MEMORANDUM

TO: Devils Lake Joint Water Resource Board

FROM: W.M. Schuh

RE: Update: Stump Lake Impact on Tolna Coulee Ground Water

DATE: 7/19/2010

Following the coalescence of Devils Lake with Stump Lake, and as Stump Lake has continued to rise, many are concerned about the consequences of possible discharge of Devils Lake water through Stump Lake and the natural outlet at Tolna Coulee. Concerns vary, with some in the Devils Lake Basin considering that spillage and down cutting might offer some relief to flooding within the basin, while those downstream on the Sheyenne River are concerned that excessive erosion could cause excessive short term discharge and damaging floods. The "short term" is defined by limitations imposed by the elevation of Devils Lake in relation to the Jerusalem Channel, which feeds water to Stump Lake. When the Jerusalem Channel ceases to feed water to Stump Lake, Tolna Coulee discharge would gradually abate.

Aside from the natural rise of Stump Lake toward the critical elevation, which was previously about 1459 feet, some concerns were raised that as Stump Lake rises and the water pressure on the upstream end of the coulee increases, the integrity of the soil and underlying materials comprising the divide between the lake and a comparable elevation downstream in the coulee would be compromised. This possibility is considered unlikely. First, at the current Stump Lake elevation (See Figure 1), there are approximately 6,000 linear feet of impeding materials acting as a berm between the lake and the lake elevation west of the divide in the coulee. Even approaching the flow elevation (1458.5 feet) the impeding materials would be about 3,000 feet thick. This provides a very substantial berm. Second, the ground-water gradients, measured at four well sites within the coulee, indicate that water is flowing toward Stump Lake from the divide. The local hydrology indicates that runoff water from steep land along the coulee, and seepage from springs within the coulee determine the local water table – and that ground-water discharge is occurring through local evaporation and through slow ground-

water movement from the divide northeastward toward Stump Lake and southwestward toward the coulee. This is shown on Figure 1. The water-pressure distribution indicates that westward ground-water flow from Stump Lake is improbable, and that slumping is unlikely. The most recent observations (7/8/2010) are consistent with previous observations.

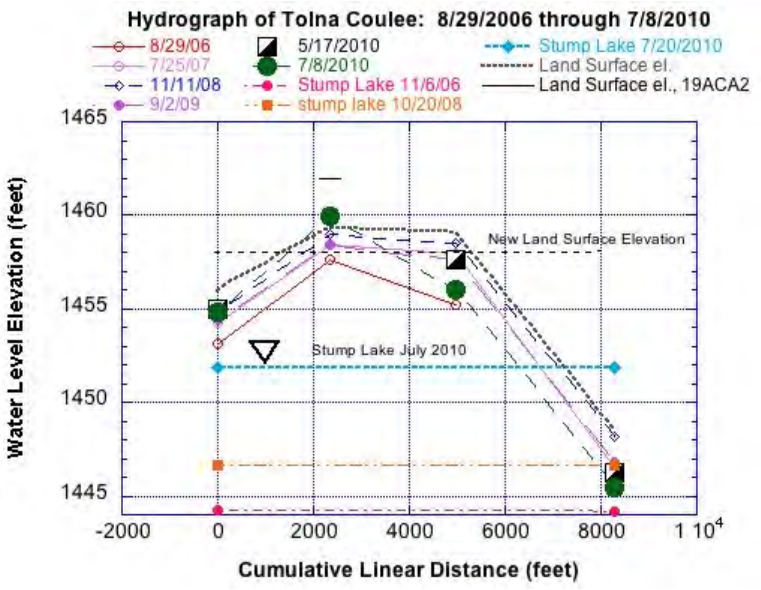

Figure 1. Ground-water profiles in Tolna Coulee from Summer 2006 through summer 2010.

Changes in the latest water elevation measurements, following removal of one foot of sediment from the coulee in 2009, are as follows: (1) The observation well at the point of highest elevation, previously called the "East Johnson" site, was removed with the excavation. It was replaced in June of 2010 with a well placed a few feet north of the excavated coulee. The land surface elevation at the replacement well is about three feet higher than the original elevation. The new elevation is shown by the short horizontal line at the 1,462 feet elevation on Figure 1. The water levels in the replacement well are higher as well, about two feet above the excavated land surface. While the first reading elevation has not been compared with a measured water surface within the excavated

portion of the coulee, it is almost certainly higher, reflecting lateral movement from the northern elevated lands toward the coulee.

(2) The water elevation in the well at the site called the "West Johnson" site has decreased substantially – from previous fluctuations between 1,558 and 1,459 feet to about 1,456. Figure 2 shows that the decreased surface-water elevations in 2009-2010 is larger than the previous range. These indicate that some of the western portion of the wetlands are likely draining slowly toward the southwest, following removal of the surface soils.

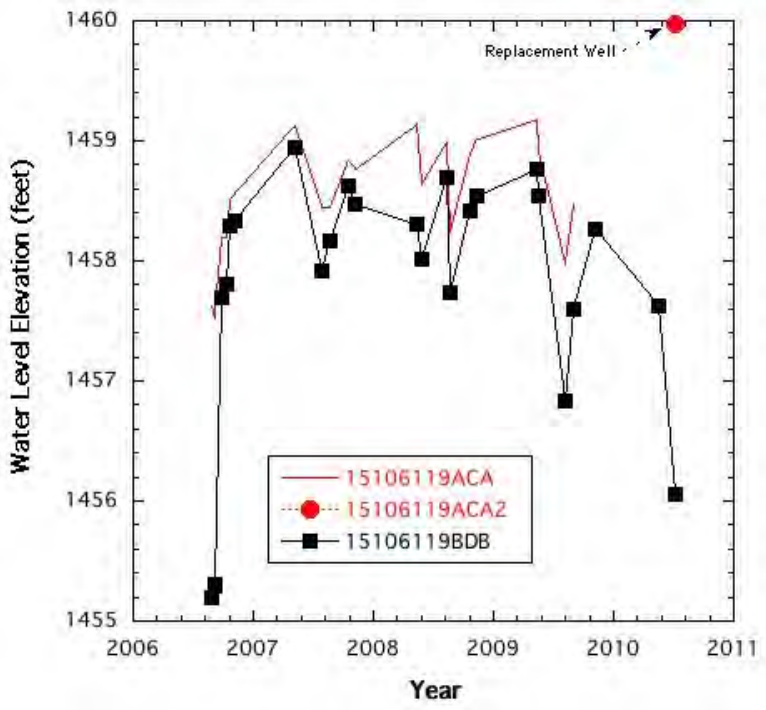

Figure 2. Hydrograph for the "East Johnson" well (19ACA) and the "West Johnson" well (19BDB).

A scenario that could plausibly accelerate the breech of the coulee by Stump Lake would water be the erosive effects of very large and concentrated precipitation events, similar to the 12 to 18 inch rains that occurred within a single day in southeastern Minnesota in 2007. The sediment excavation has removed littoral vegetation, and the resulting bare surface would be more prone to erosion during such an event (Figure 3).

Under such conditions several feet of erosion would be possible. Precipitation events of that magnitude are extremely rare, but have occurred periodically in the region.

Figure 3. Eastern coulee excavation area.