Fletcher, Tony

From: Belserene, Mark
Sent: Thursday, May 12, 2011 9:26 PM
To: Fletcher, Tony
Subject: Re: #105 Silver Lake Dam, Bucksport, Hancock, ME - May 4, 2011 Inspection

Will do, go pack for the Big Apple

From: Fletcher, Tony
Sent: Thursday, May 12, 2011 09:18 PM
To: Belserene, Mark
Cc: Ciomei, Nicholas; Ayotte, Tara
Subject: RE: #105 Silver Lake Dam, Bucksport, Hancock, ME - May 4, 2011 Inspection

Dear Mark,

Here are my hazard and condition reports for Silver Lake Dam. Please ask Tara to read the relevant sections and forward this report to Verso Paper.

DAM HAZARD INSPECTION

Convention: Compass directions are not used at the dam. The terms left or right refer to sides looking downstream. Abbreviations are shown in caps occur after the initial use of the expression, and used thereafter in the report. In previous reports the dam has been describes as being in fair or poor condition. These terms are not used in this report. The term **Necessary Remedial Measures** mean measures recommended to improve public safety in terms of the law. Each report has recommendations.

Inspections: Following the recent magnitude 1.5 earthquakes reported SW of Bucksport, Tuesday May 3, 2011, hazard and condition inspections were done of Silver Lake Dam on the morning of Wednesday, May 4, 2011 at 9 am.

This inspection was done for two reasons, 1) to determine if damage was done to the dam, 2) to do "hazard" and "condition" inspections as required by Title 27 B, MRSA Chapter 24 "Dam Safety".

Ownership and Operation: Silver Lake Dam was built in 1930 and modified in 1985. The dam is owned and operated by Verso Paper, Bucksport. Prior to the inspection I reviewed the file which contains inspection reports by MEMA, the Corps and MBP. The previous MEMA condition inspection was done in April 2003.

Arranging the Inspection: I asked Mr. Ciomei of MEMA to arrange for somebody from Verso Paper to be at the dam to accompany me on this inspection. He unsuccessfully tried to contact the Environmental Manager, Perry Dargitz, who is #3 on the dam's "Emergency Action Plan" (**EAP**) "Notification Flow Chart" (**NFC**). This post was reported vacant, so he contacted Verso Security who arranged for Mr Wes Shute to accompany me to the dam.

Description of Dam: The dam is 33' high, 465 feet long, earth embankment dam with a central concrete gravity spillway section. The drawing show the embankments have concrete cores. The spillway is a concrete, mass gravity, ogee spillway, with upstream and downstream mass gravity concrete wings walls. The ogee concrete spillway crest has been raised by fixing two, 20' 6" long, 5' 6" high steel bulkheads on the crest. The bulkheads are slotted into, and bolted to the dam. The elevation of the Top of the Dam (**TOD**) is 233.0', the top of the steel bulkheads are at Normal Pool Elevation (**NPE**) of 229.5', the concrete spillway crest 224.0', the sluice sill 220.25', and the lowest elevation of foundation is approx. 200.0'. The current freeboard above **NPE** is 3.5' and the dams height from lowest point in the foundation to **TOD** is 33'. Wave run-up and erosion is controlled using upstream stone rip-rap. There is grass cover on the embankments. A walkway bearing on walls crosses the spillway and vehicular access to this structure is prevented by a steel barricade. The walkway has a safety handrail and a fence exists on the spillway wing walls. The principal spillways is a 6' wide, stop log sluice gate, built between two concrete wing walls, set in the center of the concrete spillway between two similar steel

bulkheads bolted on to the dam. The stop logs control **NPE**. Removal of all stop logs will reduce **NPE** by 9' 3". There is no bottom drain or outlet to the dam.

Pipelines Under Dam: It appears from the drawings that two pipelines, one 10" Cast Iron (**CI**) and one 12" **CI**, exist under the right embankment of the dam approximately 35' from, and parallel to, the right spillway retaining wall. It is not known if these pipes are in use, or their effect on the safety of the dam.

Storage: At **NPE** Silver Lake Reservoir stores 9,400 acre feet of water and is 670 acres in area. The lake supplies Verso Paper with 22 million gallons of water per day (mgd). I understand this dam also supplies water to the Town of Bucksport.

Hazard: Silver Lake Dam is located on the Tannery River, upstream of downtown Bucksport, and is currently classified a "high potential hazard dam" (**HH**). Title 37 B MRSA C 24 "Dam Safety" requires the dam to have an **EAP**.

