Upper Pelican River Subwatershed (HUC10 – 0902010307)

The Upper Pelican River subwatershed is located within Clay (1%), Becker (55%), and Otter Tail (44%) Counties. Within the 340 square mile drainage area, Campbell Creek originates near Richwood (Figure 13). This short creek flows south and empties into Mud and Floyd Lakes. The Pelican River originates in a wetland complex east of Floyd Lake. It is a public, altered watercourse upstream of Big Detroit Lake. The river above Big Detroit Lake is under a "protection" status due to watershed condition and risk, but not due its IBI scores (Stream Protection Prioritization Committee, 2018). The Pelican River then flows through a series of lakes including Lake Sallie, Lake Melissa, Little Pelican and Pelican Lakes, Lake Lizzie, and Prairie Lake. Sucker Creek, a designated trout stream also flows into Big Detroit Lake. The Upper Pelican River subwatershed watercourses formed in an area of geologic outwash. Confining the outwash to the east and west are stagnation moraines from two separate advancements of glaciers.

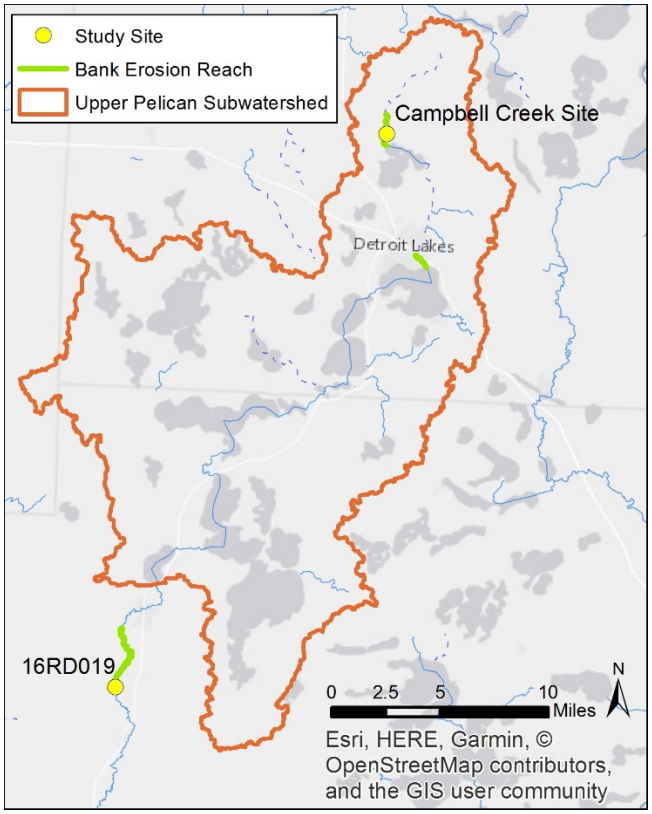

Figure 13. Upper Pelican River subwatershed (HUC 10).

The LiDAR derived water surface profile from river miles 0 to 4 is 0.003 and from 5 to 8 it is 0.0003 (Figure 14). The remainder of the slopes are relatively flat as the Pelican River flows through a series of lakes. Between Big Detroit Lake/Muskrat Lake and Lake Sallie is Dunton Locks. This dam was removed, and rock arch rapids were installed in 2001 to allow for fish passage. Bucks Mill

