

1991 WATER USE REPORT
BENTON LAKE NATIONAL WILDLIFE REFUGE
Great Falls, Montana

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Prepared by: *Stephen J. Tuttle*

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Reviewed by: *James E. McCallum*

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TABLE 1: WATER RIGHTS AND USE AT BENTON LAKE NWR

REFUGE WATER RIGHTS							1991 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	133 AF	Annual
Lake Creek runoff	B	Dam	500 cfs	14,000 AF	F & W	Marsh	Units I-VI	645 AF	Annual
Diffuse runoff	C	Dam	Natural	392 AF	F & W	Marsh	Unit IVa	40 AF	Annual
Diffuse runoff	D	Dam	Natural	23 AF	F & W	Marsh	Unit IVa	0 AF	Annual
Other diffuse runoff	E,F,G	Dam	Natural	176 AF	F & W	Marsh	Unit IV	70 AF	Annual
Other diffuse runoff	H,I	Dam	Natural	303 AF	F & W	Marsh	Unit VI	55 AF	Annual
Muddy Creek (Irrigation flows)	K	Pump - 3x 16.6 cfs	50 cfs	14,600 AF	F & W	Marsh	Units I-VI	8028 AF	Annual
Other		Dam			F & W	Marsh	Unit V	0 AF	Annual
TOTALS				29,631 AF				8971 AF	

TABLE 2 WATER RIGHTS AND USE ON BENTON LAKE WMD

WATER RIGHTS					1991 WATER USE				
Source	Point Diversion Map	Means of Diversion	Flow Rate	Claimed Volume	Use	Type	Place	Amount Acre Ft.	Period
<u>Furnell WPA</u>									
Trail Creek (s)	SE1/4NE1/4 SW1/4 S22	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	2	Annual
Stock Dam #2 (s)		Dam	Natural flow	2.5 AF	F & W	Pond	SE1/4SW1/4 SE1/4, Sec. 16	2	Annual
Stock Dam #3 (s)		Dam	Natural flow	2.5 AF	F & W	Pond	NE1/4NW1/4 SW1/4, Sec. 21	2	Annual
Unnamed coulee or dry runs (s)	011806	Dam	18 cfs	6.4 AF	F & W	Pond	SE1/4NE1/4 NW1/4, Sec. 28	3	Annual
" (s)	011807	Dam	12 cfs	6.4 AF	F & W	Pond	SE1/4SE1/4 SW1/4, Sec. 8	1	Annual
" (s)	011808	Dam	6 cfs	6.4 AF	F & W	Pond	W1/2NE1/4 Sec. 17	1	Annual
" (s)	011809	Dam	24 cfs	6.4 AF	F & W	Pond	SW1/4NW1/4 NW1/4, Sec. 21	1.5	Annual
" (s)	011811	Dam	3 cfs	6.4 AF	F & W	Pond	SW1/4SW1/4 NW1/4, Sec. 20	1.5	Annual
Alder Creek (s)	011810	Direct use	12 cfs	6.0 AF	F & W	Lake	T. 21N., R. 11 E., Sec. 19	75	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

