Critical Issue #4 Flood Studies and Design Capacity

Introduction

Completion of the Four Lakes Task Force (FLTF) flood studies and the spillway capacity designs for the dams is one of four critical Issues in the Lake Restoration Plan for Secord, Smallwood, Edenville and Sanford dams.

After the failures of Edenville and Sanford dam in May 2020, the Michigan Dam Safety Task Force evaluated the statutory structure, budget and program design of the Water Resources Division Dam Safety Program. It also reviewed the adequacy of Michigan's dam safety standards, and the level of investment needed in Michigan's dam infrastructure. There also is ongoing discussion about changing the State of Michigan's required spillway capacity requirements for High Hazard Dams.

This report is a progress update on FLTF work on flood studies in the Four Lakes Watershed[1] which will be used to determine the new dam capacity required.

Project Team

The project team of GEI Consultants, Ayres Associates, and Applied Weather Associates (AWA) are developing the design storm on behalf of FLTF, as of this reporting. FLTF understands that the current spillway capacity of ½ PMP, will likely change as a result of the Dam Safety Task Force recommendation and will follow the current Federal Emergency Management Agency (FEMA) Dam Safety Guidelines for selecting Inflow Design Floods (IDF).

The Probable Maximum Precipitation (PMP) and Probable Maximum Flood (PMF) reports have been produced and are on the FLTF website[2]. GEI is in the process of performing a risk assessment to determine the IDF using the techniques prescribed in FEMA P-94. Once complete, the risk assessment will be submitted to EGLE for regulatory concurrence in late 2021.

Current Estimated Dam Spillway Capacity Increases as Reported in the FLTF Lake Restoration Plan[3]

	Secord	Smallwood	Edenville	Sanford
Pre May 2020	7,695	10,185	20,670	29,690
Design Estimate	21,150	24,550	52,275	47,470
Capacity increase	275%	240%	253%	178%

Table in Cubic Feet Per Second (CFS)

Summary of Estimated Peak Discharges from the 2021 Ayres PMF Study

Summary of Estimated Design Flood Flows				
Storm	**Secord**	**Smallwood**	**Edenville**	**Sanford**
10-year*	2,800	4,200	12,000	13,000

[1] See Attachment 1

[2] See the FLTF website

[3] Source; Charter 7c Table 14 of the FLTF Restoration Plan

50-year*	3,900	6,000	18,000	19,000
100-year**	6,730	9,020	21,300	18,200
200-year	7,900	10,400	25,400	20,700
500-year	9,710	12,600	32,100	28,700
1,000-year	11,300	14,500	37,400	34,600
5,000-year	15,900	21,200	52,800	53,400
1/2 PMP***	12,700	15,600	44,600	44,900
1/2 PMF	15,000	24,000	56,500	58,500
3/4 PMF	22,500	36,000	84,750	87,750
PMF	30,000	48,000	113,000	117,000

*10-, and 50-year flows from the DEQ Flood Discharge Database
** 100-year through PMF flows from the 2021 Ayres PMF Study
*** Current State Requirement

Estimated Design Capacity of Dams Stated in Flood Frequency

	Secord Project	Smallwood	Edenville	Sanford
Pre-May 2020 Dam capacity	7,695	10,185	20,670	29,690
May 2021 Design Estimate	21,150	24,550	52,275	47,470
Current State Requirement	12,700	15,600	44,600	44,900
Dam Design Estimate in Flood Frequency	>10,000 Years	>10,000 Years	>5,000 Years	>5,000 Years

Is this enough? FLTF believes the dam capacity design estimate would suggest cost estimates are in the range of planning, but there is work to do going forward to establish the IDF and set the final design capacities.

The rest of this paper is intended to provide an overview of the progress on flood studies and new capacity design required for the dams.

Four Lakes Task Force - Flood Hydrology Studies

Neither the Secord nor the Edenville dams met the spillway capacity requirements to safely pass the PMF as required under the Federal Energy Regulatory Commission (FERC) requirements. In the May 2019 Lake Study submitted to the Midland and Gladwin county Circuit Courts, FLTF committed to confirming the PMF and increasing spillway capacities.

- The PMF Study update was completed by Ayres on May 15, 2020. The report was prepared before the May 2020 flood and used data available before that event. After the failure, FLTF determined that additional storm calibration to the May 2020 flood event and additional analyses were warranted to confirm Probable Maximum Precipitation (PMP)

- FLTF retained AWA to calculate a site-specific PMP and probability assessment of various rainfall depths for the Tittabawassee River basin. The AWA report is dated June 2021 and provided updated rainfall depths and temporal distributions to Ayres to develop the site-specific 1/2 PMF and PMF inflow hydrographs. AWA also derived the Annual Exceedance Probability (AEP) of the rainfall up to and including the PMP
- FLTF retained Ayers to estimate the PMF using the site-specific PMP provided by AWA. The PMF is an update to the May 2020 estimate (determined before the Edenville Dam failure) and incorporates additional storm calibration events including the May 2020 flood events that resulted in the catastrophic failure of the dams. The Ayres PMF report is dated July 2021 and was submitted to AECOM and EGLE in late July 2021
- These reports have been shared with engineers and hydrologists from EGLE, FERC and the US Army Corps of Engineers (USACE), as well as AECOM and GEI Consultants and, will be finalized and published in August 2021. They are on the FLTF website

