Revised August 24, 2017

Presented by
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The Twin Lakes Story

Executive Summary

The Town of Warren and its residents are being adversely impacted by extremely high water in Twin Lakes, which has risen to historic, all-time highs, and is causing significant damage to homes, property, and roads. The situation in the Town has escalated to the point where the Town Board has declared a State of Emergency.

Twin Lakes is a pair of shallow, seepage water bodies that are about 200 acres in size located about a mile southwest of the Village of Roberts in St. Croix County, WI. These lakes are listed individually in DNR inventory as East Twin Lake, and West Twin Lake. They are shallow glacial surface water basin lakes, and have no natural incoming or outgoing tributaries such as rivers or streams.

Of primary concern is the observation by numerous residents that the rising water of the lakes has been a long term trend, with an apparent significant acceleration in the last few years. West Twin has overflowed its traditional boundaries, and has flooded about a half mile of residential valley to its north. There is much speculation, conjecture, perception and opinion among residents and local authorities as to the root cause of the historic high water levels. Of equal debate is what actions to take, if any, to resolve the issue and protect the Town and its residents.

Flooding of roads and residences has only begun to occur in recent years, beginning in 2015. Rainfall during this period has also been consistently above the average norms, so it is a natural assumption that heavy rains are the main cause of the recent flooding. Indeed, recent flooding all across the State can be attributed directly to above average precipitation. Rainfall is the number one factor cited by local officials when questioned by residents to explain the Twin Lakes flooding. See aerial footage taken of Twin Lakes on June 14, 2017

Other residents, who have been observing the lakes for decades, point at other factors, such as industrial development around the perimeter of the lakes altering the watershed. One incident cited is the blasting away of a limestone hill just south of the lakes which triggered a mudslide during subsequent storms, and washed a significant amount of silt into the lakes. This occurred at approximately the same time as the beginning of the accelerated accumulation of water.

Another factor often cited is the contribution of tens of millions of gallons of treated wastewater effluent that a water treatment plant, operated by the Village of Roberts, makes to the lakes each year. The effects of the water treatment plant are often quickly dismissed by local officials as a significant contributing factor to the flooding, since it has been in operation since 1962, and there have not been issues with flooding until approximately 2015.

In response to the community's need to cut through the perception, conjecture, and opinion related to the situation with the lakes, to compile hard data from which to draw informed conclusions, and to interact with other government agencies in formulating a solution strategy, residents of the Town of Warren have organized into a "Friends of Twin Lakes" Unincorporated Nonprofit Association. The mission of the Friends of Twin Lakes is to examine and document the facts, raise awareness of the issues, and work together with the greater community as well as appropriate local, county, and state governing entities to acknowledge the problem, then collaborate on a long-term, sustainable solution to manage, protect, preserve, and improve the beautiful natural resources provided by Twin Lakes.

This document is the result of months of research, investigation, interviews with subject matter experts and local residents, and data modeling that applies existing research done by the WI Department of Natural Resources, National Weather Service, US Geological Survey, St. Croix County, and Village of Roberts among others.

We believe this work to be the first effort to use all of the various information sources to build a data model that spans the period from 1974 - 2017, calculate the expected behavior of the lakes based on that data model, and then compare the calculations with actual observed measurements taken at various points in time throughout the 43 year period.

The results conclusively demonstrate that while rainfall is the major source of input to the lakes, and lake levels vary significantly along with the precipitation cycles, it is undeniably the cumulative effects of the sustained effluent output from the Village of Roberts water treatment plant, when combined with the other natural input sources, that have exceeded the capacity of Twin Lakes to absorb the combined water volume. The current flooding situation has been over 50 years in the making. The above average rainfalls of recent years have only hastened the reaching of the critical flood point.

The data strongly demonstrates that without proactive management, there is no reason to expect that the rising water trend will change in future years, but rather will increase along with the growth of the Village of Roberts, and it's increasing wastewater effluent discharge. There will continue to be the natural fluctuation associated with changing precipitation patterns, so it is possible that there may be a short term receding of water if there is a future period of less precipitation. The long-term trend, however, will continue to be slowly increasing overall water elevations in the Twin Lakes, and worsening of the flooding problems now plaguing the valley area north of the West Twin.

Creating and implementing a sustainable management plan for Twin Lakes is key to the continued prosperity and growth of both the Town of Warren, and the Village of Roberts. All decision makers, governing entities, and legislators have a duty to work together in the best interest of all residents, and to manage and preserve the beautiful natural resources of Twin Lakes.

The major challenge that lies ahead is to get the various governing agencies to collectively recognize the long term nature of the problem, acknowledge that the wastewater treatment plant is the major, controllable factor in the chronic rising water levels, and collaborate with one another and the community to formulate and implement a sustainable management plan strategy. It is in this spirit that the Friends of Twin Lakes present this document as an objective starting point to begin the dialog.

The Details

Lake Status

Once known for producing desirable fish, Twin Lakes is currently on the state's impaired waters list for a number of reasons. According to the Wisconsin Department of Natural Resources, both lakes suffer from excess nutrient enrichment, poor water quality and experience heavy algal blooms.

Documented Lake Levels

Two key lake level elevation observations are of special interest, since they establish documented lake levels at specific points over a fairly wide span of time. The measurement included on a detailed topological map of Twin Lakes in 1974 shows the lake elevation at 959 ft. (above mean sea level or MSL). Another measurement taken as part of a detailed study required by the DNR for certification of the Roberts water treatment plant documents the elevation of West Twin at 965.08 ft MSL in January of 2008. These two measured elevation points provide known values that can validate calculations made by a data model. An unofficial elevation measurement taken with aviation grade altimeter equipment accurate to within +/- 2 ft documented the height of the West Twin to be 971 ft in August of 2017. Using the most conservative value from this variance range suggests the lake elevation should be gauged at approx 969 ft MSL for evaluation purposes.

These documented observations are used to gauge the validity of the calculations of the following data model used to explain lake behavior over the 43 years period between 1974 and 2017. The observed overall rise in lake stage during this period is 121 inches or 10 feet.

