August 28,1991

Memorandum to:

Dave Carnochan
Lands - Espanola District

RE: Regulation of water levels on Lake Manitou

1.0 Dam Structure

The Sandfield Dam, located in Sanfield Township (Lot 7, Concession 111) was built in 1960 by MGS to control water levels on Lake Manitou. The surface area of this lake is approximately 105 sq.km,(26,000 acres).

Elevations on the dam have been historically referenced by a local datum. Specific features of the dam and how they relate to the geodetic datum located on top of the spillway are outlined in Table 1 and shown on Figure 1.

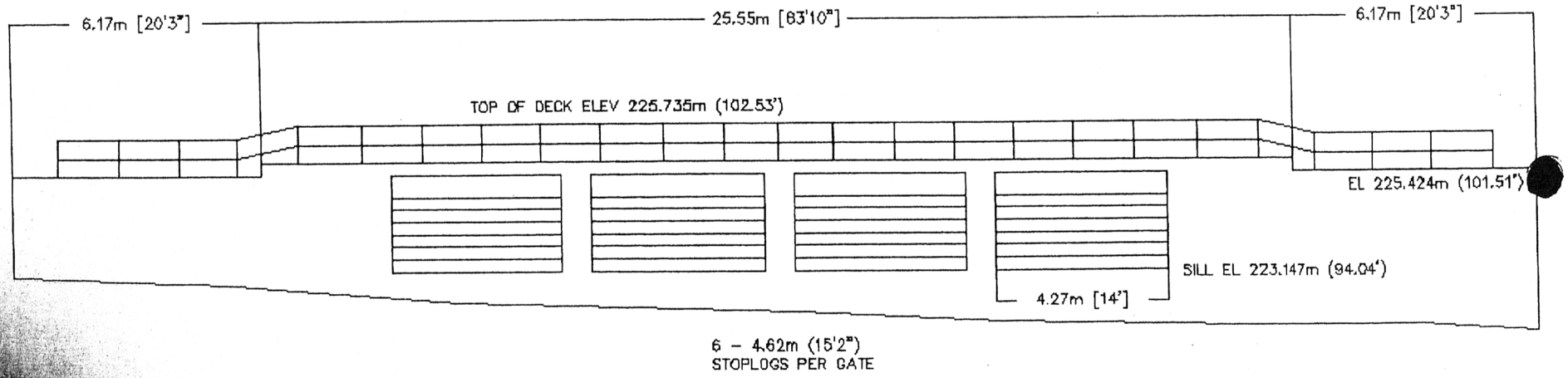
Table 1: Dam Features

	Local Datum (Ft)	Geodetic Datum (m)
Top of will	94.04	223.147
Top of Spillway	101.51	225.424
Top of Deck	102.53	225.735

The dam consists of ~~three (3)~~ four (4), fourteen (14) foot wide gates and two (2), wingwalls each 20.3 feet long. Each gate contains a total of six one foot deep logs. One gate utilizes a half log (six inches high) during the summer months.

The staff gauge is read in feet with the top of the gauge corresponding to approximately 101.0 feet.

Figure 1: Manitou Lake Dam
Profile View



2.0 Historic Water Levels

Historic targets for water levels in Lake Manitou are as follows:

- late fall to break-up - 98.5 feet
- maximum spring level - 99.5 feet (ie. by June 1)
- normal summer level - 99.0 feet (ie. by July 1)

Lake levels of 99.5 feet or greater combined with wind induced wave action will cause erosion problems around the lake. At a level of 99.7 feet, flooding will occur.

Historic water levels have generally been within the target levels previously outlined. Figure 2 details mean, minimum and maximum levels in each month of the year for the twelve (12) year period from 1974-1986.Data after 1986 is scarce.

Table 2 summarizes lake levels and stop log manipulations over this same period.

Table 2: Average water level and stop log settings 1974-1986

Month	Historic Mean Water Level(ft)	Historic Mean Total - Logs out
January-February	98.9 - 99.0	5 - 6
March-April (main run off)	99.0 - 99.3	7 - 8
May-June	99.3 - 99.4	2 - 3
July-August	99.0 - 99.2	1.5 - 2
September-October	98.8 - 98.9	2 - 2.5
November-December	98.7 - 98.9	4 - 5

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3.0 Flooding Problems in 1990

In 1990 the recorded water levels in Lake Manitou from July until November were significantly above the historical maximum levels (Figure 2).
These high levels apparently resulted from an attempt to hold back water to supplement flows in the Manitou River for fall spawning salmon.
This manipulation resulted in flooding and erosion problems around Lake Manitou. **It is recommended that the manipulation of stop logs on the lake return to its historical operation pattern.**

4.0 Guidelines

The guidelines outlined in Table 3 should be used to set stop logs and water levels on Lake Manitou. The rating curve along with historic maximum and minimum levels are displayed in Figure 3.

