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SUMMARY OF REGULATIONS AND GUIDELINES
MISSISSIPPI RIVER HEADWATERS RESERVOIRS
U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT, ST. PAUL, MN

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Introduction: The guidelines, regulations and the general plan for operating the Mississippi River Headwaters reservoirs is contained, for the most part, in the 1963 (revised in 1968) Master Regulation Manual. However, various changes in the operation plans have occurred since the 1960's. As a result, this document is provided in an attempt to provide a summary of the current plan for use by parties interested in participating in the Mississippi River Headwaters Reservoir Operation Plan Evaluation (ROPE).

History, Headwaters Reservoirs: The U.S. Army Corps of Engineers Mississippi River Headwaters reservoirs consist of 6 sites as follows (see **Enclosure No. 1**):

i. Lake Winnibigoshish
ii. Leech Lake
iii. Pokegama Lake
iv. Big Sandy Lake
v. Cross Lake/Pine River Dam
vi. Gull Lake

General regulations governing the operation of the Mississippi Headwaters dams were first established by the War Department in 1889 and were formally modified in 1931, 1935, 1936, 1944 and 1988.

The area surrounding the Headwaters lakes was largely undeveloped (i.e. a wilderness) when the dams were first constructed in the late 1800's and early 1900's. Consequently, there were no serious objections to widely fluctuating lake elevations. During this period it was not uncommon to store all of the spring runoff, which often resulted in very high lake levels. The water would then be released all summer long to augment flows downstream (for navigation, mill power etc.), which in turn often resulted in low lake levels. As a result, the first official regulation from the Secretary of War governing the operation of the Headwaters Dams (dated 1889) did not contain any information on water levels. Water levels could fluctuate from the bottom of the dam's gates (commonly called the "sill") to a point lower than the acquired flowage rights elevation (see **Table 1**) while ensuring the safety of the dam.

During and after the first third of the 1900's, as recreation and the number of homes on the reservoirs increased and agricultural and urban development downstream began to occur, local landowner interests became more important in governing reservoir regulation. For example, in 1929 and 1930 the Headwaters reservoirs were lowered in an effort to test their capabilities to increase flows below St. Paul, MN. Subsequent dry weather (low inflows) resulted in continued low water levels. Resort owners and local residents organized and demanded the establishment of minimum operating levels to provide them with more reliable conditions. As a result, on 11 February 1931, following a request from the Minnesota Lake Levels Association, the Secretary of War revoked the 1889 regulations and issued the 1931 order. The new order included both high and low

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reservoir operating limits (the lower limits were no longer the sills at each dam), minimum outflows, and minimum summer flows at St. Paul and other rules. Additional regulations were issued in 1935, 1936, 1944 and 1988 as additional issues surfaced. 2.2.1.1

A copy of the United States law, which incorporates all the changes made through the 1944 order, can be found in the Code of Federal Regulations, Title 33, Section 207.340 while the 1988 addition can be found in Public Law 100-676, Section 21 of the Water Resources Development Act of 1988. The reservoirs are also regulated according to regulations approved by higher authority (Chief of Engineers) and guidelines from the Minnesota Department of Natural Resources. Tribal Trust is considered at all times.

The various regulations and guidelines governing the regulation of the Headwaters reservoirs are summarized below as well as in **Tables 1, 2 and 3**. The aforementioned 1963 Water Control Plan for each reservoir can be found at: http://www.mvp.usace.army.mil/finder/display.asp?pageid=143. Under each of the Lake Group links on the web site click on "Current Operating Plan". Links to this website are provided throughout this document for readers who are interested in more detail on particular subjects.

Water Control Plan Summary

1.0 Normal Summer Range/Band. The Summer Band represents the range of water levels that are the most beneficial to a majority of the users during the summer months. The summer bands resulted from an investigation of desirable summer water levels through public consultation in the late 1920's or early 1930's. The Summer Band at Lake Winnibigoshish was lowered one foot in 1975. The Summer Band at Pokegama Lake was lowered 0.25 foot in 1952. The band widths are: 0.5 foot on Winnibigoshish, Pokegama, Sandy and Cross, 0.4 foot on Leech, and 0.25 foot on Gull. Some documents list the "Normal Summer Band" as the "*Desirable Summer Range/Band*". See **Table No. 1, Row 1 and Table 2** for additional information on the summer bands. 2.2.1.1

2.0 Ordinary Operating Limits. These limits were adopted through public consultation in the 1930's and 1940's (see **Table 1, Row 2 and Table 2**). In general, the limits range from the normal winter drawdown level (see **Paragraph 7.2.**) to the elevation above which erosion begins to accelerate in a particular reservoir. They are meant to be a range of elevations residents might expect to experience in an "ordinary" annual cycle. In actual practice, the lower elevations are reached in most years as part of the winter drawdown, however; depending on the reservoir, the upper limits are reached less frequently. At Leech a normal drawdown elevation of 1293.80 feet has been found to be adequate as opposed to the listed value of 1293.20 feet. The limits are a narrower range contained within the Present/Total Operating Limits (see **Table 1, Row 3**). 2.2.1.1

3.0 Present/Total Operating Limits. These limits represent the absolute upper and lower limits within which the Corps is allowed to operate the reservoirs (see **Table 1, Row 3 and Table 2**). The Total Operating Limits originated from regulations issued by the Secretary of War between 1931 and 1944 and are listed in the Code of Federal

Regulations, Title 33, Section 207.340 (the lower limits are listed in the 1935 regulation order). These regulations narrowed the original informal limits that had been used before and after the 1889 regulation. However, the upper limits at Pokegama, Sandy and Cross Lake were modified in later years. Pokegama and Sandy's upper limits were raised in the 1950's following the adoption of the spring and summer Aitkin Flood Control Guide curves (see **Paragraph 7.1.**) to permit more storage for downstream flood control. Cross's upper limit was raised in 2001 following the completion of the dam safety rehabilitation which raised the dam 4 feet. The lower limits represent the maximum winter drawdown levels, which can be utilized if the snowpack indicates that a drawdown to the normal "ordinary" levels (see **Paragraph 2 and 7.2.**) will not be adequate.