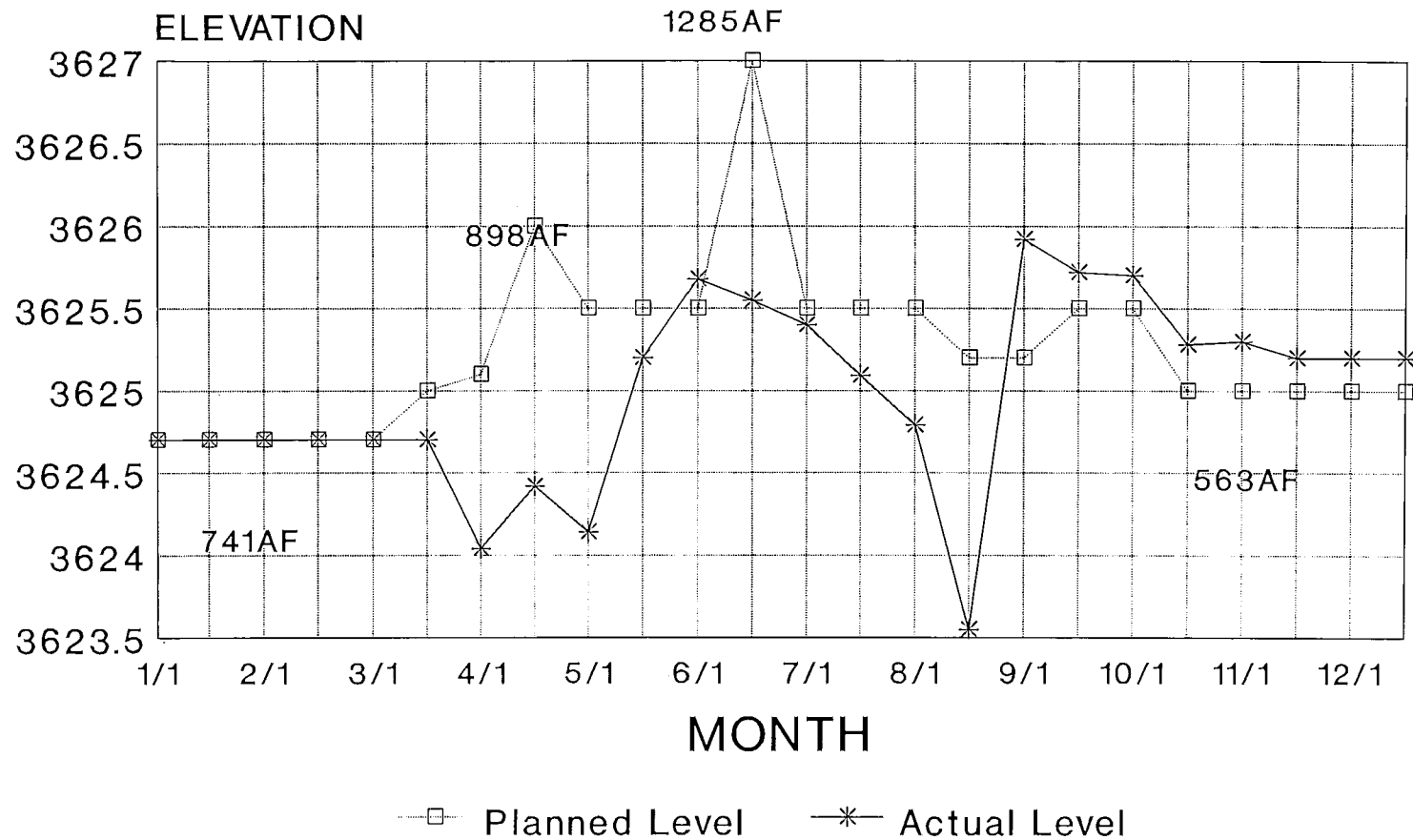
TABLE 2 (CONINUED) WATER RIGHTS AND USE ON BENTON LAKE WMD

WATER RIGHTS					1991 WATER USE				
Source	Point Diversion Map	Means of Diversion	Flow Rate	Claimed Volume	Use	Type	Place	Amount Acre Ft.	Period
<u>Blackfoot WPA</u>									
Unnamed springs	NE1/4SW1/4 SE1/4, S15 T14N, R11W	Direct use	Natural flow	483 AF	F & W	Marsh	S1/2 S15 N1/2 S22, T14N, R11W	400	Annual
Big Blackfoot River	SW1/4SW1/4 NW1/4 S22 T14N, R11W	Pump	N/A	370 AF	F & W	Marsh	N1/2 S22 SE 1/4 S15 T14N, R11W	None	Annual
<u>Sands WPA</u>									
Beaver Creek Water Contract*	NE1/4 S27 T32N, R15E	Headgate	Unknown	50 AF	F & W	Lake	Sands WPA	50	Annual
TOTAL				1427.75					539 AF

* This is a ten year water contract which was transferred to the FWS by the previous landowner. The contract is for 50 AF annually. The water is diverted from Beaver Creek through a water distribution system on private lands which flows into the WPA.

