

1988 WATER USE REPORT

BENTON LAKE NATIONAL WILDLIFE REFUGE

Great Falls, Montana

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TABLE I: WATER RIGHTS AND USE AT BENTON LAKE NWR

REFUGE WATER RIGHTS

1988 WATER USE

Source	Point of Diversion Map	Means of Diversion	Flow Rate	Claimed Volume	Use	Type	Place	Amount	Period
Headquarters well	J	Pump	45 gpm	2 AF	Domestic	Fire Pro- tection	Headquarters	0 AF	Annual
Diffuse runoff	A	Dam	Natural ✓	135 AF	F & W	Marsh	Unit III	0 AF	Annual
Lake Creek runoff	B	Dam	500 cfs ✓	14,000 AF	F & W	Marsh	Units I-VI	200 0 AF	Annual
Diffuse runoff	C	Dam	Natural ✓	392 AF	F & W	Marsh	Unit IVa	0 AF	Annual
Diffuse runoff	D	Dam	Natural ✓	502 AF	F & W	Marsh	Unit IVa	0 AF	Annual
Other diffuse runoff	E, F, G	Dam	Natural	Unspecified	F & W	Marsh	Unit IV	0 AF	Annual
Other diffuse runoff	H, I	Dam	Natural	Unspecified	F & W	Marsh	Unit VI	0 AF	Annual
Muddy Creek (Irrigation flows)	K	Pump - 3x 16.6 cfs	50 cfs ✓	14,600 AF	F & W	Marsh	Units I-VI	7517 AF	Annual
Other		Dam			F & W	Marsh	Unit V	0 AF	Annual
TOTALS				29,631 AF				7517 AF	

TABLE II: WATER RIGHTS AND USE ON BENTON LAKE WMD

Source	WATER RIGHTS				1988 WATER USE				
	Point Diversion Map	Means of Diversion	Flow Rate	Claimed Volume	Use	Type	Place	Amount Acre Ft.	Period
<u>Furnell WPA</u>									
Trail Creek (s) 22	SE1/4NE1/4 SW1/4 Sec.	Headgate	2 cfs	480 AF	F & W	Wetlands Grasslands	Furnell	None	Annual
<u>Kingsbury Lake WPA</u>									
Stock Dam #1 (s)		Dam	Natural flow	1 AF	F & W	Pond	NE1/4NW1/4 SE1/4, Sec. 21	None	Annual
Stock Dam #2 (s)		Dam	Natural flow	2.5 AF	F & W	Pond	SE1/4SW1/4 SE1/4, Sec. 16	None	Annual
Stock Dam #3 (s)		Dam	Natural flow	2.5 AF	F & W	Pond	NE1/4NW1/4 SW1/4, Sec. 21	None	Annual
Unnamed coulee or dry runs (s)	011806	Dam	18 cfs	6.4 AF	F & W	Pond	SE1/4NE1/4 NW1/4, Sec. 18	None	Annual
" (s)	011807	Dam	12 cfs	6.4 AF	F & W	Pond	SE1/4SE1/4 SW1/4, Sec. 8	None	Annual
" (s)	011808	Dam	6 cfs	6.4 AF	F & W	Pond	W1/2NE1/4 Sec. 17	None	Annual
" (s)	011809	Dam	24 cfs	6.4 AF	F & W	Pond	SW1/4NW1/4 NW1/4, Sec. 21	None	Annual
" (s)	011811	Dam	3 cfs	6.4 AF	F & W	Pond	SW1/4SW1/4 NW1/4, Sec. 20	None	Annual
Alder Creek (s)	011810	Direct use	12 cfs	3.25 AF	F & W	Lake	T. 21N., R. 11 E., Sec. 19	30	Annual
Well, 5" casing (g)	011812	Windmill & tank - non- functional	.50 gpm	3.5 AF	F & W	Tank	NE1/4NW1/4 NW1/4, Sec. 21	None	Annual
TOTAL				524.75 AF	30 AF				

