

See Summary of Waterfowl Use by Units attached.

WATER MANAGEMENT PROGRAM - 1965

Des Lacs National Wildlife Refuge

Water conditions

The table below shows the Des Lacs pool elevations for 1964, indicating a comparison of gage readings at the time of freeze-up with approved elevations for the end of the year. The amount of variation between actual and approved levels is also indicated:

Pool No.	Winter Elevation		Approved Level		Deficiency or Excess
	Gage	Sea Level	Gage	Sea Level	
1	11.62	1781.62	11.56 on	12-31-63	+.06
2	8.36	1785.36	6.00-8.00	1785.00	+.36
3	8.50	1785.50	8.00	1785.00	+.50
4	8.56	1785.56	6.00-8.00	1785.00	+.56
5	6.08	1783.08	5.00	1782.00	+1.08
6	5.98	1782.98	6.00	1783.00	-.02
7	3.26	1780.26	3.00	1780.00	+.26
8	3.12	1780.12	3.00	1780.00	+.12

Total precipitation for calendar year 1964 was 15.97 inches, this being .51 inches or 3 percent above the normal of 15.46 inches. Precipitation for the first 4 months of the year was normal with a total of 23 inches of snow for that period. The amount for May, July and August was below average but it was far above normal for June as it was last year. The total for the 4 month summer period was 1.20 inches above the long-term average. September and October were rather dry but precipitation was slightly above normal for November and December. The important factor is the 19 inches of snow which fell after mid-November leaving a 10 inch cover on the ground at the end of the year. This is the largest amount of snowfall for the fall period since 1959.

It was again impossible to maintain desired pool levels at all times during 1963 primarily because of run-off into the smaller units and lack of storage capacity. This was caused by extensive run-off during June as the result of abnormal rainfall. Water levels were considerably higher in Units 2 through 8 on May 1, after the spring run-off was over, than they were one year earlier. Approved levels for some units have been lower during recent years to encourage habitat improvement in former relatively barren areas. Therefore, a surplus of 3 feet of water existed in Unit 7 on May 1.

Heavy rains occurred during the period June 8-19 which created considerable run-off. Water levels began raising again about mid-June and in most pools the level was soon above the earlier crests. As much surplus water as possible was held because of the limited outflow which could be released through the Unit 8 bypass ditch. As a result Units 2,3 and 4 were all above normal or full stages for a while. In general levels were down to normal and dropping slowly by the end of July. It was soon learned that the Unit 8 bypass ditch

was a definite bottleneck affecting the water management program. This small level ditch, which was built without any gradient or fall, will not handle an adequate volume of water to permit a draw-down of Unit 7 within a reasonable period. The by pass structure was wide open from April 8 to Sept. 30 in order to release the surplus water from Unit 7. Because of these conditions the water level was too high and desirable vegetation in Unit 7, which had been developing during the past 2 years, actually decreased.

As near as can be determined about 314 acre feet of water went over the Unit 8 spillway. In addition, an estimated 190 acre feet of water was also released from Unit 8 through the 36 inch culvert. This draw-down was completed in 8 days as compared to 2 or 3 weeks formerly, prior to completion of the central drain direct from open water to the outlet structure.

The year ended with an estimated net gain of only 899 acre feet. The reason for this small gain, in view of the relatively good run-off, is due to the fact that the levels for Units 2 through 8 were near operating levels the year before at freeze-up for the first time in several years. In general, the water levels of most units are slightly above operating levels at present. This seems like a good condition after several recent dry years. On the other hand Unit 4, the reservoir pool, is too high to accomodate much spring run-off without spilling.

Recommendations

It is proposed in some cases to raise water levels in accordance with good water management practices, providing an adequate supply of water is available. The prospects for spring run-off are better at present than any time since 1959.

Unit 1

Sago is the predominant submerged aquatic plant found in this pool. This plant just about held its own this year with a slight increase north of the Bowbells Crossing. This was offset by a reduction south of the Crossing where public outboard boating was permitted for the first time. Seed production was also below par in the south portion of the Upper Lake. This may have been influenced by boating but there is no evidence available to confirm this fact. The narrow margin of round-stemmed bulrush, found along a considerable portion of the shoreline, showed no change. Little change was to be expected with only a moderate fluctuation in the water level during the year.

