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MEMORANDUM
June 9, 1983

To: Bob Ramsey

From: Lynn Singleton and Gary Bailey

Subject: Snake Lake Water Quality Investigation

INTRODUCTION

A brief water quality study of Snake Lake was conducted to determine the presence of significant problems. The study consisted of a one-day sampling trip and reconnaissance and a comparison of current data with that given in Johannessen (1976).

STUDY SITE

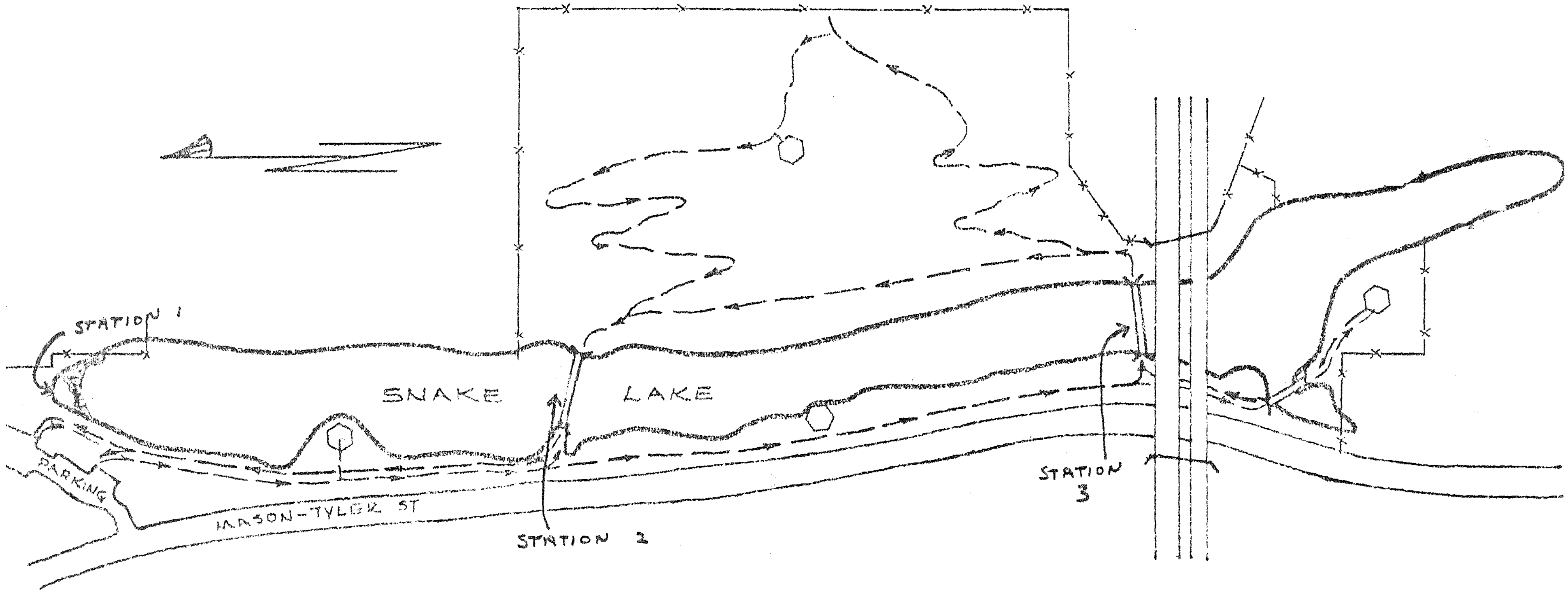
Snake Lake is located near the center of Tacoma and is bounded by Mason-Tyler Street on the west, by South 19th Street on the north, and by South 31st Street on the south. The east side of the lake is wooded and is the site of a nature center (Figure 1). The lake functions as a storage basin for excess stormwater which enters primarily at the north end. The lake has a surface area of eight acres, but during the summer contains water only in small pools in the deepest areas.

The mean depth of the lake when full is 1.5 to 2 meters. Summer water levels are less than 1 meter.

The lake is heavily vegetated with emergent brush in the shallower areas and submerged vegetation in the deeper areas (Johannessen, 1976).

METHODS

Water samples were collected at the north end of the lake (Station 1), at the north footbridge (Station 2), and at the south footbridge (Station 3). Sediment samples were collected at Station 1. Water samples were also collected from nearby China Lake for a comparison. China Lake, located approximately one mile away, contains highly colored water and, like Snake Lake, has served as a peat-mining area.



1 inch = ≃ .06 mile

Figure 1. Snake Lake.

Temperature and dissolved oxygen (Winkler method) were measured at the surface at all stations (Table 1) and additionally near the bottom (2-meter depth) at Station 2. All laboratory analyses were performed according to procedures given in *Methods for Chemical Analysis of Water and Wastes* (U.S. EPA, 1979).

RESULTS

At the time of sampling, there was no discernible flow into the lake from the influent pipe at Station 1 and the water at Station 1 was isolated from the rest of the lake by a sediment bar (Figure 1). The water at Station 2 was highly colored, as is typical of waters containing tannic acids and lignins. Some aquatic organisms observed at Station 3 were *amphipoda* (scuds), *gastrapoda* (snails), insects, and an amphibian larvae (tadpole). No adult frogs were observed.

