FINDLEY LAKE – LAKE EVALUATION AND RECOMMENDATIONS

TOWN OF MINA, CHAUTAUQUA COUNTY, NY

DECEMBER 2021

PREPARED FOR:

FINDLEY LAKE WATERSHED ASSOCIATION
ATTN: MR. ED MULKEARN
PO BOX 125
FINDLEY LAKE, NY 14736

PREPARED BY:

PRINCETON HYDRO, LLC
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Findley Lake Watershed Association
C/O Mr. Ed Mulkearn
PO Box 125
Findley Lake, NY 14736

RE: Findley Lake
Lake Consulting Services - 2021
PH Project Number: 2024.001

December 4, 2021

Dear Mr. Mulkearn:

Princeton Hydro, LLC is pleased to present this final report detailing the results of the July water quality monitoring event and detailed management recommendations. Thank you for the opportunity to provide Findley Lake with environmental consulting and engineering services.

If you have any questions regarding this report, please do not hesitate to call.

Sincerely,

Senior Project Manager – Aquatics; Senior Aquatic Ecologist
Princeton Hydro, LLC

cc: Fred Lubnow, PhD, Director of Aquatic Resources, Princeton Hydro, LLC

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1.0 INTRODUCTION

Princeton Hydro, LLC (Princeton Hydro) was contacted by Findley Lake to review relevant background data for the lake including historic New York Citizens Statewide Lake Assessment Program (CSLAP) data and studies pertaining to septic influence on lake water quality in Spring of 2021.

Princeton Hydro reviewed all relevant data and met with Findley Lake to discuss the water quality of the lake, pertinent data gaps, and to review what data would need to be collected to understand lake management, including utilization of nutrient inactivation, aeration, or other techniques. During this meeting, Princeton Hydro noted that internal phosphorus loading may be a driver of growing season / summer blooms. Currently, the Total Maximum Daily Load (TMDL) for the lake (NYS DEC, 2008) notes that internal loading was not considered in the development of the TMDL due to the lack of data for confirmation. Still, this document identifies that the New York State Department of Environmental Conservation (NYS DEC) acknowledges the need for additional monitoring to determine if phosphorus release from the sediments plays a significant role in the phosphorus loading of Findley Lake. CSLAP data showed intermittent deep-water sampling with the majority of phosphorus analysis to be derived from surface water samples. In addition, full water column profiles of dissolved oxygen were not available.

As such, Princeton Hydro designed a sampling, modeling, and recommendation protocol to evaluate internal loading in the lake through sampling and modeling and to use this data to develop site specific recommendations for potential internal nutrient control. Such restoration techniques could therefore help reduce phosphorus loading and resulting harmful algal blooms (HABs).

The following report details the results of a single water quality monitoring event conducted in July 2021, an estimation of the internal nutrient release from the lake, and a list of potential management options to reduce this load and improve water quality conditions.

2.0 WATER QUALITY MONITORING

2.1 INTRODUCTION

The water quality monitoring event consisted of a single, mid-summer event in 2021. The purpose of this monitoring was to collect a comprehensive suite of limnological parameters that can be utilized to understand nutrient concentrations, transport, and algal growth. In turn, this data will be utilized to inform internal load assessments (Section 3) and recommendation of restoration measures (Section 4).

2.2 METHODOLOGY

Princeton Hydro sampled three (3) in-lake stations at Findley Lake on July 12, 2021 (Table 2.1, Appendix I).

Table 2.1: Findley Lake – 2021 Monitoring Stations

Station	**Latitude**	**Longitude**
ST-1	42.099650°	-79.721090°
ST-2	42.107914°	-79.723635°
ST-3	42.115208°	-79.73222°

At each of the three (3) stations an In-Situ Aqua Troll 500 meter was utilized to measure temperature, dissolved oxygen, dissolved oxygen percent saturation, specific conductance, and pH at 1.0 m intervals from surface to bottom. Prior to data collection, the meter was calibrated according to manufacturer recommendations. In addition, transparency was measured with a Secchi disc.

At a single deep station (ST-2), surface water samples were collected for the analysis of total phosphorus (TP), soluble reactive phosphorus (SRP), total Kjeldahl nitrogen (TKN), ammonia (NH3), nitrate (NO3), total suspended solids (TSS), and chlorophyll *a*. A deep-water sample at this station was collected 1 m above the sediments and analyzed for TP, SRP, and TSS. At ST-1 and ST-3, surface and deep samples were collected for TP, SRP, and TSS. All samples were placed on ice to 4°C and transported under chain-of-custody procedures to Environmental Compliance Monitoring (ECM) of Hillsborough, NJ for analysis.

At ST-2, a surface and mid-depth grab sample was collected for phytoplankton. This sample was appropriately preserved and analyzed by Princeton Hydro at our biological laboratory for taxonomy (to genus level) and cell count (cells/mL). In addition, a water column tow was conducted for the identification and semi-quantitative assessment of the phytoplankton and zooplankton in the water column.

2.3 RESULTS

IN-SITU DATA

In-situ data showed the lake to be thermally stratified during the July monitoring event. Thermal stratification is a phenomenon whereby warm surface water (epilimnion) is separated by colder, deep water (hypolimnion) by a transition zone (thermocline). This pattern occurs as water of different temperatures has different densities with cooler water being denser than the warmer, surface waters. Surface water temperature during the July event at ST-2 was 24.76°C (76.57°F) while deep water temperature was 10.26 °C (50.47°F) (Figure 2.1).