TABLE III: RECORDED MARSH UNIT ELEVATIONS FOR 1988

BENTON LAKE NATIONAL WILDLIFE REFUGE

Date	Flowline	UNIT I		UNIT II		UNIT III		UNIT IVa		UNIT IVb		UNIT IVc		UNIT V		UNIT VI	
		Elev.	Sal.*	Elev.	Sal.*	Elev.	Sal.*	Elev.	Sal.*	Elev.	Sal.*	Elev.	Sal.*	Elev.	Sal.*	Elev.	Sal.*
		3621.0		3615.0		3613.0		3613.0		3614.5		3613.0		3613.0		3613.0	
01/01	Frozen	3624.5		3620.7		3616.0				3615.9		3614.5		3615.7		3615.5	
01/15		3624.5		3620.7		3616.0				3615.9		3614.5		3615.7		3615.5	
02/01		3624.5		3620.7		3616.0				3615.9		3614.5		3615.7		3615.5	
02/15	Opening	3624.5		3620.6		3616.0				3615.9		3614.5		3615.6		3615.5	
03/01	up 02/21	3624.5		3620.6		3616.0				3616.0		3614.5		3615.5		3615.6	
03/15	Froze 3/10	3624.5		3620.5		3615.9				3615.9		3614.4		3615.5		3615.5	
04/01	1st ice	3624.0		3620.4		3615.8				3615.7		3614.3		3615.5		3615.3	
04/15	03/20	3624.3		3620.4		3615.6				3615.5		3614.1		3615.4		3615.2	
05/01		3625.4		3620.3	1650	3615.3	7500			3615.7		3615.0		3615.1		3614.9	
05/15		3625.65		3620.75		3615.25				3616.1		3614.7		3615.75		3615.6	
06/01		3625.45		3620.5		3615.45				3616.0		3614.95		3616.15		3615.65	
06/15		3625.5		3620.5		3615.9				3615.9		3615.0		3616.0		3615.8	
07/01		3625.5		3620.45		3615.7				3615.6		3614.7		3615.6		3615.6	
07/15		3625.5		3620.35		3615.75				3615.7		3614.3		3615.4		3616.4	
08/01		3625.75		3620.65		3615.4				3615.85		3614.2		3615.4		3615.2	
08/15		3625.5		3620.9		3615.3				3616.0		3614.3		3615.5		3615.3	
09/01		3625.4		3620.7		3615.3				3616.2		3614.0		3616.0		3615.4	
09/15		3625.7		3620.7		3615.4				3616.6		3614.9		3616.2		3615.6	
10/01		3625.5		3621.0		3615.2				3616.75		3614.8		3616.3		3616.0	
10/15	1st ice	3625.2		3620.8		3614.9				3616.7		3614.6		3616.0		3615.9	
11/01	cover 10/27	3625.1		3620.75		3614.7				3616.6		3614.5		3616.0		3615.8	
11/15	Open	3625.0		3620.7		3614.6				3616.5		3614.4		3616.0		3615.7	
12/01	Frozen	3625.0		3620.7		3614.6				3616.5		3614.4		3616.0		3615.6	
12/15	11/19	3625.0		3620.6		3614.6				3616.5		3614.4		3616.0		3615.6	
12/31		3625.0		3620.6		3614.6				3616.5		3614.4		3616.0		3615.6	
Maximum Elevation		3627.0		3622.0		3618.0		3618.0		3618.8		3618.0		3618.0		3618.8	
General Pool																	
Bottom		3623.0		3619.0		3615.0		3615.0		3615.0		3615.0		3615.0		3615.0	

