



Sturgeon Lake High-Water Committee Report
December 2019

Introduction

With the water level rising on Sturgeon Lake, a large number of lakeshore owners reported increasing damage to property. The concerns were brought forward at the June 8th, 2019 meeting of the Windemere Township Lakes Association. At that meeting, pursuant to the Association's Bylaws, the board chair authorized an ad hoc committee be established (Sturgeon Lake High Water Committee) to further research the water level issue. This report summarizes that committee's work to date.

Table of Contents

Background.....	page 4
Damage Assessment.....	page 4
Sturgeon Lake Water Level.....	page 6
Previous High-Water Concerns.....	page 6
Climate.....	page 8
Conclusion.....	page 8
Recommendation.....	page 9
References.....	page 10
Appendix A.....	page 11
Appendix B.....	page 13
Appendix C.....	page 14
Appendix D.....	page 15
Appendix E.....	page 26
Appendix F.....	page 29
Appendix G.....	page 30

Background

Sturgeon Lake

Sturgeon Lake is located in northern Pine County Minnesota, approximately 2 miles east of the town of Sturgeon Lake. The lake has a current surface area of approximately 1,700 acres, 9.5 miles of shoreline, a maximum depth of 40 feet, and a mean depth of 22 feet. It is located within the Kettle River watershed area. A public access is located on the north end of the lake adjacent to County Road 50 (Minnesota Department of Natural Resources, 2019). The lake has two commercial resorts and is home to the YMCA's Camp Miller. There are approximately 322 parcels of property with shoreline on the lake. According to Pine County records, the assessed market value of the property is approximately \$68,331,500 with approximately \$813,919 in property taxes due on that property in 2019 (Beacon, Pine County MN, 2019)

Windemere Township Lakes Association

The membership of the Windemere Township Lakes Association is comprised of individuals who own property on, or have an interest in, any of the 13 lakes represented by the association. The association also has corporate sponsors who have an interest in the lakes represented. The objective of the association is:

“...to protect and improve the quality of the lakes, the values of the property, and the natural recreation facilities of Windemere Township. Some of the specific matters of concern of this organization will be water, noise, land and air pollution, and ecology, as it pertains to the natural resources and health of the residents of Windemere Township and the civic and community matters that affect the property values and recreational potential of the township.” (Windemere Township Lake Association, 2019)

Damage Assessment

In an effort to gain a better understanding of the type and level of damage occurring to property on Sturgeon Lake, the Windemere Township Lakes Association authorized the Sturgeon Lake High-Water Committee to create, publish and disseminate a non-scientific survey to all property owners on Sturgeon Lake. The survey consisted of closed and open-ended questions related to various aspects of damages and costs associated, as well as general observations (See Appendix A).

In August, the survey was mailed to 277 Sturgeon Lake property owners identified by Pine County Land Records Office. Also included in the mailing was an addressed stamped envelope for return of the survey. Approximately 100 of the surveys were completed and returned to the High-Water Committee. Information from the surveys was consolidated into four major areas; Shore Erosion, Landscaping Damage, Flooding, Structure/Other Damage, and Personal Property Damage. The type of damage and associated cost was transferred to a Microsoft Excel file for review. Additionally, for each survey response a brief damage highlight note, or additional information such as pictures supplied, was added to the Excel File. A limitation of the survey was that some respondents did not indicate whether the damage costs they provided were actual costs, professional estimates or personal estimate

Summary of Survey Findings

Of the 93 survey responses that indicated one or more type of damage, 39 did not indicate a cost associated with the damage. On some surveys, the respondents indicated they had no idea how much the damage would cost or if repair was possible. (Note: The indication of damage with no costs given are represented by a numeric “1” in the damage type box on the damage survey file) (See Appendix B)

Shore Erosion Damage

Of the 93 survey responses reporting some type of damage due to high water, 84 indicated shore erosion damage. Total estimated cost associated with that damage was \$638,059. Twenty-nine responses indicated damage but did not list a cost.

Landscaping

Of the 93 survey responses reporting some type of damage due to high water, 36 indicated landscape damage. Total estimated cost associated with that damage was \$115,274. Fourteen responses indicated damage but did not list cost.

Flooding

Of the 93 survey responses reporting some type of damage due to high water, 30 indicated damage associated with flooding. Total estimated cost associated with that damage was \$77,857. Seventeen responses indicated damage but did not list cost.

