How Do We Deal with Our Aging Structures?

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Bruce received a BS in engineering technology from NMSU in 1994 and has worked for the U.S. Army Corps of Engineers as a civil engineer since 2003. Currently, he is assigned as the lead geotechnical engineer for the design and construction of the Albuquerque Levee Rehabilitation, Middle Rio Grande (Isleta to Belen), and the Rio Grande Levee (San Acacia to San Marcial).

The following is a transcription of the talk presented at the conference by Bruce Jordan.

Good morning. When I started with the U.S. Army Corps of Engineers (Corps), it was beaten into me that the Corps has two main authorities. The first authority is navigation, but that doesn't really affect us here in New Mexico. Our second authority is flood control and my talk is primarily concerning flood control. I understand that the Corps gets involved in restoration projects and involved in holding water for other people; we have special authorities, but primarily our job concerns flood control and navigation so that is what I'll address.

I am looking primarily in the Albuquerque District at Middle Rio Grande levees in terms of dealing with our aging infrastructure (Fig 1). It is important to pinpoint those that I am talking about: Corrales levee, which we built in 1997 and is owned by the Middle Rio Grande Conservancy District (MRGCD); the Albuquerque levees, which we built in the 1950s are also owned by MRGCD; Mountain View Isleta units and Belen Units constructed by MRGCD in the 1930s; San Acacia to Bosque del Apache Units, which were initially constructed by MRGCD in the 1930s but have since been upgraded or overbuilt by the Bureau of Reclamation (BOR) when they constructed their low-flow conveyance channel.

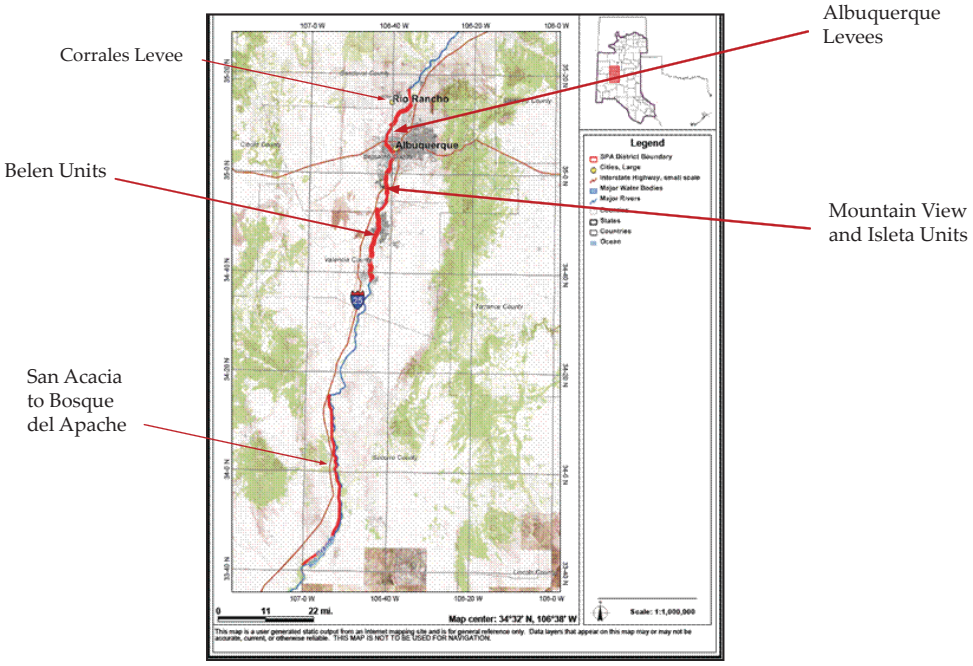

Figure 1. Middle Rio Grande levees

Let me mention a bit of history of floods in the Middle Rio Grande: the Corrales 1874 estimated a flood-flow of 100,000 cfs; in 1904, the Albuquerque Journal reported a four mile-wide river at Albuquerque; in 1929, in the San Acacia Unit, we lost the town of San Marcial in heavy August rains; in 1941, we had the Belen Bridge washout. In 1925, the MRGCD was formed. It was initiated in 1923 but had to wait for a court decision to determine that it was constitutional. From 1930 to 1935, MRGCD constructed approximately 190 miles of levee, spoil embankment, primarily as part of the drainage. The MRGCD calls this the Riverside Drain that helps drain some of the water table for irrigable lands in order to put them back into development. So projects were mostly spoil levee construction, which was common for that time. From 1953 to 1957, the Corps constructed Phases I, II, and III of the Albuquerque Levees as a flood control project, which is an engineered levee. From 1951 to 1959, the Bureau of Reclamation constructed the Low Flow channel to Elephant Butte, upgrading those levees in the Socorro area. In 1997, the Corps came back and constructed the Corrales levee.