The Data Model

In 2009, the USGS did a comprehensive study / simulation of groundwater flow throughout a three county area of Pierce, Polk, and St. Croix Counties. The findings from this simulation provide the basis for calculating the behavior of the lakes during the target period from 1974 through 2017. As part of the 2009 simulation, P.F. Juckem [1] simulated the groundwater/lake-water interaction near Twin Lakes. Juckem notes that:

*"Simulation of groundwater/lake-water interaction for Twin Lakes indicates that **groundwater inflow and outflow represent about 5 and 20 percent,** respectively, of the total lake-water budget. **Precipitation and evaporation, representing about 85 and 80 percent**, respectively, of the total lake-water budget, dominate the lake budget are are likely to be important factors controlling the lake stage. Augmentation from a **wastewater-treatment plant accounts for the remaining 10 percent** of water entering*

*the lake. Overland **runoff was assumed to be negligible** and therefore was not simulated. Similar to regional groundwater-flow directions, groundwater in the local glacial aquifer near Twin Lakes flows from the northeast to the southwest."*

This is summarized in the following table from the report:

Type of source or sink	Inflow to Twin Lakes (% of total)	Outflow from Twin Lakes (% of total)
Direct precipitation on the lakes	85	0
Direct evaporation from the lakes	0	80
Surface-water runoff or streamflow	0*	0
Augmentation (effluent from a wastewater-treatment plant)	10	0
Groundwater flow	5	20

Figure 1 - USGS Simulation Report Summary

* While the simulation does not break out a specific percentage factor for surface water runoff, the data model incorporates an aggregate allowance for runoff as part of the groundwater flow calculations. See the following sections for detail.

The Basic Math

Using the information presented in the USGS Simulation report, the following overall formula for calculating the change in lake elevation is derived as the following:

> ***Change in elevation = (liquid precip + overland runoff + groundwater inflow + wastewater) – (evaporation + seepage)***

By starting with a known lake level elevation at a specific point in time, the above calculation can be rolled forward year over year to establish a derived expectation of the lake elevation over successive years. These calculated levels can then be compared to actual observed lake elevations at key points in time to validate the calculation model.

Lake Inflows

Precipitation

Water naturally enters the lakes mostly through direct rain precipitation and related runoff from the surrounding land, which historically has been mostly farm land. Local precipitation data dating back to 1974 is readily available from the National Weather Service and NOAA. (See Appendix for detailed table). A graph of the local liquid precipitation is as follows:

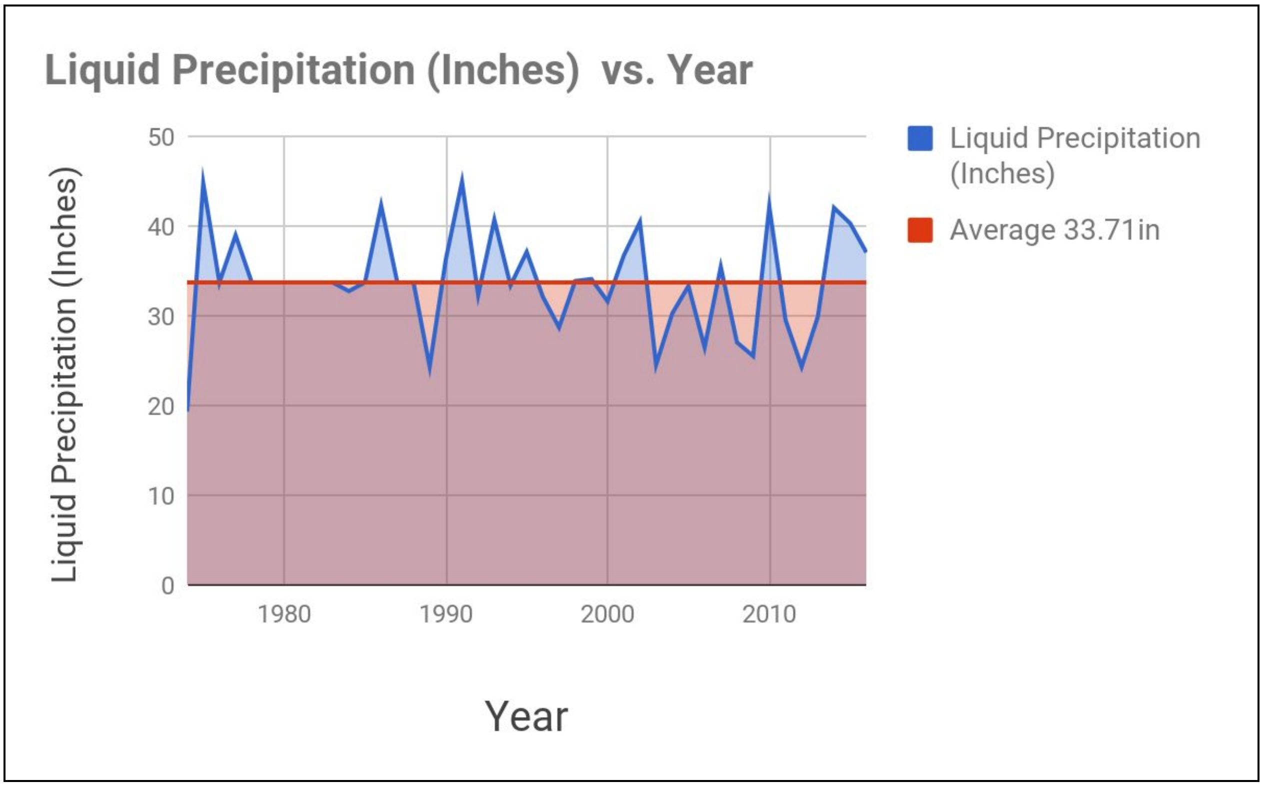

Figure 2. Annual Rainfall Totals

It is interesting to note that the last three consecutive years have seen above average rainfalls, with the average annual rainfall being 33.7”. The common narrative among local officials is that the main cause of the current flooding conditions is due to this uncommon period of heavy rainfall, which the data shows is a false perception.

