Antrim County Operator of Dams
P.O. Box 217, Bellaire, MI 49615

Mr. Terry Van Alstine
Chair, Antrim County Board of Commissioners
Bellaire, Michigan

April 18, 2022

Dear Commissioner Van Alstine,

Please accept the following Annual Report of the Drain Commissioner and Operator of Dams for 2021. The Update on the Hydrology Study was submitted earlier to the Board and is included here as part D of the Annual Report.

Annual Report of the Antrim County Operator of Dams for 2021

A) Unsettling Times for Dam Owners

On the night of August 11, 2021 a torrential rain fell in a narrow band from the Lake Michigan shoreline at about the Grand Traverse County boundary line, extending in a northeasterly path to Lake of the Woods. A rain gauge on Clam Lake registered 5.71" over a period of four hours, and other gauges to the south suggest that more than that may have fallen in the center of the band-shaped formation. Finch Creek, a small watershed south of Clam Lake, overtopped the embankment of Alden Highway, a height of over 10 feet, and the road collapsed, sending a plume of sediment downstream into Grass River Natural Area and inundating the natural creek. No one was hurt, but Helena Township lost a fire truck.

The next morning, the level of Elk Lake had risen about 8–9" since the day before. The gates at the Elk Rapids Hydroelectric Dam were opened to maximum capacity and two stop logs were removed at the Elk River overspill. At 1 pm, the lake was 5" above normal and dropping. It was the single highest water level and storm water event to affecting the Elk Rapids Hydroelectric Dam since I began working for the County in 1997.

The surface area of Elk Lake is 12.6 square miles, so 8–9" additional inches of water is an enormous amount of water, and all that additional water was storm water that fell from the sky in the space of four hours. Was it a 100-year storm? The answer is both "no" and "yes." No, this was not a 100-year storm, if one considers the entire ERCOL drainage area. The majority of the watershed received less than an inch of rain during the entire duration of the storm. Yes, this probably was a 100-year storm, if one considers only the Finch Creek watershed and the immediately surrounding area. The volume and intensity of the storm was exceptionally high, but only in a concentrated area.

Here's a good way to put these changing storms in perspective (drawn from the work of the Lake Level Committee). In the 11-year period from 2002–2012, the water level of Intermediate Lake rose above 608.0 twice and never rose above 608.5 feet above sea level. In the 5-year period from 2013 to 2018, the Intermediate Lake water level has risen above 608.0 ten times and above 608.5 feet five times! The elevation of the 100-year floodplain on Intermediate Lake is 609.1 feet above sea level. The data is pretty straightforward: weather patterns are changing and continuing to confound. (Please see the Update on the Hydrology Study at the end of this report.)

B) Elk Rapids Hydroelectric Facility

The County share of electrical generation revenues in 2021 was $18,188 (10% of total sales of $181,874). This is a significant increase from $15,388 in 2020 and starts to reverse the downward trend over the last 4 years (2020-$15,388, 2019–$18,572, 2018–$19,357, 2017–$21,138). The increased generation revenues are thanks to the decrease in Lake Michigan water levels. As Lake Michigan falls, the head (falling distance) of water at the dam increases. More head means more gravitational force on the falling water and hence, more power generation. Hopefully the trend of lower Lake Michigan levels will continue for a variety of reasons.

As you may recall, the bids for roof replacement and roof hatch installation at the hydro dam were approved early in 2020 and the project has been delayed by the contractor several times. The roof membrane was installed in 2021 and appears to be complete, however the contractor, IRT has yet to produce an inspection certification to secure the product warranty. Neither have they installed the roof hatch or repaired damage to the interior ceiling that occurred during the installation of the roofing. IRT attempted to collect partial payment late in 2021, however the construction contract does not provide for any payment on the project until completion, so the County declined their request. As of this writing, IRT has not provided any schedule for the completion of the project in 2022. In the meantime, the roof is secured and not leaking.

