# Sustainable Lake Management Plan Gem Lake Ramsey County, MN



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## 1. Acknowledgements

VLAWMO wishes to thank the following:

- The City of Gem Lake
- Gem Lake Homeowner's Association
- Gretchen Artig-Swomley for assisting with the VLAWMO Water Quality Monitoring Program for many years and for allowing VLAWMO staff access to calibrate a lake level gauge.
- V. Kathleen Robins for allowing VLAWMO staff to access her property to gather lake samples for the VLAWMO Water Quality Monitoring Program.

VLAWMO's mission is to protect and enhance the water resources within the watershed. Activities include water quality monitoring, wetland protection, and water quality improvement projects. The cornerstone of VLAWMO's success is our vital partnerships; without the help of all those listed above, we would not be able to fulfill our mission. We appreciate all of your work and assistance.

## 2. Introduction

Gem Lake is located in the City of Gem Lake, Ramsey County (Figure 1) and lies within the Vadnais Lake Area Water Management Organization (VLAWMO) watershed area. Gem Lake is a 22 acre shallow lake with a maximum depth of 16 feet and an average depth of 9 feet. The lake has no public access and is surrounded by private, residential development, mostly on large, wooded lots. The City of Gem Lake has ordinances in effect which prohibit the use of motorized watercraft on the lake as well as regulations regarding the clearing of vegetation along the shoreline.

Figure 1: Location Map



Gem Lake has a subwatershed size of 306 acres. A watershed is the land area that contributes runoff to a particular point along a waterway. Watersheds can be broken down into smaller geographic units called subwatersheds. Section 3.B of this report has more information about the subwatershed.

Gem Lake was listed on the State of Minnesota's 303(d) Impaired Waters List in 2010 due to high levels of nutrients (phosphorus) which inhibit aquatic recreation. Because of this designation, a Total Maximum Daily Load (TMDL) report has been written which investigates possible causes for the high levels of nutrients and how much of a reduction is needed in order to meet the State standards. The TMDL study concluded that Gem Lake must reduce the amount of TP reaching the lake by 24% in order to reach the water quality goals for the lake. Further information regarding nutrients in the lake and the TMDL findings are found in Section 4.F. Additionally, a Retrofit Study was done within the Gem Lake subwatershed to determine the locations for possible future water quality projects (called Best Management Practices or BMPs for short) that would provide a positive impact on Gem Lake. The TMDL and Retrofit Study reports are included as appendices to this document. This Sustainable Lake Management Plan (SLMP) will look at the overall conditions of the lake and subwatershed area and tie in the findings of the TMDL and Retrofit Study to serve as a tool towards future projects and programs to help protect and enhance the water quality of the lake.

## 3. Watershed Features

#### A. History

The City of Gem Lake became incorporated in 1959. Prior to that it was considered part of the Town of White Bear. A detailed history is found in *Farms & Fox Hunts, A History of the City of Gem Lake, Minnesota, 2005*, written by James A. Lindner. According to this document, the land around Gem Lake was first settled by affluent families in the mid to late 1800's who were looking for a more secluded place to relax as opposed to building homes on White Bear Lake, which was more of a tourist attraction. Additionally, the document states that people settled there not necessarily for the lake but to have land for horses and to conduct fox hunts.

#### Aerial Photo History

Figure 2: 1940 Aerial photo of Gem Lake



In 1940, the area has a few homes near the lake and what agriculture use within the subwatershed. What is now known as Hoffman Road is on the eastern side of the photo with homes built off the east side of the road. The railroad that runs parallel to Hoffman Road is also present.

Figure 3: 1953 Aerial photo of Gem Lake



In 1953, a few more homes are cropping up in the subwatershed area. Highway 61 has been built and some development is occurring on the eastern side of the intersection of what is currently called County Road E and Highway 61.

Figure 4: 1974 Aerial photo of Gem Lake



By 1974, commercial development is occurring at the intersection of Highway 61 and County Road E, along with more residential development along Scheuneman Road. Along the western edge of this photo, you can see that what is now known as Interstate 35E has been built.

Figure 5: 1985 Aerial photo of Gem Lake



In 1985, more development has occurred in the area, especially between Scheuneman Road and the railroad tracks. Additionally, the residential developments around Daniels Farm Road and Big Fox Road are starting to show up.

Figure 6: 2006 Aerial photo of Gem Lake



By 2006, the Hillary Farm residential area begun construction and the Gem Lake Golf Club has been developed.

Figure 7: 2012 Aerial photo of Gem Lake



By 2012, there are more homes in the Hillary Farm area. More homes are planned for the Hillary Farm development.