The statistical rainfall trend over the charted time period is actually slightly declining:

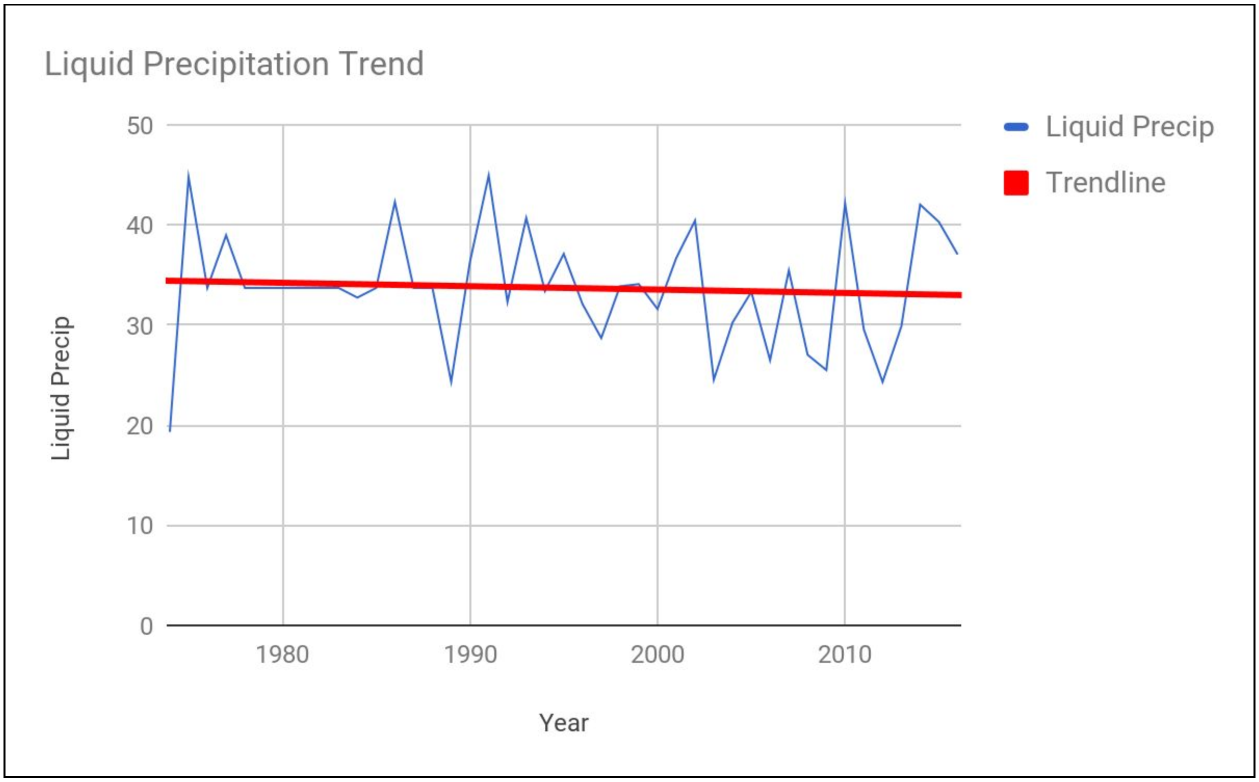

Figure 3. Precipitation Trend

This suggests that with rainfall being the largest driver of lake elevation, and absent other inputs, we would expect to see fluctuating lake levels, but with a slight decline of the average lake elevation over the long term. The sum of total rainfall during the examined period shown above is 1449.6 inches, or 120.8 feet.

Surface Runoff

The 2009 USGS simulation documentation states that overland flow was assumed to be negligible given the lack of surface streams in the area. However, the USGS simulation estimates that about 5% of the total water flowing into the lakes can be attributed to groundwater inflow. While the subsequently presented data model does not include specific representative data elements for overland runoff, it does include overall runoff factored into the groundwater inflow calculations.

Wastewater Effluent

In addition to rainwater and runoff, the Village of Roberts has been discharging wastewater effluent from its water treatment plant into the lakes since 1962. The plant currently contributes approximately 100,000 gallons of treated effluent water to the lakes each day. It has the capacity to, and is licensed to, discharge, four times that amount.

For modeling purposes, a calculation was made based on current population of the Village of Roberts, divided into the known current daily discharge of effluent into the lakes, to arrive at an average discharge in gallons per day per resident. This usage factor was then projected backwards in time using population growth of the Village to arrive at a reasonable approximation of the slowly increasing effluent discharge into the lakes as the population of the Village increased.

The conservative cumulative total for the wastewater effluent discharged by the Roberts Water Treatment Plant between 1974 and 2017 is approximately 1.04 billion gallons. This equates to a total of 185 inches, or 15.4 feet of water added to the lakes.

Groundwater / Runoff Inflow

Some research has suggested that only a small percentage of the lake volume is contributed by groundwater slowly flowing in, although no conclusive studies have been done to establish this as fact. The USGS simulation estimates that about 5% of the total water flowing into the lakes can be attributed to groundwater inflow. This translates into about 96 inches, or about 8 feet of additional water flowing into the lakes during the 43 year period.

Lake Outflows

Evaporation

According to the USGS Simulation Study, evaporation is the primary method of water exiting the lakes, accounting for an estimated 80% of the total outflow. The methodology used to calculate evaporation for the data model was to use pan evaporation totals provided by the Minnesota Dept. of Natural Resources from a relatively nearby observation point at the University of St. Paul. Pan evaporation is used to estimate the evaporation from lakes.[2] There is a correlation between lake evaporation and pan evaporation.[3] Evaporation from a natural body of water is usually at a lower rate because the body of water does not have metal sides that get hot with the sun, and while light penetration in a pan is essentially uniform, light penetration in natural bodies of water will decrease as depth increases. Most textbooks suggest multiplying the pan evaporation by 0.75 to correct for this.[4] Using these calculations, the data model indicates that 1185.4 inches, or 98.8 feet of water have evaporated from the lakes over the 43 year measurement period.