Figure 1

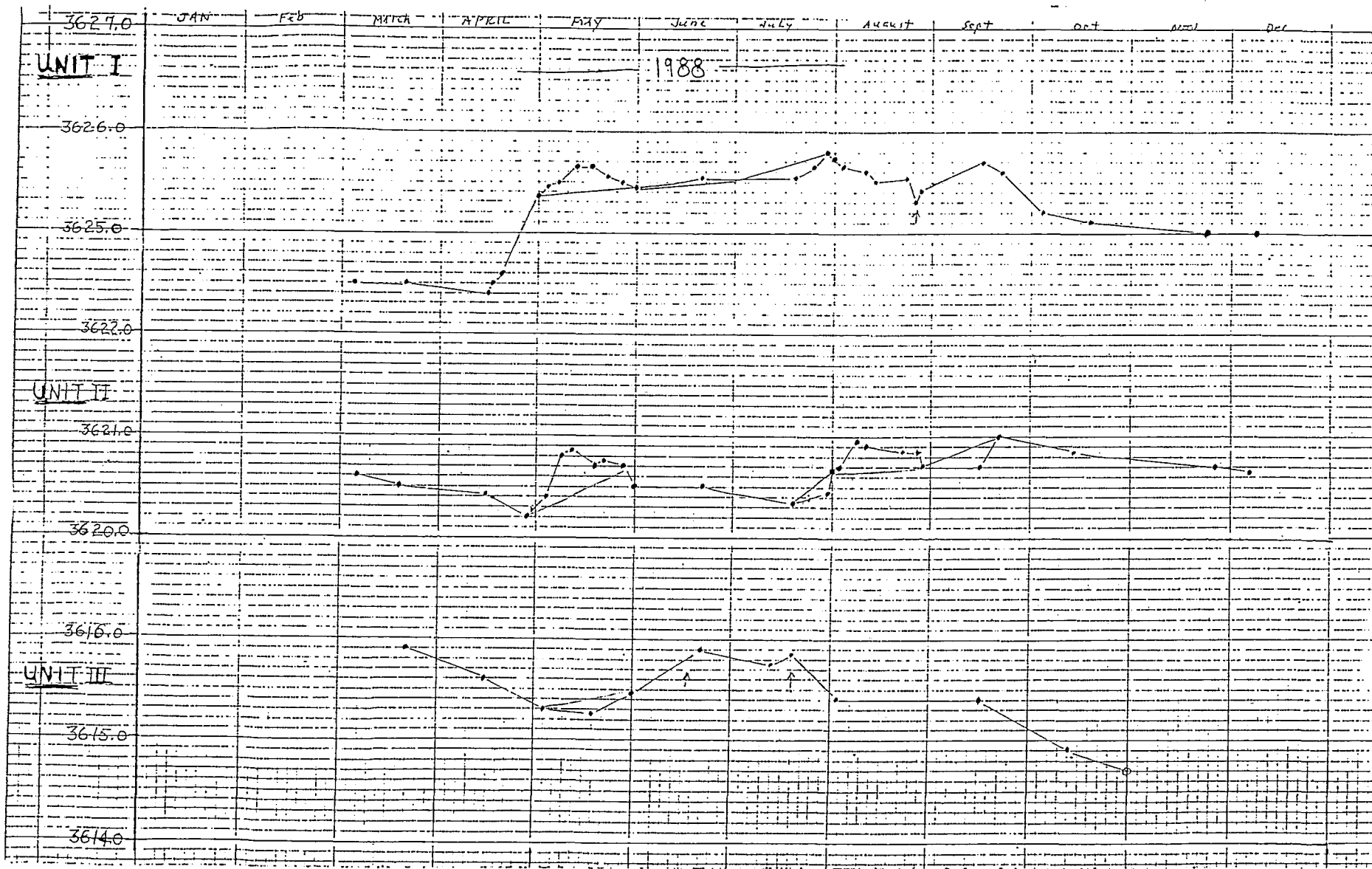


Figure 2

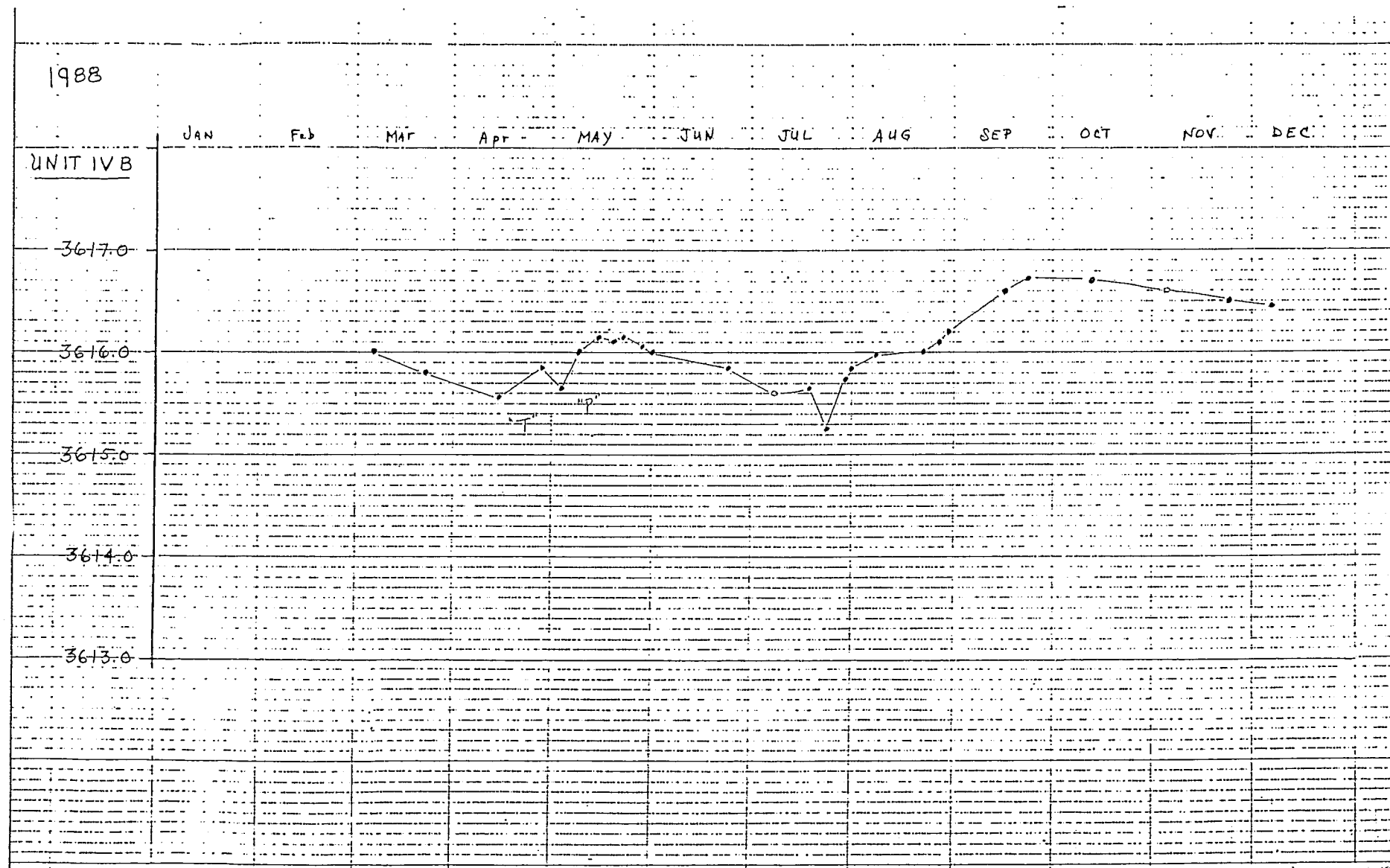