Figure 2 is a construction drawing for the Albuquerque levees depicting the difference between a spoil levee and an engineered levee. You can see the spoil pile is non-engineered; it has thickness but does not have any definite slope control. The figure shows the spoil levee being moved and actually being used as the borrow materials for the engineered levee. The installation of the toe-drain system helped relieve pressure so it didn't escape.

In 2005, the Corps provided a report to Congress on the condition of the Albuquerque levees. As part of that report, I, along with the other engineers in the district, surveyed those levees to ascertain their true condition. As you can see in Figure 3, we have animal burrows in the Albuquerque levees. The photos in the figure are all engineered levees. We have sloughing of the Riverside drain; the subsurface discharge pipe in the top right photo has been exposed by about 20 feet, so we've lost that. The actual drainage system has been compromised by sedimentation. And then we have our famous and lovely trees, which have been an issue for the Corps for the last five years.

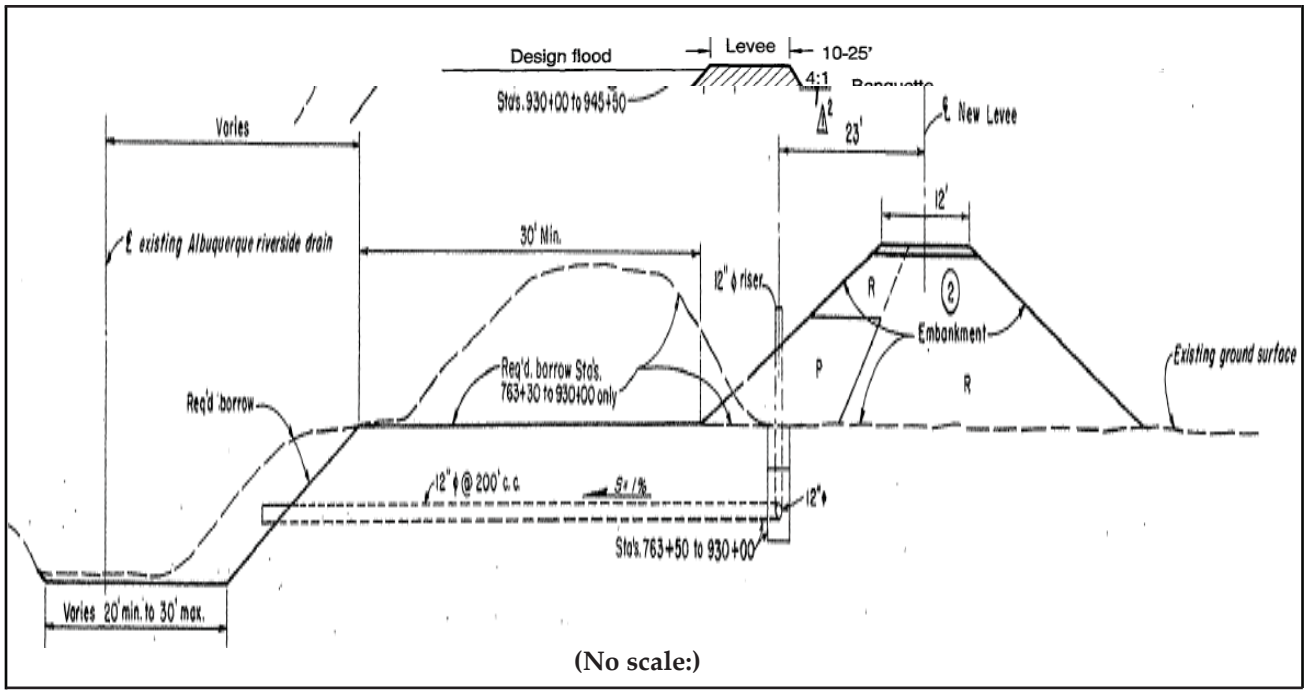

Figure 2. Typical levee section from the Albuquerque levees construction drawings

Figure 3. Current Albuquerque levee conditions

Figure 4 shows the un-engineered levee at Bosque Farms, and in 2005 we topped out on a discharge from Cochiti of about 6,500-7,000 cfs in this area. We tried to stay at 7,000 cfs for about a week, but the conditions made us back off the discharges. There was subsequent sloughing of the Riverside Drain. It was a fast occurring event so we weren't necessarily worried about losing the levee from a breech in the levee, but losing the levee from the water seepage coming under the levee (a foundation issue) and breaching the levee from it washing away from underneath was a concern.