Groundwater Seepage

Modeling the actual groundwater seepage outflows from Twin Lakes proposes a particular challenge, since there are no actual hard measurements of total seepage outflow, although efforts have been made to obtain data on which to base estimates.

Referring back to the formula for calculating changes in lake levels:

> ***Change in elevation = (liquid precip + overland runoff + groundwater inflow + wastewater) – (evaporation + seepage)***

All values are known, except for the seepage rate. By doing some basic algebra, the overall seepage rate can be derived using the values from the above inflow and outflow calculations, along with the actual observed change in lake elevation (ft):

> ***10 = (120.8 + 8 + 15.4) – (98.8 + seepage) or***
> ***10 = 144.2 - 98.8 - seepage or***
> ***10 = 45.4 - seepage or***
> ***seepage = 45.4 - 10 or***
> ***seepage = 35.4 ft***

This calculated seepage rate equates to 26% of the overall lake outflow budget, which falls reasonably in-line with the 20% estimate projected by the USGS simulation, particularly in light of the fact that the evaporation calculation is also an estimate derived using a single conversion factor from the rate of pan evaporation.

This fixes the actual overall average annual seepage rate of the lakes to be in the vicinity of 10 inches, or .8 feet per year.

In 2007, a groundwater monitoring system was installed to monitor the groundwater-surface water interaction within East and West Twin Lakes. There is no evidence that the groundwater monitoring system installed in 2007 has been monitored or maintained since that time. In the spring of 2016, one of the three piezometer well caps was underwater.

In a 2008 report to the DNR, a consultant reported equivalent vertical hydraulic conductivity (seepage) estimates for piezometer sets placed in East and West Twin Lakes. The estimate for the East Twin piezometer set was 30 in/yr and the estimate for the West Twin piezometer set was 758 in/yr. These estimates do not appear to be representative of the actual seepage of Twin Lakes, which was observed to be about 10 in/yr for the 43-year period from 1974 to 2017, based on historic records.

Putting It All Together

The following series of charts provides a great deal of solid, evidence based graphical views of the behavior of the lakes over the course of the measurement period. These can be used to create "what if" scenarios to judge the impact that changes can / will have.

Modeling Lake Behavior

Figure 5. shows the individual inflow and outflow components described above on a single graph which illustrates the impact of each in inches per year of inflow or outflow over the 43 year measurement period. Items shown above 0 are adding water to the lakes, items below 0 are removing water from the lakes.

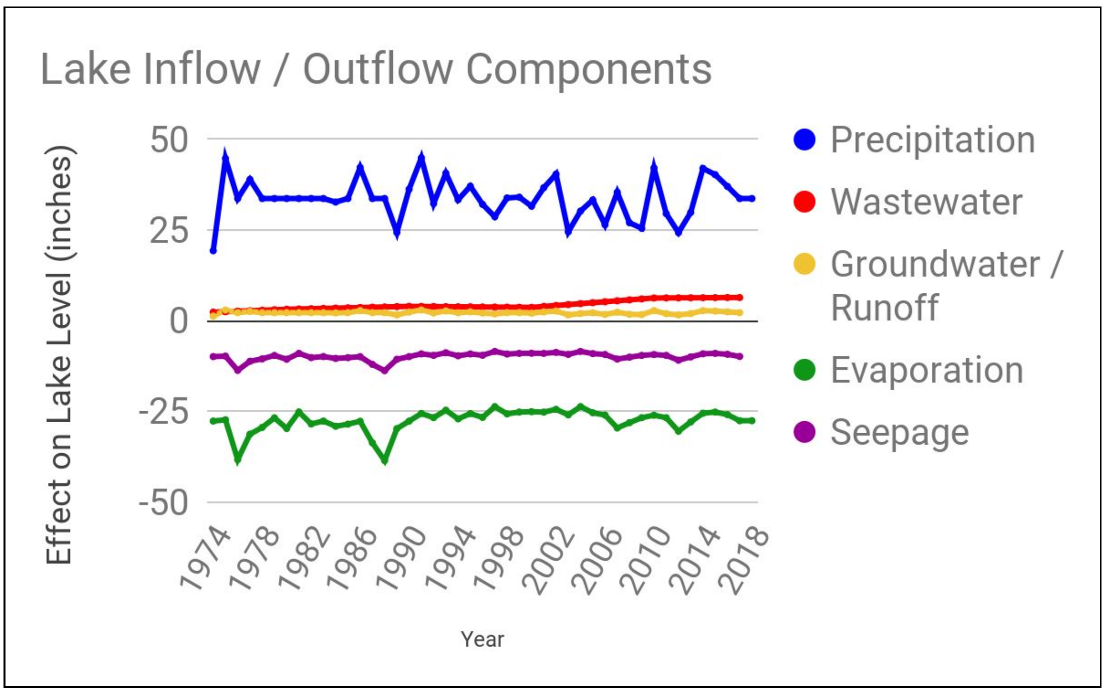

Figure 5. Lake Inflow / Outflow Components

Figure 6. Shows the calculated net effect on lake level when all components are combined. Note while the 43 year cumulative average rate of change shows an approximate increase of 2.83 inches / year, the true statistical trend is an accelerating rate of annual increase.

