. The water level was low enough that we were able to walk the upstream bench. There were pop-outs to the asphalt on the upstream bench that will be repaired. Vegetation control was excellent and additional bait traps have been strategically placed on the embankment providing adequate rodent control. The abutments were normal and stable. The erosion at the downstream left groin is up to two feet deep and should be repaired.

Dike 2: The asphalt crest of Dike 2 was level and in good condition. The upstream and downstream slopes are covered with a rip-rap cover. Both slopes were uniform, normal, and stable. The toe was dry and normal. Vegetation and rodent control were satisfactory.

The Main Dam and both Dikes appeared normal compared to my prior visits.

Inspected by Joe Boyce 12/30/15
Date of Inspection 12/16-17/2015 12/31/15
Date of Report 12/23/2015

Photos taken? Yes X No
cc for Owner/Book

1/4/16

INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS

Name of Dam Mathews Dam No. 35-0

Date of Inspection 12/16-17/2015

Observations and Comments

Spillway The spillway approach, weir, channel, and downstream exit were open and clear. The weep holes in the spillway appeared unobstructed. The concrete that comprised the spillway appeared to be structurally sound and in good condition.

Outlet The I/O tower was inspected and remains in stable condition. The I/O tower contains [redacted] valves per [redacted]. The bottom [redacted] valves are used the most frequently for water deliveries and are the hardest to schedule to be operated. The [redacted] valves were fully cycled 100% during this inspection. The outlet system also includes [redacted] Valves and [redacted] (that isolate the [redacted] Valves) in the downstream outlet structure. [redacted] Valves [redacted] and [redacted] along with [redacted] Valves [redacted] through [redacted] were fully cycled during this inspection. All the [redacted] and [redacted] Valves operated smoothly. A schedule to operate a third of the valves each inspection has been implemented, and about a third of the valves were operated during this inspection. See the table below on what valves need to be operated during the upcoming inspections.

Proposed Annual Outlet Operation Schedule:

	Outlet Component to Cycle
Year 1 (Completed)	[redacted]
Year 2	[redacted]
Year 3	[redacted]

Seepage There were no concerning signs of seepage detected on the embankments, groins, or toes. However, the old hydraulic piezometers at the toe of Dike 1 are leaking. The piezometer tubing is very old and brittle and a couple of the tubes have ruptured and water is squirting out of the tubes. The owner should develop a plan to remedy the leaking piezometer tubes. Finishing touches to the new real-time monitoring for the Palmer Bowlus weirs are being fine-tuned so the seepages for these weirs were not available. Weir 1 and 2 downstream of the Main Dam were dry. Weir 1 was silted in and was obstructed with vegetation. The silt and vegetation at Weir 1 was requested to be cleared. The Main Dam toe weir has a gap under the weir plate that water is flowing underneath and not providing an accurate reading. The weir plate needs to be repaired. The flow appeared to be less than 5 gpm. The new spillway weir was trickling and the old spillway weir was flowing about ¼ gpm. The [redacted] was leaking about 0.25 gpm. All flows were clear and normal for the low reservoir level.

Name of Dam Mathews Dam No. 35-0

Date of Inspection 12/16-17/2015

Observations and Comments

It should be noted that there is a clay pipe that has been exposed in the unlined channel of the new spillway. The clay pipe appears to collect seepage and direct it toward new spillway weir box. The clay pipe has been damaged and the alignment is off. Even though the clay pipe is broken, seepage water can still make its way to the weir box. The owner should look into whether it is in their best interest to repair the damaged collector pipe. There used to be constant vegetative overgrowth in this area of the spillway channel prior to this seepage collector pipe and weir being installed.

Instr. The instrumentation at this dam consists of 56 piezometers, 99 survey monuments, and 11 seepage locations. The latest instrumentation report was dated March 24, 2015 and covers the monitoring period from January 1, 2014 through December 31, 2014. The data was previously reviewed and commented on in the previous inspection report. It was noted that there were a few seepage and piezometer anomalies that should be addressed in the next instrumentation submittal.

Erosion at the downstream left groin of Dike 1 should be repaired.

Name of Dam Mathews Dam No. 35-0

Date of Inspection 12/16-17/2015

Concrete damage on the upstream slope of Dike 1 should be repaired.

Water is flowing out of the old hydraulic piezometer tubes at the toe of Dike 1.

INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS

Name of Dam Mathews Dam No. 35-0

Date of Inspection 12/16-17/2015

Weir 1 silted in and obstructed with vegetation.

[redacted]

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

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INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS

Name of Dam	Mathews	Dam No.	35	County	Riverside
Type of Dam	Earth	Type of Spillway	Open Channel with Ogee Crest Side Channel		

Water is 57.1 feet below spillway crest and 71.1 feet below dam crest.

Water Surface Elevation – 1,332.9

Weather Conditions: Cloudy and cool, light rain before inspection, 50 - 60° F

Contacts Made: Dennis Godfirnon with Metropolitan Water District of Southern California (MWD)

Reason for Inspection: Periodic Maintenance Inspection of Jurisdictional Dam

Important Observations, Recommendations, or Actions Taken

1. Repair the embankment damage caused by burrowing rodents on the downstream slope of Dike No. 1, near the left abutment (see Photo 4). Rodent abatement measures should be concentrated on this area.
2. Repair the eroded section of the downstream shoulder/downstream slope of the main dam (see Photo 6).
3. All of the [redacted] valves in the I/O tower that were reported to be inoperable during our previous inspection were reported to have been repaired; all [redacted] valves in the I/O tower are now functional.
4. I discussed with Mr. Godfirnon the need to establish a revolving schedule to facilitate the full cycling of all the outlet components during DSOD inspections a minimum of once every three years; a summary is included in Table 2 of this report.
5. The graphs of piezometer data show that several of the piezometers at the spillway, Dike No. 1, and Dike No. 2 have saturation levels that are above the reservoir water surface elevation or are unresponsive. This condition needs to be investigated and an explanation should be provided in the next instrumentation submittal.
6. The size and elevation range on the vertical axis of the graphs displaying the piezometer data make it difficult to evaluate the plotted data, especially for the current monitoring period. Adjusting the elevation range to increase the vertical exaggeration will make the plots easier to read and more effective. Include a cross section of the embankment for each piezometer installation.
7. I recommend a more comprehensive engineering evaluation of the instrumentation data be included with future surveillance report submittals. The written evaluation should specifically correlate the instrumentation data obtained during the monitoring period with the safe performance of the main dam and both dikes. The evaluation should identify and address any abnormal or erroneous readings and comment on the overall adequacy of the instrumentation network.