EAP: The **EAP** was prepared by Kleinschmidt Associates (**KA**), dated August 2010, and is on file at MEMA. remarks: On the "Notification Flow Chart" (**NFC**) #3 is no longer employed by Verso Paper and must be replaced. Also, the **NFC** must include the **ARC**, and the **NWS** repositioned under the dispatcher. Generally the **EAP** does not consider "alternate routes", "road closures", "evacuation lists" and American Red Cross (**ARC**) shelters. The **EAP** has not been integrated into the Town of Bucksport's "emergency operations plan" (**EOP**). The **EAP** has not been agreed by all parties nor tested by **MEMA**.

Impact of Breach: EAP shows an inundation map based on a "fair weather breach" of Silver Lake Dam. To indicate the impact this breach on the Town of Bucksport, it is estimated that the flood wave will arrive at the Route 1 bridge in Bucksport in 23 minutes after breach and peak at 7,700 cfs in 1 hour 32 minutes. All bridges between the dam and the sea are likely to be washed out, and houses and buildings along the river banks damaged or overturned. Water supply to the Verso Mill would probably be cut, and the Mill is likely to stop operation. This is a flood of great size and speed. The impact on people will depend on the time of day the breach occurs and what sort of warning residents receive.

Preparation: To save lives and protect property during such a catastrophic event, there must be an effective, current and tested plan of action in place which can be activated at the right time. Consideration in the **EAP** must be given to immediate actions such as; saving the dam, warning and evacuation of people, working either side of a flooded river, closing roads and diverting traffic, control of pedestrians, establishing shelters, health, employment of contractors, dealing with the press, and the like. It is essential that the transportation system continue working as best as possible. These matter must be discussed by the dam owner and first responders, and the **EAP** designed to mitigate the impact of the dam breach.

Hazard Inspection: To confirm the dams hazard potential, a visual inspection was done of the dams downstream watercourse, after the condition inspection. Road crossings and houses along the stream banks were noted. It appeared that no bridge or culvert en route has the capacity to pass the anticipated dam breach flood. Some road crossing were old. Judging by the size of the Route 1 bridge and steepness of the river, extensive damage to downtown Bucksport was likely. The dam was confirmed High Hazard (**HH**) dam.

Necessary Remedial Measures (HAZARD): To improve public safety, I recommend that the dam owner;

1) Update the **NFC** with immediate effect
2) Change the name of the first responder (#3 on the **NFC**) and also place an alternate in a separate box on the **NFC**
3) Include the National Weather Service (**NWS**) under "dispatch"
4) Place the **ARC** on the **NFC**
5) Show the **ARC** shelter location, and their role during an emergency, in the dam's EAP
6) Have the Maine Emergency Management Agency (**MEMA**) conduct an "EAP familiarization exercise" with the dam owner, town and county and all first responders before the end of May 2011. The "EAP familiarization exercise" is when MEMA and all first responders visit the dam together, then look at all downstream areas which would be affected by a dam breach, meet afterwards, update all contacts and agree on EAP procedures. Changes may be written in by hand to this interim plan before a final document is produced
7) Include in the **EAP** a "traffic plan" including "alternate routes" and "road closure plans"
8) Include in the **EAP** an inventory of houses & buildings in the dam breach flood zone (see **EAP** inundation map)
9) include in the **EAP** a list of all evacuees, their phone numbers and building they live in, in the **EAP**
10) Facilitate a **MEMA** dam "table top exercise" (**TTX**) when the **EAP** is complete, not later than August 2011
11) Integrate the updated **EAP** into the Bucksport Emergency Operations Plan (**EOP**)

Condition inspection: Done on a cool overcast day, without snow on the ground. The reservoir was slightly lower than normal pool. Embankment surfaces were damp from earlier rain but easily accessible. The inspection route was from left to right across the top of the dam, right embankment upstream and downstream, downstream spillway, downstream and upstream left embankment. Inspection accompanied by the dam operator, Mr. Wes Shute representing Verso Paper.

General Public Safety & Vandalism: No upstream boat warning sign or barrier. Pedestrians permitted to cross the top of the dam via a foot bridge with handrails. Vehicular traffic excluded from crossing the bridge by a steel barrier at each end. A fence exists on the retaining walls. Graffiti noted under the bridge and on the right bridge approach. No vandalism was seen.

Vegetation: The embankments have a good grass cover and some earth is visible on the upstream and top of the dam. Some trees and brush grow on the upstream slopes of both embankments. Brush growth on the downstream face of the right embankment is thick and well established. The downstream concrete stilling basin of the spillway has thick brush growing on sediment in the basin. Poison ivy growing on the right embankment prevented brush removal.

Animal activity: None seen.