UNIT I

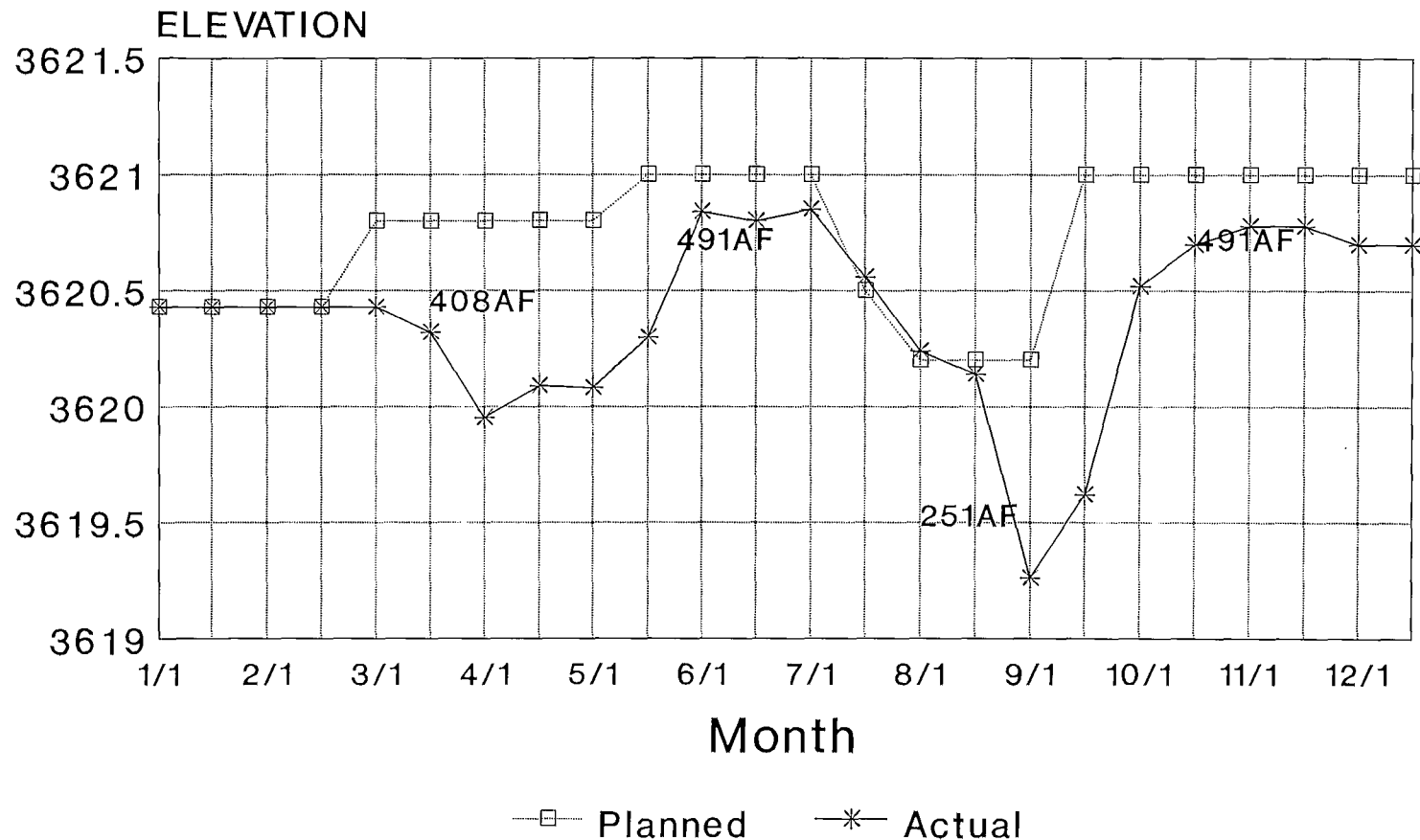
Marsh Unit Elevations 1991



1991

Unit II

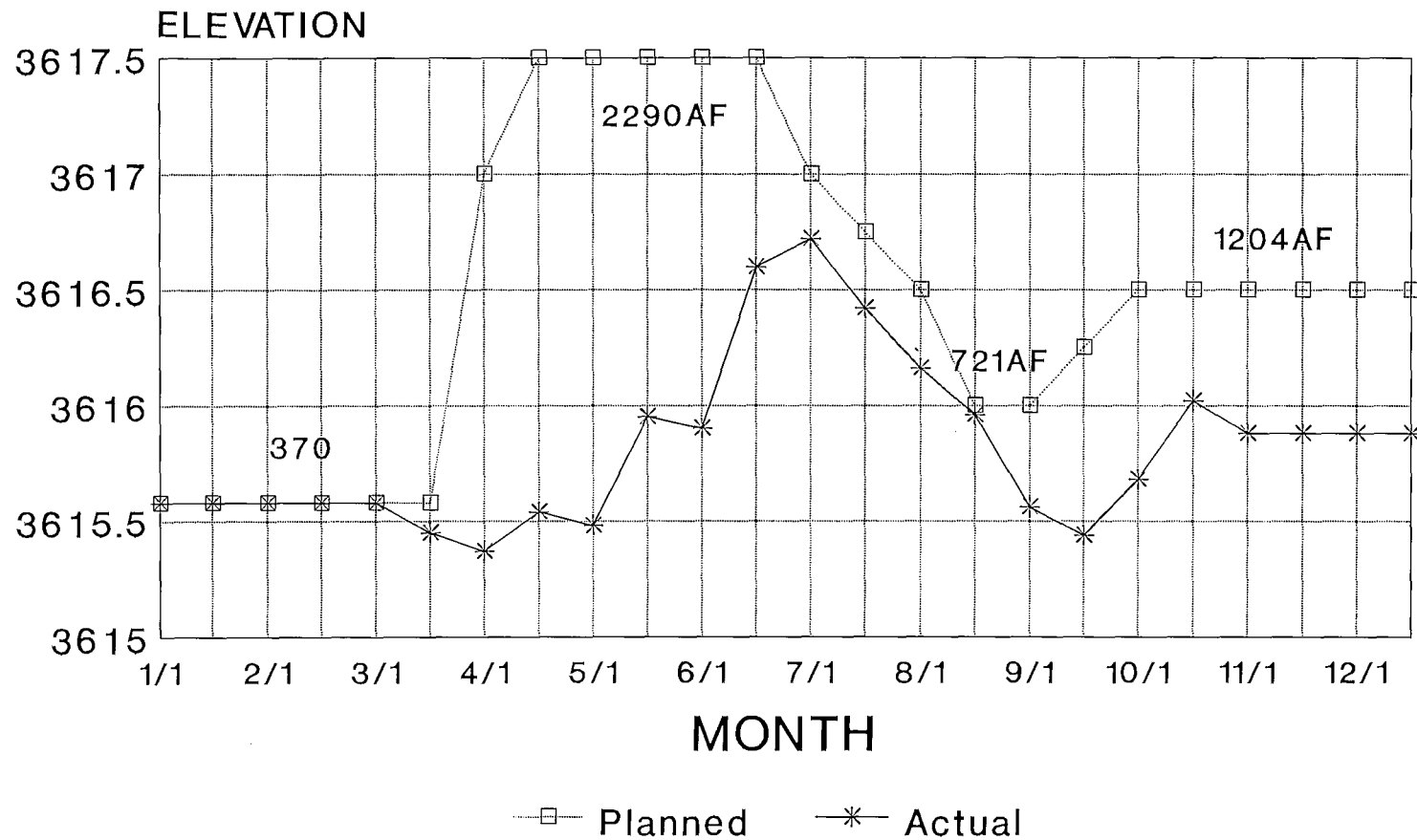
Marsh Unit Elevations 1991



1991

UNIT III

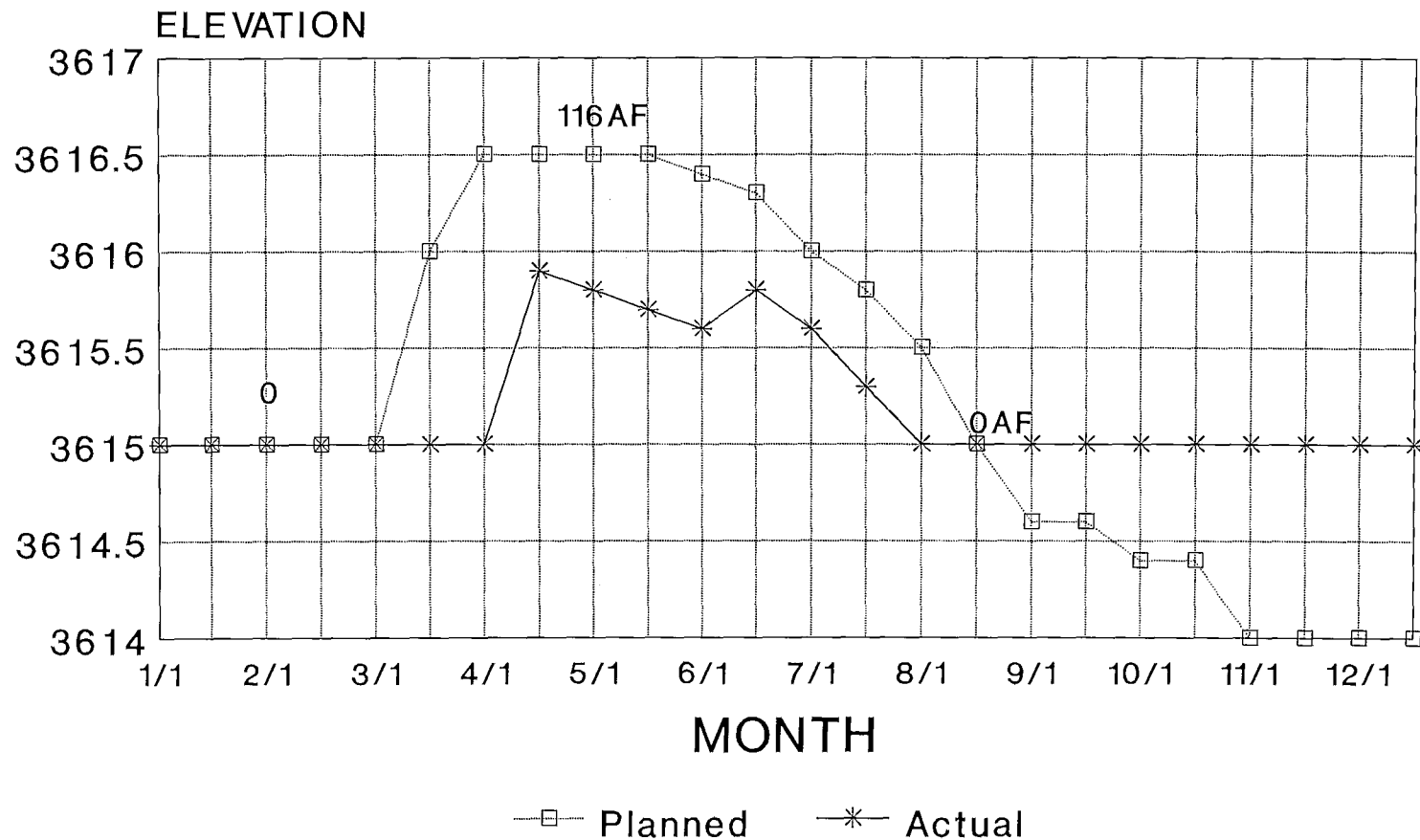
Marsh Unit Elevations 1991



1991

UNIT IVa

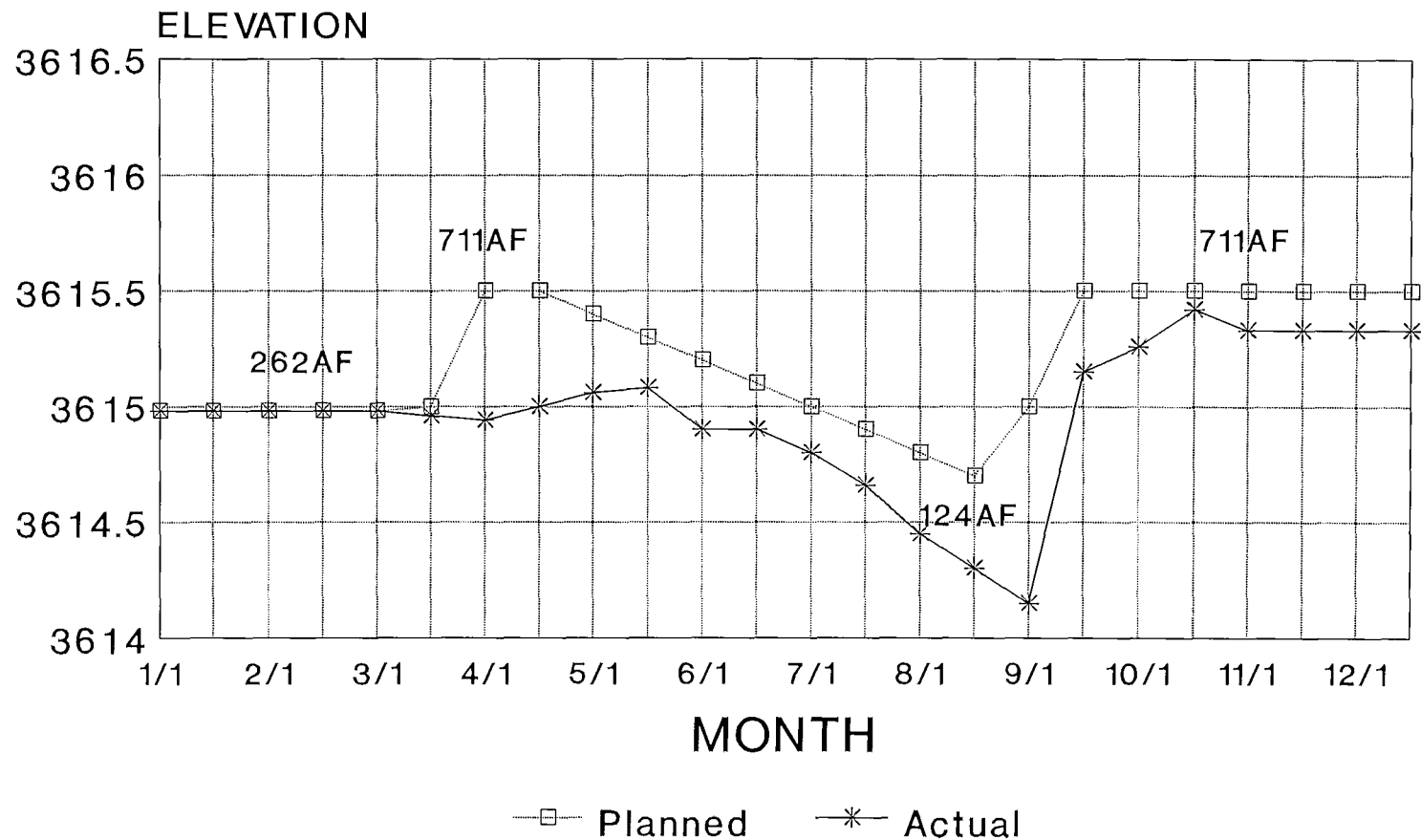
Marsh Unit Elevations 1991



1991

UNIT IVc

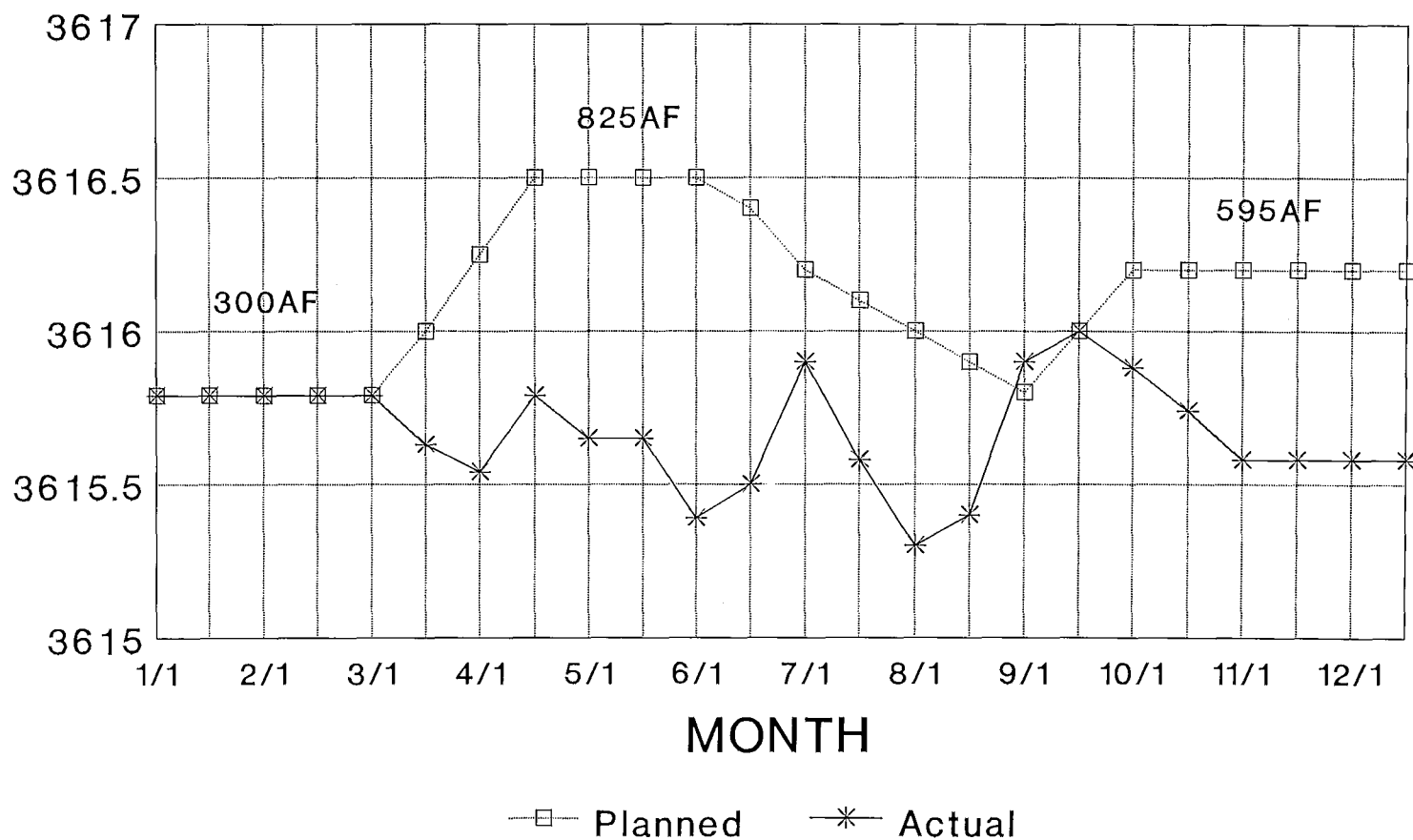
Marsh Unit Elevations 1991



1991

UNIT V

Marsh Unit Elevations 1991



1991

II. NARRATIVE DESCRIPTION

A. Weather Conditions

The eight refuge marsh units began thawing in late February and were completely ice free by March 18th. Summer was