Conclusions

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

Inspected by: R. Fessler RFF 7/14/15

Photos taken? Yes X No

Date of Inspection: 12/17&18/2014 JEE 7/1/15

Copy for: Owner / File / Field Book

Date of Report: 05/27/2015

Name of Dam Mathews Dam No. 35

Date of Inspection December 17 & 18, 2014

Observations and Comments

Dam

Main Dam La Sierra Avenue, a busy roadway, runs across the crest of the main dam. We drove and walked sections of the crest as traffic allowed; we then walked the upstream slope, groins, downstream slope and along the downstream toe of the dam. The dam crest and parapet wall were well-aligned; the asphalt-covered crest appeared level with no signs of concerning settlement or significant cracking. The visible portion of the concrete-lined upstream slope appeared uniform and stable with no significant cracking or noticeable signs of distress. The rip-rap covered downstream slope was also uniform, appeared stable, and remains in good condition. There was a small section on the top of the downstream slope, at the dam crest behind the guardrail, where runoff from La Sierra Avenue has begun to erode the embankment (see Photo 6). I discussed with Mr. Godfirnon the need to have the damaged section repaired before the erosion progressed any further; he conveyed he would inform maintenance staff to have it taken care of. The dam's contact with the abutments appeared normal; no signs of instability were observed in the groins or along the downstream toe.

Vegetation control was satisfactory on and around the main dam. Damage to the embankment caused by burrowing rodents was present but was at a level that is considered minimal. The rodent control measures in place at the main dam appear to be effective and should be maintained; any burrows or holes discovered should be collapsed and filled with compacted soil and/or gravel to prevent the progression of embankment damage.

Dike No. 1 [redacted] which is located northeast of the main dam. The dam crest and parapet wall were well-aligned across the entire length of the dam; the asphalt-covered crest appeared level with no signs of settlement or significant cracking present. The downstream access road and visible portion of the concrete-lined upstream slope was uniform and appeared stable with no significant cracking or signs of distress. The rip-rap covered downstream slope was uniform, appeared stable, and remains in good condition. The visible portion of the dam's contact with the abutments appeared normal and stable; no signs of instability were observed in the groins or along the downstream toe.

Vegetation control was excellent on and around Dike No. 1. Damage to the embankment, caused by burrowing rodents, was minimal over the majority of the dam's surface and in the surrounding areas, with the exception of a small area on the downstream slope, near the left abutment (see Photo 4). Rodent abatement measures should be increased and/or focused on this area; all existing burrows or holes should be collapsed and filled with compacted soil and/or gravel to discourage additional burrowing and to prevent the progression of damage to the embankment. The rodent control measures in place for the remainder of Dike No. 1 appeared to be effective and should be maintained and monitored to ensure the ongoing effectiveness.

Name of Dam Mathews Dam No. 35

Date of Inspection December 17 & 18, 2014

Observations and Comments

Dam *(cont'd)*

Dike No. 2 We walked the crest, portions of each of the slopes, the downstream left groin, and along the downstream toe of Dike No. 2, which is located just southeast of the main dam. The dam crest and parapet wall were well-aligned; the asphalt-covered crest appeared level with no signs of settlement or significant cracking present. The visible portion of the concrete-lined upstream slope appeared uniform and stable with no significant cracking or signs of distress. The downstream slope was also uniform, appeared stable, and remains in good condition. The dam's contact with the abutments appeared normal; no signs of instability were observed in the groins or along the downstream toe.

Vegetation control was satisfactory on and around Dike No. 2, with the exception of a small palm growing on the upstream side of the parapet wall and a group of cactus plants along the bottom of the concrete liner on the upstream slope. Vegetation control for these items had been requested as part of our previous inspection report; Mr. Godfirnon conveyed that he was under the impression they had already been removed and that he would see to it that it would be taken care of. Damage to the embankment caused by burrowing rodents was present but was at a level that is considered minimal. The rodent control measures in place at Dike No. 2 appear to be effective and should be maintained; any burrows or holes discovered should be collapsed and filled with compacted soil and/or gravel to prevent the progression of embankment damage.

Spillway

There are two spillways at this dam; they are referred to as the Old Spillway and the New Spillway. The New Spillway is located northwest of the Old Spillway and it replaced the Old Spillway, which is no longer functional. I inspected the New Spillway and found that the concrete control weir remains in good structural condition with no significant cracking or damage observed. The sloped walls of the spillway channel remain well-aligned; no significant cracking or distress was evident in the spillway channel concrete. The approach area, control section, and exit channel of the spillway were unobstructed and clear of debris.

Outlet

Outlet system components were not exercised during this inspection as members of MWD's Operations staff were working on tasks at other locations and not available. We accessed the I/O tower and the forebay control structure and found that all visible components of the outlet system appeared to be in excellent working condition and were very well-maintained. I inquired as to the status of repairs needed to restore the functionality of several of the I/O tower [redacted] valves that were reported to be [redacted] during our previous inspection. Mr. Godfirnon reported that all of the formerly [redacted] valves had recently been repaired and that all [redacted] valves in the I/O tower are again in working order.

Components of the dam's outlet are continually maintained and fully exercised annually by MWD's Operations and Maintenance staff. The table below summarizes the type and number of

Observations and Comments

Outlet *(cont'd)*

individual outlet components along with the dates that the components were last independently operated by the owner along with the dates they were last operated during a DSOD inspection. It was reported that all of the outlet components performed well during the most recent operation.