Waterfowl use data will be included for all units. However, because of recent drouth conditions, and dry pools some years, the figures given have been influenced somewhat during the past 6 years by the availability of water rather than entirely by the conditions of habitat.

Waterfowl use for 1964 was 1,825,180 as compared to 1,113,070 use days last year and the 5 year average of 1,919,560.

It is firmly believed that the lower water levels during the past 7 years have been responsible in part for the favorable increase of aquatic and marsh plants during that period. For this reason it is recommended that no water be turned into Unit 1 unless it tops the flashboards or such action is essential to alleviate danger to life or property down stream.

Unit 2

For the time being Unit 2 must remain at the same level as Unit 1 when water is available because of the damaged spillway between the two pools.

Unit 3

This small impoundment is a popular waterfowl feeding area most years. Ducks are attracted to the unit by the sago generally produced there. A level equal to spillway crest seems desirable during the growing season for optimum development of the sago beds. The amount of sago decreased during 1964 because the water level remained too high after the June rains until late in the growing season. This pool is shallow and in a normal year it usually is quite low or dries up by fall. The drying appears to be beneficial in maintaining a good stand of aquatics.

Waterfowl use for 1964 was 31,542 use days--some-what less than the 35,000 for last year but still above the 5 year average of 27,569.

Unit 4

This pool is known as the middle lake which serves as the storage area for supplying waters elsewhere in the impoundment system. To serve as a reservoir the water level must be held higher than the surrounding units. Sago pondweed is the only submerged plant that has been found in the unit. Seed production was low in 1964, as it has been many years in the past, and the acreage declined at least 25% as compared to 1963. The decrease in acreage was definitely caused by high water levels which persisted during most of the growing season. This condition is also believed responsible for the long history of poor seed production after experiencing much better success during the dry years when water levels were lower.

Total waterfowl use for 1964 was 548,856 use days--somewhat better than the 486,997 use days for 1963 but still below the 5 year average of 607,916.

Lower water levels will definitely allow a favorable increase in both food and cover plants. With most of the smaller units, which are

served by Unit 4, presently near or above operating levels the need for stored water should be much less in 1965. In order to favor food and cover production it is recommended that the summer level be established at 1786.00 for 1965. If that level is not reached water may still be diverted from this unit, when needed for other pools below, so long as the stage remains at 1784.00 or higher. A further drawdown to 1783.00 in the late summer or fall is also recommended providing water is needed for maintaining desired levels in the lower units at that time of the year.

Unit 5

This small, shallow unit was very low or dry for several years resulting in encroachment of cattails. A large amount of the cattail was eliminated by drowth and chemical treatment. The predominant emergent cover is now round-stemmed bulrush. It is believed that a higher water level will now improve the habitat.

Waterfowl use for 1964 was 128,296 use days--considerably higher than the 95,067 for 1964 and almost double the 5 year average of 64,917.

It is recommended that an elevation of 1784.00, after the run-off, be approved for this unit. It must be understood, of course, that this level will be exceeded whenever it is necessary to divert additional water through the unit to pools below.

Unit 6

The habitat in this pool has not responded as well as in Unit 7 with low level operation because the pool dried up completely one year and was very shallow another season when water was not available. Because of these conditions the pool became almost completely overgrown. The existing cover is still considered to be too dense for good duck use and such use the last 2 years has been lower than anticipated. It is believed that another moderate raise in the water level, which probably should have been raised in 1962, will improve the habitat in 1965.

Total waterfowl use for 1964 was 125,524 use days--only about 50% of the 253,246 for 1963 but only moderately lower than the 5 year average of 154,351.

A level of 1783.50 is recommended for 1965, six inches higher than in 1964.

Unit 7

The habitat improved tremendously in this formerly barren pool while water levels were low and after it was dry during the drowth years. This improvement continued with low water level operation until 1964. It was impossible to release surplus water at an adequate volume to lower the level within a reasonable time owing to inadequate

outlet structures. The Unit 8 by pass ditch structure was wide open from April 8 until September 30 in order to withdraw surplus water. Because of this water levels were much too high during the entire growing season. As a result some of the excellent stand of submerged and emergent plants which had been developing were damaged and destroyed. It is estimated this will set back the habitat development by 2 years.

