State of Illinois
Illinois Department of Natural Resources

Operation of the Stratton and Algonquin Dams

Fox River, Lake and McHenry Counties
April 2025

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OPERATION OF THE STRATTON AND ALGONQUIN DAMS

Fox River, Lake and McHenry County, Illinois,

The State of Illinois

Illinois Department of Natural Resources

Office of Water Resources

April 2025

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ABSTRACT

The Office of Water Resources has operated the gate control structure at Stratton Dam since 1939 and the Algonquin Dam control works since 2002. This report gives a description of the control works and outlines the operational plan.

The Office of Water Resources first developed and publicly discussed the operational plan for Stratton Lock and Dam in 1989. The 1989 plan was revised in 1991 to address the issue of ice jam flooding in Kane County downstream of Algonquin and since that time the plan has included a method of operation which would minimize the threat of ice jams. In 2002, the new hinge crest gates at Stratton Lock and Dam and Algonquin Dam were completed, and a modified operational plan was developed and discussed publicly which incorporated operations of the gate at Algonquin Dam. In 2021, construction of new Torque Tube Gates to replace the sluice gates was completed. This plan incorporates all the updated construction that has occurred at Stratton Lock and Dam and Algonquin Dam. This plan continues to be reevaluated as updated information becomes available.

The operations of the Stratton Lock and Dam continue to evolve with new technology. While improvements to the operating plan can be made, there is no guarantee of substantial reductions in flood stages as flooding is a natural phenomenon along the Chain of Lakes and the Fox River.

All summer and winter pool elevations are target elevations. Natural events such as droughts, wind, storms and flooding will push pool elevations outside of these target ranges on a regular basis. While the goal of operations is to maintain pool elevations within these ranges, it is impossible to maintain pool elevations within these target ranges at all times.

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HISTORY AND OWNERSHIP

STRATTON DAM

McHenry County was established on January 16, 1836. The government plat for Township 44 North, Range 8 East was signed December 17, 1839, and no dam at McHenry was indicated on this survey. Early in the 1900's a group of property owners and others organized the Fox River Navigable Waterway Association. In 1907, this association secured a Federal Permit and constructed a wooden dam across the Fox River to improve navigation for recreation in the Chain-O-Lakes. This dam deteriorated, and was replaced with a three foot steel sheet piling structure equipped with three foot high flash boards prior to 1915. This dam was constructed with a lock at the east end, on the opposite side of the present lock. This dam was indicated on a 1923 map prepared by the Division of Waterways and was similar to the 1915-16 River and Lakes Commission maps, covering the Fox River.

In 1923-24, the titles, rights and interest in the dam, lock and adjacent properties were conveyed to the State of Illinois after passage of the McHenry County Dam Act (615 ILCS 100). This act provides the Department of Natural Resources with the duty of maintaining the "*dam at a suitable height to properly provide a sufficient depth of water north of the dam in the Fox River and the lakes adjacent thereto and connected therewith to enable said waters to be navigable*." A November 9, 1936 survey of the dam site showed the crest length to be 210.7 feet. The dam crest was at elevation 733.6 with the top of the three foot flash boards at 735.6. On the date of the survey the pool elevation was 736.07 and the tailwater elevation was 732.50. Major damage occurred to the structure from the floods of November 1937 and July 1938.

In 1939, the State of Illinois Department of Public Works and Buildings, Division of Waterways (predecessor to the Office of Water Resources), under contract FR-14 constructed the present dam and the former 5 sluice gate control structure (Department of Public Works, 1938). Also in 1939, the State of Illinois made the initial land acquisition of 15 acres for McHenry Dam State Park, which became a part of Moraine Hills State Park, which is located on the east side of the Fox River.

The present boat lock was constructed in 1958-60 under Department of Public Works and Buildings contracts FR-109 and FR-113. The lock was opened for public use on June 1, 1960. In 2014 construction on contract FR-435 was started. This contract replaced the existing sluice gates with three hydraulically operated torque tube gates, extended the lock an additional 75 feet and improved the controls to the hinged crest gate. Construction of the lock and torque tube gates was completed in 2021. A number of other contracts have been awarded and completed since 1939 to repair and maintain the existing dam, buildings and site areas. None of these contracts has changed the hydraulic characteristics of the outlet works except for the installation of the hinged crest gate in 2002 by the United States Army Corps of Engineers.

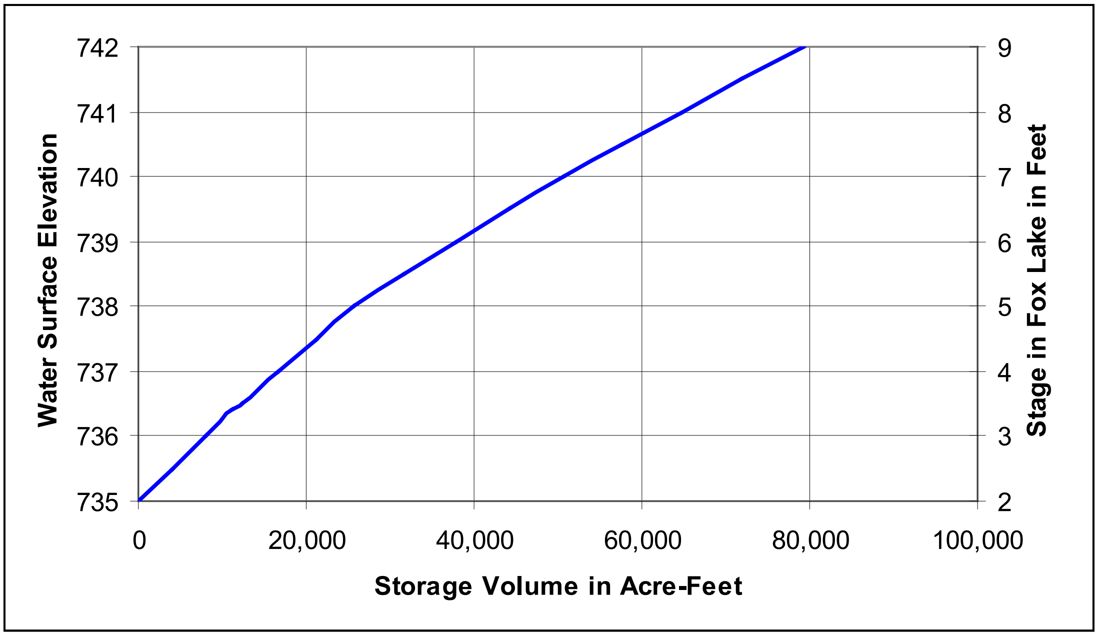
ALGONQUIN DAM

McHenry County was established January 16, 1836. The government Township 43 North, Range 8 East plat was signed on April 18, 1840. A ferry called Cornishers Ferry was indicated in the NW 1/4 of Section 34. The Village of Algonquin was formerly called Oceola. William Sloan was given authority to build a mill dam by an Act of Legislation approved February 11, 1853. A dam was built about 1854. In 1915 a dam existed along with a mill and a tail race on the east side of the river. On May 12, 1939 the State of Illinois acquired title by Quit Claim to the mill lot and dam from the Public Service Co. of Northern Illinois. In 1946-47 the State, Division of Waterways under contract PW-8 built the Algonquin Dam, a short distance south of the old dam and also removed the old dam. In 2002, the United States Army Corps of Engineers installed the hinged-the crest gate at Algonquin Dam.

DESCRIPTION OF CHAIN OF LAKES & UPPER RIVER

The Chain of Lakes has a surface area of approximately 6,900 Acres (Kothandaramon, 1977) and is primarily used for recreation with limited flood control benefits. There are approximately 1,250 square miles, or 800,000 acres, that drain to Stratton Lock and Dam. Between an elevation of 736.8 feet (low end of summer pool target range) and 737.2 feet (high end of summer pool target range) there is 3,000 acre-feet of storage in the Chain of Lakes; an average of 3/64 inch of runoff from the watershed upstream of the Chain of Lakes will fill the 3,000 acre-feet.

Figure 1: Storage in Chain of Lakes



DESCRIPTION OF STRATTON DAM

Stratton Dam is located at river mile 97.7 (Healy, 1979) on the Fox River and controls the outflow of water from the Fox Chain of Lakes in McHenry County. The drainage area at the dam is 1,250 square miles.

The dam control structures consist of a spillway, three torque tube gates, a hinged crest gate, a navigation lock and a fish ladder. The specifics of the control works given in Table 1 are from Department of Transportation, 1976 and recent survey by IDNR. Important note: the crest length of Stratton Dam before the placement of hinged-crest gates was 282 feet.

Table 1: Stratton Lock and Dam Control Works

Fixed Spillway Data	
Crest Length	221 ft.
Radius of Spillway Crest Curvature	419 ft.
Spillway Crest Average Elevation	736.76 ft. NGVD
Spillway Low Point Elevation	736.68 ft. NGVD
Approach Channel Bottom Elevation	729.5 ft. NGVD
Downstream Channel Bottom Elevation	725.1 ft. NGVD
Length of Fish Ladder Crest	4 ft.

Elevation of Fish Ladder Crest	Adjustable
Height of Spillway	6.5 ft.
Spillway Shape	Broad Crested
Torque Tube Gates Data	
Number of Torque Tube Gates	3
Width of Gate Opening	27.83, 27.92, 28.25 ft
Gate Sill Elevation	731.0 ft. NGVD
Top of Gate Closed (Upright)	737.25 ft. NGVD
Top of Gate Open (Flat)	731.25ft. NGVD
Hinged Crest Gate Data	
Width of Gate Opening	50 ft.
Top of Gate Closed (Upright)	737.20 ft. NGVD
Top of Gate Open (Flat)	730.50 ft. NGVD
Concrete Floor Elevation	730.08 NGVD
Top of Pier	742.0 NGVD

NGVD refers to the National Geodetic Vertical datum of 1929

0 stage of headwater gage = elevation 733.0 NGVD

0 stage of tailwater gage = elevation 730.15 NGVD

In 1988, the United States Geological Survey (USGS) completed a study under contract with the Division of Water Resources (DWR) to look at discharge ratings for the control structures at Stratton Dam (Fisk, 1988). Beginning in 2004 the USGS made additional flow measurements for various flow conditions and gate openings to update the earlier Fisk report and to develop a discharge rating for the hinged crest gate.

Table 2 gives a summary of the hydraulic conditions and discharge equations derived for different flow regimes at the Stratton Dam control structures.

Table 2 Discharge Equations for Different Flow Regimes at Stratton Dam Control Structure

Structure	Flow Regime	Hydraulic Conditions	Equations
Broad-Crested Weir	Free	$\frac{h_{3_{BCW}}}{h_{1_{BCW}}} \leq 0.60$	$Q_{BCW} = C_{BCW} B h_{1_{BCW}}^{1.5}$ $C_{BCW} = 2.94 h_1^{0.087}$ $B = 225ft$ $Q_{BCW} = 661.5 h_{1_{BCW}}^{1.59}$
Torque Tube Gate	Free	$\frac{h_{3_{HCG}}}{h_{1_{HCG}}} \leq 0.75$	$Q_{HCG} = C_{HCG} B h_{1_{HCG}}^{1.5}$ $C_{HCG} = 3.87 \left(\frac{h_{1_{HCG}}}{p_{HCG}}\right)^{-0.135}$ $B = 28ft$ $Q_{HCG} = 108.4 h_{1_{HCG}}^{1.365} p_{HCG}^{0.135}$
Torque Tube Gate	Submerged	$\frac{h_{3_{HCG}}}{h_{1_{HCG}}} > 0.75$	$Q_{HCG} = C_{HCG} C_{HCG-S} B h_{1_{HCG}}^{1.5}$ $C_{HCG-S} = 0.471 \left(\frac{h_{3_{HCG}}}{h_{1_{HCG}}}\right)^{-2.94}$ $Q_{HCG} = 50.04 h_{1_{HCG}}^{4.305} h_{3_{HCG}}^{-2.94} p_{HCG}^{0.135}$
Hinged-Crest Gate	Free	$\frac{h_{3_{HCG}}}{h_{1_{HCG}}} \leq 0.75$	$Q_{HCG} = C_{HCG} B h_{1_{HCG}}^{1.5}$ $C_{HCG} = 3.87 \left(\frac{h_{1_{HCG}}}{p_{HCG}}\right)^{-0.135}$ $C_{HCG} = 3.87 \left(\frac{h_{1_{HCG}}}{p_{HCG}}\right)^{-0.135}$ $B = 50ftB = 50ft$ $Q_{HCG} = 193.5 h_{1_{HCG}}^{1.365} p_{HCG}^{0.135}$