Figure 3

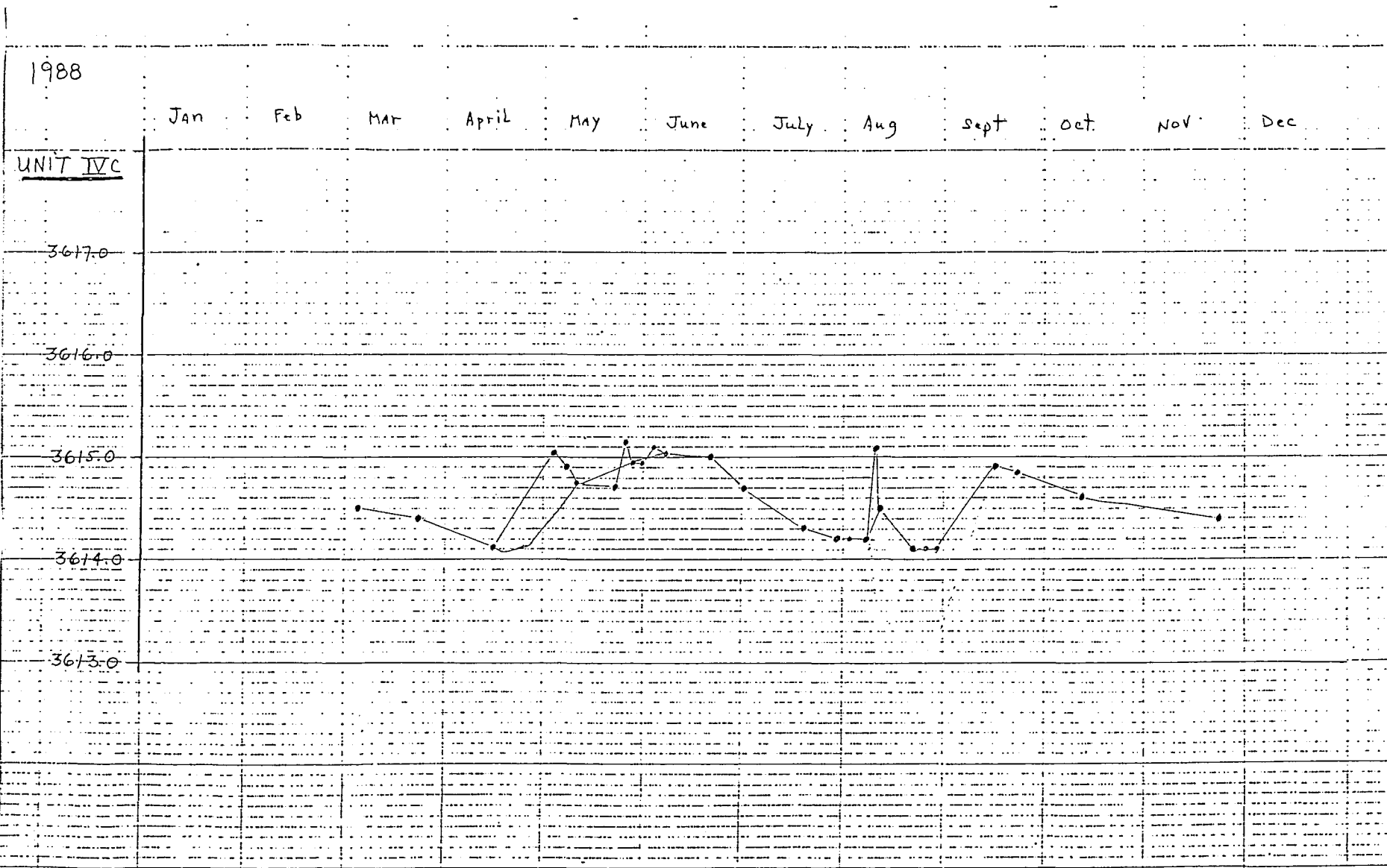


Figure 4