In 2021, the Stockhausens made several upgrades to the equipment, continued to maintain the equipment in good working order, and continued to cultivate an excellent relationship with all of our stakeholders. (An excellent performance of day-to-day operations can often be overlooked because we forget that the status quo and a lack of drama are exactly what we want out of good management.) The Stockhausens are also taking advantage of the availability of Scott Kleinhuizen, the Assistant Operator of Dams, who has decades of experience operating hydro plants in the Pacific Northwest. Scott is now on call for emergencies and situations that need an experienced hand. The cost of Scott's contributions are reimbursed to Antrim County by Elk Rapids Hydroelectric LLC.

Last year we were able to begin welcoming visitors into the facility again. We instituted a program of mini tours led by Deb Donovan, ER Hydro LLC's daily plant operator. For years, curious folks have asked to see inside the facility, and now Deb has the option to conduct short ad hoc tours at her discretion as time allows. This has resulted in several appreciative emails to the Operator of Dams. On September 10th, we held a larger event for members of the Elk-Skegemog Lake Association and general public. At least 150 people toured the facility that day with myself, Scott, Deb and Stock Stockhausen as hosts.

As part of the County's obligations in the Federal Energy Regulatory Commission (FERC) license, we have been required to monitor dissolved oxygen levels at the dam since 2007. Early on, we realized that this seemed a superfluous exercise given the time and expense, but we complied. Last year, Bill Stockhausen asked FERC to relieve us of this obligation and, surprisingly, they agreed. In a separate situation, a FERC compliance officer contacted us over "irregularities" in our reporting of lake level readings under Article 402. Our FERC license uses the same language as the circuit court order that orders the level to be at a set elevation (with no mention of allowed deviation). Since Elk Lake fluctuates upward after rains, the compliance officer pointed out we were technically out of compliance with the license when that happens. She graciously offered a process to revise the license. However, revising a FERC license carries its own potential complications, so instead I wrote a lengthy explanation of the customary protocol for the operation of the Elk Rapids Dam, and she attached it to the license as an addendum.

C) Intermediate Lake and the Bellaire Dam

Every three years, the Dam Safety Department of the MDNR requires the Bellaire Dam to undergo a thorough inspection by a certified dam safety engineer. Mr. James Coughlin performed the inspection late last summer. Mr. Coughlin's report is attached.

The inspection includes two short-term recommendations: remove woody vegetation, and seal the top of the concrete spillway walls; and two long-term recommendations: install limit switches on the vertical gates, and perform a flood routing study. Two of the four recommendations are already completed and the other two are in the works.

Scott and I cleared the vegetation as Mr. Coughlin suggested last fall. In the process of removing the shrubs, we discovered several large stumps cut flush to the ground at the base of the embankment. We believe the stumps date back to at least 1974 when the radial gates were constructed. The location of stumps on an embankment can be cause for concern, because old roots that decay can leave passages through which water can leak. However these stumps are so far down grade that the likely path of the roots does not compromise the integrity of the impoundment. Mr. Coughlin has inspected the stumps and we will keep a close eye on them going forward.

The patching and sealing of the concrete walls is planned for this year. We also plan to install protective covers over the motors and gear units that are most vulnerable to the wear and tear of exposure.

Instead of installing limit switches on the vertical gates, Scott Kleinhuizen designed emergency cut-off switches that are attached to the existing control equipment. If the switch that controls the motor that drives the gate should fuse and jam in the "on" position, the operator can instantly hit the cut-off switch and stop the motor. This solution alleviates the need for limit switches that are much more expensive to install and complicated to maintain. Scott installed the new cut-off switches last year (2021).

Mr. Coughlin's recommendation to "perform a complete flood routing to more accurately determine staging during significant rainfall events" is already in the works. In fact, the new computer model will make it fairly easy to accomplish. While attending the HEC-RAS training last year, we worked on a simulation of a river as it reached flood stage. In real time, the computer displays graphically how the river rises as the rain begins to collect and shows the changing elevation of the river. While the model will make it much easier to do, I will need outside help to program the simulation.

Unsurprisingly, last year Intermediate Lake reached its peak elevation of 2021 on August 11th at 607.9 feet above sea level after the rain event mentioned above that hit Elk Lake and Finch Creek so hard. Other than that event, the rainfall and, therefore, the lake levels remained in an acceptable range.