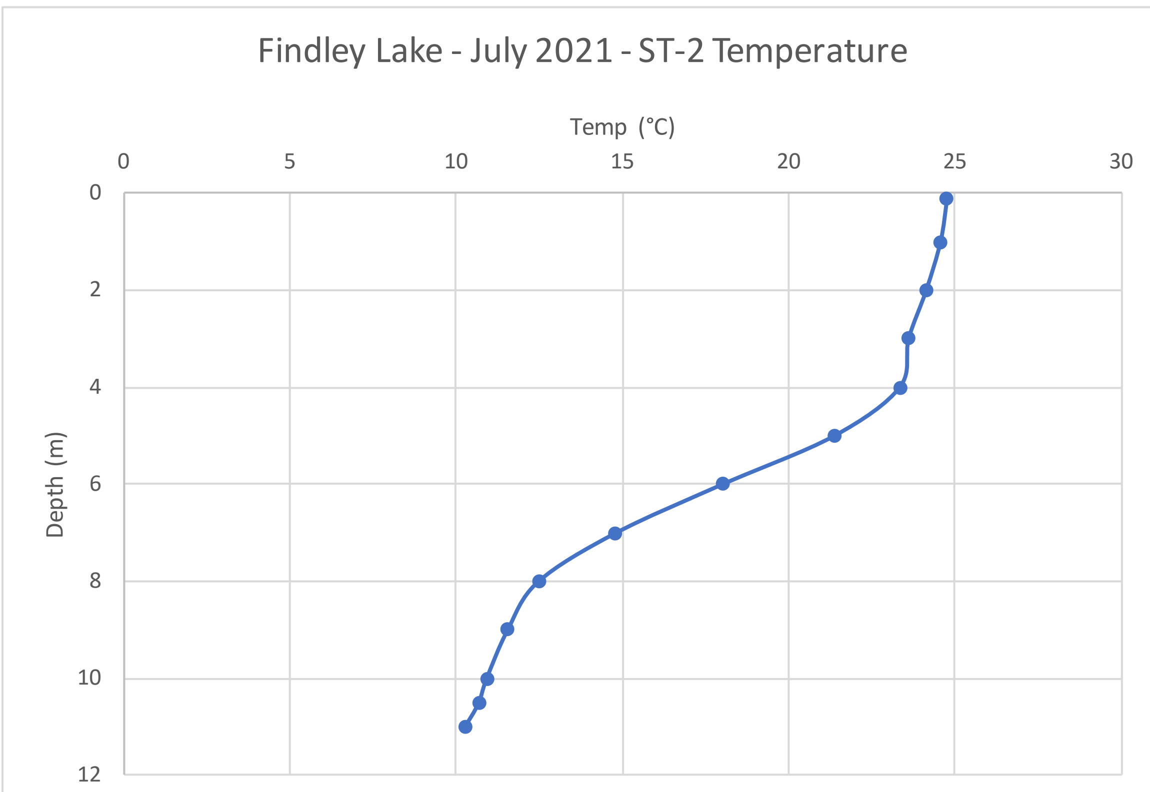

Figure 2.1: Findley Lake – ST-2 Temperature

Thermal stratification, in the summer months, has important implications in productive waterbodies as density driven resistance to mixing prevents the deep-water layers from mixing with the surface. As such, oxygen may become depleted in the deep waters and not able to be replenished from the atmosphere.

Dissolved oxygen (DO) measures at ST-2 showed supersaturated (DO > 100% saturation) conditions in the surface waters, indicative of high rates of photosynthetic activity, and depleted DO in the deep waters (Figure 2.2).