Table 1. Outlet Component Summary

Outlet Component	#	Independent Operation by Owner	Operation in DSOD Presence
[redacted] Valves	[redacted]	December 2014	January 2014
[redacted] Valves	[redacted]	December 2014	November 2011
[redacted] Valves	[redacted]	December 2014	November 2011
[redacted] Gates	[redacted]	December 2014	January 2014

Because of the magnitude of the outlet system and the number of individual components involved that need to be scheduled in coordination with DSOD's inspection and fully cycled in the presence of DSOD staff every three years, I discussed with Mr. Godfirnon the need to establish a revolving schedule. It was agreed that developing a plan would be beneficial for all involved; with input from a member of the MWD's Operations and Maintenance Division, the schedule summarized in Table 2 below was developed.

Table 2. Proposed Annual Outlet Component Exercising Schedule

	Outlet Component to Cycle
Year 1	[redacted]
Year 2	[redacted]
Year 3	[redacted]

Mr. Godfirnon conveyed that he would inform MWD management of my proposed plan to see if there were any concerns or questions and that he would contact me to confirm.

Seepage

The ground surface at all three dams, and the entire surrounding area, were wet from light to moderate rain the day before the inspection. There were no obvious or unusual signs of seepage observed on the downstream face of the dams or in the abutment contacts. Seepage readings are taken monthly at several locations for each of the three dams and several reading were taken and confirmed by Mr. Godfirnon during the inspection. The measurements taken were reported to be consistent with historic quantities and the seepage observed was clear.

Observations and Comments

Instrumentation

Instrumentation for this dam consists of the following:

Table 3. Instrumentation Summary

Instrumentation	Main Dam	Dike No. 1	Dike No. 2	TOTAL
Survey Monuments	37	48	14	*99*
Piezometers	8	31	8	*56*
Seepage Weirs	6	4	1	*11*

The most recent submittal of instrumentation data was received by DSOD in April of 2015, in a report dated 03/24/2015. The monitoring period for the data included with the report was January 1, 2014 through December 31, 2014.

Survey Monuments Survey monuments are located on the crest and upstream slopes of the main dam and both dikes and along the downstream to of Dike No. 1. Ten year plots of the surveyed data are included with the surveillance report. The most recent survey of the dam took place in December 2014. The maximum values for lateral movement and vertical settlement were 0.5-inch or less for each of the monuments. The magnitude of these movements is negligible and considered normal and acceptable for dams of these sizes and types.

Piezometers Ten-year plots were provided for all piezometer data. The 8 piezometers on the main dam include 2 upstream open well piezometers (C1 and C2) and 6 piezometers at the old and new spillways (S1, S2, S3, S4, S6 and S7). The open well piezometers appear to be responsive to variations in reservoir elevation and/or were dry during the reporting period. The spillway piezometers reported saturation levels above that of the reservoir elevation during the second half of the monitoring period; this should be explained and/or addressed. Reading of the downstream piezometers (D1-D13), located in the filter zone and buttress, have been suspended due to reported employee safety concerns. A means to restore the monitoring of these piezometers should be established.

The 31 piezometers for Dike No. 1 include 20 in the embankment, 9 in the foundation, and 2 at the right abutment. The 8 piezometers at Dike No. 2 include 2 in the embankment (2-1 and 2-4), 2 in the zone between the embankment and foundation (2-2 and 2-7), and 4 in the foundation (2-3, 2-5, 2-6, and 2-8). The graphs of piezometer data show that several of the piezometers at Dike No. 1 and Dike No. 2 saturation levels above the reservoir water surface elevation or are unresponsive; the behavior and performance of each of the piezometers needs to be investigated and an explanation should be provided.

Seepage One-year and ten-year plots were provided for all seepage locations. Readings for several of the seepage monitoring stations were either dry or had readings less than historic

Observations and Comments

Instrumentation *(cont'd)*

quantities, as expected due to the lower than normal water levels in the reservoir during the 2014 monitoring period. All of the recorded seepage quantities were within or were slightly less than their historic range, varied in response to precipitation in the area, and appear normal for these dams. Graphs 35-111 and 35-111A are labeled as Dike 1; it appears that they are mislabeled and should be labeled Dike 2.

The instrumentation program and monitoring frequency at this dam are currently judged to be adequate. No additional instrumentation is needed at this time; however the anomalies noted in regard to the seepage and piezometer data need to be addressed.