Hinged-Crest Gate	Submerged	$\frac{h_{3_{HCG}}}{h_{1_{HCG}}} > 0.75$	$Q_{HCG} = C_{HCG}C_{HCG-S}Bh_{1_{HCG}}^{1.5}$ $C_{HCG-S} = 0.471\left(\frac{h_{3_{HCG}}}{h_{1_{HCG}}}\right)^{-2.94}$ $C_{HCG-S} = 0.471\left(\frac{h_{3_{HCG}}}{h_{1_{HCG}}}\right)^{-2.94}$ $Q_{HCG} = 91.14h_{1_{HCG}}^{4.305}h_{3_{HCG}}^{-2.94}p_{HCG}^{0.135}$

Figure 2: Stratton Dam Spillway

Figure 3: Plan View of Stratton Lock and Dam

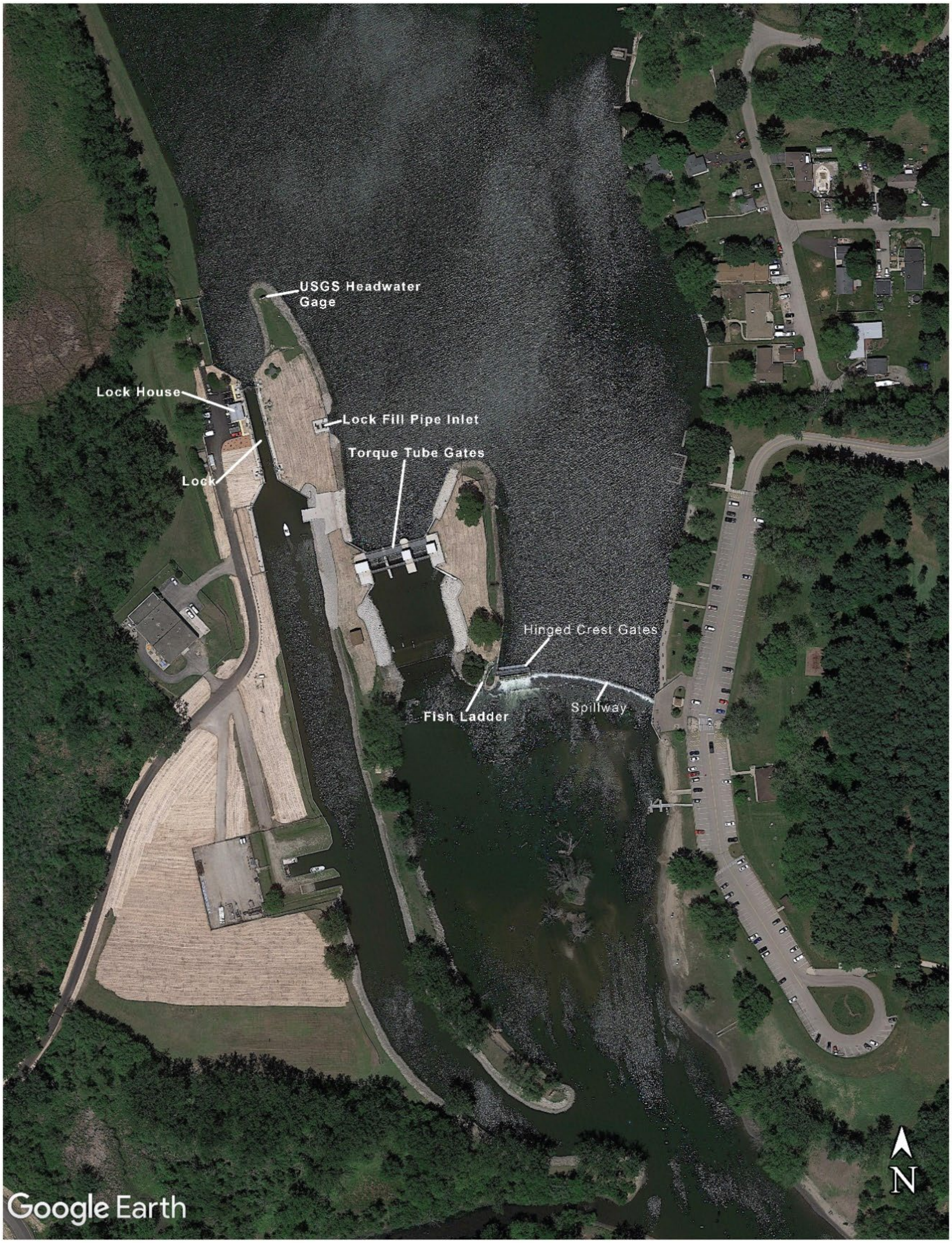


Figure 4: Downstream End of Stratton Dam Fish Ladder

Figure 5: Downstream Side of Stratton Torque Tube Gates

Figure 6: Stratton Dam Hinged Crest Gate

Figure 7: Cross Section of Stratton Torque Tube Gate

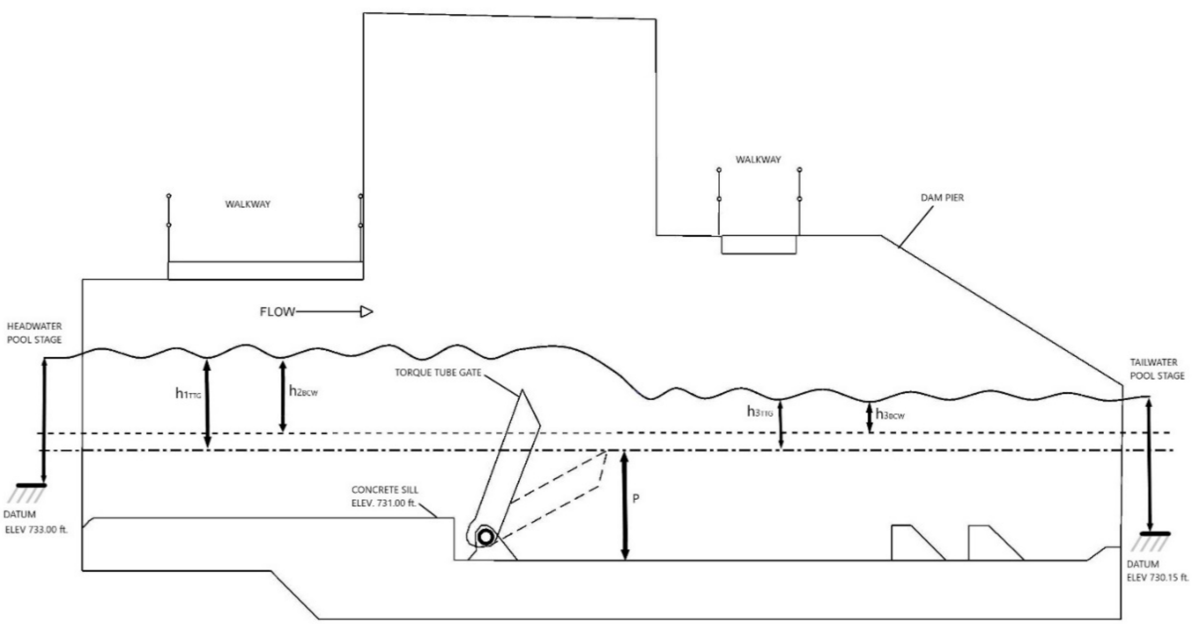


Figure 8: Downstream Rendering of Torque Tube Gates

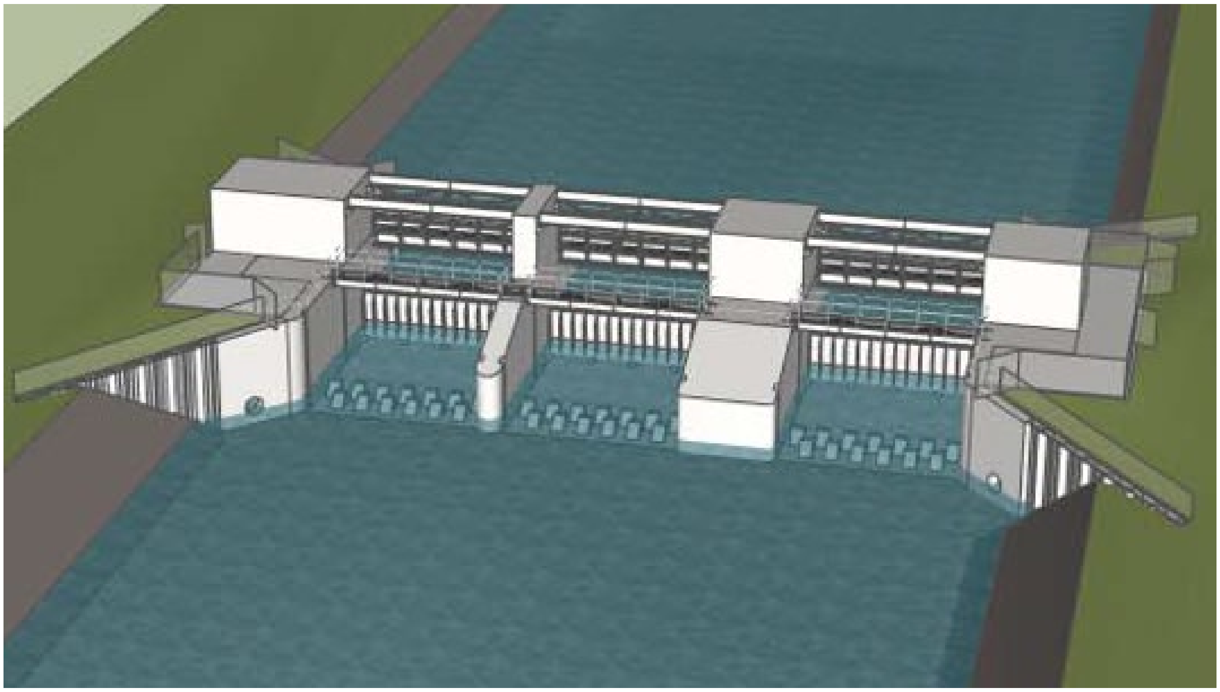
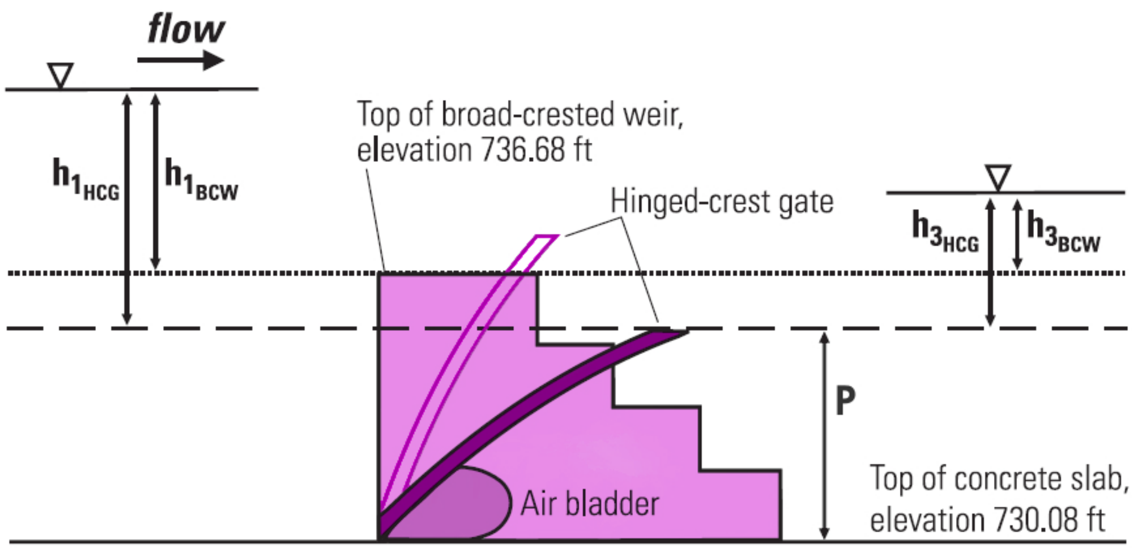


Figure 9: Cross Section of Stratton Hinged Crest Gate and Broad Crested Weir



This section view of a generic hinged crest gate shows how the inflation/deflation of the air bladder that is underneath the steel gate skin causes the steel gate skin to raise or lower.

DESCRIPTION OF ALGONQUIN DAM

Algonquin Dam is located at river mile 81.6 on the Fox River. The drainage area at the dam is 1,403 square miles. An 849 acre reservoir is created by the dam which is primarily used for recreation. Table 3 shows the spillway data for Algonquin Dam from the Department of Transportation, 1976 report and recent survey by IDNR. Important note: the crest length of Algonquin Dam before the placement of hinged-crest gates was 300 feet.