#### B. Gem Lake Subwatershed Area

Gem receives water from various sources. The subwatershed is shown in the green area of the map below and is 306 acres in size. The subwatershed area is about 15 times larger than the surface area of the lake. This is relatively small for a subwatershed. A positive aspect of a small subwatershed area is that there is not a lot of land contributing to stormwater runoff into the lake. The land use within the subwatershed is primarily undeveloped or residential. A large source of possible stormwater runoff comes from Highway 61. Gem Lake is slightly unusual in that water doesn't flow out of the subwatershed area. Gem Lake is the end point of stormwater runoff for this area and doesn't outflow into another part of the watershed. That means all stormwater runoff must be filtered and infiltrated within the subwatershed rather than moving on to another waterbody.



Figure 8: Gem Lake Subwatershed

#### C. Soils

The soil directly under and near Gem Lake is Seelyeville which is an organic muck. The soils near the lake are mainly Kingsley and Mahtomedi which tend to be soils that drain easily and are well suited for agriculture and homesites. Mahtomedi soils are found in forest areas as well.



Figure 9: Soils around Gem Lake

#### D. Wetlands

Gem Lake and the marsh surrounding it is classified as a Type 5/3 according to the Wetland US Fish & Wildlife Circular 39 classification system. Additionally, there are 2 small Type 3 wetlands south of Gem Lake. A Type 3 wetland is described as a shallow marsh. The soil is usually waterlogged in the spring and often covered with more than 6 inches of water. A Type 5 wetland is an open water wetland which included shallow ponds. Water is usually less than 6 feet deep and typically surrounded with vegetation. Both types of wetlands provide habitat for fish, birds, and other wildlife, retain floodwater, and protect water quality.





#### 4. Lake Features

#### A. Shoreline Inventory

The land surrounding Gem Lake is low density residential. Homes are situated on large lots and there is a rule protecting the clearing of vegetation around the shoreline. There are no obvious signs of shoreline erosion.

#### B. Lake Depth

Gem Lake drops in depth rather quickly off the shoreline. VLAWMO's survey found the deepest point was 16 feet.

Figure 11: Gem Lake Depth



#### C. Fish Survey

Blue Water Science was hired to conduct a fish survey in September 2011. The report is attached as Appendix C. The survey found that the lake had a healthy supply of black crappies. The report concluded that Gem Lake is susceptible to winter fish kills and that if the lake were to experience another fish kill, the crappies would be eliminated and minnows would be the dominant species. Since Gem Lake is land locked, there is no opportunity for fish to migrate naturally. The report also stated that it is not recommended that fish be stocked unless a winter aeration system is installed since the fish would all be lost with a winter kill. Installation of an aeration system was discouraged because the lake is in a natural setting and letting nature take its course is a good management strategy for a lake like Gem which is more conducive to wildlife rather than a recreational fishery.

#### D. Aquatic Vegetation

VLAWMO staff conducted an aquatic vegetation survey on June 30, 2010. Due to Gem's depth, plant life was only found around the perimeter of the lake. Once water depth goes past 4 feet, it gets harder for sunlight to reach down far enough to support plant life. Gem Lake does not have a diverse plant community within its waters. The 3 most abundant plant species found were Clasping-leaf Pondweed, Pickeral Weed, and White Water Lily. However, no invasive plant species were found in the lake which is a positive thing. Results of the survey are located in Table 1.





Table 1: Aquatic Vegetation Survey Results

Gem Lake Aquatic Plant Survey 6/30/2010							
Prevalence on a Scale of (1-5)							
GPS Points	Bushy Pondweeds and Naiads (Najas spp.)	Large-leaf Pondweed	Clasping- leaf Pondweed	Coontail	Pickerel weed	Yellow Water Lily (Nuphar variegatum)	White Water Lily (Nymphaea odorata)
106	1	0	0	0	4	0	2
107	0	0	0	0	4	0	2
108	0	1	0	1	3	0	2
109	0	0	3	0	0	0	0
110	0	0	0	0	0	0	0
111	0	0	0	0	1	0	1
112	0	3	2	1	0	0	3
113	0	3	3	0	0	0	1
114	0	0	0	0	0	0	0
115	0	2	2	0	0	0	0
116	0	0	0	0	0	0	0
117	0	0	0	0	2	5	0
118	0	0	4	0	0	0	5
119	0	0	3	0	0	0	5
120	0	0	2	1	5	3	0
121	1	0	2	3	0	0	0
122	2	2	1	2	0	0	0
123	0	0	1	0	0	0	2
124	0	0	0	0	0	0	0
125	0	0	0	1	0	0	0
TOTALS	4	11	23	9	19	8	23

