DOMESTIC WATER WITHDRAWALS FROM LAKE SAMISH

by

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This Open File Technical Report presents the results of a hydrologic investigation by the Water Resources Program, Department of Ecology. It is intended as a working document and has received internal review. This report may be circulated to other Agencies and the Public, but it is not a formal Ecology Publication.

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INTRODUCTION

Lake Samish serves as the water supply for a majority of the residents living along its shores. Presently there are about 350 domestic water users withdrawing water from the lake. There are an additional 18 applications for water rights at this time, 16 for single domestic and 2 for multiple domestic. Because the Lake Samish area is served by sewer, much of the withdrawn water is exported from the watershed. There is a concern that this loss of water significantly impacts the fisheries resource of Friday Creek, the outflow of Lake Samish. Friday Creek, a naturally intermittent stream, often drys up in late summer.

The Washington Department of Fisheries (WDF) believes that water withdrawals from Lake Samish exacerbate natural low flow problems in Friday Creek. Low flows preclude upstream or downstream fish passage, limit rearing habitat, and may strand juvenile fish rearing in that reach. WDF would like a permanent closure to further appropriations from Lake Samish. Since Friday Creek is closed to further appropriations they believe the lake should be also.

The policy of WDOE has been to issue single domestic supply to riparian landowners even if the lake is a tributary of a closed stream (West, 1985). The WDOEs contention is that the effect on the lake is so minimal that the department does not consider it a problem. WDF believes otherwise. In a letter to WDOE (Wilkerson, 1986), WDF stated a concern over the "cumulative impacts of additional small withdrawals" from Lake Samish. WDF concluded that:

> "It is safe to assume that any withdrawal has some level of impact on outflow. Considering the serious problems currently experienced in Friday Creek, WDF feels that any further degradation, regardless of degree, is unacceptable."

The controversy over cumulative withdrawals from lakes which are tributary to streams that are closed is not restricted to Lake Samish. Ted Mix (1976) outlined a method for examining this controversy using Lake Steilacoom (SWRO) as an example. His conclusion supported WDOE policy:

> "...[domestic] withdrawals from lakes have little effect on the outlet stream, and that lakes and their tributaries must be considered independently from the outlet stream."

There is little question that additional withdrawals from Lake Samish will decrease the water available for streamflow in Friday Creek. The unknown in this issue is the magnitude of these flow reductions. Whether the reductions "significantly" increase fisheries problems is related to the magnitude of change. Determining the magnitude of potential flow reductions in Friday Creek is the topic I was asked to address, and one which has been looked at before.

HISTORY

In 1977 the WDOE conducted a preliminary water budget investigation of Lake Samish (Nemecek, 1977). Water allocation at that time was about 51.44 acre-ft./yr. (AF/yr.) or 0.2 percent of the annual available runoff (estimated at 18,400 acre/ft.). The Whatcom County Public Health Department estimated that at least 120 residences and two trailer courts were using water in 1969. The EIS for the Lake Samish wastewater treatment plant estimated there were 395 homes or trailers around the lake in 1974 and estimated a population of 1200 people. They predicted an annual population growth rate of five percent. Based on this growth, the Nemecek report estimated future water use in 1990 as 343 AF/yr. (1.8 percent of available runoff) and for 2000 as 697 AF/yr. (3.7 percent of available runoff). The conclusion reached in 1977 is of interest today:

> "...with available data, the amounts of projected usage are essentially insignificant as they are far below present accuracy limits of estimates of available supply. The only argument against further withdrawals is that outflow will theoretically stop slightly sooner (on the order of a few hours) and resume slightly later".

The EIS for the wastewater treatment plant estimated that because of water transfers out of the basin, the water available for streamflow in 1990 would be decreased by about 345 AF/yr. This would amount to an average decline in lake level of about 0.62 inches during the summer. They concluded that:

> "...for Friday Creek, it can be expected that the period of no flow from the lake will occur for a longer period during the summer."

This brings us up to the present: what is the actual quantity of water withdrawn from the lake?

PRESENT WATER USE

In 1977, Nemecek estimated water use, based on water rights, at a maximum of 13.55 acre-ft/day, with a yearly total of 51.44 acre-ft. West (1985) reported that water rights as of March 1985 were 142.44 acre-ft/yr. Current certificated water rights total 198.14 acre-ft/yr (Moore 1987). Summer irrigation certificated rights are 21.87 acre-ft/month. Unfortunately, these water rights do not reflect the actual water used. It is usual for actual use to be less than total water rights where irrigation is not a major use.