4.0 Federal Average Annual Flow/Minimum Flow. The aforementioned regulations issued between 1931 and 1944 (see **Paragraph 3**) also contain required average annual flows from the reservoirs, which are related to the minimum Total Operating Limit (see **Table 1, Rows 3 and 4**). The regulation states: 2.2.1.1

"....the average annual discharge from the respective reservoirs shall not be reduced below the following values..." [which are listed in **Table 1, Row 4**]

"No discharge other than the minimum specified.....shall be permitted when a reservoir is at or below its minimum stage ...[which are also listed in **Table 1, Row 4**]....*except such increase of discharge as may specifically be directed by the Chief of Engineers"*

In summary:

a. The specified average annual discharge must be released every year.

b. When the reservoirs are below the lower Total Operating Limit elevation, no discharge larger than the annual average value is allowed unless directed by the Chief of Engineers.

This information is listed in the Code of Federal Regulations, Title 33, Section 207.340. Note that there are cases where this regulation will conflict with the Minnesota Department of Natural Resources low-flow guidelines (see **Table 1, Row 6** and **Paragraph 6** below). The Water Control Plans containing this requirement can be found at http://www.mvp.usace.army.mil/finder/display.asp?pageid=143 under the Lake Group links. See **Table No. 2** for additional information on the Federal Average Annual flow requirements.

5.0 Congressional Notification Levels. In 1988, Minnesota Governor Rudy Perpich asked the Corps of Engineers to make supplemental releases from the Headwaters reservoirs to meet downstream water use requirements. When rainfall returned to the region in early August of 1988, the Corps denied the request. Congressman Oberstar however, determined that some Congressional oversight was needed related to the use of the water contained within the reservoirs for the benefit of upstream and downstream uses. As a result, the Congressman sponsored Section 21 of Public Law 100-676 (Water

Resources Development Act of 1988). The law states that the Secretary of the Army must notify Congress 14 days in advance of any reservoir going outside the prescribed minimum and maximum operating limits (see **Table 1, Row 5**). See **Table No. 2** for additional information on the Congressional Notification Limits.

6.0 Low-Flow Guidelines, Minnesota Dept. of Natural Resources. After taking measures to insure that the average annual federal discharge/volume/minimum flow requirement can be satisfied (see **Paragraph 4** above), the Minnesota Department of Natural Resources (MDNR) guidelines are followed (see **Table 1, Row 6**). The MDNR guidelines suggest minimum flow values if a reservoir is at or above the lower federal elevations limits listed in **Table 1, Row 3**. Furthermore, if a reservoir is below the lower limit, the minimum discharge is reduced by half. However, during an extreme dry period, over the span of many months or years, the MDNR guidelines could conflict with the federal average annual discharge requirement. The federal regulations are primary. See **Table No. 2** for additional information on the MDNR low-flow guidelines. 2.2.1.1

7.0 Operation for Flood Control. The following are issues related to the regulation of the Headwaters reservoirs for flood control and during periods of high water.

7.1. Winnibigoshish, Leech, Pokegama; Sandy: Aitkin Flood Control. Winnibigoshish, Leech, Pokegama and Sandy reservoirs are regulated for flood control at Aitkin, MN. Pokegama and Sandy are operated according to Spring and Summer Flood Control Guide Curves for Aitkin, MN (see **Enclosures 2 and 3**). However, this flood control operation is accomplished with the assistance of Winnibigoshish and Leech (where the largest amount of storage resides). Winnibigoshish and Leech also store water to assist Pokegama in accomplishing its final winter drawdown. All six of the reservoirs are regulated, if necessary, for other downstream flood-prone areas. Pokegama's curves are identical to the curves published in the Sandy Water Control manual.

The aforementioned Pokegama/Sandy/Aitkin Flood Control Guide Curves were developed from an analysis of 14 historic flood events at Aitkin when the river exceeded a 17-foot stage. The analysis, therefore, is based on a certain amount of hindsight. Actual operations in any particular year may result in the use of more or less reservoir storage than indicated by the curve to effect stage reductions at Aitkin. However, the curves are followed as closely as possible. The relationship is also affected by the areal distribution and time-volume relationships of individual floods. The curves show the relation between maximum reservoir elevations and the corresponding peak flood stage at Aitkin, which will result, on the average, in the minimum total flood damages to affected interests in the three principle damage areas.