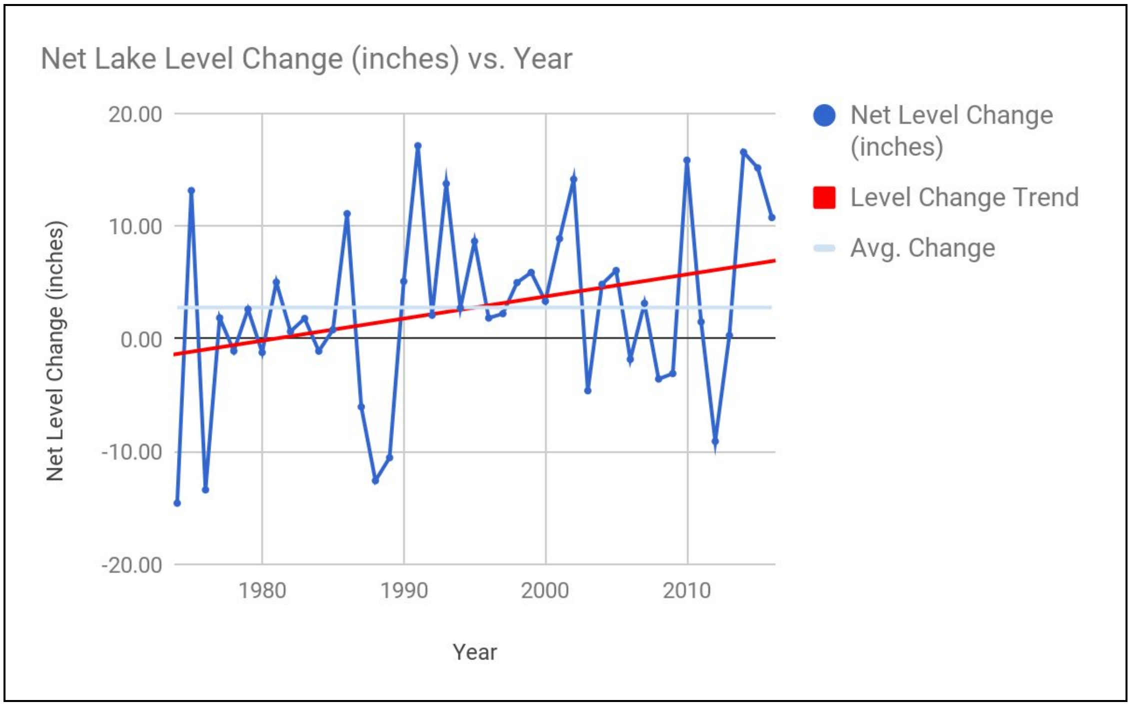

Figure 6. Net Lake Level Change

Figure 7. Shows the cumulative effects on the lake elevation over time, based on the calculations defined by the USGS simulation and the individual components described above. The approximate elevation threshold where property and infrastructure damage began to occur is shown in red.

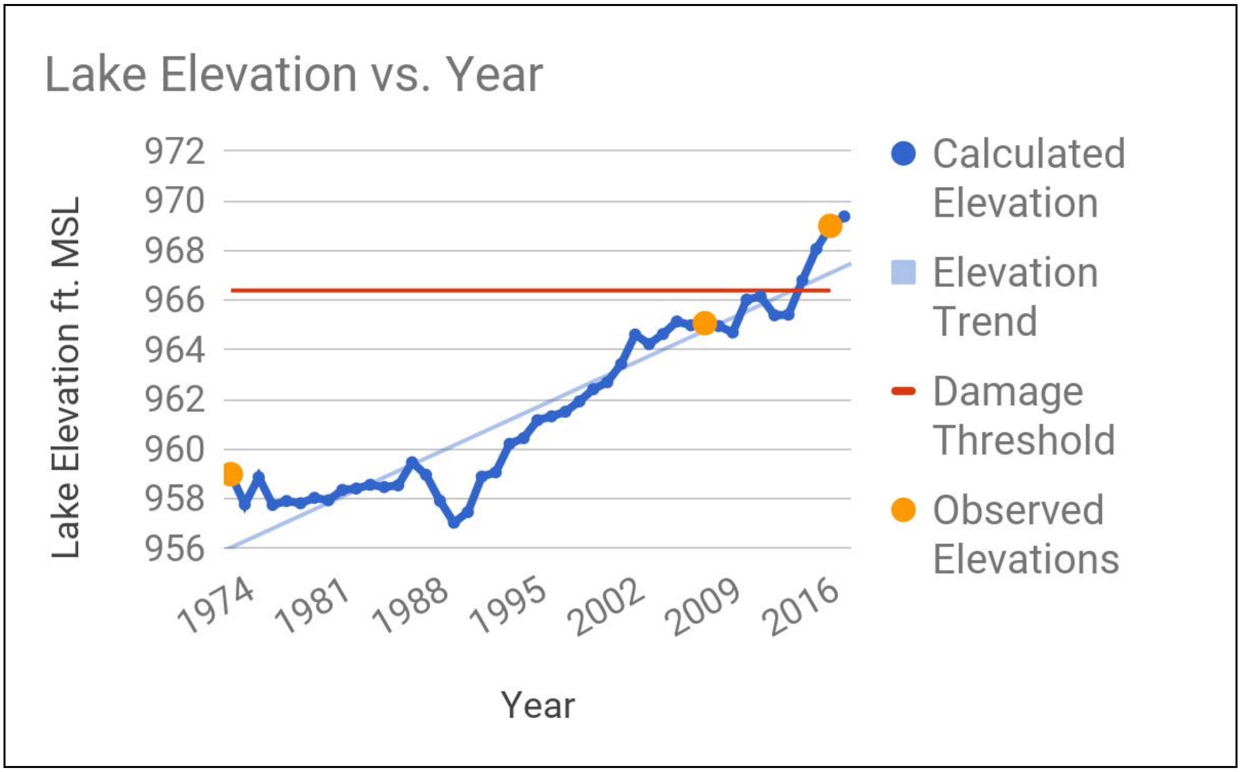

Figure 7. Calculated Lake Elevation

The Observed Elevations shown in orange are points where the actual lake elevations were measured. The extremely close alignment of actual observed elevations with the calculated elevations spanning over four decades proves that the data model is a good representation of actual behaviors, and that the behaviors observed are in very tight alignment with the USGS simulation model. It clearly shows that the recent three year period of above average rainfall hastened reaching the damage threshold, but is not the root cause of the flooding conditions.

What If?

With a solid, established data model to work with, it becomes possible to alter parameters in various “what if” scenarios to see the impact on the results. Figure 8 uses the 43 year averages for all parameters to project lake elevations over the next 10 year period from 2017 to 2027. The model demonstrates that if nothing changes, the expected lake elevation will be an average of 973 feet by 2027, which represents an additional 5 feet of elevation above the current 2017 level.