Structure/Other

Of the 93 survey responses reporting some type of damage due to high water, 50 indicated damage associated with their structures. Total estimated cost associated with that damage was \$370,089. Sixteen responses indicated damage but did not list cost.

Personal Property

Of the 93 survey responses reporting some type of damage due to high water, 8 indicated damage to personal property. Total estimated cost associated with that damage was \$20,951. One response indicated damage but did not list cost.

Damage Total

Total for all damage when costs were provided was \$1,222,230.

Damage Photos

Several survey responses included photos or other documentation. Some of that documentation is included with this report. (See Appendix C)

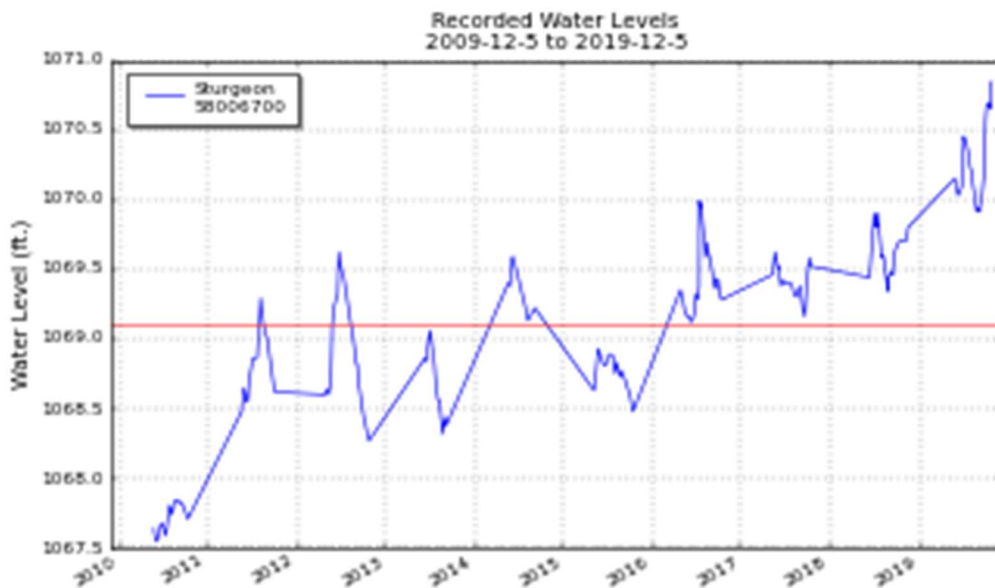
Survey Comments

Several surveys included personal comments regarding the high water at Sturgeon Lake and the damage. Some comments reflected frustration with the situation and the lack of political interest and the lack of a solution.

Sturgeon Lake Water Level

Many long-time lakeshore property owners have shared remembrances of the shoreline of Sturgeon Lake being hundreds of feet from its current location. In some instances where the water depth is now several feet deep there were trees, camping areas, and even a road.

According to the Minnesota Department of Natural Resources (MNDNR), Sturgeon Lake currently has no natural outlet (MNDNR Hydrologist, H. Lindgren, personal communication, October 2019). Consequently, when there are periods of heavier than normal precipitation, other water level stabilizing processes such as evaporation are not sufficient to eliminate excess water and the lake level rises. While acknowledging the reality of lake level fluctuations, the level of Sturgeon Lake is at a historical level. A recording of the lake level taken by the DNR on October 25, 2019 indicated the highest level the lake has ever been since records started in 1945. The level recorded was at 1070.84 feet. That places the level 4.77 feet above the record low of 1066.07 recorded in September of 1977 (Department of Natural Resources, 2019). The surface area of the lake has increased hundreds of acres to its current 1,700-acre size. According to DNR records, Sturgeon Lake has risen approximately 3.3 feet in the last ten years with 2.3 feet of that increase in the past four years.



Previous High-Water Concerns

In October of 1973, the water level on Sturgeon Lake was recorded at 1068.68, 2.16 feet lower than current level (MNDNR, 2019). However, even then lakeshore owners were concerned about shore erosion as well as property damage. Senator Florian Chmielewski, the state senator for the area, became involved and apparently forwarded a letter of concern from a constituent to then Governor Wendell Anderson. Governor Anderson responded to Senator Chmielewski indicating that he was advised that in the 1950s a local engineer by the name of Hanshu had made surveys and developed a project to provide an outlet for Sturgeon Lake via a natural waterway through Rush and Little Rush Lakes and a pipeline to Passenger Lake and on to the Willow River. The Governor went on to indicate that he had also been advised that the then landowners association was reviving that project and was going to work with Pine County on moving forward with the project (See Appendix D).