The new protocols that were instituted in 2019 continued to work well in 2021. I received a few inquiries from residents about Intermediate Lake appearing lower than normal, which would be a natural consequence of the new protocol. The earlier draw down in the fall helped to lower the winter level to a very low level and provided us more reservoir volume when the melt began this spring. We still receive some resistance about closing dam gates on the weekend for the Intermediate River dwellers, but the more manageable lake levels have reduced complaints in general.

We also chose to install a new staff gauge under the Old State Road bridge in Central Lake—the official visual gauge to determine the level of Intermediate Lake. Scott did a beautiful installation by replacing the old gauge with an identical, but brand new face that makes it very easy for anyone to determine the level of the lake. Of course, it matches the readings that most people find on the internet.

D) Update on the Hydrology Study

2021 Was a pivotal year for the Hydrology Study. The Operator of Dams spent much of his time meeting with the Lake Level Committee, coordinating with the U.S. Army Corps of Engineers (USACE) and contributing to various aspects of the effort.

On April 7, the Lake Level Committee held a Zoom seminar on the results from the 2020 lake level logging project. (This seminar was previewed in last year's Annual Report.) Loggers were set in St. Clair, Six Mile, Ellsworth, Benway, Intermediate, Bellaire, Clam and Torch Lakes in 2020, eight lakes in all, with an additional logger installed at the trestle bridge above the Bellaire Dam in the Intermediate River. The seminar detailed the fluctuations of the lake levels and compared them to the rainfall gauge data that was collected by volunteers on several of the lakes. This data was also used by the USACE to help calibrate the computer models and drew praise from the hydrologist working on the project. One important takeaway from the data: St. Clair Lake and Six Mile Lake behave as a single body of water and their levels continued to fall even after gates were closed at the Bellaire Dam and Intermediate Lake leveled off—indicating that the Bellaire Dam does not directly influence the lakes upstream from Ellsworth.

The Operator of Dams attended parts of a two-week training program on using HEC-HMS/HEC-RAS modeling software conducted online by the USACE in May 2021. The program was a very useful introduction to the capabilities of the software and will come in handy later. We also purchased a computer for the Department that will host the "official" version of the computer models at the County building.

What We Are Getting from the USACE

What we refer to as the Hydrology Study, will actually consist of several components. The package we will receive from USACE will be comprised of two separate, but related computer models. The first model simulates the hydrology of the ERCOL watershed (or entire drainage area), that is, how much rainfall collects on the land, where it goes, and in what volume. The second model simulates the hydraulics of the ERCOL lakes and connecting rivers, that is, once the water flows off the land, how fast the water moves through the lakes and at what elevations.

The two models work together. When we want to simulate, say, a 3" rain, which falls over a period of 24-hours, the operator inputs that data into the hydrology model. The results from the hydrology model then feed into the hydraulic model. The hydraulic model will then calculate how high the lake levels will be, and how long it will take the water levels to recede.

Each model will be accompanied by a separate written report. Each report explains in detail how the computer model was created. These reports are highly technical in nature as they explain each choice that the modeler made as she created the algorithms and set the parameters of every part of the calculations. They are invaluable to the engineers that use the model, so they can ascertain exactly how the model was put together and how to customize it for future use.

So, we will get a written Hydrology Report, and a separate written Hydraulic Report. The public interest will be focused on the Hydraulic Report, because that report will contain the results of all the analysis on our Chain of Lakes that the USACE did after they completed the computer model.

The Hydraulic Report will contain the results of the 100-year storm analysis, along with the results of three scenarios: the impact of the Ellsworth culverts on lake levels upstream, dredging the Intermediate River between Intermediate Lake and the Bellaire Dam, and dredging the Torch River.

Keep in mind that the reports were written by engineers for engineers. They will need to be explained to the general public.