Table 3: Guidelines

Month	Target Water Level (ft.)	Approximate Total # of Logs Out
January-February	98.9	5-6
March	99.0	7-8
April	99.2	7-8
May-June	99.3	2-3
July	99.2	1.5-2
August	99.0	1.5-2
September	98.9	2-2.5
Oct.-Nov.-Dec.	98.8	4-5

FIGURE 2

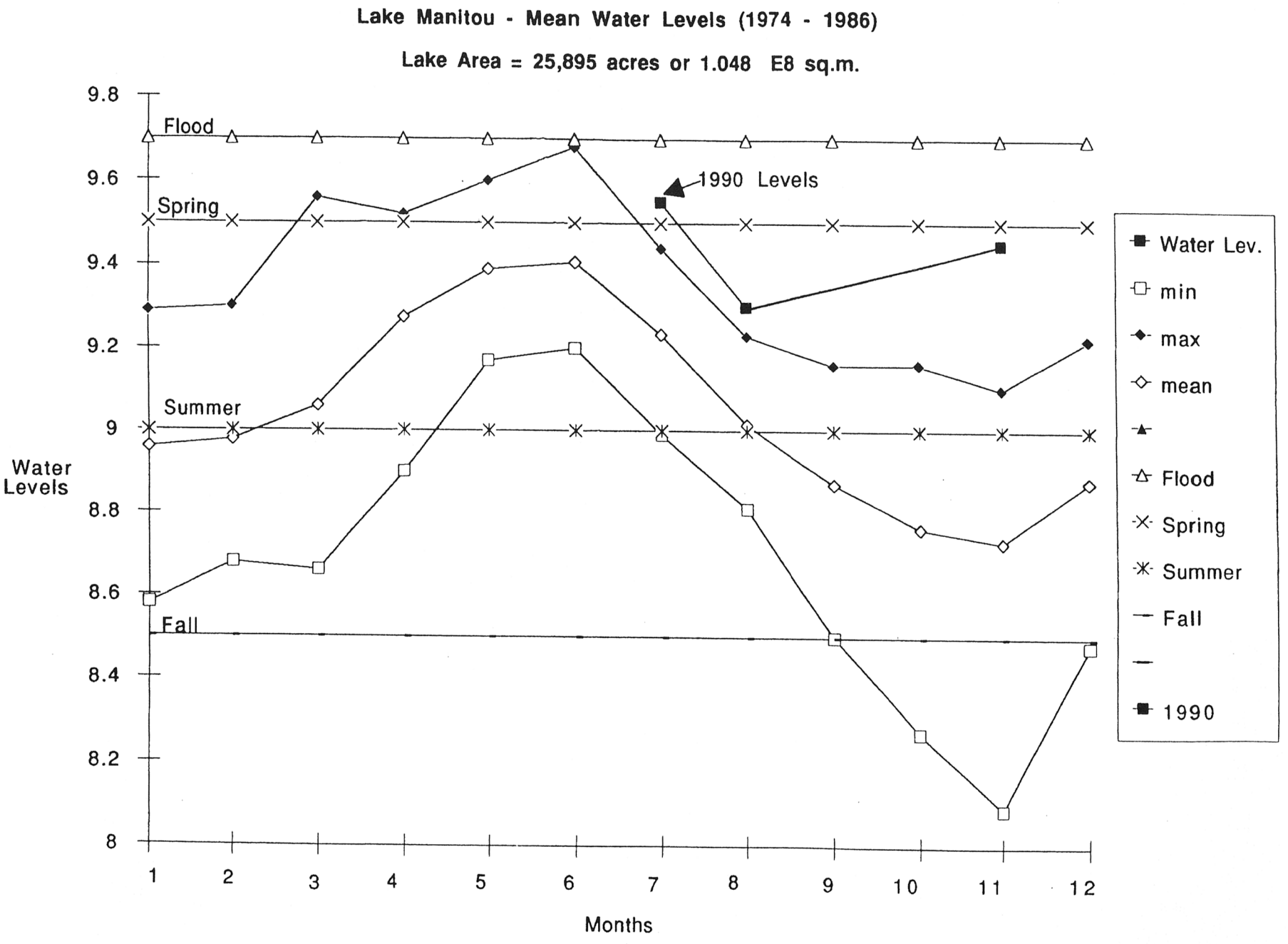

Lake Manitou - Mean Water Levels (1974 - 1986)
Lake Area = 25,895 acres or 1.048 E8 sq.m.