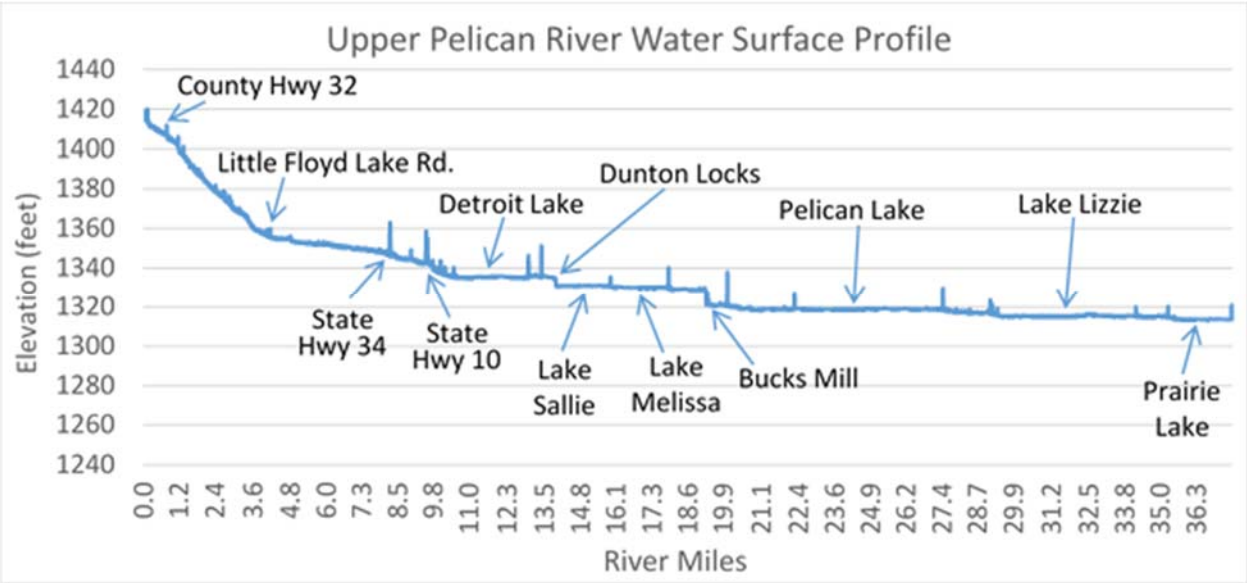

Figure 14. Upper Pelican River LiDAR derived water surface profile.

dam is located downstream of Lake Melissa. The height of this dam is 16 feet (MN DNR, 2019), and it is a complete barrier to fish passage.

Pelican River

Bank erosion on the Pelican River was estimated between US Hwy 10 and Big Detroit Lake, in Detroit Lakes. In general, the stream banks were in good condition. Compared to the other nine bank erosion study reaches, this reach had the lowest rate (per foot) of estimated erosion (Figure 12). The Pelican River had frequent access to its adjacent floodplain and the bank height ratio was predominantly 1.0 (actual bank height compared to bankfull height). The riparian vegetation was predominantly perennial grasses, both manicured and more natural compositions. In several areas, trees, shrubs, and herbaceous plants provided shade and bank stability. Spotted touch-me-not (*Impatiens capensis*) was frequently observed along the water's edge.

Riffles with packed gravel were present within this study reach; however, in many areas, riffles were embedded with finer substrates (sand). Both road crossings at North Shore Drive and Lori Ave. consisted of two 10-ft. cement box culverts. Both crossings had significant deposition within the culverts (Figure 15). The alignment at the Lori Avenue crossing may be contributing to the accumulation of sediment with the tight bend immediately downstream. The bankfull width was estimated to be around 18 feet wide.

Figure 15. Pelican River between US Hwy 10 and Big Detroit Lake. Photos taken on 9/7/2018.

Campbell Creek

Near the origination of Campbell Creek to around 260th Street the LiDAR derived water surface slope is 0.005 (Figure 16). From Whiskey Creek Dr. to 230th St. the slope is flatter (0.0006). The remaining length of the watercourse has a slope of 0.004. There are four water quality sample sites on Campbell Creek where total suspended solids (TSS) have been measured. The water quality TSS standard for this watercourse is 30 mg/L. From upstream to downstream the maximum TSS values collected were 31, 932, 76, and 1464 mg/L. The standard was exceeded 2%, 19%, 21%, and 21% of the time, respectively.