In November of 1973, Mr. Ward Blake, the Pine County Zoning administrator, wrote to the county board of commissioners. In that letter he indicated that the county engineer had inspected the watershed area and met with a committee of the landowner's association and several long-time residents regarding the high-water situation. Through the research, Mr. Blake indicated that legal and illegal mismanagement of land use had occurred over many years. He went on to indicate that roads (including CR46), culverts, buildings etc. were suitable only at certain water levels. Further, he indicated that the county could intervene but that any projects should be considered carefully. Finally, Mr. Blake concluded "...there is a serious condition of flooding lands, floors and sewage disposal systems in much of the shoreland of Sturgeon Lake. I do not feel this situation should be ignored" (See Appendix E).

In January of 1974, Mr. Ronald Hanson the area engineer for the United States Department of Agriculture, wrote to Mr. Konval Bergum the District Conservationist in Hinckley, Minnesota regarding the "Sturgeon Lake Project". In his letter, Mr. Hanson pointed out the high-water level on Sturgeon Lake and indicated a high rainfall the previous two years, high ground water levels and no outlet from Sturgeon Lake have contributed to the high water. Mr. Hanson identified three alternatives to lower the lake level

1. Construction of an open drainage ditch to outlet into the Willow River.
2. A lake level control structure using a buried pipe outlet from the lake to a stable outlet point.
3. A combination of the previous two alternatives.

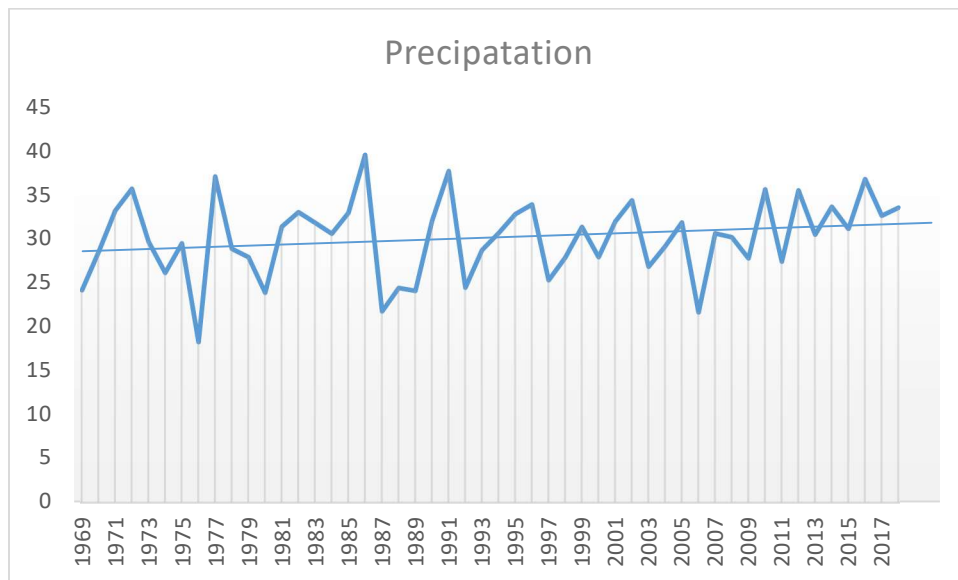
In the letter, Mr. Hanson provided a map with four rough proposed routes from Sturgeon Lake to the Willow River. He also estimated that depending on which alternative was used the cost of construction would be between \$100,000 and \$500,000 and would take considerable time. He concluded by identifying other entities that would need to be involved in such a project and recommended that an engineering firm be hired for design (See Appendix F).

From the correspondences, it appears a high-water mitigation project was moving forward. Unfortunately, only 4 years later the lowest water level since recording began was recorded at Sturgeon Lake. It is likely that with the water level so low, individuals, organization and entities

associated with a high-water mitigation project had little enthusiasm for spending the time and money required for a project that may never be needed.