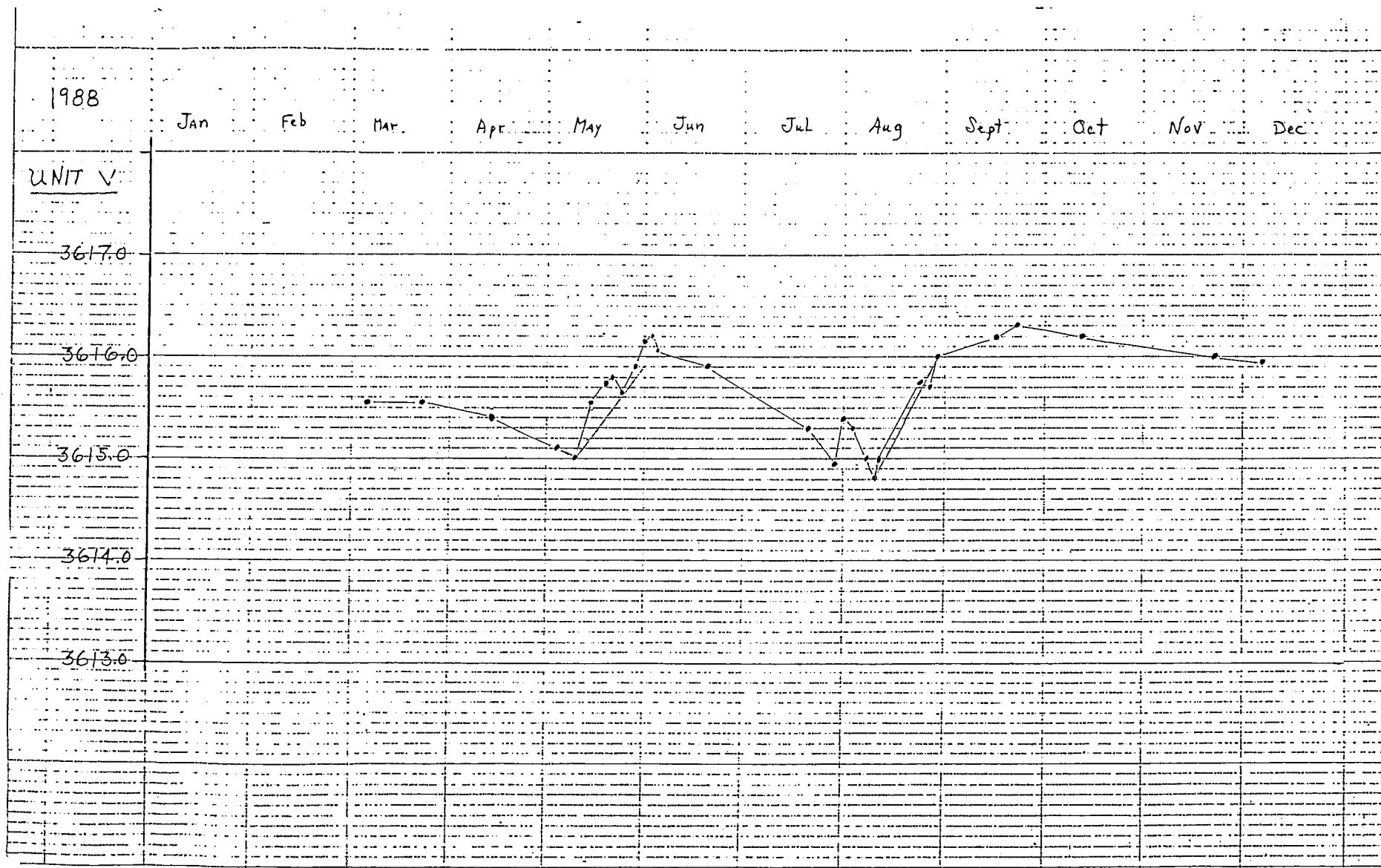
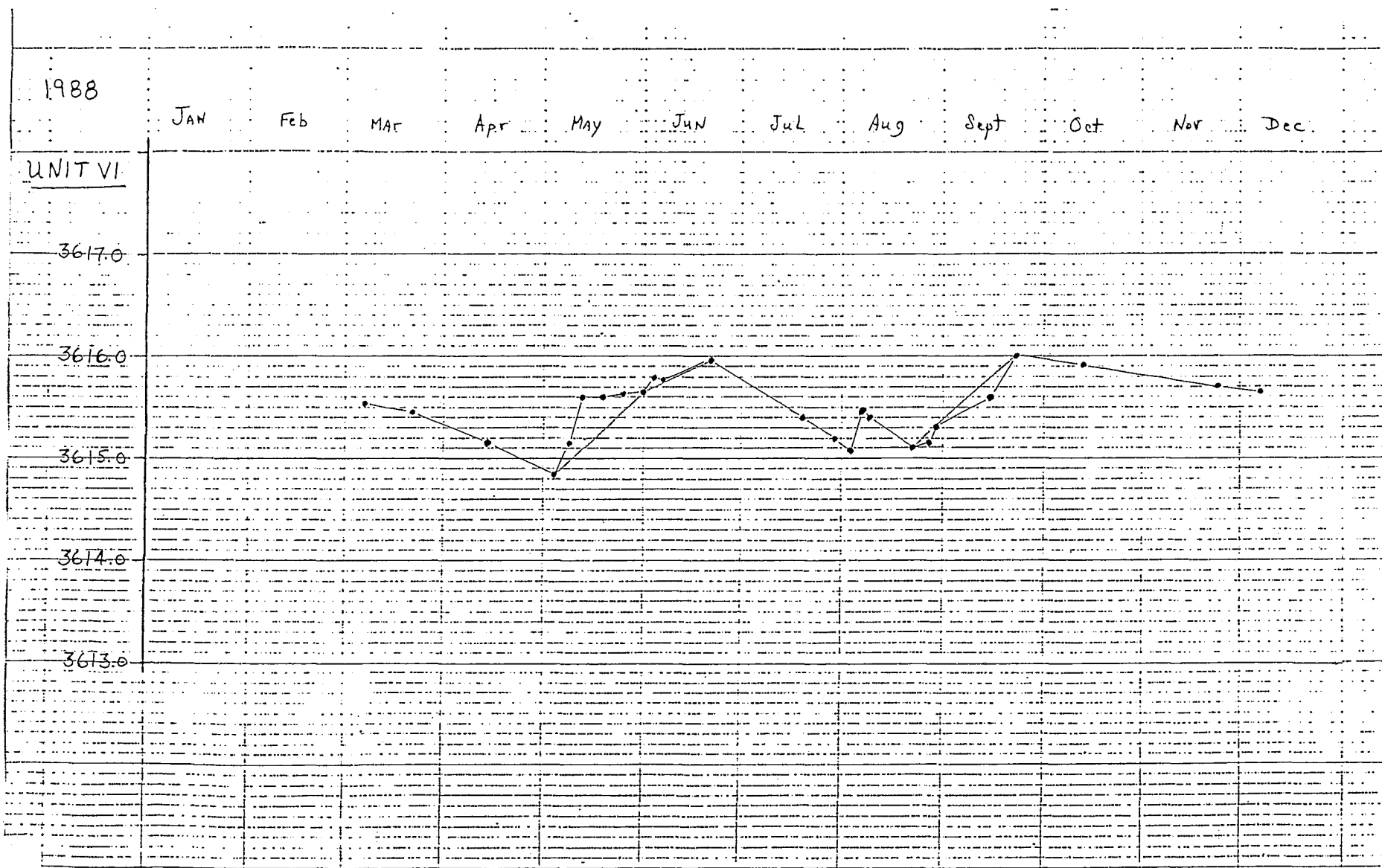