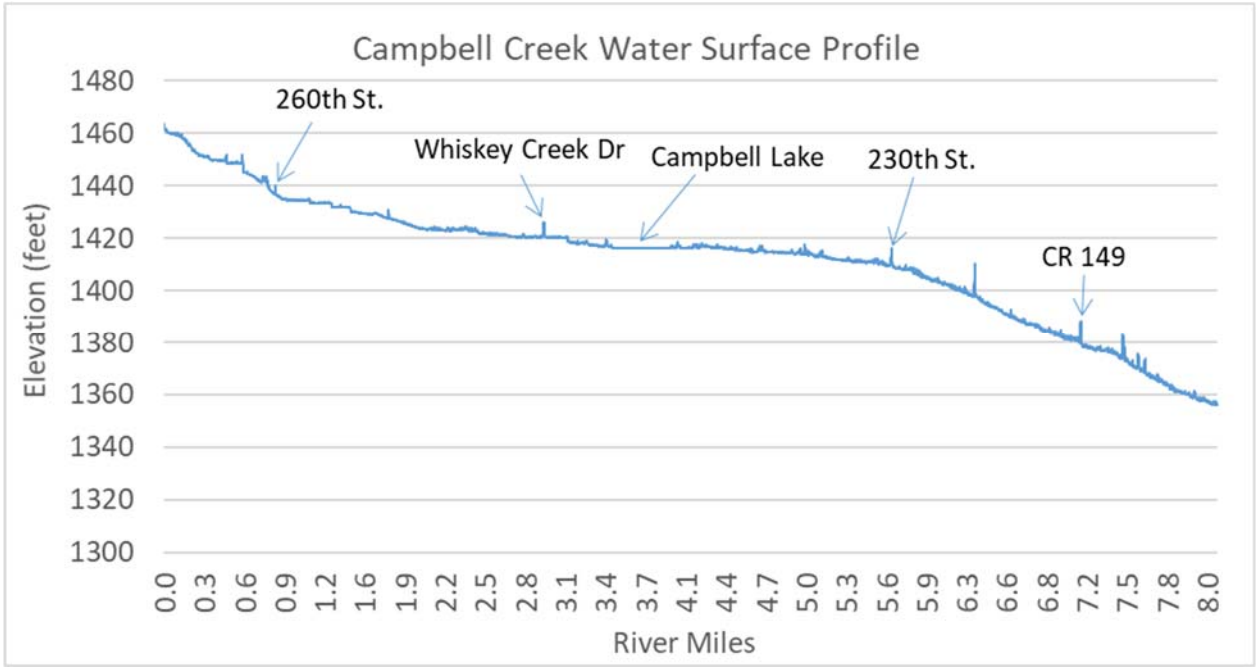

Figure 16. Campbell Creek LiDAR derived water surface profile.

Bank erosion was assessed along two segments of Campbell Creek, totaling 1.9 miles. On 9/5/2018 bank erosion was assessed between 230th St. and CR 149. Through this reach several different stream types and riparian vegetation compositions were observed. Near 230th St. the channel had been straightened and spoil piles were adjacent to the channel. The channel and floodplain were narrow between these spoil piles (Figure 17). Moving downstream the riparian vegetation changed from herbaceous cover with sporadic tree canopy to forested cover. The channel widened out, and for the most part, a depositional flat was observed near the estimated bankfull elevation. Though the floodplain was wider, the channel still did bump against the valley walls in a few locations, creating high cut banks. Downed wood was also often directing flow into the valley walls; however, the opposite banks had access to a floodplain, which would help reduce velocities during flood events. The majority of these high banks appeared to be relatively stable.

Figure 17. Campbell Creek from 230th St to CR 149. Photos taken on 9/5/2018.

Riffles consisted of packed gravel and a few sporadic cobble-sized particles. Sand and finer particles were also observed in the channel. Moving towards CR 149, the channel did not have access to its floodplain and it was incised (Figure 18). Higher rates of erosion were measured through the lower end of the study reach. Some areas of the riparian zone were pastured. The cattle access points to the channel were accelerating bank erosion as well. Fine substrate deposition was occurring on the channel bed upstream of CR 149.

Figure 18. Campbell Creek upstream of CR 149. Photo taken on 9/5/2018.

A full channel assessment was completed upstream of CR 149. A water quality monitoring station (MPCA S002-163) is located immediately downstream. The contributing drainage area to this location is 12.6 square miles, and the predominant land uses were deciduous forest (32%), cultivated crops (23%), hay/pasture (19%), emergent herbaceous wetlands (11%), open water (4%), and developed, open space (4%) (USGS, 2011).