Climate

Minnesota Department of Natural Resources (MNDNR, 2019) records indicate that there was a significant increase in precipitation from the late 1960's through 1972. Published data from the MNDNR indicates that precipitation in the Sturgeon Lake area in 1968 of 41.26 inches and in 1972 of 35.73 inches are the top two precipitation years since 1895, likely contributing to the high-water issues in 1973-1974. Conversely, the precipitation amount in 1976 of 18.28 was the second lowest since 1895, likely leading to the abandonment of high-water mitigation projects. As pointed out by the MNDNR, these fluctuations in precipitation influence the water level of Sturgeon Lake. However, in reviewing a 30-year precipitation chart for the Sturgeon Lake area, note that the long-term trend has been for an annual average increase in precipitation (MNDNR). Regardless of causation, the data indicates climate change and, although there may be years of brief precipitation relief, the trend is for a continued annual precipitation increase and therefore continued pressure on the water level of Sturgeon Lake (University of Minnesota, 2007).



Conclusion

The current historically high-water levels on Sturgeon Lake are a reality. There can, and will likely be, much discussion on the causal factors leading to the high-water level. However, with the reality of the high water is the reality of the damage. Federal, state, county, and township governmental organizations are concerned with water quality, habitat, and watershed issues, as well as private property issues. The members of the Windermere Lakes Association, and even non-members, share those concerns and want the lake to be a gem among Minnesota's

10,000. As Mr. Blake, the Pine County Zoning Administrator stated in his 1974 letter, “I don’t think this should be ignored”.

Members of the Windermere Township Lakeshore Association’s Sturgeon Lake High Water Committee have reached out to the following agencies and have received some limited feedback regarding the high-water situation. We express our gratitude for listening to our concerns.

United States Army Corp of Engineers
Minnesota Department of Natural Resources
 Area Hydrologist
 Flood Hazard Mitigation Manager
Pine County Soil and Water Conversation District
Area Pine County Commissioner
Pine County Engineer

The high-water level of Sturgeon Lake has had significant impact on many individuals and businesses. There is much speculation about why the lake level is at historic highs; poor management of development, I 35 cutting off a natural drainage, or climate change. Regardless of cause, the level of Sturgeon Lake is historically high and the prospect that it will go even higher in the future is real.

There is probably no easy solution to the high-water. However, with the substantial issues associated with the level, it seems reasonable that government entities could facilitate research on the issue, provide potential solutions and alternatives, and communicate with the impacted citizens regarding their lives and property. The first action should be obtaining an understanding of why the water level is high and what can be done about it.

Recommendation

The Windemere Township Lakes Association recommends that the Windemere Township Board and Pine County Board of Commissioners request and fund an engineering study regarding the high-water level of Sturgeon Lake, to include potential future water levels, potential future infrastructure and personal property damage, mitigation strategies/plans and costs.

References

- Beacon Pine County MN. (n.d.). Retrieved December 10, 2019, from <https://beacon.schneidercorp.com/Application.aspx?AppID=197&LayerID=2640&PageTypeID=2&PageID=1488>
- Minnesota Department of Natural Resources State Climatology Office, 2019, Retrieved December 3, 2019 from http://climateapps.dnr.state.mn.us/gridded_data/precip/monthly/monthly_gridded_precip.asp
- Minnesota Department of Natural Resources, Lake Finder (2019), Retrieved December 1, 2019 from <https://www.dnr.state.mn.us/lakefind/showlevel.html?downum=58006700>
- University of Minnesota (2007), *Lake Level Response to Climate in Minnesota*, Retrieved December 1, 2019 from https://www.lccmr.leg.mn/projects/2006/finals/2006_07_appx-c_lake_levels.pdf
- Windermere Township Lakes Association (2019), Retrieved December 1, 2019 from <http://windemere.mnlakesandrivers.org/>

**Sturgeon Lake Shorelands High Water Adverse Impacts Survey
August 2019**

Name: _____

Lakeshore Address: _____

Mailing Address, if different: _____

Phone: _____ Email: _____

Have high water levels had an adverse impact on your property?

Yes _____ No _____ If "No" there is no need to complete survey.