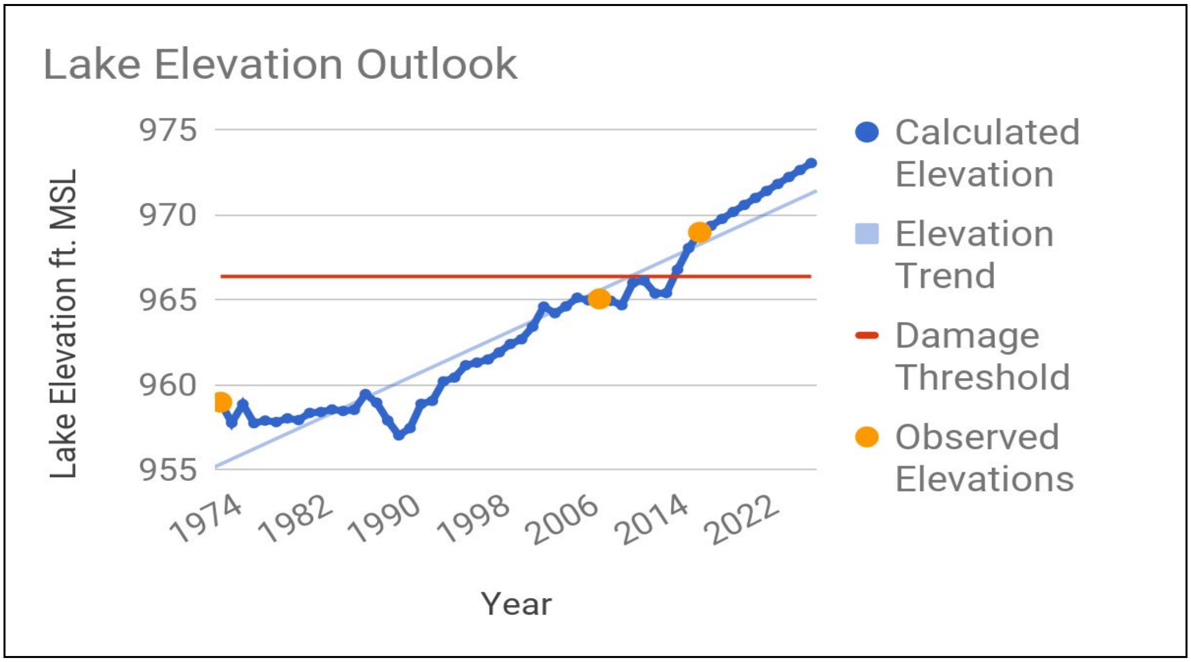

Figure 8. Lake Elevation 10 Year Outlook

This on-going increase of lake stage will continue to envelope private property and public infrastructure, and worsen the public health and safety concerns that triggered the Town of Warren to declare an on-going State of Emergency.

The only controllable parameter in the lake stage formula is the amount of wastewater introduced into the lakes by the water treatment plant. Figure 9 shows the results of the same data model calculations, but without the additional burden of the effluent from the Wastewater treatment plant.

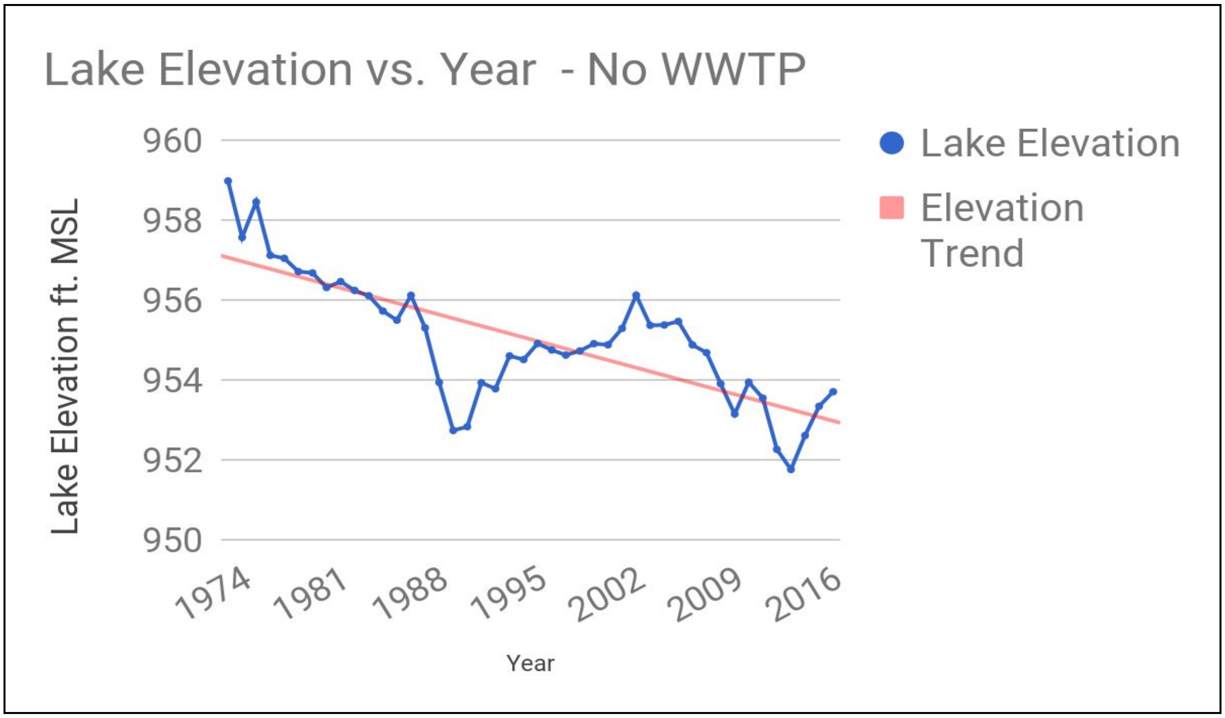

Figure 9. Lake Elevation Behavior Without Wastewater Effluent

If the effects of the water treatment plant effluent is completely removed from the model, and all other components remain the same, the results show that the lake level would be approximately 6 feet lower in 2017 than it was in 1974. This suggests that the lakes are capable of dissipating at least some sustained effluent flow from the treatment plant, but only a fraction of the current / historic volume. Figure 10 shows the long term lake elevation with a sustained .02 MGD effluent flow, which is 20% of the current flow rate.