Figure 5



I. NARRATIVE DESCRIPTION

A. Weather Conditions

In a word - drought. Milder than usual winter conditions and warm dry winds much of the year aggravated wetland habitat conditions. Winter ice conditions held until February 21 when some open water was noted along the shoreline of Units V and VI. Colder weather on March 10th caused the marshes to close over again briefly. Warm dry conditions prevailed and the last ice was gone on March 20, 1988. In the fall, a hard winter storm hit and froze all units closed on October 27th without any preliminary warning. Warmer weather and winds helped waterfowl expand their roost holes the same week. The hard and "soft" water battled back and forth for two weeks, then on November 19th old man winter slammed the door until next spring.

- B. Measurements of water rights and use at Benton Lake are dependent on individual marsh unit water level gauge readings and associated field observations as no other recording instruments are in place. The accuracy of these projections is somewhat limited. Volume of water pumped from the Muddy Creek pumping station is calculated by multiplying pump hours by the rated capacity of the pumps. Runoff events occurring over long time periods or during periods of high evaporation complicate evaluation of such measurements. Runoff occurring during periods of pumping also becomes difficult to separate or measure.

The winter provided no snowpack and spring rains only helped recharge the soil somewhat but produced no measurable runoff into refuge marshes. A shortfall in carry over (stored) water from 1987, coupled with continuing drought conditions in 1988 resulted in reduced water production at Benton Lake in 1988. See Table V for details on pumped water volumes and distribution by marsh unit for 1988.

Pumping operations (Table VI) were incapable of replenishing the marshes for spring migration and it was late May to early June before marsh units were anywhere close to target management levels. See Figures 1-5. Pumping operations were reduced during mid summer to conserve budget dollars for fall refilling. This was an effort to provide for migrants, waterfowl hunting and hopefully regain stored waters for winter carry-over into 1989. All three pumps were utilized in August and September to the extent provided by available water at the pumping station. Fall pumping was terminated prematurely on September 18th by a snow/ice storm that took down the power lines. After a two week delay, power was restored. Weather and water conditions then caused us to postpone further pumping until the spring of 1989. Table VII provides the annual pumping summary from our Muddy Creek pump station. Water from Unit II was used early in the season to

help maintain optimum habitat condition in Unit IVb. The inter-unit pump system was used to transfer stale water from Unit V low basins and borrow areas into Unit IVc. See Table VIII.