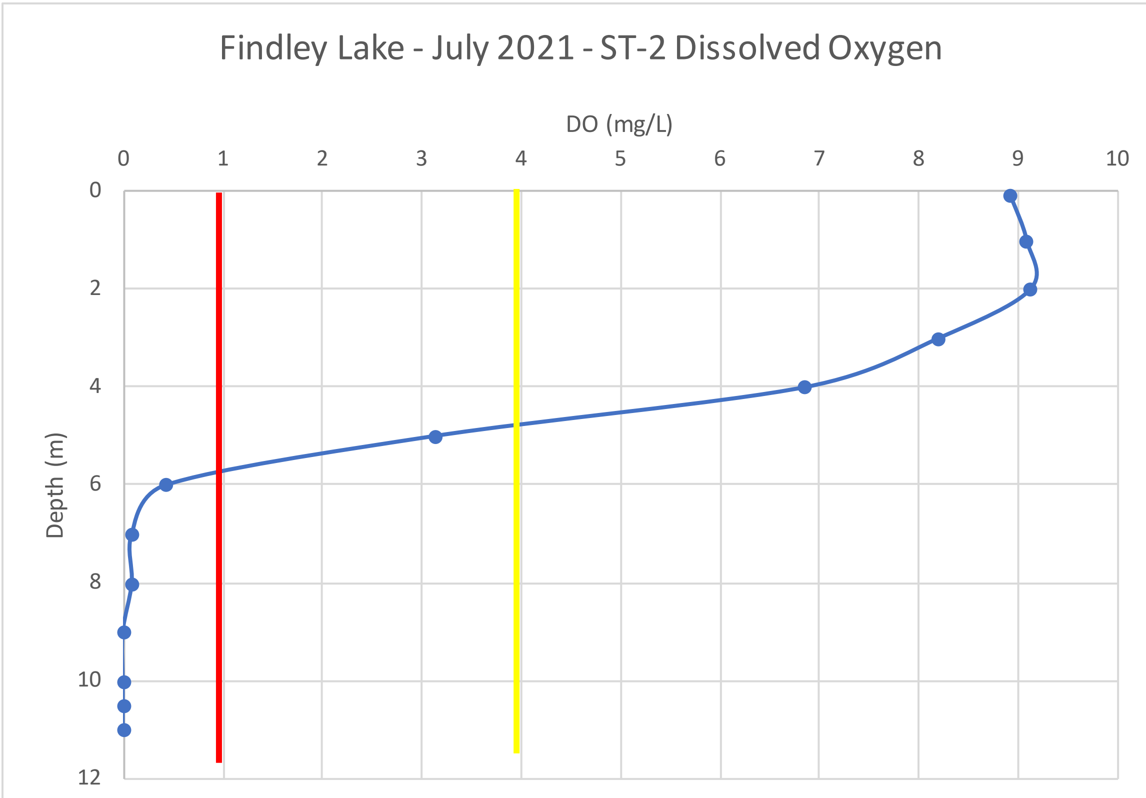

Figure 2.2: Findley Lake – ST-2 Dissolved Oxygen

DO measures were ample in the surface waters and then declined below the recommended level for warm-water fishes (4 mg/L; yellow line) at 5 m depth. The lake became anoxic (no oxygen) from 6 m to the bottom as shown in reference to the red line in Figure 2.2. Anoxia has important implications not only as unhabitable area for fish and other aquatic organisms but can also trigger the release of nutrients and metals from the sediment via a process commonly termed 'internal loading.' Internal loading can, therefore, serve as an internal pump of phosphorus, fueling algal growth, during the summer months.

pH values at ST-2 ranged from 8.95 at 1 m to 7.13 at 9 m depth. Surface water values were sufficiently elevated as a result of higher levels of algal and plant productivity while reductions with depth were noted due to increased bacterial respiration and a lack of a photosynthetic input (Figure 2.3).

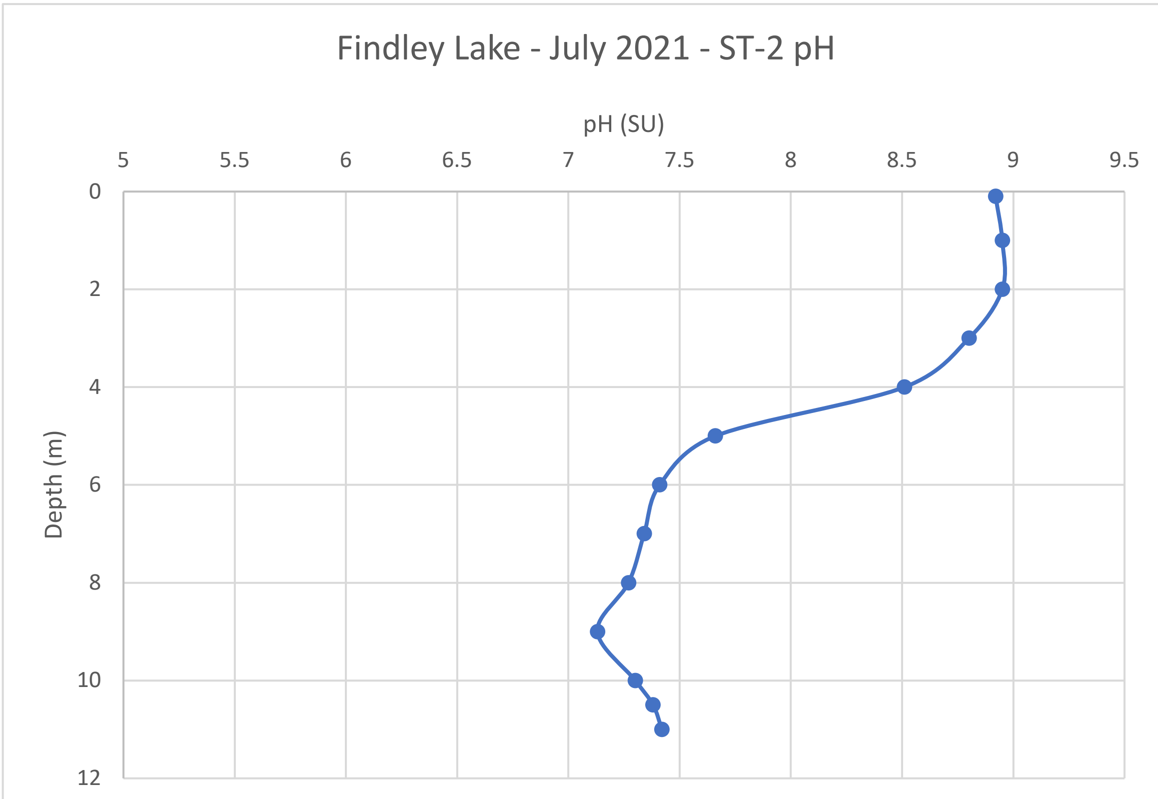

Figure 2.3: Findley Lake – ST-2 pH

Specific conductance values also showed strong variation with depth ranging from 181 µS/cm at the surface to 257 µS/cm in the deep waters. Increasing deep water conductivity may be associated with increased phosphorus and metals loading from the sediments under anoxic conditions (Figure 2.4).