Table 3: Algonquin Dam Control Works

Fixed Spillway Data	
Crest length	242 ft
Spillway Crest Average Elevation	730.10 ft. NGVD
Spillway Low Point Elevation	730.10 ft. NGVD
Approach Bottom Elevation	722.20 ft. NGVD
Downstream Bottom Elevation	723.40 ft. NGVD
Height of Spillway	9.0 ft
Spillway Shape	Ogee
Hinged Crest Gate Data	
Width of Gate Opening	50 ft
Top of Gate Closed (Upright)	730.60 ft. NGVD
Top of Gate Open (flat)	724.00 ft. NGVD
Concrete Floor Elevation	723.58 ft. NGVD
Top of Pier	735.00 ft. NGVD

0 stage on Algonquin headwater gage = elevation 729.48 NGVD

0 stage on Algonquin tailwater gage = elevation 719.48 NGVD

Table 4: Discharge Equations for Different Flow Regimes at Algonquin Dam Control Structures

Structure	Flow Regime	Hydraulic Conditions	Equation of Flow
Ogee Spillway (Hinged-Crest Gate Closed[1])	Free	$\frac{h_{3OS}}{h_{1OS}} < 0.60$ or	$Q_{OS} = C_{OS} B h_{1OS}^{1.5}$
Ogee Spillway (Hinged-Crest Gate Open[2])	Free	$\frac{h_{3OS}}{h_{1OS}} < -5.0$	$C_{OS} = 2.67 h_{1OS}^{0.363}$ $B = 242 ft$ $Q_{OS} = 646.1 h_{1OS}^{1.863}$
Ogee and Spillway and Hinged Crest (Hinged Crest Gate At Spillway Elevation)	Free	$\frac{h_{3OS}}{h_{1OS}} < 0.60$	$Q_S = C_S B h_{1OS}^{1.5}$ $C_{OS} = 2.34 h_{1OS}^{0.546}$ $B = 292 ft$ $Q_{OS} = 683.3 h_{1OS}^{2.046}$
Ogee Spillway (Hinged-Crest Gate Open)	Affected	$-5.0 < \frac{h_{3OS}}{h_{1OS}} < 1$	$Q_{OS} = C_{OS} C_{OS-A} B h_{1OS}^{1.5}$

Structure	Flow Regime	Hydraulic Conditions	Equation of Flow
			$C_{OS-A} = 0.442 p_{HCG}^{0.149} \left(\frac{h_{1_{OS}} - h_{3_{OS}}}{h_{1_{OS}}}\right)^{0.930} \left(\frac{h_{1_{HCG}} - h_{3_{HCG}}}{h_{1_{HCG}}}\right)^{-0.905}$ $Q_{OS} = 285.5 h_{1_{OS}}^{0.930} p_{HCG}^{0.149} (h_{1_{OS}} - h_{3_{OS}})^{0.930} \left(\frac{h_{1_{HCG}} - h_{3_{HCG}}}{h_{1_{HCG}}}\right)^{-0.905}$

Structure	Flow Regime	Hydraulic Conditions	Equation of Flow
Hinged-Crest Gate	Free	$\frac{h_{3_{HCG}}}{h_{1_{HCG}}} \leq 0.77$	$Q_{HCG} = C_{HCG} B h_{1_{HCG}}^{1.5}$ $C_{HCG} = 3.33 \left(\frac{h_{1_{HCG}}}{p_{HCG}}\right)^{-0.152}$ $B = 50ft$ $Q_{HCG} = 166.5 h_{1_{HCG}}^{1.348} p_{HCG}^{0.152}$
Hinged-Crest Gate	Submerged	$\frac{h_{3_{HCG}}}{h_{1_{HCG}}} > 0.76$	$Q_{HCG} = C_{HCG} C_{HCG-S} B h_{1_{HCG}}^{1.5}$ $C_{HCG-S} = 0.882 \left(\frac{h_{3_{HCG}}}{h_{1_{HCG}}}\right)^{-0.472}$ $Q_{HCG} = 146.9 h_{1_{HCG}}^{1.820} h_{3_{HCG}}^{-0.472} p_{HCG}^{0.152}$

Figure 10: Cross Section of Algonquin Dam

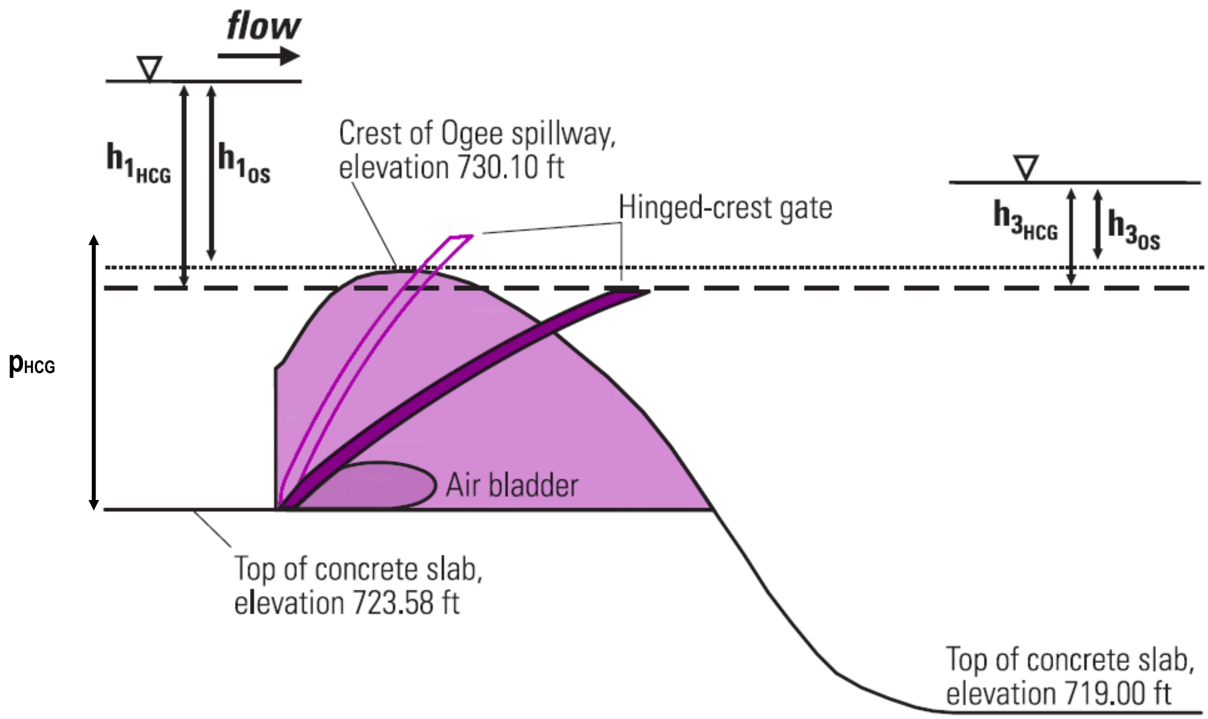


Figure 11: Aerial View of Algonquin Dam

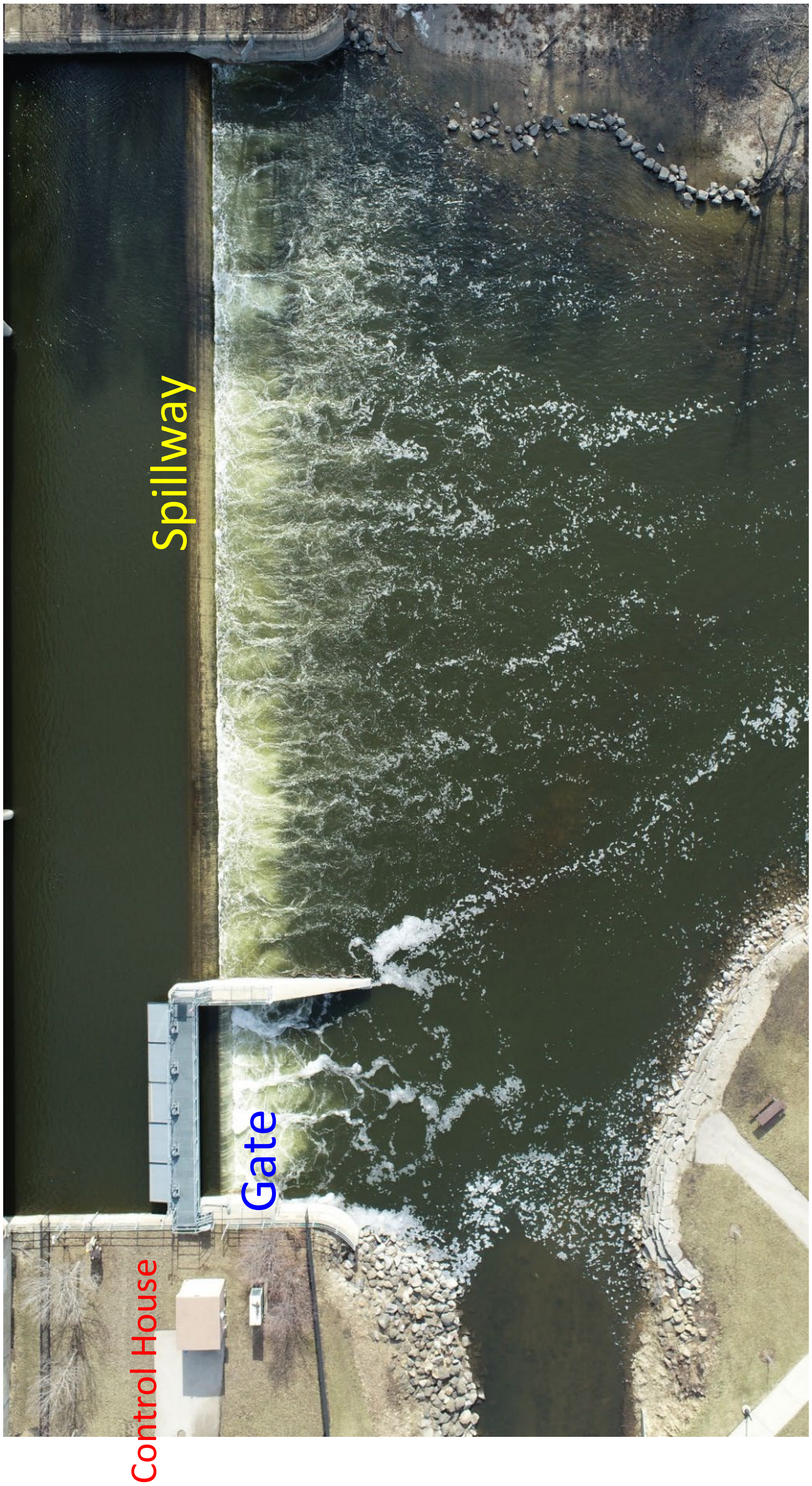


Figure 12: Algonquin Dam Spillway

Figure 13: Algonquin Hinge Crest Gate

OPERATION OBJECTIVES

Daily operations at Stratton Dam and Algonquin Dam are managed by collecting data, evaluating conditions, reviewing forecast data and determining operational adjustments to affect the resulting system performance.

Some of these data being collected include the following:

Forecasted flows into the system from National Weather Service

Lake Stages as measured at Channel Lake, Nippersink Lake, and Fox Lake

River flows as computed for the Fox River at New Munster, Wisconsin, Fox River at Miller Bridge near McHenry and Nippersink Creek at Spring Grove

River stages at Johnsburg, McHenry pool, McHenry tailwater, Algonquin and Elgin

These two dams affect the flows and stages in four distinct reaches of the Fox River:

Reach 1 - State line to outlet of Pistakee Lake

Reach 2 - Pistakee Lake outlet to Stratton Lock and Dam

Reach 3 - Stratton Dam to Algonquin Dam

Reach 4 - Fox River downstream of Algonquin

Primary flow control is achieved at Stratton Dam. The operation of this structure can affect the outflow from the lakes and river above Stratton Dam and the inflow to Reach 3. Gate adjustments at Algonquin affect the stages through Reach 3 but have little effect on flows passing downstream. There are no operational controls in Reach 1 or Reach 4.

Operational Objectives:

1. During summer normal flow conditions, the dams are operated to maintain the recreational pools in Reach 1, Reach 2 and Reach 3. The objective stage upstream of Algonquin dam is 1.8 feet. Normal summer pool in the Chain of Lakes is in the range of 3.8 to 4.2 feet.