Figure 4. MRG Levee (Bosque Farms) conditions

Figure 5 shows 2005 runoff in the Socorro area. The BOR had extensive problems with the way that the levee was constructed. The low-flow channel borrow material was dumped on top of the original spoil levee and they found voids within that lower section and have had to fight the resulting seepage. The actual bank of the low-flow channel seems pretty stable, but they have experienced catastrophic failure of the levee further south of Socorro from seepage coming through the levee.

Figure 5. Socorro Levee conditions

Changes in criteria for levees for the Corps have been made to help combat some of the condition problems that we have seen over the last 50 years from studying at Albuquerque levees. We have adopted a change in our filter design criteria, which was first presented by the Natural Resources Conservation Service (NRCS). It is contained in chapter 26 of their National Engineering Handbook (Part 633), and we at the Corps have adopted that as part of our levee and dam construction manual. Another criteria change deals with vegetation on the levees. The Corps has, since at least the 1980s, had guidance for keeping trees out of levees, although guidelines were not always widely executed (ETL 1110-2-571 "Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment, Dams, and Appurtenant Structures"). We have since clarified that and shown that we now need a 15-foot minimum root-free zone. We would like for the levee to be vegetated but only with grasses. We also do not want tall grasses because we need to be able to inspect for the presence of animal burrows. During times of flood, we need to be able to evaluate where the seepage is coming from, if seepage is present. The ETL has been finalized after a thorough three-year process of white-paper comments.

Current Albuquerque construction studies include the Albuquerque Levees Condition Report 2005, which recommends rehabilitation of the current levees. In my eyes, this means completely

removing the existing levee, putting in a new drainage system, and then putting the levee back down. It will include hydrology upgrades so it might not be the same size as the current levee. The current levee is built for a 42,000 cfs event, but that is pre-Cochiti. Cochiti takes the peak off of that number quite a bit. Another study produced the Middle Rio Grande Flood Protection, General Reevalution Report for Mountain View, Isleta, and the Belen Units, and a third report is for the Rio Grande Floodway, Limited Reevaluation Report for San Acacia to Bosque del Apache. Preliminary estimates for construction are: a $120 million for Albuquerque, $100+ million for the Middle Rio Grande Flood Protection, and $115 million for the Rio Grande Floodway (San Acacia to Bosque del Apache).

What does this mean for our water? Figure 6 is from Mussetter Engineering Inc.'s hydraulic report for the Middle Rio Grande and Albuquerque levees. It shows the 500-year snowmelt event being routed through Albuquerque. You can see the Corrales Levee, the Albuquerque levees, Paso del Norte and Montano bridge, and that floodwaters stay within the two levee systems. It is hard to see at this scale but the red boxes are for 100-day durations. We are describing floodwater up against the levee for 100 days, which is quite a long time to depend on that levee. Figure 7 shows what happens when we take the Albuquerque levee section out of the model and we have flooding that travels past Edith, which is quite a distance from the Rio Grande. We would also have extensive flooding in the greater metropolitan area.

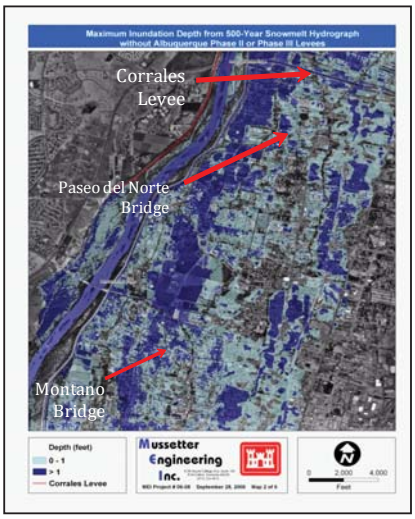

Figure 6. Mussetter Engineering Inc.'s hydraulic report for the Middle Rio Grande and Albuquerque levees