Water Levels
9.8
9.6
9.4
9.2
9
8.8
8.6
8.4
8.2
8
Flood
Spring
Summer
Fall
1990 Levels
1 2 3 4 5 6 7 8 9 10 11 12
Months
Water Lev.
min
max
mean
Flood
Spring
Summer
Fall
1990

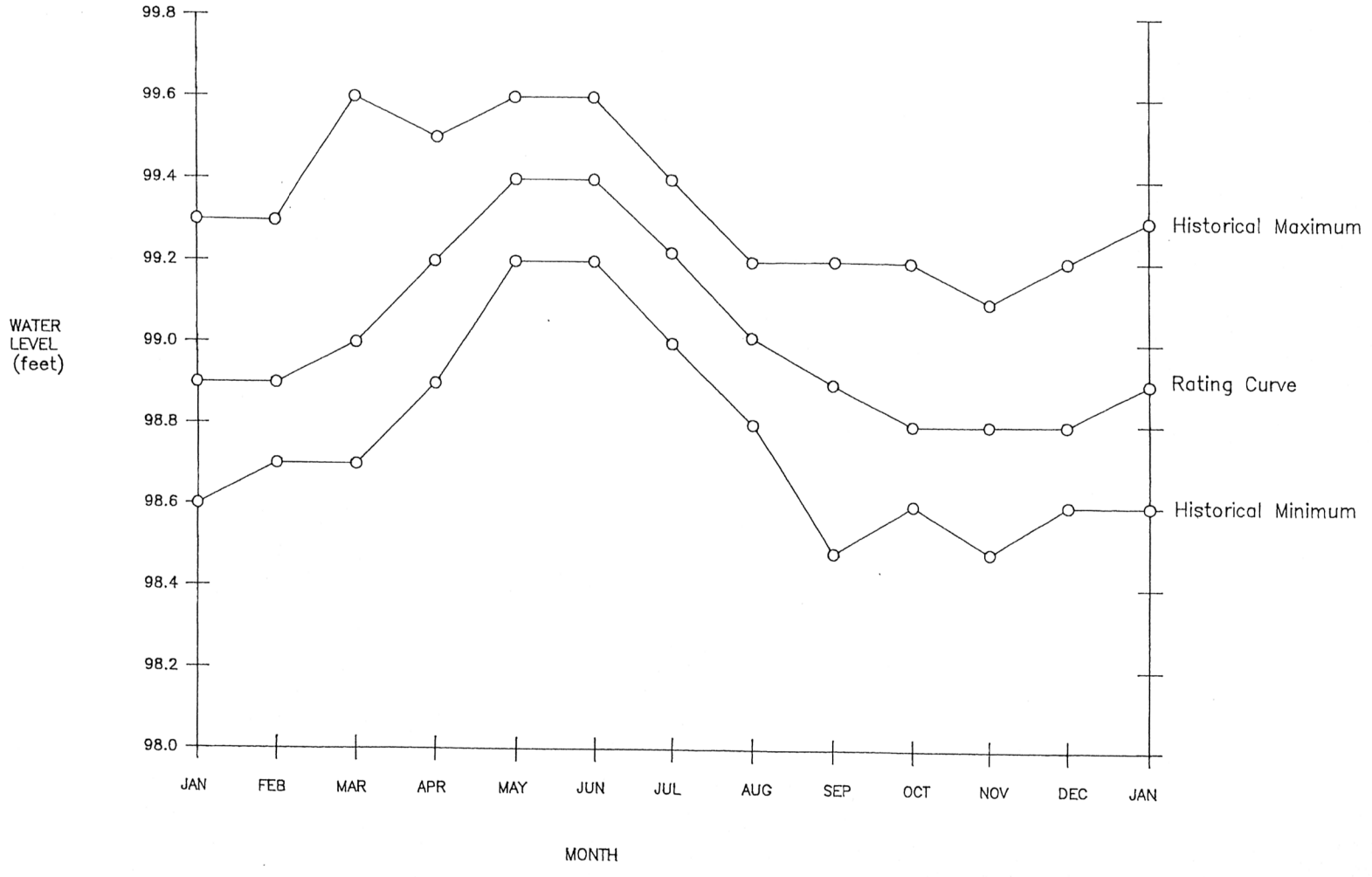
Figure 3

LAKE MANITOU RATING CURVE

Based on Historical Water Levels (1974 – 1986)

Lake Area = 25,895 acres or 105 sq.km.