characterized as dry and windy. Fall weather was mild with above normal temperatures and winds throughout September and October. During November and December the marshes iced over and thawed several times. Single digit temperatures in mid-December resulted in a hard freeze and the units remained frozen for the remainder of the year.

B. Lake Creek Gage Station

Historic measurements of runoff and corresponding water rights at Benton Lake have been dependent on individual marsh unit gauge readings and water capacity charts developed years ago. The accuracy of these measurements has been limited since small runoff events may not be reflected on a gage, those occurring over a long time period are influenced by high evaporation and runoff during periods of pumping are difficult to separate or measure. Ideally, all watersheds should be fitted with gage stations that would accurately measure runoff and allow for better tracking of water received. A USGS gage station installed on the Lake Creek in July 1990 was the first step in improving the measurements of flows that enter the refuge.

Data collected at the gaging station this year was used to estimate runoff received from the Lake Creek drainage. These data revealed an apparent error in the marsh capacity tables for Unit I. During the period of March 24th through April 21st runoff received by Unit I based on an increase in elevation from 3624 (270 AF) to 3625.14 (608 AF) indicated a net increase of 338 AF. This figure based on capacity tables is considerable greater than the 190 AF figure from the gage station. This discrepancy may be related to the change in marsh unit I capacities due to the deposition of 25 years of silt from runoff and pumped water. Comparison will be conducted again in 1992 between gage station readings and capacity tables. If large differences are again noted then a resurvey of the unit to generate a new capacity table will be warranted.