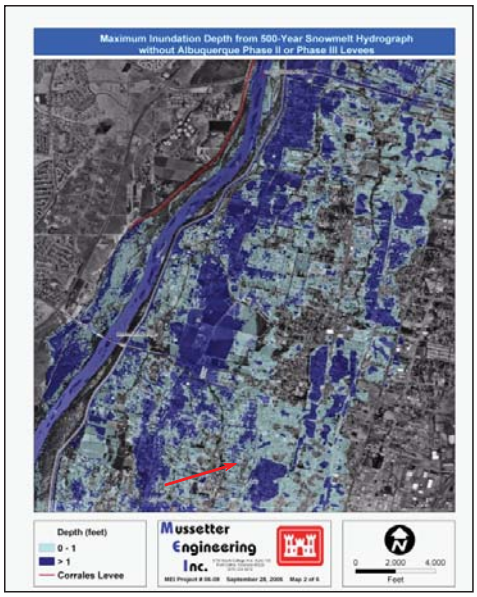

Figure 7. Maximum inundation depth from 500-year snowmelt hydrograph without Albuquerque Phase II or Phase III levees

Figure 8 is the hydrograph for Cochiti for that 500-year flood. You will notice the duration is approximately 110 days long, fairly stable at 7,500 cfs, and peaks at about 14,500 cfs. That peak would activate the Cochiti spillway. No one thinks that there will be a 500-year event. Look at Figure 9, on the top is the normal pool for Cochiti with a recreation pool elevation of 5340.3 ft. On the bottom is a photo of the 1987 record pool. This was a high water year but it wasn't a terrific flood, it wasn't a 100-year event and you can see that record pool is within 60.5 feet from the notch and activating the spillway. We created the pool; the reservoirs downstream of Cochiti were full, and we didn't want to flood the communities of Isleta, Mountain View, Bosque Farms, or Belen. We held the water and didn't release it out of Cochiti. If we had three years of that, I could see how it could activate the spillway at Cochiti without another large event. If we had to release the floodwater, we would be pushing 7,000 cfs down the river. The Corps couldn't do much about it because it needs to release the floodwater to get the capacity back in anticipation of the next spring runoff.

Thank you.

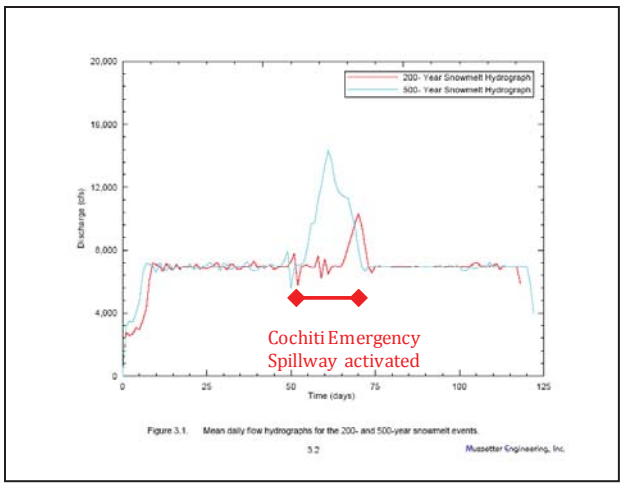

Figure 8. Hydrograph for Cochiti and the 500-year flood.

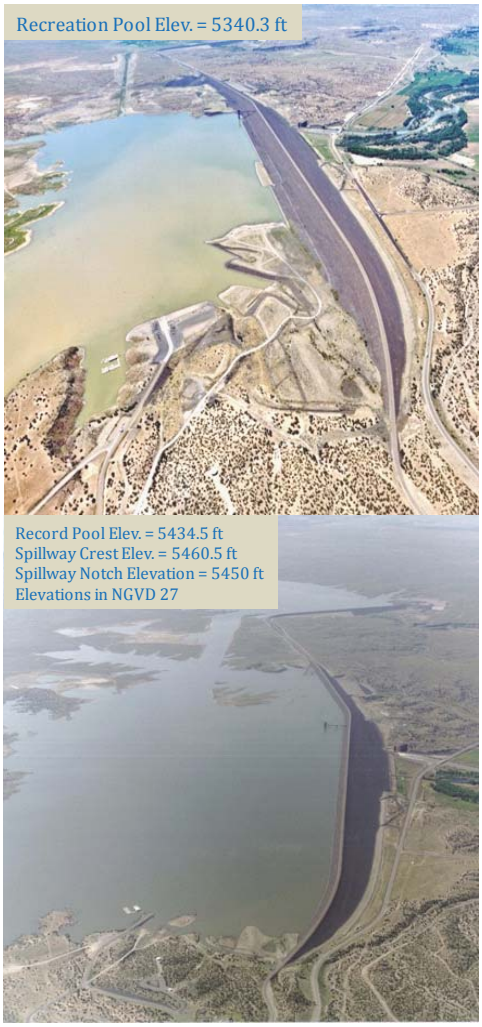

Figure 9. Normal pool and 1987 record pool for Cochiti Dam