7.1.2. Cross Lake/Pine, Flood Control: The 1963 (rev. 1968) Cross Lake/Pine Water Control Plan states: *"The situation at stations on the Mississippi River from Fort Ripley to the Twin Cities shall be considered in determining the outflow. If protection from flooding is needed at any of these stations, the inflows shall be stored as necessary until [the] maximum operation limit..... is reached."*

7.1.3. **Gull, Flood Control:** The 1963 (rev. 1968) Gull Lake Water Control Plan states: *"If it is necessary to store inflows for downstream protection, allow pool to rise to maximum and ordinary operating limit, elev. 1194.75 ft."*

7.2. **Winter Drawdown:** The reservoir water levels are lowered every winter to create room for flood control storage in the spring. The drawdown begins in the fall (Sept. or early Oct.) and concludes prior to the spring breakup. The drawdown is targeted for completion by February 28 with the exception of Winnibigoshish, Leech and Pokegama. The drawdown of Winnibigoshish and Leech is targeted for February 15 to allow time for reducing the outflows from the two dams in time to allow the final drawdown at Pokegama. The drawdown elevations are "targets". The actual drawdown elevation in any given year is adjusted as the extent of the snowpack reveals itself over the course of a winter. The final drawdown elevation can be higher, or in some cases lower, than the "normal" drawdown target (see below). 2.2.1.1

i. **Nomal Drawdown ("normal snowpack"):** A normal snowpack constitutes approximately 3 to 6 inches of snow water content. The normal drawdown target elevations are the lower elevations of the Ordinary Operating Limits as listed in **Table 1, Row 2 and Table 3.** The exception is Leech where a normal drawdown elevation of 1293.80 feet has been found to be adequate as opposed to the listed value of 1293.20 feet. In the case of Pokegama, Sandy and Gull, the normal drawdown elevation is also the lower Total Operating Limit (see **Table 1, Row 3 and Table 3**). See also **Paragraph 2 and Table 2, Row 2.**

If, during the drawdown of Pokegama, the elevation at the Days High Landing gage approaches 1271.5 feet, before Pokegama Lake reaches its desired drawdown level, the discharge is reduced to maintain 1271.5 feet at the gage. This prevents the lowering of lakes and wetlands in the White Oak Lake area.

ii. **Extreme Drawdown (high snow water content):** If the water content of the snow is higher than normal, Winnibigoshish, Leech and Cross Lake can be drawdown to the lower Total Operating Limit (see **Table 1, Row 3 and Table 3**). See also **Paragraph 3** and **Table 2, Row 3.**

7.5. **Outflow Restrictions.** See also **Paragraph 11** for rate-of-release guidelines some of which that apply to all operating conditions (wet and dry).

7.5.1. **Winni/Leech Outflow Restriction:** The Corps has an informal agreement with local landowners and the MDNR that states we will limit the combined discharge from Winnibigoshish and Leech to 2,200 cfs to alleviate flooding problems along the river reaches upstream of Pokegama. Property damage can occur along the Mississippi River as well on adjoining lakes/flowages like Little Winnibigoshish Lake, Ball Club Lake, White Oak Lake and Mud/Goose Lake. Water can sometimes back up to the city limits of Deer River, MN. The 2,200 cfs guideline is not in the official 1963 (rev. 1968) Master Water Control Manual (it was adopted later).

7.5.2. **Sandy Outflow Restriction:** Sandy's flood control operation is hampered by the backwater effect of the Mississippi River up into the Sandy River. During flood periods, the Sandy River below Sandy Dam, due to backwater from the Mississippi, can rise to a level that equals (or exceeds) the lake level. This reduces the amount of water that be released from the dam (to zero in many years) which results in very high lakes levels (often exceeding the flowage rights elevation). As a flood is receding, an increase in the discharge from Pokegama (to evacuate stored water) is delayed so as not to prolong the recession of the Mississippi River levels in the Sandy area to aid in the lowering of Sandy's lake level.

7.5.3. **Maximum Outflow Guideline, Minnesota Dept. of Natural Resources.** The District also has an informal agreement with the MDNR regarding maximum releases from the dams in relation to pool levels. Information on these guidelines can be found at http://www.mvp.usace.army.mil/finder/display.asp?pageid=143 under each of the Lake Group links (click on "Current Operating Plan under each link") with the exception of Pokegama which does not have a guideline. See **Table 2, Row 10.**

7.6. **Inundation of Knutson Dam.** Cass Lake, above Knutson Dam, can be inundated by water levels behind Winnibigoshish Dam. The Corps owns flowage rights on the Cass Lake chain of lakes. See **Paragraph 9.**

8.0 Operation for Fish Spawning, Minnesota Dept. of Natural Resources. Lake Winnibigoshish and Cross Lake/Pine are operated for fish spawning according to Minnesota Department of Natural Resources guidelines as follows:

8.1. **Winnibigoshish, Fish Spawning, MDNR:** This guideline represents an informal agreement with the Minnesota Department of Natural Resources. When runoff conditions in the spring permit, Winnibigoshish reservoir is regulated to enhance walleye spawning. A difference in the water level between Lake Winnibigoshish and Little Cut Foot Sioux Lake creates a current, which induces a spawning run into Little Cutfoot. The target is a reservoir level of between elevation 1297.44 and 1297.75 feet by approximately April 25. An elevation of 1297.75 feet during the period 18 to 25 April is optimal as it coincides with the top of the walleye egg-stripping boards that are placed at the inlet to Little Cut Foot Sioux bay by the Minnesota Department of Natural Resources. Between 25 April and the first day of the fishing season (approx. mid- May) the lake is gradually raised to the Normal Summer Band (1297.94 to 1298.44 ft.). Spring runoff conditions do not allow this plan to be implemented every year. This guideline was adopted after 1963 (rev. 1968) Master Water Control Manual was published. See **Table 2, Row 8.**

8.2. **Cross Lake/Pine, Fish Spawning, MDNR:** This guideline represents an informal agreement with the Minnesota Department of Natural Resources. In past years (prior to 2002), the beginning of Cross Lake's drawdown has been delayed as late as December 15. The start of the drawdown was delayed in the fall, relative to the other Headwaters reservoirs, to promote whitefish spawning. The whitefish are dependant on cool water temperatures, as well as an adequate depth of water, for successful spawning.