There is an apparent improvement in water quality from the inlet (Station 1) to the south (Station 3). Although Station 1 was isolated at the time of sampling, it is expected that this trend would exist with higher water levels and flow through the lake. The lake probably acts as an effective treatment system to remove sediments, metals, and nutrients from the influent runoff water.

Most of the water quality parameters are within the range of values presented by Johannessen (1976), indicating there have been no great changes in water quality since 1976. Dissolved oxygen and pH values were higher for China Lake, but other values were similar to Snake Lake Stations 2 and 3 (Table 1).

A serious water quality problem is evident in water concentrations of Cu and Zn, and sediment concentrations of Pb, Cu, and Zn (Table 1, Table 2). The current criterion limit for zinc established for the protection of aquatic organisms is 47 µg/L (U.S. EPA, 1980a). The zinc concentration at Station 1 is nearly three times this recommended limit. The copper concentration at Station 1 (20 µg/L) is also much higher than the current criterion of 5.6 µg/L (U.S. EPA, 1980b). Although metal concentrations were low at the other two stations, it is anticipated that metal concentrations will disperse through the lake in proportion to the amount of inflow. Johannessen (1976) reported an average (n = 20) of 150 µg/L copper.

Sediments collected near Station 1 range from moderately polluted (Ni, Cr, Cd) to heavily polluted (Pb, Zn, Cu) (Table 2). Metal concentrations of sediments probably decrease with distance downlake from Station 1. These high metal concentrations in the sediments may be the reason for the absence of adult frogs in Snake Lake. Frogs overwinter partially buried in lake sediment and in the case of Snake Lake, would be exposed to very high metal concentrations.

Table 1. Water quality data for Snake Lake and China Lake, Tacoma (April 27, 1983).

Station	Temperature (°C)	Dissolved Oxygen (mg/L)	% Saturation	pH (S.U.)	Turbidity (NTU)	Sp. Conductivity (µmhos/cm)	COD (mg/L)	NO_3-N (mg/L)	NO_2-N (mg/L)	NH_3-N (mg/L)	O-PO_4-P (mg/L)	Total-P (mg/L)	Total Hardness (mg/L)	Chloroplyll a (mg/m^3)	Pheophyton a (mg/m^3)	Secchi Disk (M)	Cu (Total µg/L)	Cd (Total µg/L)	Cr (Total µg/L)	Ni (Total µg/L)	Pb (Total µg/L)	Zn (Total µg/L)
1-Surface	11.0	5.6	62	6.7	6	75	56	0.32	<0.01	0.07	0.05	0.12	36				20	<2	<10	<50	<50	130
2-Surface	13.6	7.1	75	6.3	4	43	19	<0.01	<0.01	<0.01	0.02	0.09	24	3.4	14.0	1.7	<10	<2	<10	<50	<50	16
2-Bottom	12.8	6.1	65	6.4	5	45	22	<0.01	<0.01	<0.01	0.02	0.07	28				<10	<2	<10	<50	<40	22
3-Surface	15.5	7.8	79	6.5	2	51	22	<0.01	<0.01	0.01	0.01	0.05	28				<10	<2	<10	<50	<50	20
China Lake - Surface	--	10.2		7.0	3	33	22	<0.01	<0.01	0.01	<0.01	0.04	20				<10	<2	<10	<50	<50	<5

Water criteria at hardness of 36 mg/L
Zinc acute 7.8 ug/L
Copper " 5.8 ug/L

Zinc	Hardness	Criteria
	24	5.6
	28	6.3

Table 2. Metals (mg/Kg dry) in sediments of Snake Lake (Station 1) and a classification of sediment pollution.

Metal	Snake Lake Sediment	Sediment Criteria (Engler, 1980)		
		Nonpolluted	Moderately Polluted	Heavily Polluted
Pb	1300, 1100	<40	40 - 60	>60
Zn	500, 520	<90	90 - 200	>200
Cu	190, 170	<25	25 - 50	>50
Ni	41, 43	<20	20 - 50	>50
Cr	40, 43	<25	25 - 75	>75
Cd	3.5, 3.6	--	--	>6

Sediment criteria
severe effect

Pb 250 mg/Kg dry
Zn 820
Cu 110
Ni 75
Cr 110
Cd 10

The principal problem with Snake Lake seems to be conflicting uses. In order to function efficiently as a storage reservoir, the storage capacity must increase during dry periods and according to data presented by Johannessen (1976), Snake Lake is an excellent reservoir for catching storm runoff and then releasing the water slowly. This loss of water causes Snake Lake to become a series of shallow pools during extended dry periods and greatly reduces the amount of aquatic habitat. The current hydrologic cycle might be similar even if it were not serving as a runoff reservoir.

The heavy metals and probably other pollutants such as petroleum products are typical of road runoff, and Snake Lake probably functions efficiently at removing these pollutants. This removal, however, may be causing some ecological disruption.

There are several possible options to create a system which could function for runoff storage and a stable ecological system, but implementation would require additional study, considerable time, and expense.

LRS:GB:cp

Attachments

cc: John Bernhardt
Darrel Anderson
Files