

Devils Lake Water Improvement District

Post Office Box 974 • Lincoln City, Oregon 97367
(503) 994-5330 • FAX (503) 994-6040

November 28, 1997

Mr. William E. Ferber
Watermaster District 16
Northwest Region
Oregon Water Resources Department
Field/Technical Services Division
158 Twelfth St. NE
Salem, OR 97310

RECEIVED

DEC - 8 1997

WATER RESOURCES DEPT.
SALEM, OREGON

RE: 97 Water Year (WY) Water Rights Annual Report

Dear Bill:

The Devils Lake Water Improvement District (DLWID) is pleased to submit the following water rights annual report. This report covers the 1997 Water Year and is the first ever report submitted by the DLWID.

This report covers the DLWID's two water rights R-71703 and S-71813. The Devils Lake Water Improvement District has just begun a long-term monitoring program.

The DLWID would appreciate your review of this report and any follow-up advice on how to improve it. Please call me at (541) 994-5330 with questions concerning data contained in the report.

We look forward to hearing from you. Thank you for your time and consideration.

Sincerely,

Bob Storer
DLWID Manager

cc: DLWID Board

c:97WYWaterRights



**Devils Lake Water Improvement District (DLWID)
Water Rights R-71703 and S-71813
Annual Report Summary
1997 Water Year**

**Submitted to:
State of Oregon
Water Resources Department**

**Submitted by:
Bob Storer
DLWID Manager**

November 28, 1997

Table of Contents

I.	Introduction.....	3
II.	Devils Lake Water Improvement District.....	3
III.	Water Rights.....	4
IV.	Fish Control Structure.....	5
V.	Monitoring Program.....	5
	Description of Devils Lake and its Watershed	
	Long-term Lake & Watershed Monitoring Program	
	Precipitation	
	Lake Level	
	D-River Outflow	
	Watershed Inflows	
	Pan Evaporation	
VI.	Monitoring Results.....	7
VII.	Appendices	
	A. Water Rights	
	B. Daily Precipitation Table and Water Year Plot	
	C. Daily Lake Level Table and Water Year Plot	
	D. Lake Level/Precipitation Water Year Plot and Monthly Plots	
	E. D-River Stage/Discharge Curve and Summary Sheet	
	F. Rock Creek Stage/Discharge Curve and Summary Sheet	
	G. Thompson Creek Stage/Discharge Curve and Summary Sheet	
	H. Other Watershed Inflow Streams Monthly Summaries	
	I. Daily Pan Evaporation Data/Calculations	
	J. Photos	

I. Introduction

This is the Devils Lake Water Improvement District's (DLWID's) first annual report summarizing data collected within the Devils Lake watershed during the 1997 water year (WY) beginning October 1, 1996 through September 30, 1997. The purpose for collecting these data is twofold: 1) to comply with water rights reporting requirements; and 2) for development of a water budget for Devils Lake.

As stated in the state of Oregon Water Resources Department water rights permit, "the permittee shall keep a complete record of the amount of water used each month and shall submit a report which includes the recorded water use measurements to the Department annually.

A generalized equation for the water budget of a lake is as follows:

$$\text{Inflow} + \text{precipitation} = \text{Outflow} + \text{evaporation} + \text{change in lake storage}$$

Section 2 of this report introduces the Devils Lake Water Improvement District (DLWID). Section 3 summarizes the DLWID's water right permits. Section 4 discusses the DLWID's fish control structure and purpose. Section 5 summarizes the five monitoring program elements including precipitation; lake level; D-River outflow; lake inflows; and evaporation. Section 6 discusses the results of each of the monitoring program elements during the 1997 WY. Section 7 includes raw data, printouts, and Appendices A-J.