The MDNR has recently recommended a change. Beginning in the fall of 2003, the drawdown will start on or about October 1st. The process is currently being evaluated to determine whether or not the earlier start to the drawdown might be better overall. See **Table 2, Row 8.**

9.0 Reservoir Flowage Rights. The values listed in **Table 1, Row 9** are for general use only. In many cases, an exact elevation cannot be assigned to the flowage rights as rights were obtained on: entire forty acre parcels; by condemnation of entire strips of land; and by other means. In some cases, the records are simply not clear on the subject or subsequent erosion has created problems. Flowage rights for the Cass Lake chain of lakes (upstream of Knutson Dam) are approximately 1 foot above the flowage rights on Winnibigoshish. Lake Winnibigoshish inundates Knutson Dam when the reservoir exceeds approximately elevation 1301.5 feet. The Corps also has flowage rights between Winnibigoshish/Leech and Pokegama as well as in other areas of the Headwaters.

10.0 Channel Capacity. The values listed in **Table 1, Row 10** are the approximate non-damaging discharge in the river reach below the dam. These values can vary greatly depending the situation during a particular flood due to backwater effects, floating bog, weed growth, ice conditions and other factors. See also **Paragraph 7.5.**

11.0 Rate-of-Release Guidelines, Minnesota Dept. of Natural Resources: The District has its own guidelines as well as agreements with the Minnesota Department of Natural Resources (MDNR) regarding rate-of-release changes. See also **Paragraph 7.5.**

i. Routine Rate-of-Release Rule: This regulation can be found in the 1963 (rev. 1968) Master Water Control Manual. It states: "Reductions or increases in discharge from [the] reservoirs are restricted insofar as practicable to changes in stage of not more the 6 inches per day in the discharge channels." See **Table 4.**

ii. Low-Flow Rate-of-Release Rule: In addition, the District is a formal signatory to the Mississippi River Low-Flow Management Plan which indicates no more that a 10 percent change in outflow at Winnibigoshish and Pokegama in any 2 hour period when the USGS gage at Grand Rapids reports an average daily flow of 400 cfs or less. See **Table 4.**

In all cases, a large percent increase or decrease in the total magnitude of the flow is not advisable (e.g. going from 300 to 100 cfs or 2,000 to 1,000 cfs in one gate move). The District's Environmental Section is consulted when changes are being made during critical flow periods particularly during low-flow conditions. Two or three gate changes per day are often necessary during critical flow periods to alleviate stress to fish and wildlife resources.

Table 1
Mississippi River Headwater Reservoir System
Operating Elevations in 1929 NGVD and Stages in Feet

	Winni-bigoshish	Leech	Pokegama	Sandy	Cross L. Pine R.	Gull
1. Normal Summer Range/Band Stage in Feet Middle of the Summer Band Elev.	1297.94-1298.44 9.0 - 9.5 1298.19	1294.50-1294.90 1.8 - 2.2 1294.70	1273.17-1273.67 8.75 - 9.25 1273.42	1216.06-1216.56 8.75 - 9.25 1216.31	1229.07-1229.57 12.75 - 13.25 1229.32	1193.75-1194.00 6.0 - 6.25 1193.87
2. Ordinary Operating Limits Stage in Feet	1296.94-1300.94 8.0 - 12.0	1293.20-1295.70 0.5 - 3.0	1270.42-1274.42 6.0 - 10.0	1214.31-1218.31 7.0 - 11.0	1227.32-1230.32 11.0 - 14.0	1192.75-1194.75 5.0 - 7.0
3. Present/Total Operating Limit Stage in Feet (2002)	1294.94-1303.14 6.0 - 14.2	1292.70-1297.94 0.0 - 5.24	1270.42-1278.42 6.0 - 14.0	1214.31-1221.31 7.0 - 14.0	1225.32-1235.30 9.0 - 18.98	1192.75-1194.75 5.0 - 7.0
4. Federal Regulations, Title 33, Min. Level and Ave. Annual Flow	1294.94 / 6.0 150 cfs	1292.70 / 0.0 70 cfs	1270.42 / 6.0 200 cfs	1214.31 / 7.0 80 cfs	1225.32 / 9.0 90 cfs	1192.75 / 5.0 30 cfs
5. Cong. Notification Levels, Public Law 100-676, Sect. 21, WRDA 88	1296.94/1303.14 8.0 / 14.2	1293.20/1297.94 0.5 / 5.24	1270.42/1276.42 6.0 / 12.0	1214.31/1218.31 7.0 / 11.0	1227.32/1234.82 11.0 / 18.5	1192.75/1194.75 5.0 / 7.0
6. MN Dept. of Natural Resources Minimum Flow Guidelines Min. Release Elevation, Stage and Minimum Flow	≥ 1294.94 / 6.0 100 cfs, < 1294.94 50 cfs	≥ 1292.70 / 0.0 100 cfs, < 1292.70 50 cfs	(See Note No. 6.) 200	≥ 1214.31 / 7.0 20 cfs, < 1214.31 10 cfs	≥ 1225.32 / 9.0 30 cfs, < 1225.32 15 cfs	≥ 1192.75 / 5.0 20 cfs, < 1192.75 10 cfs
7. Flood Operation, Control Points	Aitkin/Pokegama	Aitkin/Pokegama	Aitkin/Sandy	Aitkin	Ft. Ripley etc.	As Needed
8. Fish Spawn, Operation Guidelines	Fish Spawn	———	———	———	Fish Spawn	———
9. Flowage Rights Acquired To Elev.: Stage in Feet	1306.86 17.92 +	1301.94 9.24 +	1280.42 16 +	1222.31 15 +	1238.82 22.5 +	1194.75 7
10. Est. Downstream Chan. Cap., cfs	2,000	1,500	6,000	(8.)	2,000-2,500	950
Gage Zero Elev., 1929 NGVD	1288.94	1292.70	1264.42	1207.31	1216.32	1187.75