2. When summer flood flows occur, the torque tube gates at Stratton Lock and Dam are utilized to pass flood waters downstream with the following constraints and/or conditions:

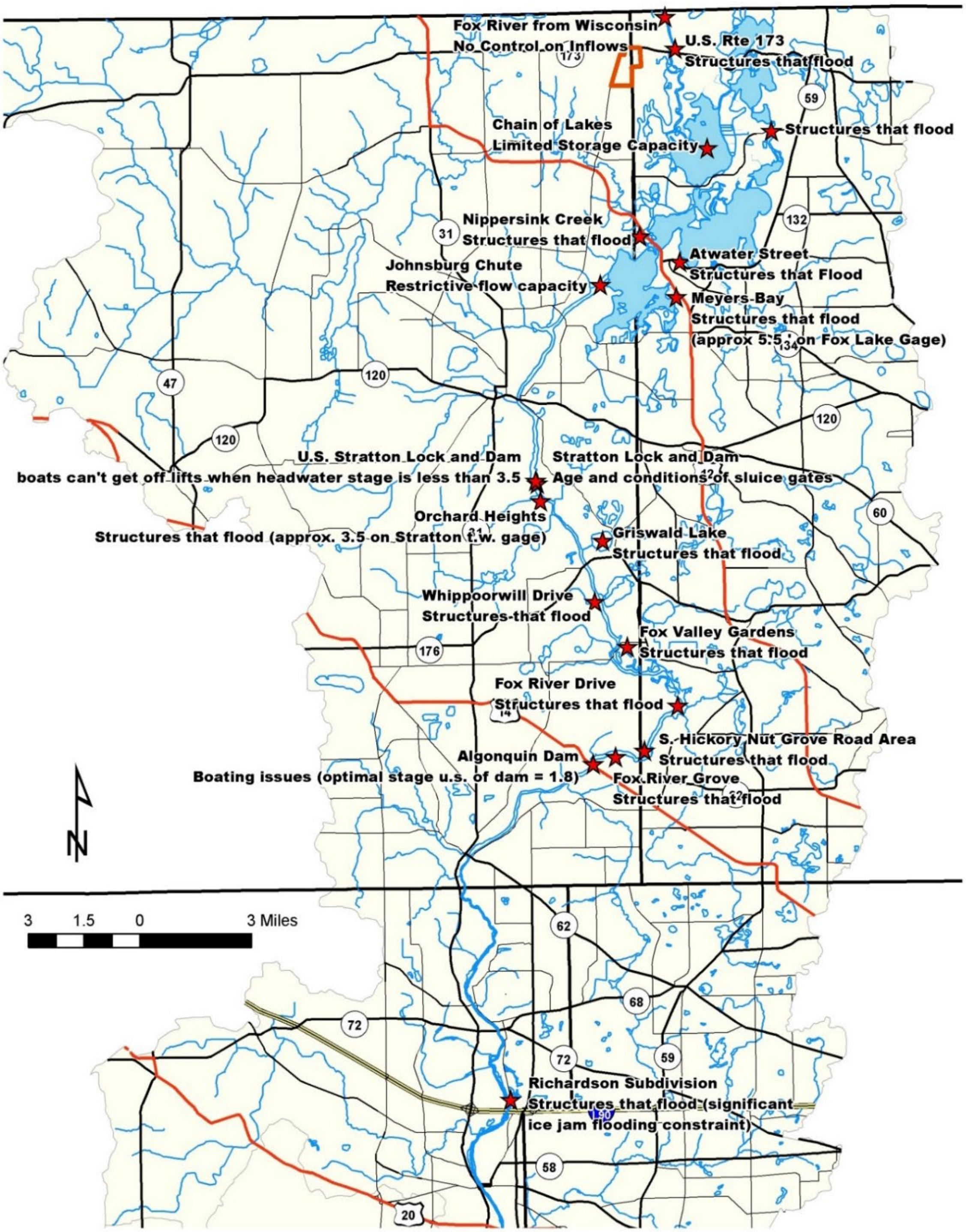
    - Flood stages in Reach 1, Reach 2, Reach 3, or Reach 4

- Observed rainfall and projected total inflows to the Chain of Lakes
- Forecast rainfall over the Fox River watershed.
- Hinged Crest gate not operated until flows or stages are expected that would indicate substantial flooding upstream and downstream.
- Volume of available storage in the Chain of Lakes

There is not enough storage in the Chain of Lakes, nor capacity in the downstream river, to eliminate flooding. Flooding occurs due to large or extended periods of rainfall, or due to snow melt, or combinations of such events.

3. During winter ice jam events the torque tube gates at Stratton Lock and Dam are utilized to restrict flows downstream to 1100 cfs if possible with the following constraints and/or conditions:
    - An accumulation of 60 degree-freezing days
    - Very cold temperatures (daily high temperature < 20 degrees)
4. The OWR regularly monitors inflow points at New Munster, Wisconsin, Nippersink Creek and other local runoff in Illinois to verify inflows to the system and monitors rainfall records to determine total inflows which the system will receive in the near future. Forecasted and predicted conditions are then reviewed, and the best operational procedure is determined. Those operational decisions consider all impacts, upstream as well as downstream of Stratton Lock and Dam. Frequently, flows are restricted to allow downstream tributaries to peak before releases are increased, or in wintertime periods, to minimize ice related conditions. At other times, outflows are increased early to minimize the peak stages on the lakes as well as well as minimizing the peak stage in the lower river, though this may extend the duration of a lesser stage in the lower river. Figure 14 identifies some of the operational constraints that must be considered during the operation of Stratton and Algonquin Dams.

Figure 14: Operational Constraints



GAGING

Stream gaging plays a major role in the operation of Stratton Dam. Table 5 lists the telemetry stations used in the daily operations, and Figure 15 and Figure 16 shows the location of these gages. The telemetry equipment is an electrical apparatus that measures water stage and transmits it by telephone or satellite to a receiving station. At the receiving station the water stage is then recorded. Twice daily and more frequently during major storm events each of these stations are contacted and readings are taken. In addition, wind speed and direction, precipitation, current temperature, and maximum and minimum daily temperature are recorded at Stratton Dam.

Numerous web sites identify present conditions as well as forecast conditions. Some of those web sites are listed here for public access:

DAILY FOX RIVER STAGES

USGS Current Conditions for the Nation

REAL TIME AND FORECASTED PRECIPITATION DATA

USGS National Water Dashboard - https://dashboard.waterdata.usgs.gov/

NWS National GIS Map Viewer - https://viewer.weather.noaa.gov/

Quantitative Precipitation Forecasts (QPFs) - https://www.wpc.ncep.noaa.gov/#page=qpf

Table 5: Fox River Stream Gaging Stations (Current)

Station Name	Gage #	Years of Record	Area (mi^2)
Gages Used for Daily Operations			
Fox River at New Munster, WI (Wilmot)	05545750	1939-present	811.0
Channel Lake near Antioch	05547000	1939-present	
Fox Lake near Lake Villa	05547500	1939-present	
Nippersink Lake at Fox Lake	05548000	1939-present	
Nippersink Creek near Spring Grove	05548280	1966-present	192.0
Fox River at Johnsburg	05548500	1939-present	1205.0
Fox River at Miller Bridge near McHenry	05549400	2020-present	1246.7
Fox River at McHenry	05549500	1941-present	1250.0
Fox River at Stratton Dam (TW)	05549501	1987-present	1250.0
Fox River at Algonquin (HW)	05550000	1915-present	1403.0
Fox River at Algonquin (TW)	05550001	2002-present	1403.0
Downstream Tailwater at Foot bridge		2009-present	
Additional USGS Continuous Recording Gages (Current and Historical)			
Fox River at Waukesha, WI	05543830	1963-present	126
Mukwonago River at Mukwonago, WI	05544200	1973-present	74.1
Poplar Creek at Elgin	05550500	1951-present	35.2
Fox River at South Elgin	05555100	1989-present	1556
Ferson Creek near St. Charles	05551200	1960-present	5.7
Fox River near Montgomery	05551540	2002-present	1732
Fox River at Yorkville	05551580	2012-present	1804
Blackberry Creek near Yorkville	05551700	1960-present	70.2
Fox River at Dayton	05552500	1914-present	2642

Figure 15: Gaging in Southern Portion of Watershed

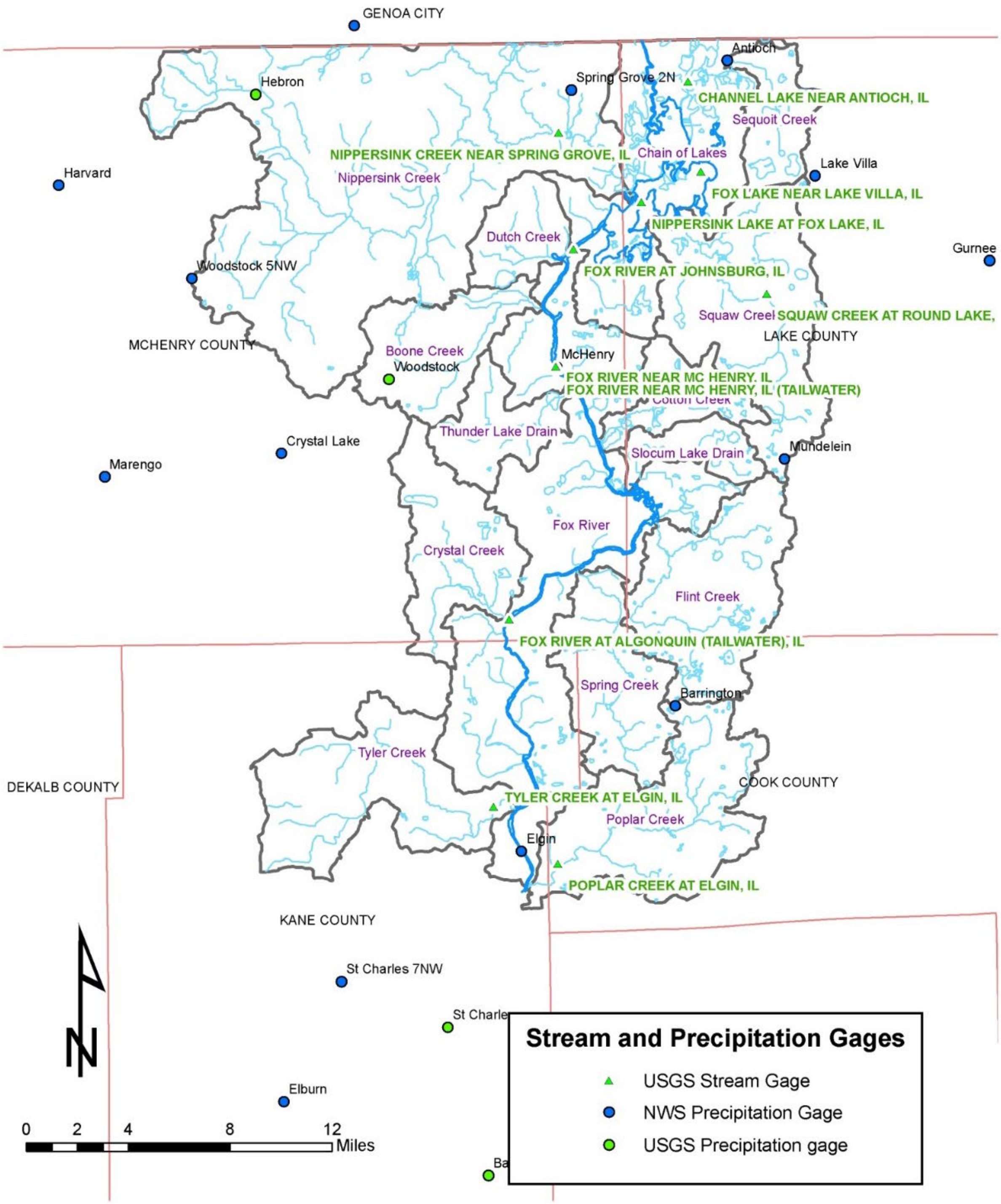
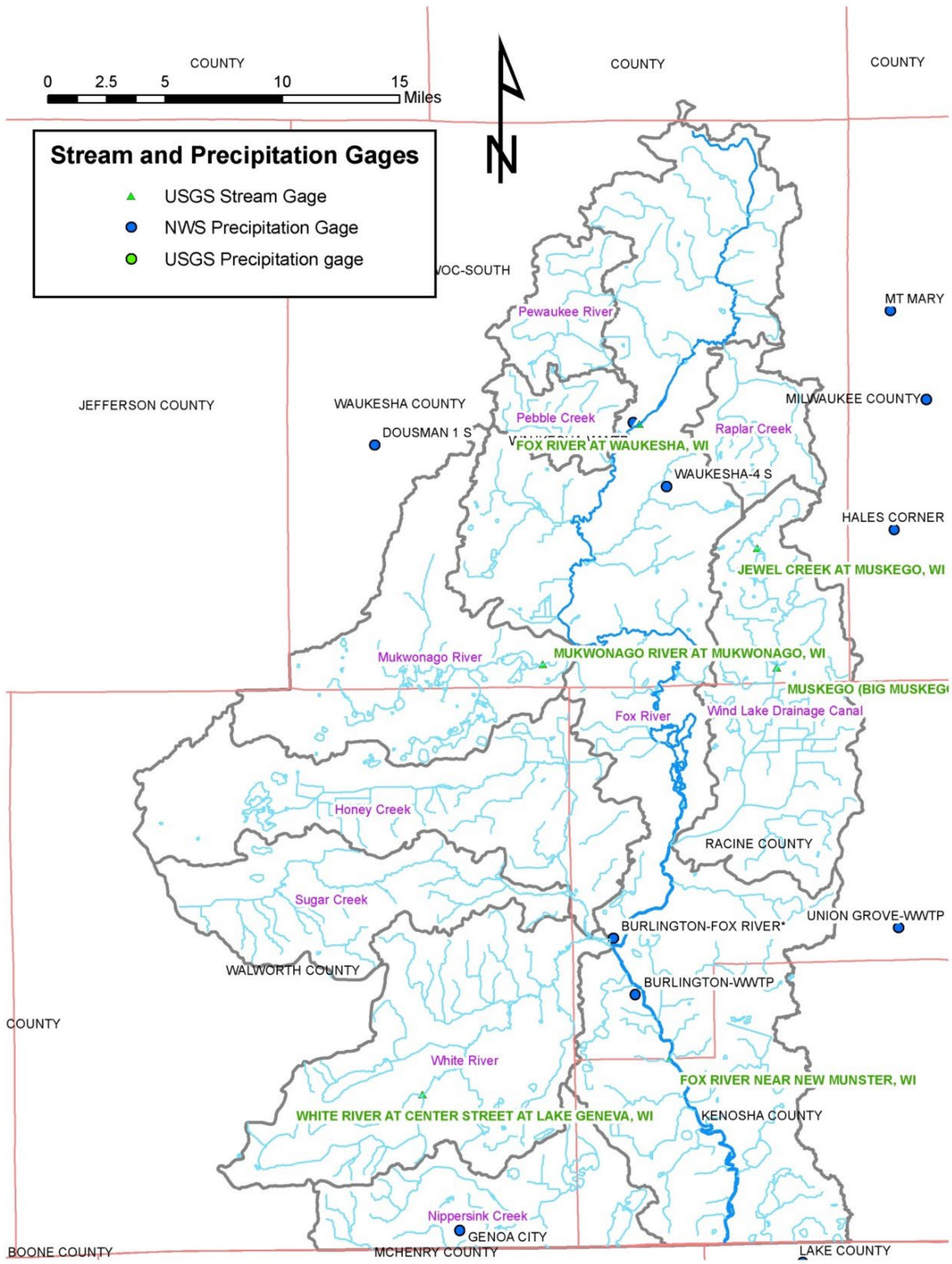