The decline in aquatic foods and emergent cover is definitely reflected in waterfowl use records. Waterfowl use for 1964 was only 532,945 use days--not quite one-half of the 1,144,546 for 1963 but still not so far below the 5 year average of 638,666.

A level of 1780.00 was recommended during the past 4 years but that stage was not attained until 1963. In 1964 the actual level was much higher. It is now recommended that the same level of 1780.00 be approved for 1965 with the hope that surplus water does not exceed that stage for any long periods.

Unit 8

Water management is limited in this unit as there is presently no means for diverting any additional water into the pool. The Calco gate is located too high to completely drain the pool. A drawdown to about 1780.00 can now be effected quite rapidly since completion of the central drain in 1961.

This unit receives all of the run-off from Baden Coulee but during some recent years that supply was not adequate to fill the pool. Water levels have been held low during the past 5 years to help reduce and eliminate the former undesirable heavy stand of cattail. This action has proven partially effective as the cattails amount to only a fraction of their former abundance.

Waterfowl use for 1964 was 182,560--considerably higher than the 110,558 for 1963 and far above the 5 year average of 100,572.

Increased waterfowl use can definitely be attributed to the increased production of sago in the open water portion of the pool. A stage of 4.00 to 5.00 feet on the gage seems optimum for sago development. Considerable shallow marsh could be flooded at higher stages, providing water was available. It is doubtful if such action would increase waterfowl use--actually it is believed that just the opposite would happen as the result of less sago pondweed. For this reason only a small increase in the water level, to elevation 1782.50, is recommended for 1965.

The table following includes recommended pool elevations for Des Lacs impoundments during 1965

Also attached are table showing the estimated total refuge inflow, average water level elevations, water surface acreages and capacity for each unit, each month. Average gage readings have been included again this year, although not called for, as we like to keep such information for the record.

RECOMMENDED WATER LEVELS - 1965

Unit No.	During Spring Run-Off		Spring Run-Off to Aug. 31		Sept. 1 to Freeze-up	
	Gage	Sea Level	Gage	Sea Level	Gage	Sea Level
1 (Up.Lake)	"as is"	---	"as is"	---	"as is"	---
2	10.00	1787.00	9.00	1786.00	6.00-8.00	1783.00
3	9.00	1786.00	9.00	1786.00	8.00	1785.00
4 (Mid.Lake)	10.00	1787.00	9.00	1786.00	6.00-8.00	1783.00
5	7.00	1784.00	7.00	1784.00	6.00	1783.00
6	6.50	1783.50	6.50	1783.50	6.50	1783.50
7 (Low.Lake)	3.00	1780.00	3.00	1780.00	3.00	1780.00
8	5.50	1782.50	5.00	1782.00	Est. 3.50	1780.50

January 6, 1965

Homer L. Bradley
Refuge Manager

Summary - ESTIMATED WATER INFLOW, USE AND OUTFLOW - 1964

Unit	January 1963		Highest Reading Spring 1964		Estimated Outflow		December 1964	
	Gage	Acre Feet	Gage	Plus Additional Inflow	Acre Feet	Gage	Acre Feet	Acre Feet
1	11.56	31,997.0	12.92	41,336.6	-	11.62	32,384.0	
2	7.98	156.2	10.25	618.9	-	8.36	198.7	
3	8.10	18.5	10.76	179.1	-	8.50	32.0	
4	8.14	3,574.0	10.72	5,969.6	-	8.56	3,889.5	
5	5.94	36.1	8.60	522.7	-	6.08	41.7	
6	5.84	292.2	7.22	739.3	-	5.98	312.9	
7	3.00	1,090.2	6.50	2,697.4	1,524.7 *	3.26	1,172.7	
8	2.08	45.2	7.36	431.7	504.0	3.12	77.3	
Totals		37,209.4		52,495.3	2,028.7		38,108.8	

* It is estimated that 1,524.7 acre feet was released from Unit 7 during period April 8 to Sept. 30 and 314 acre feet overflow plus 190 acre feet released from Unit 8.