Please check the types of impact/damage experienced:

Shoreland erosion

Details: _____

Est. Repair Cost: _____

Trees, shrubs, landscaping lost

Details: _____

Est. Repair Cost: _____

Flooding

Details: _____

Est. Repair Cost: _____

Damage to Structures

Home/Cabin

Nature of Damage:

_____ Foundation _____ Basement _____ Floor Joists

_____ Flooring _____ Siding _____ Decks

_____ Other

Details: _____

Est. Repair Cost: _____

Garage

Nature of Damage:

_____ Foundation _____ Basement _____ Floor Joists

_____ Flooring _____ Siding _____ Decks

_____ Other

Details: _____

Est. Repair Cost: _____

CONTINUE ON BACK

Nature of Damage:

<input type="checkbox"/> Foundation	<input type="checkbox"/> Basement	<input type="checkbox"/> Floor Joists
<input type="checkbox"/> Flooring	<input type="checkbox"/> Siding	<input type="checkbox"/> Decks
<input type="checkbox"/> Other		

Details: _____

Est. Repair Cost: _____

Other Structures

Nature of Damage:

<input type="checkbox"/> Foundation	<input type="checkbox"/> Basement	<input type="checkbox"/> Floor Joists
<input type="checkbox"/> Flooring	<input type="checkbox"/> Siding	<input type="checkbox"/> Decks
<input type="checkbox"/> Other		

Details: _____

Est. Repair Cost: _____

Personal Property

Details _____

Est. Repair Cost: _____

Other

Septic system or Holding tanks

Details _____

Est. Repair Cost: _____

Access to property, e.g., paved or gravel driveways:

Details _____

Est. Repair

Cost: _____

Access to Lake, e.g., to launch boat, to enter water due to new steep bank, etc

Details _____

Est. Repair Cost: _____

Any other adverse impact due to record high lake level

Details _____

Est. Repair Cost: _____

Please add any additional comments on separate sheet and return with survey.

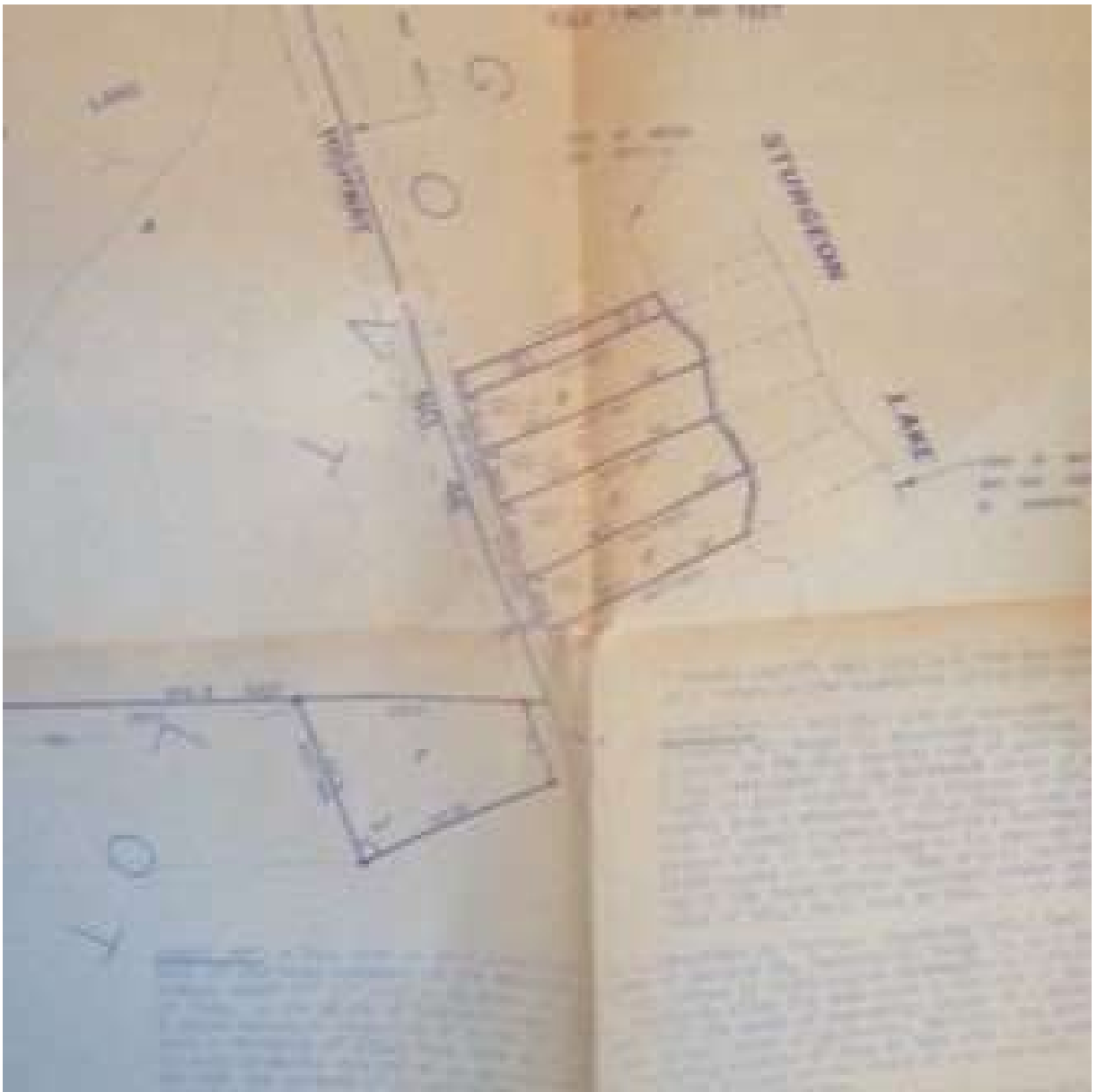
THANK YOU FOR YOUR INPUT!