Figure 16: Gaging in Northern Portion of Watershed



STRATTON AND ALGONQUIN OPERATIONS

Operations at Stratton Dam and Algonquin Dam are divided into four operational periods: low flow, normal flow, flood warning, and flood flow. Figure 17 shows each of the periods on flow duration curves for the Nippersink, New Munster, McHenry, and Algonquin gages.

Below an inflow of 390 cfs (known as Q_{75} - 75 percent flow duration) operations are low flow. From Q_{75} to Q_{25} (25 percent flow duration) operations are normal flow. During periods of normal flow, the operations at Stratton Dam maintain outflow equal to inflow. This range of inflows is from 390 cfs to 960 cfs.

Inflows greater than 960 cfs are considered to be flood flows. There are three different types of flood events at Stratton Dam. 1) rainfall-snowmelt events when at winter pool, 2) winter ice jams, and 3) rainfall events when at summer pool. Each of these event types is outlined in the following text.

Important information to consider in flood operations is rainfall and runoff frequency distributions. Listed in Table 6 are the 50% thru 1% annual probable discharges for the Algonquin, New Munster and Nippersink stream gages using the annual maximum series of recorded discharges regardless of the season in which the discharge occurred. The statistical analysis was completed in HEC-SSP version 2.2 utilizing the 17C EMA method of computation.

Table 6: Annual Discharge Probability Distributions for Select Gages (in cfs)

Gage Location	50%	20%	10%	4%	2%	1%
Algonquin	3387	4720	5527	6466	7112	7719
New Munster	2800	4048	4919	6066	6952	7863
Nippersink Creek	1243	1956	2403	2925	3283	3614

Figure 17: Flow Duration Curves

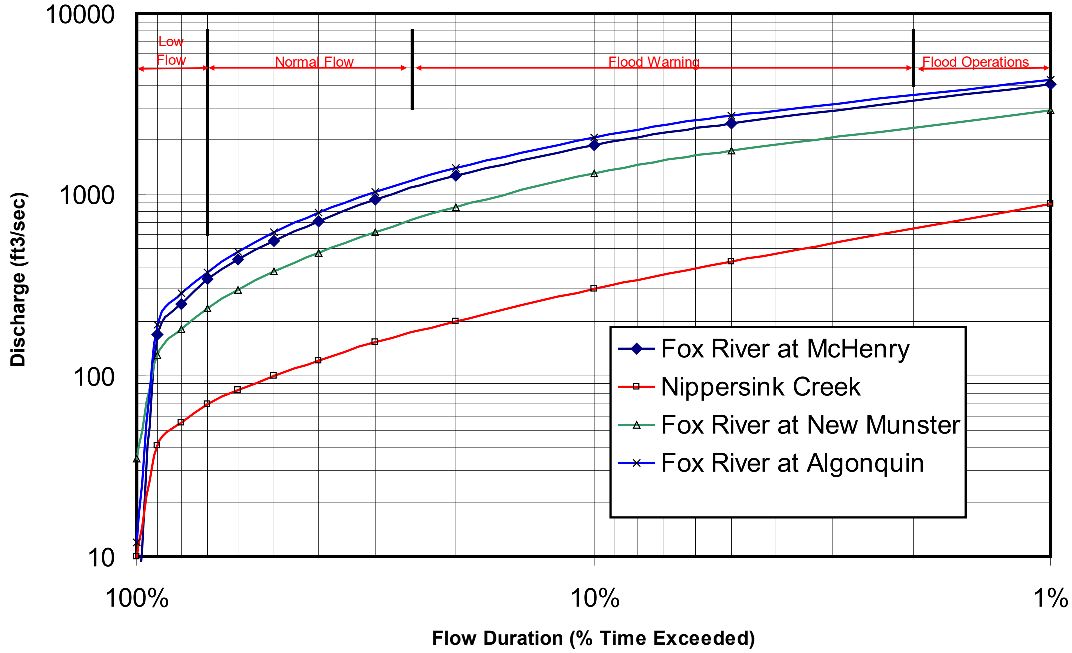


Table 7 shows the seasonal rainfall frequency distributions for the 24-hour storm period, for the northeast zone of Illinois (Angel, 2020).

Table 7 Annual Precipitation Probability for 24-Hour Storm Period (inches)

Probability	100%	50%	20%	10%	4%	2%	1%	.2%
Precipitation	2.77	3.34	4.30	5.15	6.45	7.50	8.57	11.24

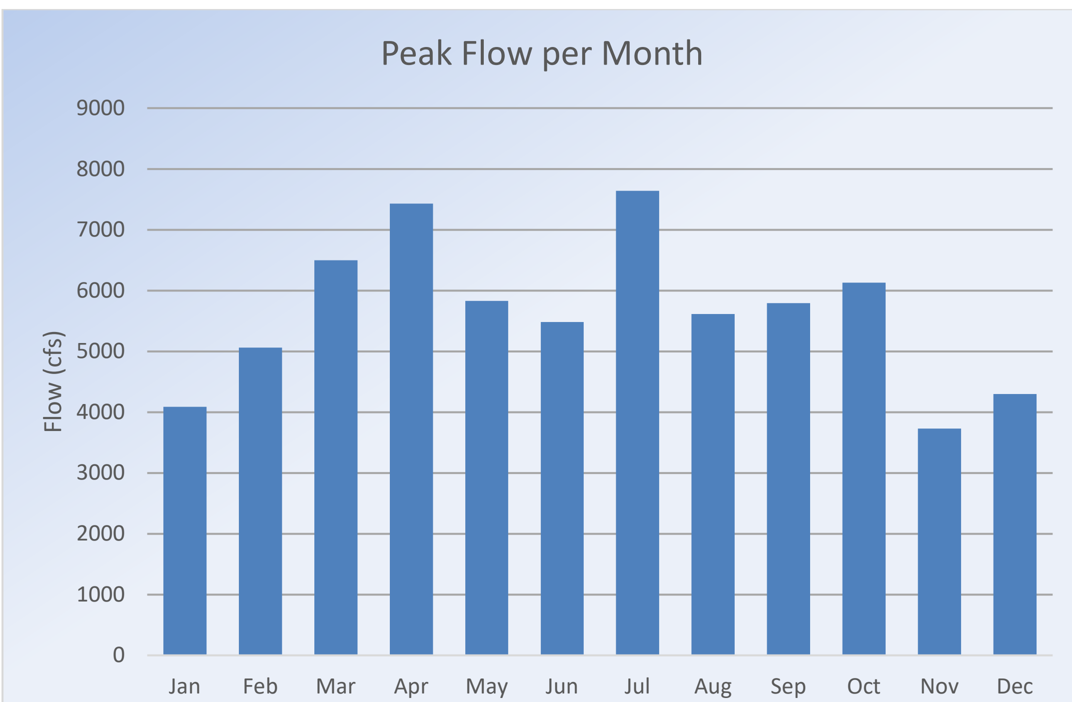
RAINFALL SNOWMELT EVENTS AT WINTER POOL

Most of the flooding events in the Fox watershed occur in the March, April, May (spring) time period. Table 8 lists the percent of days per month in which 50% floods have occurred at the Algonquin stream gaging station (1916-2022). Of the 100 storm events since 1916 that have been greater than the 50% annual probability (3387 cfs) or the annual peak event if less than two year event, 46 have occurred during the months of March or April.

Table 8: Percent Days per Month of 50% Floods

Month	Percent of days	Greatest Peak (cfs)
January	0.4%	4090
February	1.3%	5060
March	9.1%	6500
April	8.4%	7430
May	5.5%	5830
June	3.4%	5480
July	1.6%	7640
August	1.1%	5614
September	1.4%	5790
October	1.9%	6130
November	0.2%	3730
December	0.4%	4300

Figure 18: Peak Flow per Month for Algonquin Gage (Discharge)



Most of the major events occur when the lakes are at a winter pool elevation of 735.5 feet (Fox Lake stage of 2.5 feet). At this elevation the maximum discharge at the dam if the gates are completely open is approximately 1650 cfs. This discharge is less than the bankfull discharge of 2700 cfs and the no structural damage discharge of 3490 cfs. The hinged-crest gates at Stratton and Algonquin are most useful under these conditions, because the storage both upstream and downstream of these two dams can be optimized so the flood conditions upstream of these two dams can be lessened. An additional 1200 cfs can be passed if the hinged crest gate at Stratton Dam is completely open; this is a combined discharge of 2,850 cfs which is slightly higher than the bankfull discharge of 2700 cfs.

WINTER OPERATIONS/ICE JAMS

At approximately the 2 year discharge of 3200 cfs, out-of-bank flooding begins in Richardson Subdivision (Elevation 712.5) for open water conditions. With ice jams, this stage is usually reached at a flow of 1100 cfs. The ice jams form during the first major cold period of the winter before an ice cover on the river has formed. Ice jams also occur after a warming trend has broken up the ice cover and an extreme cold period again generates ice. The jam usually occurs when temperatures are below 20°F for several days. As these temperatures occur, Figure 19 can be used with known Algonquin discharges to estimate the flood stages at East Dundee. Daily communications, to monitor river stages, will be made with Kane County during these freeze up periods.

When degree-freezing days accumulate to 60 or more, flows from Stratton and Algonquin Dams are typically limited to approximately 1,000 cubic feet per second. For example, if the daily average of the minimum and maximum temperature is 20°F., the degree freezing days are 12 ($32^{o} - 20^{o} = 12$). This operational criterion was developed from an engineering study performed by the U. S. Army Corps of Engineers, Cold Regions Research Laboratory. The mean discharge at East Dundee for the winter months of December, January, and February is 853 cfs, 723 cfs and 843 cfs respectively (Knapp, 1988). Since that report was published in 1990, this office has operated the Stratton Dam and Algonquin Dam by following the criteria to minimize ice conditions on the lower river.

Fluctuating the pool within the Chain of Lakes during winter conditions causes impacts beyond the flood mitigation it provides. Ice forms at the level of the lakes, and as the lake level rises and falls, shoreline stress is created. This impacts local shoreline owners and the ecological habitat of the shorelines. Structural damage can occur to steel shoreline walls and to docks as flows fluctuate. Perched ice increases the hazards for recreational users of the Chain of Lakes.

The void between the ice and water poses danger to ice fishermen and snowmobilers. Also, local stormwater drainage is inhibited when ice level is above normal summer pool.

<u>Example of winter operations:</u>

The weather conditions in early December of 2007 created high inflows in the Chain of Lakes. Cold temperatures created conditions conducive to ice formation. After December 6, 2007, restricted outflows from Stratton Dam helped to minimize the threat of ice jam flooding. On December 22, 2007, warm weather resulted in snow melt and the Chain of Lakes received additional inflow and lake stages rose. Due to forecasts for the return of cold weather, the outflows from Stratton Dam were restricted to those that could be safely released considering possible ice conditions. The outflows were less than the inflows and lake levels rose over 0.5 feet due to these conditions. Degree freezing days accumulated to over 70 as of Jan. 3, 2008, and cold weather continued. Flows at Algonquin were estimated at less than 1,100 cfs, the result of operations which restricted outflows during cold weather. With predicted warm weather and resulting increased runoff into the lakes, the lake levels were predicted to rise unless outflows were increased; these increased outflows could have resulted in greater risks downstream if cold weather returned.