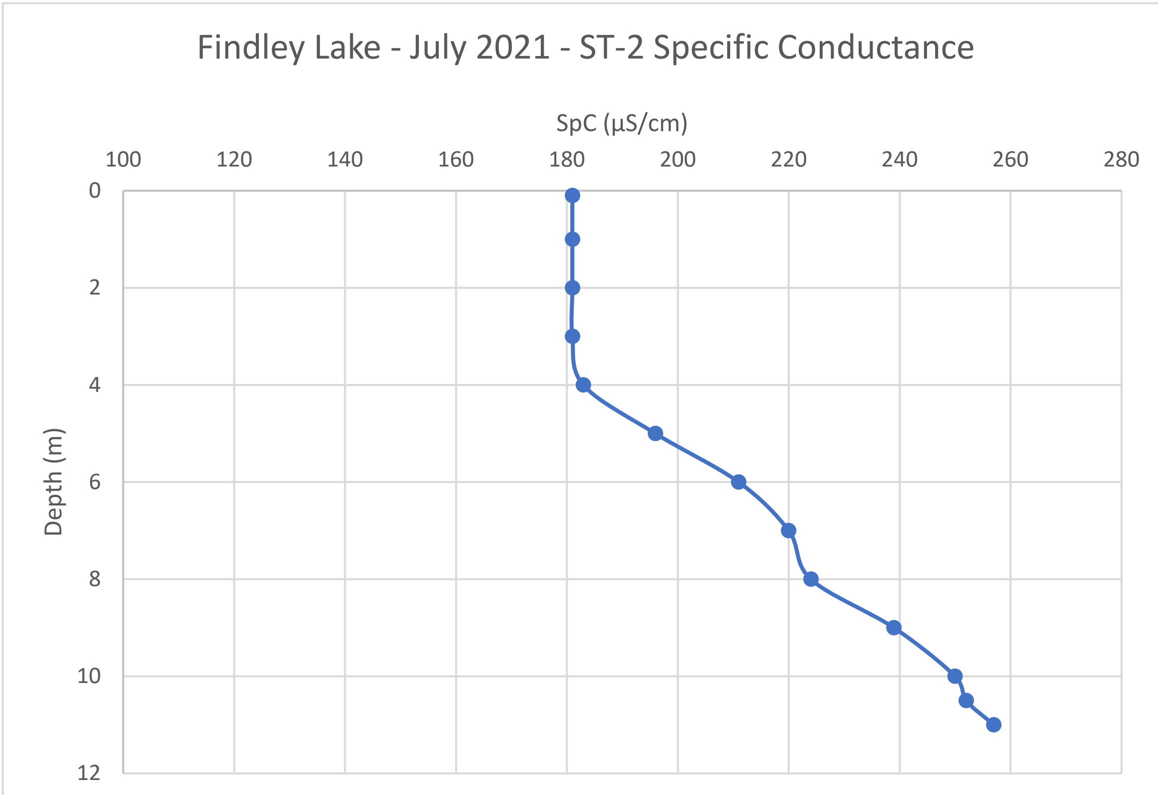

Figure 2.4: Findley Lake – ST-2 Specific Conductance

Secchi disc transparency was 3 m (10') at ST-2, 2.1 m (6.9') at ST-3, and 1.9 m (6.2') at the shallow ST-1 station. The mid-lake value of 3 m was excellent in terms of clarity as values greater than 1 m are typically desired for acceptable recreational use and aesthetics. Still, it was obvious there were large particulate cyanobacteria in the water column. As such, these organisms may have proliferated later in the summer season leading to a decline in this value.

DISCRETE DATA

Discrete data collected as part of the July 12, 2021 sampling effort is provided below in Table 2.2.

Table 2.2: Findley Lake – July 12, 2021 Discrete Data

Station	Depth	Chl *a* (µg/L)	NH3 (mg/L)	NO3 (mg/L)	TKN (mg/L)	SRP (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	Surface					0.002	0.03	2
	Deep					0.002	0.04	5
ST-2	Surface	7.1	0.04	0.04	ND < 0.10	ND < 0.002	0.02	2
	Deep					0.007	0.07	8
ST-3	Surface					0.002	0.02	3
	Deep					0.002	0.07	15

Total phosphorus is typically the primary limiting nutrient in freshwater lakes in the northeast United States. Small increases in phosphorus can lead to large increases in algal biomass and can help shift algal assemblage from beneficial chlorophytes, diatoms, and chrysophytes to a cyanobacteria dominated community. Common sources of phosphorus to lakes are derived from both external sources, such as septic transport, stormwater, waterfowl, and streambank erosion, and internal regeneration from iron-bound phosphorus under anoxic conditions. The latter is termed internal loading and typically occurs during the warm summer months when algae are most prolific.

TP concentrations in the lake ranged from 0.02 mg/L to 0.07 mg/L with higher concentrations in the deep waters of ST-2 and ST-3. TP levels greater than 0.03 mg/L can lead to elevated algal densities while values of 0.05 mg/L can promote bloom like formations. SRP, which is the largely inorganic, dissolved form of phosphorus and one that can be easily assimilate for growth, ranged from non-detectable (ND < 0.002 mg/L) in the surface waters of ST-2 to 0.007 in the deep waters of ST-2. Generally, values should remain below 0.005 mg/L.

Elevated phosphorus in the deep waters of ST-2 and ST-3 may be indicative of internal sediment release of this nutrient under anoxic conditions. Additional water quality monitoring, conducted throughout the growing season, would assist in determining the ultimate extent and duration of this loading.

Nitrogen levels, as represented by nitrate, ammonia, and TKN, were all relatively low and not indicative of any acute nitrogen pollution at the time of sampling.