Appendix B

Shore Erosion	Landscaping	Flooding	Structures/Other	Personal Property	highlights (Note:"1" in sheet represents listed damage but no monetary estimate provided)
7000		1	5000	6500	Flooded basement/washed out drive/personal belongings
1	5000				Loss of trees and removal/unk \$ for shoreline bank repair
10000			3000		boat house
1	1				Loss of 40 foot trees/deck almost underwater/repair \$ unk
1000	600		6000		Loss and removal of trees/mold on siding/shed foundation/driveway washed out
1000		1			dead trees/flooded land
					lost 5 feet of shoreline
5000			1700		pump holding tank twice/new post brackets to raise dock
8000					5-10 feet of shoreline pushed back
1	5260		3850		high water and ice damage
4500					actual yard repair cost/actual driveway repair cost/loss of shoreline and beach
					beach flooded
			500		needed to extend dock
5000					trees falling in lake/stairs impacted by ice/poor water clarity due to erosion
25000	1000	15000	4600		multiple issues/see comment sheet
500			200		beach gone/damage to slate sidewalk
1			500		loss of trees no longer able to store boat and dock on shore during winter
6500	1600		5000		multiple issues/see sheet for comments
1					no beach or easy access to water due to steep drop off
1					
22000			60000		had to demolish and repour finished basement/see sheet for further details
	5300		11000		Flooded yard repair/had to raise floor in basement and add drainage equipment
5000			15000		high water ice push moved shore 6 feet up and damaged dock
20000			21000		shoreline repair/basement repair/personal property/stress
20000	2000		27760		multiple issues/see comment sheet and pictures
1	1				major erosion/getting close to well
		1			flooded garage
1			300		lower quality shoreline/new poles etc to raise dock
2000	5000		20000		lost lot of yard/garage and driveway under water for 5 months/see comment page
150000	20000				expensive repairs on Island shoreline/loss of stairs deck and trees/no access to lake
10000	500		5000		Destroyed rip rap/many trees lost/lake access problems due to steps washing our
3950		1	1200		Backyard, garage and shed still underwater/driveway needed repair
		1			Water continually flooded yard
21000					Beach erosion/Yard is flooded due to sump in basement constantly running
1					Beach erosion/
1					Beach erosion
30000	25000	3000	50000	500	multiple issues/see survey for comments
200		1	1		Standing water/driveway very soft
1	1	1	1		Edelweiss/see sheet for comments
	1				High water likely to cause ice damage
			525		Rock retaining wall undermined
1					Bank washing out
1					Beach area completely gone
			1800		20 year old stone wall washed out/storage building undermined
10000		600	1		ice heaving due to high water/100 per month to run sump pump 24/7/hold tank fills
1					
4000		1	1		lost 25 feet of shoreline/water under cabin rotting floor joist
1	1		1		Will need more adjustments for dock
10000					oreline reconstruction and tree replacement
10000					eroding shoreline
1		1	1		shoreline and ramp washed out/trouble with sanitary pump/flooded waste tank
1		500			less usable yard
50000	30000	5000			loss of 10-15 feet of shore that has been there 45 years/fire pit/Landscaping loss
1		1			difficult access due to steep drop/barriers destroyed/flooded driveway
1	1	1	1		erosion/landscaping/water in crawl space/see sheet for comments
1	1	1	1		erosion/landscaping/water over road/dock underwater/see sheet for comments
5000	1000				beach lost/landscape including trees
1	1		7600		15 feet of erosion/2018 lakeshore restoration severely damaged/flooded road
3000					erosion/2-3 drop into water now on shore
17000			5000		ice and ice heaves lifted house/extensive shoreline restoration
5000			5000		loss of walkway to shore and minimal access to boathouse/boathouse unusable
500	0				noted they had damage even though they are in a sheltered cove
1	1	1			multiple issues see sheet for comments
500			25000		Damage to basement of home
10000			25000		erosion/Deck sinking and pulling away
5000	100				erosion/water up to bank no where to sit
1	1			1	lakeshore area unusable....priceless
5800	1500	1450	2610		repair shoreline/landscaping/elevate sandpoint/shed underwater/see pictures
5000		640			beach completely eroded/had to purchase pumps/additional cost to empty septic
1	1	1	1		Lost 110' of beach/shed foundation, flooring, siding/worst in 48 years
7580	300	150	630		New rock retaining wall damaged/shed sat in water all season
1500	800		3000		shoreline erosion/loss of tree/collapsed foundation on wellhouse shed
2000	1200		2800		shoreline erosion/moved boathouse 4 times now tearing it down before ends in lake
13000					shoreline erosion required rock fill
2000			3000		shoreline erosion/boathouse required repair due to flooding
20000	4000	5000	40000		multiple issues see sheet for comments
1000	500	1500			Lost 8 feet of shoreline/lot is flooded
25000					very severe ice push
2000					erosion
1					eroding bank
1000		5000	1000	5000	erosion/flooded lot/constant sump pumping/basement flooded
5000			1		shoreline erosion/loss of shoreline storage area
25000		15000			loss of 8 feet x 100 feet of shoreline/yard flooded/need ramps to put dock in
1			1	1250	lost storage shed and stairs/lost 8 feet of shore/lost rip rap
10000					needed to raise rock wall/had to move boat house
1	1	1	1		see comments
2500		25000			erosion/lost all of property on west side of CR46 water and power unusable also
1	1	1	1		4 foot drop/loss of trees/flooded pole building/unable to pump septic fear of floating
1			1000	4000	had to remove boathouse/lost retaining wall and stairs
5500	600	1	1	200	basement flooding/constant sump operation
12000	1				loss of lake access/dock cannot be used
4500	4000		4500	3500	loss of electric/pictures provided
0					
638059	115274	77857	370089	20951	
Shore Erosion	Landscaping	Flooding	Structures/Other	Pers Property	