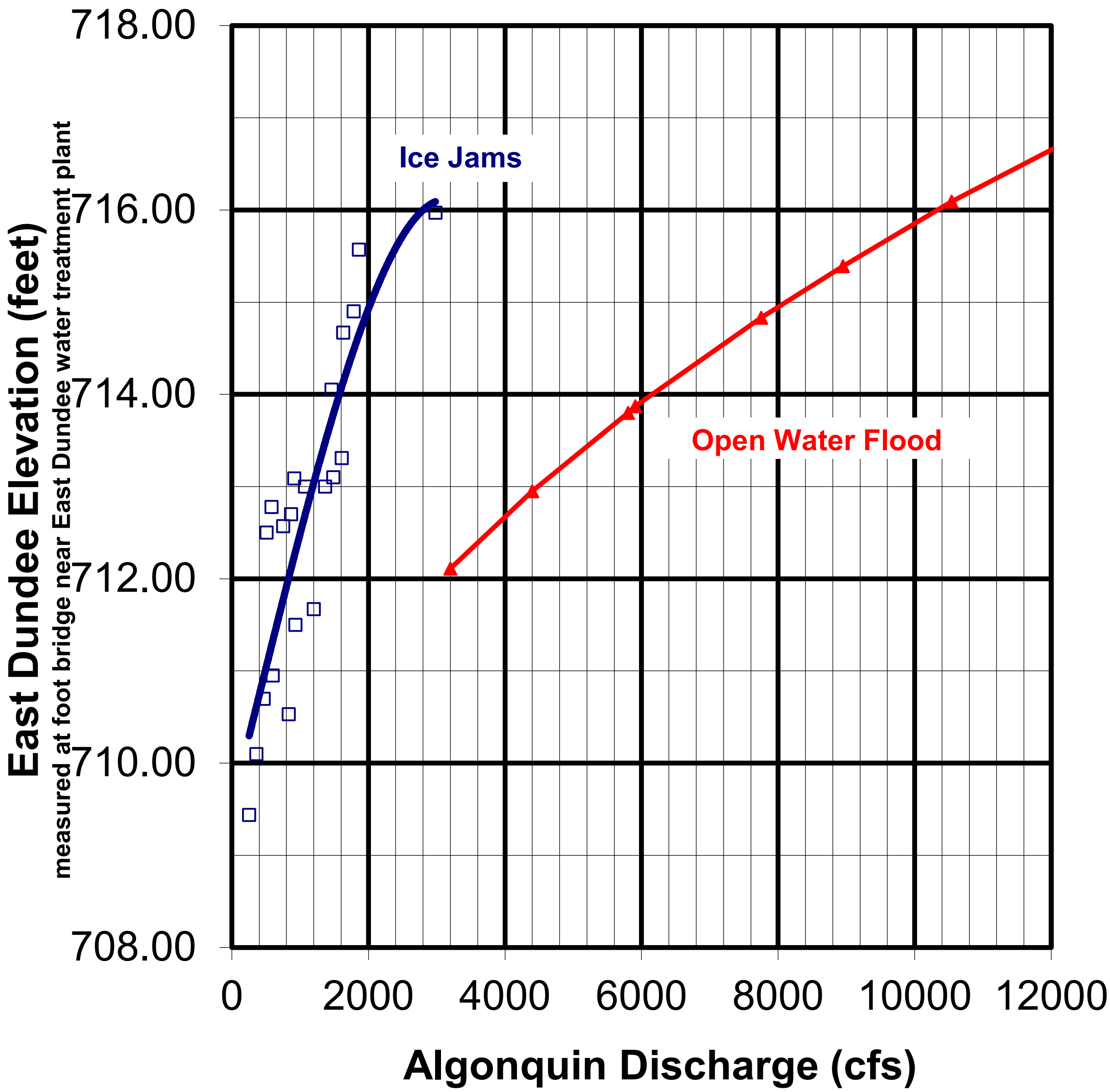
Table 9: Ice Jams and Flood Flows

Water	Date or Frequency	Algonquin	East Dundee
1963	12/5/1962	253	709.44
1990	12/14/1989	359	710.10
1989	12/17/1988	464	710.70
1989	2/5/1989	510	712.50
1965	1/17/1965	582	712.78
1980	12/17/1979	600	710.95
1982	12/18/1981	750	712.57
1978	12/21/1977	834	710.53
1962	12/15/1961	868	712.70
1979	12/13/1978	912	713.09
1961	12/13/1960	932	711.50
1993	12/24/1992	1073	713.00
1975	1/17/1975	1200	711.67
1991	12/24/1990	1366	713.00
1981	12/20/1980	1460	714.05
1992	12/6/1990	1487	713.10
1984	12/18/1983	1610	713.31
1988	1/4/1988	1632	714.67
2010	1/4/2010	1780[e]	714.9
1985	1/3/1985	1860	715.57
2009	1/9/2009	2267	n/a
1988	2/7/1988	2981	715.97
1994	12/28/1993	642	711.00
1995	12/12/1996	894	712.00
1995	1/29/1995	1100	711.70
1996	1/30/1996	1171	713.00
1998	1/14/1998	1920	712.60

Water	Date or Frequency	Algonquin	East Dundee
1983	12/12/1982	3850	712.77
	1 yr	3200	712.11
	2 yr	4400	712.95
	5 yr	5800	713.80
	10 yr	5910	713.87
	25 yr	7750	714.83
	50 yr	8950	715.39
	100 yr	10540	716.09
	500 yr	13475	717.22

East Dundee Ice Boom Installed January 25, 1995 thru November 2005

Figure 19: Ice Jams and Flood Flows



RAINFALL EVENTS AT SUMMER POOL

Since the construction of the existing dam and gate structure at McHenry in 1939, 30 events greater than the 2 year flood have occurred while at summer pool. 20 of these 30 events have occurred in the last 15 years. These events are listed in Table 10.

Table 10: Summer Pool Flood Events since 1939

Peak Events greater than 2-year event (33387 cfs) that occurred between May 1 and October 15 and after 1939 (when dam was constructed)			
Year	Month	Day	Algonquin Dam Average Daily Discharge
1967	6	17	3960
1972	9	24	4700
1973	5	4	5730
1986	10	3	6170
1996	5	23	4570
1999	6	18	4710
2000	6	17	5060
2001	6	17	3450
2002	6	7	3780
2004	5	31	6020
2007	8	26	6690
2008	5	13	3680
2008	6	19	5760
2008	7	24	3670
2009	5	4	3680
2010	5	16	4250
2010	8	1	3680
2011	5	1	3500
2013	5	1	5440
2013	6	27	5170
2017	5	3	4080
2017	7	22	7640

2018	5	22	3970
2018	6	27	5480
2018	9	6	4110
2019	5	11	4760
2019	5	30	4190
2019	9	17	5670
2019	10	8	5020
2020	5	24	5830

FISH LADDER OPERATIONS

The fish ladder should be "open" and operational from mid-March through mid-August. As water levels increase weir boards should be installed to maintain as smooth a transition between pools as possible. OWR staff at the Stratton Lock and Dam will oversee general operation and maintenance of the ladder. IDNR Fisheries staff will assist with opening and closing procedures (as needed) and periodically investigate fish use.

1. Placement of ladder boards should allow for an equal rise from the lowest pool (#1 near the tailwater) to highest pool (#7 near the headwater). Rise between each pool should not exceed 6" to 8".
2. Drain holes (also called turbulence holes) may need to be plugged during winter-pool flows so water can accumulate in pools 7, 6, 5, 4 and 3.
3. ladder boards need to be adjusted so flows are equalized as the Chain of Lakes fills toward summer pool.
4. At summer pool the "attractor tube" should be open to help draw fish toward the ladder. Prior to summer pool, flows through the attractor tube may be too low to draw fish toward the ladder. The attractor tube may be most functional when water is flowing over the low head dam to the east of the fish ladder.
5. At winter pool shut down water flows via a ladder board at the headwater between November and early March to reduce the likelihood of ice damage.

OPERATIONS FORECASTING

The ability to operate the gates at the Stratton and Algonquin dam requires estimations of future flows into the system and the resulting water surfaces to ensure the system runs as efficiently as possible to meet the goals. This is typically conducted in two portions: the flow coming into the system, (referred to system inflows) and the water surface elevation that resolved from those flows coupled with the gate settings. These estimates, or forecasts, are created from complex computer modeling that includes dozens of observed parameters that can change over short periods of time based on future weather conditions. The parameters can also change over long periods of time, such as land use changes, weather patterns and water use changes.

PAST FORECASTING METHODS

The Illinois State Water survey completed three studies to help develop and evaluate a flood control management policy for Stratton Dam (Knapp 1991 and Knapp 1992) and Stratton and Algonquin Dams (Knapp 1997). Two models were developed for use in these evaluations: 1) a rainfall-runoff watershed model (PACE), and 2) an unsteady flow-routing model (FEQ) to simulate the hydraulics of both the lakes and the Fox River.

The rainfall-runoff model (PACE) has been replaced with the National Weather Service, River Forecast Center flow forecasts.

The United States Geological Survey developed a HEC-ResSim model in 2016 for the purpose of operations of the Stratton Dam (Domanski 2016) that replaced the FEQ model. The model was documented in the report “Development and Evaluation of a Reservoir Model for the Chain of Lakes in Illinois”. This model was used to simulate the hydraulics in the lakes. The HEC-ResSim model has been replaced by an unsteady 2-Dimensional HEC-RAS model. This model has allowed for a greater understanding of water surface elevations throughout the entire system.

SYSTEM INFLOW FORECASTS

The purpose of the inflow forecasts provided by the National Weather Service is to estimate streamflow with consideration of recent and future rainfall predictions. The Fox River model typically uses watershed rainfall information from storms that have occurred and are forecasted to occur to develop inflow estimates to the Fox River system. The National Weather Service (NWS) has established a river inflow to the Chain of Lakes based on the Fox River at the New Munster, Wisconsin gage, the Nippersink gage and the remaining contributing area to the Chain of Lakes.

Over a dozen forecasts are provided to the IDNR that include, but not limited to rainfall forecasts for up to seven days. It is understood that the accuracy of the forecasts model decrease as the duration of the forecast is extended. Additionally, various probabilistic rainfall forecasts are provided for various forecast lengths. This means that a model may include a rainfall out to three days including the 50% probability of occurrence, 95% probability of occurrence, and the 5% probability of occurrence. All the various models are considered along with what the National Weather Service's lists as their official forecast. This official forecast considers rainfall in the next 24-48 hours depending on the season or rainfall event type. All forecasts provide forecasted inflow to the Chain of Lakes out to 14 days.

These forecasts are shared with the IDNR a minimum of twice daily. This forecasts along with evaporation and groundwater inflows are evaluated to estimate the amount of flow entering the system.

In prior years, operations of the gates at the McHenry dam only considered rainfall that was officially recorded. The limitation with this method is that it assumes no further rainfall would occur. The limitation of using the new method, is that the forecasted rainfall may not occur. Since the publication of the 2012 operations manual, the IDNR has determined that due to the limited storage of the system and probability that the forecasts are more likely to represent future conditions than no rainfall, the IDNR has begun evaluating future rainfall in its operational considerations while still operating within the guidelines required by the McHenry County Dam Act (615 ILCS 100).

SYSTEM WATER SURFACE FORECASTING

An unsteady 2-D HEC-RAS hydraulic computation model is utilized to generate final forecasted elevations for the Fox River System. The model accepts the following inputs from the engineer to best predict the water surfaces elevations throughout the system over various points in time:

- System inflow forecasts (described above)
- Current water surface elevations (OWR monitors 14 locations daily)
- Current Dam gate settings and expected future settings
- Forecasted direct rainfall onto the water surface (not accounted in inflow forecast)
- Wind direction and magnitude
- Groundwater inflows and evaporation losses

The complexity of the computational model requires significant time to prepare the data and to run the model. This can lead to efforts that exceed multiple hours to run a single scenario. To improve the efficiency in obtaining the optimal gate settings, a spreadsheet has been created to estimate outcomes from a variety of scenarios. The optimal solution can then be determined in the computational model in a timely manner.

The new water surface model makes great improvements over the prior forecasting measures. 1) The model no longer assumes a single elevation for all the Chain of Lakes. Therefore, difference in the various lakes can be evaluated as well as within a single lake. This is frequently observed during high wind events. This also allows the IDNR to improve the accuracy of predicted impacts throughout the entire system. 2) The water within the model can travel in any direction allowing for more accurate evaluations

OPERATIONAL GUIDELINES

In the simulation studies, the outflow was increased by opening the gates to one of three target discharge levels: 1) 1800 cfs, which is when the lower river is flowing at high levels while maintaining adequate freeboard, 2) 2250 cfs, maximum discharge for which no boating restrictions are implemented, and 3) up to 3000 cfs which is the maximum discharge without overbank flooding.