TN:TP ratio at ST-2 surface was 7:1 while the DIN:TP ratio was 4:1. These ratios are relatively low and favor the formation and prevalence of the cyanobacteria.

Chlorophyll *a* concentrations in the surface waters of ST-2 were moderate at 7.1 µg/L. Concentrations greater than 6.7 µg/L are classically associated with eutrophic conditions when compared to Carlson's trophic state index. Still, most recreational lakes aim to maintain concentrations below 20 µg/L for acceptable aesthetics. For the latter threshold, this value was acceptable.

PLANKTON DATA

Phytoplankton samples were collected at the surface and mid-depth of ST-2. Surface samples showed a total cell count of 54,869 cells/mL of which 99% were represented by the nuisance cyanobacteria dominated by *Dolichospermum, Aphanizomenon,* and *Oscillatoria*. Mid-depth samples showed a total cell count of 80,881 cells/mL with cyanobacteria comprising 89% of the community. The predominant cyanobacteria were *Coelosphaerium, Dolichospermum,* and *Aphanizomenon*. Cell densities greater than 20,000 cells/mL are indicative of a large amount of algae in the water column.

The water column tow showed an assemblage with numerous cyanobacteria in addition to a dense population of the dinoflagellate *Ceratium*. Several greens, diatoms, and golden algae were also identified in lower numbers. The zooplankton tow showed an abundance of beneficial *Daphnia* in addition to several other cladocerans and copepods. No rotifers were identified.

3.0 INTERNAL LOAD ESTIMATE

The internal phosphorus load is the pulse of phosphorus which may occur in certain lakes with anoxic hypolimnion and an abundance of iron-bound phosphorus. Under these conditions, the bond between phosphorus and iron may break thereby releasing dissolved P into the water column. When this occurs, certain cyanobacteria can make use of this nutrient through their ability to vertically migrate; sinking to utilize deep phosphorus and then rising to utilize light for growth. In addition, in polymictic lakes, this nutrient may be mixed into the photic zone when thermal stratification breaks down during strong storm events.

Historically, information related to oxygen levels and phosphorus concentrations at depth were not collected for Findley Lake. As such, Princeton Hydro measured *in-situ* oxygen throughout the water column and collected deep-water TP and SRP data to get an estimate of the zone of anoxia and potential release of P from the sediments. From this data, it appears that at least 5 m (16') and deeper portions of the water column go anoxic. In addition, deep water TP at ST-2 was 0.07 mg/L compared to 0.02 mg/L in the surface. These conditions are indicative of potential internal loading.

For this estimate, Princeton Hydro estimated that approximately 25% of the lake area (30 hectares) go anoxic for a period of ninety (90) days. This correlates with an anoxic depth of approximately 15' and greater. It is likely, as the growth season progresses, that the zone of anoxia goes further than the 15-16' measured during the July 2021 monitoring event. As such, this zone is an estimate. The area of anoxia was determined with help from the Findley Lake bathymetric map (NYSDEC). Following delineation of the oxic and anoxic zone, a loading coefficient of 6 mg/m2/day for anoxia loaded P was applied to the anoxic zone for a period of 90 days. An oxic loading coefficient of 0.6 mg/m2/day was applied to the oxic zone during this period and throughout the entirety of the lake for an additional; 30 days. The results of this analysis are depicted below (Table 3.1).

Table 3.1: Findley Lake – Internal Load Estimate

Anoxic Period		**Oxic Period**	**Watershed Load***	**Total Load**
Anoxic area (kg)	Oxic area (kg)	Total area (kg)	(kg)	(kg)
157	48	21	426	652

**Per TMDL*

The internal load estimate for Findley Lake is 226 kg/yr which is 35% of the annual load. On an annual basis, this is significant enough to warrant management. The internal load was also evaluated on a 120-day growing season basis by breaking the watershed load down into 12-month loading segments of 35.5 kg/P/month. In this analysis, the internal load is 61% of the growing season P load. As such, management of this load would likely produce tangible water quality benefits in a cost-effective manner for Findley Lake.

4.0 IN-LAKE MANAGEMENT OPTIONS

In-lake management for Findley Lake should focus largely on mitigating internal phosphorus release under anoxic conditions. Such management does not replace the need for ongoing watershed management including streambank stabilization, stormwater management, waterfowl management, and septic/sewer management.

Mitigating internal nutrient loading typically occurs in lake management via one of two means; aerating the deep portions of the lake to maintain the iron-phosphorus bond during the summer or chemically treating the lake sediments with an aluminum or other compound that creates a stronger bond with P than iron, thereby maintaining sequestration of P in the sediments under anoxia.

4.1 NUTRIENT INACTIVATION

Nutrient inactivation is a common in-lake management tool utilized to control phosphorus availability and internal phosphorus loading. Over the past forty years, nutrient inactivation has been successfully implemented in the management and restoration of numerous lakes and reservoirs located in Pennsylvania, New Jersey, New England, and the mid-West (Cooke, et al., 2005). Some of these products have been used for over four decades in the restoration of eutrophic, phosphorus-rich lakes (Cooke, et al., 1977; Cooke, et al., 2005). Numerous studies and supporting data, going back into the 1980s, demonstrate the effectiveness of nutrient inactivant treatments, in many cases accomplished following a single application of a nutrient inactivant (Huser, et al., 2016). New York State currently has a moratorium on the utilization of aluminum based nutrient inactivation projects but has evaluated this management technique during pilot projects in 2018. As such, regulatory restrictions on these applications may change in the future.