II. Devils Lake Water Improvement District (DLWID)

The Devils Lake Water Improvement District (DLWID) is a special district authorized by Oregon Revised Statutes (ORS) 552, and was formed by an order of the Lincoln County Commissioners and sustained by a vote of the citizen's in the district in 1984. The DLWID goals are to: 1) improve and maintain water quality and quantity in Devils Lake and its watershed and provide a healthy environment for fish, wildlife, and human use; 2) improve recreational opportunities and provide safe navigation in Devils Lake; and 3) promote awareness of Devils Lake as a natural resource. The District monitors the physical, chemical, and biological components of the lake and its watershed. During 1983, a Phase I diagnostic study of the lake and its watershed was conducted. In 1985, a signed agreement with the Oregon Department of Environmental Quality was initiated to implement phase II restoration. During 1986-1987, 27,000 sterile grass carp were introduced and in 1993, 5,000 additional fish were added. During 1994, a paleolimnology study was conducted. During 1995-1996 a water quality and revegetation study was conducted. During 1996-1997 the DLWID began a long-term monitoring program. The DLWID also conducts lake restoration activities and during the 1996-1997 focused on: 1) erosion prevention and sediment control; 2) long-term monitoring; and 3) public involvement and educational activities.

III. Water Rights

Water Rights Application Number R-71703

On June 18, 1991, the Devils Lake Water Improvement District submitted an application to the Oregon Water Resources Department for a water use permit. The Department issued a Proposed Final Order on May 21, 1996 and issued permit R-11968 on October 10, 1996 (see Appendix A).

The purpose or use of the stored water is for recreation. The maximum volume allowed is 1,360.0 acre-feet once each year. The DLWID measures daily lake levels with a continuous stage recorder (see Section 5). The date of priority for this water right is June 18, 1991. The area submerged by the reservoir, when full, will be 680.0 acres and the maximum depth of water will be 21.0 feet. The maximum height of the dam (fish control structure) shall not exceed 4.0 feet. No more than three splash boards measuring no more than eight inches each (totaling a maximum of 24 inches) are to be used at any one time. No more than one 8-inch high splashboard is to be used during the period of November 1 through March 31 of each year.

The Oregon Department of Fish & Wildlife (ODFW) office personnel in Newport shall be notified if movement of adult fish into the lake or juvenile fish out of the lake is, or is likely to be, impaired. If passage is impeded, appropriate measures as directed by ODFW shall be taken by the DLWID to facilitate passage.

Water Rights Application Number S-71813

On August 27, 1991, the DLWID submitted an application to the Oregon Department of Water Resources for a water use permit. The Department issued a Proposed Final Order on May 21, 1996 and issued permit 52672 on October 10, 1996 (see Appendix A).

The purpose or use of this water is for in-stream flows and water quality/fisheries. The minimum rate allowed is 0.662 cubic feet per second (cfs) in the D-River from October 1 through July 31 of each year; however, during August and September of each year, the inflow must equal the outflow. The date of priority for this water right is August 27, 1991.

As stated on page 2 of this permit, "before water use may begin under this permit, the permittee shall install a meter or other suitable measuring device as approved by the Director. The DLWID monitors the lake outflow (D-River) daily by reading a staff gage mounted on the fish control structure and by obtaining monthly streamflow measurements. This area is subject to high tides and surfs, which result in constant channel movement (fill and scour) and the DLWID, spends approximately \$7,500 annually to maintain (channel dredge and remove logs and debris). Additionally, the stream reach is adjacent to the D-River Wayside State Park (see Figure1). This park receives 1.4 million visitors annually. This area is also subject to vandalism. As a result, the DLWID has not installed a recording device at this location.

On March 24, 1997 DLWID personnel toured the Devils Lake watershed with Mr. Bill Ferber, District 16 Watermaster. It was agreed on this date that the DLWID would continue to: 1) obtain daily stage readings at the fish control structure; 2) obtain monthly discharge measurements at this location and at various locations throughout the watershed and 3) install and measure pan evaporation. These monitoring elements would be sufficient to comply with the requirement that inflow must equal outflow during August and September.