1. The most desirable levels for the summer season.
2. The Ordinary Operating Limits represent the range that minimizes the degree of high and low water damages. The lower limit is the normal drawdown target level for high snow water content, the exception being Leech which uses 1293.80.
3. The Present Operating Limits are in accordance with the latest regulations from Congress or subsequent studies. The upper and lower limits provide maximum storage for flood control and other purposes.
4. Title 33, Code of Federal Regulations, Sect. 207.340(d) prescribes the min. operating limits and min. ave. annual discharges as set forth in the 1936 and (for Leech) 1944 regulations.
5. Public Law 100-676, Section 21; of the Water Resources Development Act of 1988 requires the Secretary of the Army to notify Congress 14 days prior to a reservoir being below the minimum or above the maximum listed here. The District will notify the Secretary well in advance of the 14-day period.
6. The MDNR elev. and flows are based on an informal agreement between the Corps and the MN Dept. of Natural Resources and are followed after taking measures to insure the federal ave. annual flow requirement is met. When Pokegama is below elev. 1273.17 ft., releases are limited to the sum of the Winni. And Leech discharges. In addition, 200 cfs has been adopted as the minimum discharge when Pokegama is at or above elev. 1273.17 ft.
7. Flowage rights on the Cass L. Chain obtained to elev. 1307.86 (18.92 ft. stage).
8. The channel below Sandy Lake is affected by backwater from the Miss. River. The channel capacity below the confluence of the Miss. River and the Leech Lake River is 2,200 cfs. High flows in the 2,000 to 2,500 cfs range from Pine River Dam cause high water problems on Big Pine Lake.

Table 2
Mississippi River Headwater Reservoir System
Summary of Sources for Water Control Regulations and Guidelines (see also Table 1)

	Code of Federal Regulations or Laws	U.S. Army Corps Of Engineers 1963 Water Control Manual	Minn. Dept. of Natural Resources Guideline	Notes
1. Normal Summer Range/Band		✓		See Note No. 1 Below
2. Ordinary Operating Limits		✓		See Note No. 2 Below
3. Present/Total Operating Limit	✓	✓ Pokegama, Sandy and Pine upper limits raised by St. Paul District studies		See Note No. 3 Below
4. Federal Regulations, Title 33, Average Annual Flow/Minimum Flow	✓	✓		See Note No. 4 Below
5. Cong. Notification Levels, Public Law 100-676, Sect. 21, WRDA 88	✓			See Note No. 5 Below
6. MDNR Minimum Flow Guidelines Min. Release Elevation, Stage and Minimum Flow		✓	✓ All 6 Reservoirs	See Note No. 6 Below
7. Flood Control		✓		See Note No. 7 Below
8. Guidelines For Fish Spawning			✓ At Winnibigoshish and CrossLake/Pine only	See Note No. 8 Below
9. Dam Rate-of-Release Guidelines for Gate Movements			✓ At Winni, Leech Pokegama and Cross Lake/Pine	See Note No. 9 Below
10. MDNR Max. Outflow Guideline		✓	✓	With the exception of Pokegama, See Note No. 10

1. The normal summer bands are published in the 1963 (rev. 1968) Headwaters Dams and Reservoirs, Master Regulation Manual. The Master Manual was authorized by the Chief of Engineers. See Paragraph 1.
2. The Ordinary Operating Limits and drawdown guidelines are published in the 1963 (rev. 1968) Headwaters Dams and Reservoirs, Master Reg. Manual. The Master Manual was authorized by the Chief of Engineers. See Para. 2.
3. The Present Operating Limits are in accordance with regulations from the Secretary of War and subsequent studies. The lower limits are listed in Title 33, Code of Federal Regulations, Sect. 207.340(d.7.). The upper limits are in a letter from the Acting Secretary dated May 14, 1935. The upper limits at Pokegama, Sandy and Pine were raised 2 ft., 3 ft., and 0.48 ft. respectively following subsequent St. Paul District studies (and approved by higher authority). See Paragraph 3.
4. The minimum average annual flow requirements are listed in Title 33, Code of Federal Regulations, Section 207.340(d.2.). The values are also minimum flows when the reservoirs are at or below the lower limits. See Para. 4.
5. Public Law 100-676, Section 21, of the Water Resources Development Act of 1988 requires the Secretary of the Army to notify Congress 14 days prior to reservoir water levels reaching specified limits. See Paragraph 5.
6. The MDNR low-flow elev. and flows are based on an informal agreement between the Corps and the MDNR and are published in the 1963 (rev. 1968) Headwaters Dams and Reservoirs, Master Reg. Manual. See Paragraph 6.
7. Winnibigoshish, Leech, Pokegama and Sandy are operated for flood control at Aitkin, MN. See Paragraph 7.
8. Winnibigoshish and Cross Lake have fish spawning guidelines. See Paragraph 8.
9. See Paragraph 11 and Table 4. Sandy and Gull do not have MDNR rate-of-release guidelines.
10. See Paragraph 7.5.3. Pokegama does not have a MDNR maximum flow guideline. See also Paragraph 7.5.1.