The gaging station also provided an insight into the amount of water that was pumped water from Muddy Creek. Prior to the gage station the amount of water pumped was based on theoretical pump capacities. The amount of water pumped was based the capacity of each pump times the number of hours each pump was operating (Table 6) each month. This theoretical acre feet pumped figure was always greater than amount received by each marsh units according to the staff gage and capacity tables. This year that difference was 2615 AF and is identified as the total pumped water unaccounted for in Table 4. Previous water management reports identified this unaccounted water as estimates of evaporation and transport losses. Using data from the gage during this year indicates that the amount

of water that flows through the gage is less than the theoretical capacity. Pump records indicate that 8028 AF were pumped compared with 7129 AF that flowed through the gage. This data indicates that the pump capacities based on the theoretical figures are not accurate and that their use will overestimate pumped water. Although there is certainly some loss of pumped water as it flows 15 miles to the gage station the maximum CFS of 39 at the gage station is also less than the theoretical 42 CFS of the pumps.

For the purpose of this year's report the Lake Creek Gage Station data was used only to estimate runoff flows. Calculations of pumped water are based on pump capacities and marsh unit capacity tables. Plans for 1992 include additional use of the gage station data and eventually conversion to the gage for all inflows that enter Unit I.

C. Water Use Discussion

Lack of winter snow and below normal spring rains resulted in little runoff into the refuge. March and June runoff totaled 943 acre-feet compared to 911 acre-feet in 1990 and 7301 acre-feet received in 1989. Runoff received by marsh unit, month and water right is shown in Table 3.

Although all marsh units had some water in early spring the surface acres (SA) and acre-feet (AF) totals for the refuge were well below objective levels. Objective levels for April were 4,600 SA compared to 2,700 actual acres. Because of this deficit supplemental water was pumped from the Muddy Creek in May and June and again in during August, September and October. Water pumped during the year totaled 8,028 AF. Pumping costs totaled \$57,809 or \$7.20/AF. Table 6 summarizes the annual water pumping for 1991.

Pumped water was distributed to all units except IVa (Table 4). There is no feasible way to transfer water to that unit. A proposed Duck's Unlimited project in Unit IVa will eventually provide greater flexibility in water management by allowing water to be transferred from Units I and II. The project was originally scheduled for construction in 1990 but due to funding problems it has been rescheduled for 1993.

Table 5 computes average surface acres for the units and provides a means of estimating water consumption based on long term average evaporation rates for this area of 2.5 feet for the April to October period. Evaporative loss based on this figure would have been 7352 AF. Actual consumption was 5036 AF (Table 7).

Units I (Figure 1) and II (Figure 2) were drained for one to two days in August so that silt accumulated at the outlet structures could be removed.

Unit III (Figure 3) the largest marsh, received nearly one-quarter of the pumped water. Emergent vegetation continued to expand and cattail and hardstem bulrush stands are now established throughout

the unit. This unit traditionally experiences avian botulism and this year was no exception. To combat botulism the unit is normally allowed to draw down naturally through evaporation and transpiration. Then if botulism develops, the remaining water is drawn down by the use of electric pumps. Unfortunately the inter-unit pumping system failed this season resulting in a major botulism outbreak. After the botulism season 264 AF of pumped water were delivered to the unit for fall migration

With the exception of Unit IVa (Figure 4), all units had adequate water during April, May and June for breeding waterfowl and other waterbirds. Unit IVa contained little water in April and was dry from June-December.

Unit IVb (Figure 5) received 27 AF of pumped water in the spring. Water levels were allowed to drop during the botulism season and refilling began in September. Pumping delivered 274 AF during the fall. Emergent growth continues to improve throughout the unit.

Unit IVc (Figure 6) received no pumped water during the spring and was nearly dry by late August. Fall pumping delivered nearly 500 AF of much needed water. Thousands of mallards, pintails, green-winged teal and other ducks were attracted to alkali bulrush, lambsquarter, and other shallow flooded vegetation. This in turn attracted large numbers of hunters once the fall waterfowl hunting season began.

Unit V (Figure 7) received only 275 AF of pumped water during the spring and was nearly dry by September. Five-hundred seven-teen AF of pumped water was added in late summer and provided enough water for the hunting season.

Unit VI (Figure 8) received 274 AF during the spring and 608 AF in the fall. The marsh was allowed to drawdown naturally in late August due to botulism. The draw downs were successful in limiting the botulism mortality without the use of the inter-units pumps.

All units at year's end contained more water than at year end in 1990. The marsh surface acres totaled 3944 SA (3191 AF) in December compared to 2925 SA (1871 AF) in January. A Water Balance Worksheet in Table 7 summaries beginning and ending water levels and amounts for the eight marsh units.

