UDC 556.552/.555

Saiko High Water: A preliminary report

西湖増水調査速報

S. HERATH*, Kimiro MEGURO*, Taikan OKI** and Kazuhiko MIURA**

ヘーラト スリカーンタ・目 黒 公 郎・沖 大 幹・三 浦 一 彦

1. Introduction

Recent water rise in the Saiko lake has drawn a great deal of public attention. The water levels have been gradually rising over a period of three months and by October, about 80 buildings were flooded and a good part of the ring road around lake was under the water. Water related disasters are generally associated with a short time scale, such as with floods, typhoons, landslides etc,. What has caught the public attention with the Saiko lake was the long period over which the water was rising, and the helplessness against this gradual rise. A four member team from INCEDE and Musiake laboratory visited the Saiko, Kawaguchi lakes area, and this communication reports the background of the phenomena and the initial impressions.

2. Overview

2.1 Physical Characteristics

Lake Saiko is one of the five lakes round Mt. Fuji formed by volcanic activities. The details of the lakes are given in the table 1. Fig. 1 shows the layout of 4 of these lakes. Due to the volcanic origins, there are no natural outlets from these lakes. Rainfall falling on the surrounding catchments are transported by natural rivers and ground water movement in to them, and the lake water levels rise according to the rainfall received. In recent history, several diversions have been constructed to utilize the lake storages for power generation, as well as to control the water levels. The only outlet from the lake Saiko with a capacity of 4 m³/s discharges in to Kawaguchi lake and is owned by the Tokyo Electric Company. Also the main outlet from the Kawaguchi lake belongs to Tokyo Electric Company. Another large diversion from the Kawaguchi lake is currently under construction and is expected to be completed by 1994. The details of these diversions are listed in table 2.

2.2 Water Levels of the lakes

Historical records has it that water levels of Saiko to be much higher in the past, for example Showa emperor was said to have taken a boat when he visited a hotel beside the lake. In Kawaguchi lake too, the water level had been higher about 50 years

Table 1. The five lakes around Mt. Fuji

Name	Area (km²)	Depth (m)	Perimeter (km)
Saiko Lake	2.22	90.9	10.5
Kawaguchi Lake	5.63	21.8	19.9
Motosu Lake	5.06	133.0	12.9
Shoji Lake	0.87	25.5	5.0
Yamanaka Lake	5.63	21.8	19.9

Table 2. Diversions from the lakes

Name	From	To	Capacity (m³/s)	Established
Tou-den Saik	Saiko lake	Kawaguchi lake	4	1919
Tou-den Usobuki	Kawaguchi lake	Sagami river	7.79	1918
Kencho zuido	Kawaguchi lake	Sagami river	0.3	1912
Nikkeikin	Motosu lake	Fuji river	3.2	1957
(under construction)	Kawaguchi lake	Fuji river	22.21	1994 (expected)

*INCEDE, 5th Dept. I.I.S.

**Musiake laboratory, 5th Dept. I.I.S.

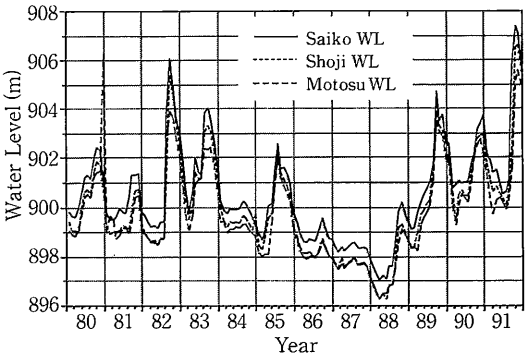


Fig. 2 Monthly Water Levels of Saiko, Shoji and Motosu Lakes

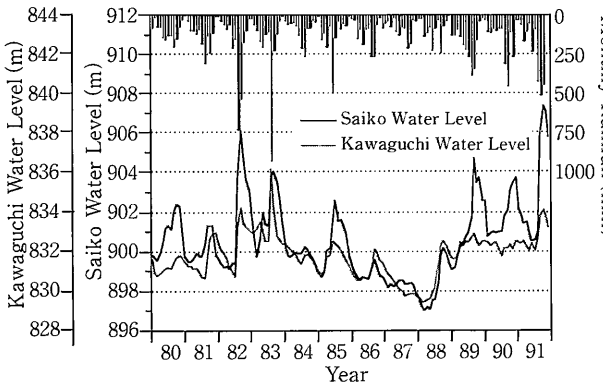


Fig. 3 Monthly water levesls of Saiko and Kawaguchi Lakes with Rainfall at Kawaguchi

ago. There had been a gradual decline of water levels over the years, and new develpment has taken nearer to the lowered water, together with the development of a low lying ring road around the Saiko lake.