A measure of actual water use is available from the local sewer district (Water District #12). They record the volume of waste water exported from the district. Since the entire area is sewered, and the largest source of water is Lake Samish, these volumes represent the amount

of water presently used "in-house" by Lake Samish residents (Table 1). According to their records, the average monthly consumption during the summer is about 5.55 acre-ft/month. This is equal to about one-fourth of the current water rights. This water use, however, does not include "outside" use of water such as irrigation and lawn watering etc. This water use must be added to the "in-house" use to determine the total water consumed.

However, water pumped from the lake to water lawns and gardens is not entirely a "new" or "additional" loss from the lake system. Residential development modifies the local hydrology. A greater impervious area, including roofs and roads, increases the direct runoff into the lake. The removal of native vegetation reduces transpirational loss of water thus increasing the water reaching the lake. Domestic consumption must be balanced against these increases to lake storage. Residential development increases runoff to the lake while at the same time pumping it back out for lawn watering. The unknown in this process is whether more is consumed by development than is gained.

Thus, "outside" use (a water loss) is partly balanced by other water gains caused by development. The net consumption is probably no greater than "in-house" use during summer months. However, I have no data on this use.

Based on this assumption, the current water use during the summer months is 10 to 11 acre-ft./month (about 90-100 gallons per person per day based on a population of 1200). This amounts to about one-half the present water rights. This trend should continue; residential users must pay, via pumping costs, for every gallon used and I see no reason why they would consume their entire water right.

Table 1. Water volume exported via sewer system (acre-ft).

Year	July	August	Sept	Average	Annual
1979	5.61	5.63	4.58	5.27	69
1980	7.11	6.25	6.09	6.48	78
1981	5.64	6.12	4.96	5.57	67
1982	5.26	5.76	4.83	5.28	66
1983	4.88	5.27	6.00	5.38	65
1984	6.14	6.23	5.04	5.80	68
1985	6.39	5.65	4.97	5.67	66
1986	6.24	6.37	5.40	6.00	70
1987	4.46	4.60	4.45	4.50	62

Summer average 5.55 acre-ft/month

5.55 acre-ft/month = 0.09 cfs
5.55 acre-ft/month = 0.08 inches over 810 acre lake.

PENDING WATER RIGHT APPLICATIONS

There are presently 16 single domestic and two multiple domestic applications on hold pending approval. Based on a standard allocation of 0.5 acre-ft/yr. per household (450 gallons/day), the single domestics amount to about 8 acre-ft/yr. of additional appropriation. The two multiple use applications (one for 9 units and one for 40 units) would add another 25 acre-ft./yr to the appropriations. If pending applications are approved and one-half the allocated water is actually consumed, an additional 0.3 acre-ft./month for the single domestic and about 1.0 acre-ft./month for the multiple applications will be added to present water use during July, August, and September. To improve this estimate and document "outside" use would require metering of water consumption.

The bottom line is what effect do the current withdrawals have on the late summer streamflow in Friday Creek? And what will be the effects of an additional withdrawal of 0.3 acre-ft./month for single domestic and 1.0 acre-ft./month for multiple domestic?

ANALYSIS

As a prelude to the analysis, I spent considerable time soliciting and collecting information on the water supply of Lake Samish. Data included precipitation and lake level records maintained by Water District #12 and the Lake Samish Community Association, and published climatological records. I also reviewed historical streamflow records for Friday Creek, as well as recent measurements made by WDOE's NWRO.

The original objective was derivation of a simple model of lake storage based on precipitation and other climatic variables. Fluctuations in lake storage would be used to predict the outflow via Friday Creek. The frequency of low-flows would be computed using the predicted late summer outflow over the past 50-years. The final step would be to subtract water use from the lake storage and determine the increased frequency with which various low-flow discharges occurred in Friday Creek.

After studying the available data and examining the range of expected hydrologic change, I realized that a detailed analysis was not feasible. The necessary data is not currently available and the gaging accuracy required to collect the data is beyond our capabilities. Because the interest is in low streamflow, the period of interest is reduced to one or two months during late summer. Thus an annual water budget is of little value. The water supply needs to be quantified during the very period when it is smallest. Although the total lake storage is large, the majority is dead storage and only about the top one foot (810 acre-ft.) remains for runoff after June. Errors in collected data and in prediction techniques that would be acceptable in an annual water budget are not acceptable when predicting the lowest flows of the year.