Nutrient inactivation products are typically applied in one of two ways: 1) strip water column P and/or 2) 'seal' sediment bound P in anoxic hypolimnion.

The primary objective for a nutrient inactivation project for Findley Lake would be to 'bind' sediment bound P to prevent internal release over a period of 5-10 years. There are a number of products that could be utilized for such an effort including:

- Aluminum sulfate (alum)
- Sodium aluminate
- Buffered alum (alum + sodium aluminate)
- Polyaluminum chloride (PACl)
- PhosLock (lanthanum)
- Various ferric (iron) products

Of the above, the most commonly used nutrient inactivant is aluminum sulfate (alum). Alum has been used for over 70 years in drinking water treatment plants as a coagulant to strip water of particulate material. Dating back to at least the 1980s, alum has also been widely used in managing and restoring lakes (Cooke, et al., 2005). A primary advantage of alum is that it is produced in bulk and is therefore relatively inexpensive and easy to obtain.

Upon contact with water, alum forms a "fluffy" amorphous aluminum hydroxide precipitate. This precipitate is the result of the liberation of aluminum ions, which are immediately hydrated, and through a progressive series of hydrolysis, form aluminum hydroxide. The resulting colloidal, amorphous floc has high coagulation properties that bind, concentrate, and settle particulate phosphorus and other suspended materials from the water column. The aluminum hydroxide also effectively binds dissolved forms of phosphorus. Because the floc is heavier than water, it settles out of the water column over a 12-24 hour period and becomes integrated into the lake's soft sediments. The remaining active aluminum hydroxide contained in the floc binds interstitial pore water phosphorus, including that released under periods of anoxia. Any bound phosphorus becomes "inactivated" meaning that it is unavailable for biological uptake by benthic algae and phytoplankton.

The phosphorus bound by the alum is insoluble in water. The major benefit of using alum and the other aluminum and lanthanum-based nutrient inactivants is that the bound phosphate is not redox sensitive and the bound phosphorus will remain biologically unavailable even if the overlying waters become anoxic. This cannot be accomplished using the iron based inactivant products. Welch and Cooke (1999) showed that following a single surface application of alum, the internal loading rate in 7 out of 7 dimictic, eutrophic lakes was reduced on average by 80%, while water column bio-available concentrations of phosphorus remained low for an average of 13 years.

The primary disadvantage of alum is that it will cause the pH of a treated lake to decrease and become more acidic. The extent to which this happens is largely a function of the lake's buffering capacity, defined by its natural alkalinity. If the pH following an alum treatment drops below 6.0-5.5, the aluminum in the applied alum can enter a dissolved state which may prove toxic to fish and other aquatic life. However, the literature also shows that alum can be safely utilized with no negative consequences to aquatic biota if changes in pH are effectively managed (Welch and Cooke, 1999; Steinman et al. 2004). Essentially this means applying alum only in lakes having adequate buffering capacity as well as applying alum carefully in an amount that does not cause the pH to drop excessively. NYSDEC has historically used a pH threshold of 6.5 as the lower threshold limit for alum treatments. Prior to any alum treatment, it is recommended to conduct a 'bench test.' This test aims to determine:

- Amount of alum that can be applied before reaching the critical lower pH threshold
- Amount of alum needed to mitigate internal nutrient release
- Amount of alum above the minimum dose, but below the safe dose, to account for treatment longevity

The water sample used for alum bench testing must be representative of the entire water column; that is composed of lake water collected from the epilimnion, metalimnion, and hypolimnion. The bench test begins with the analysis of pH, alkalinity, chlorophyll a, soluble reactive phosphorus (SRP), total phosphorus (TP), total dissolved phosphorus (TDP), total aluminum (Al), and dissolved Al, and if the lake is characterized by a large amount (> 10 mg/L) of inorganic suspended sediment (turbidity) an analysis of total suspended solids (TSS). The measurement of pH and alkalinity establishes the baseline buffering capacity of the lake and is used to determine if a treatment will depress the pH below NYSDEC's 6.5 pH safety threshold. The measurement of chlorophyll and TSS will help identify the amount of particulate material present in the water column that could negatively affect the overall effectiveness and efficacy of the alum application. As noted, the settling floc will bind suspended material. If at the time of the treatment high concentrations of phytoplankton and suspended sediment are present in the water column this could decrease the amount of aluminum hydroxide actually available to bind dissolved phosphorus. The TP, SRP, and TDP data are used to quantify the pre-treatment concentrations of total phosphorus present in the water column (TP) and the amount of that phosphorus that is biologically available (TDP and SRP). The aluminum analyses provide information pertaining to the pre-treatment amount of total and dissolved aluminum present in the water column.

The alum bench test involves the introduction of specific amounts of the alum to a subsample of lake water. This is done in a stepwise fashion of increasing doses. After each addition of alum, the pH is recorded. Alum is added systematically until the cumulative dose results in the pH falling below 6.5. The process is then repeated using another subsample of lake water again until the pH of the sample falls below 6.5. This is determined to be the maximum Safe Dose. The initial battery of parameters including the phosphorus and aluminum species is then re-analyzed and the resulting data compared to the pre-treatment data. The bench test should demonstrate that there is no significant change in dissolved aluminum concentrations at the observed pH safety threshold of 6.5. No significant dissolution and attendant increase in aluminum toxicity would be expected until an induced pH of 5.5.