Movement in the Embankments: Embankment movement and cracking could not be easily assesses because of the good grass cover masking the earthwork surfaces of both embankments. Minor ruts and depressions are on the top of both embankments. Rutting can be attributed to vehicle and pedestrian activity. A search for longitudinal are lateral cracks on all surfaces of each embankment revealed little. A grassed channel exists down each embankment / retaining wall interface. The cause of this channel may be settlement along the wall or erosion. There is some lumping of a small local area on the right embankment, on the downstream face near the top of the dam and the spillway wing wall. This area was pointed out to Mr. Shute who said he would monitor its movement.

Leakage: No leaks were seen from the embankments except at the lower end of the left downstream wing wall which is discussed later.

Wave erosion: Little wave erosion was seen on the unprotected upstream embankment. Some rip rap appeared to have been benched by wave action. No undermining of the rip-rap was seen.

Surface Erosion of the Embankments: No surface erosion could be seen on any of the plane embankment slopes, however, a significant deposit of silt was noted in the stilling basin of the spillway. This deposit is discussed next.

Sediment in the stilling basin: The source of this sediment could be; 1) the toe drain, 2) from the left embankment, 3) water draining from the retaining wall and left embankment interface, 4) surface runoff, 5) a spring or any combination of those 5 sources. This body of silt is several feet thick at the downstream end of the left concrete retaining wall and is covered by brush.

Seepage: In the right embankment no wet areas on the downstream embankment were found. A section or stone cobbles has been laid along this toe and seepage is concealed. No toe drain was seen. In the left embankment, no excessively wet patches had formed on the embankment. Again the toe drains are concealed, however, there is a significant flow stemming from the at the lower end of the left abutment wall, as discussed above. The source of this flow could be; 1) the outlet of the toe drain, 2) a leak in the embankment, 3) seepage from the retaining wall, 4) surface runoff, 5) a natural spring. The spring and sediment should be monitored and investigated.

The Principal Spillway: The stop logs were not examined and the gate and seals was not tested. No debris or ice blocked flow. Joint leakage was insignificant. The timber stop logs were all in position and functional.

The Concrete Spillway: The spillway is an un-reinforced "mass gravity" structure. In other words, the structure resists water and embankment forces by its own weight. Theoretically the structure is in compression vertically, under all loading conditions. Drawings indicate there is some steel reinforcement in the tops of the mass gravity wings walls, but the amounts are insignificant and would have little effect on its mechanics. No deflection or movement was observed along any concrete surfaces or corners. This does not mean that none has occurred. Some erosion and spalling of the concrete surfaces can be seen. Some of the concrete work has been repaired.

While no movement in the concrete of the spillway structure was seen, one obvious defect in the concrete was general cracking of the wing walls and spillway. The cause of concrete cracking could be material or construction

deficiencies. The width and depth of the cracks were not measured, but were of sufficient size to convey water from behind the structure, to exposed surfaces, where dissolved salts deposit at cracks called efflorescence.

Steel Bulkheads on the Spillway: A close inspection of both steel bulkheads on the spillway crest would entail lowering the pond and removing them. Currently the bulkheads retain water and were viewed from the walkway. No deflection or bending was seen. Paintwork appeared in fair condition. A leak stemmed from the left of the left steel bulkhead.

Condition Inspection Conclusions: Silver Lake Dam is a high hazard dam exhibiting with defects as reported above. The dam did not appear to be affected by the recent earthquake. Concerns are; uncontrolled tree growth on the structure, movement near the top of the right embankment and spillway, a steady leak and related sediment deposited at the toe of the left spillway retaining wall, deteriorating concrete work, un-inspected steel bulkheads, a bulkhead leak, no piezometers in the embankments to monitor the water table in the dam, no visible toe drains.

Necessary Remedial Measures (CONDITION): To improve public safety, I recommend that the dam owner;

1) Cut down and root out all brush and trees from the embankments and spillway stilling basin
2) Clear out the sediment in the spillway basin
3) Determine the cause of the apparent slump in the downstream right embankment and monitor
4) Determine seepage from the right embankment
5) Find the left and right embankment toe drains and monitor their flow
6) Determine the origin of the the spring from the toe of the left concrete retaining wall
7) Investigate the effect of the pipelines under the dam
8) Monitor the condition of all exposed concrete faces
9) Have the steel bulkheads and joint surfaces inspected
10) Consider installing Piezometers in each embankment
11) Provide construction details of the dam, repairs and the water mains under the right embankment
12) Provide the maintenance and operating plan for the dam

In conclusion, this is a high hazard dam which requires EAP testing, repairs and monitoring, all of which must be done without delay.

Tony Fletcher PE
Maine State Dam Inspector