Appendix C

Old Survey of Sturgeon Lake Shoreline Relative to CR 46



Appendix D
Approach to Sturgeon Island Bridge



Appendix D
Erosion at County Road 46



Appendix D
Front Yard of Cabin 1962



Appendix D
Same Cabin 2019



Appendix D
Example of Cabin Before



Appendix D
Same Cabin 2019



Appendix D
Additional Example



Appendix D
Additional Example



Appendix D
Additional Example



Appendix D

Bank Erosion



Appendix D

Water from Dago Lake at I35





WENDELL R. ANDERSON
GOVERNOR

Appendix E

STATE OF MINNESOTA

OFFICE OF THE GOVERNOR

ST. PAUL 55155

November 16, 1972

The Honorable Florian Chmielewski
State Senator
Sturgeon Lake, Minnesota

Dear Senator Chmielewski:

Thank you for your letter of October 13th enclosing Mr. E. D. Kuhn's letter to you concerning high water levels of Sturgeon Lake, Pine County.

I have been informed by the Department of Natural Resources that the ditch which permits outflow from Sturgeon Lake to Dago Lake is artificial and was dug a number of years ago. It was dug by persons unknown who apparently thought relief from high water would follow. However, since Dago Lake has no surface outlet and an area of only slightly more than 100 acres while Sturgeon Lake has an area of nearly 1500 acres, Dago Lake quickly filled up without providing the relief sought. I am advised that the ditch crosses the right-of-way of County State Aid Highway No. 46 and directs the water to and away from the culvert. I am also advised it was illegally constructed. Therefore, it appears feasible and proper, I believe, for the county to plug either the ditch within the right-of-way or the culvert. This would stop the flow of water to Dago Lake.