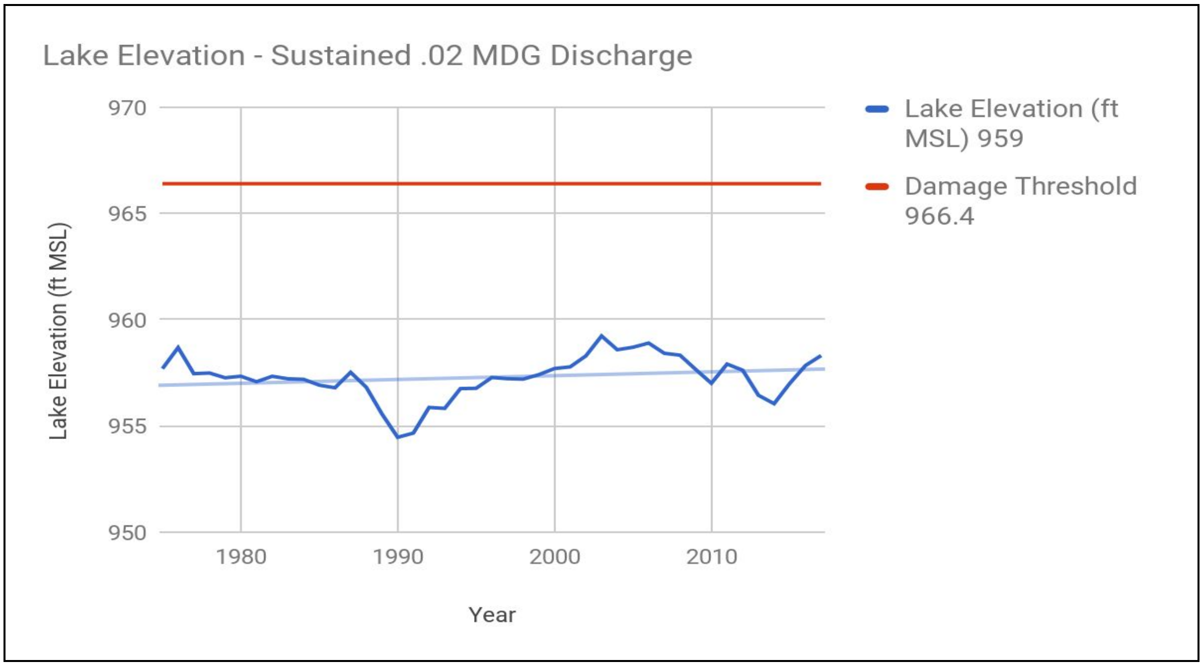

Figure 10. Lake Elevation Trend with .02 MGD Effluent Flow

Even at this low sustained effluent discharge rate, the long term effects on the lake elevation still results in a slowly rising trend, but the effects are much less significant, and would have remained well below the damage threshold well into the foreseeable future.

Conclusions

Using actual historical rainfall and evaporation data, and combining it with the parameters provided by the 2009 USGS Simulation, a very accurate data model of lake behavior can be constructed. The proof of the accuracy is the fact that when applying the calculations over a 43 year period, the projected elevations match very precisely with actual lake levels observed and recorded at specific points in time.

The data model very clearly demonstrates that the long-term, sustained effluent flow from the Village of Roberts Wastewater Treatment Plant into the Twin Lakes is the major contributing factor to the current flooding conditions. The capacity of the lakes to absorb and dissipate the effluent flow has been exceeded for many years, and continues to be exceeded, leading to current flooding conditions. The above average rainfall of 2014-2016 hastened the exceeding of critical flood stage of the lakes, but is not the root cause.

Unless relatively drastic measures are taken to divert effluent flow to locations other than the Twin Lakes basins, the flooding will continue to increase year over year. Properties bordering the lakes that have already been effected have a very bleak outlook, and can expect the problems to worsen significantly over time. Other properties being threatened by the flooding, but not yet adversely affected will likely be seriously impacted in the next several years.

It is in the best interest of all residents of the Town of Warren, and the Village of Roberts, that a long term, sustainable plan be developed and implemented to manage the beautiful natural resources of Twin Lakes.

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References

1. Juckem, P.F., 2009, Simulation of the groundwater-flow system in Pierce, Polk, and St. Croix Counties, Wisconsin: U.S. Geological Survey Scientific Investigations Report 2009–5056, 53 p. (https://pubs.usgs.gov/sir/2009/5056/pdf/sir2009-5056.pdf)

2. Tony Moore (April 18, 2007). "Officials defend dam against attacks". Brisbane Times. (https://en.wikipedia.org/wiki/Pan_evaporation#cite_note-18)

3. E. Linacre (March 2002). "Ratio of lake to pan evaporation rates" (https://en.wikipedia.org/wiki/Pan_evaporation#cite_note-19)

4. Wikipedia - “Pan Evaporation - Lake Evaporation vs. Pan Evaporation” (https://en.wikipedia.org/wiki/Pan_evaporation)

Appendices

Appendix 1. Rainfall

The rainfall data gathered from the National Weather Service and NOAA and used in the generation of the data model. For missing years, averages (33.71) were inserted.

