JAN 2004

MFR- NORTH PARK LAKE DREDGING

REVALUATION USING GEOTUBES AND SHORT PUMPING DISTANCES

Note: original text by Glyn Banks. Format changes made by LRP.

After reviewing the revised engineering requirements for removal of 405,000 cu yds of sediment in North Park Lake and Pine Creek Lake and placement of sediments in temporary dewatering geotubes at three locations near the lake prior to truck haul to a reclaimed strip mine site located on project sponsor-owned property, in lieu of pumping these sediments directly to a disposal site approx. 18,000 ft from the main lake, I have concluded that this ecosystem restoration project can best be performed by a portable 10-inch cutterhead dredge equipped with an idler barge for wide radius cuts.

I conducted several model dredge production runs suitable for feasible study values for 10-inch discharge values to determine horsepower requirements and expected minimum production values for both initial fill and final “topout” of geotubes through a pipe manifold system at each dewatering site.

For this analysis, I used the average static heads and pipeline lengths from the lake to each of the three temporary handling sites as provided by Gary Cooper. The second optimized simulations depict the maximum optimized production [generally corresponding to an approx velocity of 10-13 ft per sec] for each pumping condition while the first simulation depicts a minimum production based on reduced pipeline velocities of 7.6 fps as the tubes reach their maximum capacity, yet still prevents fine sand sediment “fallout” in the dredge pipeline[from Turners book entitled Fundamentals of Hydraulic Dredging].

To prevent tube blowouts due to over-pressurization of tubes as the dewatering rate in each tube decreases once the tube is filled to approx 75% of design capacity, flow rates into each tube must not exceed 1000 gpm or possibly lower for hard to dewater fine grained sediments. To refine this dewatering rate, a hanging bag test needs to be performed to further design the performance period of the entire contract since the dewatering capacity of the geotube layout and operations will determine the true economics of this geotube alternative disposal system versus the traditional disposal pit located 18,000 ft from the lake.

Actual dredging production for these operations “must” vary according to the capacity remaining in each geotube as filling operations proceed. These detailed calculations can be performed later for the actual design phase study. The general results from these simulations for the respective Mars, Bull Pen and County geotube layout sites are as follows:

Dredge Size	Pipeline Length	Static Head	Horsepower Required	Est. Production
10 inch	1500 ft	10 ft	44	68.5 cu yds/hr
10 inch	1500 ft	10 ft	176	124.0 cu yds/hr
10inch	3500 ft	170 ft	196	68.5 cu yds/hr
10inch	3500 ft	170 ft	306	92.0 cu yds/hr
10inch	1650 ft	13 ft	48	68.5 cu yds/hr
10inch	1650 ft	13 ft	177	120.8 cu yds/hr

For general estimating purposes, I would require no larger than a standard 10 inch dredge size since the "limited" dewatering capacity of the geotube operation will cause a "less than ideal" dredging efficiency for one of sites[Mars] during all fill operations and at all of the sites during "topout" fill operations. The horsepower required does not limit the practical side of this operation as long as the plant horsepower and pipe sizes are actual values. Plastic pipe can be used on most of the job. Steel or plastic pipe distribution manifolds for the geotubes at each site must be set up with individual flow control valves for each geotube being filled.

Generally small dredge operations are conducted for 12 hours per day. I would estimate that approximately 2.0 hours of each day will be used for non-effective dredging time, i.e. changing swing wire locations/anchors, stepping ahead, repositioning the dredge, fueling operations, pump cleanouts, etc. If a lot of debris is encountered, these non-effective dredging times will go up because the line will need to pumped free of all materials prior to shutdown and the entire line needs to filled with flowing water prior to sending sediment to the geotube area. Since the entire area to be dredged was farmland prior to the lake's construction and there is no evidence of physical debris in the borings or on the lake, I do not think debris will be a major problem. Since the sediment type is a varying mixture of silt, clay, and fine sand, actual dredge production should be slightly higher than what we have initially calculated because silty clays pump more readily and at lower velocities than the fine sands used in the simulations.

The total length of geotubes for all three temporary placement sites is 6,800 ft. Approx 6 cu yds/foot of tube can be placed in these 45 ft tubes at max capacity, but the government may want to restrict this maximum volume placed in the tubes in order to maximize the dewatering performance of the tubes while providing a longer time frame whereby the dredge can work at maximum efficiency [generally at a corresponding velocity of 12 ft per sec] in lieu of operating at a reduced efficiency [generally corresponding to 7.6 ft per sec for tube max filling operations]. Since the calculated dredge production per day can vary from 685 cu yds [68.5 X 10 hrs] to 1200 cu yds [120 X 10 hrs], it is easy to see that maximizing the efficiency of the dredge operations can lead to significant savings in overall project cost.

If the government restricts the fill of the tubes to approx 75% of the design capacity of approx 6 cu yds per foot to roughly 4.5 cu yds per foot of tube, the total tube length for the entire job has a capacity of 4.5 X 6,800 or 30,600 cu yds.. Since the max capacity of the dredge per 10 hr pumping day at max efficiency is 1200cu yds, it will only take approx 26 days to fill all the tubes. I do not think the present tube layout has sufficient dewatering capacity to allow the dredge to have continuous operations without shutting down and waiting for the tubes to dewater.

A hanging bag test should be performed to refine this potential operation and aid in determining the required additional tube placement sites and/or chemical dewatering additives which could allow the dredging to continue uninterrupted as dewatering operations proceed.

If Marshall Lake is to restored as we discussed in the previous field visit, draining of the lake by temporarily cutting the closure dam and using low ground pressure dozers and excavators with dump trucks would be the preferred construction plan since the precise-elevation placement of sediments necessary for wetlands enhancement and plantings near the existing shorelines can be more accurately performed with land-based equipment