INSPECTIOI ⁻ DAM AND RESERVOIR IN CER ... IED STATUS

Name of Dam Mathews Dam No. 35

Date of Inspection December 17 & 18, 2014

Photo 1: View of Dike No. 1 crest

Photo 2: View of upstream slope of Dike No. 1

Photo 3: View of downstream slope of Dike No. 1

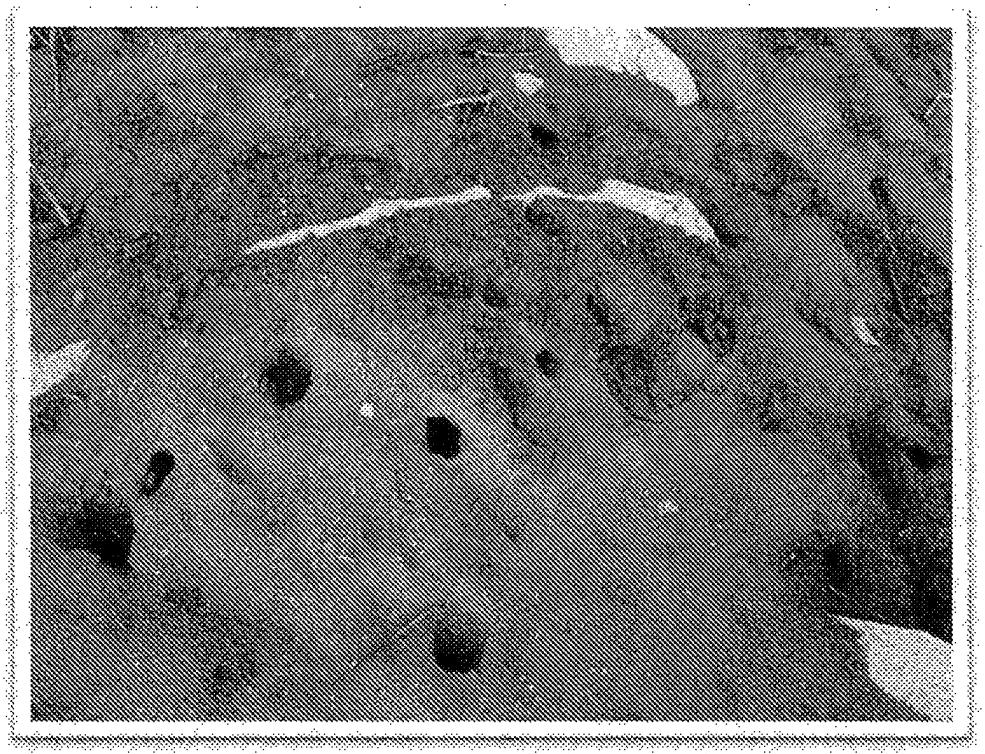

Photo 4: View of rodent burrowing on Dike No.1

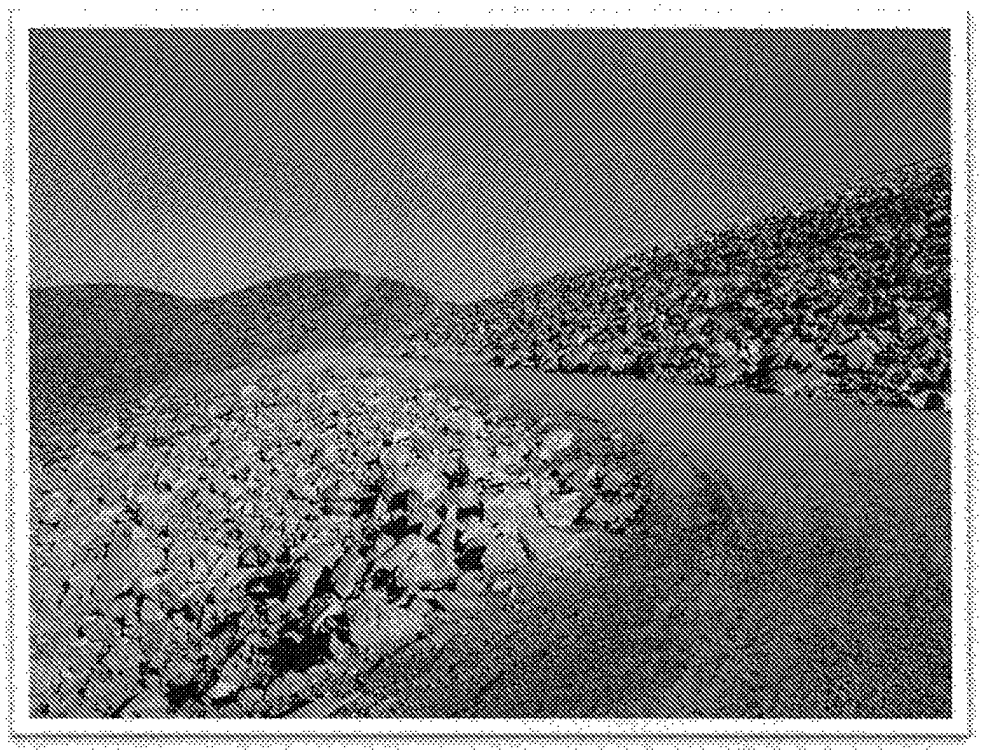

Photo 5: View of access road and downstream slope of the main dam

Photo 6: View of erosion damage on downstream slope of the Main Dam

Name of Dam Mathews Dam No. 35

Date of Inspection December 17 & 18, 2014

Photo 7: View of upstream slope of Dike No. 2

Photo 8: View of objectionable vegetation on upstream slope of Dike No. 2

Name of Dam Mathews Dam No. 35

Date of Inspection December 17 & 18, 2014

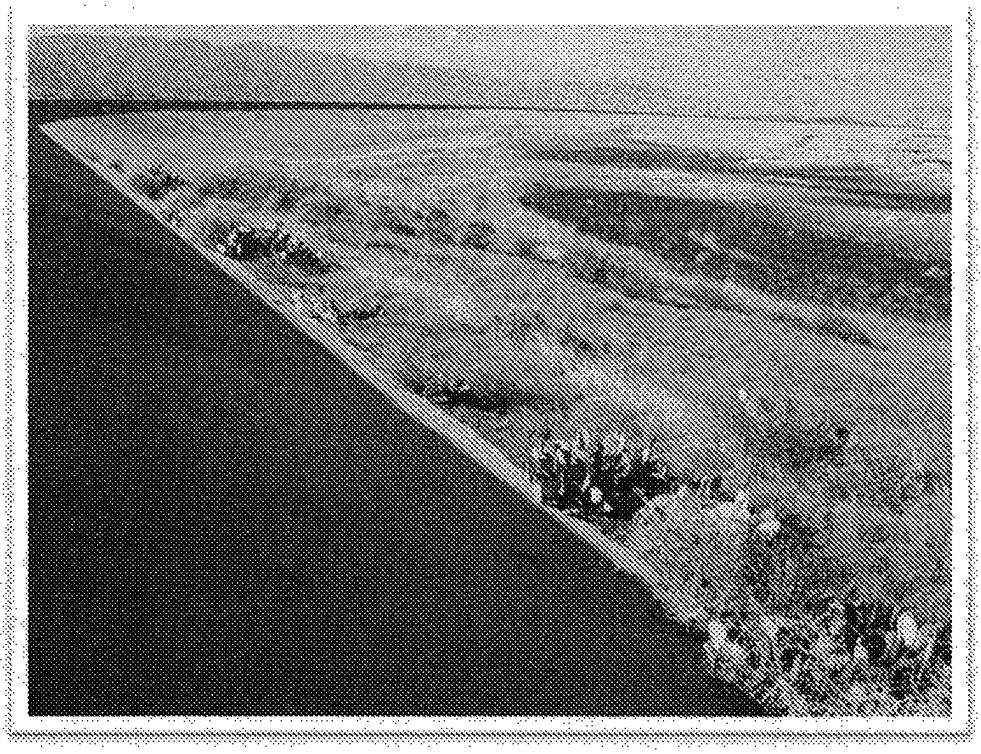

Photo 9: View of objectionable vegetation on upstream slope of Dike No. 2

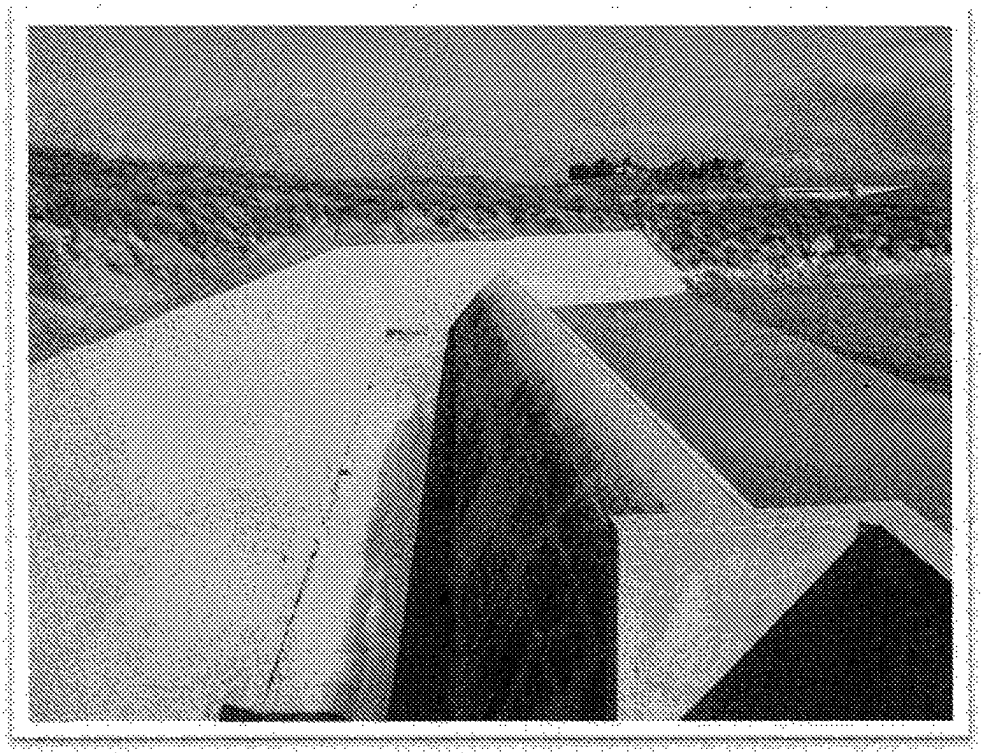

Photo 10: View of the 'New Spillway' approach and weir

Name of Dam Mathews Dam No. 35

Date of Inspection December 17 & 18, 2014