Top of Spillway is 101.51 feet



Since Lake Manitou has a large surface area (ie. 105 sq.km), a significant volume of water is stored for each small increase in water level. For example, a 4 inch or 0.1 metre increase in lake level will increase storage by 10.5 million cubic metres of water. If we assume that the dam is operated with 2 logs out of each gate and 2 feet of flow over the opening it would take +/- 9 days to draw down this increase at an outflow rate of approximately 13.4 cms.

Table 4 outlines the same information for a 4 inch draw down at several log settings and a constant water level of 99.0 feet.

Table 4: Time to draw 4 inches on Lake Manitou

# Logs Out or Height of Water (each of 4 gates)	Total Out Flow (cms)	Time to Draw Down 4" (days)
0.5	1.7	71
1.0	4.7	26
1.5	8.7	14
2.0	13.4	9
2.5	18.7	6.5
3.0	24.6	4.9
3.5	42.6	2.9
4.0	50.3	2.4
4.5	58.9	2.1
5.0	67.9	1.8
5.5	77.4	1.6
6.0	87.2	1.4
6.5	97.5	1.2
7.0	108.2	1.1

Table 5 outlines the expected out flow from the dam at a variety of water levels and log settings.

Table 5

LAKE MANITOU

RATING CURVE DATA

GATES				WATER LEVELS (metres)							
1	2	3	4	101	100	99	98	97	96	95	94
LOGS OUT				TOTAL FLOW (cfs)							
0	0	0	0	168	0	0	0	0	0	0	0
0.5	0	0	0	209	14	0	0	0	0	0	0
0.5	1	0	0	295	56	0	0	0	0	0	0
0.5	1	1	0	387	98	0	0	0	0	0	0
0.5	1	1	1	476	140	0	0	0	0	0	0
1	0	0	0	257	42	0	0	0	0	0	0
1	1	0	0	346	84	0	0	0	0	0	0
1	1	1	0	435	126	0	0	0	0	0	0
1	1	1	1	524	168	0	0	0	0	0	0
2	1	1	1	635	257	42	0	0	0	0	0
2	2	1	1	746	346	84	0	0	0	0	0
2	2	2	1	857	435	126	0	0	0	0	0
2	2	2	2	968	524	168	0	0	0	0	0
3	2	2	2	1098	635	257	42	0	0	0	0
3	3	2	2	1228	746	346	84	0	0	0	0
3	3	3	2	1358	857	435	126	0	0	0	0
3	3	3	3	1488	968	524	168	0	0	0	0
4	3	3	3	1636	1098	635	257	42	0	0	0
4	4	3	3	1784	1228	746	346	84	0	0	0
4	4	4	3	1932	1358	857	435	126	0	0	0
4	4	4	4	2080	1488	968	524	168	0	0	0
5	4	4	4	2243	1636	1098	635	257	42	0	0
5	5	4	4	2406	1784	1228	746	346	84	0	0
5	5	5	4	2569	1932	1358	857	435	126	0	0
5	5	5	5	2732	2080	1488	968	524	168	0	0
6	5	5	5	2910	2243	1636	1098	635	257	42	0
6	6	5	5	3088	2406	1784	1228	746	346	84	0
6	6	6	5	3266	2569	1932	1358	857	435	126	0
6	6	6	6	3444	2732	2080	1488	968	524	168	0

5.0 Water supply for fall Spawning

The remaining problem is to supply supplemental water during the fall salmon spawn. The increased flows are required from September through until November to accommodate several spawning species. Keeping high levels of water in the lake results in erosion problems during the late summer and fall. On average significant inputs of rainfall do not occur until November so it will be difficult to maintain a high lake level and matching high outflow during the drier months of September and October.

By keeping the lake level higher in the summer to allow for this flow (ie +/- 99.0 through until November) there may be a problem with getting water out of the lake over winter due to downstream constrictions and ice bridging effects.

Should the District wish to pursue the development of the storage alternative to supply increased fall flows our engineering staff could do further studies to determine if it is a workable solution.

I trust that the above information is useful. Please call with any questions.

David Holla.

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Enclosure