LOWQIP Technical Abstract v. 11.23.19

Lake Okeechobee is nutrient rich [ hypereutrophic] with water column concentrations of 150 TP [parts per billion total phosphorus nutrient ] and increasing. From its origin 5,000 yrs. ago, the 1970’s level of ~ 50 ppb TP came from natural aerial, rivers and groundwater inflows. Man’s recent major re-working lake conditions: HHD reduced surface area ~ 25%, reduced littoral zone ~ 25%, SAV loss ~ 90%, lowered lake overflow stage from natural ~22 ft. NGVD to regulated LORS of 12.5 to 15.5 ft. NGVD, cultural eutrophication from destruction of the Kissimmee River’s natural cleansing floodplain wetlands and minor back-pumping, combined have produced by 1998 a TP water column concentration >100 ppb TP. This level is conducive to major toxic cyanophyte blooms such as occurred in 2013, 2014, 2016, 2017 and 2018. The 2019 bloom has not been discharged to the northern estuaries as previously since USACE lowered the lake to ~ 11 ft NGVD in winter rather than the 12.5 ft. NGVD plan of LORS. No Everglades restoration project -CERP, CEPP and LOWRP- has a credible Lake Okeechobee **in-lake** improvement project to prevent future outbreaks.

Even if LOWRP can achieve full TMDL inflow, a doubtful achievement, a guessed/estimated 250,000 Mt TP [550 million lbs.] exists as total lake sediment. Of that total legacy, recent deposition of the top 10 cm. [4 inches] of “molasses” muck alone has been analyzed at about 50,000 Mt of that total. Lake Okeechobee’s “molasses” muck layer alone contains ~ 60 X more TP than the water column above it. This layer frequently stirred from non-hurricane wind induced waves mix 3 to 5 cm of top sediment layer back into the water column. Lake Okeechobee’s surface waves develop wave heights in its long fetch sufficient to reach and stir this muck layer compared to smaller lakes of comparable depth and wind. Winter muck stirring increases bioactive TP within the water column resulting in TP concentration increases and seasonally limits open water photosynthesis depth between 3 to 8 ft. depths. This internal cycling is one of two major causes of the lake’s increasing hypereutrophic status; a status above cyanophyte blooms thresholds. The lack of deep light penetration also retards growth and long -term survival of highly beneficial SAV’s. In many of the author’s retention lakes of comparable depth, SAV coverage extends to near lake bottoms where 40- year stable existence reduces water column TP levels to 61- 77 ppb TP, a level below toxic cyanophyte blooms. The average depths of the author’s lakes are similar to Lake Okeechobee.

Net whole lake sediment accumulation rates of TP in pre-impact before 1910 averaged ~ 0.08 g/m2 /yr, after 0.47 g/m2 /yr ; a six[6] fold increase. Sediment deposition in the lake has been mostly net positive as denoted by the roughly 3 ft [1m] depth to hard rock with short time periods of sediment loss. Chemical and biological mechanisms before 1910 created a ~ 40 ppb TP water column concentration with little organic muck top layered. These same mechanisms in post-impact conditions of ~ 3.3 times river inflow amounts of TP have created the toxic cyanophyte TP concentrations > 100 ppb TP. LOWRP cannot completely reverse higher river inflows to pre-impact inputs nor reduce higher sediment deposition rates that combined lead to higher water column TP concentrations. The net result is continued higher TP water column concentrations with almost yearly cyanophyte toxic bloom production after all CERP and LOWRP projects are on-line. Legacy sediment internal cycling added to river inputs will maintain or increase toxic water TP concentrations.

The river and aerial TP inflow theoretically determined to not further increase the lake’s TP level is 140 Mt/yr TMDL [total maximum daily load]. It consists of 105 Mt/yr. from all rivers and 35 Mt/yr. aerial deposition. In addition to internal cycling, the other cause of the lake’s hypereutrophic TP water column level is recent decadal river inflows of ~ 500 Mt/yr that exceed the TMDL by 3.3 times. Even though the lake consistently receives more TP then pre-impact, some restoration models assume the TMDL baseline inflow. This calculates an unrealizable improvement attainment time but provides some measure of time scale by legacy removal mechanisms at that pre-impact inflow. These mechanisms are chemical alum addition to the water column resulting in water column concentration to 40 ppb TP in ~15 yrs.; the same as early 1970’s when cyanophyte blooms did not occur or of negligible effect. Sediment removal alone [muck removal] would achieve 1970’s water quality in ~ 30 yrs. But at inflows of ~ 500 Mt/yr these time scale are unreasonably short yet noteworthy for legacy removal operations at 2003-dollar cost: alum addition at $0.5 Billion, muck removal at $3 Billion- 3.5 Billion.

Full TMDL attainment is not realistic. The author introduces the Lake Okeechobee Water Quality Improvement Plan [LOWQIP] as a timed sequence of alum treatment of water column and underlying top sediment TP followed by hydraulic removal. The time scale is dependent on speed of removal operations and reduction to river inflow attained by LOWRP. Three non-mutually exclusive dredge spoil locations: in-lake man-made spoil islands with slopes suitable for native rooted SAV’s or deep injection wells, or lake shore containment with dewatering and commercial recovery of TP as fertilizer are options. All options provide long-term SAV water quality improvement and sediment stabilization acreages of ~ 50,000 +ac. Dredge spoil islands reduce wind fetch re-stirring sediment, increase bass habitat, new island safety and recreational amenities. Shoreline dredge spoil infrastructure allows resource recovery of 50,000 + Mt TP. DIW installation affords repeated future operations. LOWQIP improvements would reduce Lake Okeechobee’s water column to ~ 60 to 80 ppb TP to below toxic cyanophyte production in possibly 1 to 2 decades with possible lake’s overall quality lasting 100’s of years.

A cleaner lake Okeechobee water column will provide high water quality headwater volumes to the Caloosahatchee River ~ 0.7 Maf/yr. ensuring minimum flow, maintenance of fresh/ salt estuary balance, partial recovery of fresh and saltwater grass beds, improved clam fishery and eliminate microcystin toxicities to human health and wildlife. Increased westward discharge of cleaner water to the Caloosahatchee could eliminate eastward lake discharges to the St. Lucie River severing its artificial discharge connection. Both northern estuaries would restore most natural functions. A cleaner Lake Okeechobee discharge to the STA’s would increase its functional lifetimes by about two times. LOWQIP is a logical extension of the author’s success in long term attainment of ~ 77 ppb TP in the St. Lucie West DRI, St. Lucie County, Fl.