What Has Already Been Completed

At this point, all the components are completed and being reviewed. Early this year, the USACE provided a draft of the Hydrology Report to the Lake Level Committee (LLC). The LLC team generated several pages of notes and submitted them to the USACE for review. Later, we received an updated report—still, technically speaking, a draft—that incorporated all of our notes. Soon after, we received the hydrology computer model itself and members of the LLC have been studying the model and learning how to use it.

About a month ago, we received the Hydraulic Report. The Hydraulic Report is considerably more complex and took more work, but the LLC team generated another several pages of notes and questions and submitted them to the USACE. USACE will need some time to review our notes. Then, I expect we will receive the final hydraulic report and computer model.

Once all the reports and computer models are in final form, USACE will hold two meetings: the technical hand-off meeting and the public information meeting. The technical hand-off meeting is for staff members and interested parties that expect to actually use the computer models and is more technical in nature. The public meeting is for stakeholders and members of the public that are focused on the results of the studies and general information.

What We Know So Far

All the results are preliminary, but we expect that the following will be in the final report:

- The culverts and Bridge Street at Ellsworth are confirmed to be the principle determining factor of the lake levels on St. Clair and Six Mile Lake. The USACE did a special analysis substituting a much larger type of culvert to show what the difference in lake levels would be.
- The dredge scenarios suggest that they are likely to affect flows and levels during normal weather, but may not significantly reduce flooding during heavy storms.

Next Steps

As you can understand, this is not a process that can be rushed. We appreciate the Commissioners' patience as we allow USACE to take what time is necessary to complete the project. It is clear now, just how ambitious the scope and size of the computer model actually is, even stretching the resources of the USACE.

- We will schedule the USACE meetings as soon as possible and publicize them accordingly.
- The LLC is committed to continue working on the model, even after the USACE finishes. In fact, the review process with USACE has helped us to realize the potential benefits and pitfalls as we manage the model in the future.
- The LLC will soon be issuing a Request for Proposals to the academic and technical community of Michigan announcing the completion of the HEC-HMS/HEC-RAS computer model of ERCOL and inviting them to contact us to discuss their potential interest.
- Three Lakes Association will be hosting a large public event in July that will focus on the hydrology study results and include the Operator of Dams as a presenter.

Kudos

According to the USACE hydrologists, the lake level-logging project was instrumental in calibrating the computer models and noted that fact in their reports. Our citizen scientists' project of tracking rain data was especially mentioned, since our volunteers gathered the most localized and accurate data of all the data sources they used for precipitation.

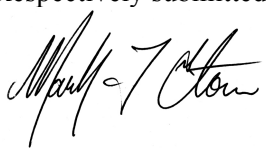
The degree to which the USACE has been transparent and willing to work so closely with the LLC, even to the extent of allowing us to review and advise on preliminary reports, has been a testimony to the skills and professionalism of the LLC members. I can't thank them enough for their efforts and commitment. They deserve all the County's thanks. They are: David Christian, Janet Hickman, Fred Sittel, and David Holtschlag. Our "citizen scientists" that collected the rainfall data and hosted lake level loggers at their homes are Linda Vanandel, Dave Heeres, Andy Hickman, Dianne VanHuysen, Jim Fisher, Bill Frey, and Fred Sittel.

Annual Report of the Antrim County Drain Commissioner for 2021

The sole County Drain under the Drain Commissioner's authority is the outlet from Birch Lake in Elk Rapids Township that drains into Grand Traverse Bay. Nevertheless, the Drain Commissioner fields multiple calls about drainage issues of Antrim County residents each year and attempts to steer them to the proper resources to address their problems.

I attended a meeting at Schuss Mountain in October at the invitation of the CEO of the resort. Recent heavy rains have created drainage problems in low areas in and around Schuss Village and they were considering the formation of a legal drainage district administered by the drain commissioner to fund drain improvements. After touring the area and a lengthy discussion the group concluded that the legal covenants of the landowner association were already adequate to raise the funds necessary and a new legal drainage district would over complicate the situation.

Respectively submitted,



Mark Stone
Antrim County Operator of Dams
Antrim County Drain Commissioner

Encl: Bellaire Dam Inspection Report, September 2021