	UNIT								
MONTH	I	II	III	IVb	IVc	V	VI	TOTAL	TOTAL PUMPED
MAY	167	240	297	27	0	0	274	1005	1590
JUNE	66	15	819	0	0	275	0	1175	1569
AUGUST	466	176	0	0	0	0	0	642	827
SEPTEMBER	0	243	75	134	433	517	259	1661	2560
OCTOBER	34	51	189	144	163	0	349	930	1482
TOTALS	733	725	1380	305	596	792	882	5413	8028
TOTAL PUMPED WATER UNACCOUNTED FOR								2615	AF

TABLE 5
AVERAGE SURFACE ACRES-1991

<u>MONTH</u>	<u>UNIT</u>								<u>TOTAL</u>
	<u>I</u>	<u>II</u>	<u>III</u>	<u>IVa</u>	<u>IVb</u>	<u>IVc</u>	<u>V</u>	<u>VI</u>	
MARCH	250	219	252	0	210	545	517	429	2422
APRIL	286	206	266	86	212	594	548	554	2752
MAY	337	246	536	0	224	597	433	547	2920
JUNE	338	311	1034	50	232	471	523	648	3607
JULY	338	278	1001	10	212	295	508	613	3255
AUGUST	291	217	868	0	102	135	236	511	2360
SEPTEMBER	356	192	347	0	138	591	545	314	2483
OCTOBER	346	280	564	0	230	1016	629	647	3712
Average	318	244	609	18	195	531	492	533	2940
Total	2542	1949	4868	146	1560	4244	3939	4263	23,511
Evaporative Loss	795	610	1523	45	488	1328	1230	1333	7352

Total Evaporative loss = 7,352 AF

TABLE 6

ANNUAL WATER PUMPING REPORT 1991

A. PUMPING DATA

1. Hours Operated

Pump No. 1	2374
Pump No. 2	2568
Pump No. 3	2173
Total	7115

2. Acre feet pumped	8028
3. Kilowatt hours	1,656,640
4. Electricity costs	\$57,809.33

B. WATER QUANTITY DATA

1. Acre feet on hand(beginning)	1871
2. Acre feet received	6356
3. Acre feet account	7983
4. Acre feet on hand(close)	3191
5. Normal Net Evaporative loss	7352
6. Acre feet consumed(actual)	5036
7. Acre feet difference	+1320
8. Cost/acre foot	\$7.20

TABLE 7

WATER BALANCE WORKSHEET - ALL UNITS

Calendar Year 1991 "Report"

Unit	<u>Elevations</u>		<u>Surface Acres</u>		<u>Acre Feet Contained</u>		Acre Feet Received	Acre Feet Discharged	Acre Feet Consumed
	Beginning	End	Beginning	End	Beginning	End			
I	3624.70	3625.20	290	330	471	624	1355		1202
II	3620.43	3620.78	250	310	300	398	748		650
III	3615.58	3615.88	760	887	360	614	1513		1259
IVa	3615.00	3615.00	0	0	0	0	40		40
IVb	3616.05	3616.30	225	239	150	204	305		251
IVc	3614.98	3615.33	580	1007	250	524	666		392
V	3615.79	3615.58	660	519	300	178	792		914
VI	3615.00	3616.25	160	652	40	649	937		328
TOTALS			2925	3944	1871	3191	6356		5036
Change				+1019		+1320			

D. Wetland Management District

Wetland conditions deteriorated throughout the district in 1991. Little spring runoff was received. Precipitation that was significantly above normal throughout much of the WMD in late spring and early summer did little to recharge dry basins. An extremely dry summer and fall dried up virtually all basins by freeze-up. The Jarina, Blackfoot and Sand's WPA's were the only three WPA's in the district that held any water at year's end.

No water rights were exercised on the Furnell WPA. Most basins were dry by early July.

Kingsbury Lake WPA received virtually no spring runoff and the entire lake was dry by late summer. All of the stock ponds on the unit were dry by fall. No water rights were exercised on this unit.

A new screw gate structure and culvert crossing were installed on the Havre Irrigation Canal which provides water for the Sands WPA. The old structures had deteriorated badly and had begun to leak. The water permit for fifty acre feet was exercised on this unit. An additional 210 acre feet was purchased and additional water was donated by local landowners. The Hill County Commissioners requested that we take additional water on the unit in the spring to alleviate flooding on the Havre golf course. We complied with this request. Over 600 acre feet of water was diverted into the Sand's WPA in 1991.

Nearly 100 acres of wetlands restored by Duck's Unlimited in October of 1990 on the Blackfoot WPA were filled in 1991 using artesian spring water on the WPA. Water was diverted from Pool 3 (the primary source of artesian spring flows) to Pools 4 and 1. Additional water was diverted from Pool 4 to reflood Pool 1 in October. All pools were full at freeze up.