Four Lakes Task Force – Hydraulic Studies

- GEI performed an engineering study to further develop the conceptual design for dam rehabilitation and reconstruction to the 30% schematic level based on the following. Spillway design estimated capacity was selected during the 2021 flood study
- The spillway capacity for all four dams will be greater than EGLE requirements and the IDF will follow a process outlined in FEMA guidelines[4] for selecting an IDF
- These guidelines include a risk-informed decision process using incremental consequence analysis to establish an IDF based on comparing the increase in downstream water surface elevation, velocity, and/or consequences due to failure of the dam when compared to the same flood without dam failure

Secord and Smallwood Lakes Spillway Discharge Capacity

- The impoundments were ordered drawn down for inspection and repair and are considered serviceable by EGLE
- FLTF's focus this year is on getting the IDF established for Secord and Smallwood, progress through 90% design by early next year and to prepare for construction in the second half of 2022
    - FLTF expects the spillways will pass water flow that is greater than a 10,000-year flood event for these dams
    - This is part of the EGLE permitting process FLTF is performing to repair and improve these two dams

Edenville and Sanford Lakes Spillway Discharge Capacity

- The 2021 FLTF focus is on the interim stabilization of the Edenville and Sanford dams with a budget of over $20 million for design and construction
- Upon EGLE concurrence of the IDF for Secord and Smallwood, FLTF will then move downstream to Edenville and Sanford as part of the final reconstruction design for Edenville and Sanford. Edenville had both upstream and downstream flooding
- On Sanford Based on the results of the May 2021 flood study, the difference between dam-in and dam-out is expected to be negligible at around the 5,000-year storm event

[4] Selecting and Accommodating Inflow Design Floods for Dams (fema.gov) FEMA P-94

- These dams' full design engineering will start in early 2022, with Construction for Reconstruction starting in 2023

While these dams are scoped individually, they will also be calibrated to ensure one dam will be able to pass through another. There is significant design work being undertaken and the FLTF will keep the community informed as we progress.

Midland County and the MBA Infrastructure Committee and the sponsorship of the United States Army Corps of Engineering (USACE) Project

While this is an independent study of the FLTF, the FLTF has been involved. This project is a historical effort to upgrade the studies of Storms and Floods, and to identify mitigation alternatives for Midland County. While FLTF is focusing on one aspect of the watershed above Sanford, it will provide its work product upstream to the USACE for this project.

Midland County communities and the City of Midland are at the base of a major watershed, with major storms dating back to the 1800s, the watershed includes several major rivers including the Tittabawassee River, Sturgeon Creek, Snake Creek, Bullock Creek, Salt River, Chippewa River, and Pine River. It has been decades since an overall study has occurred, and certainly not with the technology and information that is now available. While the FLTF is study upstream of Sanford, the Midland/MBA/USACE work is focused downstream.[5]

- Shortly, after the May 2020 flood, Congressman Moolenaar requested all agencies to meet with FLTF to determine what authority the agencies had and support they could provide in the emergency related to the Four Lakes. Our primary federal support has come from the USDA Natural Resources Conservation Services for erosion and dam stabilization
- USACE could not provide recovery services or flood study services as the dams at the time of failure were privately owned. It also could not support study or future engineering or construction support, as the Dams did not meet the USACE requirements for the benefit to cost ratio (BCR) for flood control
- What was agreed on, with support from Senator Stabenow and Congressman Moolenaar, was that USACE could provide support outside of the Four Lakes watershed, and provide flood study and risk mitigation planning support downstream. The City of Midland, County of Midland, FLTF and USACE, after a series of meetings, agreed to have Midland County sponsor a study
- The Midland Business Alliance MBA Infrastructure committee has raised private funds for study on flood mitigation in the county of Midland, and saw an opportunity to support the USACE-Midland County Project, which required 50% local or in-kind funds

The Midland County/MBA/USACE project scope:

- **USACE project description**: "There is a great need to have a good understanding of the flood hydrology of the basin, and to know how the Tittabawassee River and some of its tributaries respond. This work would include full hydrology and hydraulics analysis of the Tittabawassee River, Sturgeon Creek, Snake Creek, Bullock Creek, Salt River, Chippewa River, and Pine River in the areas of concern. In addition to analyzing the statistical flood events that are typical for a

[5] See Attachment 2

flood study, the 50%, 20%, 10%, 2%, 4%, 1%, and 0.2% annual exceedance probability (AEP)[6], the County and USACE would work with the USGS to create a flood map library of the National Weather Service's Advanced Hydrologic Prediction Service (AHPS) flood categories and USGS flood stages of the Tittabawassee River at Midland to be added to the USGS Flood Inundation Mapper (FIM) program."