IV. DLWID Fish Control Structure

In September, 1986 the Division of State Lands and the Oregon Fish & Wildlife Department gave permission to the DLWID to construct a fish control structure at the outlet of Devils Lake (see Figure 2). The purpose of the structure is to keep the aquatic plant-eating Chinese Grass Carp (White Amur) in Devils Lake from swimming out to the ocean by way of the D-River, while allowing for the passage of adult and juvenile salmon and trout.

The structure worked well until it was badly damaged by storm action on February 1, 1990. Reconstruction of the structure occurred in the fall of 1990. The rebuilt structure functions the same as the previous one, but was lowered in height and was designed to break away before metal or concrete can be damaged. This structure was also damaged and repaired during November 13-18, 1997.

V. Monitoring Program

Description of Devils Lake and its Watershed

Devils Lake is 275 hectares (680 acres) and has a 3.1 km² (12-square mile watershed). The maximum length (fetch) is 5.1 km (3.0 miles) and the average width is 0.6 km (0.4 miles). The lake has a maximum depth of around 6.1 meters (20-feet) and a mean depth of less than 3.0 meters (10-feet). The volume is approximately 6,070 acre-feet.

There are approximately 65 surface water inflows to Devils Lake (Figure 3). The largest inflows are Rock Creek and Thompson Creek. Rock Creek is the principal source, draining about 60 percent of the drainage basin. Thompson Creek drains the moderately sloped northern portion of the watershed.

The D-river is the lake's outflow. The D-River drops 3.0 meters to the Pacific Ocean. It is listed by the Guinness of World Book of Records as the "world's shortest river".

DLWID Long-Term Monitoring Program

Devils Lake has been studied periodically for about 25 years, since 1972. Many of the lake's physical, chemical, and biological components were examined including water quality, hydrology, fisheries, waterfowl, aquatic vegetation, and sediments. Distinct firms and researchers performed many of these studies. Unfortunately, there is no

consistent long-term monitoring program or database. Sampling stations, sample depths, and variables were collected with different equipment and during changing seasons and time. As a result, it is very difficult to establish a baseline or assess trends with these data.

The DLWID began a long-term monitoring program during 1996-1997. The proposed program will establish a consistent monitoring program with appropriate quality assurance/quality control (QA/QC) protocols. This program should be carried out for a minimum of five-years and reassessed prior to conducting a subsequent five-year monitoring period.

Data collected as part of this long-term monitoring program will be one tool used in a three-phased approach to apply adaptive management techniques. The three objectives for this long-term monitoring program include: 1) develop a baseline and assess trends; 2) develop water and nutrient budgets; and 3) implement best management practices (BMPs) and source controls and evaluate their success and failure.

Water Rights Monitoring Program Elements

Precipitation

Precipitation is manually recorded daily with a Tru-Check rain gage, which accurately measures 0.01" to 6.0". The rain gage is installed at the DLWID Manager's house on the south end of the lake. Daily precipitation table and WY Plot can be found in appendix B.

Lake Level

A Stevens F-Type Chart recorder installed in Devils Lake State Park (see Figure 1) continuously records lake level. During 1993-1997, the DLWID Manager read the staff gage daily and checked /marked on the chart recorder paper weekly (date, time, and lake level/gage reading). Two staff gages also are read to check accuracy. One staff gage is installed next to the chart recorder, and the other at the fish control structure. Daily lake level table and WY plot are in Appendix C). Lake level/precipitation WY plot and monthly plots can be found in Appendix D.

D-River Outflow

As stated earlier, D-River outflow is measured monthly using a top-setting wading rod and Swoffer velocity meter. Streamflow measurements are made using U.S. Geological Survey methodology. D-River stage/discharge curve and summary sheet is located in Appendix E.