I am advised that in the 1950's, a local engineer named Hanshu made surveys and developed a project to provide an outlet for the lake to the Willow River via a natural waterway to Rush - Little Rush Lakes and a pipeline to Passenger Lake which naturally outflows to the Willow River through Big Slough Lake. The project is being revived by the Windemere Township Lake and Landowners Association, General Delivery, Sturgeon Lake 55783, of which Mr. Gale B. Beccue is chairman. In connection therewith,

Appendix E

Page 2

Mr. Beccue wrote Mr. Eugene Gere on October 14th. A copy of that letter is indicated as having already been sent to you and a copy is enclosed for Mr. Kuhn. Although the letter has not yet been answered, it was delivered by a member of the organization, Mr. Glenn Rover, who was advised that the project requires a permit from the Commissioner of Natural Resources. He was also told that such permits, for projects affecting the water levels of lakes, are issued only to public agencies, such as counties, municipalities and perhaps townships.

It appears that the association is going to work through Pine County to effect the construction of the project. I suggest that Mr. Kuhn contact Mr. Beccue regarding it and perhaps join the organization.

Thank you for writing. Mr. Kuhn's letter is returned. I suggest that if he has additional questions, he contact Mr. Eugene Gere, Director, Division of Waters, Soils and Minerals, Department of Natural Resources, 300 Centennial Office Building, St. Paul, Minnesota 55155.

With warmest personal regards.

Sincerely,



Wendell R. Anderson

WRA:sh

Appendix F

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Federal Building, Room 113, 515 W. First Street, Duluth, Minnesota 55802

SUBJECT: ENG - Assistance - Windemere Township Landowners DATE: January 29, 1974
 Ass'n (Sturgeon Lake Project)

TO: Konval H. Bergum, District Conservationist
 SCS, Hinckley, Minnesota

The problem is the water level of Sturgeon Lake is high causing beach erosion and individual home drainage and foundation problems. This is caused by several things. One is the higher than normal rainfall which occurred during the last two years. Second is the higher ground water levels which occur with a higher rainfall period. Third Sturgeon Lake is a pocketed lake and has no defined outlet.

The solution to this problem can be accomplished by one of three basic alternatives:

1. Construction of an open drainage ditch to outlet into the Willow River. This would require a couple lake level control structures and necessary grade control structure for channel stability.
2. A lake level control structure using a buried pipe outlet from the lake to some stable outlet point.
3. Some combination of the previous two alternatives.

Routes of a possible installation works are shown on the attached map. The routes shown are general locations and may be varied. The estimated cost of construction would be from \$100,000 for routes no. 1 and 4 to \$500,000 for route no. 2 with route no. 3 in between. Other costs to arrive at total installation and construction are: engineering, administration, land and water rights. Note: estimated pipe size for various estimates were based upon an approximate water removal rate of $\frac{1}{2}$ " per day from the lake surface.

Several other items which should be considered before selection of type of outlet and route are:

1. Effects on existing land use
2. Possibilities of excess water loss if deep ditch is used (Sandy conditions in the area)
3. Properties that will be affected
4. Rate of lake level draw down
5. Establishment of all lake levels involved in an alternative



Appendix F

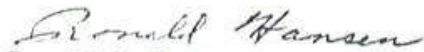
Konval Bergum

Page 2

This job will require a large amount of time. Due to this it should either be an RC&D project or will require Mr. Major's approval before working on as a CO-01 project. In either case the local people should come to some decision as to which route and possible alternative they would like a preliminary plan developed on. Then a preliminary profile survey could be run and borings taken to develop a preliminary design. A study of ground water movement should also be involved in the preliminary engineering work to assist in determining hydrology of the watershed and outlet needed.

The Commissioner of Natural Resources will have to establish levels of all lakes involved to be used in a final design. It may be beneficial to Kelsh plot this area for design purposes. An impact statement will need to be developed for this project also.

The above data should shed some additional light on this project. They may wish to hire a private engineering firm to design this project. When some decisions have been made as to route and approach to take on this project the area staff will assist as needed.


Ronald H. Hansen
Area Engineer

Attachment

Appendix G