52,495.3	
- 37,209.4	Acre Feet - Major Inflow
15,285.9	
52,495.3	
- 2,028.7	Acre Feet - In Refuge
50,466.6	
50,466.6	
- 38,108.8	Acre Feet - Major Use
12,357.8	
38,108.8	
- 37,209.4	
899.4	Acre Feet - Total gain for calendar year 1964

Unit 1 - 1964

<u>Month</u>	<u>Average Gage Reading (Ft.)</u>	<u>Elevation (msl assumed)</u>	<u>Area (Acres)</u>	<u>Capacity (Acre-feet)</u>
January	11.56	1781.56	3430	31,997
February	11.56	1781.56	3430	31,997
March	11.56	1781.56	3430	31,997
April	12.80	1782.80	3970	38,963
May	12.74	1782.74	3946	38,653
June	12.70	1782.70	3930	38,447
July	12.62	1782.62	3908	38,163
August	12.16	1782.16	3714	35,660
September	11.92	1781.92	3610	34,319
October	11.70	1781.70	3500	32,900
November	11.62	1781.62	3460	32,384
December	11.62	1781.62	3460	32,384

Unit 2 - 1964

January	7.98	1784.98	90.9	156.2
February	7.98	1784.98	90.9	156.2
March	7.98	1784.98	90.9	156.2
April	9.88	1786.88	194.9	423.6
May	9.70	1786.70	182.9	392.5
June	9.72	1786.72	184.2	396.0
July	9.92	1786.92	196.5	430.5
August	9.24	1786.24	152.2	313.0
September	8.74	1785.74	124.6	241.9
October	8.50	1785.50	113.9	214.6
November	8.36	1785.36	107.6	198.7
December	8.36	1785.36	107.6	198.7

Unit 3 - 1964

January	8.10	1785.10	25.6	18.5
February	8.10	1785.10	25.6	18.5
March	8.10	1785.10	25.6	18.5
April	10.40	1787.40	49.5	120.0
May	9.86	1786.86	47.4	88.6
June	9.80	1786.80	47.2	85.9
July	10.00	1787.00	47.9	95.1
August	9.32	1786.32	45.4	63.7
September	8.88	1785.88	41.8	43.8
October	8.50	1785.50	33.9	32.0
November	8.50	1785.50	33.9	32.0
December	8.50	1785.50	33.9	32.0

Unit 4 - 1964 (Including 4A)

Month	Average Gage Reading (Ft.)	Elevation (msl assumed)	Area (Acres)	Capacity (Acre-feet)
January	8.14	1785.14	724.6	3584.0
February	8.14	1785.14	724.6	3584.0
March	8.14	1785.14	724.6	3584.0
April	10.20	1787.20	751.0	5100.2
May	9.94	1786.94	754.0	4904.2
June	9.86	1786.86	744.2	4845.1
July	10.06	1787.06	747.6	4994.0
August	9.44	1786.44	738.0	4534.7
September	8.92	1785.92	730.9	4151.4
October	8.60	1785.60	728.3	3918.6
November	8.56	1785.56	728.0	3889.5
December	8.56	1785.56	728.0	3889.5

Unit 5 - 1964

January	5.94	1782.94	32.5	36.1
February	5.94	1782.94	32.5	36.1
March	5.94	1782.94	32.5	36.1
April	7.78	1784.78	116.8	128.3
May	6.26	1783.26	43.6	51.2
June	6.88	1783.88	66.9	83.9
July	6.48	1783.48	51.9	62.8
August	6.82	1783.82	64.7	80.7
September	6.54	1783.54	54.1	66.0
October	6.30	1783.30	45.1	53.3
November	6.08	1783.08	36.8	41.7
December	6.08	1783.08	36.8	41.7

Unit 6 - 1964

January	5.84	1782.84	172.4	292.2
February	5.84	1782.84	172.4	292.2
March	5.84	1782.84	172.4	292.2
April	6.84	1783.84	230.4	404.8
May	6.00	1783.00	183.9	315.9
June	6.12	1783.12	190.5	328.6
July	6.02	1783.02	185.0	318.0
August	5.96	1782.96	181.0	310.0
September	6.06	1783.06	187.2	322.3
October	6.06	1783.06	187.2	322.3
November	5.98	1782.98	182.5	312.9
December	5.98	1782.98	182.5	312.9

Unit 7 - 1964 (Including 7A)

corrected 3/14/69
HRS.