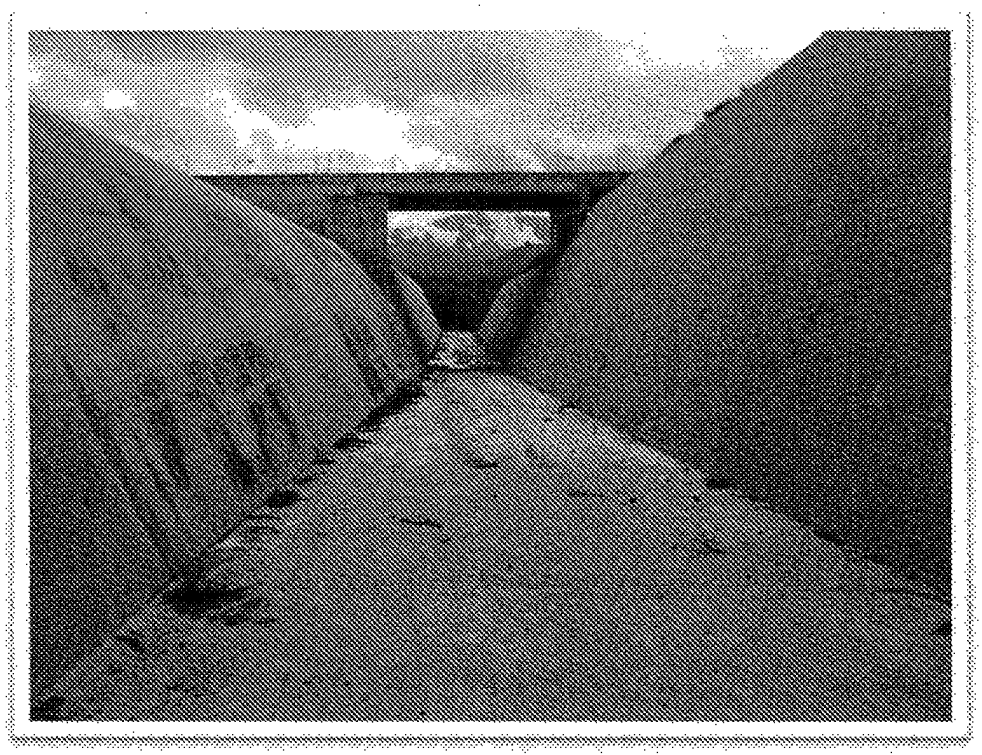

Photo 11: View of the 'New Spillway' channel

Photo 12: View of downstream slope and left abutment of the Main Dam

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

FILE File

INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS

Name of Dam Mathews Dam No. 35-0 County Riverside
Type of Dam Earth Type of Spillway Open channel with ogee crest side channel control
Water is 15.4 feet below spillway crest and 29.4 feet below dam crest.
W.S.E. at El. 1374.6
Weather Conditions Sunny and cool
Contacts Made Dennis Godfirnon of MWD
Reason for Inspection Periodic Maintenance

Important Observations, Recommendations or Actions Taken

- Recommend erosion gullies on the dike crests and piezometer access ramps be backfilled with gravel to prevent progressive erosion.
- Review the abrupt drop in the C-2 open-well piezometer that occurred last year, and other piezometer data that appears anomalous as discussed in "Instrumentation" below. Report your findings immediately or in the next submittal as appropriate.