Table 3
Mississippi River Headwater Reservoir System
Winter Drawdown Operating Elevations with a Comparison to Normal Levels, 1929 NGVD

	Winni-bigoshish	Leech	Pokegama	Sandy	Cross L. Pine R.	Gull
1. Normal Summer Range/Band Stage in Feet Middle of the Summer Band Elev.	1297.94-1298.44 9.0 - 9.5 1298.19	1294.50-1294.90 1.8 - 2.2 1294.70	1273.17-1273.67 8.75 - 9.25 1273.42	1216.06-1216.56 8.75 - 9.25 1216.31	1229.07-1229.57 12.75 - 13.25 1229.32	1193.75-1194.00 6.0 - 6.25 1193.87
2. Normal Drawdown Elevation Stage in Feet Distance Below Summer Level, Ft.	1296.94 8.0 1.25	1293.80 0.5 0.9	1270.42 6.0 3.0	1214.31 7.0 2.0	1227.32 11.0 2.0	1192.75 5.0 1.12
3. Maximum Drawdown Elevation Stage in Feet (2002) Distance Below Summer Level, Ft.	1294.94 6.0 3.25	1292.70 0.0 2.0	1270.42 6.0 See Above	1214.31 7.0 See Above	1225.32 9.0 4.0	1192.75 5.0 See Above
Gage Zero Elev., 1929 NGVD	1288.94	1292.70	1264.42	1207.31	1216.32	1187.75

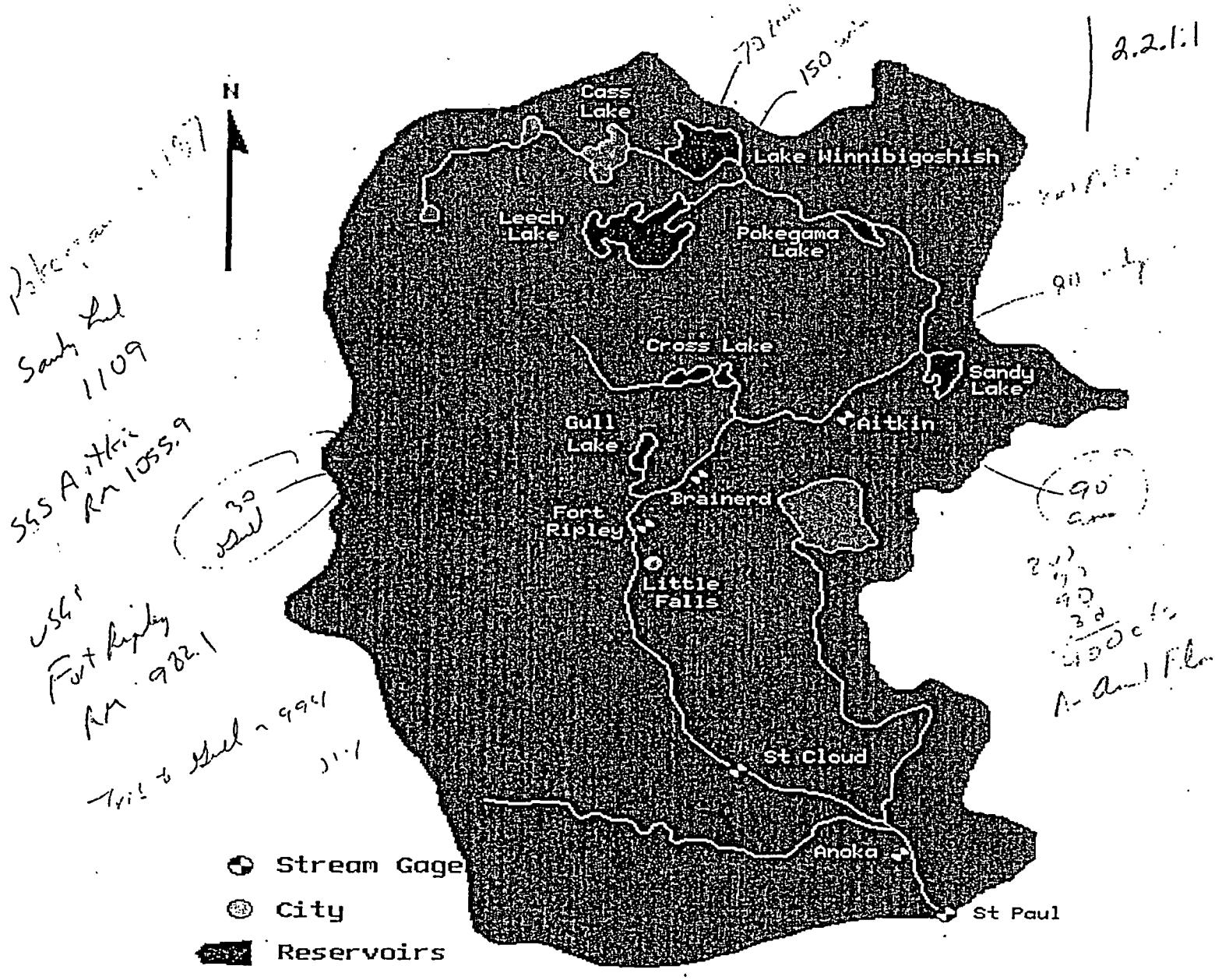
1. The most desirable levels for the summer season.
2. The normal drawdown elevation is for normal snow water content. Leech's "Normal Drawdown" by regulation is elevation 1293.20 ft. but elev. 1293.80 has been found to be adequate (see Table 1 and Paragraphs 2.0 and 7.2).
3. Pokegama, Sandy and Gull's normal drawdown elevations equal their maximum drawdown levels.