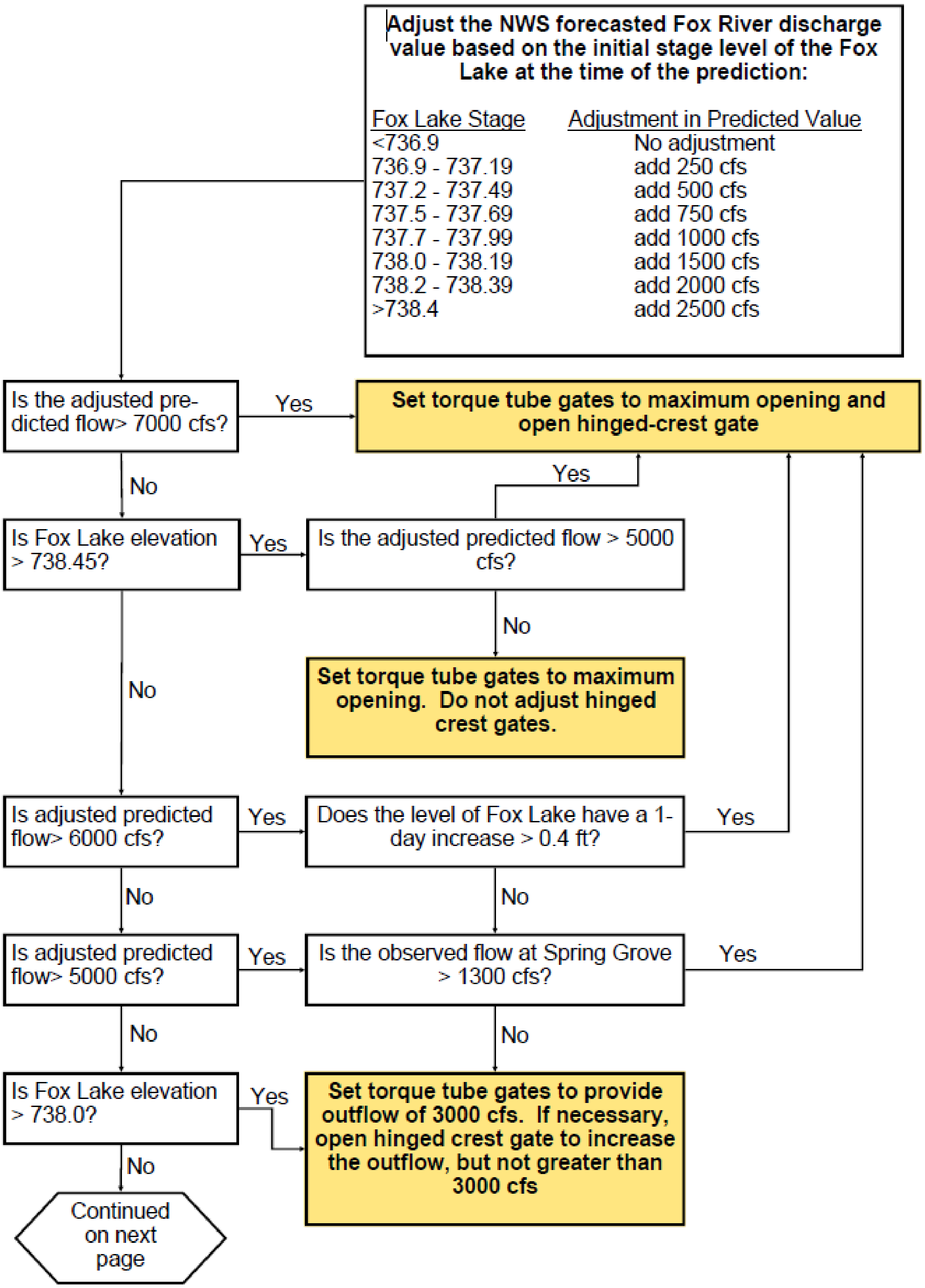
The criterion for opening the gates to release 3000 cfs, described below, requires relatively certain knowledge that severe (overbank) flooding is approaching the Chain of Lakes. Releases from Stratton Dam are allowed to exceed the target discharges when high stages in the lakes cause increasing amounts of uncontrolled flow over the Stratton Dam spillway.

The following policy was determined after analyzing: 1) the simulated impacts of various operation alternatives, 2) expected relationships between the flow predictions and associated observed flows, and 3) the frequency at which the policy will be employed.

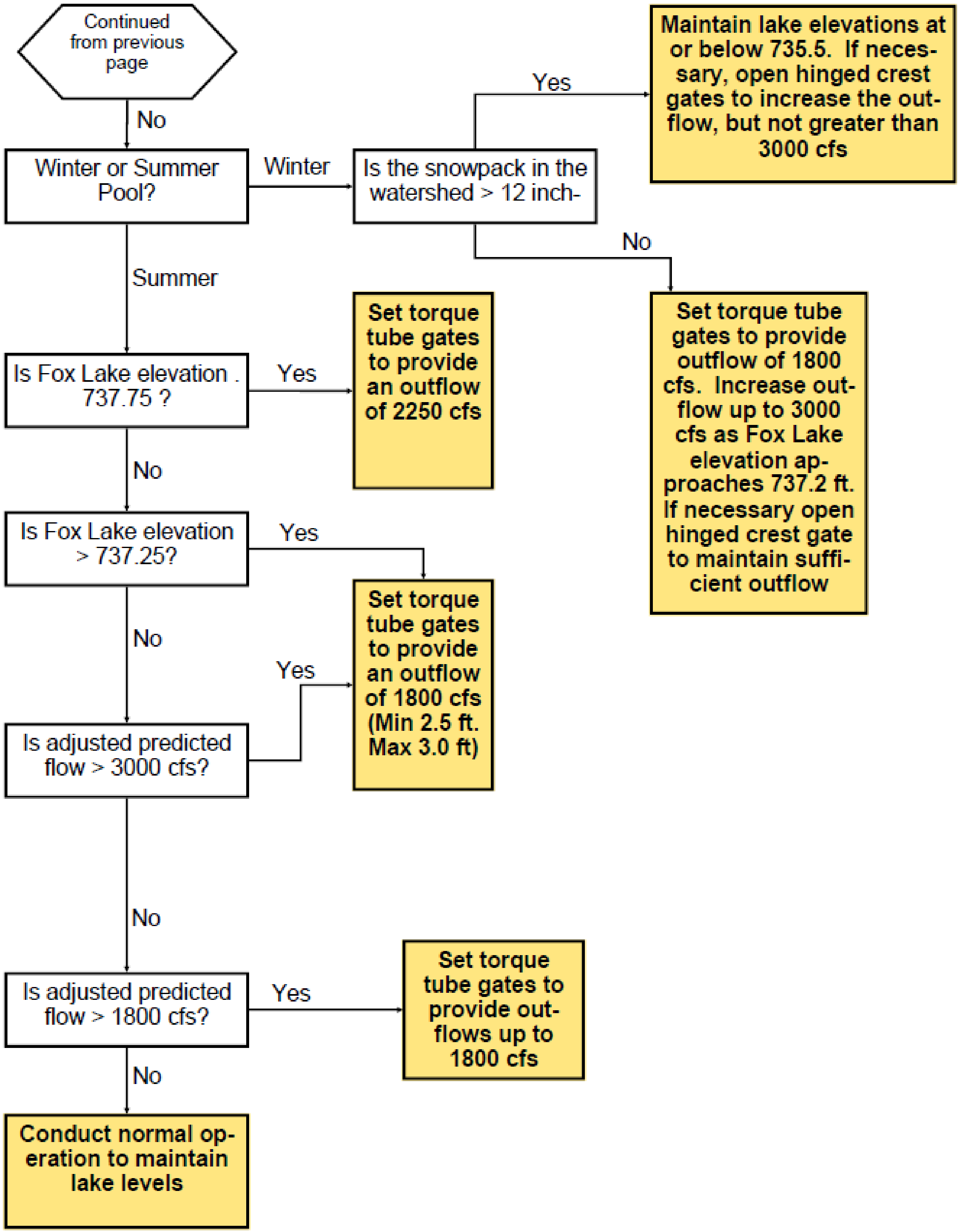
This flood control policy is designed so that the operation of the Stratton Dam gates does not directly induce flooding downstream except when the flow prediction model indicates the approach of extremely high flows, in which case the occurrence of downstream flooding is certain.

The flow chart showing the criteria for operating both the torque tube gates at Stratton Dam and hinged-crest gates at Stratton and Algonquin Dams is shown in Figure 20 (modified from Figure 17, Knapp 1998). This flow chart is used both during a flood event and after a flood event as a guide to operations. Additional information gathered during a flood event such as the likelihood of ice jams forming, or the flow conditions of downstream tributaries may require deviations from the guidance of the flow chart in order to minimize the overall flood potential of the Fox River. All predictions refer to predicted inflows coming into the Chain of Lakes as calculated by the NWS forecast model which include the Fox River, Nippersink Creek, and all remaining ungagged contributing areas. The data needed to traverse the flow chart is a predicted value of the inflow to the Chain of Lakes from the NWS forecast model and the Fox Lake at Lake Villa stage.

Figure 20: Operations Chart



All predictions refer to predicted inflows coming into the Chain of Lakes as calculated by the NWS RFC



All predictions refer to predicted inflows coming into the Chain of Lakes as calculated by the NWS RFC

FLOOD WATERNING PLAN

Flood prediction is the means by which local officials can estimate the occurrence of a flood and foresee its impact on their community. This assessment of the potential flood impact defines the nature of the response activities to be used in protecting life and property. Once river stage predictions are available, local officials need to assess the impact of the predicted stage on their community.

Four warning levels will be used along the Fox River. Each warning level is tied into a river stage elevation which in turn corresponds to some expected degree of flooding in a community.

Table 11: Flood Warning Stages along the Fox River

Location	Bank Full		Minor Flood		Mobilization		Major Flood	
	Elev.	**Dis.**	**Elev.**	**Dis.**	**Elev.**	**Dis.**	**Elev.**	**Dis.**
New Munster	741.0	3200	742.5	4700	743.0	5500	743.5	6200
Fox Lake	737.5		738.5		739.5		740.5	
Johnsburg	737.0		738.0		739.0		740.0	
Stratton Pool	737.0	3000	737.5	5200	738.0	5900	739.0	7500
Stratton	735.0	2900	736.0	4200	737.0	5500	738.0	6900
Algonquin	732.0	2500	733.0	6000	733.5	7100	734.0	8300
Carpentersville	722.5	2700	723.0	4200	723.5	5600	724.0	7400
East Dundee	712.0	2800	712.5	3600	713.0	4400	714.0	6200

The four warning levels will be identified as bank full stage, minor flood stage, mobilization stage, and major flood stage.

LEVEL 1 WARNING LEVEL

Bank full stage is defined as the river stage which equals the lowest riverbank elevation. Initial flooding will occur in areas adjacent to the river, but will not result in damages to property or a risk to the safety of residents.

LEVEL 2 WARNING LEVEL

Minor flood stage is defined as the river stage which results in the flooding of low-lying agricultural and park lands, roads, and basements. Bank erosion may also occur as may some minor damages.

LEVEL 3 WARNING LEVEL

Mobilization stage is defined as the river stage which results in low-level flooding of homes and businesses. The problems caused by this flooding situation can be adequately handled by local authorities with minimal assistance from State and Federal agencies.

LEVEL 4 WARNING LEVEL

Major flood stage is defined as the river stage which results in significant flood damage to public and private property and an increased risk to the safety of residents. Evacuation of flooded areas is necessary under this level of flooding. Problems caused by this level of flooding often overtax local resources, and Federal and State assistance may become necessary.

LOW FLOW OPERATIONS

Low flow operations follow the instream flow criteria discussed in "Instream Flow Protection: A Planning Standard for Illinois Streams", developed by the State Water Plan in 1983. When inflow is above 390 cfs the minimum release at Stratton Dam is 240 cfs. As the inflow drops below 390 cfs the release is then calculated as inflow plus lowest flow expected for a 7-day period once in every ten years ($Q_{7,10}$ = 94 cfs) divided by 2. In addition, during the summer months when the lock is in operation there is an additional 8 to 10 cfs average daily discharge downstream from lockage.

In equation form, the minimum outflow during low flows is:

$$Q_{OUT} = (Qin + Q7{,}10)/2$$

$$Q_{OUT} = (Qin + 94)/2$$

Presently Aurora, Elgin and Fermi National Accelerator Laboratory are the major users of Fox River water. Table 12 lists the average rate of withdrawal for these water users.