Month	Average Gage Reading (Ft.)	Elevation (msl assumed)	Area (Acres)	Capacity (Acre-feet)
January	3.00	1780.00	139.3 382.12	311.9 1090.24
February	3.00	1780.00	139.3 382.12	311.9 1090.24
March	3.00	1780.00	139.3 382.12	311.9 1090.24
April	5.64	1782.64	423.8	2066.5
May	5.22	1782.22	419.6	1989.1
June	4.70	1781.70	413.9	1772.7
July	4.52	1781.52	412.0	1698.5
August	3.86	1780.86	398.3	1429.2
September	3.44	1780.44	390.5	1263.7
October	3.18	1780.18	385.5	1161.2
November	3.26	1780.26	387.1	1172.7
December	3.26	1780.26	387.1	1172.7

Unit 8 - 1964

January	2.08	1779.08	28.4	45.2
February	2.08	1779.08	28.4	45.2
March	2.08	1779.08	28.4	45.2
April	6.92	1783.92	112.3	340.1
May	5.46	1782.46	82.0	198.6
June	4.38	1781.38	48.8	127.6
July	4.38	1781.38	48.8	127.6
August	3.78	1780.78	35.3	100.0
September	3.44	1780.44	34.1	88.3
October	3.22	1780.22	33.4	80.7
November	3.12	1780.12	33.1	77.3
December	3.12	1780.12	33.1	77.3

Est. Additional Inflow 1964

File with our copy
Water Management Program

<u>Unit 1</u>		<u>acre feet</u>
^{Raise} ✓ .24	- 12.56 - 12.80 =	1,238.4
✓ .10	- 12.72 - 12.82 =	<u>516.0</u>
		1,754.4

<u>Unit 2</u>		
.85	- 9.40 - 10.16 =	
✓ .76	- 9.40 - 10.16 =	131.32

<u>Unit 3</u>		
✓ .14	- 9.96 - 10.10 =	8.07
✓ .08	- 10.18 - 10.26 =	4.97
✓ .50	- 9.54 - 10.04 =	<u>23.68</u>
		36.72

<u>Unit 4</u>		
✓ .14	- 10.20 - 10.34 =	106.14
✓ .12	- 9.98 - 10.10 =	39.88
✓ .52	- 9.58 - 10.10 =	361.89
✓ .14	- 10.00 - 10.24 =	<u>25.09</u>
		533.00

Estimated
Outflow
Released

Unit 5

Acre Feet

✓ .90 -	7.66 - 8.56 =	88.31
✓ .10	6.50 - 6.60	5.27
✓ 1.04 -	6.06 - 7.10 =	53.52
✓ .64 -	6.40 - 7.04 =	32.60
✓ .94 -	6.14 - 7.08 =	48.30
✓ .64 -	6.28 - 6.92 =	33.69
		<u>261.69</u>

Unit 6

✓ .04 -	6.10 - 6.14	4.23
✓ .50 -	5.74 - 6.24	63.89
✓ .14 -	6.04 - 6.18	14.81
✓ .48 -	5.66 - 6.14	65.15
✓ .14 -	6.02 - 6.16	<u>14.81</u>

162.89

Unit 7 (Ditch choked with weeds - est. 1/2 capacity this year) 3/14/69 H&R.

✓ .24 -	4.60 - 4.84	98.83	} Spilled 1362.1 Spilled 162.6 1,524.7
✓ .04 -	4.72 - 4.76	16.48	
✓ .12 -	3.14 - 3.26	<u>47.30</u>	
		162.61	

Unit 8 (Only 1/2 flow from 7.00 - 7.40) 3/14/69 H&R.

✓ .08 -	7.02 - 7.10	<u>8.40</u>	overflow - 314.0
✓ .13	6.64 - 6.77	13.66	
✓ .50 -	4.12 - 4.62	26.45	Release 190.0
✓ .10 -	4.50 - 4.60	<u>5.29</u>	total 504.0
		<u>53.80</u>	

Des Racs - Waterford Race (Including Swans, Horses, Trucks & Carts) (Expanded Dec. 1964)