Monthly average water levels of the lakes show high correlation among different lakes. Especially, the water levels of Saiko, Motosuko and Shojiko show almost identical movement as shown in fig. 2, in spite of water withdrawals from Motosu and Saiko while Shoji is completely isolated. This suggests that these three lakes are fed by the same groundwater table. The fig. 3 shows the monthly water level variations of Saiko and Kawaguchi lakes together with the monthly rainfalls observed at Kawaguchi. It can be seen that average water level of Saiko to be about 68m above the Kawaguchi lake water level. Also the period '89-'90 show stable water levels in Kawaguchi even during heavy rains. This is probably due to the stricter operation of Kawaguchi lake water storages after its declaration as a major river in 1983.

The lag correlogram between the Kawaguchi monthly rainfall and monthly average lake water levels for the period between 1980-1991 showed Saiko water levels to have the highest correlation with rainfall at a one month lag. With enough data it may be possible to develop a hydrological model for the region, but this will require investigations into the extent and characteristics of the aquifers surrounding the lakes.

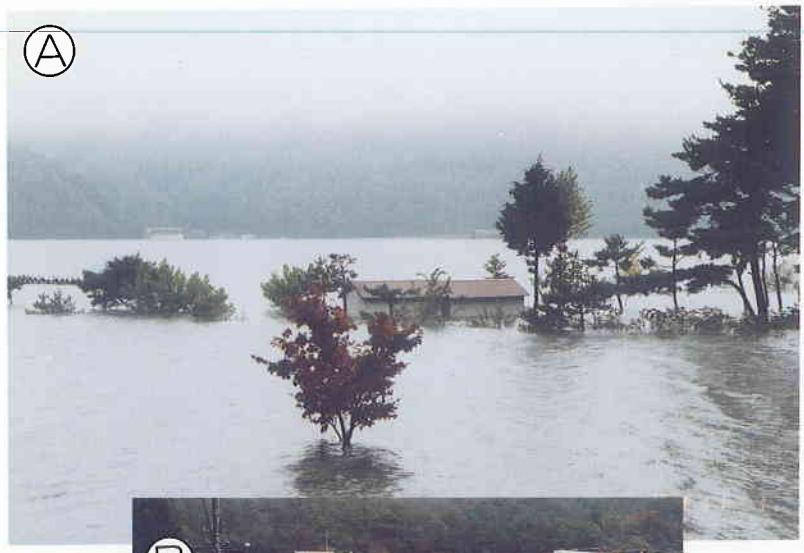
3. History of Disasters and Development

The Saiko-Kawaguchi lake areas have experienced damage from flooding and landslides in the past. In September 1966, Saiko and Nenba areas of Ashiwada village experienced severe land slide (Yama-tsunami) damage from typhoon No. 26. The damage to the Ashiwada village was estimated as 187 persons killed or injured and 3.9 million yen of property damage. After this disaster, all the people were moved to new villages constructed in safe locations named Nenba and Saiko minshuku mura (Japanese style pension villages). With this, the main livelihood of the residents of the area changed from agriculture to tourism.

Kawaguchi lake area suffered serious damage from rising water in August 1983. After this flooding, lake Kawaguchi was declared as a major river, thus enabling the government agencies to take part in its water storage planning. Fig. 1 (G) shows the levels of previous floods at Kawaguchi Lake, against 1991 water levels.

4. Observations in 1991

The continuous heavy rainfall received in the area is the main reason for the extra-ordinary water level rise in Saiko and Kawaguchi in 1991. During the months of September, October and November typhoons No. 12, 14, 15, 17, 18, 19, 20 and 21 have brought a large volume of precipitation. The rainfall records at Kawaguchi lake show 422.5, 511 and 448 mm of rain during these 3 months totalling to 1381.5 mm. Ashiwada Mura gauging station, which is close to Saiko, shows rainfalls of 365, 771.5 and 615 mm for the same 3 months totalling 1751.5 mm. These