Conclusions

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

Observations and Comments

Dam

[redacted] The crest and concrete parapet wall were level, well-aligned, and in good condition. The upstream and downstream slopes were uniform with no sign of instability. The visible portions of the upstream concrete panels were in generally satisfactory condition with no bulges, warps, or slumps. Dennis said he didn't think they had repaired the spalls that I had discussed in my previous inspection report (January 2009). No concerning vegetation or erosion was noted on the downstream riprap dam face or groin areas. Some minor rodent activity was noted. The main dam v-notch weir was clean and the passing flow was clear. There was no gauge and Dennis reported they took measurements by tape at this weir. The old spillway weir was clear and the passing water was clear. Dennis measured the flow at 0.125' which was consistent with past readings. The new spillway weir was likewise clean and passing clear flow measured at 0.075, which is consistent with past readings. Dennis reported the willows and reeds congesting the discharge point at the toe of the dam, which he indicated could swamp the Main Dam seepage weir, were to be cleared but they were waiting for environmental clearance (to avoid nesting season) to do the work.

Dike 1 – The asphalt paved dam crest and the concrete parapet wall were level, well-aligned, and in good condition. There was normal cracking in the asphalt. The upstream and downstream slopes were uniform with no sign of instability. The visible portions of the upstream concrete panels were in generally satisfactory condition. No concerning erosion or rodent activity was noted on the downstream riprap dam face or groin areas. The native grass on the toe apron is kept closely mowed. Rodent bait stations were placed every few hundred feet apart.

Dike 2 -- The entire upstream face of Dike 2 was exposed because of the low lake level. The riprap upstream and downstream slopes were uniform with no sign of instability. The asphalt paved dam crest and the concrete parapet wall were level, well-aligned, and in good condition.

The dam and dikes appeared overall well-maintained. Recommend erosion gullies on the dam crest and piezometer access ramps be backfilled with gravel to prevent progressive erosion. All of

Photos taken? Yes X No
cc for Owner/Book

Inspected by Anna Kolakowski AK
Date of Inspection 01/08/2014
Date of Report 04/08/2014

4/30/14

the abutments were stable.

Spillway — The spillway approach was dry. The concrete elements of the approach apron, ogee control section, channel, and walls were in good condition with no open or misaligned joints or concerning cracks. The approach, crest, and channel were clear of obstruction and the weepholes were dry. The vegetation was satisfactorily trimmed 5 feet from the spillway structure.

Outlet — We inspected the outlet tunnel which had been ventilated for the inspection. The [redacted] concrete-lined tunnel, which was excavated into bedrock, was in generally good condition. I noted that there were hoop cracks in the concrete tunnel lining that showed minor dripping leaks starting at Sta. 14+61 (stations painted on the tunnel wall). The area downstream of the tunnel was clear.

The I/O tower and access bridge were in excellent condition. There are [redacted] with [redacted] valves per tier [redacted] The visible valves appeared to be in good condition (Photo 4). The valves at [redacted] were all successfully hydraulically operated full cycle during this inspection with the exception of Valve [redacted] which was inoperable. It took about [redacted] to operate each valve full cycle. Reportedly all the valves that become inoperable (those reported this time were Valves [redacted] are regularly maintained by divers. Gates [redacted] at the [redacted] were successfully hydraulically operated full cycle during this inspection.

Logs showing operation of the [redacted] valves in the forebay headworks between October 29 and October 31, 2013 was provided by Dennis Godfirnon via email following the inspection. The log at the tower indicated the tower valves were exercised in the past year.

Seepage — The reservoir level was relatively low and no seepage was noted on the dam or dikes, groins, or toe areas. The weir readings noted during the inspection were as follows and were within the normal range:

Weir #	Weir Type	Location	Flow Reading (ft)	Flow volume (gpm)
PBC	Palmer Bowlus	Dike 1	none	20
PBD	Palmer Bowlus	Dike 1	none	100
PBE	Palmer Bowlus	Dike 1	none	80
PBM	Palmer Bowlus	Dike 1	none	100
Tunnel	Orifice	Tunnel	none	none
Old Spillway	30° v-notch	Old Spillway	0.125	2.1
New Spillway	30° v-notch	New Spillway	0.075	< 1.0
Main Dam	90° v-notch	Main Dam toe	n/a	5.0

Instr. — Instrumentation at this dam consists of survey monuments, piezometers, and seepage weirs. The latest surveillance submittal dated February 13, 2014, covers the monitoring period January 1, 2013 through December 31, 2013. The instrumentation submittal for this dam is presented in an excellent format that includes an engineering evaluation, plans showing the location of instrumentation, and plots that provide for clear evaluation of the data.

The weir data was evaluated and all seepage flow is consistent with past behavior corresponding to reservoir stage and precipitation. There are some anomalous peaks that cannot be explained by ambient conditions, but these quickly return to the normal pattern and remain within historical

levels. The operating weirs are instrumented with alarms, and seepage patterns will continue to be monitored.

The survey data (lateral and vertical movement) was evaluated and no concerning settlement or lateral movement was identified in the reporting period or on the 10-year plots.

All of the piezometers (D-1 through D-13) that monitor saturation levels in the downstream shell have been abandoned due to access and safety concerns. The owner's engineering evaluation provides the opinion that the limited information provided by the abandoned piezometers (they have either been dry or flat) is better provided by the seepage instrumentation (90 degree v-notch weir) at the toe of the dam, which also would provide early warning of any significant changes in seepage level caused by adverse changes in the embankment or foundation, or malfunction of the filter and drain zones.