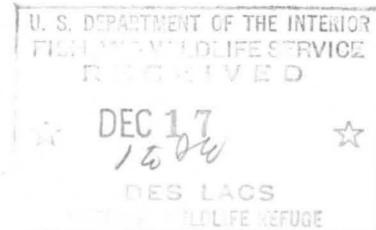
Unit	1960	1961	1962	1963	1964	Percent Change over ave.	Total	5 year Average
1	1,362,480	1,384,537	3,912,447	1,113,154	1,825,180	-5.8	9,597,798	1,919,560
2	167,063	18,970	111,566	133,056	162,337	+37	592,992	118,598
3	28,525	6,412	36,365	35,000	31,542	+14	137,844	27,569
4	885,780	568,547	549,402	486,997	548,856	-10	3,039,582	607,916
5	36,309	12,257	52,654	95,067	128,296	+98	324,583	64,917
6	184,149	53,851	154,987	253,246	125,524	-19	711,757	154,351
7	753,921	143,984	620,935	1,141,546	532,945	-17	3,193,331	638,666
8	41,811	28,686	139,244	110,558	182,560	+82	502,859	100,572
Total	3,460,038	2,217,244	5,577,600	3,368,624	3,537,240	-8	18,160,746	3,632,149

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
1006 West Lake Street
Minneapolis, Minnesota 55408

December 9, 1964

MEMORANDUM

To : Refuge Managers, Region 3
From : Regional Supervisor, Branch of Wildlife Refuges
Subject: 1965 Water Program and 1964 Water Use Data



Please submit three (3) copies of the Annual Water Program by January 15, 1965. Be sure the submittal includes a record of water use for calendar year 1964 and pertinent details on any pollution and detergent troubles.

Actual water conditions for 1964 should be briefly described and impoundment data showing the average monthly elevation, acreage and capacity of each pool for every month of calendar year 1964 shall be given in a table. A suggested table listing the pool data desired is given as follows:

IMPOUNDMENT DATA

Pool _____ for Calendar Year 1964
no. name etc.

(Data is based on average monthly water surface levels.)

<u>Month</u>	<u>Average Gauge* Reading (feet)</u>	<u>Average Elevation</u>	<u>Area (acres)</u>	<u>Capacity (acre-feet)</u>
January through December	6.3	1271.0	400	820
	5.3	1270.0	350	575

* This column is optional.

Where recorded data are not available an estimate based on observations and judgment should be made. All estimated figures which are given shall be identified.

A summary of refuge inflow and outflow for calendar year 1964 determined from available stream flow records shall also be given. If flow records are not available, an estimate may be made. If you make an estimate of stream flow, explain how it was done.

Please attach a letter size map or a small sketch showing the approximate location of all water gauges on the refuge.


Forrest A. Carpenter

UNITED STATES GOVERNMENT

Memorandum

TO : Refuge Manager, Des Lacs Refuge
Kenmare, North Dakota

DATE: March 24, 1965

In reply refer to: R

FROM : Assistant Regional Supervisor, Branch of Wildlife
Refuges, Minneapolis, Minnesota

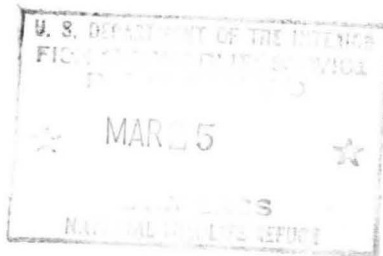
SUBJECT: Annual Water Program - 1965

Your proposals for managing waters on the Des Lacs Refuge during calendar year 1965 are approved. You have done an excellent job of recording vegetative changes and waterfowl use in relation to water levels of each unit. Your appraisal of the value of drawdowns for Des Lacs Refuge seems correct. The aquatic submergent and emergent habitat has been much improved the past several years by your judicious use of the drawdown and reflooding technique.

Attached is a letter of comment from the Regional Engineer. Please review and fulfill any requests contained therein.

Edward J. Smith
Edward J. Smith

Enc.



Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

Regional Supervisor,
Branch of Wildlife Refuges

March 23, 1965

Regional Engineer

EH-R Des Lacs
Water Mgmt. Plan

Des Lacs NWR, North Dakota - 1965 Proposed Annual Water Management
Program

We have reviewed the subject plan and concur in the proposed operation.

The proposed plan requires an increase in storage of about 550 acre-feet to reach optimum levels. Normal evaporation losses of 5,000 acre-feet must also be made up during the year. Downstream water right releases sometime require an additional yearly 1,000 acre-feet release.

We have roughly estimated that the spring runoff might contribute at least 1100 acre-feet to refuge pools 2-8 and it is recommended that the refuge manager start to lower unit 4, .75 of a foot as soon as possible in an attempt to provide the additional storage this spring.