Table 12: Fox River Average Rate of Withdrawals

User	MGD	CFS
Aurora	10.0	15.5
Elgin	14.0	21.7
Fermi Lab	1.0	1.5
Total	**25.0**	**38.7**

TRANSITION TO SUMMER POOL

The majority (85%) of the historical annual peak flood events occurred as a result of snowmelt and early spring rainfall. Historical streamflow data was reviewed from 1940 at Wilmot and from 1916 at Algonquin to develop an operational plan for the transition from winter to summer pool.

The first of May will remain the target date for summer pool (elevation 737) to coincide with the opening of the locks to navigation. The lakes may be brought to summer pool earlier if all the following criteria are met.

1. The inflow from the winter snow melt event has passed;

2. The inflow to the lakes has dropped below the annual mean inflow of 685 cfs as measured at the New Munster (544 cfs) and Nippersink (141 cfs) gaging stations;

3. When the mean inflow of 685 cfs is obtained, there must not be any significant precipitation indicated on the National Weather Service 168-hour (7-day) quantitative precipitation forecast (QPF).

This transition is typically non-linear as it depends on current weather conditions and forecasts provided by the National Weather Forces. A linear transition would eliminate the benefit of providing additional storage for snow melt and rainfall events.

WINTER DRAWDOWN

Winter drawdown at Stratton Dam starts on November 1 and continues to December 1 of each year. The normal drawdown is two feet below the crest of the spillway (736.76 feet), to an elevation of 734.76 at Stratton Dam. The resulting drawdown in the lakes is normally about 18 inches as monitored at the lake stations with the lowest drawdown at 735.5. The winter drawdown provides an additional 14,400 acre-ft of storage for storage in the Chain-O-Lakes as measured from a summer pool stage of 4.2 feet to a winter drawdown stage of 2.5 feet.

On September 11, 1986, the Flood Control Advisory Committee of the Chain-O-Lakes Fox River Waterway Management Agency, recommended that winter drawdown of the Lakes area commence on the 15th day of October and reach normal winter water level by the 15th day of November. It was the general opinion of the committee that this change would minimize damage to the lower river area. Prior to this time the drawdown ran from November first to December first. In 1992 at the request of the Chain-O-Lakes Fox River Waterway Management Agency the winter drawdown was returned to November first. Numerous complaints from users having problems navigating in the waterway led to this return to the original drawdown period.

The winter drawdown was re-investigated in 2011. Numerous requests were made during the previous 5 years to change the winter drawdown, i.e. eliminate winter drawdown or increase winter drawdown. The construction of the hinged crest gates does not reduce the need for the winter drawdown. Winter drawdown provides flood damage reduction benefits to numerous structures on the Chain of Lakes and Fox River. Increasing the winter drawdown, lowering of the winter pool stage, would increase these flood damage reduction benefits. However, there are environmental impacts associated with increases to the winter drawdown.

Delaying winter drawdown has been requested several times. Climatological data for the winters of 2000 – 2010 was reviewed. The 60° freezing days, the indicator of potential ice jams where outflows from Stratton Dam should be reduced to 1000cfs to minimize flooding, are reached by December 10 over 70% of the time. Therefore, the reduction of stage in the Chain of Lakes needs to be accomplished before December 10. Shortening the time to accomplish winter drawdown risks the potential for shoreline erosion. If an ice cover forms on the lakes before winter pool stage is reached, potential damage to seawalls and piers could occur as the pool under the ice drops.

Inflows to the Chain of Lakes as measured at the Fox River near New Munster, Wisconsin and Nippersink Creek near Spring Grove will be monitored during November. Long range temperature and precipitation forecasts by the National Weather Service will also be monitored. If inflows are below normal; temperatures are forecasted to be above normal; and precipitation forecasted to be below normal delaying of the winter drawdown will be considered. For this case, the winter drawdown will begin on November 1 but the drawdown may be completed at a slower rate to extend the completion into December.

EMERGENCY OPERATIONS DAM BREACH

As part of the dam safety analysis conducted in 1998 for the proposed hinged-crest gates at Stratton and Algonquin Dams, a dam breach analysis was conducted for each of the dams. Results of the dam breach analysis indicate that a breach of the Stratton or Algonquin Dams will not increase the threat to life nor property damage. In the event of a breach at either structure the flow conditions of the river will require monitoring just as during any other flood period.

Both Stratton and Algonquin Dams are masonry (concrete) structures. Both structures are relatively low in height with small storage upstream. The dam breach analysis examined three different breach events: the Probable Maximum Precipitation (PMP), 100-Year, and Static (normal pool) event. A comparison was made between the natural condition and the breach condition for each of the three events to determine changes in the water surface elevations resulting from the breach.

For the PMP and 100-year dam breach events there is very little impact downstream of the dams. This can be explained by the fact that when the simulation of the breach occurs the river channel and overbank areas are already inundated by the flood waters and the river stage differential between the pool and tailwater at the dams is minimal.

Under the third scenario, each of the structures was breached at a normal pool stage. Under these conditions the maximum difference exists between the pool and tailwater stages. The simulated breaches cause increases in stage and discharge directly downstream of each structure as the pool areas is drained. When the Stratton Dam is breached the change in the stage directly downstream was 1.43 feet. When Algonquin Dam was breached the change in the stage directly downstream was 2.25 feet. In both cases as the flood wave travels downstream its effects are attenuated.

The increase in maximum discharges from the simulated breaches under the normal pool conditions at Stratton and Algonquin Dams coincide with flow rate equivalent to the discharges which would be expected from between the normal two and five-year flood events. Neither of these flood events poses a serious threat to life nor a risk of substantial property damage. Conditions may warrant the restriction of boat traffic and the possible closing of the river.

PERMITS AND APPROVALS

This operation guidelines incorporates regulatory authorities and comments exercised by the following:

Illinois Department of Natural Resources

- Office of Water Resources permit for construction of hinged crest gates
- Comprehensive Environmental Review Program

United States Army Corps of Engineers

- Environmental Assessment for Hinged Crest Gates
- Special Area Management Plan

Illinois Environmental Protection Agency

- 401 water quality review of hinged crest gates

IMPROVEMENTS TO OPERATIONS:

The IDNR Office of Water Resources is constantly evaluating its method to improve understanding the conditions that impact operations. This can include additional studies, use of newer technologies, and obtaining additional data and information. The improvements listed herein are a snapshot at the time of publication.

IMPROVEMENTS SINCE LAST PUBLICATION

1. Development of an operations reservoir model focusing on the simulation and communication of flows and to prepare proactively for precipitation events in near real time. The IDNR contracted with USGS to develop a HEC-ResSim model. The development of this new reservoir model improves the current IDNR–OWR operation workflow by allowing the operational simulation to be on the same time scale as the NWS forecast simulation. (Completed in 2016)
2. The IDNR OWR has been collecting structure information including first floor elevations and assessor information to determine potential flood damages for various flood stages. This information can be used evaluated to assess and optimize the operations plan and well as potential mitigation and flood control opportunities.
3. Installation and operation of the Fox River at Miller Bridge near McHenry, IL radar gage site, USGS Site No. 05549400. The new gage measures both stage and water velocity to estimate

the flowrate moving through the system near the Stratton Dam. This flowrate is consistent with the flow leaving the system through the Stratton Dam (Implemented in 2020).

4. Demolition of the sluice gates and construction of the torque tube gates and the expansion of the lock capacity. The gate replacement improved safety and reliability while allowing for easier adjustment of the gates. The lock capacity was doubled while making operation of the lock more efficient (Completed in 2021).
5. IDNR/OWR survey crews surveyed the upper river and chain of lakes areas to update current storage and conveyance data. This data will be used in the ongoing upper river conveyance analysis as well as the updated operations hydraulic model. (Surveyed in 2021).
6. Development of a new operations model The IDNR contracted with USGS to develop a 2-Dimensional, unsteady HEC-RAS model. The new model will allow for more detailed water surface information, including direct rainfall onto the river and lakes, and water surface impacts due to wind.

IMPROVEMENTS UNDER DEVELOPMENT

1. Evaluation of conveyance in the upper river – IDNR is performing a study on the conveyance of water in the upper river to Stratton Dam. The study evaluates the benefits of dredging the Upper River on increasing outflows early in a storm to reduce flood impacts in the Chain of Lakes. Completion of this study is expected in 2025.
2. Collection of boat-ground impacts – IDNR is collecting data via an online survey from boaters to identify where boats had ground impacts. This is to help identify shallow areas for boaters’ safety, potential dredging needs and potential restrictive flow area in the Upper River section.

IMPROVEMENTS TO BE COMPLETED IN THE FUTURE

1. Expand the new operational model from Stratton Dam to Algonquin Dam utilizing newly acquired channel bathymetry and modeled using 1-dimensional cross sections. This will allow IDNR to better access impacts downstream during operations.
2. Continue measuring outflows from torque tube gates under various conditions to improve the accuracy of the operations model outflows.
3. Collection of flood impact data – IDNR is collected data via an online survey from property owners that experience flood impacts. This will be used to verify reports we receive and to calibration our economic impact assessment.
4. Economic Impact Assessment - The assessment of flood damages to residential and commercial structures, as well as an assessment of recreational use which is impacted due to boating restrictions, will help to measure the positive and negative effects of the present operating plan.
5. Operational Plan Revisions - With improved data collection, improved models, a better understanding of the positive and negative impacts of the present operating plan, we can look to the development of a modified operating plan. Specific modifications that have been requested include more proactive use of the gates, evaluation of boating restrictions, and investigation of adjustments to boundary constraints (flood prone structures, river capacity, etc.)

REFERENCES

Department of Public Works and Buildings, Division of Waterways, 1938. Twenty-First Annual Report of the Division of Waterways, July 1, 1937 to June 30, 1938.

Department of Transportation, Division of Water Resources, 1976. Fox River Dams Study Report, 102 pp.

Domanski, M.; Marian, 2016. Development and Evaluation of a Reservoir Model for the Chain of Lakes in Illinois, Illinois, United States Geological Survey, Scientific Investigation Report 2016-5155.

Fisk, Gregory G., 1988. Discharge Ratings for Control Structures at Stratton Dam on the Fox River, Illinois; U.S. Geological Survey Water Resources Investigations Report 87-4226, 24 pp.

Healy, R.W., 1979. River Mileages and Drainage Areas for Illinois Streams - Volume 2, Illinois River Basin, U.S. Geological Survey, Water Resources Investigation 79-111, 302pp.

Angel, James R. and Momcilo Markus, 2020. Precipitation Frequency Study for Illinois, Illinois State Water Survey, Bulletin 75, 24pp.

Knapp, H. Vernon, 1999. Fox River Basin Streamflow Assessment Model: 1999 Update to Hydrologic Analysis, Illinois State Water Survey Contract Report 649, 84 pp.

Knapp, H. Vernon and Terry W. Ortel, 1991. Hydrologic Modeling of the Fox River Watershed, Illinois State Water Survey, Contract Report 518, 89pp.

Knapp, H. Vernon and Terry W. Ortel, 1992. Effect of Stratton Dam Operation on Flood Control Along the Fox River and Fox Chain of Lakes, Illinois State Water Survey, Contract Report 533, 79pp.

Knapp, H. Vernon, 1998. Influence of Streamflow Forecasts and Hydrometeorological Conditions on Stratton Dam Operations, Illinois State Water Survey, Contract 635, 53pp

Kothandaraman, V., 1977. Fox Chain of Lakes Investigation and Water Quality Management Plan, Cooperative Resources Report 5, Illinois State Water Survey, Illinois State Geological Survey, 200pp.

Illinois State Water Plan Task Force, 1983. Instream Flow Protection: A Planning Standard for Illinois Streams, Special Report No. 6, 28 pp.

Metcalf and Eddy, Inc., 1980. Improvements for Flood Control and Boating, Fox Chain of Lakes and Fox River Lake, McHenry and Kane Counties Illinois, 121 pp.

Straub, T.; Johnson, G.; Hortness,J.; and Parker, J., 2009, Control-Structure Ratings on the Fox River at McHenry and Algonquin, Illinois, United States Geological Survey, Scientific Investigations Report 2009-5186, 61 pp.

U.S. Army Corps of Engineers, Chicago District, 1984. Interim Report Fox River and Tributaries Illinois, Draft Feasibility Report with Draft Environmental Impact Statement, 114 pp.

U.S. Army Corps of Engineers, Chicago District, 1984. Interim Report Fox River and Tributaries Illinois, Supporting Documentation Technical Volume B. Hydrology and Hydraulics.

U.S. Army Corps of Engineers, Chicago District, 1995. Fox River Illinois Stratton and Algonquin Dams, Section 205 Addendum to the October 1989 Detailed Project Report.

Westcott, Nancy and H. Vernon Knapp, 2006. Evaluation of the Accuracy of Radar-based Precipitation for Use in Flow Forecasting for the Fox Chain of Lakes, Illinois State Water Survey, Contract Report 2006-005, 22pp.

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