Watershed Inflows

There are more than 65 surface water inflows to the lake. These consist of streams, creeks, culverts, pipes, and drainageways. Eighteen of the largest water sources or those

that have observable nonpoint pollution problems are currently being measured on a monthly basis (see Table 2 and Figure 3). Flows discharging from culverts are measured by obtaining depth, diameter, and velocity measurements. Measurements are computed using computerized flow equations. Stage/discharge curves for Rock Creek and Thompson Creek are located in Appendix F + G. Other watershed inflow monthly summaries are located in Appendix H.

Pan Evaporation

A Qualimetrics, Inc. Class A Evaporation Station (Model 6820-A) was installed on July 16, 1997. The pan evaporation station was installed at the Banai Brith Summer Youth camp on the northeast side of the lake. Weekly readings of evaporation, wind speed, and air, pan, and lake temperatures were recorded through October 8, 1997. Calculations and raw pan evaporation data are located in Appendix I.

VI. 1997 Water Year Monitoring Results

Precipitation

The 1997 WY was one of the wettest on records. More than 126” of precipitation was recorded. The wettest month (December) had more than 27” while the driest month (July) only had 1.74”. Table 1 shows the monthly precipitation totals and Figure 4 shows the precipitation amounts recorded during the 1985-1997 Water Years. Appendix B lists daily precipitation table and 1997 WY plot.

Table 1 1997 Water Year Monthly Precipitation for the Devils Lake Watershed

Month	Total Precipitation (inches)
October (1996)	13.3
November	15.58
December	27.63
January (1997)	17.01
February	5.04
March	14.15
April	8.59
May	5.51
June	4.59
July	1.74
August	3.42
September	10.03
Totals	126.59

Lake Level

The lowest lake level during the 1997 WY was 8.60 feet on November 9-10, 1996. The highest lake level was 12.00 feet on December 27, 1996. A series of spring storms during March and April 1997 kept the lake level higher than normal during the summer period. Additionally, an unusually strong storm occurred during September 14-18. 6.75" of precipitation was recorded during this period. Fourteen splashboards were pulled from the fish control structure. The lake level still rose 4.0" from 9.49 to 9.84 feet. Appendix C lists daily lake levels and a WY plot and Appendix D illustrates a lake level/precipitation WY plot and summarizes monthly plots of the same.

D-River Outflow

Fourteen streamflow measurements were made in the D-River approximately 200-feet downstream of the fish control structure. A significant riffle serves as a stream channel control and is just upstream of the measurement site. This channel, however, is extremely unstable due to its location (approximately 150-feet) from the ocean and tidal action. The highest flow measurement (695-cfs) was made just upstream of the fish control structure on December 26, 1996. From this measurement, it was estimated that more than 450 million gallons of water discharged from the lake in 24-hours during December 26-27, 1996.

The lowest discharge measurement (10.62-cfs) was made on July 1, 1997. All boards were installed in the fish control structure at this time. Appendix E lists a summary sheet of discharge measurements and a stage/discharge curve for the D-River during the 1997 WY.

Watershed Inflows

Eighteen watershed inflows were measured monthly during the 1997 WY. The highest flows were measured during a 5.00" storm event that occurred during a 24-hour period on November 19, 1996. The lowest flows were measured during September 3, 1997. Table lists the lowest/highest and mean measured flows. Appendices F, G, and H summarizes: Rock Creek stage/discharge curve and measurement summary sheet; Thompson Creek stage/discharge curve and measurement summary sheet; and other watershed inflow monthly measurements, respectively.

Table 2 Summary of Watershed Inflow Measurements (lowest/highest and means in cfs)

