

Project Memorandum

To: Mr. Chris Speen, President - LAPOA
From: Jeff Anagnostou, P.E., C.P.G.
Date: June 24, 2015
Re: Lake Arrowhead Management Plan Progress Report
- AGS Project No. 15-5067

As part of our lake management plan investigation, Applied Geotechnical Services, Inc. (AGS) visited Lake Arrowhead on Saturday June 20, 2015 to perform secchi disc depth measurements, sampling and analytical testing of water samples from the lake, as well as to obtain groundwater level readings from the 4 groundwater observation wells on the LAPOA property. The water testing was performed to assess the current trophic state of the lake (i.e., basically the health or quality of the lake) and develop a maintenance and management plan to maintain the lake quality.

SUMMARY OF DREDGING OPERATIONS & LAKE LEVEL:

The dredging operations began in July 2014 and were completed in late September 2014. During the dredging operations, approximately 67 million gallons (9 million cft) of water was pumped from the lake. In addition, approximately 55,000 cubic yards of muck was removed from the bottom of the lake. In a closed system, the dredging would have resulted in a decline of the lake level of approximately 2 feet.

No actual surveying of the lake level has been performed since completion of the dredging operations. However, informal benchmarks were established on docks located along the east and south sides of the lake. Based on the current water level relative to these benchmarks, we understand the lake level has risen over 22 inches (approximately 2 feet) since completion of the dredging.

GROUNDWATER OBSERVATION WELL READINGS

As shown on the following table, the groundwater level within the four wells has risen approximately 0.4 to 0.8 feet since the previous groundwater level readings obtained on September 20, 2014. The groundwater level within Groundwater Observation Well OW-2 has risen 0.6 feet. OW-2 is located adjacent to the LAPOA picnic pavilion up-gradient from the lake.

Prior to the start of dredging operations, the groundwater level in OW-2 was approximately 2 feet higher than the lake level. As the groundwater level in OW-2 appears to have risen less than the lake level, it appears the dredging operations have been successful in promoting more efficient recharge of the lake from groundwater.

Groundwater Level Readings					
Well No.	OW-1	OW-2	OW-3	OW-4	
T.O.C. Elev. (ft)	1298.50	1282.68	1302.3	1309.80	
G.S. Elev. (ft)	1295.45	1279.58	1299.0	1307.00	
6/30/12 GW Elev. (ft)	1264.7	1261.7	1262.6	1256.2	
7/20/12 GW Elev. (ft)	1264.4	1261.7	1262.6	1256.1	
8/14/12 GW Elev. (ft)	1264.5	1261.2	1262.1	1255.3	
5/24/14 GW Elev. (ft)	1266.4	1262.9	1264.2	1257.7	
7/03/14 GW Elev. (ft)	1266.9	1263.2	1264.5	1258.2	
9/20/14 GW Elev. (ft)	1267.1	1263.2	1264.7	1258.4	
6/20/15 GW Elev. (ft)	1267.5	1263.8	1265.3	1259.2	
Note: Depth measured from T.O.C. (top of casing)					

WATER QUALITY TESTING RESULTS

During our site visit, secchi disc and temperature measurements were taken and water samples were obtained from the photic zone of the lake. The water samples were obtained from the southern, eastern, and western portions of the lake. The samples were analyzed for dissolved oxygen, nitrate-nitrogen, total alkalinity, pH, and phosphate by titrimetric procedures.

The test results were used to assess the trophic state of the lake based on the Carlson Trophic State Index (TSI) used by the Michigan Department of Environmental Quality (MDEQ). The test results indicate the lake is in an oligotrophic state (i.e., lakes characterized by clear water, low nutrient concentrations, and few aquatic plants and algae).

DREDGE DISPOSAL BASIN

The dredge disposal basin appears to be functioning properly at this time. In order to complete the permit requirements, it will be necessary to cover, grade, and seed the disposal area. The basin is currently too wet for grading and seeding. Continued monitoring of the disposal basin area will be performed to determine when the dredged material has dried sufficiently to allow the grading and seeding operations to be completed. AGS will prepare a short letter and submit to the MDEQ describing the current disposal basin conditions.

AGS is currently preparing the final Lake Management Plan report. We anticipate submitting the report within approximately 2 weeks.

We hope this information is sufficient for your present needs. Thank you for your use of our services.