Two upstream open well piezometers (C-1, C-2) continue to be monitored in the Main dam. [redacted]

Spillway piezometers (S-1 through S-7) located in the embankment section bridging the old spillway are responsive to the reservoir level and appear to be tracking normally except for S-4 (paired with S-3) which frequently shows saturation levels above that of the reservoir level. Piezometer S-7 (paired with S-6) tracks flat.

A number of Dike 1 piezometers frequently show saturation levels above that of the reservoir level. Dike 2 Piezometer 2-4 (above reservoir level) and 2-7 have tracked flat and unresponsive for a number of years.

The instrumentation at this dam is judged to be satisfactory with the exception of some the piezometer performance. The owner should report their review of anomalous readings immediately or in the next submittal as appropriate.

Name of Dam Mathews Dam No. 35-0

Date of Inspection 01/08/2014

Photo 1. View of the Main dam looking north.

Photo 2. View of the Main dam looking south.

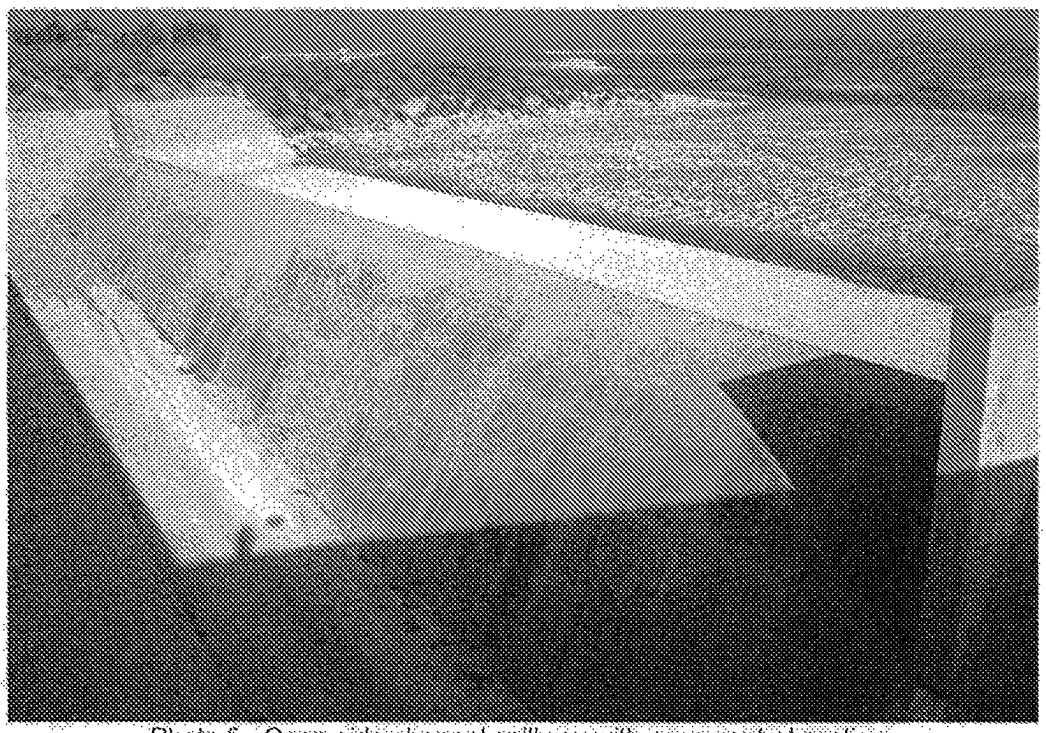

Photo 5. Open side channel spillway with ogee control section.

Photo 6. Golden Eagle on the Dike 1 parapet.

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

FILE

INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS

Name of Dam Mathews Dam No. 35 County Riverside
Type of Dam Earth Type of Spillway Concrete weir
Water is 28.4 feet below spillway crest and 42.4 feet below dam crest.

Weather Conditions Moderate
Contacts Made Chris Hill, Dennis Godfirnon, Evelyn Ramos, and Valerie Nevarez with MWD
Reason for Inspection Periodic Maintenance Inspection

Important Observations, Recommendations or Actions Taken
The Main Dam weir had a crack in the weir plate along the bottom weld and should be repaired.
The valves in the outlet tower should be operated during the next inspection with the necessary authorizations obtained.

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

Observations and Comments

Dam

Main Dam: The asphalt road on the crest was in good condition. The crest and parapet wall were level and well aligned. The upstream slope was traversed and the visible concrete panels were found to be in good condition. The rip-rap covered downstream slope was uniform with no signs of instability. Vegetation and rodent control were satisfactory.

Dike 1: The paved crest and parapet wall were straight, level, and in good condition. The visible concrete panels on the upstream slope were in good condition. There were a few minor erosion rills on the downstream shoulder, but not deep enough to warrant repair at this time. Vegetation control was excellent. There was no concerning rodent activity detected and new bait stations that only trap ground squirrels have been installed.

Dike 2: The asphalt crest was level and in satisfactory condition. The upstream and downstream rip-rap covered slopes were uniform and normal. The abutments were stable and in good condition. Vegetation and rodent control were adequate.

Spillway

The spillway approach, channel, and downstream exit were open and clear. The weep holes were unobstructed. The concrete that comprises the spillway was in sound condition.

Outlet

The [redacted] was inspected and found to remain in good condition with no signs of distress. The tunnel remains relatively dry with only a couple minor seeps. The I/O tower was entered and remains stable and in good condition. [redacted] We should see all the valves in the outlet tower fully cycled during the next inspection. Tower valves [redacted] were reported to be inoperable. The remaining valves in the tower were operated within the last month, according to the log book. The tower valves are operated monthly. There are [redacted] valves and [redacted] valves located at the forebay that were fully cycled 100% during the November 2011 inspection with ease.