Inflow Station (#)	Lowest flow	Mean flow	Highest flow	N= no. of measurements
Indian L. (2)	0.09	0.77	4.88	12
NE 20 th (7)	0.02	0.29	1.42	12
Br. Nr. 26 th (9)	0	5.04	21.2	9
Trib. S. of 35 th (19)	0.003	1.83	10.6	12
RV Park (20)	0	7.51	56.6	10
GC @ mouth(21)	0	12.4	75	10
Trib. # 22 (22)	0	0.61	2.14	7
Neotsu Cr. (23/24)	0.38	9.51	82	13
Trib. # 28 (28)	0.15	0.65	1.34	9
Thompson Cr. (29)	0.32	11.10	72.1	13
Trib. # 32 (32)	0.05	0.73	1.99	9
Trib. # 37 (37)	0	1.02	7.01	12
Rock Cr. (52)	4.36	22.6	55.10	13
Seid Cr. (53)	0	16.7	200 (?)	7
3 rd Ave. (2) (55)	0.04	4.25	16.9	13
3 rd Ave (1) (56)	0.03	1.26	5.51	13
LP out (65)	0.22	2.26	12.84	12
GC Pond-in (66)	0.01	5.86	59.6	12

(?) This measurement was estimated and is rated very poor with slow velocities, high depths, and significant vegetation. The actual flows were probably significantly lower than this estimate.

Daily Pan Evaporation Data

The pan evaporation station was installed on July 16, 1997. Maintenance and service was performed daily through July 19, 1997. Weekly surveys (Table 3) were then performed through October 8, 1997. Maintenance and service included: 1) adding or removing water in the pan; 2) reading and recording the hook-gage, min-max thermometer, and wind totalizing anemometer. The best evaporation data was recorded during July 16 through August 20 when no precipitation occurred. After 8/20, unusually high precipitation was recorded as follows:

<u>Dates</u>	<u>Total Precipitation (inches)</u>
8/20 – 8/27	2.49”
8/28 – 9/3	0.93”
9/10 – 9/17	6.61”
9/18 – 9/24	0.84”
9/25 – 9/30	2.58”
10/1 – 10/8	5.03”

Totals 8/20 – 10/8 18.48”

Table 3 summarizes the recorded daily and weekly data obtained from the pan evaporation station

Date	Time	Hook Gage	Wind(miles)	Avg. Wind Speed	Min Pan Temp	Max Pan Temp	Air Temp	Lake Temp	Remarks
7-16-97	1100	3.62	3.6						Installed
7-17-97	1310	3.42	48	1.71					
7-18-97	1612	3.25	88.5	1.50					
7-19-97	1618	3.11	131	1.77					
7-23-97	1259	2.63	257.8	1.38		75			
7-30-97	1245	1.51	498.7	1.43		72			
Refill to		3.74							
8-6-97	1250	2.71	771.5	1.89		74			
8-9-97	1600	2.14	881.5	1.47		92 (?)			Installed temp
Refill to		4.33			59				
8-20-97	0950	3.57	1,333	1.75	55	79	62	69	
8-26-97	Full								
8-27-97	0845	4.80	1734	2.38					
Bailed down to		3.60							
9-3-97	0826	3.41	2045	2.16	55	64	60	69	
9-10-97	1515	2.92	2283	1.36	53	75.5	67	70	
9-17-97	1130 full	Bailed 2.33	2683		53	73	59	63	5.0” precip
9-24-97	0815	2.50	2898	1.87			56	65	
10-1-97	0845	Bailed 2.49	3286	2.31	54	96 (?)	61	62	
10-8-97	1100	full	3854	3.34	64	47	52	57	Pulled

Watershed Rights Compliance

Lake Level

The splashboards were installed in the fish control structure on March 29, 1997 and removed on October 9, 1997. The lake level ranged from 9.04 to 9.96 during this period.

Inflow versus. Outflow

Table 4 illustrates the computed and estimated lake inflow versus the outflow during August and September 1997. Due to significant storm events during August 20, August 24-30, and September 10-30, the lake inflow was more than the lake outflow and the DLWID did not meet compliance of this permit. This was somewhat unusual in terms of climatic conditions and during normal summers and hence normal precipitation patterns, the DLWID should not have any problems complying with this stipulation.