Table 4
Mississippi River Headwaters Dams
Minnesota Department of Natural Resources Guidelines for Rate of Release Changes, See Paragraph 11

Dam	Rate of Release Guideline
Winni-bigoshish	Reductions or increases in discharge are restricted insofar as practicable to changes in stage of not more the 6 inches per day in the discharge channel. No more that a 10% change in outflow in any 2 hr. period when the USGS gage at Grand Rapids reports an ave. daily flow of 400 cfs or less. No restriction when operating for walleye spawning.
Leech	Reductions or increases in discharge are restricted insofar as practicable to changes in stage of not more the 6 inches per day in the discharge channel.
Pokegama	Reductions or increases in discharge are restricted insofar as practicable to changes in stage of not more the 6 inches per day in the discharge channel. No more that a 10 % change in outflow in any 2 hour period when the USGS gage at Grand Rapids reports an average daily flow of 400 cfs or less.
Sandy	Reductions or increases in discharge are restricted insofar as practicable to changes in stage of not more the 6 inches per day in the discharge channel.
Pine/Cross Lake	Reductions or increases in discharge are restricted insofar as practicable to changes in stage of not more the 6 inches per day in the discharge channel.
Gull	Reductions or increases in discharge are restricted insofar as practicable to changes in stage of not more the 6 inches per day in the discharge channel.

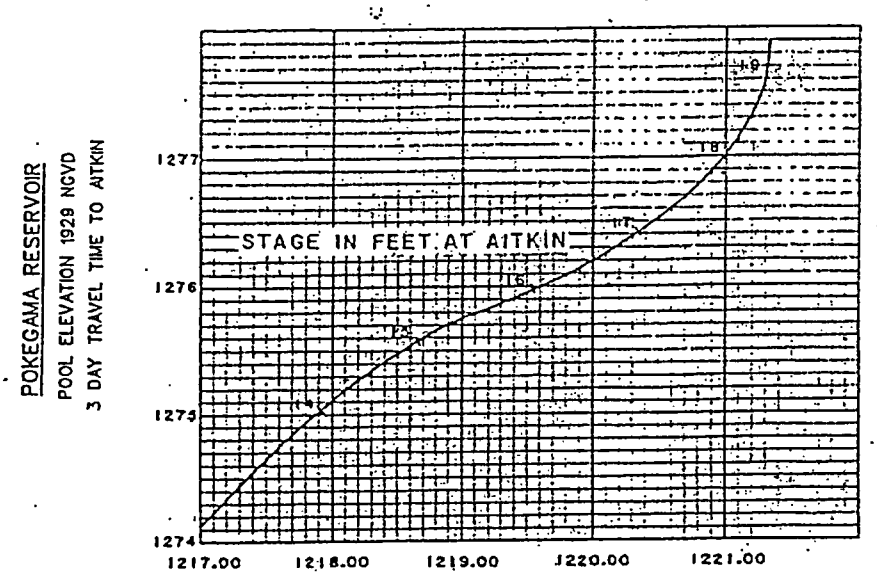
Note on Source: Miss. R. Headwaters, 1963 (rev. 1968) Master Water Control Manual. Not applicable when operating for flood control and/or to prevent property damage. During other times, reasonable judgment must be exercised. For example, a large percent increase or decrease in the magnitude of the flow is not advisable (e.g. going from 300 cfs to 100 cfs in one move). The District's Environmental Section should be consulted when changes are being made during critical flow periods particularly during low-flow conditions. Two or three gate changes per day may be necessary during critical flow periods to alleviate stress to fish and wildlife resources. For the 10 percent guideline at Winni and Pokeg see the Mississippi River Low-Flow Management Plan, dated September 1996.

Mississippi River Headwaters Watershed



Enclosure No. 1

GUIDE CURVE FOR SPRING FLOOD, APPROXIMATELY MARCH - 15 MAY



SANDY LAKE RESERVOIR
POOL ELEVATION 1929 NGVD
1 DAY TRAVEL TIME TO AITKIN

NOTES:

1. THE SPRING AND SUMMER GUIDE CURVES WERE DEVELOPED FROM AN ANALYSIS OF 14 FLOOD EVENTS AT AITKIN WHEN THE RIVER EXCEEDED A 17-FOOT STAGE. THE ANALYSIS, THEREFORE, IS BASED ON A CERTAIN AMOUNT OF HINDSIGHT. ACTUAL OPERATIONS IN ANY PARTICULAR YEAR MAY RESULT IN THE USE OF MORE OR LESS RESERVOIR STORAGE THAN INDICATED BY THE CURVE TO EFFECT STAGE REDUCTIONS AT AITKIN. THE CURVES SHOULD BE FOLLOWED AS CLOSELY AS POSSIBLE. THE RELATIONSHIP IS ALSO AFFECTED BY THE AREAL DISTRIBUTION AND TIME-VOLUME RELATIONSHIPS OF INDIVIDUAL FLOODS AS WELL AS THE ACCURACY OF FLOOD FORECASTS.

2. THE CURVE SHOWS THE RELATION BETWEEN MAXIMUM RESERVOIR ELEVATION AND CORRESPONDING PEAK FLOOD STAGE ON THE MISSISSIPPI RIVER AT AITKIN WHICH WILL RESULT (ON THE AVERAGE) IN THE MINIMUM TOTAL FLOOD DAMAGES TO AFFECTED INTERESTS IN THE THREE PRINCIPAL DAMAGE AREAS.