Photos taken? Yes X No ____
cc for Files

Inspected by Joe Boyce 3/6/2013
Date of Inspection 12/3-4/2012
Date of Report 1/3/2013 1/7/13

INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS

Name of Dam Mathews Dam No. 35

Date of Inspection 12/3-4/2012

Observations and Comments

Seepage

There was no sign of seepage on the downstream slopes, groins, or toes from the Main Dam, Dike 1, or Dike 2. Weir 1 was dry and Weir 2 had a slow trickle (probably from the recent rainfall). These weirs are typically dry. The following readings were obtained from field measurements and from the automated Geomation data:

Weir	Flow (gpm)
Main Dam	0.7
New Spillway	0.7
Old Spillway	1.8
[redacted]	0.5
Palmer Bowlus C	20.9
Palmer Bowlus D	48.6
Palmer Bowlus E	38.2
Palmer Bowlus M	124.9
F2 (Submerged)	Needs Replacement

Visual field inspection of the weirs at the New Spillway and Old Spillway showed higher flow readings than the Geomation data and should be recalibrated. The Main Dam weir had a large crack in the weir plate along the bottom weld and should be repaired. The majority of seepage was flowing through the crack in the weld so the 0.7 gpm flow over the Main Dam weir is actually higher. Seepage flows were significantly lower than normal due to the low reservoir level.

Instr.

The instrumentation at this dam consists of piezometers, survey monuments, and seepage points. The latest instrumentation report was dated February 1, 2012. This instrumentation report covers the period from January 1, 2011 through December 31, 2011 for Mathews Dam.

The instrumentation submittal included data on 8 piezometers at the Main Dam, 31 piezometers at Dike 1, and 8 piezometers at Dike 2. The 8 piezometers at the Main Dam include 6 piezometers (S1, S2, S3, S4, S6, and S7) located in the embankment or foundation where the old spillway was located. Piezometers S1 and S6 are located in the foundation with S1 located upstream of the core and S6 located downstream of the core. Piezometers S2, S3, and S4 are located in the embankment upstream of the core and Piezometer S7 is located downstream of the vertical filter drain and above the downstream blanket drain. Data for Piezometer S7 was constantly dry during the monitoring period and shows the vertical filter drain and blanket drain are functioning like they were designed to keep the downstream embankment dry.

Observations and Comments

The other piezometers track reservoir levels fairly closely and follow normal trends and conditions. The tip of Piezometer S4 is located at the highest elevation (1372.8') in the upstream embankment and was above the reservoir level for a portion of the monitoring period. Piezometers C1 and C2 are located at the maximum section of the Main Dam located below the crest of the original embankment. These two piezometers are not influenced by reservoir levels and were fairly constant during the monitoring period. Piezometers C1 and C2 fluctuate slightly after precipitation events. Piezometers D1 through D13, installed in the 1960's, are inoperable and no longer monitored. There are seepage locations at the downstream toe that are continuously monitored. The owner believes that adverse changes in the embankment, foundation, or malfunction of the filter and drain zones would be shown with significant increases in seepage levels.

There are a total of 32 piezometers located at Dike 1 (only 31 piezometers read) that include 20 piezometers in the embankment (only 19 read), 10 piezometers in the foundation, and 2 in the right abutment. There were two unusual readings noted in our prior maintenance instrumentation report. Piezometer 1-19 dropped approximately 50 feet in mid-2009 from Elevation 1355 to Elevation 1305. The 10-year data shows Piezometer 1-19 remains fairly constant around Elevation 1360 and after the drop, has held steady around Elevation 1305 through 2011. The other unusual jump was from Piezometer 1-16 that increased approximately 20 feet around September 2010. This reading was odd because the reads through the end of the 2010 monitoring period were (+20 feet) above the reservoir surface elevation. According to the current instrumentation report, it appeared that the September 2010 data for Piezometer 1-16 was erroneous and the 20 foot jump above the water surface has been removed and the readings now show normal levels throughout the monitoring period. Mr. Godfirnon reported that Piezometer 1-19 is an old hydraulic piezometer and has likely failed. The remaining piezometers at Dike 1 show normal trends and conditions that were tracking reservoir levels normally, or were unaffected by reservoir levels and precipitation staying fairly constant throughout the monitoring period.

The 8 piezometers at Dike 2 include 2 piezometers (2-1 and 2-4) located in the embankment, 2 piezometers (2-2 and 2-7) located on top of the foundation at the base of the embankment, and 4 piezometers (2-3, 2-5, 2-6, and 2-8) located in the foundation. Piezometers 2-1, 2-4, 2-5, and 2-7 are not influenced by reservoir levels and are fairly constant through the monitoring period. These readings were not unusual since the average reservoir level just reaches the base of Dike 2. The remaining 4 piezometers are highly influenced by reservoir levels and follow historical trends.

All the functioning piezometers appear to be responding to head water levels and rainfall normally with no concerning trends or conditions. The piezometer network is judged satisfactory for this dam.

There are 37 survey monuments on the Main Dam, 48 monuments on Dike 1, and 14 monuments on Dike 2. Survey data shows movements in the horizontal and vertical directions. Horizontal movements were less than 1.5 centimeters and vertical movements were less than 0.7 centimeters between subsequent surveys taken during the monitoring period with no concerning trends. All movements were small and insignificant for this size and type of dam with no concern to dam safety.

INSPECTION OF DAM AND RESERVOIR IN CERTIFIED STATUS

Name of Dam Mathews Dam No. 35

Date of Inspection 12/3-4/2012

Observations and Comments

There are 6 seepage locations at the Main Dam, 4 seepage locations at Dike 1, and 1 seepage location at Dike 2. Weirs 1 & 2 were dry throughout the 2011 monitoring period. All the other seepage readings appeared normal and responded accordingly to rainfall and reservoir surface elevations. The seepage data was well within historical limits.

The instrumentation for this dam is judged adequate and no new instrumentation is needed at this time.

There was a crack in the bottom weld of the Main Dam weir that needs to be repaired. The majority of flow was passing through the crack in the weld and not flowing over the notch.