Table 4 Inflow vrs. Outflow

Date	Stream Inflow	Precipitation	Total Inflow	Outflow	Evaporation	Total Outflow	Remarks (permit compliance)
8/1/97	357	0	357	529	9,857	10,386	Yes
2	367	0	367	529	9,857	10,386	Yes
3	367	0	367	520	9,857	10,377	Yes
4	326	0	326	520	9,857	10,377	Yes
5	326	0	326	511	9,857	10,368	Yes
6	352	0	352	511	9,857	10,368	Yea
7	367	0	367	494	11,003	11,497	Yes
8	367	0	367	478	11,003	11,481	Yes
9	326	0	326	467	11,003	11,470	Yes
10	326	0	326	456	3,938	4,394	Yes
11	367	0	367	456	3,938	4,394	Yes
12	326	0	326	435	3,938	4,373	Yes
13	326	0	326	435	3,938	4,373	Yes
14	326	0	326	428	3,938	4,366	Yes
15	326	0	326	428	3,938	4,366	Yes
16	326	0	326	425	3,938	4,363	Yes
17	326	0	326	420	3,938	4,358	Yes
18	326	0	326	420	3,938	4,358	Yes
19	326	0	326	417	3,938	4,355	Yes
20	326	27,675	28,001	412	3,938	4,350	NO
21	367	0	367	420	0	420	Yes
22	367	0	367	417	0	417	Yes
23	367	0	367	417	0	417	Yes
24	611	26,837	27,448	420	0	420	NO
25	734	6,709	7,443	422	0	422	NO