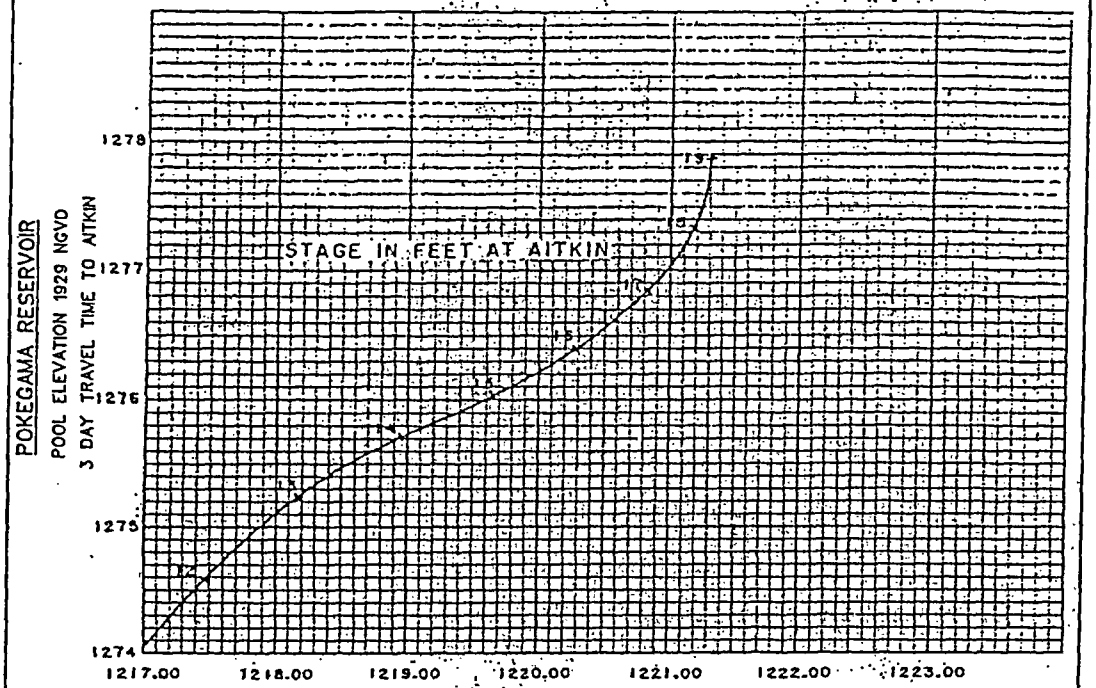
1 DAY TRAVEL TIME TO AITKIN FROM SANDY LAKE
3 DAY TRAVEL TIME TO AITKIN FROM POKEGAMA RESERVOIR

AITKIN GAGE ZERO - 1182.41
POKEGAMA GAGE ZERO - 1264.42
SANDY GAGE ZERO - 1207.31

MISSISSIPPI RIVER HEADWATERS
NAVIGATION AND FLOOD CONTROL PROJECT
RESERVOIR REGULATION MANUAL
APPENDIX 3, POKEGAMA LAKE
SANDY LAKE & POKEGAMA RESERVOIRS
GUIDE CURVE FOR SPRING FLOODS
APPROXIMATELY MARCH - 15 MAY
U.S. ARMY CORPS OF ENGINEERS
ST. PAUL ENGINEERING DISTRICT
ST. PAUL, MINNESOTA

Enclosure No. 2

GUIDE CURVE FOR SUMMER FLOOD, APPROXIMATELY 15 MAY - SEPTEMBER



SANDY LAKE RESERVOIR
POOL ELEVATION 1929 NGVD
1 DAY TRAVEL TIME TO AITKIN

NOTES:

1. THE SPRING AND SUMMER GUIDE CURVES WERE DEVELOPED FROM AN ANALYSIS OF 14 FLOOD EVENTS AT AITKIN WHEN THE RIVER EXCEEDED A 17-FOOT STAGE. THE ANALYSIS, THEREFORE, IS BASED ON A CERTAIN AMOUNT OF HINDSIGHT. ACTUAL OPERATIONS IN ANY PARTICULAR YEAR MAY RESULT IN THE USE OF MORE OR LESS RESERVOIR STORAGE THAN INDICATED BY THE CURVE TO EFFECT STAGE REDUCTIONS AT AITKIN. THE CURVES SHOULD BE FOLLOWED AS CLOSELY AS POSSIBLE. THE RELATIONSHIP IS ALSO AFFECTED BY THE AREAL DISTRIBUTION AND TIME-VOLUME RELATIONSHIPS OF INDIVIDUAL FLOODS AS WELL AS THE ACCURACY OF FLOOD FORECASTS.

2. THE CURVE SHOWS THE RELATION BETWEEN MAXIMUM RESERVOIR ELEVATION AND CORRESPONDING PEAK FLOOD STAGE ON THE MISSISSIPPI RIVER AT AITKIN WHICH WILL RESULT (ON THE AVERAGE) IN THE MINIMUM TOTAL FLOOD DAMAGES TO AFFECTED INTERESTS IN THE THREE PRINCIPAL DAMAGE AREAS.

1 DAY TRAVEL TIME TO AITKIN FROM SANDY LAKE
3 DAY TRAVEL TIME TO AITKIN FROM POKEGAMA RESERVOIR

AITKIN GAGE ZERO - 1182.41
POKEGAMA GAGE ZERO - 1264.42
SANDY GAGE ZERO - 1207.31

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ST. PAUL ENGINEERING DISTRICT
ST. PAUL, MINNESOTA

Enclosure No. 3