- **FLTF will provide the following as it relates to the Tittabawassee at the confluence of the Salt River to the projects:**
    - Hydrographs for:
        - No dams
        - Dams at the stabilized and interim state, to occur by the end of 2022
        - New dams based on the current design capacity of the new dam
    - Flood Frequencies and peak discharge of 2- to 5,000-year flood
    - Risk assessment for selecting the IDF and final reconstruction spillway capacity at Secord and Smallwood (2022), Edenville and Sanford (2023)
    - Post dam failure topographic and bathymetric surveys on the Tittabawassee from Sanford Lake the confluence with the Salt River
- This study intends to have better models, flood prediction, and risk assessment to determine future projects or actions to mitigate floods in Midland County

[6] The Statistical Flood Events percentages are in the 2-to-500-year Frequency Range

ATTACHEMENT 1 – SCOPE OF FOUR LAKES WATER SHED[7]

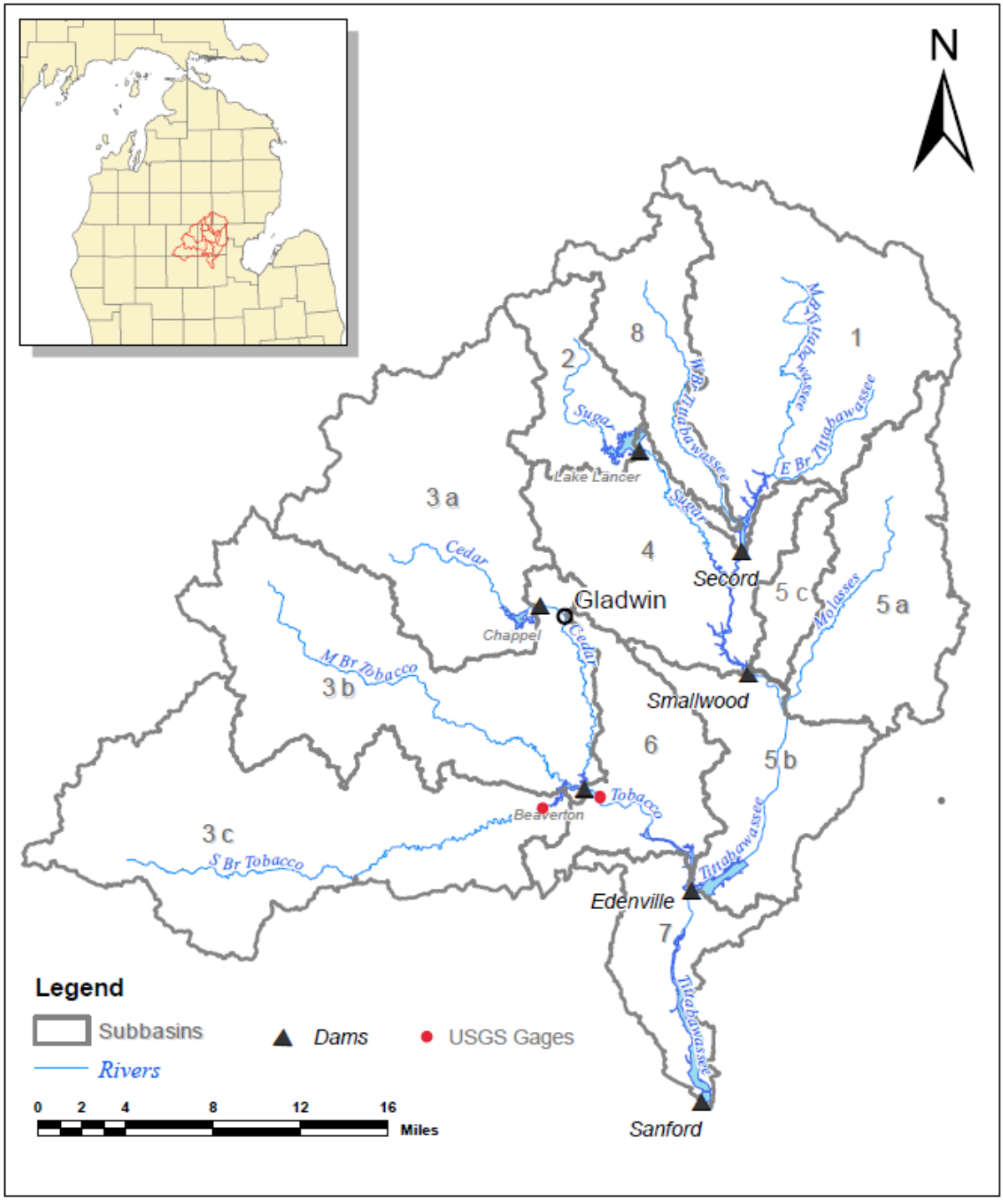

Exhibit 1: Tittabawassee River Watershed
Tittabawassee River Dams
Gladwin and Midland Counties, Michigan
June, 2021

AYRES RIVER ENGINEERING + WATER RESOURCES

[7]

Attachment 2 – Extent of the Midland County Study[8]

Figure 1: Extents of the Midland County PAS Study