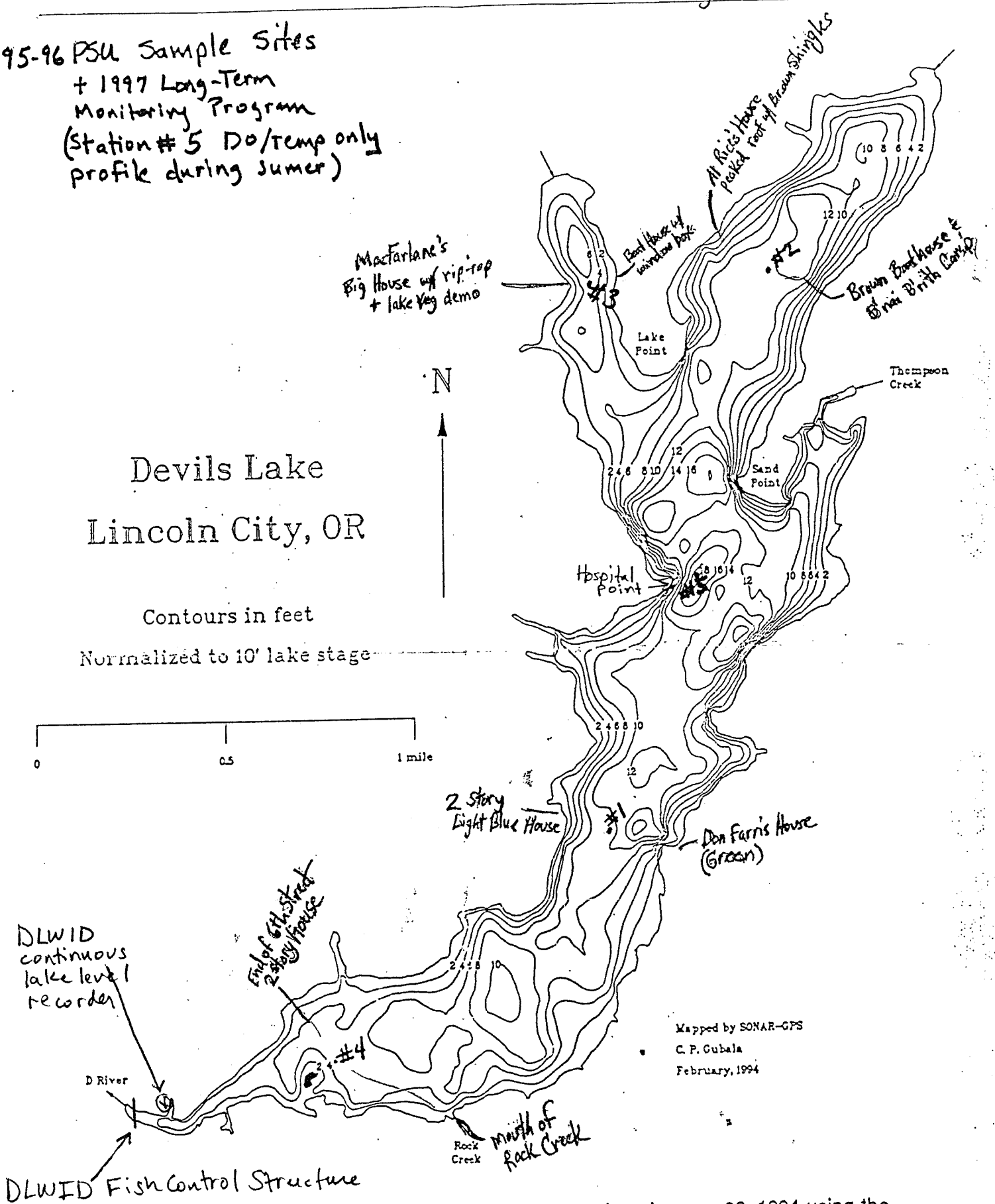
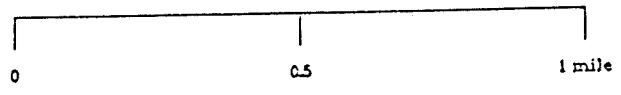
26	937	109,023	109,960	456	0	456	NO
27	326	4,193	4,519	478	0	478	NO
28	407	60,382	60,789	486	0	486	NO
29	856	5,032	5,888	530	0	530	NO
30	815	0	815	509	0	509	NO
8/31/97	407	0	407	511	0	511	Yes
9/1/97	367	0	367	501	0	501	Yes
2	326	0	326	486	0	486	Yes
3	300	0	300	478	0	478	Yes
4	293	0	293	478	4,028	4,506	Yes
5	289	0	289	472	4,028	4,500	Yes
6	285	0	285	461	4,028	4,489	Yes
7	285	0	285	451	4,028	4,479	Yes
8	367	0	367	440	4,028	4,468	Yes
9	611	0	611	440	4,028	4,468	Yes
10	734	15,096	15,830	430	0	430	NO
11	856	9,225	10,081	427	0	427	NO
12	856	9,225	10,081	430	0	430	NO
13	1,223	15,096	16,319	427	0	427	NO
14	1,550	83,864	85,414	427	0	427	NO
15	1,550	92,251	93,801	478	0	478	NO
16	1,550	164,501	166,051	754	0	754	NO
17	4,238	67,930	72,168	2,037	0	2,037	NO
18	4,280	58,705	62,985	550	0	550	NO
19	3,545	0	3,545	420	0	420	NO
20	3,545	0	3,545	408	0	408	NO
21	3,382	0	3,382	408	0	408	NO
22	2,649	0	2,649	403	0	403	NO
23	1,915	0	1,915	395	0	395	NO
24	1,793	0	1,793	387	0	387	NO
25	1,915	36,062	37,977	387	0	387	NO
26	4,279	81,348	85,627	408	0	408	NO
27	3,382	1,426	4,808	420	0	420	NO
28	3,056	0	3,056	415	0	415	NO
29	2,690	0	2,690	408	0	408	NO
9/30	3,382	61,220	64,602	428	0	428	NO

95-96 PSU Sample Sites
+ 1997 Long-Term
Monitoring Program
(Station # 5 DO/temp only
profile during summer)

Devils Lake Lincoln City, OR

Contours in feet

Normalized to 10' lake stage



Mapped by SONAR-GPS
C. P. Gubala
February, 1994

DLWID Fish Control Structure

Revised bathymetric map of Devils Lake measured on January 28, 1994 using the methodology of Gubala et al. (In Press).