These data limitations are apparent when examining the effects of the proposed incresed summer withdrawals on lake levels. One inch of water over

a lake area of 810 acres is equivalent to about 67.5 acre-ft. An instantaneous single domestic withdrawal of the magnitude we are discussing (0.3 acre-ft.) would cause the lake level to decline 0.005 inches. Withdrawal of an additional 1.0 acre-ft. for multiples would cause the lake to decline another 0.015 inches. Although we might be able to measure the lake elevation with this precision, we would need several hundred years of record to make any sense out of such small changes. Additionally, the results would only be meaningful in a static watershed without climate change, development, and logging, etc.

The same data and gaging limitations are apparent when discussing the current water use estimate. The present 11 acre-ft./month withdrawal is equivalent to a decline in lake level of about 0.16 inches (slightly more than 1/8 inch) during the month. However, the lake elevation records indicate that in August and September it is common for the lake to drop several inches (or greater) each month. The records indicate that during the low flow days, the lake level commonly drops about 1/8 inch per day. In effect, the current monthly water consumption is equivalent to a one day drop in lake elevation. If the stream now dries up on September 10th because of withdrawals, it would not dry up until September 11th without the withdrawals. That is, present withdrawals may cause the lowest Friday Creek flows to occur one day earlier than they would under natural conditions. Likewise, a return to higher stream flows might be delayed by as much as one day.

Gaging of streamflow will also be inadequate to quantify this issue with any statistical significance. The current water use, about 11 acre-ft/month, is equivalent to 0.2 cfs. The pending 1.3 acre-ft/month withdrawals would add another 0.02 cfs to lake withdrawals. Although the withdrawals represent a one for one reduction in lake storage, they do not necessarily reflect a one for one reduction in streamflow in Friday Creek. Reductions in streamflow will lag the actual lake withdrawals with storage effects attenuating the reductions. Quantifying these flows and the small changes expected is beyond the capability of normal stream gaging techniques.

The magnitude of flow reductions will depend on the level of the lake during the period the water is withdrawn. Streamflow from the lake is controlled by lake level and the higher the water level the greater the discharge. This is not a linear relationship, however. A reduction in lake level of one inch when the lake is 5 ft. above normal has a proportionately smaller effect on streamflow than when the lake is only one foot above normal. For example, the discharge through a weir (q=2.5 stage ^2) with a water level of 5'0" is 62.5 cfs. At 4'11" the discharge is 60.4 cfs, a difference of 2.1 cfs or a 3% change. The difference in discharge for a one inch drop from one foot (12"=2.5 cfs) to 11" (2.1 cfs) is 0.4 cfs or a 16% change.

Thus the present withdrawals have their greatest effect on Friday Creek when it is at its lowest flow, ie. just before drying up. Only when the flow drops below about one cfs would I expect present withdrawals to cause a measureable change in streamflow. However, at this flow, the stream is probably already of low value to fish. I do not know at what minimum flow the fisheries value is nill, but I would guess that it is greater than one

cfs. The proposed additional single domestic withdrawals (0.005 cfs) will have no practical impact on Friday Creek. The proposed multiple domestic withdrawals, although greater than the proposed single domestic, are also relatively small in magnitude and will not significantly change the present streamflow in Friday Creek.

SUMMARY

The effects on Friday Creek of domestic withdrawals from Lake Samish are small, although the actual magnitude and timing of the reductions in streamflow remain unknown. Determining the "significance" of the reduced streamflow will require a judgement on the fisheries "value" lost. In my opinion, the effects of the additional water rights on streamflow will be insignificant. I also believe that prior water rights have had a negligible effect on low streamflow. Impacts on streamflow from forest practices, urban drainage, and beaver dam management are all greater than the effects of domestic withdrawals.

I do not believe that additional gaging or study will definitively settle this issue. Improving the estimate of actual water consumption would settle the question of how much water is used, but whether present and proposed domestic withdrawals have a "significant" effect on the fisheries resource will remain a judgement call.

BIBLIOGRAPHY

Mix, Ted, 1976, Water Right Diversions from Lakes and Subsequent Effects on Outlet Streamflow, Office Report #55, Department of Ecology.

Moore, Tom, 1987, Water Supply in Lake Samish, Department of Ecology.

Nemecek, E.A., 1977, Memo - Water Supply, Lake Samish, Department of Ecology.

West, Steve, 1985, Department of Ecology letter to Duane Phinney, Department of Fisheries.

Wilkerson, William R., 1986, Letter from Department of Fisheries to Roy C. Bishop Department of Ecology.