A

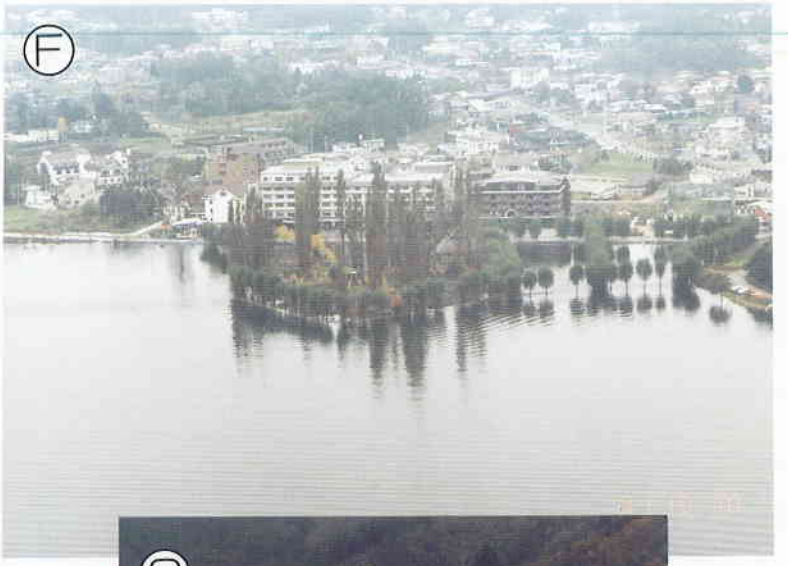

D


B


Saiko Lake
Kawaguc
Shoji
Lake
Motosu Lake
Saiko
Lake
A
B
C
D
E


前浜荘
C


E



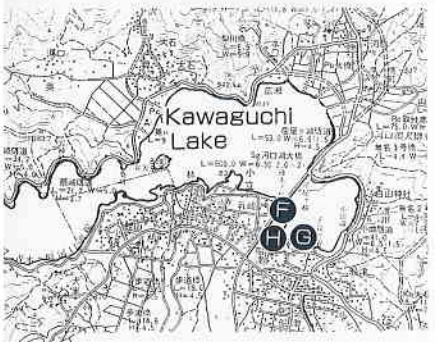


Fig.1 Layout of the Lakes and floods in 1991

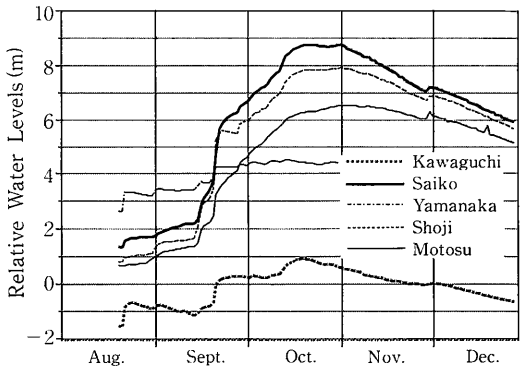


Fig. 4 Daily waterlevel Movement of the five lakes during last four months of 1991

rainfalls are extraordinary in a region where average annual rainfall is about 1500 mm (average of the past 10 yrs.).

The daily water level changes of the five lakes are shown in fig 4. The origin of the y axis corresponds to 899.233m for Saiko, Shoji and Motosu lakes, 833.525 m for Kawaguchi lake and 978.485 for Yamanaka lake. The average monthly water levels for Saiko for the years 1980-1990 for the months September, October and November are 901.8m, 901.6m and 901.3m respectively. The daily water levels recorded in 1991 for the same months show that maximum water levels for each month to be 4.08m, 6.37m and 5.80m higher than these averages respectively.

The ring road around Saiko lake was not usable since the middle of September. In some pats, the road was completely under the water (fig. 1, E) while in some other parts water seeping through drainage systems inundated the roads (fig. 1, B).

The Kawaguchi lake water too was at a critical level thus making it impossible to receive excess water from the upstream Saiko (fig. 1 F). In a few places around the lake Kawaguchi, road running around the lake was at a lower elevation than the lake water level, protected by sand bags and pumps operating around the clock (fig. 1 H).

Almost all of the buildings affected near Saiko were leisure related (fig. 1(D, E), while the permanent housing of the residents were located in high areas. No deaths or serious injuries have been reported. Although the damage assessment has not been completed, major losses are expected to be the loss of income from visitors for vacation and sightseeing and the cost of renovation of roads.

By the end of 1991, water levels of saiko has fallen down below the road levels except for a few fow lying stretches. Road rehabilitation was in progress and it is expected that Saiko area would be rehabilitated in time for the 1992 tourist season.

6. Concluding Remarks

The 1991 high waters resulted from heavy rains in the region. Critical water levels in the Kawaguchi lake made it impossible to utilize the only outlet from Saiko lake discharging in to kawaguchi lake. The situation can be expected to improve with the completion of new diversion from Kawaguchi lake in 1994.

However, for the foreseeable future, maintenance of safe water levels in Saiko will be dependent on the present outlet to Kawaguchi lake. The catchment of the groundwater table supplying the lake could be very largre as indicated by similar water levels of the three lakes shown in fig. 2, and hence this withdrawal may not be effective against heavy and sustained rains.

The needs of the tourism as well as the interests of power generation, makes it necessary to maintain sufficient water levels in the lake as long as possible. This does not give enough leverage to avoid flooding by rare and heavy rainfalls, and as such emphasis has been shifted to practical flood mitigation measures in order avoid series damage.

(Manuscript received, January 8, 1991)