Year	Liquid Precipitation (Inches)	Extreme Max Precip (Inches)	Date of Occurrence	Station
1974	19.32	1.79	Aug-16	River Falls
1975	44.76	2.92	Jul-01	River Falls
1976	33.71			
1977	38.97	4.03	Aug-31	River Falls
1978	33.71			
1979	33.71			
1980	33.71			
1981	33.71			
1982	33.71			
1983	33.71			
1984	32.74	2.37	Jun-08	River Falls
1985	33.71			
1986	42.28	2.92	Jun-22	River Falls
1987	33.71			
1988	33.71			
1989	24.34	2.35	Sep-01	River Falls
1990	36.3	3.1	Jun-03	River Falls
1991	44.93	2.31	Sep-08	River Falls
1992	32.31	3.56	Sep-16	River Falls
1993	40.69	4.5	Aig-09	River Falls
1994	33.39	2.11	Oct-17	River Falls
1995	37.11	2.8	Aug-13	River Falls
1996	32.1	1.8	Mpv-17	River Falls
1997	28.7	3.42	Jul-02	River Falls
1998	33.87	1.74	Apr-01	River Falls
1999	34.09	2.33	Aug-22	River Falls
2000	31.6	2.09	Nov-02	Baldwin
2001	36.7	2.97	Aug-02	Baldwin
2002	40.43	3.04	Aug-21	Baldwin
2003	24.54	2.7	Jun-25	Baldwin
2004	30.25	2.53	Sep-15	Baldwin
2005	33.31	2	Sep-25	Baldwin
2006	26.49	3.15	Aug-02	Baldwin
2007	35.44	2.84	Aug-14	Baldwin

2008	27.03	2.46	Aug-28	Roberts
2009	25.5	1.64	Aug-08	Roberts
2010	42.14	2.56	Jul-06	Roberts
2011	29.54	2.92	Jul-16	Roberts
2012	24.32	1.25	May-06	Roberts
2013	29.88	2.7	Jun-22	Roberts
2014	42.03	4.25	Jun-01	Roberts
2015	40.3	5.07	Jul-06	Roberts
2016	37.05	2.97	Sep-06	Roberts

Appendix 2. Evaporation

Pan evaporation rates used in the data model were obtained from the MN Dept. of Natural Resources. See http://www.dnr.state.mn.us/climate/wxsta/pan-evaporation.html for original source document

Monthly Pan Evaporation - U. of M. St. Paul Campus

MONTHLY PAN EVAPORATION, INCHES

Year	APRIL 21-30	MAY	JUNE	JULY	AUG.	SEPT.	OCT. 1-10	TOTAL
1972 *	1.85	6.08	8.03	6.76	5.62	4.08	0.92	33.34
1973	1.75	5.82	8.45	8.73	7.64	4.33	0.89	37.61
1974	2.03	5.54	7.46	9.46	6.49	4.62	1.29	36.89
1975	0.70	7.02	6.34	9.41	6.58	4.29	2.08	36.42
1976 *	1.85	8.40	11.08	10.96	10.54	6.62	1.61	51.06
1977	2.94	9.42	8.48	9.20	6.65	4.06	0.96	41.71
1978	1.61	8.00	7.21	6.87	8.30	6.02	1.21	39.22
1979	1.30	6.32	8.53	7.82	5.23	5.33	1.18	35.71
1980	2.88	7.62	7.75	8.83	6.55	4.51	1.47	39.61
1981	1.14	6.45	6.61	7.72	5.83	4.97	0.84	33.56
1982	2.77	6.29	7.49	8.52	7.81	4.21	0.85	37.94
1983 *	1.85	6.53	7.05	8.47	7.23	4.52	1.23	36.88
1984	2.37	7.13	6.88	8.88	7.26	5.24	1.03	38.79
1985	1.98	7.79	7.89	9.07	5.95	4.39	0.95	38.02
1986	1.65	7.21	8.34	7.97	6.71	3.88	1.20	36.96
1987	2.88	8.33	10.96	8.62	7.01	5.36	1.74	44.90
1988	1.77	10.38	11.83	11.73	8.96	5.20	1.54	51.41
1989	1.74	6.47	7.80	8.93	7.26	5.90	1.57	39.67
1990	1.96	6.27	7.24	7.65	6.63	5.45	1.71	36.91
1991	2.09	5.24	7.90	7.44	6.31	4.04	1.08	34.10
1992	1.32	8.83	6.89	5.80	6.69	4.80	1.30	35.63
1993	2.01	5.44	6.46	6.94	6.38	4.10	1.58	32.91
1994	1.32	8.67	7.36	7.02	6.58	3.94	1.18	36.07
1995	1.45	6.16	7.24	7.98	5.80	4.66	0.84	34.13
1996	1.75	5.95	6.53	7.53	7.71	4.60	1.47	35.54
1997	1.99	5.91	7.42	5.43	4.97	4.34	1.51	31.57
1998	2.22	7.50	5.57	7.32	5.79	5.13	0.72	34.25

1999		1.95	6.15	6.26	7.92	5.57	4.71	1.01	33.57
2000		2.20	5.81	6.15	6.89	6.17	4.84	1.38	33.44
2001		2.03	5.29	6.93	8.03	6.28	3.83	1.20	33.59
2002		1.11	6.25	7.25	6.69	6.09	4.47	0.71	32.57
2003		2.09	5.93	6.23	6.88	6.84	5.25	1.39	34.61
2004		1.91	5.41	6.30	6.63	5.14	4.91	1.27	31.57
2005		1.20	4.35	6.96	8.82	6.49	4.81	1.20	33.83
2006		1.21	5.98	7.91	9.16	5.72	3.29	1.41	34.68
2007		2.19	6.86	8.81	8.70	6.12	5.38	1.37	39.43
2008	*	1.85	6.83	6.42	8.71	7.83	4.57	1.26	37.47
2009		1.81	8.22	6.94	7.10	6.09	4.78	0.71	35.65
2010		1.81	6.02	5.99	7.66	7.72	4.19	1.35	34.74
2011	*	1.85	5.17	7.21	7.70	6.57	4.83	2.32	35.65
2012		1.48	7.74	8.13	8.41	7.14	6.37	1.34	40.61
2013	*	1.85	6.09	7.31	8.39	7.26	4.89	1.44	37.23
2014		1.86	6.29	6.70	7.93	5.44	4.75	1.03	34.00
2015	*	1.85	5.36	6.78	8.20	6.12	4.25	1.02	33.58
2016	*	1.85	6.27	7.02	7.64	5.46	4.69	1.59	34.52

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