Table IX computes average surface acres for the units and provides a means of estimating expected water consumption. This is based on long term average evaporation rates for this area of 2.5 feet for the April to October period. An annual water budget worksheet (Table XI) was developed and shows the correlation between this theoretical consumption rate (5979 AF) and the apparent rate as measured in the individual units (7944). The large disparity of nearly 2000 acre feet is a measure of the drought conditions (lack of rainfall) and warm windy weather, thus effecting the evaporation rate and causing frustration in trying to gain ground on stored water carryover. Table X illustrates unit volumes and surface acres at the beginning and end of 1988.

TABLE IV: 1988 RUNOFF WATER RECEIVED

	U N I T S							
Time	I	II	III	IVa	IV	V	VI	Totals
Carry over*								
January								None
February		No measurable runoff in 1988						None
March								None
April	208							208
May	763 971							None
June								None
Other								None
Totals	208							208

accumulation during freeze-up winter period

WATER RIGHTS:

A. Unit III basin (runoff from north)	None
B. Lake Creek runoff (Units I, II, plus	208
C. Unit IVa (main watershed)	None
D. Unit IVa (south watershed)	None
EFG. Unit IV (basin runoff)	None
HI. Unit VI (basin runoff)	None
Sub-total	208
Unit V (not filed on)	None
TOTAL	208

TABLE V: PUMPED WATER DISTRIBUTION

Month	Total	Units							Comments
		I	II	III	IVb	IVc	V	VI	
April	109	109							
May	1637	72	125	115	105	299	605	316	
June	1575	148	100	457	100	160	337	273	Unit gauge readings could account for only 4365 AF of pumped water
July	477	103	85	130	41	38	80	0	
Aug.	1911	162	114	230	183	145	713	364	
Sept.	1807	169	115	0	272	200	523	528	
TOTALS	7516	763	539	932	701	842	2258	1481	

TABLE VI: 1988 PUMPING PATTERN

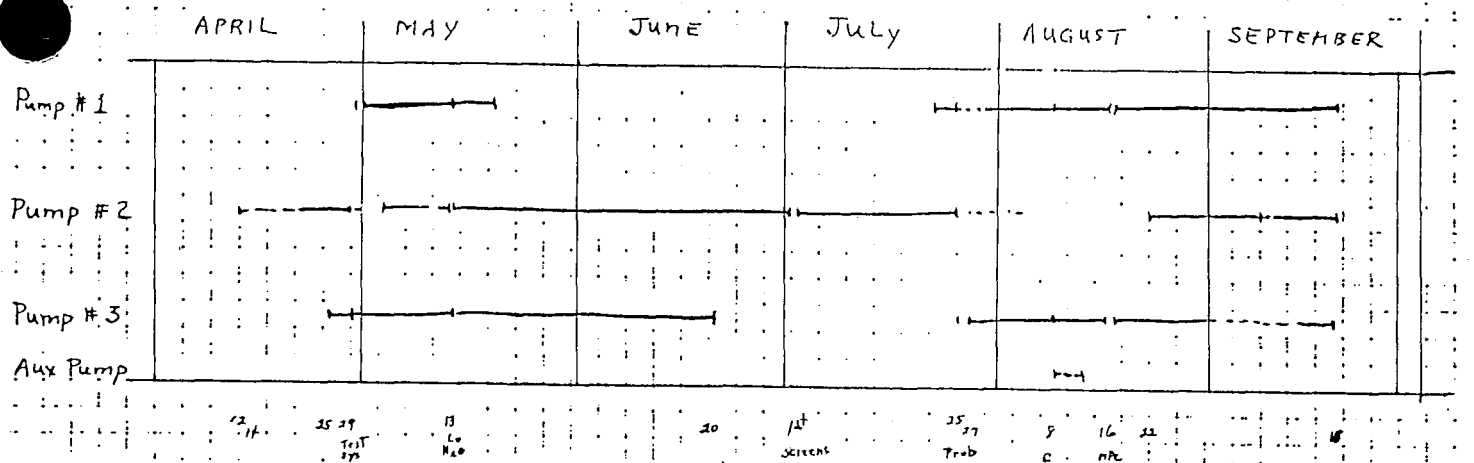


TABLE VII: ANNUAL WATER PUMPING REPORT - 1988

A. PUMPING DATA

1. Hours Operated

Pump No. 1 1787

Pump No. 2 2818

Pump No. 3 2265

Total 6870

2. Acre feet pumped

~~7516~~ 7517

3. Kilowatt hours used 1,565,760

4. Costs \$51,192.22

B. WATER QUANTITY DATA

1. Acre feet on hand (beginning) 2146

2. Acre feet received (pumped + runoff) (~~7516~~ 7724 7725)

3. Acre feet account 9663 → 9971

4. Acre feet on hand (close) 1926

5. Normal net evaporative loss 5980

6. Acre feet consumed (actual) 7944 7945

7. Acre feet difference 220

8. Cost/acre foot \$6.81

TABLE VIII: WATER TRANSFER BETWEEN UNITS

Month	Units						Comments	
	I	II	III	IVb	IVc	V		VI
January								
February								
March								
April		-69		+49				Gravity flows
May								
June								
July								
August					+45	-65		(Ip) desalting V into IVc with inter-unit pumping system
September								
October								
November								
December								
(-)		69				65		
TOTALS								
(+)				49	45			BALANCE*