Determining the Effective Dose is accomplished during the same testing regime. As noted above this equates to the amount of alum needed to reduce SRP and TDP to non-detectable concentrations. The Effective Dose should be reached well before the Safe Dose alum volume is exceeded. The concentration of total phosphorus should remain approximately the same throughout the analysis because the soluble forms of phosphorus are simply converted by the added alum from a dissolved state into particulate state.

Some dosing rates for aluminum-based products range from 150-750 gallons/acre dependent on internal release rate and duration of control. Further testing would be required to determine the optimal dose of product but at an estimated rate of 300 gallons/acre, an opinion of cost for potential application would be in the $120,000 to $170,000 range *if permissible by NYSDEC*.

4.2 LAKE DESTRATIFICATION / AERATION

Destratification (complete water column mixing) aeration systems use compressed air to vertically circulate the entire water column thereby preventing thermal stratification from occurring or from persisting. This results in a water column characterized by relatively uniform surface to bottom water temperatures and densities. As a result, the entire water column can be easily circulated from surface to bottom. Lake water reoxygenation occurs due to the constant and consistent vertical mixing of the water column and the exposure of the water to the atmosphere. Although compressed air facilitates water column mixing, it is the exposure of the water to the atmosphere rather any oxygen transfer associated with the compressed air that is responsible for the vast majority of reoxygenation.

Destratification systems create a vertical convection current that results in the bottom waters being circulated to the surface of the lake, replicating the natural mixing of a lake during periods of turn over or when the water column is of uniform water temperature and density. This is accomplished by the strategic placement of air diffusers throughout the lake, but especially within the lake's deeper reaches. The air compressors and the negatively buoyant air lines account for majority of the cost associated with destratification aeration systems. The diffusers are relatively inexpensive (approximately $600 per diffuser unit). The compressor(s) must be housed in a suitably sized compressor building. To mitigate the noise and heat resulting from the operation of the compressor(s), the compressor building must be both heat and sound insulated and vented. Destratification systems are operated continuously; typically starting in early- to late-spring (before thermal stratification occurs), throughout the entire summer until early fall (when stratification normally breaks down and the lake would naturally turn over). Operational costs are a function of the size of the required compressor(s). The compressors for a destratification system servicing a relatively large lake typically require 3-Phase, 220-volt or 440-volt power source.

Initial capital costs for the installation of a destratification system in Findley Lake would be in the range of $150,000 to $200,000. Challenges may exist in terms of compressor locations in order to obtain the most efficient line runs and may need the agreement of numerous private property owners. Annual costs are associated with electricity to run the systems, periodic (3-5 year) compressor rebuilds, and routine monitoring.

5.0 REFERENCES

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Dennis, J.J. Noel, D. Miller, and C. Eliot. 1989. Phosphorus Control in Lake Watersheds. A Technical Guide to Evaluating New Development. Maine Dept. of Environmental Protection.

https://www.dec.ny.gov/outdoor/26958.html

https://www.dec.ny.gov/docs/water_pdf/tmdlfindley08.pdf

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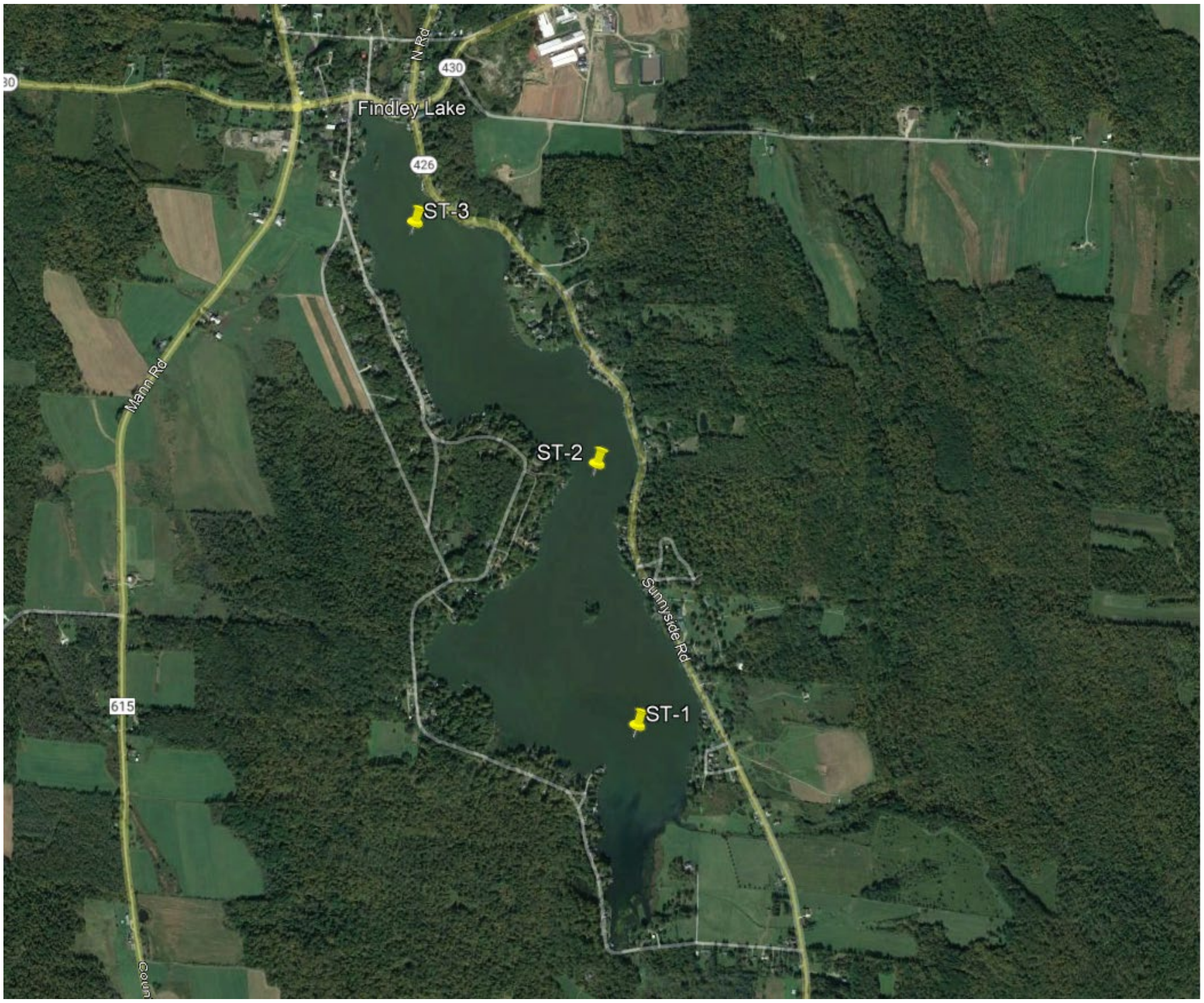
APPENDIX I