#### E. Water Quality Summary

Water quality data has been collected on Gem since 1997. Samples from the lake are collected every two weeks from May through September and tested for Total Phosphorus (TP) and Chlorophyll A (Chl A) and a Secchi Depth Transparency (SDT) measurement is taken. Phosphorus is the primary cause of excessive plant and algae growth in lake systems. Phosphorus originates from a variety of sources, many of which are human related. Major sources include human and animal wastes, soil erosion, detergents, septic systems and stormwater runoff. There can also be internal loading of phosphorus in a lake from the sediment. Chl A is a green pigment in algae. Measuring Chl A concentration gives an indication of how abundant algae are in a waterbody. The State of Minnesota has established water quality standards which state that a shallow lake should have TP levels at 60ug/L or below, Chl A levels at 20 ug/L or below and a SDT of 1 meter or greater. When monitoring data shows that a lake is not meeting these standards, they are placed on the Impaired Waters List and a TMDL study is done to determine sources of pollution and set goals for reductions.

As stated earlier in this report, Gem Lake was listed as an Impaired Water by the State of Minnesota due to the high levels of TP and Chl A. Table 2 shows the historical averages of these two water quality indicators. Those numbers in red denote when the data was over the State limits. In the last 4 monitoring seasons, the lake has actually been below the maximum levels. This may be linked to the reconstruction of Highway 61 in 2011 which included improvements to swales along the highway. Those swales filter the pollution in stormwater runoff from the highway and reduce the amount reaching the lake. This data is indicative that the lake may be on the right path towards health.

Gem Lake Historical Avg TP/Chl A/SDT					
Year	TP (ug/L)	Chl A (mg/m3)	Secchi (m)		
1997	54	23	1.2		
1998	33	24			
1999	26	16	1.2		
2000	36	17	1.1		
2001	56	12	1.8		
2002	39	25	1.3		
2003	52	20	1.4		
2004	49	0	1.5		
2005	43	26	0		
2006	63	25	0		
2007	48	33	1.1		
2008	64	17	1.5		
2009	89	28	1.3		
2010	53	24	1.4		
2011	32	6.4	2.1		
2012	41	11	2		
2013	35	17	2		
2014	31	8	2.9		

Table 2: Gem Lake Water Quality Annual Averages

Another water quality indicator VLAWMO monitors is the level of Chloride in the lake. In the spring, just as ice out occurs, a sample is collected. Table 3 shows results from 2010-2014. Since salt is heavily used on roads to clear them

of ice and snow, monitoring chloride is important. The State of Minnesota is still working on developing what the limit should be for a lake but given all the discussions that have taken place to date, none of VLAWMO's lakes are in danger of being listed as impaired for chloride levels.

Gem Lake Chloride Results (mg/L)			
2010	35		
2011	40		
2012	44		
2013	45		
2014	40		

Table 3: Gem Lake Chloride Results

Another measurement of a lake's health is the Tropic State Index. This is used by State and Federal agencies to track overall health. The data gathered from monitoring (TP, Chl A, and SDT) is put into an equation and the results correspond to a characteristics for the lake. Based on 2014 data, Gem Lake falls within the Mesotrophic – Eutrophic lake descriptions. Mesotrophic lakes have moderately clear water but may undergo anoxic (low oxygen) levels in the summer. Eutrophic lakes commonly have low oxygen levels and will often have algae blooms in the summer. Gem Lake is trending to the healthier Mesotrophic classification and will hopefully continue to show clearer water with low TP and Chl A levels.

## 5. Lake Management Plan for Gem Lake

There are numerous studies and reports done for the Gem Lake Subwatershed which provide recommended projects and programs to protect the health of the lake.

Action Item	Description	Leader	Cost Estimate \$ = <\$1,000 \$\$ = \$1,000-\$2,500 \$\$\$ = \$2,500-\$5,000 \$\$\$\$ = \$5,000-\$25,000 \$\$\$\$ = \$25,000-\$100,000
			\$\$\$\$\$ =>\$100,000
Continued Lake	Continue current monitoring program of	VLAWMO	\$
Monitoring	twice monthly lake sampling to measure		
	nutrient levels, dissolved oxygen and		
	temperature levels.		
Enhanced	Collect storm samples within the Gem	VLAWMO &	\$\$
Monitoring	Lake Subwatershed to determine areas of	Ramsey Co	
	concern.		
Swale Feasibility	Install and/or enhance swales along	VLAWMO, City of	\$\$\$\$-\$\$\$\$\$
and Installation	Highway 61.	Gem Lake, MNDOT	
Water Quality	Install water quality improvement projects	VLAWMO, City of	\$\$\$-\$\$\$\$\$
Improvement	within the subwatershed.	Gem Lake,	
Projects		MNDOT, Property	
		Owners	

Table 4: Action List for Gem Lake

Partnership is vital to achieving our goals in this watershed. VLAWMO will continue to work with the City of Gem Lake, Ramsey County and State agencies to move forward with the action items listed in this SLMP with the goal of protecting and enhancing Gem Lake's water quality.