*Gauge reading inaccurate in measuring these small amounts

TABLE IX: AVERAGE SURFACE ACRES

	I	II	III	IVa	IVb	IVc	V	VI	TOTAL
April	283	236	397	-	176	194	326	278	1890
May	347	291	204	-	216	529	494	439	2520
June	345	261	454	-	193	528	690	569	3040
July	354	254	441	-	162	192	309	375	2088
Aug.	347	314	241	-	222	126	337	341	1928
Sept.	348	329	134	-	254	478	745	509	2797
Oct.	327	317	18	-	254	235	738	593	2482
Total	2351	2002	1890	-	1477	2282	3639	3104	16745
Ave. SA	336 x2.5	286	270	-	211	326	520	443	2392
ap. (2.5)	840	715	675	-	527	815	1300	1108	5980

TABLE X: 1988 WATER BALANCES

UNIT	Elevations		Surface Acres		Acre Feet Contained		Acre Feet Received	Acre Feet Discharged	Acre Feet Consumed
	Beginning	End	Beginning	End	Beginning	End			
I	3624.5	3625.0	272	318	412	563	971		820
II	3620.7	3620.6	294	280	376	347	539		568
III	(3610.0)?	3614.6	922	17	721	5	932		1648
IVa	-	-	-	-	-	-	-		-
IVb	3615.9	3616.5	209	248	113	252	701		562
IVc	3614.5	3614.4	208	154	70	52	887		905
V	3615.7	3616.0	599	727	246	448	2213		1991
VI	3615.5	3615.6	486	536	208	259	1481		1430
TOTALS			2990	2280	2146	1926	7724		7944
NET				-710		-220			

TABLE XI: WATER BUDGET WORKSHEET

Item/Unit	Acre Ft.	I	II	III	IVb	IVc	V	VI
E.O.P. Year (AF)	2146	412	376	721	113	70	246	208
Over Winter +/-								
Runoff	Date/AF							
Feb.	-	-	-	-	-	-	-	-
Mar.	-	-	-	-	-	-	-	-
Apr.	208	208	-	-	-	-	-	-
May	-	-	-	-	-	-	-	-
June	-	-	-	-	-	-	-	-
July	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-
TOTAL	208	208	0	0	0	0	0	0
Pumped in Date/AF								
April	209	109						
May	1637	72	125	115	105	299	605	316
June	1575	178	100	457	100	160	337	273
July	477	103	85	130	41	38	80	0
Aug.	1911	162	114	230	183	145	713	364
Sept.	1897	169	115	0	272	200	5234	528
TOTAL	7516	763	539	932	701	842	2258	1481
Inter-Unit Pumping - Dates								
May	-	-	-	-	-	-	-	-
June	-	-	-	-	-	-	-	-
July	-	-	-	-	-	-	-	-
Aug.	08-10 (45)	-	-	-	-	+45	-45	-
Sept.	-	-	-	-	-	-	-	-
TOTAL	(45)					+45	-45	
TOTAL IN	7724	971	539	932	701	887	2293	1481
A.F Account	9870	1383	915	1653	814	957	2439	1689
E.O.Y.	1926	563	347	5	252	52	448	259
Net difference	7944	820	568	1648	562	905	1991	1430
Average Surface Acres	2392	336	286	270	211	326	520	443
Estimated Evaporation Rate	5979	839	725	675	527	815	1300	1108

Wetland Management District

Drought continues to plague Montana with water conditions in the district being the worst since the WMD was established in 1975. All but three WPA's (Jarina, McCormick and Furnell) were completely dry for the entire year. Combined with previous years of drought, this paints a dismal picture for waterfowl populations.

Spring wetland conditions in the Sweetgrass Hills were poor with most basins drying up by mid-June. No water rights were exercised on the Furnell WPA due to the lack of runoff. No runoff was available for alfalfa irrigation on the adjacent Wehr ranch.

Kingsbury Lake WPA was all but dry during the year. The perimeter stock ponds quickly dried up by mid summer due to low levels from last year's drought followed by no spring runoff in 1988. Needless to say, no water rights were exercised.

The Sands WPA completely dried up for the first time in many years. Spring wetland conditions on the Jarina WPA were poor with all the seasonal basins (Type I's and III's) being dry by June and the larger Type IV's and V's nearly dry in August.

Significant winter snow pack will be necessary to turn things around next year.