Findley Lake
ST-3
ST-2
ST-1
Mann Rd
Sunnyside Rd
N Rd
430
426
615

APPENDIX II

Findley Lake - 7/12/21 - *In-situ* Data								
Station	Depth			Temp	Spc	DO	DO%	pH
	Max	Secchi	Sample					
	(m)	(m)	(m)	(°C)	(µS/cm)	(mg/L)	(%)	(units)
ST-1	2.1	1.9	0.1	25.18	183	10.23	129.8	9.02
			1	23.97	191	8.53	105.9	8.56
			1.9	22.00	175	8.02	40.6	7.36
ST-2	11.0	3.0	0.1	24.76	181	8.92	112.4	8.92
			1	24.56	181	9.08	114.0	8.95
			2	24.13	181	9.12	113.6	8.95
			3	23.60	181	8.20	101.1	8.80
			4	23.33	183	6.86	84.1	8.51
			5	21.36	196	3.13	37.0	7.66
			6	17.99	211	0.43	4.7	7.41
			7	14.79	220	0.09	0.9	7.34
			8	12.47	224	0.10	0.9	7.27
			9	11.55	239	0.00	0.0	7.13
			10	10.92	250	0.00	0.0	7.30
			10.5	10.68	252	0.00	0.0	7.38
			10.9	10.26	257	0.00	0.0	7.42
ST-3	8.9	2.1	0.1	24.19	184	8.82	110.0	8.95
			1	24.07	183	8.68	108.0	8.97
			2	23.28	184	7.87	96.5	8.87
			3	21.96	171	6.04	72.2	8.38
			4	20.47	164	3.78	43.8	7.74
			5	17.89	229	0.30	3.3	7.35
			6	14.43	244	0.00	0.0	7.27
			7	11.48	271	0.00	0.6	7.21
			8	9.68	324	0.00	0.0	7.13

Findley Lake - 7/12/21 - Discrete Data								
Station	**Depth**	**Chl a**	**NH3**	**NO3**	**TKN**	**SRP**	**TP**	**TSS**
		(µg/L)	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**
ST-1	Surface					0.002	0.03	2
	Deep					0.002	0.04	5
ST-2	Surface	7.1	0.04	0.04	ND < 0.10	ND < 0.002	0.02	2
	Deep					0.007	0.07	8
ST-3	Surface					0.002	0.02	3
	Deep					0.002	0.07	15

Phytoplankton and Zooplankton Community Composition Analysis

Sampling Location: Findley Lake | **Sampling Date: 7/12/21** | **Examination Date: 7/20/21**

Site 1: ST-2 Surface Phyto | **Site 2: ST-2 Mid Phyto** | **Site 3: ST-2 Tow**

Phytoplankton

Bacillariphyta (Diatoms)	1	2	3
Fragilarira		7,799	C
Asterionella		503	P

Chlorophyta (Green Algae)	1	2	3
Scenedesmus			P
Chlamydomonas	121		

Cyanophyta (Blue-Green Algae)	1	2	3
Dolichospermum	42,207	25,157	A
Merismopedia			P
Aphanizomenon	6,271	12,579	A
Coelosphaerium		34,591	A
Oscillatoria	6,030		P
Microcystis			P

Euglenophyta (Euglenoids)			

Chrysophyta (Golden Algae)			
Dinobryon			P

Cryptomonads			

Pyrrhophyta (Dinoflagellates)			
Ceratium	241	252	B

Zooplankton

Cladocera (Water Fleas)	1	2	3
Daphnia			C
Bosmina			P
Diaphanosoma			C

Copecoda (Copepods)	1	2	3
Cyclops			C
Mesocyclops			C

Rotifera (Rotifers)	1	2	3

Sites:	1	2	3
Phytoplankton (cells/mL)	54,870	80,881	
Cyanobacteria (cells/mL)	54,508	72,327	
Zooplankton (org/mL)			

Comments: Surface phycocyanin reading 11 ppb

Phytoplankton Key: Bloom (B), Common (C), Present (P), and Rare (R)

Zooplankton Key: Dominant (D), Abundant (A), Present (P), and Rare (R); Herbivorous (H) or Carnivorous (C)