The Rosgen stream type at this location was an E5 with a narrow width-to-depth ratio (7.7) and a sand bed (D_{50} = 2 mm). A Pfankuch stability assessment and detailed channel survey were completed on 9/21/2018. The Pfankuch stability rating was *poor* (unstable). The channel did not have access to its floodplain during minor flood events (incised). Due to this incision, the banks above bankfull elevation were steep and some mass wasting was evident (Figure 19). Cutting on the lower banks was present. The channel bed was inundated with fine particles on top of gravel substrate.

Figure 19. Campbell Creek. Photo taken on 9/21/2018.

On 8/1/18, bank erosion was assessed downstream of CR 149 to Mud Lake. The substrate fluctuated between sand and packed gravels. Through some of the depositional areas the channel was inundated with fine particles and organic matter. There were several higher banks through this reach (Figure 20). Many of these taller banks were covered in perennial vegetation and had clay present in the soil profile, which can help the bank resist erosion. These high banks could be surveyed and monitored to assess actual erosion rates. Annual photos could also be taken to monitor changes over time.

Figure 20. Campbell Creek downstream of CR 149 to the outlet into Mud/Floyd Lakes. Photos taken on 8/1/2018.

Lower Pelican River Subwatershed (HUC10 – 0902010308)

The Lower Pelican River subwatershed is located in Otter Tail County. The northern extent is at the outlet of Prairie Lake, north of Pelican Rapids. Within the 153 square mile drainage area of the subwatershed, the Pelican River meanders south to Fergus Falls (Figure 20). It is classified as a public watercourse throughout this subwatershed. Reed Creek flows east through Long and Reed Lakes before emptying into the Pelican River, between the cities of Erhard and Elizabeth.

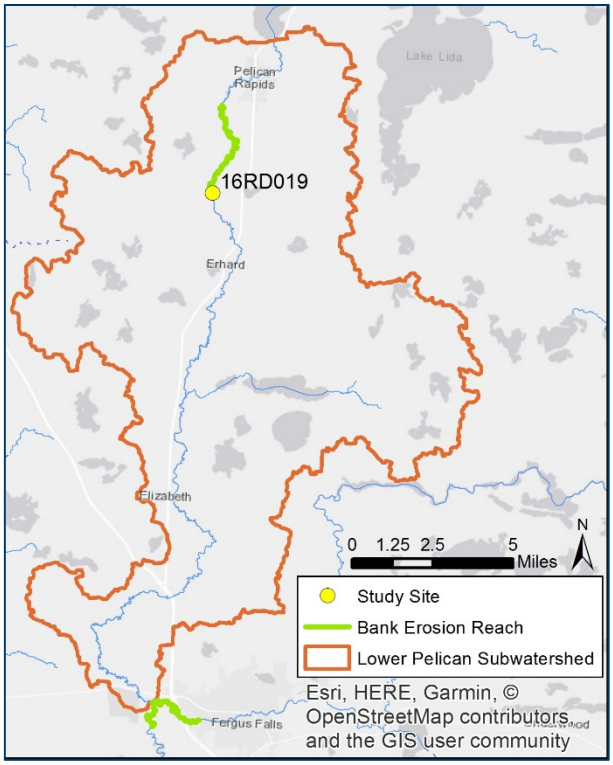

Figure 21. Lower Pelican River subwatershed (HUC 10).

The surface geology is similar to the upstream Pelican River subwatershed. The river flows through glacial outwash, with the Des Moines lobe stagnation moraine to the west and the Wadena Lobe stagnation moraine to the east. The outwash plain is narrower through this subwatershed than upstream. The LiDAR-derived water surface slope from river mile 10 to 15 is 0.0007 and from river mile 16 to 20 it is 0.0004 (Figure 22). The slope steepens some around miles 26 to 32 (0.001).

There are two dams within this subwatershed. The dam in the City of Pelican Rapids was constructed in 1870 (MN DNR, 2019); the height is 12 feet. The dam near the city of Elizabeth was built in 1878 and modified in 1922; the height is 16 feet.