We are attaching two rough zerox prints showing a revised area and capacity for Upper Des Lacs Lake based on limited data in our files. We suggest that the refuge manager be given these prints and that he use these values in future reports. The water right filing capacity figure for the Upper Des Lacs Lake was 55,000 acre-feet originally, but it appears that it is closer to 38,000 acre-feet at present.

We would suggest that the refuge manager inform this branch at least once weekly of any change in precipitation, snow cover, or water content on the ground until the spring break up is over.

We still would like a letter-size map or small sketch of the refuge showing approximate gauge locations as previously requested in your request memorandum dated December 9, 1964.

John D. Umberger

Refuge Inflows, Dec and Outflows 1964

Unit	Storage Change Jan.-Dec 1964	Ave. Surface A/c. Apr.-Oct.	Est. Fees Crop. Trans. (33")	Total	Est. Release Overfill	Release Over Levee	Estimated Inflows
1	+ 228	3,019	8,302	8,530			8,530
2	+ 42	162	446	488			488
3	+ 13	46	126	139			139
4	+ 305	740	2,035	2,340			2,340
5	+ 6	61	168	174			174
6	+ 21	192	528	549			549
7	+ 82	409	1,125	1,207	954	2,416	4,571
8	+ 32	53	146	178	189		367
	+ 729	4,682	12,876	13,605	E 1,143	E 2,416	E 17,164

Estimated Fees, Crop. Trans.

12,876

Plus - Storage Change

+ 729

Total

13,605

Plus Estimated Release

3,559

Total Inflows

17,164

Prepared March 1969-NAB. -- Using latest data and computations

Inflow Unit 7-1964 - (over Stop-Logs)

[illegible]

Inflow - Unit 7-1964 (Over Spillway)

Date	Crest	Gauge	above Crest	² Factor	^{100'} Spill	CFS	Days	Acres Feet
4/3	6.80	6.96	.16	.222	22.20	This column	Single	44.4
4/4	"	7.00	.20	.30	30.0		60.0	
4/5	"	7.02	.22	.35	35.0		70.0	
4/6	"	7.08	.28	.50	50.0		100.0	
4/7	"	7.08	.28	.50	50.0		100.0	
4/8	"	7.20	.40	.84	84.0		168.0	
4/9	"	7.22	.42	.874	87.4		174.8	
4/10	"	7.20	.40	.84	84.0		168.0	
4/11	"	7.00	.20	.30	30.0		60.0	
4/12	"	6.88	.08	.084	8.4		8.4	
Subtotal								953.60
Brought Fwd.								2416.04
Total								3,369.64

Outflow - 1964 (Area X Velocity = CFS for Ditch)

Unit 7	ave. Gauge	Days	2 Value	10'	100% CFS	1/20 Reg. Flow
4/8-17	6.155	10 days	50.79	Spill	507.9	5,079. 254
4/18-30	6.247	13 days	51.50		515.0	6,695. 335
5/1-31	5.38	31 "	40.72		407.2	12,623. 631
6/1-30	4.70	30 "	33.93		339.3	10,179. 509
7/1-31	4.56	31 "	31.85		318.5	9,873. 494
8/1-31	3.94	31 "	25.69		256.9	7,963. 398
9/1-30	3.51	30 "	21.82		218.2	6,546 327
11/1-15	.06 overlogs	15 days	.063	Spill 10'	.63 x 15	9.45 = 9

Copied from Above -

Outflow 1964 - Unit 7

Dates	ave. Gauge	Days	2 Value	10'	Daily CFS	100% CFS	1/20 Flow CFS	E. acre Feet
4/8-17	6.155	10	50.79	"	507.9	5,079	254	508
4/18-30	6.247	13	51.50	"	515.0	6,695	335	670
5/1-31	5.38	31	40.72	"	407.2	12,623	631	1262
6/1-30	4.70	30	33.93	"	339.3	10,179	509	1018
7/1-31	4.56	31	31.85	"	318.5	9,873	494	988
8/1-31	3.94	31	25.69	"	256.9	7,963	398	796
9/1-30	3.51	30	21.82	"	218.2	6,546	327	654
11/1-15	.06	15	.063	"	.63	9.45		9

Total

Est. 2,957
Probably not nearly correct - Est. at 1/20th of 2 value flow

$\frac{1}{2}$ up to 7.40[illegible]